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Trends and Prospects for Cassava in Nigeria

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TRENDS AND PROSPECTS FOR CASSAVA IN NIGERIA

by

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FOREWORD

Cassava is a staple food crop cultivated in several developing countries, largely by small farmers. It is a source of subsistence and of cash income for poor farmers as well as a source of rural employment, particularly of women. During the past 20 years, production of cassava has expanded rapidly in Asia, particularly in Thailand in response to expanded demand for its import in the European Community, where it is used as livestock feed. There are concerns, however, about the likely decline in demand for cassava as food as incomes rise in developing countries and also about the stability of the European demand. To assess the prospects for cassava in the future, IFPRI has examined the trends and prospects for production, utilization, and trade of cassava in Third World countries under a special project partially funded by the International Development Research Centre (IDRC) of Canada.

In addition to the analysis of international data at the global and regional levels, case studies were taken up in six countries: India, Indonesia, the Philippines, and Thailand in Asia and Nigeria and Zaire in Sub-Saharan Africa. The results of these studies were discussed at a workshop in Washington, D.C. in August 1987, where project researchers, selected cassava scientists, and representatives of international organizations participated. The report on the proceedings of the workshop will be published separately. The results of the individual case studies are being published as a series of working papers. Trends and Prospects for Cassava in Nigeria, by S. O. Adamu, is the fifth in the series.

J. S. Sarma

ACKNOWLEDGMENTS

The major part of the fieldwork of this case study was carried out by Rotimi Ojo as my research assistant. In addition, A. O. Olorunda of the Department of Food Technology and G. O. Obigbesan of the Department of Agronomy, both of the University of Ibadan, made contributions in their disciplines. My thanks also go to an anonymous reviewer for his comments and suggestions.

Last but by no means the least, the comments of J. S. Sarma of IFPRI on an earlier draft and those of the participants at the workshop to discuss the case studies prepared for the project were found useful and have been incorporated.

All these notwithstanding, whatever shortcomings this study may have are my responsibility.

S. O. Adamu

1. INTRODUCTION

The main objectives of this study are to analyze past trends in production, area, yield per hectare, and domestic utilization of cassava in Nigeria; to give a broad indication of the prospects for the supply and demand of cassava in 1990 and 2000; and to suggest, on the basis of such analysis, appropriate policies for cassava production, utilization, and trade.

The emphasis will be on the prospects for the use of cassava as food and the scope that exists for expanding its consumption in rural and urban areas through adoption of improved processing and storage technologies. In this context the study will examine the role of cassava in the farming system and the effect of technological improvements on rural employment and income. It will study the prospects for direct consumption of cassava as food in fresh and processed forms in rural and urban areas. The scope for its utilization as feed, starch, and other purposes will be explored, and cassava processing and storage technologies and their impact on increased production and consumption of cassava products will be examined.

NIGERIA IN PROFILE

Nigeria's climate is tropical, characterized by high humidity, generally high temperatures, and substantial rainfall along the coast, falling toward the north, where average monthly rainfall may be 5 centimeters during the dry season (November to March).

Nigeria has about 98.3 million hectares of land within its borders. About 10 percent of this is used for farming and tree crops. About 32 percent is forest, and 57 percent is uncultivated and fallow land and bush. There is no clear cut distinction between fallow and uncultivated land, nor between fallow and cropped.

Cropping periods vary from 1 to 5 years or more. Fallow periods vary from 1 or more years to as much as 20 years. Gardens and cropping areas near homes and villages may be continuously cultivated for a long time with village wastes used as fertilizer. A substantial

part of the land in Nigeria is intercropped with some crops occupying the land over almost the entire crop season.[1]

Official projected estimates of the population of Nigeria put the number of people in the country in 1983 at 191,832 million. Because there has been no acceptable census since 1963, all projections are based on the 1963 census, making use of varying growth assumptions with no statistical justification.

DATA AND METHODOLOGY

The analysis in this study follows essentially the methodology used in all IFPRI studies on trend analysis and projection of food production, consumption, and trade. But there are some major differences. Most of the statistical data used are those obtained from Nigeria.

The methods used, in accordance with IFPRI's approach, include fitting trends and trend projections and computation of group averages and average growth rates. Apart from these, simple statistical methods, including simple regression estimates, are used to calculate trend coefficients.

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[1] O. Babalola, J. A. Bartholomew and G. O. Obigbesan, "The Development Conservation and Production Potentials of the Soil Resources in Nigeria," Journal of Environmental Management 7 (1978): 9-28.

2. THE CURRENT SITUATION OF CASSAVA

Cassava is grown almost all over the country from the rain forest belt to the savannah (Figure 1). It is eaten boiled, cooked and pounded into "fufu," processed into "gari," "lafun" (cassava flour), and so forth.[2] Traditionally most cassava consumed in Nigeria is in the form of gari, a fermented and dehydrated flour with a high starch content.

Cassava is easily propagated. It can be stored in the ground long after maturity, and not all of it has to be harvested all at the same time. These qualities can ensure a constant food supply to farmers for most of the year without storage problems. Cassava can survive 4-6 months of dry weather and recover from damage caused by severe incidence of some insect pests, diseases, or bushfire. For all these reasons, cassava is able to play a vital role in alleviating famine conditions by providing a sustained food supply when other crops fail.

Cassava is one of the major crops in Nigeria. Since 1961, it has consistently ranked fourth in output, given in wheat equivalent (see Table 1). The other major crops are sorghum, millet, yams, and maize.

Agricultural statistics in Nigeria are generally weak but are especially so for cassava (see Appendix 1). An obvious evidence of this is the proliferation of historical series. Table 2 shows some of the series that have been used.[3] The adjusted series by Adamu will be used together with the FAO series in this study. A state-by-state

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[2]See the numerous names given the crop by Nigeria's ethnic groups, listed in E. O. Etejere and R. B. Blat, "Traditional Preparation and Uses of Cassava in Nigeria," Economic Botany 39 (No. 2, 1985): 157.

[3]See World Bank, Nigeria: Agricultural Sector Memorandum, Report No. 4723-UNI (Washington, D.C.: World Bank, 1985) for a critical review of the series given in Table 2, except for the series by Adamu. For that series and another assessment of the others, see S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986. That work also contains a critical evaluation of the high output figures in World Bank, Nigeria: Agricultural Pricing Policy, Report No. 4945-UNI (Washington, D.C.: World Bank, 1985).

Figure 1--Map of Nigeria showing major cassava-producing states

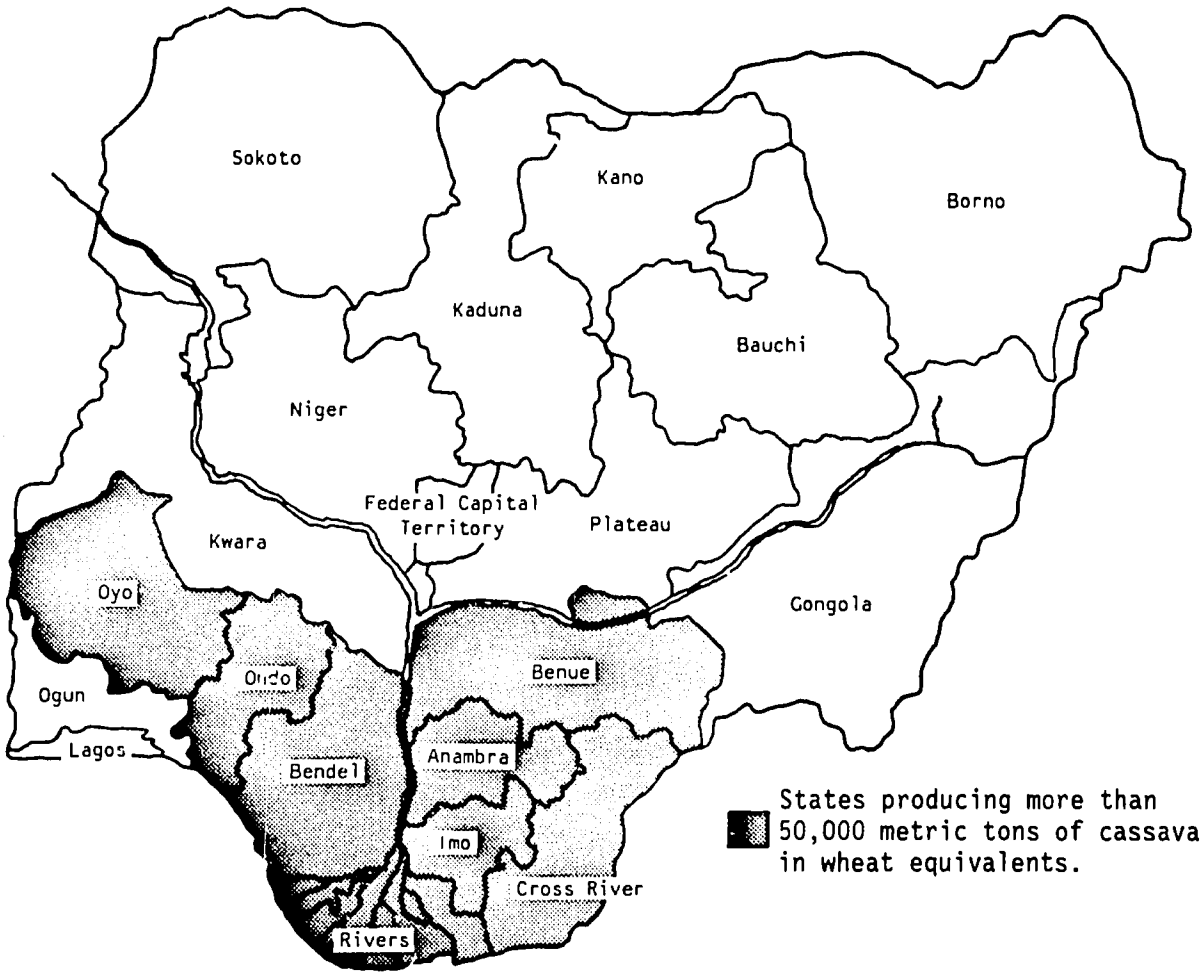

Table 1--Average production of major crops and distribution, 1961-83

Crops	Average Production[a]				Distribution			
	1961-65	1965-69	1969-73	1979-83	1961-65	1965-69	1969-73	1979-83
	(1,000 metric tons)				(percent)			
Rice	169.0	193.3	297.7	232.8	1.1	1.4	2.0	1.9
Maize	1,109.7	1,063.0	1,071.8	702.7	6.9	7.7	7.2	5.8
Millet	2,624.5	2,388.3	3,021.9	2,869.4	16.4	17.3	20.3	23.8
Sorghum	4,202.5	3,382.3	3,453.6	3,851.5	26.2	24.5	23.2	31.9
Cassava	2,226.8	2,126.0	2,337.1	1,560.4	13.9	15.4	15.7	12.9
Yams	3,587.2	2,540.2	2,352.0	1,590.7	22.4	18.4	15.8	13.2
Cocoyams	373.8	276.1	312.6	54.7	2.3	2.0	2.1	0.5
Pulses	562.2	621.2	684.8	660.0	3.5	4.5	4.6	5.5
Groundnuts	1,170.1	1,214.9	1,354.6	543.8	7.3	8.8	9.1	4.5
Total	16,025.8	13,805.4	14,886.0	12,065.9	100.0	100.0	100.0	100.0

Source: S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

[a]The figures for noncereals are given in wheat equivalents.

breakdown is one of the advantages that Adamu's adjusted series has over the FAO series.

Table 3 presents 1981/82-1983/84 averages of the output of cassava in Nigeria for its 19 states (the political structure of Nigeria is outlined in Appendix 2). The importance of the southern states in the production of cassava is demonstrated. In these states, the only major competing crops are yams and maize. But cassava has an edge over them because it can be produced on less fertile land with or without fertilizer. The relative importance of yams and cassava are shown in Table 4. Note that all the southern states devote more land to cassava than to yams. This is not so in the northern states, especially Benue-Plateau, where more yams are currently produced than cassava. This is partly due to the relative efficiency of the two crops.

The estimation of area devoted to agricultural crops is not as straightforward as estimating production because not all the crops are planted alone. There is also the effect of the estimating procedure of the Federal Office of Statistics (FOS), discussed in Appendix 1, which is biased against crops like cassava.

Table 2--Comparative cassava production figures

Year	FOS	CBN	FAO	USDA	Adamu Adjusted Series
			(1,000 metric tons)		
1970	5,213	5,180	9,084	11,871	10,426.0
1971	4,508	4,719	9,172	12,396	9,016.0
1972	2,571	3,156	9,570	12,700	5,142.0
1973	2,901	2,729	9,600	13,000	5,802.0
1974	3,882	3,206	10,000	13,300	7,764.0
1975	2,321	3,352	10,000	13,600	4,642.0
1976	1,875	3,237	10,800	13,900	5,625.0
1977	2,900	1,935	10,600	14,150	8,700.0
1978	1,578	2,009	10,500	14,150	4,734.0
1979	1,506	1,976	10,500	14,600	4,518.0
1980	874	1,988	11,000	13,100	5,243.1
1981	582	2,159	11,000	11,800	3,492.0
1982	909	2,308	11,700	11,700	5,454.0
1983	1,171	...	...	...	7,074.0

Sources: The FOS (Federal Office of Statistics) figures are from Nigeria, Federal Office of Statistics, Rural Agricultural Surveys 1980/81 and various later years (Lagos: FOS, various years). The CBN (Central Bank of Nigeria) and USDA (U.S. Department of Agriculture) figures are from Francis Sulemanu Idachaba, Priorities for Nigerian Agriculture in the Fifth National Development Plan, 1986-90 (Ibadan: Federal Agricultural Coordinating Unit, 1985). The FAO (Food and Agriculture Organization of the United Nations) figures are from Food and Agriculture Organization of the United Nations, Production Yearbook (Rome: FAO, various years). And the Adamu Adjusted Series is based on the FOS series and comes from S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Table 3--Food crop production, 1981/82-1983/84 averages

State	Total Production of Food Crops	Cassava Production	Cassava as a Share of State Food Crop Production
	(1,000 metric tons of wheat equivalent)		(percent)
Lagos	3.20	2.70	84.38
Ogun	33.90	17.57	51.83
Oyo	419.30	304.23	72.56
Ondo	196.60	85.43	43.45
Bendel	497.73	295.13	59.29
Rivers	218.17	184.87	84.74
Cross River	164.50	75.77	56.06
Imo	429.23	220.60	51.39
Anambra	346.93	113.93	32.84
Kwara	386.33	30.90	8.00
Niger	324.20	4.23	1.30
Benue	764.33	218.77	28.62
Plauteau	694.17	3.62	0.52
Gongola	501.03	36.37	7.26
Borno	535.80	0.00	0.00
Bauchi	881.87	2.93	0.33
Kaduna	1,510.37	1.83	0.12
Kano	1,186.47	20.00	1.69
Sokoto	3,427.10	0.00	0.00
Nigeria	12,521.23	1,618.88	12.93

Source: Computer printout for S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Table 4--Share of production, by states, 1979-83

State	Yams	Cassava
	(percent)	
Lagos	...	0.2
West (Ogun, Ondo, Oyo)	8.4	24.9
Bendel	12.8	20.3
Rivers	1.4	10.8
Cross River	4.9	5.5
East Central (Imo, Anambra)	14.6	18.1
Kwara	6.6	1.6
Benue-Plateau	34.0	12.5
North East (Gongola, Bauchi, Borno)	8.6	4.6
Kaduna	2.3	0.2
Kano	...	1.1
North West (Niger, Sokoto)	6.3	0.2
Nigeria	100.0	100.0

Source: S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Between 1961 and 1983 crop production declined. This was due to a variety of factors, including the civil disturbance of 1966-70, urban drift of the population, and the emergence of oil.

The emergence of oil in the Nigerian economy resulted in the economy absorbing the large oil revenues accruing during the period, especially after 1973, without generating an equivalent amount of employment in the system. The aim of translating this huge amount into investments in social, physical, and economic infrastructure failed because the amount of work done was nowhere near the amount of money expended. The result of this was too much money in the urban areas of the country with too little domestic production, resulting in an importing spree.

The effect of all this was that a large number of people moved from rural to urban areas and out of agriculture. Official figures indicate that in 1960 the urban population was 13.1 percent of the total population. By 1970 it had risen to 16.4 percent and by 1980 to 20.9 percent, with regional variations. Those states that were mostly urban before, like Lagos and West, were most affected. Of the total labor force, agriculture accounted for 71 percent in 1960, 62 percent

in 1970, and 54 percent in 1980. For a country whose main source of power in farming is human, such a movement from agriculture can be tragic for food production.

Table 5 shows the effect of movement from agriculture in different parts of the country between 1973-75 and 1981-83. The number of farming households (usually single farmer households) was 8.8 million between 1973 and 1975 but fell to 5.6 million between 1981 and 1983. The largest reduction was in North East, while the largest annual rate of decrease was in Lagos, followed by Kwara, West, and Mid-West (Bendel). The low contributions and annual rates of decrease of Kano, North Central, and North West are noteworthy. North West contributed least and had the smallest average annual rate of decrease.

CASSAVA CULTIVATION IN THE SUBSISTENCE AND MODERN SECTORS

As in most countries in the tropics, crop production in Nigeria is done mostly by smallholders who produce food both for household consumption and for the market. These farmers use traditional farming equipment, like hoes and cutlasses. But with the government's programs to improve farming and the income of farmers, many of the farmers have developed an interest in using fertilizers and getting credit to obtain inputs for their farming.

According to available information, over 90 percent of cultivators farming land are in ownerlike possession of it, while generally less than 5 percent rent land. The remainder is accounted for by squatters or is farmed on a communal basis. Holdings are generally small. Olayide et al. show that 69 percent of farm holdings can be classified as small (0-4 hectares); 25 percent can be classified as medium (5-9 hectares); and 6 percent can be classified as large (10 hectares or more).[4]

Large-scale plantation agriculture was developed in Nigeria historically for the production of such export crops as oil palms, cocoa, rubber, and cashews. Only recently have large-scale farms been set up by private organizations and individuals to supplement the efforts of small farmers; the share of the modern sector in food production is at present very small. FOS data indicate that 14,993 tons of cassava were produced on modern holdings in 1983/84, about 0.2 percent of estimated total national production of 7 million tons in 1983/84. Some commercial farms have helped boost cassava production by multiplying improved cassava varieties for distribution to farmers.

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[4]S. O. Olayide et al., "Food Production in Nigeria," report of Agricultural Statistics Task Force, University of Ibadan, Ibadan, 1979 (mimeographed).

Table 5--Growth of farming households, 1973-75 to 1981-83

Region/State	1973-75 Average		1981-83 Average		Absolute Increase or Decrease		Average Annual Rate of Growth
	Number	Share of Total	Number	Share of Total	Number	Share of Total	
	(1,000)	(percent)	(1,000)	(percent)	(1,000)	(percent)	(percent)
West							
Lagos	116.23	1.3	2.73	0.1	-113.5	3.5	-37.4
West	735.47	8.0	296.10	5.3	-439.37	13.6	-10.7
Mid-West	400.80	4.5	163.40	2.9	-237.4	7.4	-10.6
East							
Rivers	183.40	2.1	97.93	1.8	-85.47	2.7	-7.5
South East	504.57	5.7	255.50	4.6	-249.07	7.7	-8.2
East Central	1,443.93	16.4	982.07	17.6	-461.86	14.3	-4.7
North							
Kwara	297.83	3.4	97.77	1.8	-200.06	6.2	-13.0
Benue-Plateau	662.03	7.5	406.07	7.3	-255.96	7.9	-5.9
North East	1,746.80	19.8	906.60	16.2	-840.20	26.0	-7.9
Kano	1,104.70	12.5	969.23	17.3	-135.24	4.2	-1.6
North Central	691.43	(7.8)	587.27	10.5	-104.16	3.2	-2.0
North West	939.23	10.6	832.47	14.9	-106.76	3.3	-1.5
Nigeria	8,826.47	100.0	5,588.83	100.0	-3,237.64	100.0	-5.6

Sources: Nigeria, Federal Office of Statistics, Rural Agricultural Sample Survey, various issues 1973-83 (Lagos: FOS, various years); Nigeria, Federal Office of Statistics, Rural Economic Survey, various issues, 1970-80 (Lagos: FOS various years).

USES OF CASSAVA FOR DIFFERENT PURPOSES AND TYPES OF CASSAVA PRODUCTS

Broadly speaking, cassava can be used as food for human consumption, as animal feed, and as a raw material in manufacturing. In Nigeria the use of cassava for animal feed or raw material is at present insignificant. Little is traded that is not shown in the official trade statistics. This does not mean, however, that some cassava products are not smuggled across Nigerian borders into or out of neighboring countries.

In Nigeria, cassava is used mainly as food for human consumption, and there are a variety of forms that cassava foods can take, as Tables 6 and 7 reveal. The most important cassava product in Nigeria is gari, and it accounts for an average of more than 70 percent of all cassava products. Gari can be eaten with cold water poured over it or mixed with hot water to form a paste and eaten with vegetables. It is obtained from cassava tubers that are peeled, washed, grated, fermented, then sieved and fried.

Table 6--Traditional cassava and cassava-based food

Cassava Products	Areas Where Predominant in Diet
Gari	Country-wide
Kpokpo gari	Bendel
Fufu (wet)	
Partly fermented meal	Cross River
Fully fermented meal	Eastern states; parts of Bendel
Lafun (fermented, dried, and milled)	Western states
Cassava flour (sliced, dried and milled)	Western and northern states
Starch (wet) meal	Niger delta
Abacha (peeled, sliced, cooked or blanched, soaked, washed, and dried)	East central states
Fresh roots (sweet variety-boiled or roasted)	Northern states
Varieties of stew preparation	Mostly in the southern states

Source: J. C. Obi, "Cassava as a Potential Source of Industrial Raw Materials," in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources and Rural Development, Lagos, 1986 (mimeographed).

Note: The author made some adjustments to Obi's figures.

Table 7--Manufactured new cassava food products

Products	Source of Production and Distribution
Vitafufu (enriched cassava-based flour containing 50 percent cereals. It has instant and noninstant forms)	Produced by the National Root Crops Production Company; marketed through distributors all over Nigeria
Instant gari flours Casafufu; Casavita Gariana	Produced by the National Root Crops Production Company; marketed through distributors all over Nigeria
Casavita	Product of Tropic Foods Limited; marketed throughout Nigeria
Kassavita	Product of Tropic Foods Limited; marketed throughout Nigeria

Source: J. C. Obi, "Cassava as a Potential Source of Industrial Raw Materials," in A. Joshua, "Proceedings of the National Seminar on the Alternative Uses of Cassava," Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources and Rural Development, Lagos, 1986 (mimeographed).

Note: The author made some adjustments to Obi's figures.

Apart from cassava eaten fresh or boiled, all the other products go through fermentation. A group of the products--"akpu" or "abaca"--is made of cassava peeled, sliced, cooked or blanched, soaked, washed, and dried before eating. The others--fufu, lafun, and edible starch--end up as paste in one form or another. Fufu is sieved fermented cassava pulp and looks like a sticky dough or porridge. It is generally sold wet, wrapped in leaves. Lafun (cassava flour) is sun-dried, fermented whole roots that are milled and sieved. Starch is a wet meal obtained by various techniques. It may be precipitated from the solution pressed out of the grated cassava roots during the preparation of gari. Sometimes starch is obtained from the grated cassava that is soaked directly in water.[5]

[5]Etejere and Blat, "Traditional Preparation and Uses of Cassava in Nigeria," p. 39.

Traditional cassava products then can be grouped into four categories: gari, starch, akpu or abaca, fufu, and fresh or boiled cassava tuber. It is in these four categories that they will be studied. This classification is necessary because, as Table 8 shows, the product often bears different names in different parts of the country.

Apart from the traditional means of eating cassava, a variety of other ways of using cassava have been developed (see Table 7).[6] Cassava can also be processed for alcohol; 170 liters of alcohol can be derived from each ton of cassava (compared with 200 kilograms of gari). Cassava chips and pellets are used by the animal feed industry as a substitute for some of the grains in feed rations. They are also exportable. Cassava flour is also exportable and used in the manufacture of livestock feed. Finally, cassava starch has a number of industrial applications. The most important applications at present are as animal feed, especially for pigs, and the production of starch. Although there are no statistics on all these other usages, they are insignificant.

YIELDS AND TECHNOLOGY

Table 8 presents the average yields for 1979-83 compared with averages for 1961-65, 1965-69, 1969-73, and 1976-78. These periods showed growth rates for the whole country of 0.5, 0.4, 0.2, and 8.3 percent. Average yields varied widely among states, even among the major producing areas of the southern states. The more disaggregated the results, the more the variations become obvious. Oyo, Bendel, Rivers, and Benue states turned out to be areas with high yield rates.

The variations of yields may be caused by a number of factors. These include variations in the fertility of soils available for root crops, competing crops, and relative exposure to the development, release, and adoption of improved cassava varieties. The ability of cassava to thrive in poor soil even without fertilizer means that if farm inputs like fertilizers become relatively costly and so fall out of the reach of farmers, cassava can serve as the crop of last resort. In recent years, this may have been happening. High yields cannot be

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[6]For a catalog of the uses of cassava in the human diet, see J. A. Odunmaku, "The Uses of Cassava in the Diet," in "Proceedings of the National Seminar on the Alternative Uses of Cassava," ed. A. Joshua, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources and Rural Development, Lagos, 1986 (mimeographed). Also see a number of the other sources in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," especially J. C. Obi, "Cassava as a Potential Source of Industrial Raw Materials."

Table 8--Growth rates of cassava yields, by state or region, 1961-6 to 1979-83

Political Structure/ Region or State	Period/ Average Yield		Period/ Growth Rate
	(metric tons/hectare)		(percent)
All Nigeria	1961-65	1979-83	1961-65 to 1979-83
Nigeria	9.37	10.250	0.5
Four regions	1965-69	1979-83	1965-69 to 1979-83
West	10.992	14.540	2.0
Mid-West	12.008	11.489	-0.3
East	9.595	9.288	-0.2
North	6.135	8.439	2.3
Nigeria	9.711	10.250	0.4
12 states	1969-73	1979-83	1969-73 to 1979-83
Lagos	11.133	8.738	-2.3
West	13.393	14.606	0.9
Mid-West	10.971	11.489	0.5
Rivers	9.975	12.256	2.1
South East	10.459	8.471	-2.1
East Central	7.866	8.237	0.5
Kwara	7.403	5.708	-2.6
Benue-Plateau	6.814	10.959	4.9
North East	5.490	8.220	4.1
North Central	3.957	7.752	7.0
Kano	6.601	3.549	-6.0
North West	6.563	4.715	-3.3
Nigeria	10.008	10.250	0.2
19 states	1976-78	1979-83	1976-78 to 1979-83
Lagos	7.586	8.737	3.6
Ogun	8.222	8.222	0.0
Oyo	7.282	17.661	24.8
Ondo	7.764	9.875	6.2
Bendel	12.333	11.489	-1.8
Rivers	12.350	12.256	-0.2
Cross River	6.541	8.471	6.7
Imo	6.899	8.926	6.7
Anambra	7.875	7.372	-1.6
Kwara	9.167	5.708	-11.2
Niger	2.178	4.715	21.3
Benue	4.443	11.222	26.1
Plateau	5.550	6.042	2.4
Gongola	6.201	8.393	7.9
Borno	...	...	...
Bauchi	2.286	4.794	20.3
Kaduna	3.353	7.752	23.3
Kano	2.632	3.549	7.8
Sokoto	...	...	...
Nigeria	7.439	10.250	8.3

Source: Computer printout for S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Notes: Some of the data for 1979-83 were adjusted to remove errors in the printout. For an outline of how the regions or states were subdivided or their names changed as the political structure changes, see Appendix 2.

due to use of fertile soil alone. There is reason to believe that farmers are using improved cassava varieties, perhaps because of the activities of research institutes and multinational companies, which are engaged in seed multiplication and distribution of bundles of improved cassava cuttings to farmers in their areas of operations (see Table 8). Differences in yields could be due to age at harvest and also weather.

The numerous varieties grown in Nigeria are usually grouped into two main categories for economic convenience: bitter and sweet cassava. The fresh, sweet varieties are eaten like yams, while the bitter variety, which contains hydrocyanic acid (HCN), is processed to obtain a variety of products, as discussed above. There is a continued effort to evaluate promising cassava cultivars for resistance to diseases and pests and consequent higher yields.

Low average yields have been attributed primarily to cassava pests and diseases--cassava mosaic disease (CMD), cassava bacterial blight (CBB), and, more recently, to cassava mealybug (CMB) and green spider mite (CGM). To overcome these production constraints in Nigeria, the IITA has played a unique role. It has developed improved cassava varieties and breeding populations and families that are high yielding, resistant to diseases and insect pests, good in quality for consumer acceptance, and low in cyanide content. The IITA has also conducted successful research on land preparation, methods of planting, fertilizer requirements, intercropping, harvesting, and time of planting (see Tables 9 and 10). At the national level, much work has also been done by the National Root Crop Research Institute (NRCRI) in Umudike.[7] Tables 11 and 12 give evidence of the performance of the improved varieties at experimental stations and on farmers' fields. All these varieties have been released for adoption since 1978. It is certain that the pockets of high or improved yields reported for 1979-83 are due to this development. These results get to farmers mostly through the National Accelerated Food Production Programme (NAFPP), which began in 1975.

NAFPP stemmed from a four-year study undertaken by IITA beginning in 1973 on the possibilities for achieving a "green revolution."[8] The objective was to develop the ability of farmers to produce more and better-quality staple foods, such as maize, rice, millet, sorghum, cassava, and wheat. The four major links of the program are organizing research and extension teams on a crop commodity basis; giving

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[7]Because government allocations of funds are not easily available in detailed breakdowns, not much is available on expenditures on research.

[8]Olayide et al., "Food Production in Nigeria."

participating farmers the important role of identifying and distributing seeds of improved lines; providing intensive training facilities for extension workers in crop production techniques and linking them with researchers and the councils of research planning; and providing efficient administration and a continuous flow of information on food production, demand, farm inputs, food distribution, priorities for resource allocation, and prices. The program covers rapid multiplication of improved varieties of cassava as well.

Table 9--Comparison of improved and local methods of cassava production on 1 hectare in relation to labor use

Operation	Improved Method		Local Method	
	Labor	Costs	Labor	Costs
	(man days)	(N)	(man days)	(N)
Land clearing	2[a]	80.00	60	300.00
Seed-bed preparation	6[a]	240.00	150	750.00
Planting	15	63.00	15	63.00
Weeding[b]	40	245.00	120	600.00
Fertilizer application	25	105.00	25	105.00
Harvesting	75	375.00	75	375.00
Total cost	...	1,103.00	...	2,193.00
Sole crop				
Revenue (N/hectare	...	3,750.00	...	1,500.00
Profit	...	2,061.00	...	-693.00
Mixed crop				
Revenue (N/hectare)	...	4,875.00	...	2,627.00
Profit	...	3,060.00	...	1,122.00

Source: National Root Crop Research Institute, Briefs on Cassava (Umidike: NRCRI, 1985).

Note: The yields for cassava grown as a sole crop were 25 metric tons with improved methods and 10 metric tons with local methods.

[a]This figure is in tractor hours.
[b]Herbicides were applied during weeding, but the figure for labor does not include the labor used to apply them.

Table 10--Balance sheet for a household growing improved cassava in Oyo Local Government Area, 1986

Item	Value
	(N)
Gross income	
Sale of cassava tubers (4.06 metric tons at N380/metric tons)	1,543.00
Sales of processed gari (40 x 20 bags at N1,650/metric ton)	5,359.00
Rent earnings from cassava processing equipment	162.00
Miscellaneous income from cassava-related jobs	739.00
Value of home-consumed cassava (1.83 metric tons at N380/metric ton)	695.00
Total	8,498.00
Less cost of goods sold	
Cassava cuttings	177.00
Losses due to deterioration of tubers and gari (15)	1,035.00
Total	1,212.00
Gross margin	7,286.00
Less operating expenses	
Labor for	
Land preparation (5.89 metric tons at N60.25/metric ton)	354.87
Production (5.89 metric tons at N60.98/metric ton)	359.17
Processing (5.89 metric tons at N184.59/metric ton)	1,087.24
Marketing (39.67 days at N5.00/day)	198.35
Total for labor	1,999.63
Land	50.02
Machine grating	129.92
Transportation	706.80
Miscellaneous expenses	117.80
Total operating expenses	3,004.17
Net operating margin	4,281.83
Less fixed expenses	
Depreciation on production tools and processing equipment	145.00
Net profit from cassava for the household	4,136.83

Source: A. E. Ikpi, T. Gebremeskel, Natalie E. Hahn, H. Ezumah, and J. A. Ekpere, Cassava--A Crop for Household Food Security, a 1986 Situation Analysis for Oyo Local Government Area, Nigeria, International Institute of Tropical Agriculture-United Nations Children's Fund Collaborative Program (Ibadan: IITA, 1986), pp. 84-85.

Table 11--Performance of recommended improved varieties and unimproved varieties, 1982/83

Variety	Fresh Yield	Cassava Dry Matter	Yield of Gari	Yield of Fufu Flour	Resistance to Pests and Diseases
	(metric tons/ hectare)	(percent)	(metric tons/ hectare)		
Improved					
U/7706	35.5	30.0	7.0	7.7	Very good
U/41044	37.0	28.4	6.7	7.4	Good
TMS 30555	32.5	26.2	4.2	5.4	Good
TMS 30211	28.0	25.0	3.9	4.2	Very good
TMS 30572	23.1	31.3	4.2	5.6	Very good
Unimproved					
Uwugo	12.2	35.3	2.7	3.6	Poor
53101	10.8	34.0	2.5	2.9	Poor

Source: National Root Crop Research Institute, Briefs on Cassava (Umudike: NRCRI, 1985).

Note: The varieties with designations that begin with U were developed by the NRCRI; those that begin with TMS were developed by the International Institute of Tropical Agriculture (IITA). The others are unimproved local varieties.

Table 12--On-farm yields and farmers' preferences for improved high-yielding cassava varieties in Umuahia ADB zone, 1985/86

Variety	Yield			Farmers' Preferential Rating		
	Bendel	Olokoro	Uzuakoli	Bendel	Olokoro	Uzuakoli
TMS 50572	18.6	14.2	17.3	1	1	1
TMS 30555	15.5	9.9	16.9	3	4	2
TMS30211	14.4	13.9	14.3	4	2	3
U/41044	15.3	11.8	11.3	2	3	4

Source: National Root Crop Research Institute, Annual Report, 1985 (Umudike: NRCRI, 1985).

Notes: The varieties with designations that begin with U were developed by the NRCRI, and those that begin with TMS were developed by IITA. The others are unimproved local varieties.

REGIONAL SPECIALIZATION

Because of the way the states are arranged, the pattern of vegetation makes a rough crop pattern for the country evident. The major cassava-producing areas are the southern states and the middle belt (see Table 13). In fact, the middle belt produces all the major crops of Nigeria. Yams, maize, and rice are found there in large quantities. Sorghum, millet, pulses, groundnuts, and the root crops are complements.

Table 13--Major crop production, by state, 1979-83 averages

State	Cassava	Yams	Maize	Rice	Sorghum	Millet	Pulses	Groundnuts
			(1,000 metric tons of wheat equivalent)					
Southern states								
Lagos	3.3	0.2	0.2	...	...	...	...	...
Ogun	24.0	2.0	11.0	2.2	1.9	...	0.1	0.2
Oyo	288.5	73.9	50.6	4.2	...	...	0.6	0.9
Ondo	75.6	58.4	18.0	12.2	...	...	...	0.9
Bendel	316.7	203.7	48.0	13.3	...	...	0.8	7.6
Rivers	168.2	22.6	12.0	...	...	...	...	...
Cross River	86.0	78.1	9.2	3.2	...	...	...	0.3
Imo	176.5	98.1	29.6	23.3	...	...	0.2	0.3
Anambra	106.5	133.9	34.6	14.7	...	...	0.6	4.8
Middle Belt								
Kwara	25.6	104.2	38.8	11.5	64.8	10.6	12.8	1.9
Niger	...	110.1	29.4	23.7	184.4	15.4	0.1	15.8
Benue	189.3	299.8	45.6	17.0	105.0	48.0	5.8	45.6
Plateau	4.9	241.7	59.8	8.4	201.6	49.8	4.4	20.2
Gongola	69.1	137.0	74.6	12.6	401.2	50.6	2.8	44.7
Northern states								
Borno	...	...	29.0	61.4	149.6	196.4	21.0	20.8
Bauchi	2.6	...	78.6	3.3	356.4	278.6	54.0	38.9
Kaduna	2.4	36.4	84.0	8.4	526.4	380.6	108.2	80.9
Kano	17.8	...	24.4	0.8	480.0	427.0	152.4	96.8
Sokoto	...	0.6	25.2	12.0	1,380.2	1,412.4	101.3	157.5
Nigeria	1,560.4	1,590.7	702.7	232.8	3,851.5	2,869.4	660.0	543.8

Source: Computer printout for S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D. C., 1986.

The major reasons for the regional specialization of agricultural crop production in Nigeria generally and cassava in particular are the physical features of the country. These areas are in the forest zone of the country with average rainfall exceeding 1,000 millimeters per year.

Researchers have also confirmed that there are regional preferences for varieties of cassava. There is a high preference for sweet cassava in the north, no preference at all in the east, while preferences are divided equally between sweet and bitter cassava in the southwest.[9]

THE ROLE OF CASSAVA IN FARMING SYSTEMS

Cassava grows under diverse soil and agroecological conditions. It is generally the last crop in a rotation before the land is returned to bush fallow. Although the highest yields are obtained through proper management and in soils that promote development of tuberous roots, cassava can still produce good yields under the most adverse soil conditions where other crops may not. This can be attributed partly to its deep root system.[10] Cassava, it is said, can penetrate soils of relatively high density. After receiving no rain for about 10 weeks, the leaf-water potential of cassava was observed at IITA to be -6 to -8 atmospheres compared with -10 to -12 for sweet potatoes.

Intercropping characterizes traditional cropping systems in Nigeria. Cassava is rarely grown alone except on a few large-scale mechanized farms. It is commonly intercropped with vegetables, plantation crops, yams, sweet potatoes, melons, maize, rice, and legumes.[11] The intercropping pattern depends on environmental conditions and the food preferences of the region.

The results of several cassava-based intercropping studies at IITA have shown that land productivity is higher when cassava is intercropped with maize, beans, and cowpeas than under monocropping of maize or cowpeas.[12] It is clear that cassava is ideal for intercropping with short-duration crops, since they mature when cassava is just attaining its maximum leaf area and beginning to produce tubers. All

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[9]D. H. Oben and K. M. Menz, Sweet Versus Bitter Cassava: The Prospect for Low Cyanide Varieties in Nigeria, Agricultural Economics Discussion Paper No. 8/80 (Ibadan: International Institute of Tropical Agriculture, 1980).

[10]International Institute of Tropical Agriculture, Research Highlights for 1980 (Ibadan: IITA, 1981).

[11]Hahn et al., "Cassava Improvement in Africa," p. 218.

[12]Ibid, p. 219.

that is required is for agronomic research to identify the optimum for plant populations, plant types, the time and rate of fertilizer applications for the crop mixture, the spatial arrangement of the crops, and the time of cassava planting in relation to other crops in the mixture.

Plans have been made to move specific on-station research to farms.[13] After the results are released to farmers for adoption, the farming system will be able to achieve higher production and use environmental resources such as light, water, and the nutrients required for crop growth more efficiently. For example, an appropriate cropping pattern for cassava-maize intercropping yields a land-equivalent ratio of more than 1.6. This means that the farmer can use 60 percent less land in intercropping to obtain the same output produced by sole-cropping cassava or maize.[14]

Another implication of all these is that producing cassava alone is not as economical as combining cassava with other crops like maize, melons, and sweet potatoes, which a farmer can harvest early to sustain himself before the cassava is ready to be harvested.

THE ROLE OF WOMEN IN THE PRODUCTION, PROCESSING, AND UTILIZATION OF CASSAVA

Women play major roles in all stages of agricultural production, processing, and utilization (Table 14).[15] Women have nearly total control over weeding, processing, and storage. Nearly all stages of processing are becoming mechanized, but peeling still has to be done by hand. Women excel at this.

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[13]International Institute of Tropical Agriculture, Annual Report for 1984 (Ibadan: IITA, 1985), pp. 175-182.

[14]National Root Crop Research Institute, Briefs on Cassava (Umudike: NRCRI, 1985), p. 5.

[15]See M. E. Burfisher and N. R. Horenstein, Sex Roles in the Nigerian Tiv Household, Cases for Planner (West Hartford: Kumarian Press, 1985). See also the results of the numerous seminars, conferences, and workshops that have been held on the roles of women in development. For example, see Institute of African Studies, Nigerian Women and National Development (Ibadan: Institute of African Studies, 1985); and Nigerian Institute of Social and Economic Research, Women in Development (Ibadan: NISER, 1984).

Table 14--Gender roles and average workhours spent producing, processing, and marketing in Oyo Local Government Area, 1986

Activities	Men		Women		Children		Total		
	Fami	Hired	Family	Hired	Family	Hired	Family	Hired	Total
	(hours/person/year)								
Land preparation									
Farm clearing	135	88	...	...	...	...	135	88	223
Tree felling	74	23	22	...	...	...	96	23	119
Farm burning and packing	12	36	36	...	...	...	48	36	84
Total	221	147	58	...	...	...	279	147	426
	(52)	(34)	(14)				(66)	(34)	(19)
Production									
Planting	31	108	18	...	45		94	108	202
Weeding	19	9	231	54	157	...	407	63	470
Harvesting	54	40	45	9	31	...	130	49	179
Total	104	157	294	63	233	...	631	220	851
	(12)	(19)	(35)	(7)	(27)		(74)	(26)	(38)
Processing									
Peeling	...	...	50	145	100	...	150	145	295
Washing	...	...	17	39	38	...	55	39	94
Grating (machine)	...	...	5	...	16	...	21	...	21
Bagging and dewatering	...	...	5	...	16	...	21	...	21
Sieving	...	...	12	2	4	...	16	2	16
Frying	...	...	45	73	56	...	103	73	176
Total	...	...	154	259	325	...	479	259	738
			(21)	(44)	(44)		(65)	(35)	(33)
Marketing	8	...	224	...	6	...	238	...	238
	(3)		(94)		(3)		(100)		(10)
Total workhours spent	333	304	730	322	564	...	1,627	626	2,253
	(15)	(14)	(32)	(14)	(25)		(70)	(28)	(100)

Source: A. E. Ikpi, T. Gebremeskel, Natalie E. Hahn, H. Ezumah, and J. A. Ekpere, Cassava--A Crop for Household Food Security, a 1986 Situation Analysis for Oyo Local Government Area, Nigeria, International Institute of Tropical Agiculture-United Nations Children's Fund Collaborative Program (Ibadan: IITA, 1986), p. 82.

Note: The figures in parentheses are the percentages of the total time spent on the activity.

An exploratory study was carried out by IITA involving 62 women in five villages in Oyo State.[16] It found that at least 25 of the 62 women were independent owners of land primarily inherited from their fathers or husbands. All of them were involved with marketing of food products, which took about 25 percent of their time. Half of their time was spent in agricultural work in the fields. Processing cassava into gari or cassava flour and selling it was a major activity of the women of these villages. Some of them purchased whole fields of cassava from farmers and then organized both the harvesting and processing for market sales. The interviews consistently indicated that about half of the food produced on farm was marketed; the other half was consumed at home. Women who owned their land hired more labor than male farmers with farms of comparable size. The labor was used primarily for land clearing and weeding.

The variations in the data presented in Table 15 can be used to identify four patterns. One group of states has a high rate of

Table 15--Female labor force participation rates, 1984

State	Urban Areas	Rural Areas
	(percent)	
Lagos	51.35	48.31
Ogun	81.16	80.36
Oyo	63.85	62.70
Ondo	80.00	56.25
Bendel	48.39	31.48
Rivers	62.86	69.91
Cross River	40.49	63.69
Imo	56.33	53.33
Anambra	49.12	63.37
Kwara	74.44	56.90
Niger	4.94	0.25
Benue	29.95	62.44
Plateau	8.06	7.28
Gongola	16.18	37.74
Borno	2.63	10.34
Bauchi	7.69	2.30
Kaduna	10.92	2.17
Kano	6.11	4.53
Sokoto	6.42	2.40
Nigeria	34.80	36.12

Source: Nigeria, Federal Office of Statistics, Labour Force Survey, December 1984, Preliminary Results (Lagos: FOS, 1985).

[16] International Institute of Tropical Agriculture, Research Highlights for 1984 (Ibadan: IITA, 1985).

female participation in the labor force with the urban rates relatively higher than rural rates (Kwara, Ogun, Oyo, Ondo, and Bendel). A second group has urban rates lower than rural rates (Rivers, Cross River, Anambra, Benue, and Gongola). An intermediate group has high rates of female participation, but little difference between urban and rural rates (Lagos and Imo). The last group has low female labor force participation (Niger, Plateau, Borno, Bauchi, Kaduna, Kano, and Sokoto). This analysis shows that the areas with high rates of women participating in the rural labor force are the major cassava-producing areas. It may be noted that the employment of women outside the home is also governed by religious considerations.

THE ROLE OF CASSAVA IN FOOD SECURITY

Food security is an ability to produce an adequate quantity of food throughout the year, regardless of environmental and political problems. Cassava has characteristics that make it a "security" crop. It provides the low-income people with a basic food staple. It has the potential to provide more calories per unit area than any food crop. It is adaptable to diverse climate and cultural conditions; it can survive dry spells of up to 4-6 months, and can withstand locust or grasshopper attacks. It is propagated by the stems, which can be cut and planted in any type of soil, fertile or infertile, with or without fertilizers, and can thus survive under harsh conditions where other crops would fail. It generally requires less labor to produce and costs less to manage than cereal crops. Its roots and leaves are both valuable as human food and livestock feed. Finally, it can be harvested at any time throughout the year because of its ability to stay in the ground even after it is ready for harvest.

3. TRENDS IN CASSAVA PRODUCTION, UTILIZATION, TRADE, AND PRICES

TRENDS IN AREA, PRODUCTION, AND YIELD RATE

According to FAO, the production of cassava from 1961 to 1983 grew at an average annual rate of 3.7 percent (see Table 16).[17] This was due essentially to increases in the area harvested, which resulted in an average annual growth rate of 3.9 percent, while output per hectare declined at an annual rate of 0.3 percent. On the other hand, Table 17 shows that the average annual growth rate of production was -2.0 percent; that of area harvested, -2.2 percent; and that of yield, 0.3 percent.[18] These latter results are exactly the opposite of FAO's, but they have the support of the analysis given above, and they incorporate the improvements in certain pockets of the major areas producing cassava that started to benefit from the research work of IITA, the national research institutes, and NAFPP after 1978.

A detailed picture of the growth rates is presented in the remaining parts of Table .. for 1965-69 to 1979-83 and 1969-73 to 1979-83. From 1965-69 to 1979-83, only East (Rivers, Cross River, Imo, and Anambra) and North (Benue, Kwara, Niger, Plateau, Gongola, Borno, Bauchi, Kano, Kaduna, and Sokoto) showed positive growth rates in production. From 1969-73 to 1979-83, only Rivers showed a positive average growth rate for production. This shows that production during 1979-83 did not reach that of 1969-73.

The area harvested generally decreased. Only the East region recorded a positive average growth rate from 1965-69 to 1979-83. From 1969-73 to 1979-83, Rivers, Benue-Plateau, and North Central (Kaduna) states recorded positive average growth rates for the area harvested.

When it comes to yield rates, the story is different. Average growth rates were positive for all regions, except Mid-West (Bendel), between 1965-69 and 1979-83, as high as 2.3 percent for West (Lagos, Ogun, Oyo, and Ondo). From 1969-73 to 1979-83, West (Ogun, Oyo, and Ondo), Rivers, East Central (Imo and Anambra), Benue-Plateau, North East (Gongola, Borno, and Bauchi), and North West (Niger and Sokoto) had positive average growth rates.

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[17]Food and Agriculture Organization of the United Nations, "Supply Utilization Accounts Tape," Rome, 1984.

[18]Adamu, "Trends of Food Production and Consumption in Nigeria."

Table 16--FAO cassava production and utilization statistics, 1961-63 to 1981-83

Production use	Average 1961-63	Average 1971-73	Average 1981-83	Average Annual Growth Rate 1961-63 to 1971-73	Average Annual Growth Rate 1971-73 to 1981-83	Average Annual Growth Rate 1961-63 to 1981-83
	(metric tons)			(percent)		
Production						
Area (hectares)	815,333	950,000	1,200,000	1.54	2.36	3.94
Production	7,583,333	9,447,333	10,883,333	2.22	1.43	3.68
Yield (metric tons/hectare)	9,3166	9,9451	9,0596	0.66	-0.93	-0.28
Utilization						
Feed	75,833	94,473	108,833	2.22	1.43	3.68
Waste	1,137,500	1,417,100	1,632,500	2.22	1.43	3.68
Processed	5,990,833	7,463,393	8,597,833	2.22	1.43	3.68
Food	379,167	472,367	544,167	2.22	1.43	3.68
Cassava flour						
Input	5,691,290	7,090,233	8,167,940	2.22	1.43	3.68
Production	1,308,997	1,630,751	1,878,626	2.22	1.43	3.68
Waste	65,450	81,537	93,931	2.22	1.43	3.68
Food	1,243,546	1,549,412	1,784,694	2.22	1.43	3.68
Cassava tapioca						
Input	299,541	373,170	429,892	2.22	1.43	3.68
Production	59,908	74,634	85,978	2.22	1.43	3.68
Waste	1,797	2,239	2,579	2.22	1.43	3.68
Food	58,111	72,395	83,399	2.22	1.43	3.68

Source: Food and Agriculture Organization of the United Nations, "Supply Utilization Accounts Tape," Rome, 1984.

Table 17--Average annual growth rates of production area harvested, and yields of cassava, by region or state, 1961-65 to 1979-83

Dates/Region or State	Production	Area Harvested	Yield
		(percent/year)	
1961-65 to 1979-83			
Nigeria	-2.0	-2.2	0.3
1965-69 to 1979-83			
West	-7.0	-9.1	2.3
Mid-West	-1.3	-0.6	-0.8
East	0.6	0.1	0.4
North	0.1	-0.2	0.2
Nigeria	-1.5	-1.6	0.1
1969-73 to 1979-83			
Lagos	-28.8	-27.8	-1.4
West	-8.6	-9.7	1.2
Mid-West	-0.5	-0.6	-0.2
Rivers	12.1	9.9	2.0
South East	-11.6	-9.8	-1.9
East Central	-10.3	-4.4	2.3
Kwara	-17.6	-8.8	-2.7
Benue-Plateau	-2.5	2.1	0.7
North East	-3.3	-0.9	4.2
Kano	-6.8	-0.8	-6.0
North Central	-7.2	13.8	-18.4
North West	-16.8	-21.5	5.9
Nigeria	-8.1	-3.2	-0.1

Source: S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Note: For an outline of how the regions or states were subdivided or their names changed as the political structure changed, see Appendix 2.

Table 18 relates cassava production to the output of the major crops in the country. For example, for the whole country, the share of cassava in total production was 13.9 percent, by 1979-83 it fell by 666,400 metric tons, a decrease of 16.8 percent. The results are similar to those of Table 17.

Table 18--Cassava's share and contribution to the growth of output of major food crops, by region or state, 1961-65 to 1979-83

Date/Region or State	Share at Beginning of Period	Absolute Change in Production Increase/Decrease	Contribution to Output Growth
	(percent)	(1,000 metric tons of wheat equivalent)	(percent)
1961-65 to 1979-83			
Nigeria	13.9	-666.4	-16.8
1965-69 to 1979-83			
West	40.8	-688.96	-34.1
Mid-West	54.1	-66.38	-57.3
East	35.9	40.68	12.0
North	3.1	3.14	1.3
Nigeria	15.4	-711.52	-26.2
1969-73 to 1979-83			
Lagos	78.1	-94.44	-77.7
West	44.3	-565.24	-37.0
Mid-West	42.5	-19.64	-10.1
Rivers	60.9	114.38	97.1
South East	50.6	-207.9	-52.1
East Central	29.5	5.24	2.4
Kwara	12.2	-58.9	-14.0
Benue-Plateau	11.7	49.04	43.9
North East	2.1	20.0	4.7
Kano	1.9	-18.24	-2.7
North Central	0.3	-2.62	-0.3
North West	1.0	-17.64	-1.1
Nigeria	15.7	-792.9	-27.0

Source: S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Note: For an outline of how the regions or states were subdivided or their names changed as the political structure changed, see Appendix 2.

Table 19 shows the relative contribution of area harvested and yield to the growth of cassava production. Cassava is one of the crops whose output fluctuated greatly between 1961 and 1983 (Table 1). Table 20 enlarges on this picture by giving some intermediate trends.

Table 19--Contribution of area harvested and yield to the growth of cassava production, by region or state, 1961-65 to 1979-83

Dates/Region or State	Area Harvested	Yield
1961-65 to 1979-83		
Nigeria	-110.0	10.0
1965-69 to 1979-83		
West	-130.0	30.0
Mid-West	-46.0	-56.0
East	16.7	83.3
North	-200.0	300.0
Nigeria	-107.0	7.0
1969-73 to 1979-83		
Lagos	-96.5	-3.5
West	-112.8	12.8
Mid-West	-120.0	20.0
Rivers	81.8	18.2
South East	-84.5	-15.5
East Central	-209.5	109.5
Kwara	-79.0	-21.0
Benue-Plateau	79.4	20.6
North East	-27.0	127.0
Kano	-12.0	-88.0
North Central	300.0	-400.0
North West	-128.0	28.0
Nigeria	-94.0	-6.0

Source: S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Note: For an outline of how the regions or states were subdivided or their names changed as the political structure changed, see Appendix 2.

Table 20--Distribution and growth rates of production for cassava, by region or state, 1961-65 to 1979-83

Early and Late Periods/Region or State	Share of Total Cassava Production		Growth Rates		1974-78 to 1979-83
	Early Period	Late Period	Early Period	Late Period	
	(percent)				
1961-65 and 1979-83					
Nigeria	...	100.0	-2.0	-1.3	-3.7
1965-69 and 1979-83					
West	47.5	25.1	-7.0	-6.3	-8.3
Mid-West	16.9	20.3	-1.3	0.8	-5.1
East	21.9	34.4	0.6	2.1	-2.1
North	13.7	20.2	0.1	-1.4	2.9
1969-73 and 1979-83					
Lagos	4.0	0.2	-28.8	-25.5	-31.9
West	39.4	24.9	-8.6	-9.5	-7.7
Mid-West	13.8	20.3	-0.5	4.7	-5.1
Rivers	2.2	10.8	12.1	15.2	9.0
South East	12.1	5.5	-11.6	-23.7	-2.5
East Central	14.3	18.1	-2.1	3.8	-7.2
Benue-Plateau	6.0	12.5	3.0	4.5	1.4
North East	2.1	4.6	3.3	-20.2	33.8
Kano	1.5	1.1	-6.8	-4.5	-9.1
North Central	0.2	0.2	-7.2	20.7	-28.7
North West	0.9	0.2	-16.8	-17.4	-16.3
Kwara	3.5	1.6	-11.2	-20.7	-0.6

Source: S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Note: For an outline of how the regions or states were subdivided or their names changed as the political structure changed, see Appendix 2.

Apart from Rivers, Benue-Plateau, and North East, all states in the 12-state structure had negative growth rates of production between 1969-73 and 1979-83. Among the three with positive growth rates, only North East had a negative rate for one of the two subperiods shown in Table 20, but the growth rate for 1974-78 to 1979-83 was large enough to offset the earlier negative growth rate and obtain a positive overall growth rate. States such as Mid-West, East Central, and North Central had positive growth rates for 1969-73 to 1974-78 but negative rates for 1974-78 to 1979-83.

CHANGES IN DOMESTIC UTILIZATION

It is common to find statements made like "the tuberous roots supply 70 percent of the daily calorie intake of over 50 million Nigerians" without any justifiable basis. The first serious food analysis about Nigeria was made in 1972.[19] When it was felt that data were improving in quantity and quality, a task force produced another report in 1979.[20] As shown in Appendix 2, much of the statistical approach to cassava developed for the earlier report is contained in Abiagom's 1971 work.[21] From this source, it was shown that cassava products were consumed in the proportions shown in Table 21, and the extraction rates were as follows: for gari, 33.3 percent; for akpu/fufu, 50 percent; for cassava flour, 25 percent; and for starch, 20 percent. Whether or not these percentages were correct for the end of the 1960s and the early 1970s, it would be of interest to find out what the rates are for more recent periods in order to assess changes in domestic utilization.

As said above, much of the utilization of cassava in Nigeria is for human food. The only other major use is to feed pigs. No data exist on this. It is only now, as a result of shortages of raw materials and a ban on the importation of wheat, that attention is being focused on other uses of cassava.

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[19] S. O. Olayide et al., A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria, 1968-85 (Lagos: Federal Department of Agriculture, 1972).

[20] Olayide et al., Food Production in Nigeria.

[21] J. D. Abiagom, "Report on Production/Utilization/Processing Account of Food Crops in Nigeria, for the Purpose of Preparing Food Balance Sheet for Nigeria," prepared for the National Agricultural Development Committee of Nigeria, 1961-69, Federal Office of Statistics, Lagos, 1971 (mimeographed).

Table 21--Estimates of the proportions of cassava products in total cassava consumption

Abiagom		FAO Supply Utilization Accounts Tape		1980/81 National Consumer Survey	
Product	Share of Total	Product	Share of Total	Product	Share of Total
	(percent)		(percent)		(percent)
Fresh cassava	15	Feed	1	Cassava tuber (fresh or boiled)	19
Gari	5	Fresh or boiled	5	Gari	65
Akpu/fufu	60	Cassava flour	75	Akpu/fufu	14
Starch	10	Cassava tapioca	4	Starch/ cassava flour	2
Cassava flour	10	Waste	15		

Source: J. D. Abiagom, "Report on Production/Utilization /Processing Account of Food Crops in Nigeria, for the Purpose of Preparing Food Balance Sheet for Nigeria," prepared for the National Agricultural Development Committee of Nigeria, 1961-69, Federal Office of Statistics, Lagos, 1971 (mimeographed); Nigeria, Federal Office of Statistics, "National Consumer Survey, 1980/81," Lagos, n.d. (computer printout); and Food and Agriculture Organization of the United Nations, "Supply Accounts Utilization Tape," Rome, 1984.

Ideally, a national consumption survey would be a major source of consumption data on specific items. Many consumption surveys have been conducted in Nigeria, but detailed results on expenditures or consumption have not been published, except for the 1980/81 national survey. This was computerized, and the printout exists for limited circulation. The results summarized and presented in Tables 22 and 23 are based on this source.[22] Retail prices data, which exist only for gari among the cassava products, are also from the FOS collection of regular prices.

[22]Nigeria, Federal Office of Statistics, "National Consumer Survey, 1980/81," Lagos, n.d. (computer printout).

Table 22--Consumption of food items as proportions of total consumption expenditures, by state 1980/81

State	Urban Areas					Rural Areas				
	Yams	Cassava	Others	Total	Share of Consumption from State's Production	Yams	Cassava	Others	Total	Share of Consumption from State's Production
	(percent)									
Lagos	1.18	1.73	50.28	53.19	0.06	4.11	10.58	34.16	48.85	2.97
Ogun	5.28	8.48	38.97	52.73	2.80	5.92	13.10	43.31	62.33	19.00
Oyo	7.24	3.90	34.87	46.01	1.50	19.36	8.57	37.97	65.90	31.56
Ondo	12.43	6.07	28.99	47.49	6.10	13.03	9.07	35.91	57.01	19.90
Bendel	0.53	0.59	48.53	49.65	1.96	14.38	18.48	23.89	56.75	18.77
Rivers	2.43	2.40	46.48	51.31	4.09	8.15	12.19	40.77	61.11	21.92
Cross River	4.06	7.02	39.88	50.96	2.25	7.39	11.59	36.94	56.52	19.17
Imo	5.39	7.45	31.50	44.24	0.46	7.06	9.67	38.53	55.26	16.67
Anambra	10.46	5.34	37.21	53.01	7.91	14.38	10.68	38.29	63.35	26.78
Kwara	5.12	3.65	47.96	56.73	3.55	9.92	3.29	53.46	66.67	37.97
Niger	4.45	3.00	49.73	57.18	2.90	6.58	2.14	54.46	63.18	26.62
Benue	5.82	3.08	32.28	41.18	2.84	32.08	4.73	30.67	67.48	48.95
Plateau	8.10	3.00	48.91	60.01	0.29	14.74	2.36	46.61	63.71	29.52
Congola	4.65	1.10	50.03	55.78	1.50	11.73	0.75	48.74	61.22	25.36
Borno	3.84	1.51	59.78	65.13	2.11	2.16	0.72	62.01	64.89	25.13
Bauchi	2.77	1.03	53.10	56.90	1.41	0.66	0.32	59.24	60.22	25.92
Kaduna	6.85	2.19	53.46	62.50	4.37	2.11	0.83	64.98	67.92	34.48
Kano	1.90	0.56	62.02	64.48	6.26	1.26	0.75	69.77	71.78	25.89
Sokoto	3.10	1.36	65.42	69.88	1.91	0.17	...	68.23	68.40	29.54

Source: Nigeria, Federal Office of Statistics, "National Consumer Survey, 1980/81" Lagos, n.d. (computer printout).

Table 23--Consumption of cassava, 1980/81

State	Average Price of Gari	Urban Areas: Average Household Expenditures on Gari Per Month	Urban Areas: Expenditures on Gari as a Share of Total Cassava Consumption	Urban Areas: Estimate of Total Gari Consumption	Rural Areas: Average Household Expenditures on Gari Per Month	Rural Areas: Expenditures on Gari as a Share of Total Cassava Consumption	Rural Areas: Estimate of Total Gari Consumption	Cassava Consumption in Gari Equivalent
	(kobo/ kilogram)	(N)		(1,000 metric tons)	(N)		(1,000 metric tons)	
Lagos	69.25	4.06	0.936	18.08	14.84	0.976	18.95	38.74
Ogun	74.57	9.03	0.903	8.92	10.88	0.943	25.47	36.89
Oyo	69.04	5.66	0.900	29.41	6.92	0.664	42.94	97.35
Ondo	101.46	8.44	0.967	8.42	10.02	0.896	30.18	42.39
Bendel	111.34	1.17	0.932	0.88	14.14	0.805	68.38	85.89
Rivers	57.60	5.10	0.975	6.61	11.62	0.622	50.07	87.28
Cross River	51.01	10.61	0.899	7.24	9.38	0.580	117.88	211.29
Imo	70.86	13.92	0.850	11.38	7.01	0.546	99.02	194.74
Anambra	74.40	6.84	0.599	7.66	4.69	0.407	52.63	142.12
Kwara	75.33	3.88	0.855	4.01	1.83	0.502	5.01	14.66
Niger	94.66	3.60	0.743	5.01	1.53	0.785	3.41	11.09
Benue	54.48	2.84	0.578	1.20	1.69	0.268	12.56	48.93
Plateau	93.28	2.83	0.877	0.74	0.96	0.530	4.35	9.05
Gongola	50.03	1.14	0.827	0.47	0.34	0.507	3.51	7.50
Borno	87.68	1.12	0.702	1.06	0.27	0.431	2.08	6.34
Bauchi	93.82	1.31	0.883	0.35	0.16	0.471	0.98	2.48
Kadunas	100.96	2.72	0.904	2.98	0.28	0.349	2.69	11.01
Kano	97.49	0.66	0.696	1.09	0.45	0.640	5.29	9.83
Sokoto	150.66	4.86	0.728	0.97	0.0	0.00	0.0	1.33
Total	...	...	...	135.55	...	...	923.36	1,058.91

Sources: Based on data from Nigeria, Federal Office of Statistics, "National Consumer Module of the National Integrated Survey of Households," Lagos, n.d. (computer printout); and retail prices from the Federal Office of Statistics.

Table 23 shows how total cassava consumption in gari equivalent was derived. This is put at 1.06 million metric tons for the whole country. Using the population total of 85.8 million, cassava consumption per capita per year in gari equivalent was calculated to have been 12.34 kilograms in 1981. Converting this to fresh cassava, consumption in 1980/81 was 60.2 kilograms or 0.165 kilograms per day per capita.

The analysis was not as simple as this because there were variations among states and between urban and rural areas. The major consuming areas were Lagos, Ogun, Oyo, Ondo, Bendel, Rivers, Cross River, Imo, Anambra, and Benue. In these states, the population, both urban and rural (except for Lagos and Bendel), depend on cassava for more than 10 percent of their daily dietary energy. (The percentage for Bendel may be in error because of defects in the survey data for that state.) These major cassava-consuming states accounted for 51 percent of the 1980/81 population and consumed 93.1 percent of total cassava in gari equivalent. Between them they produced more than 93.4 percent of total production.

The proportions for the different cassava products based on Supply Utilization Accounts estimated by FAO and derived from the 1980/81 national consumer survey are presented in Table 21. Estimates by Abiagom and those derived from the 1980/81 national consumer survey are easily compared. The major difference concerns the proportions assigned to gari and akpu. The main reason for the low estimate for gari (as noted in Appendix 1) is that Abiagom used a survey based on rural Nigeria. The survey was not national. Moreover, there is the problem of classification because of the different names given to cassava products in different parts of the country. From the data presented in Table 21, there is reason to believe that akpu and fufu are grouped together and that starch and cassava flour (lafun) are together. Anambra and Imo have the highest proportions of akpu, and in the West, 0.05 percent is assigned to Oyo, a major cassava flour (lafun) consumer. Some of the cassava tubers can also be processed within the household into any of the products except gari. The problem with the FAO estimates is that cassava tapioca is not easily identified with any category on the other lists except gari. The role of gari seems to be far more important, however. The proportion attributed to cassava flour is not comparable to the proportions attributed to it on the other lists. Nor are the assumptions made by FAO known.

There is a need to be careful about the treatment of waste when dealing with cassava. Waste rates must be treated separately from the extraction rate. In the FAO data, only 10 percent of total production

is classified as lost to waste.[23] But the FAO data apparently allow for considerable losses in cassava processing, because the extraction rates for cassava products from fresh cassava are much lower than those theoretically obtainable. Hence the real waste figure is probably much higher.

Waste rates are of two types even apart from extraction rates. There is waste because there may be no rudimentary on-farm storage facility for harvested cassava in a village. Hence the cassava is spoiled, damaged by goats and other ruminants, and otherwise lost after the harvest. Ikpi et al. put these losses at 15 percent.[24] There is also waste during processing. The most important processing waste is from peeling. Onyekwere and Koleoso put this at 25 percent for hand peeling and at more than 30-40 percent for mechanical peeling.[25]

It is over and above these sources of waste that the extraction rate is applied. It seems reasonable to put the extraction rates for gari at between 16.0 and 33.3 percent, say at 25.0 percent, the extraction rate for fufu at 18.0 percent, and the extraction rate for starch and cassava flour at 15.0 percent.

Table 24 is compiled on the basis of these extraction rates. The waste rate assumed is 15 percent of production before processing and the factor used to calculate the amount of fresh cassava from the gari equivalent is 4.0. On this basis, the total amount of cassava products going to interstate trade would be 1,301,910 metric tons (or 325,478 metric tons of gari), excluding statistical discrepancies. The statistical discrepancy is 220,990 metric tons, which is tentatively put under animal feed. The discussion above suggests that only a small proportion of this should be assigned to animal feed. The rest must be explained as a defect in the production or consumption estimates (see Appendix 1).

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[23]James H. Cock, Cassava: New Potential for a Neglected Crop (Boulder, Colo., USA: Westview Press, 1985), p. 7.

[24]A. E. Ikpi et al., Cassava--A Crop for Household Food Security, a 1986 Situation Analysis for Oyo Local Government Area, Nigeria, International Institute of Tropical Agriculture-United Nations Children's Fund Collaborative Program (Ibadan: IITA, 1986), p. 66.

[25]O. O. Onkyekwere and O. A. Koleoso, "Industrial Procesing of Cassava Products--The Federal Institute of Industrial Research Experience," a paper presented to the FAO Workshop on Cassava, Abidjan, Ivory Coast, November 28-December 1983. The results for gari processing are shown in International Institute of Tropical Agriculture, Annual Report for 1979 (Ibadan: IITA, 1980): p. 8.

The most surprising aspect of Table 24 is the high amount of cassava consumption accounted for by imports for Cross River, Imo, and Anambra. If the production data are correct, there must be a lot of trade between these three states and the adjoining states of Rivers, Bendel, and Benue, which have a lot of cassava available for export. Otherwise, there may be serious errors in estimating production, consumption, or both for Cross River, Imo, and Anambra.

Table 24--Cassava production and utilization, 1980/81

State	Production	Trade between States		Available Supply	Waste Before Processing	Food in Gari Equivalent
		Exports	Imports			
		(1,000 metric tons)				
Lagos	24.00	...	134.56	158.56	3.60	38.74
Ogun	174.00	0.34	...	173.66	26.10	36.89
Oyo	576.00	100.20	...	475.80	86.40	97.35
Ondo	228.00	24.24	...	203.76	34.20	42.39
Bendel	1,188.00	666.24	...	521.76	178.20	85.89
Rivers	558.00	125.18	...	432.82	83.70	87.28
Cross River	492.00	...	426.96	918.96	73.80	211.29
Imo	390.00	...	447.46	837.46	58.50	194.74
Anambra	486.00	...	155.38	641.38	72.90	142.12
Kwara	90.00	17.86	...	72.14	13.50	14.66
Benue	444.00	181.68	...	262.32	66.60	48.93
Niger	0.78	...	43.70	44.48	0.12	11.09
Plateau	20.76	...	18.54	39.30	3.10	9.05
Gongola	510.00	403.50	...	106.50	76.50	7.50
Borno	0.00	...	25.36	25.36	0.00	6.34
Bauchi	10.98	...	0.59	11.57	1.65	2.48
Kaduna	0.00	...	44.04	44.04	0.00	11.01
Kano	50.58	3.66	...	46.92	7.60	9.83
Sokoto	0.00	...	5.32	5.32	0.00	1.33
Total	5,243.10	1,522.90	1,301.91	5,022.11	786.47	1,058.91

Source: Based on Table 23 and data from S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Notes: There is a statistical discrepancy of 220,990 metric tons between production and the available supply. It is assumed that the amount of the discrpancy was supplied through imports otherwise unaccounted for. It is also assumed that the amount was used as animal feed, even though it is likely that only a small proportion was in fact used in that way. The rest must be explained as a defect in the statistics (see Appendix 1).

TRENDS IN PRICES

Cassava production is essentially an activity of rural areas, and so purchases begin on the farm. Some cassava is bought when the tubers are still in the ground, and the purchaser does the harvesting. This approach is common, with women processing the cassava into gari. But often the cassava is transported by the farmer or by itinerant cassava merchants into the nearest village market, where it is often sold to women who process cassava, or part may be sold directly to consumers who use them within the household. Table 25 presents an analysis of prices obtained in such markets. For lack of data, the series used are for 1966-1983. A common feature is high growth rates, especially in major cassava-producing states. The period between 1974-78 and 1979-83 had the highest growth rates of prices among all regions except for East, and among all states except for Kano and North West. This clearly suggests that within this period, cassava production fell.

Table 26 shows the movement of the cassava producer price index relative to all items in the producer price index of the major annual agricultural crops in Nigeria. Production of cassava is very sensitive to price changes. High production can only be sustained by high prices. This in itself means that cassava production is sensitive to demand.

Partly because the consumption of cassava is mostly in the form of gari, the only cassava prices collected nationally are for gari. Most gari produced in the villages is sold in village marketplaces, where buyers, mostly wholesalers, buy it and send it to urban areas. The production then finds its way to distributors or to direct consumers such as institutions. The distributors sell to the retailers, who sell to the urban consumers. Table 27 contains results of an analysis of retail prices by broad geographical groups. It is not impossible to find prices in the major gari production states higher than in those states with low production. For example, in 1981-83, prices were lower in Lagos than in Bendel or West. On the other hand, prices in noncapital towns are not necessarily lower than those of the capital towns.

The trends of the prices are quite high. Apart from providing information on trends, Table 28 gives data on seasonal variations. These were obtained by fitting a linear trend with seasonal components on the data analyzed with results in Table 27. The seasonal coefficients show that prices are usually low in the fourth quarter (October-December), but start rising, usually reaching their peak in the second quarter (April-June), the period before the harvest of any farm product. As the harvest starts in the third quarter, prices start falling again. The hunger period in Nigeria is usually between March and July. Within this period, the prices of most agricultural commodities are usually high, as gari prices have shown.

Table 25--Producer prices of cassava and their average annual growth rates, 1966-70 to 1978-83

Region	Average			Average Annual Growth Rates		
	1966-70	1974-78	1979-83	1966-70 to 1974-83	1974-78 to 1979-83	1966-70 to 1979-83
	(N/metric ton)			(percent)		
West	58.46	111.61	249.02	8.4	17.4	11.8
Mid-West	59.54	114.66	363.84	8.5	26.0	14.9
East	32.20	135.17	311.72	19.6	18.2	19.1
North	76.06	125.79	238.11	6.5	13.6	9.2

State	Average			Average Annual Growth Rates		
	1971-74	1975-78	1979-82	1971-74 to 1975-78	1975-78 to 1979-82	1971-74 to 1979-83
	(N/metric ton)			(percent)		
Lagos	96.58	127.58	259.81	7.2	19.5	13.2
West	87.28	106.46	223.86	5.1	20.4	12.5
Mid-West	92.67	117.93	343.55	6.2	30.6	17.8
Rivers	113.45	135.06	232.87	4.5	14.6	9.4
South East	126.57	164.33	216.22	6.7	7.1	6.9
East Central	102.44	140.07	305.74	8.1	21.5	14.6
Kwara	75.12	129.46	252.27	14.6	18.1	16.3
Benue-Plateau	90.16	110.73	202.70	5.3	16.3	10.7
North East	112.95	118.06	235.27	1.1	18.8	9.6
Kano	106.97	140.45	152.40	7.0	2.1	4.5
North Central	105.05	149.38	372.78	9.2	25.7	17.2
North West	90.49	149.09	219.17	13.3	10.1	11.7

Source: Nigeria, Federal Office of Statistics, unpublished data.

Table 26--Wholesale price indexes for major annual crops, 1980-84

Group/Crop	Weight	Relative Price				
		1980	1981	1982	1983	1984
		(1979 = 100)				
Group A						
Millet	15.49	102.5	195.8	150.3	214.0	214.0
Sorghum	19.42	112.3	171.5	145.8	193.0	270.2
Groundnuts	4.86	101.1	214.9	146.4	199.4	324.0
Beans	5.10	199.6	443.4	342.0	430.7	595.4
Yams	34.07	127.0	253.0	257.5	279.6	457.2
Maize	5.21	62.3	148.9	165.7	177.0	182.6
Cassava	10.27	105.4	182.0	186.3	247.0	294.6
Rice	1.59	135.8	205.8	155.1	248.1	293.2
Melon	1.28	145.5	194.6	335.5	216.5	257.9
Cocoyams	0.71	100.3	356.7	230.1	299.2	374.0
Index for Group A	98.00	116.8	221.2	204.1	245.9	358.4
Group B						
Cotton	1.27	121.8	167.8	135.4	217.9	288.5
Beniseed	0.06	105.0	105.0	105.0	120.0	120.0
Soya beans	0.03	123.0	127.1	143.4	188.5	245.9
Tobacco	0.64	104.6	114.9	84.4	91.2	114.7
Index for Group B	2.00	115.8	148.3	118.2	173.7	226.8
All crops	100.00	116.8	219.7	202.4	244.5	355.8
Ratio of cassava prices to the prices of Group A	...	90.2	82.3	91.3	100.4	82.2
Ratio of cassava prices to the prices of all crops	...	90.2	82.8	92.0	101.0	82.8

Source: Calculated from data from Nigeria, Federal Office of Statistics, and from the Central Bank of Nigeria.

Table 27--Average prices and average annual growth rates of gari products

Geographical Group	Average 1975-77	Average 1978-80	Average 1981-83	Average Annual Growth Rate 1975-77 to 1978-80	Average Annual Growth Rate 1978-80 to 1981-83	Average Annual Growth Rate 1975-77 to 1981-83	Trend Fitting Coefficient
	(kobo/kilogram)			(percent)			
Capital towns							
Lagos	31.26	46.17	97.57	13.88	28.33	20.89	5.04
West	24.86	49.06	102.58	25.43	27.87	26.65	5.39
Bendel	24.37	39.15	110.39	17.12	41.28	28.63	5.47
Coastal[a]	23.32	35.07	92.80	14.57	38.32	25.88	6.21
East Central	25.07	39.16	100.81	16.03	37.05	26.10	5.76
Middle Belt[b]	29.08	53.92	114.40	22.85	28.50	25.64	5.94
North[c]	31.55	63.01	144.51	25.93	31.88	28.87	5.90
Noncapital towns							
Lagos	...	...	...	...	...	...	...
West	...	44.62	97.13	...	29.60	...	4.49
Bendel	...	67.84	181.51	...	38.83	...	4.66
Coastal[a]	...	...	...	...	...	...	...
East Central	...	52.08	84.92	...	17.70	...	2.61
Middle Belt[b]	...	52.39	113.39	...	29.35	...	5.11
North[c]	...	63.57	132.55	...	27.75	...	6.76

Source: Calculated from data appearing in Nigeria, Federal Office of Statistics, Retail Prices and Consumer Price Indices for Selected Urban Centres, various issues (Lagos: FOS, various years).

Note: The geographical groups shown are from the 12-state system (see Appendix 2), except where noted. The notes refer to states in the 19-state system.

[a]The Coastal group is made up of the states of Rivers and Cross River.

[b]The Middle Belt is made up of the states of Niger, Kwara, Benue Plateau, and Gongola.

[c]The North group is made up of the states of Borno, Bauchi, Kano, Kaduna, and Sokoto.

Table 28--Fitting a trend with seasonal components of price statistics for gari

Geographical Group	Trend Coefficient	Seasonal Coefficient		
		2nd Quarter	3rd Quarter	4th Quarter
Capital towns				
Lagos	0.0504	0.0479	0.0517	-0.0405
West	0.0539	0.1143	0.0877	0.0035
Bendel	0.0547	0.0796	0.0250	-0.1041
Coastal[a]	0.0621	0.0968	0.0434	-0.0196
East Central	0.0576	0.1432	0.0978	-0.0541
Middle Belt[b]	0.0594	0.0995	0.0395	-0.0370
North[c]	0.0590	0.0892	0.1520	0.0667
Noncapital towns				
Lagos	...	...	...	...
West	0.0449	0.0539	0.0759	-0.0175
Bendel	0.0466	0.1121	-0.0027	-0.0653
Coastal[a]	...	...	...	...
East Central	0.0261	0.2616	0.2018	-0.0616
Middle Belt[b]	0.0511	0.0608	0.0848	-0.1359
North[c]	0.0676	0.0847	0.0775	-0.0656

Source: Calculated from data appearing in Nigeria, Federal Office of Statistics, Retail Prices and Consumer Price Indices for Selected Urban Centres, various issues (Lagos: FOS, various years).

Note: The geographical groups shown are from the 12-state system (see Appendix 2), except where noted. The notes refer to states in the 19-state system.

[a]The Coastal group is made up of the states of Rivers and Cross River.

[b]The Middle Belt is made up of the states of Niger, Kwara, Benue Plateau, and Gongola.

[c]The North group is made up of the states of Borno, Bauchi, Kano, Kaduna, and Sokoto.

Table 29 shows the seasonal prices of gari relative to the prices of other staples in Lagos for 1980 and 1984. The table is an attempt to measure the number of calories of gari that can be purchased for the same amount as 1 calorie of the compared good.[26]

[26]Compare Cock, Cassava: New Potential for a Neglected Crop, pp. 38-39.

Table 29--Prices of gari relative to prices of other staples, Lagos, by quarter, 1980 and 1984

Quarter	Food Compared	Calories per Kilogram	Calories 1980	Calories 1984	Calories of Gari That Can Be Purchased for Same Amount as One Calorie of Compared Food 1980	Calories of Gari That Can Be Purchased for Same Amount as One Calorie of Compared Food 1984
			(kobo/kilogram)			
January-March	Gari	3,420	41	150	...	...
	Yams	1,360	64	209	3.90	3.50
	Rice	3,560	104	272	2.44	1.74
	Maize	3,605	47	102	1.09	0.65
April-June	Gari	3,420	44	172	...	...
	Yams	1,360	72	156	4.11	2.28
	Rice	3,560	98	439	2.14	2.45
	Maize	3,605	53	143	1.14	0.79
July-September	Gari	3,420	53	187	..	...
	Yams	1,360	65	118	3.08	1.57
	Rice	3,560	101	552	1.83	2.84
	Maize	3,605	54	190	0.97	0.96
October-December	Gari	3,420	49	173	...	...
	Yams	1,360	68	150	3.49	1.67
	Rice	3,560	102	530	2.00	2.94
	Maize	3,605	54	145	1.05	0.80

Sources: Calculated from Nigeria, Federal Office of Statistics, Retail Prices and Consumer Price Indices for Selected Urban Centres, various issues (Lagos: FOS, various years); and S. O. Olayide, Dupe Olatunbosun, E. O. Idusogie, and J. O. Abiagom, A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria, 1968-85 (Lagos: Federal Department of Agriculture, 1972).

Fewer calories of gari can be bought for 1 calorie of maize than for any other crop shown in the table. In 1984, in fact, the amount was less than 1 calorie. During the hunger period (April-June) in 1980, more than 4 calories of cassava could be purchased for 1 calorie of yams, but this amount fell in 1984. The opposite is true of cassava's relation to rice. More cassava was bought in 1984 for 1 calorie of rice than in 1980.

TRENDS IN THE OUTPUT OF MANUFACTURED AND PROCESSED CASSAVA

The traditional processing of cassava is wholly in the hands of women, whether it is processed in the household for family consumption or at a central location such as the village or town marketplace where commercial processing goes on. Even when cassava is processed at a factory, peeling is still done manually and wholly by women. According to Ikpi et al., "In the Oyo LGA, 60 percent of the cassava produced is processed and sold while the remaining 40 percent is processed and eaten at home. The scale of operation is small with a combined annual output of gari, lafun, and fufu averaging about 3.84 tonnes a year per household....Cassava processing in the marketplace is a commercial operation....Capital investment is low in traditional cassava processing. The major equipments are the power grater and the hydraulic press."[27]

Much of the commercially processed cassava is gari. There are, at present, various operational units involved in the processing of gari--ranging from housewives using traditional methods to produce gari, not only for home consumption but for the market as well, to highly mechanized processes in factories. The factories also differ in their scale of production. Most mechanized processing is done by cooperatives and limited liability companies.

The need to get involved with mechanization of cassava processing was first recognized by the Federal Institute for Industrial Research (FIIRO). As noted by Akinrele and Beenhaker, the demand and subsequent production of cassava tubers increased tremendously between 1965 and 1970, and the market price for gari doubled during the same period.[28] Thus far, the domestic market for other cassava products, such as starch, flour, chips, syrups, and glucose, has been neither fully exploited nor significantly supplied by local production. These illustrative facts, together with the important impact of increasing population upon the future demand for gari, led Akinrele and Beenhaker to conclude that the prospective internal market for cassava products was excellent. Added to this was the method of gari production, which was hampered by what they called "uneconomic, unscientific, and unhygienic practices. Consequently, the gari produced has a variable quality, a low shelf life, a high production cost, and is not safe for human consumption without boiling."

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[27]Ikpi et al., Cassava--A Crop for Household Food Security, pp. 56-57.

[28]I. A. Akinrele and A. Beenhaker, "A Proposed Cassava Industrial Complex: Mini Investments, Maximum Returns," Federal Institute for Industrial Research at Oshodi, Lagos, 1972 (mimeographed).

As a result of this attitude, FIIRO today has designed three models of fully mechanized gari plants. These produce 125 kilograms per hour, 150 kilograms per hour, or 440 kilograms per hour. They are fabricated to order by FIIRO's engineering partner, Newell Dumford Engineering Company of Great Britain. So far six of these plants have been installed: at FIIRO (1958), near Ibadan (Iddo CF and PMS Ltd., 1975), in Ghana (Universal Cassava Products Ltd., 1976), near Abeokuta (Texaco Agro Industrial Nig. Ltd., Opeji, 1976), in the Guinea Republic (Ministere De L'Industrie), and in Ondo (Oke Ayo Farms Ltd) (see Table 30). All except the one at FIIRO produce only gari. Apart from gari, the FIIRO plant also produces gari flour, fufu, starch, and cassava flour. These factories have a variety of problems--shortages of spare parts, unstable power supplies, inadequate storage facilities, and poor transportation of cassava tubers from farm to factory, particularly a problem for factories without cassava plantations of their own. Texagri gari is marketed through TEXACO petrol stations all over the country. Some is also supplied directly to consumers. Texagri gari comes in 2-kilogram and 25-kilogram bags. Iddo Cooperative gari is marketed through appointed distributors who buy in bulk and sell to wholesalers and retailers. The Abeokuta Cooperative Society factories sell through a central body called the Ere-Agbe Coordinating Marketing Board.

While these activities are concentrated in the southwestern part of Nigeria, activities in the eastern part are equally interesting. The Projects Development Institute (PRODA) has been involved with the development of cassava production and processing since 1971. Its achievements include development of a continuous fryer (1971); development of a wooden-screw press and crate (1972); development of a pulp sifter (1973); development of a coal gas producer (1974); erection of the first factory producing 1 ton of gari per day, at Asaba in Bendel State (1976); erection of a second factory at Agbor Aladinma, Bendel (1978); commencement of the Anyakora Foods Factory at Nkwele-Ezunaka, development of a village frying unit, and development of a peeling machine (all in 1979); development of an oil-burning fryer and development of a cyclone (both in 1980); development of a self-action crate (1981); supply of village units (1982); expansion of the Anyakora Foods Factory to 4 tons per day, introduction of a dewatering/decanter centrifuge, and development of a gari sifter (all in 1983); commissioning of the Anyakora Foods Factory, and commencement of large-scale fabrication.

The NRCRI, in addition to developing improved varieties, has selected varieties that are high yielding and result in high-quality gari. In addition, it has developed products such as odorless fufu with a prolonged shelf life.

Apart from mechanization of cassava processing, especially for gari, developments have involved products like industrial starch, glues, and adhesives, and the use of cassava for composite bread-making. Much of these are to the credit of FIIRO.

Table 30--Organizations involved in the mechanized processing of gari

Unit	Owner	Date of Establishment	Fixed Cost	Variable Cost	Employment
			(N)		(number of employees)
Texagri	TEXACO (major)	1985, but started production in 1978	164,087.34	119,389.00	50
Federal Institute for Industrial Research (FIIRO)	National Research Institute	1957	124,371.98	269,760.00	30
Ido Cooperative Farming and Produce Marketing Society	Farmers	1972	155,802.00	66,253.33	n.a.
Iperu Gari Procesing Factory	Private	1983	158,300.00	128,600.00	25
Oke-Ayo Farms Factory, Ondo	Private	1981	377,500.00[a]	64,000.00	50 (20 skilled)
Cooperative under Ere-agbe Coordinating and Management Board, FDA, Abeokuta (5 cooperatives)	Farmers	1982	39,500.00	40,000.00	20 each (6 skilled)

(continued)

Table 30--continued

Scale of Operation (kilograms/ day)	Source of Cassava Tubers	Type of Cassava	Channels of Distribution	Problems
6,000-7,000	Own farm; government farms; co-operative farms	Initially local, later improved varieties	TEXACO petrol stations or directly to institutional consumers	Spare parts; inadequate supply of fresh cassava
1,200	Government farms and cooperatives	TMS 30572 TMS 30555	Directly to consumers	Spare parts; scarcity of cassava tubers; inadequate power supply
2,000	Own farm	...	Appointed distributors	Finances; scarcity of farm implements; small acreage under cultivation; pests and diseases affecting production
500	Own farm; government farms; co-perative farms	TMS 30555 TMS 30572	Directly to consumers	Transportation; increasing cost of inputs
1,500	...	TMS 30572 TMS 30555	Directly to consumers	Power supply; storage facilities; raw materials
600	Own farm	TMS 30572 TMS 30555	Through the Board	Shortage of transport, water, and power

Source: W. O. Fasasi, "Economic Appraisal of Cassava (Gari) Production and Marketing; Case Study of Gari Processing Firms in Lagos, Ogun, and Oyo States" (B.Sc. Project, University of Ibadan, 1985).

Note: Where n. a. appears, the figure was not available.

[a]This figure is for total equipment; the depreciation value is not included.

A key problem with large-scale processing of cassava is what has been called the crucial importance of a continuing, regular, adequate, and cheap supply of cassava tubers when running a factory to process cassava into any product.[29] It is widely known that there is a breakeven volume of tubers to be processed each day that must be exceeded in any gari production factory, however small, if profits are to be made. It is also known that many gari producers have not been able to keep even village gari factories adequately fed with cassava. Therefore, an effective tuber supply system is essential, preferably a plantation under factory control or at least a factory "core" plantation. Furthermore, a regular supply of tubers to the factory will have to be ensured so that the profitability of the factory will depend solely on the prices of a continuing, regular, adequate, and cheap supply of tubers.

The program of gari processing of the Rural Agro-Industrial Development Scheme (RAIDS) is based on this kind of reasoning. Instead of mechanization of gari production, RAIDS recommends a small-scale improved hand process that uses mechanically powered grating. RAIDS started its activities in 1983, and about 100 small-scale gari mills were to have been put up by 1987, designed mainly for the southwestern part of Nigeria. It is the belief of RAIDS, as stated above, that profitability varies much from year to year, according to cassava supply.

SCOPE FOR IMPROVEMENTS IN THE PROCESSING AND STORAGE OF CASSAVA

Efforts to improve the storage of cassava and cassava products have progressed well. The Nigerian Stored Products Research Institute has produced an advisory bulletin that shows that under good management, cassava roots can be stored in fresh condition, using the methods in the leaflet, for a period of 6-8 weeks.[30] Gari, if dried so that its moisture content is less than 12 percent, can be stored in simple, small containers that can be made airtight using tin, bottles, drums, or polythene bags. For cassava chips (dried cassava), the same principle applies.

Normally, fresh cassava cannot be stored for more than three days. Even the procedure contained in the leaflet cited above is only feasible on a small scale, as large-scale storage entails a number of technical and organizational problems. The way out is to design a

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[29]Rural Agro-Industrial Development Scheme, Background to the Development of Village Plant (Enugu, Nigeria: RAIDS, 1984)

[30]Nigerian Stored Products Research Institute, Cassava and Gari: Storing Your Produce, Advisory Leaflet No. 3 (Lagos: NSPRI, 1983).

crop rotation program that will ensure continuous harvesting of cassava root to feed a manufacturing plant.

As noted above, mechanization of different stages of traditional foods has gone far but certain problems still require solutions. One of these is the specification and standardization of equipment for small-, medium-, and large-scale manufacturing of cassava-based foods in order to ensure consistency and quality control. This issue is also related to packaging of finished products. Efforts should be made to develop packaging materials that will provide effective barriers between the packaged product and the external environment so that the shelf life of the product can be extended.

Improvements in processing and storage will, no doubt, encourage the production of cassava roots and eventually break the current vicious cycle between utilization and production, as utilization will be stabilized even with improvements in income.

Cassava-based foods are consumed mostly to provide calories. In other words, they are basically carbohydrate foods. The protein supply in a cassava-based diet comes from the stew meat that is taken along with it.

Attempts to fortify cassava-based foods, like gari, with vegetable protein from groundnut grits and other legumes have not been successful because the end products from such blends have not been generally accepted. There is, however, a lot of scope for such fortification of livestock feed.

Owing to the increasing demand for bread in Nigeria and the fact that wheat usually has to be imported, there has been much interest in the use of local materials, including cassava, to manufacture composite flours to reduce total wheat imports. Work done at the Tropical Product Institute indicates that successful substitution giving reasonably satisfactory volumes of loaves can be achieved using substitution rates up to 20 percent.

TRENDS IN PER CAPITA CONSUMPTION OF CASSAVA AS FOOD

As Table 31 shows, more than 70 percent of state expenditures on cassava in urban areas goes for gari, except in Anambra and Benue. In rural areas, the states with more than 70 percent spent on gari are Lagos, Ogun, Ondo, Bendel, and Niger. Purchases of cassava tubers are popular in the urban areas of Anambra, Niger, Benue, Borno, Kano, and Sokoto, and in the rural areas of Oyo, Imo, Anambra, Kwara, Benue, Plateau, Borno, Bauchi, Kaduna, and Kano. Few states purchase cassava tubers in reasonable quantities.

Table 31--Expenditures on cassava products as shares of total consumption expenditures, by state, 1980/81

State	Urban Areas					Rural Areas				
	Gari	Cassava Tuber	Akpu	Starch	Total	Gari	Cassava Tuber	Akpu	Starch	Total
	(percent)				(N/month)	(percent)				(N/month)
Lagos	0.94	0.03	0.03	...	1.73	0.98	0.02	0.00	0.00	10.58
Ogun	0.90	0.09	...	0.01	8.48	0.94	0.04	0.01	0.01	13.10
Oyo	0.90	0.06	0.01	0.03	3.90	0.66	0.22	0.07	0.05	8.57
Ondo	0.97	0.02	0.01	0.00	6.07	0.89	0.09	0.01	0.01	9.07
Bendel	0.97	0.03	...	...	0.59	0.81	0.10	0.07	0.02	18.48
Rivers	0.98	0.02	...	...	2.40	0.62	0.18	0.18	0.02	12.19
Cross River	0.90	0.09	0.01	0.00	7.02	0.58	0.10	0.31	0.01	11.59
Imo	0.85	0.10	0.01	0.04	7.45	0.55	0.28	0.16	0.01	9.67
Anambra	0.60	0.37	0.20	0.01	5.34	0.41	0.28	0.30	0.02	10.68
Kwara	0.85	0.11	0.02	0.02	3.65	0.50	0.31	0.12	0.07	3.29
Niger	0.74	0.26	...	...	3.00	0.79	0.18	0.02	0.01	2.14
Benue	0.58	0.22	0.08	0.12	3.08	0.27	0.53	0.16	0.04	4.73
Plateau	0.88	0.07	0.01	0.04	3.00	0.53	0.41	0.02	0.04	2.36
Gongola	0.83	0.11	0.04	1.04	1.10	0.51	0.15	0.19	0.15	0.75
Borno	0.70	0.23	0.03	0.04	1.51	0.43	0.40	0.03	0.14	0.72
Bauchi	0.88	0.09	...	0.03	1.03	0.48	0.44	...	0.08	0.34
Kaduna	0.90	0.07	0.02	0.01	2.19	0.35	0.51	0.07	0.07	0.83
Kano	0.70	0.20	...	0.10	0.56	0.64	0.32	0.03	0.01	0.75
Sokoto	0.73	0.21	0.06	...	1.36	...	...	...	...	...
Weighted average	0.87	0.10	0.02	0.02	3.05	0.62	0.20	0.16	0.02	6.50

Source: Derived from Nigeria, Federal Office of Statistics, "National Consumer Survey, 1980/81," Lagos, n.d. (computer printout).

Other products are consumed in reasonable quantities in rural areas. For example, akpu, also known as fufu, is consumed in Rivers, Cross River, Imo, Anambra, Benue, and Gongola. Starch (known as lafun in Oyo) is not important nationally.

The quantities of these products consumed per capita could not be derived because of a lack of appropriate price data for deflating the values.

Per capita consumption was 357 calories per day in 1968/69.[31] FAO food balance sheets put the figure at 283 calories for 1975-77. The present analysis puts the figure at 379.8 or 209 calories per day in urban areas and 412 calories per day in rural areas. Even for these figures, comparison is not easy because of differences in assumptions and methods. The results for 1968/69 must have been based on both assumptions and the meager data available, as Abiagom indicates.[32] No nonstatistical assumption has been used for the results of the 1980/81 consumer survey. There has been only straight analysis of available data. For example, the low consumption for urban Bendel and absence of a record for the rural areas of Sokoto are due to defects in the returns from the field for the survey itself. Since no adjustment was made by FOS, none has been made in this analysis.

All of the above notwithstanding, the results for 1980/81 show some interesting features. Consumption in the northern states (even in Benue, a major cassava-producing state) is less than consumption in the south. There is also the inverse relationship of consumption in urban and rural areas between the north and the south. Except for Imo and Benue, where there is not much difference between urban and rural areas, figures for the rural areas of the south are higher than those for the urban areas, while the reverse is the case in the north.

TRENDS IN THE UTILIZATION OF CASSAVA AS ANIMAL FEED

Cassava in its raw form is traditionally used as feed for livestock, particularly for pigs. Pigs are kept in most of the major cassava-growing areas, and fresh cassava provides the major source of food for them, but data available on the pig population do not reflect this, except for data on modern holdings. For example, the data shows that there are more pigs in the north than in the south. FOS seems not to be sensitive to the data it collects. There is too much

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[31]Olayide et al., A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria.

[32]Abiagom, "Report on Production/Utilization/Processing Account of Food Crops in Nigeria."

attachment to the "concept of chance" than to reality. For example, how can one explain that a state that had 168,500 pigs in 1980 had none in 1981? If these were pigs kept by households, such a drop to zero would not be likely. As there is a need to have a crop pattern map for sample selection for crop production, there must be a livestock pattern map for the same purpose.

Part of the statistical discrepancy in Table 24 may be cassava actually fed to animals, but what amount this is cannot be easily determined. In recent times, there has been interest in making cassava into chips (that is, dry cassava slices), mainly for export to Europe as livestock feed. Also with the recent shortfall in poultry feed derived from imported maize, there has been interest in using cassava either as whole meal or blended with a certain percentage of maize for livestock feed.[33] Cassava leaves are also in great demand for livestock feed, and studies on ways of preserving and packing these leaves are now in progress at the NRCRI, Umudike.[34]

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[33]D. A. Ngoka et al., "The Use of Cassava Root Meal as an Energy Substitute for Maize in Poultry Diets," Research Bulletin (Umudike), No. 3, 1984; O. A. Adebambo, "Increased Production of Animal Proteins Through Use of Cassava in Pig Feeding," in Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava"; and I. A. Olaloku, "Cassava as a Feed for Boosting Local Milk Production," in Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava."

[34]NRCRI, Annual Report, 1985 (Umudike: NRCRI, 1985).

4. EXISTING AND POTENTIAL YIELDS OF CASSAVA

Cassava is grown on marginal soils in the main producing states in Nigeria, while preference is given to crops like yams and maize for rich soil and the use of fertilizer. Cassava is also not generally irrigated. If fertilizer is applied on it at all, it is when it is intercropped or mixed with other crops.

As instructed by Edekobi, "In selecting the appropriate fertilizer for any crop mixture, the first consideration is for the nutrient needs of each crop in the intercrop. When a root crop is the dominant crop, the choice of fertilizer should be based on the requirement of the root crops. For instance, cassava has a great demand for K and Mg. Therefore when cassava is a dominant crop, any fertilizer mixture with large amount of K and Mg should be selected....Cassava requires on the average 400 kg of NPK 15:15:15 or 500-600 kg of NPK Mg 12:12:17:2 per hectare on poor soil. When intercropped with maize or yam, this rate need not be increased substantially, but the method and time of application will vary. If the land has been fallow for three or more years, apply half the rate. The fertilizer should be applied 4-6 weeks after planting."[35]

YIELDS IN RESEARCH STATIONS AND IN FARMERS' FIELDS PROJECTED TO 1990 AND 2000

Table 32 gives an indication of how fertilizer can improve cassava yields. These results compare favorably with the results from the use of improved varieties shown in Table 11. But the amount of fertilizer recommended is on the high side.

Uniform yield trials of 13 IITA improved varieties were conducted without fertilization at three locations: IITA (in the region of moderate rainfall and fertile soil), Mokwa (in dry savannah), and Onne (in the high rainfall zone on sandy, poor soil).[36] These three locations are representative of those where cassava is planted in

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[35]Ikeh B. Edekobi, "Intercropping Farming System for South Eastern Nigeria," lecture delivered at the Crop Production Training Course, Food Production Technology Transfer Station, Ugwuoba, Nigeria, 1985 (mimeographed).

[36]IITA, Annual Report for 1984.

Table 32--Yields of cassava

Fertilizer Use/ Place Yields Achieved	Inferior Soils of Low Fertility: Level of Fertilizer Use	Average Yield	Yield Range	Optimum Soil and Climate Conditions: Level of Fertilizer Use	Average Yield	Yield Range
	(metric tons/hectare)			(metric tons/hectare)		
Without fertilizer						
Farmers' fields	...	5.5	5.0-7.5	...	9.0	8.0-12.0
On-farm trials	...	8.5	7.5-13.2	...	15.0	16.0-20.0
Research stations	...	15.0	13.0-18.0	...	28.0	25.0-30.0
With fertilizer						
Farmers' fields	...	7.5	6.0-9.5	30-30-60	10.0	9.0-20.5
On-farm trials	60-30-90	13.5	12.5-19.9	60-15-60	25.0	20.0-30.0
Research stations	90-30-120	15.0	13.6-22.5	60-30-60	30.5	27.5-35.0

Source: Based on personal communications with G. O. Obigbesan, Department of Agronomy, University of Ibadan.

Notes: States with inferior soil and low fertility are Imo and Anambra and all northern states except Kwara and Benue-Plateau. States with optimum soil and climatic conditions are all southern states except Imo and Anambra.

Nigeria. The yields show that TMS 4(2) 1425 had the best all-round performance. It was selected for multiplication by the Nigerian Seed Service for distribution to farmers.

Table 33 gives the potential yields of cassava under alternative assumptions. It shows that yields can be as high as 50 metric tons per hectare at research stations, but there are limitations under farmers' field conditions that must be removed or reduced. The most important of these is poor management.

This is the reason for creating food production technology transfer stations designed to meet the agricultural manpower development of the country. It is the technical and institutionalized arm of the NAFPP, which links agricultural research and farmers in the dissemination of research findings as they relate to food-crop production. Training given includes farm management, handling of farm machinery and equipment, and pest and disease management. Three of the centers are involved with cassava.

Table 33--Projections of the potential yields of cassava to 1990 and 2000

Assumptions/Years/ Place Yields Achieved	Inferior Soils of Low Fertility		Optimum Soils and Climate Conditions	
	Average Yield	Yield Range	Average Yield	Yield Range
	(metric tons/hectare)			
Varieties existing and in pipeline				
1990				
Without fertilizer				
Farmers' fields	12	10-15	13	12-20
On-farm tests	17	15-23	20	18-30
Research stations	23	20-25	32	30-40
With fertilizer				
Farmers' fields	13	12-20	15	15-25
On-farm tests	18	15-25	25	20-30
Research stations	25	20-35	40	35-45
2000				
Without fertilizer				
Farmers' fields	14	12-18	20	18-25
Research stations	22	20-30	27	25-35
With fertilizer				
Farmers' fields	18	15-26	26	16-30
Research stations	32	23-35	45	40-55
Resources for research doubled, new varieties, improved practices				
1990				
Without fertilizer				
Farmers' fields	15	12-18	18	15-30
On-farm tests	21	20-25	25	20-30
Research stations	25	23-30	36	35-40
With fertilizer				
Farmers' fields	20	15-25	38	35-45
On-farm tests	33	31-37	43	40-55
Research stations	39	40-50	55	45
2000				
Without fertilizer				
Farmers' fields	22	20-25	32	30-40
Research stations	35	33-40	48	45-50
With fertilizer				
Farmers' fields	28	25-30	45	40-60
Research stations	43	40-50	56	50-65

Source: Based on personal communications with G. O. Obigbesan, Department of Agronomy, University of Ibadan.

Notes: States with inferior soil and low fertility are Imo and Anambra and all northern states except Kwara and Benue-Plateau. States with optimum soil and climatic conditions are all southern states except Imo and Anambra.

5. SUBSTITUTABILITY OF CASSAVA AND COMPETING CROPS

Cassava in Nigeria is unique in that it is, at present, not planted to compete with other crops that use more fertile soil. This is because it can thrive on marginal soil and still cater to the needs of farmers.

Lagemann presented data about variations in the role of root crops according to population density in eastern Nigeria, where there is a scarcity of land for farming.[37] Three crops were involved--yams, cassava, and coco yams. In terms of quantity, he found that cassava produced more than the others. It was supreme in low-density areas. As land became scarce, possibly because of an increase in population, the gross returns from yams were highest; coco yams may have been even more efficient.

IMPLICATIONS OF THE INTRODUCTION OF NEW TECHNOLOGY

Table 9 shows that the total cost for using an improved method of growing cassava was N 1,108.00, against N 2,193.00 for the local method. Similarly, there was a marked difference between output from the two methods. This led to a profit of N 3,060.00 from improved methods, against N 1,122.00 from the local method.

The profitability of production of cassava fresh roots using improved technology was established in 1984.[38] The economics of traditional technology were examined using 19 farmers scattered in Umudike and Igbariam. For these farmers, average farm size was 0.18 hectare with a range of 0.07-0.36 hectare; labor was the dominant cost, accounting for 80 percent of total costs. On the average, a profit of N 105 was observed.

In an annual report of NAFPP from Bendel State for 1985, it was reported that NAFPP had succeeded in gaining acceptance among farmers for adoption of modern agricultural techniques. Trials on cassava started in 1977. It was also reported that the program had increased the income of farmers.

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[37] J. Lagemann, Traditional African Farming Systems in Eastern Nigeria (Munich: Westforum, Verlag, 1977).

[38] NRCRI, Annual Report 1985.

These results suggest that adoption of new technology could lead to increases in income and employment. These might lead to improvements in nutrition, although this will depend on the income elasticity of demand for nutrition-improving commodities in the diet.

COMPARISON OF TECHNOLOGICAL ADOPTION AND RELATIONS OF CASSAVA WITH COMPETITIVE CROPS

IITA has shown the low productivity of a traditional farm system with negative returns to land and returns of no more than the current rural wage rate to family labor and management.[39] But with improvements from access to modern technology, returns to farm labor double the rural wage rate and returns to capital increase more than fourfold. Improved technology should stabilize the farming sector and reduce rural-urban migration.

While the IITA study assessed the value of technological adoption, Table 34 compares it for maize, yams, and cassava, the three most important crops in the major areas producing cassava. To some extent, they can be said to be competitive. It is easy to see that cassava ranks highest among the three crops--it has the lowest cost per unit of output in relation to its value--while the achievements of the three levels of technological practice follow expectations.

A comparison of Tables 33 and 34 suggests a proper direction for the adoption of improved varieties, the use of fertilizer, and bringing to farmers the achievements of the research stations. If this happens, cassava production is bound to provide high returns to farmers.

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[39] IITA, Annual Report for 1984.

Table 34--Input requirements, the cost and output of maize, yams, and cassava with three levels of technology, 1972

Level of Technology/ Crop	Yield	Inputs: Labor	Inputs: Fertilizer	Inputs: Seed	Output: Prices	Output: Gross Value	Output: Cost	Net Return Per: Total	Net Return Per: Unit of Output	Cost Per Unit of Share of Its Value
	(kilograms/ hectare)	(person/ day/hectare)	(kilograms/ hectare)		(N/kilo-gram)	(N/hectare)			(N/kilo-gram)	(percent)
Traditional farmers' practices										
Maize	1,046.9	109	...	16.8	0.63	559.5	226.0	433.5	0.41	34.3
Yams	6,276.7	185	...	1,602.8	0.68	4,268.2	850.8	3,417.4	0.54	19.0
Cassava	5,573.9	136	...	2,709	0.57	3,177.1	287.0	2,890.1	0.52	9.0
Improved farmers' practices										
Maize	3,302.5	151	188.3SP 313.8SA	17.9	0.63	2,118.4	366.2	1,752.2	0.52	17.3
Yams	9,011.5	210	125.5NPK (20:0:0)	2,712.0	0.68	6,127.8	1,247.2	4,880.6	0.54	20.4
Cassava	11,272.3	178	313.8NPK (10:10:20)	4,000.0	0.57	6,425.2	405.5	6,019.7	0.53	6.3
Research stations										
Maize	7,845.9	185	502.1 (14:14:20)	17.9	0.63	4,942.9	475.5	4,467.4	0.57	9.6
Yams	20,085.4	245	376.6SA (20:0:0)	2,712.4	0.68	13,658.1	1,345.1	12,313.0	0.61	9.8
Cassava	22,597.2	203	313.8 (10:10:20)	3,630.0	0.57	12,880.4	455.5	12,424.9	0.55	3.5

Sources: The figures for yields and inputs are from International Bank for Reconstruction and Development and International Development Association, Current Economic Position and Prospects of Nigeria, Vol. 3: Problems and Prospects of Food Production Report No. 416a (Washington, D.C.: IBRD, 1974). The rates and prices are, with adjustments, taken from Nigeria, Federal Office of Statistics, Rural Agricultural Survey 1982/83 (Lagos: FOS, 1984).

Notes: SA stands for sulfate of ammonium, SP for superphosphate; and NPK for compound fertilizer. The costs were computed with labor valued at N 2.00 per person per day; fertilizer at N 11 per kilogram; and seeds at N 0.50 per kilogram for maize, N 0.30 per kilogram for yams, and N 15.00 per kilogram for cassava. The "seeds" for cassava are actually cuttings.

6. PROSPECTS FOR CASSAVA PRODUCTION IN 1990 AND 2000

Considering the generally downward trend in cassava production between 1961 and 1983, it is not surprising that most of the trend coefficients were negative, giving rise to negative growth rates.

Table 35 presents the results of fitting a logarithmic trend to the time series data on the area and yield of cassava. No fitting was made for production. Projected production was derived by multiplying projected area harvested by projected yields. When the trend coefficients were negative, a broad assumption was made that there would be no further declines in area or in yield per hectare.

For the projected estimates contained in Table 36, it was assumed that area in the major producing states (West, Bendel, Rivers, East Central, and Benue-Plateau) would grow at a maximum rate of 5 percent (double the assumed growth rate of population within the period), except for Benue-Plateau, which would grow at the trend rate of 4.8 percent. The minor producers were assumed to grow at a maximum rate of 2.5 percent. It was also assumed that the maximum growth rate of output per hectare would be 1.5 percent, that is, no trend growth rate higher than 1.5 percent was used to make the projections.

This means that all those states with empty cells grow at 0.95 (national trend growth rate), those above 1.5 percent grow at 1.5 percent, and those below 1.5 percent and positive grow at their trend growth rate. The area harvested in the national series was held constant to provide a control.

These assumptions were adopted for two reasons. The area under cassava had declined, except for a few states, which are mostly minor cassava producers. But many individuals have recently gone back to the land for production of cassava and other crops, mostly on a commercial basis. The effect of NAFPP seems to have been tremendous and positive. All these are bound to increase both area under cassava and yields. Although there has recently been a tendency of diversion to cash crops, like cocoa, because of an increasing need for exports and dissolution of the Government Production Boards, this is not expected to affect the basic assumptions presented above.

The projections in Table 36 were all made with the same assumptions, but one set was made up of national projections. Another was based on the 4-region structure, and the third set was based on the 12-state structure. The larger the number of administrative units,

the more the variation and the better the estimates. In all the alternatives in Table 36, no assumption has been made about varieties used or use of fertilizer, except the activity of NAFPP. At present, the use of fertilizer for cassava production is minimal, if it is used at all.

Table 35--Trend values for 1983 and the growth rates of area harvested and yield

Historical Series/ Region or State	1983 Trend Values		Growth Rates	
	Area	Yield	Area	Yield
	(1,000 hectares)	(kilograms/ hectare))	(percent)	
1961-83				
Nigeria	554.3	9,297.8	...	0.950
1965-83				
West	77.3	13,818.1	...	1.269
Mid-West	96.8	11,197.6	...	...
East	172.3	9,975.9	...	...
North	183.8	5,589.9	0.592	...
1969-83				
Lagos	0.5	6,984.1	...	...
West	63.4	13,970.6	...	1.163
Mid-West[a]	96.8	11,197.6	...	...
Rivers	52.2	14,814.4	11.960	4.097
South East	23.2	7,412.1	...	...
East Central	83.8	10,591.4	...	2.673
Kwara	8.3	4,613.4	...	...
Benue-Plateau	116.1	6,082.2	4.811	...
North East	20.3	5,675.3	0.511	0.169
North Central	24.9	1,406.5	14.585	...
Kano	15.8	2,747.9	...	...
North West	0.8	6,008.0	..	3.382

Source: Computer printout for S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Notes: Where ellipses appear, the growth rate was negative. For an outline of how the regions or states were subdivided or their names changed as the political structure changed, see Appendix 2.

[a]This figure is based on the 1965-83 historical series.

Table 36--Projections to 1990 and 2000 based on past trends and other assumptions

Historical Series/ Region or State	1990 Area	1990 Yield	1990 Production	2000 Area	2000 Yield	2000 Production
	(1,000 hectares)	(kilograms/ hectare)	(1,000 metric tons)	(1,000 hectares)	(kilograms/ hectare)	(1,000 metric tons)
1961-83						
Nigeria	554.3	9,934.0	5,506.4	554.3	10,919.1	6,052.5
1965-83						
West	108.8	15,093.3	1,642.2	177.2	17,121.8	3,039.0
Mid-West	136.2	11,963.8	1,629.5	221.9	13,150.2	2,918.0
East	242.4	10,658.6	2,583.6	394.9	11,715.5	4,626.5
North	191.6	5,972.4	1,144.3	203.2	6,564.6	1,333.9
Nigeria	679.0	...	6,999.6	997.2	...	11,912.4
1969-83						
Lagos	0.70	7,462.0	5.2	1.15	8,202.0	9.4
West	89.2	15,148.4	1,351.2	145.3	17,005.3	2,470.9
Mid-West[a]	136.2	11,963.8	1,629.5	221.9	13,150.2	2,786.5
Rivers	73.5	15,828.1	1,163.4	119.6	17,397.7	2,080.8
South East	32.6	7,919.3	258.2	53.2	8,704.6	463.1
East Central	117.9	11,754.8	1,385.9	192.1	13,641.4	2,620.5
Kwara	9.9	4,928.7	48.8	12.6	5,417.9	68.3
Benue-Plateau	161.3	6,498.4	1,048.2	258.1	7,142.8	1,843.6
North East	21.0	5,742.8	120.6	22.1	5,840.6	129.1
North Central	29.6	1,502.7	44.5	37.9	1,651.8	62.6
Kano	18.8	2,935.9	55.2	24.0	3,227.1	77.5
North West	1.0	6,667.9	6.3	1.22	7,738.4	9.4
Nigeria	691.7	...	7,117.0	1,089.2	...	12,621.7

Source: Computer printout for S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Notes: Where ellipses appear, the growth rate was negative. For an outline of how the regions or states were subdivided or their names changed as the political structure changed, see Appendix 1.

[a]This figure is based on the 1965-83 historical series.

Apart from these assumptions, there are unusual trend values for 1983. Some are too low while others are too high; for example, the yields for Rivers are high. No adjustments were made for the trend projections since the high and low offset each other and the aggregate will come within an acceptable range.

Projections were also made assuming that yields will reach the potentials given in Table 33. The results of this exercise are presented in Table 37, together with the classifications of states into two groups with regard to soil, fertility, and climatic conditions.

The estimates made in Table 37 must be seen as ideal in some respects. Whatever the case may be, it will be some time before farmers use fertilizer in producing cassava as they are using it on yams and maize. But as an optimum intercropping approach becomes accepted and adopted, some use of fertilizer on cassava will be a normal practice. In general, output is consistent for different alternatives.

Table 37--Projections to 1990 and 2000 based on potential yields

Soil/ Fertilizer Use	1990			2000		
	Area	Yield	Production	Area	Yield	Production
	(1,000 hectares)	(metric tons/ hectare)	(1,000 metric tons)	(1,000 hectares)	(metric tons/ hectare)	(1,000 metric tons)
Inferior soil and low fertility						
Without	188.3	11.5	2,165.45	277.35	13.5	3,744.23
With	188.3	12.5	2,353.75	277.35	18.0	5,130.98
Optimum soil and climatic conditions						
Without	503.4	12.5	6,292.5	811.85	20.0	16,237.0
With	503.4	15.0	7,551.0	811.85	25.5	20,702.18

Source: Computer printout for S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Notes: States with inferior soil and low fertility are Imo and Anambra and all northern states except Kwara and Benue-Plateau. States with optimum soil and climatic conditions are all southern states except Imo and Anambra.

7. PROSPECTS FOR CASSAVA USED AS FOOD

Good population data in Nigeria are a luxury. There has been no acceptable population census since the 1963 census. The only data on population today are projections to 1983 based on some assumptions. The earlier projections assume a growth rate of 2.5 percent. A new projected series has just been published, also based on the 1963 data and assuming exponential growth rates of 2.5 percent from 1963 to 1975, 3.2 percent (based on the Nigerian fertility rates) for 1976-2000, and 4.7 percent for Lagos as a result of high migration.

Population projections based on these assumptions are set out in Table 38 for 1983, 1990, and 2000. In general, on the basis of the assumptions given above, the growth rate between 1983 and 2000 will be 3.3 percent. Therefore, the two population growth rates selected are 2.5 percent and 3.3 percent.

With regard to the urban-rural dichotomy of the population, not much information is available. In previous studies the following rates of urbanization were assumed: 13.1 percent for 1960, 16.4 percent for 1970, and 20.9 percent for 1980. But even then, there was a lot of variation between states. In considering the rates of urbanization between 1983 and 2000, one should bear in mind that a movement to go back to the land is emerging, both among individuals and the government. Moreover, the government is trying to make rural areas more comfortable. If these efforts are successful, the rate could be 25 percent in 1990 and 35 percent in 2000. On the basis of these assumed rates, the population was divided between rural and urban using the rate of 20.9 percent for 1983 (see Table 39).

GDP per capita for Nigeria today has not been as accurately estimated as it should be. The best series in constant prices is that with 1977/78 as its base. The trend growth rate for 1961-1983 at 1977/78 constant prices is 3.1 percent. The GDP has been declining. If this is a short-term phenomenon, two alternative growth rates are recommended. These are 3 percent (an approximate growth rate of 3.1 percent per year computed using 1961-83 GDP per capita at 1977/78 constant factor prices) and 5 percent.

DEMAND FOR CASSAVA AS FOOD PROJECTED TO 1990 AND 2000

No published income elasticity of demand for a specific item of food consumption has existed for Nigeria. Even estimates like those

used in the FAO Commodity Projections for Nigeria, on which the FAO based the Food Supply Analysis, contain no details. It is assumed that the income elasticity of demand for cassava is roughly -0.2.

Table 38--Projected population by state, 1983, 1990, and 2000

State	1983	1990	2000
		(million)	
Lagos	3.2776	4.5545	7.2872
Ogun	2.6350	3.2966	4.5398
Oyo	8.8495	11.0714	15.2467
Ondo	4.6376	5.8019	7.9900
Bendel	4.1810	5.2307	7.2034
Rivers	2.922	3.6557	5.0343
Cross River	5.9091	7.3927	10.1807
Imo	6.2396	7.8062	10.7501
Anambra	6.1104	7.6446	10.5275
Kwara	2.8992	3.6271	4.9949
Benue	4.1230	5.1586	7.1040
Plateau	3.4208	4.2797	5.8936
Gongola	4.4262	5.5874	7.6258
Borno	5.0925	6.3711	8.7739
Bauchi	4.1306	5.1677	7.1166
Kaduna	6.9627	8.7109	11.9960
Kano	9.8111	12.2743	16.9033
Niger	1.8344	2.2950	3.1605
Sokoto	7.7111	9.6471	13.2853
Abuja	0.1719	0.2151	0.2962
Nigeria	95.3456	119.7383	165.9098

Source: Nigeria, National Population Bureau, "Mid-Year Population Projections by State, 1963-2000," Lagos, 1984 (mimeographed).

Table 39--Projected population of urban and rural areas under alternative growth rate assumptions

Urban or Rural Areas	Growth Rates	1983	1990	2000
	(percent)		(million)	
Urban	2.5	19.19	27.45	49.65
	3.3	19.93	29.93	58.07
Rural	2.5	72.64	82.36	92.22
	3.3	75.42	89.80	107.84
Total	2.5	91.83	109.81	141.87
	3.3	95.35	119.74	165.91

Source: Calculated from data found in Nigeria, National Population Bureau, "Mid-Year Population Projections by State, 1963-2000," Lagos, 1984 (mimeographed).

On the basis of the estimates and assumptions above, as set out in Table 40, the demand projections were made and tabulated in Table 41. The usual IFPRI procedure was used, as follows:

$$Y_t = Y_a (1 + gz)^t,$$

where

Y_t = projected per capita demand for period t,
Y_a = base value of demand per capita at base period a, $t > a$,
g = GDP per capita growth rate, and
z = the income elasticity coefficient.

The minimum estimate was attained when the population growth rate equaled 2.5 percent. The GDP per capita growth rate equaled 5 percent, and the elasticity coefficient was -0.200 for both urban and rural areas. The highest projected demand was attained when the population growth rate equaled 3.3 percent, and the GDP per capita growth rate equaled the 5 percent.

These estimates give a range of 6.8 to 8.3 million metric tons aggregate demand for cassava as food in 2000 if the income elasticity is negative.

Table 40--Estimates and assumptions made for demand projections to 1990 and 2000

Year/Assumption	Urban	Rural	Total
1980			
Population (million)			
2.5 percent	17.779	67.288	85.067
3.3 percent	18.076	68.411	86.487
Cassava consumption total (1,000 metric tons)	661.2	4,504.2	5,165.4
Per capita			
2.5 percent	37.2	66.9	60.7
3.3 percent	36.6	65.8	59.7
Elasticity coefficient	-0.200	-0.200	...
Growth rates of GDP per capita (percent)			
1961-83 trend	...	...	3
1966-80 trend	...	...	5
1983			
Trend value (1,000 metric tons)			
National	...	...	5,153.8
4-region structure	...	...	4,898.2
12-state structure	...	...	4,750.8

Source: The assumed population growth rates are based on data found in Nigeria, National Population Bureau, "Mid-Year Population Projections by State, 1963-2000," Lagos, 1984 (mimeographed). Other estimates and assumptions are from S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Note: See Appendix 2 for the regional and state structures.

Table 41--Projection of demand for cassava for food, 1983, 1990, and 2000

Year/Population Growth Rates	GDP/Capita Growth Rates	Projected Consumption		
		Urban	Rural	Total
(percent)		(1,000 metric tons)		
1983				
2.5	3.0	701.1	4,772.7	5,473.8
2.5	5.0	692.7	4,715.3	5,408.0
3.3	3.0	716.4	4,873.9	5,590.3
3.3	5.0	707.8	4,815.2	5,523.0
1990				
2.5	3.0	979.0	5,282.6	6,261.6
2.5	5.0	951.8	5,135.6	6,087.4
3.3	3.0	1,050.3	5,665.1	6,715.4
3.3	5.0	1,021.0	5,507.5	6,528.5
2000				
2.5	3.0	1,667.4	5,569.5	7,236.9
3.3	5.0	1,556.9	5,200.5	6,757.4
2.5	3.0	1,918.7	6,405.8	8,324.5
3.3	5.0	1,791.6	5,981.4	7,773.0

Sources: The assumed population growth rates are based on data found in Nigeria, National Population Bureau, "Mid-Year Population Projections by State, 1963-2000," Lagos, 1984 (mimeographed). Other estimates and assumptions are from S. O. Adamu, "Trends of Food Production and Consumption in Nigeria," prepared for the International Food Policy Research Institute, Washington, D.C., 1986.

Note: The estimates and assumptions made for these projections are set out in Table 40.

See Table 40 and the base year for consumption in 1980.

Tentative estimates of income elasticity of demand for cassava based on the data of the 1980/81 national consumer survey indicate coefficients of 0.124 for urban areas and 0.743 for rural areas. Using these figures and 1980 as the base year for the projections, the aggregate food demand varied from 10.9 to 15.6 million metric tons in 2000 under the alternative population and per capita income assumptions. The lowest estimate was attained when the population growth rate equaled 2.5 percent and GDP per capita growth equaled 3 percent. The highest projected demand was attained when both the population and per capita GDP rates were high at 3.3 percent and 5 percent, respectively.

8. PAST TRENDS AND PROSPECTS FOR CASSAVA USED AS FEED AND FOR OTHER USES

As has been noted, cassava as feed for animals has never been standardized in Nigeria. It is known that cassava is used to feed a variety of livestock, especially pigs in the southern parts of Nigeria. But this is done without consideration of the health and productivity of the animal; fresh cassava has a poisonous nature.

The need for proper utilization of cassava as feed was recognized as long ago as 1955 by Oyenuga and by Oyenuga and Opeke, who considered the value of cassava rations for pork and bacon production and showed the economic justification for it.[40] A lot of work has been done on this since then.[41] A sample of recent work is presented in Appendix 3.

While Nigeria failed to use cassava as a ration for livestock, its use in Western Europe, where most of the exports from Southeast Asia go, is well documented.

PROJECTED DEMAND FOR CASSAVA AS FEED

There has recently been a lot of interest in using cassava as feed. This has been generated by a variety of factors. One is the need to generate more foreign exchange. Another is a shortfall in imported raw materials for livestock feed. Agriculture in Nigeria is dominated by crop production, while livestock accounts for only a small percentage (about 5-10 percent) of agricultural production, compared with more than 75 percent in most agriculturally advanced countries. Hence, there is a need to adopt the use of cassava as rations for livestock.

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[40] V. A. Oyenuga, Nigeria's Foods and Feedstuffs (Ibadan: University of Ibadan Press, 1955), and V. A. Oyenuga and L. K. Opeke, "Value of Cassava Rations for Pork and Bacon Production," West African Journal of Biology and Chemistry 1 (No. 3, 1957).

[41] Adebambo, "Increased Production of Animal Proteins Through Use of Cassava in Pig Feeding," provides a summary of this. Other works in "Proceedings of the National Seminar on the Alternative Uses of Cassava," ed. A. Joshua, also deal with it.

With the present situation regarding raw materials for livestock production, it can be assumed that animal feed will account for 2.5 percent of Nigerian cassava production by 1990 and 5 percent by 2000. This should be possible considering the recent increase in production, which has been projected to continue. On the basis of these assumptions, the feed projections are shown in Table 42.

Table 42--Demand for cassava as feed projected to 1990 and 2000

Assumptions	1990	2000
	(1,000 metric tons)	
Extrapolation of past trends		
1961-83 national series	137.7	302.6
1965-83 series for the 4-region structure	175.0	595.6
1969-83 series for the 12-state structure	177.9	631.1
Potential yield rates of varieties existing or in pipeline		
Without fertilizer	211.45	99.05
With fertilizer	247.62	1,291.66

Source: Based on Tables 36 and 37 and the assumption that animal feed will account for 2.5 percent of production in 1990 and 5 percent in 2000.

Notes: See Appendix 2 for the regional and state structures. These projections assume that area harvested remains constant and yield grows at an annual rate of 0.95 percent.

PROSPECTS FOR OTHER USES OF CASSAVA

Other uses of cassava that might become significant in 1990 and 2000 include its use in making bread, in industry (in particular, as a base chemical in the textile industry), and as an export.

The work on use of cassava for bread is spearheaded by the research institutes. Pure cassava flour cannot be used for baking

bread because it lacks protein with wheat-gluten properties.[42] Adding an improver, like pentosan, is necessary to produce loaves with good baking quality. The best baking formula for cassava bread with pentosan has been 3-5 percent yeast, 3 percent sucrose, 2-3 percent pentosan, 1 percent oil or fat, 70-85 percent water, and 1 percent salt. Bread produced using different varieties of cassava developed at IITA was evaluated, and the flour preferred contained 75 percent TMS 30001 and 25 percent wheat flour.

Thorpe-Hentel highlighted the implications for growing cassava for industrial use.[43] He saw a need to establish species of cassava specifically for industrial use. Also, the local cassava grown for food should contain only an average starch content of 4-5 percent. But industrial processing of cassava requires a cassava root with an average starch content of 18-20 percent.

Cassava produced locally, according to Thorpe-Hentel, requires more energy to bring it to point of application. Its physical stability during application on textiles requires intensive supervision. It is unstable in the presence of the most commonly used chemicals. Lastly, its shelf life is too short. Despite these shortcomings, Thorpe-Hentel argues that local starch can be modified through esterification, for example, and such modified starches can find extensive use in "sizing." Sizing is the application of an adhesive product to a single yarn before weaving, so that some specific properties are imparted to the single yarn to facilitate weaving. With cooperation among research institutes, starch could be produced locally, satisfy both farmers and the textile industry, and perhaps the excess could be exported.

FIIRO has been actively engaged in the mechanization of production of gari, gari flour, cassava flour, and fufu. It has also successfully worked on the production of modified starch, gums, glues and adhesives, glucose syrup and gluco-amylase, detoxified cassava, and composite flour for baking.[44]

But there are problems that delay the commercialization of these research results. These include the inadequacy of raw materials to meet capacities of production plant, the importation of start-off

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[42] IITA, Annual Report for 1984.

[43] M. O. Thorpe-Hentel, "Cassava Also Can be a Base Chemical Commodity for Textile Chemists," in "Proceedings of the National Seminar on the Alternative Uses of Cassava," ed. A. Joshua.

[44] P. A. Okuyiga and O. A. Koleoso, "The Uses of Cassava: FIIRO's Experience," "Proceedings of the National Seminar on the Alternative Uses of Cassava," ed. A. Joshua.

machinery and equipment, and relatively low profitability and high capital outlay. FIIRO hopes that in the near future, all the projects will be commercialized.

The last, but not necessarily the least, aspect of the prospects for other uses of cassava is the need to promote exports of cassava products like alcohol, cassava chips and pellets, cassava flour, cassava starch, beer, composite flour, and proteic flour.

It should be possible that by 2000, at least 1 percent of cassava production should go for these other uses. Table 43 presents the projected values for other uses, assuming 0.5 percent for 1990.

Table 43--Amount of cassava put to other uses, projected to 1990 and 2000

Assumptions	1990	2000
	(1,000 metric tons)	
Extrapolation of past trends		
1961-83 national series	27.5	60.5
1965-83 series for the 4-region structure	35.0	119.1
1969-83 series for the 12-state structure	35.6	126.2
Potential yield rates of varieties existing or in the pipeline		
Without fertilizer	42.29	199.81
With fertilizer	49.52	258.33

Notes: See Appendix 2 for the regional and state structure. These projections assume that area harvested remains constant and yield grows at an annual rate of 0.95 percent.

9. MAIN CONCLUSIONS AND POLICY IMPLICATIONS

From the analysis in this report, it is clear that trends in production have not shown a continuous upward increase. Neither have trends in domestic utilization, which is mostly for human consumption. There is enough evidence to show that both trends grew steadily until around 1970 and fell through the early 1970s to the middle of the decade, when the decline began to taper off.

The first effort of the government to arrest the decline was Operation Feed the Nation. This gave a boost to the production of food crops, especially cassava. The period between 1970 and 1976 saw a serious decline in area cultivated because a large number of peasant farmers left the land for urban areas, partly as a result of the oil boom of the 1970s. On the other hand, research started influencing the output of cassava after 1978, because of the IITA and national research institutes through NAFPP.

As shown in this report, increases in the utilization of cassava, often in improved form, were sustained by the mechanical processing of cassava products, especially gari. Processed gari began to reach the market in the late 1970s as the result of the pioneering efforts of some commercial concerns.

SUPPLY/DEMAND PROSPECTS FOR CASSAVA, 1990 AND 2000

A summary of the projections made in this report is given in Table 44. Two options of supply and demand each are defined. A combination of each option of supply and each option of demand is defined as a strategy, resulting in four strategies. As a way of examining the implications of the strategies, the arithmetic differences between supply options and demand options are tabulated in Table 45. If the first alternative is adopted, there will be deficits in cassava both in 1990 and 2000. If, on the other hand, the high yields projected for 1990 and 2000 under the second alternative are achieved, supply will be considerably in excess of demand and efforts will be needed to generate additional demand. These gaps are based on the assumption of the income elasticity of demand for cassava being negative. However, if the coefficients are positive (0.124 in urban areas and 0.743 in rural areas), the total demand for cassava for food would be higher, and efforts will be needed to achieve the yields assumed under the second alternative.

Table 44--Supply and demand for cassava projected to 1990 and 2000

	1990	2000
	(1,000 metric tons)	
Alternative (1)		
Supply	5,506.4	6,052.5
Demand	7,165.7	8,134.1
Food	6,087.4	6,757.4
Feed	137.7	302.6
Other uses	27.5	60.5
Waste[a]	913.1	1,013.6
Alternative (2)		
Supply	8,457.9	19,981.2
Demand	7,454.5	9,521.3
Food	6,261.6	7,236.9
Feed	211.4	999.1
Other uses	42.3	199.8
Waste[a]	939.3	1,085.6

Source: Based on data from Tables 37, 41, 42, and 43.

Note: The minimum alternative projectons were made with the assumptions that supply followed the trend from the 1961-83 national series and, for demand, that population grew at an annual rate of 2.5 percent, GDP per capita grew at an annual rate of 5 percent, the elasticity of demand in urban areas was 0.200 and in rural areas it was -0.200. The medium alternative projections were made with the assumptions that the supply was attainable from the potential yields of varieties existing and in the pipeline and, for demand, that population grew at an annual rate of 2.5 percent, GDP per capita grew at an annual rate of 3 percent, the elasticity of demand in urban areas was 0.124, and in rural areas it was 0.743.

[a]Waste is assumed to be 15 percent of food consumption.

Cassava is at present a major source of human food. What is required are policies to promote the use of cassava as feed, as a raw material, and as a foreign exchange earner. Some of these policies are by-products of the structural adjustment program of government. There may be the need to develop more specific policies.

Table 45--Projected surpluses or deficits of cassava in 1990 and 2000

Period/Alternative Projection of Demand	Alternative Projections of Supply: Alternative (1)	Alternative (2)
1990		
Alternative (1)	-1,659.3	+1,292.2
Alternative (2)	-2,130.5	+ 821.0
2000		
Alternative (1)	-2,081.6	-11,847.1
Alternative (2)	-4,024.6	+9,904.2

Source: Based on Table 44.

Note: The minimum alternative projectons were made with the assumptions that supply followed the trend from the 1961-83 national series and, for demand, that population grew at an annual rate of 2.5 percent, GDP per capita grew at an annual rate of 5 percent, the elasticity of demand in urban areas was 0.200 and in rural areas it was -0.200. The medium alternative projections were made with the assumptions that the supply was attainable from the potential yields of varieties existing and in the pipeline and, for demand, that population grew at an annual rate of 2.5 percent, GDP per capita grew at an annual rate of 3 percent, the elasticity of demand in urban areas was 0.124, and in rural areas it was 0.743.

Cassava will continue to play a vital role in alleviating famine in Nigeria and provide a sustained food supply when other crops fail. At present, the major cassava-consuming states in Nigeria account for 51 percent of the 1980/81 projected population and consume 93 percent of total cassava in gari equivalent.

CASSAVA IN THE CONTEXT OF OVERALL NIGERIAN ECONOMIC DEVELOPMENT

When all is said and done, the trends and prospects for cassava must be seen in the context of the overall economic development of Nigeria. To this end, the main conclusions and policy implications of this report must be related to the overall policy goals of the country. The role of cassava must be seen in both the short- and the

long-term. The goals of Nigerian economic development are essentially dictated by the present philosophy, called the Structural Adjustment Programme (SAP), which is designed to remove the constraints that have caused the malfunctioning of the economic system. In particular, this means examining the roles of cassava in generating income and employment; creating foreign exchange savings, directly or indirectly as a raw material for manufacturing or as an export; and as an aid in increasing food production.

Ideally, in analyzing the role of cassava in overall Nigerian economic development, all relationships with other crops in production and utilization need to be properly estimated in order to provide such benchmark data as income and the direct and cross price elasticities of demand and supply of cassava. As shown in this report, this kind of analysis has been hampered by lack of an adequate data base.

In the light of the above, policy-oriented strategies that would enable cassava to play a role in fulfilling the overall policy goals of Nigeria must be geared toward further research to develop production and utilization improvements, food production development, and development of a comprehensive data base.

Further Research Activity

Lines of research required include research that would develop further improvements in mechanical processing, diversify improved varieties for industrial use, and improve farm management, making it possible to transfer the results of research to farmers for adoption. The results would include the agronomic aspects of intercropping and effective crop rotation. Other research would be on cost-effective methods of storage that would ensure wholesomeness of the finished products, packaging, and quality-control programs. Special studies should be made to develop benchmark data such as income elasticities, the direct and cross elasticities of demand and supply for cassava, the input-output structure of cassava production, and extraction rates for different cassava products not only at research stations but at processing points for the market.

In all cases, researchers in the universities and research institutes, such as FIIRO, PRODA, and NRCRI, must be brought together for proper research direction. Government agencies responsible for this must develop appropriate policy measures for setting priorities, allocating research funds, and implementation.

Food Production Development

Nigeria has come a long way in the development of food products, from traditionally based processed food to mechanical processing of

traditional food products to development of cassava-based fast-food products. Some fresh cassava is consumed boiled or raw as a vegetable, unaffected by improvements in technology found in other countries, where development has moved toward frozen peeled cassava. There is need for food production development to make research results ready for adoption for mass production for human consumption and for livestock rations. Research institutes and the manufacturing firms need to be brought together, not only to see that the food products are manufactured, but to ensure that appropriate technologies are developed to ensure wholesomeness of finished products, hygienic and appealing packaging, and maintenance of quality control. Appropriate policy measures that facilitate proper food production development in line with the objectives of the SAP need to be developed and implemented.

Development of a Data Base

The work of food production development and the research discussed above can only be used and properly monitored if the necessary data base exists. As has been shown above, the current base is grossly inadequate. Hence, there is a need to collect comprehensive data. This requires proper planning and the devotion of adequate resources to achieve reasonable results. The exercise must be integrated in order to cover production and utilization data from both primary and secondary sources. The fieldwork must be developed to cover at least one farming year, and it must be complete enough to make estimates possible for various items of interest, taking into consideration not only national estimates but estimates reflecting cropping patterns and other variations of interest in achieving policy goals.

APPENDIX 1

CASSAVA PRODUCTION AND CONSUMPTION STATISTICS IN NIGERIA

It is well known that statistics of cassava production and utilization are in bad shape and probably worse than for any other agricultural product in Nigeria. In fact, there are as many versions of historical series as there are organizations interested in Nigerian crop production statistics.[45] But the Nigerian situation is not unique. As noted by Cock, "FAO statistics are the best available guide to global production; however errors in the estimates for individual countries can be quite large. FAO figures for Brazilian production, for example, are much greater than the estimates obtained from data in Brazil's agricultural census."[46]

It seems pertinent to remark that cassava is unusual even among root crops. All other root crops are, at most, annual crops, with unique harvesting periods. If not harvested in that period, their leaves change color and wither, and the tuber spoils or begins to germinate. The harvesting date for cassava is highly flexible. It can be as early as 7 months after planting in warm areas or be put off until 18 months after planting or later. "Cassava can remain in the ground until it is needed. It continues to grow, though the roots may become more fibrous, which lowers the eating quality. Cassava may be left to grow for two or three years before it is harvested, or it may be partially harvested as food if needed. That is, one or two roots may be harvested but the plant left standing so that it continues to grow."[47]

In Nigeria, cassava can be planted "any time during the rainy season as long as there is at least five weeks of rain after germination, so that the crop can be established well enough to survive the following dry season."[48] The implication of this is that, although

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[45]World Bank, Nigeria: Agricultural Sector Memorandum, contains a collection of these statistics and notes the divergences among them.

[46]Cock, Cassava: New Potential for a Neglected Crop, p. 3.

[47]Ibid, p. 21.

[48]J. O. Aina, "Cassava Production," Ministry of Agriculture and Natural Resources, Ilorin, n.d. (mimeographed).

there are certain periods when much of the crop is harvested, harvesting generally occurs all year round in major cassava-producing areas.

This means that care needs to be taken to avoid underestimation--or overestimation--of annual cassava production, because the production figure of a given year may ignore current production or include a carryover from the previous year. The FOS, the main official agency conducting field surveys to estimate crop production statistics in Nigeria, seems not to grasp the uniqueness of cassava as a crop.[49] FOS uses sample survey and crop-cutting methods to estimate both area harvested and yields. For yields, generally, the "enumerators harvested and weighed the crops in the yield plots at the same time the farmer informant was harvesting the crops in the other parts of the farm plots. The only crops for which yields were not recorded were those that were thinly scattered over the farm plots or those used as boundary plants."[50]

In addition to this procedure, production statistics for cassava are only for "old" cassava. The concept of an "old" crop is that the crops that are harvested during the year of survey are recorded and that the record does not include crops that are ready for harvesting but not yet harvested. These are called "new." Cassava is one of the crops for which area harvested is recorded and not area planted. But to what extent has this approach helped to obtain good estimates of annual production? This is discussed below, along with other problems and solutions to them.

FAO-FOS 1968/69 SOLUTION

The first known attempt to deal with this problem was made by K. Becker and F. Pariboni of FAO's Statistics Division in Rome and J. D. Abiagom of the Federal Office of Statistics, Lagos. This was written up as "Notes on Cassava Production in Nigeria" and reproduced in a report on production, utilization, and processing accounts of food crops in Nigeria for the purpose of preparing a food balance sheet for the National Agricultural Development Committee of Nigeria for 1968/69 and 1969/70.[51] This was a major source of the statistical methodology

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[49]For the efforts of the FOS to collect agricultural data, see Adamu, "Trends of Food Production and Consumption in Nigeria."

[50]Nigeria, Federal Office of Statistics, Rural Economic Survey: Farm Survey, 1963/64 (Lagos: FOS, 1966), p. 5.

[51]Abiagom, "Report on Production/Utilization/Processing Account of Food Crops in Nigeria."

on which the 1972 report by Olayide et al. was based.[52] The data collected from the Rural Economic Surveys of 1963/64 and 1965/66 were fully utilized. The farm survey data were used to adjust production data and the rural food consumption survey to derive the utilization.

As expressed by Abiagom, "The 1968/69 cassava production figures obtained from sample survey in Nigeria are composed of old and new cassava. The new cassava could have growth periods of 19, 12, or 9 months according to varieties. The distribution of the new cassava being unknown, it was assumed that 50 percent of the new cassava had been harvested in a crop year. From the 1968/69 production, yield and acreage data, production of old cassava in Nigeria, excluding the Eastern States, is 4,039,000 tons. In the Eastern States, production is 1,264,000 tons totalling 5,303,000 tons for all Nigeria in 1968/69. The new cassava figure given for Nigeria is 6,776,000 tons. Adding 50 percent of this to the production of old cassava would result in a production of total cassava of 8,700,000 tons;" this adjustment was made for 1961 to 1969.[53]

Partly as a way of verifying the above production figures, utilization estimates were derived from the food consumption surveys of 1963/64 and 1965/66 from which Table 46 was computed. Using the projected population total of 62,900,000 and the total fresh cassava equivalent of 5.06 pounds per capita per week, an aggregate cassava consumption figure of 7,395,000 tons was obtained. Table 46 also contains the derived proportional composition of cassava products. On this basis, the consumption of cassava worked out to be: 4 percent for gari, 66 percent for pudding (fufu, akpu), 8 percent for cassava flour, 8 percent for starch, and 14 percent for fresh cassava, less waste. The extraction rates for different preparations of cassava were 33.3 percent for gari, 50 percent for fufu/akpu, 25 percent for cassava flour, and 20 percent for starch.[54]

The correctness of the adjustments for new cassava, the estimate of cassava utilization, and the extraction rates depend on the quality of the data used and the assumptions made. But apart from these, the results have some defects. One is that the data used are too aggregated. Geographical and ethnic variations were not taken into consideration. This is bound to affect the results in a country like Nigeria. Another obvious defect is that the survey used is based only on the rural population of the country. There is no supporting

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[52]Olayide et al., A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria.

[53]Abiagom, "Report on Production/Utilization/Processing Account of Food Crops in Nigeria," p. 8.

[54]Ibid, p. 9.

Table 46--Conversion of cassava products into their fresh cassava equivalents and the derived proportional composition of cassava products

Product	Consumption	Conversion Factor	Fresh Cassava Equivalent
	(pounds/ capita/ week)	(percent)	(pounds/capita/ week)
Gari	0.05	300	0.15
Raw cassava	0.57	100	0.57
Gari rogo	0.03	400	0.12
Cooked cassava	0.12	100	0.12
Cassava flour	0.07	400	0.28
Cassava preparation	0.02	200	0.04
Fufu	1.52	200	3.04
Akpu	0.14	200	0.28
Tapioca	0.02	500	0.10
Cooked gari	0.02	300	0.06
Usi	0.06	500	0.30
Total			5.06

Product	Fresh Cassava Equivalent	Share of Product in Cassava Consumption
	(pounds/capita/week)	(percent)
Fresh cassava		
Raw cassava	0.57	...
Cooked cassava	0.12	...
Total	0.69	13.6
Gari	0.15	...
Cooked gari	0.06	...
Total	0.21	4.1
Cassava pudding		
Cassava preparation	0.04	...
Fufu	3.04	...
Akpu	0.28	
Total	3.36	66.1
Cassava flour	0.28	
Gari rogo	0.12	
Total	0.40	7.9
Starch		
Tapioca	0.10	
Usi	0.30	
Total	0.40	7.9
Total	5.06	100.0

Source: J. D. Abiagom, "Report on Production/Utilization/Processing Account of Food Crops in Nigeria, for the Purpose of Preparing Food Balance Sheet for Nigeria," prepared for the National Agricultural Development Committee of Nigeria, 1961-69, Federal Office of Statistics, Lagos, 1971 (mimeographed).

evidence for the extraction rates. As will be shown below, even if the results obtained above were valid in the 1960s, they are not tenable today.

PRODUCTION: EVIDENCE ON CASSAVA FARMING PRACTICE

Any observer who has gone around farms in Nigeria where cassava is not planted as the major crop can note that cassava is always scattered in the farm plots and is also used as a boundary crop. In effect, with the FOS approach described above, cassava is bound to be underreported, particularly as a mixed crop.

But the most important problem of cassava production statistics is the neglect of the important contribution of new cassava in annual production data. Except for what was given in the 1971 Abiagom report quoted above, the FOS has never published statistics on production of new cassava. From the data made available by FOS on new cassava, during 1963/64 and 1965/66, more new cassava farm plots were observed than old cassava farm plots, especially in the southern regions. The area per farmer under new cassava was greater than that under old cassava. This evidence is supported by the Western State Sample Survey of agriculture in 1972/73. This is generally so for cassava grown as a mixed crop, and less so for cassava grown alone.

The only officially published data on new cassava was Western State's first agricultural sample survey mentioned above. This survey came into being as a way of improving the FOS survey by an increase in sample size. More production comes from new cassava than old cassava, but whether this was half of total new cassava as assumed in Abiagom in 1971 is difficult to say. What is clear is that using production from old cassava alone will result in serious underreporting.

The sample survey of agriculture begun in 1972/73 by the Western State of Nigeria was continued, but no estimates were made for new cassava. When the state was broken into three, each of the three states continued the survey but only Oyo State's surveys were regular and reasonably timely. The results from these surveys and those of FOS are presented side by side in Table 47. FOS results as a ratio of the state-based results are presented in Table 48. As revealed in that table, no consistent pattern existed between the two. Except for 1982, area harvested and production were generally significantly lower in the FOS data. For Western State, the reverse was true in 1974/75 and 1975/76.

With regard to the relationship between sole and mixed cropping for the whole country, FOS reports show that the area planted mixed as a percentage of the total area under cassava was 20.0 percent in 1978/79, 18.1 percent in 1979/80, 17.2 percent in 1980/81, and 17.0 percent in 1981/82. Whereas for Western State or Oyo State, the

Table 47--Comparison of state and national cassava production surveys

Period	State Surveys						Federal Office of Statistics	
	Number of Farming Households	Area Devoted to Cassava	Production	Average Production Per Household	Average Area Per Household	Area under Mixed Cassava as Share of Total Area	Area Harvested	Production
	(1,000)	(1,000 hectares)	(1,000 metric tons)	(metric tons)	(hectares)	(percent)	(1,000 hectares)	(1,000 metric tons)
Western State								
1972	551	193.1	327.5	0.59	0.35	47.9	23.9	205.2
1973	...	...	...	...	...	...	97.9	749.8
1974	391	109.0	477.4	1.22	0.28	57.7	...	...
1975	457	102.3	987.3	2.16	0.22	63.9	...	...
Oyo State								
1972	261	59.6	150.0	0.57	0.23	69.8	...	...
1973	211	45.0	156.5	0.74	0.21	57.7	...	...
1974	245	49.9	142.3	0.58	0.20	62.2	...	...
1975	154	28.2	210.1	1.36	0.18	67.8	...	...
1976	173	36.4	480.4	2.79	0.21	62.8	29	185
1977	231	54.9	693.2	3.99	0.24	42.4	46	404
1978	291	81.5	1,692.2	5.80	0.28	20.4	28	161
1979	189	35.3	406.4	2.15	0.19	20.2	24	391
1980	75	21.0	266.3	3.56	0.28	5.7	7	96
1981	70	15.3	106.3	1.52	0.22	4.6	5	68
1982	80	21.0	179.4	2.23	0.26	9.1	15	183
1983	78	23.1	268.1	3.43	0.30	1.1	12	251

Sources: Nigeria, Federal Office of Statistics, Rural Economic Survey, various years (Lagos, FOS, various years); Nigeria, Federal Office of Statistics, Rural Agricultural Sample Survey, various years (Lagos, FOS, various years); Nigeria, Western State, Report of an Agricultural Survey, various years (Ibadan: Western State, various years); and Nigeria, Oyo State, Report of Rural Agricultural Sample Survey, various years (Ibadan: Oyo State, various years).

Note: The state surveys were run on a calendar-year basis, but the Federal Office of Statistics ran its surveys beginning in May of one year and ending in April of the next.

Table 48--Data from surveys of the Federal Office of Statistics as a share of the data from Western and Oyo states surveys

State/Year	Area	Production
	(percent)	
Western		
1972	12.4	62.7
Oyo		
1976	79.7	38.5
1977	83.8	58.3
1978	34.4	9.5
1979	68.0	96.2
1980	33.3	36.0
1981	32.7	64.0
1982	71.4	139.9
1983	51.9	71.6

Sources: Nigeria, Federal Office of Statistics, Rural Economic Survey, various years (Lagos, FOS, various years); Nigeria, Federal Office of Statistics, Rural Agricultural Sample Survey, various years (Lagos, FOS, various years); Nigeria, Western State, Report of an Agricultural Survey, various years (Ibadan: Western State, various years); and Nigeria, Oyo State, Report of Rural Agricultural Sample Survey, various years (Ibadan: Oyo State, various years).

Note: The state surveys were run on a calendar-year basis, but the Federal Office of Statistics ran its surveys beginning in May of one year and ending in April of the next.

percentage was over 40 percent before 1978 and decreased significantly after 1980 to 1.1 percent in 1983, which is not consistent with the actual situation, as cassava is not generally planted as a sole crop in this state.

The main objective of this analysis is to detect the major source of possible misreporting of cassava production. There is evidence of underreporting, which seems to have been caused mostly by a failure to include some percentage of new cassava. Another reason is the deliberate neglect or underreporting of cassava under mixed cropping. Therefore, there is a need to adjust FOS production data to reflect these errors.

An alternative basis for this adjustment, is presented in Table 49. If all areas observed by FOS were harvested, then annual cassava production would increase by 50 percent. On the other hand, figures based on the Western State data show that old cassava is less than 20 percent of cassava harvested. Since the FOS data covers the whole country, its results are preferred. Western State figures may not be representative of major producing states. On the assumption that 50 percent of new cassava is harvested, the increase would be by a factor of 3.00 on the basis of 1963/64, and 3.17 on the basis of 1965/66. As a result of this analysis, old cassava area harvested should be multiplied by 3 to account for the inclusion of 50 percent of new cassava into annual production of cassava.[55]

Table 49--Relative importance of new cassava

Category	Old Cassava as a Share of Total Cassava	Raising Factor[a]
Observed cassava farm plots		
1963/64	36	2.79
1965/66	31	3.27
Observed area under cassava cultivation		
1963/64	20	4.99
1965/66	19	5.34
Cassava production in Western State		
Area	18	5.71
Production	15	6.60

Source: Nigeria, Federal Office of Statistics, Rural Economic Survey: Farm Survey, 1963/64 (Lagos, FOS, 1966); and Nigeria, Federal Office of Statistics, Rural Economic Survey: Farm Survey 1965/66 (Lagos: FOS, 1967).

[a]This is the number by which the data available should be multiplied in order to offset underreporting. It is the inverse of the proportion of old cassava to total cassava.

[55]Adamu, "Trends of Food Production and Consumption in Nigeria," pp. 163-168, treats this in a different way.

The first serious analysis of food production made in Nigeria was by Olayide et al. in 1972. The report covered production data from 1959 to 1969.[56] According to the authors, the data used came from FOS. Official data published by FOS on actual area harvested and production were only from 1965/66. Yields alone were available for 1963/64 and 1964/65 in official publications. Other data published were ratios. This probably means that the Olayide report used the FOS files for the data and adjusted FOS survey results on the basis of known information. To obtain further insight into cassava production statistics, series from FOS, FAO, and the Olayide report are compared. Table 50 shows the absolute volume estimates of area harvested and production, and the ratio of the figures from FAO and the Olayide report to the FOS figures with respect to area harvested. Although the Olayide report claims that "Figures on ... food crop averages and yields are based on the statistical data compiled by the Federal Office of Statistics, Lagos and other published data where applicable,"[57] the FAO and Olayide report series are so close that they can be regarded as coming from the same source.

It is clear from these tables that, first, the major difference between the sources is in area planted. Second, the figures for yields are reasonably close. Lastly, the series of ratios can easily be partitioned into three sections for homogeneity: 1965/66 to 1975/76, 1976/77 to 1979/80, and 1980/81 to 1983/84.

All these show that what is required to obtain cassava estimates of reasonable quality using FOS series is to multiply the FOS data on area harvested by a constant factor over a set of years. Taking into consideration the results contained in previous tables and the development in agriculture since 1976, the adjustment factors recommended are

Period	Adjustment Factor
1965/66 to 1975/76	2.0
1976/77 to 1979/80	3.0
1980/81 to 1983/84	6.0

The procedure adopted for adjusting cassava at the state or national level, is as follows:

Step 1: Since only the area harvested and production figures are recorded, obtain the yield of each crop.

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[56]Olayide et al., A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria.

[57]Ibid, p. 3.

Table 50--Comparison of cassava production statistics

Year	Federal Office of Statistics (FOS)		FAO		Olayide		Area Ratio	
	Area	Production	Area	Production	Area	Production	FAO/FOS	Olayide/FOS
	(1,000 hectares)	(1,000 metric tons)	(1,000 hectares)	(1,000 metric tons)	(1,000 hectares)	(1,000 million tons)		
1961	...	...	...	...	779.4	7,400	...	...
1962	...	....	868	7,600	865.3	7,600	...	...
1963	...	...	804	7,800	801.3	7,800	...	...
1964	...	...	873	8,000	870.13	8,000	...	...
1965	302	2,976	832	8,200	829.2	8,200	2.755	2.745
1966[a]	185	1,674	913	8,400	910.2	8,400	4.935	4.920
1967	376	3,312	961	8,600	958.0	8,600	2.556	2.548
1968	420	4,104	904	8,820	901.3	8,820	2.152	2.146
1969	374	4,221	909	9,040	906.2	9,040	2.431	2.423
1970	385	5,213	913	9,084	...	...	2.371	...
1971	441	4,508	920	9,172	...	...	2.086	...
1972	360	2,571	960	9,570	...	...	2.667	...
1973	398	2,901	970	9,600	...	...	2.437	...
1974	414	3,582	1,000	10,000	...	...	2.416	...
1975	313	2,321	1,000	10,000	...	...	3.195	...
1976	363	1,876	1,080	10,000	...	...	2.975	...
1977	198	1,900	1,100	9,473	...	...	5.556	...
1978	175	1,578	1,100	10,600	...	...	6.288	...
1979	138	1,492	1,150	11,000	...	...	8.333	...
1980	93	872	1,200	11,000	...	...	12.903	...
1981	71	582	1,200	11.000	...	...	16.901	...
1982	80	909	1,250	11,700	...	...	15.625	...
1983	108	1,174	1,150	9,950	...	...	10.648	...

Source: The series from the Federal Office of Statistics is taken from Nigeria, Federal Office of Statistics, Rural Agricultural Surveys, various years. Lagos: FOS, various years. The FAO series is from Food and Agriculture Organization of the United Nations, Production Yearbook, various issues (Rome: FAO, various years). The Olayide series is .rom S. O. Olayide, Dupe Olatunbosun, E. O. Idusogie, and J. D. Abiagom, A Quantitative Analysis of Food Requirements, Supplies and Demands in Nigeria, 1968-85 (Lagos: Federal Department of Agriculture, 1972).

[a]The civil disturbance in Nigeria began in this year. It is not reflected in the FAO and Olayide series.

Step 2: Adjust the area harvested in each case for each period using the appropriate adjustment factor given above.

Step 3: Calculate adjusted production by multiplying the corresponding value in Step 1 by that of Step 2.

This is a reasonable first approximation adjustment procedure, and seems adequate for the present exercise and for the available evidence.

PRODUCTION: SURVEY DESIGN AND FIELDWORK

The discussion and conclusions presented in the last section do not mean that a proper solution has been found. The solution provided is temporary. A proper solution is required and this must be found at an official level. In doing this, attention must be given to design and fieldwork by FOS.

In all the years the FOS has done fieldwork, it has not been possible for it to develop an accurate crop pattern of Nigeria--an important aid for sample selection that ensures that all important crops in a domain are taken adequately into consideration in stratification and sample selection. It is inappropriate to assume, as the FOS does implicitly, that each crop has an equal chance of being selected even in areas where it is not expected to be grown. It is also expecting too much to expect that the yield from crop-cutting a plot selected randomly in a holding that is not equally productive will not be extremely low or high. But FOS enumerators seem to do this. In addition, coverage has been inadequate and sample size too small.

In a field check, it was found in Ondo and Anambra states that rice production was low in two years, went up again in some years, and then down.[58] It was later found that some enumeration areas were included in the sample when production was high and were dropped when it was low. Only Akoko, Akure, and Ondo divisions had high production of cassava; if they were selected to represent Ondo state, the estimate of the state's production would be extremely high. But if Ekiti North and Okitipupa were selected to represent the state, the estimate for the whole state would be extremely low.

There is also the issue about the appropriateness of the survey period, April to March of the following year.

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[58] J. K. Balogun, "Agricultural Survey Statistics in Nigeria," Lagos, 1986 (mimeographed).

Crop cutting and estimating procedures require a review, especially for cassava. The method used should be supplemented with a quick estimate when visits are made during the land preparation and planting period. Information collected during this stage must be used to improve final estimates.

When estimates are finally made, unusual cases must be explained. A situation where production fell by about 90 percent must be explained properly. Even if the survey design is perfect, the data collecting agencies must ask why and how certain estimates are different from the previous ones. The activity must not always be left to chance. If by chance the wrong field was picked and unusual results obtained compared with past trends, the FOS should be interested in knowing why it happened and how it can be corrected.

FOOD CONSUMPTION: NEW EVIDENCE AND SOLUTION

For the present exercise, the 1980/81 National Consumer Survey and extraction rates based on informed opinions and empirical results were used. The relevant results from the survey are presented in Table 31. The cassava products were classified broadly into four major groups in the source of the data, possibly to avoid classifications that would be likely to result in different names for the same product. The variation between urban and rural areas is large, except for the southwestern states of Lagos, Ogun, Ondo, Oyo, and Bendel.

The extraction rates of the different cassava products depend very much on the varieties planted. While the rates may not be high for a product like starch because of the limited processing involved, they are not the same for gari or cassava flour. Until recently, all farmers planted the unimproved varieties.

RELIABILITY OF PRODUCTION STATISTICS

On the basis of the 1980/81 national consumer survey referred to above, the consumption of cassava in gari equivalent is estimated to be 1.06 million metric tons (see Table 23). The gari extraction rate varies from 8.0 percent to 33.3 percent, depending on the variety of cassava, the age of the cassava plant at harvesting, the stage of development of the processing techniques, and the quality of gari extracted.

The gari extraction rate often quoted for traditional processing or for unimproved varieties is 25 percent. This was used for the results contained in Table 24 in the text. Even though improved varieties were introduced to farmers as early as 1978, it is not easy to assume that farmers will like to use cassava varieties with gari extraction rates as low as 16 percent. But as a way of assessing the

reliability of the estimates contained in Table 2, some selected extraction rates were used to compute the quantity of cassava consumed. These were compared with the alternative production statistics.

Allowing at least 10 percent and at most 20 percent for waste and animal feed, it is found that the estimate for 1980/81 in the Adamu adjusted series is the closest to what can be derived from the consumption estimate of the same year, and so is closest to actual production. While the FOS and CBN estimates are too low, the FAO and USDA estimates are too high. This result also provides support for the estimated historical production series used by Adamu.[59] The correct extraction rate should be between 20.5 percent and 25.0 percent.

In conclusion, it is clear that the problem of cassava production statistics in Nigeria is due partly to the nature of cassava and partly to FOS approach to data collection. Standard estimating techniques in collecting data on cassava must take into consideration its special features even when compared with other root crops in the forest zone of the tropics. To be able to obtain a proper historical series for cassava production, a special study must be mounted to examine available data on a state-to-state basis in order to come up with estimates close to reality. The production statistics must be monitored continuously.

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[59]Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava."

APPENDIX 2
POLITICAL DIVISIONS OF NIGERIA

Regions Up to 1967	12-State Structure, 1967-76	19-State Structure, Since 1976
West	Lagos	Lagos
	West	Ogun Oyo Ondo
Mid-West	Mid-West	Bendel
East	Rivers	Rivers
	South East East Central	Cross River Imo Anambra
North	Kwara	Kwara
	Benue-Plateau	Benue Plateau
	North East	Gongola Borno Bauchi
	Kano North Central North West	Kano Kaduna Sokoto Niger

APPENDIX 3

SOME STATISTICS ON THE USE OF CASSAVA AS FEED

The information in this appendix is representative of recent work on use of cassava as feed in Nigeria. The material on emergency poultry rations below and Tables 51-56 are taken from Appendix 2, which discusses the contributions of the Rural Agro Industrial Scheme (RAIDS) in the proceedings of the National Seminar on Alternative Uses of Cassava.[60]

EMERGENCY POULTRY RATIONS

On a weight basis:
(A) 1/3 maize/cassava/sorghum/millet
(B) 1/3 beans/peas
(C) 1/3 maize bran - or any bran

If you wish to increase performance marginally, increase (A) at the expense of (C), but do not increase (A) or reduce (C) by more than 15 per cent. Any vegetable (soya) or animal protein (blood and bone meal) will improve performance. Add this source of protein, keeping the other ingredients (A-C) proportional, up to a maximum of 50 percent of the total ration by weight.

Source: RAIDS.

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[60]Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava."

Table 51--Rations for layers fed by rural farmers and urban feed mills

Feed Mixer/Feed Stuff/Nutritional Value	Share of Ration
	(percent)
Rural farmer[a]	
Cassava tuber meal	40.80
Cowpea[b]	20.00
Blood meal	16.80
Bone meal	2.50
Oyster shell	7.80
Salt	0.20
Min/Vit mix (Pfizer)	0.24
Total	100.00
Crude protein	17.83
Metals energy (kilograms/gram)	2.57
Crude fiber	4.51
Urban feed mill	
Yellow maize	22.0
Cassava tuber meal	17.0
Brewer's yeast	4.9
Groundnut cake[c]	9.0
Palm kernel meal	6.8
Fish meal	5.0
Brewer's dried grains	4.9
Oyster shell	7.8
Bone meal	2.5
Palm oil	5.0
Salt	0.2
Min/Vit mix (Pfizer)	0.2
Dried cassava peels	13.9
Total	100.0
Crude protein	16.90
Metals energy (kilo calories/gram)	2.66
Crude fiber	5.47

Source: Communication with O. O. Tewe of the University of Ibadan, cited in A. Joshua, ed. "Proceedings of the National Seminar on the Alternative Uses of Cassava," Nigeria, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources, and Rural Development, Lagos, 1986 (mimeographed), Appendix 2.

[a]This diet is not balanced for amino acids. It is advisable to check its acceptability to the chicken before it is used.

[b]Cowpeas must be roasted before milling to remove antinutritional factors.

[c]Groundnut cake can be replaced with soyabean meal.

Table 52--Comparison of cassava with other ingredients in maize-substituted diets

Ingredient/ Daily Gain	Percentage Level of Substitution			
Wheat offal[a]	0	5	10	15
Daily gain	0.59	0.60	0.63	0.61
Brewers' grain[a]	0	5	10	15
Daily gain	0.60	0.61	0.61	0.60
Maize[a]	0	5	10	15
Daily gain	0.61	0.60	0.62	0.53
Cassava peel[b]	0	15	30	45
Daily gain	0.53	0.41	0.40	0.41
Cassava meal[b]	0	18	36	54
Daily gain	0.52	0.56	0.55	0.49
Cassava and molasses[a]	0	17	34	51
Daily gain	0.36	0.39	0.43	0.44

Source: G. M. Babatunde, B. L. Fetuga, V. A. Oyenuga, and A. Ayoade, "The Effects of Feeding Graded Levels of Brewers Dried Grains and Maize Cob in the Diets of Pigs on their Performance Characteristics and Carcass Quality," Nigerian Journal of Animal Production 2 (No. 1, 1975): 119-133; and E. B. Sonaiya and T. A. Omole, "Cassava Peel for Finishing Pigs," Nutrition Report International 16 (No. 4, 1977): 479-486, as cited in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," Nigeria, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources, and Rural Development, Lagos, 1986 (mimeographed).

Note: Daily gain is in kilograms per day.

[a]These figures are from Babatunde et al., 1975, cited in Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava."

[b]These figures are from Sonaiya and Omole, 1977, cited in Joshua, ed. "Proceedings of the National Seminar on the Alternative Uses of Cassava."

Table 53--Results of feeding a pig a diet of raw cassava and a protein supplement

Performance	Basal Diet	Raw Cassava Supplement	
		Ad Lib	Restricted
		(kilograms)	
Average daily gain	0.84	0.83	0.79
Average daily intake of raw cassava	...	4.05	3.89
Average dry cassava	...	1.63	1.57
Average cassava supplement			
Total feed intake	2.89	2.80	2.30
Feed/gain ratio	3.43	3.36	2.90

Source: K. K. Kuan, J. K. Mul Razak Almen, and D. J. Farrell, "Chemical Composition and Digestible Energy of Some Feedstuffs Determined with Pigs in Malaysia," Tropical Animal Production 7 (1972): 315-321, as cited in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," Nigeria, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources, and Rural Development, Lagos, 1986 (mimeographed).

Notes: The pig's weight increases from 17 to 98 kilograms. Intake is expressed on a dry matter basis, with 10 percent moisture.

Table 54--Finishing pig fed cassava with different protein sources

Protein Source Added to Fresh Chopped Cassava	Average Daily Weight Gain	Average Daily Consumption of Fresh Cassava	Average Daily Consumption of Supplement	Feed/ Gain Ratio
		(kilograms)		
Soybean meal	0.72	4.0	0.80	3.25
Meat meal	0.68	3.4	0.78	3.07
Cottonseed meal	0.59	3.1	0.79	3.38
Meat meal and blood meal	0.73	3.9	0.94	3.32
Meat meal, blood meal, and cottonseed meal	0.72	4.0	0.90	3.38
Fish meal and cottonseed meal	0.68	4.1	0.79	3.47

Source: K. K. Kuan, J. K. Mul Razak Almen, and D. J. Farrell, "Chemical Composition and Digestible Energy of Some Feedstuffs Determined with Pigs in Malaysia, "Tropical Animal Production 7 (1972): 315-321, as cited in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," Nigeria, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources, and Rural Development, Lagos, 1986 (mimeographed).

Table 55--Effect of cassava silage on a growing finishing pig

Treatment	Average Daily Gain	Intake of Supplement	Daily Consumption of Fresh Cassava	Feed/ Gain Ratio
	(kilograms)			
Fresh chopped cassava	0.75	1.00	4.04	3.43
Cassava root silage	0.77	1.01	3.84	3.25
Root and foliage silage	0.64	1.06	3.05	3.52

Source: L. E. Maust, W. G. Pond, and L. M. Scott, "Energy Value of Cassava, Rice Bran Diet with and Without Supplemental Zinc for Growing Pigs," Journal of Animal Science 35 (1972): 953-957, as cited in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," Nigeria, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources, and Rural Development, Lagos, 1986 (mimeographed).

Table 56--Fresh cassava fed to pregnant pigs in pasture and confinement

Category	1 Kilogram Control Diet on Pasture	1.7 Kilograms Fresh Cassava and 0.4 Kilograms of Protein Supplement on Pasture	3.1 Kilograms Fresh Cassava, 0.62 Kilograms of Protein Supplement during Confinement
		(kilograms)	
Sows	10.0	10.0	10.0
Sows not farrowed	9.0	7.0	7.0
Sow weight at service	165.8	163.6	162.8
Sow weight at service, 105 days	185.7	188.5	190.5
Gestation gain	19.9	24.9	37.7
Pigs per litter	10.4	10.0	7.7
Pigs at 35 days	8.3	7.3	6.9
Birth weight	1.3	1.1	1.9
35-days weight	6.9	6.1	6.5

Source: J. H. Maner, "Cassava in Swine Feeding," First Latin American Swine Seminar, Centro Internacional de Agricultura Tropical, Cali, Colombia, September 18-21, 1972, as cited in A. Joshua, ed., "Proceedings of the National Seminar on the Alternative Uses of Cassava," Nigeria, Federal Department of Agriculture, Federal Ministry of Agriculture, Water Resources, and Rural Development, Lagos, 1986 (mimeographed).

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