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Trends and Prospects for Cassava in Zaire

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INTERNATIONAL
FOOD
POLICY
RESEARCH
INSTITUTE

PN-AAC-990

TRENDS AND PROSPECTS FOR CASSAVA IN ZAIRE

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Washington, D.C.

February 1989

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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 Zaire, by Tshikala Tshibaka and Kamanda Lumpungu, is the fourth in the series.

J. S. Sarma

ACKNOWLEDGMENTS

The authors wish to acknowledge the financial support from the International Development Research Centre (IDRC). They also express their deep appreciation to John W. Mellor, IFPRI Director, for his interest in this study and to J. S. Sarma, the project leader, for his valuable comments.

The assistance from Mulubayi Tshingombe of the Faculty of Economics, University of Kinshasa, Zaire, who compiled most of the secondary data used in this study is recognized. The able computer assistance received from Darunee Kunchai, IFPRI research analyst, is greatly appreciated.

1. INTRODUCTION

This study on cassava in Zaire is part of a broader study analyzing trends and prospects for cassava in the Third World, which originally was based on the hypothesis that the future of cassava might be jeopardized by substitutes because of the small or even negative income elasticity of cassava demand for human consumption observed in developing countries. In reality, however, there are many possibilities for cassava utilization that have not been exploited yet in Third World countries. For example, the use of cassava in animal feed and some industries could be expanded, particularly in Asia and Latin America. Furthermore, cassava plays a strategic role in food security of populations, especially in food-deficit Sub-Saharan Africa, because of its high yields and its adaptability to poor soils and hard climatic conditions.

The study has four objectives. First, to assess the position of cassava in Zaire's food sector. Second, to analyze past trends in area, production, and yield of cassava and its domestic utilization in Zaire. Third, to give a general indication of the projections of demand for and supplies of cassava in 1990 and 2000. Lastly, to suggest, on the basis of such analysis, appropriate policies for the production, utilization, and marketing of cassava.

Most of the data used in the study came from four main national sources and one international source. The national sources are the Division of Agricultural Statistics of the Ministry of Agriculture, the Bank of Zaire, the National Institute of Statistics, and the Department of Agricultural Economics, Institut Facultaire des Sciences Agronomiques de Yangambi, which made microeconomic data on farming systems in the Zairean Basin available. The international source is the Food and Agriculture Organization of the United Nations.

The main problem was lack of reliable data on production and utilization of cassava for various purposes at national and regional levels.

2. AGRICULTURE IN ZAIRE: AN OVERVIEW

Zaire straddles the equator, with its northern boundary at 5°20' latitude and its southern boundary at 13°20' latitude. Its geographical area is 2.3 million square kilometers. It is third in size among African countries and accounts for 7.5 percent of the area of the continent. Three distinct climatic zones can be identified: equatorial, tropical, and temperate uplands. In the equatorial zone, annual precipitation is more than 1,600 millimeters. There is almost no dry season. In the tropical zones, there are two seasons: rainy and dry. The dry season becomes progressively longer as one moves away from the equator, and, consequently, total precipitation decreases. The uplands are situated in the east and northeast of the country and have a moderate climate. Because of these diversified climates, Zaire has an enormous agricultural potential.[1]

The country is divided into nine administrative regions including Kinshasa, the capital city. Bas-Zaire, Kinshasa, and Shaba are totally in the tropical zone. Bandundu, Kasai Occidental, Kasai Oriental, Equateur, and Haut-Zaire have both tropical and equatorial climates. Kivu has all three climatic zones.[2] The vegetation of the southern regions, namely Bas-Zaire, Kinshasa, Bandundu, Kasai Occidental, Kasai Oriental, and Shaba, is predominantly savannah, while the other regions are mainly forest.

ORGANIZATION OF AGRICULTURE IN ZAIRE

Agriculture in Zaire has a dualistic nature. The sector has two basic components: smallholder and plantation agriculture. The plantations are large corporations that rely on paid labor and capital and use modern techniques of agricultural production. They produce mainly nonfood crops such as coffee, cocoa, rubber, tea, and palm oil. The bulk of their crop output is exported.

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[1]F. Jurion, and J. Henry, De l'Agriculture Itinérante à l'Agriculture Intensive (Brussels: Institut National pour l'Etude Agronomique du Congo, 1967).

[2]Kivu region has recently been subdivided into three regions: Maniema, North Kivu, and South Kivu.

Smallholder agriculture is made up of peasant farmers. They represent 93 percent of the agricultural labor force. These farmers depend mostly on household labor, which is the main determinant of their production. Capital is largely limited to simple tools and seeds from previous crops. Land is abundant overall. Access to it is not a constraint, but cultivated area per farm household rarely exceeds 1 hectare in the forest zone and 2 hectares in the savannah region.[3] The techniques of production used are predominantly traditional.

Smallholder farmers primarily produce food crops. Cassava, maize, rice, and plantains are the most important. In fact, nearly all of the food crops, cotton, and groundnuts are produced by smallholders. The bulk of food crop output is consumed in the country. In some areas of the country, smallholders also produce nonfood crops such as coffee, cocoa, tea, and palm oil. These farmers contribute 30 percent of agricultural exports; the remaining 70 percent is provided by the plantation sector.

INTRODUCTION OF CASSAVA IN ZAIREAN AGRICULTURE

Cassava was first introduced to the west coast of Africa from Latin America, and thereafter it spread to other parts of the continent. It reached Zaire in the sixteenth century. Its rapid spread across the country was initially handicapped by lack of communication facilities in the central basin of the Zaire River. After 1876, however, its cultivation spread across the country. This rapid expansion is attributed to its propagation by cuttings, its tolerance of dry weather, its adaptability to many types of soil in different climatic conditions, and the flexibility of its harvesting periods. Cassava was also imposed on farmers by the colonizing nation in order to avoid famine.[4]

In Zaire, cassava grows well in regions where the mean precipitation varies from 1,200 to 1,500 millimeters, the mean temperature is 23°C to 24°C, and the dry season lasts two-to-three months. In those conditions, all soils, except asphyxiating soils, are suitable to cassava. Farmers prefer recent forest soil because of its richness in natural nutrients and its ability to hold cassava roots for many

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[3]Tshikala B. Tshibaka, The Effects of Trade and Exchange Rate Policies on Agriculture in Zaire, Research Report 56 (Washington, D.C.: International Food Policy Research Institute, 1986).

[4]P. Yaya, "Le Rôle du Manioc dans l'Economie Congolaise," Faculté des Sciences Economiques, Lovanium, Zaire, 1966 (mimeographed).

years, but cassava yields a good harvest even in the dry, sandy soils where other food crops cannot be grown.[5]

Cassava is often grown in association with other crops. Hand tools are used without fertilizers or pesticides. Local varieties are used. In the equatorial region, cassava is mostly grown with foodcrops such as maize, rice, and plantains. In the tropical regions, such as Bas-Zaïre, it is cultivated in association with beans. The advantage of mixed cropping is considerable: it increases farmers' incomes and lowers infestation by weeds.

One special feature of the production of cassava in Zaire is that it is mostly a woman's crop. In the forest area, land preparation is performed by adult male members of the household, while in the savannah, both adult male and female members contribute to land preparation. Like other food crops, cassava is planted and weeded primarily by female members of the household, with substantial help from male members, however. Harvesting, transportation, processing, and marketing of cassava are almost entirely performed by female members of the household. In all, the contribution of female labor to cassava production is large.[6] The design of cassava-related policies will definitely have a strong impact on both employment and income of peasant women.

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[5]M. Naku, "Phytotechnie Générale," Institut Facultaire des Sciences Agronomiques, Yangambi, Zaire, 1982 (mimeographed).

[6]Tshikala B. Tshibaka, "Food Production in a Land Surplus, Low Labor Productivity Economy: The Zairean Basin," International Food Policy Research Institute, Washington, D.C., 1988 (mimeographed).

3. ECONOMIC POTENTIAL AND NUTRITIONAL VALUE OF CASSAVA

In a number of Sub-Saharan countries--Zaire, Congo, Gabon, Cameroon, Central African Republic, Guinea, Liberia, and Sierra Leone--cassava is not only a root crop but also an important vegetable. An appraisal of cassava's potential in these countries has to include the production of both roots and leaves. These two cassava products give the total picture of the potential food output and income a smallholder farmer can derive from cassava. Such an approach can help policymakers, the donor community, and researchers to give cassava its proper place in the food sector in the Sub-Saharan region and accordingly its due attention in the food policy research agenda.

In this connection, this chapter assesses the position of cassava in smallholder agriculture in the Zairean Basin. In other words, cassava is compared with other major food crops produced in the area. To this end, the following variables are considered: diffusion of the crop in the area, resource requirements and productivity, returns to labor and capital inputs, and nutritional value. From this analysis, some policy recommendations will be drawn.

The farm-level data used in this chapter are derived from a survey conducted in one area of the Zairean Basin, a forest zone in the humid tropics.[7] The main food crops produced in the area include cassava, rice, maize, and plantains. These crops are grown under a mixed cropping system by smallholder farmers.

DEGREE OF DIFFUSION

Cassava is the most widely grown and the most important food crop in the peasant agriculture of the Zairean Basin. Among 132 farmers surveyed during 1982/83, 97 percent had cassava in their crop mix, 62 percent had maize, 61 percent had rice, and 39 percent had plantains. Cassava was grown on 44.7 percent of the cultivated area, while rice was grown on 28.6 percent, maize on 21.4 percent, and plantains on only 5.3 percent.

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[7]For details on data source and limitations, see Tshibaka, "Food Production."

RESOURCE REQUIREMENTS, PRODUCTIVITIES, AND RETURNS

Research conducted in the Zairean Basin and elsewhere in the country indicates that 5 metric tons of edible cassava leaves per hectare can be produced under a peasant farming system without adversely affecting root output. It estimates that the harvesting of this quantity of cassava leaves would require an average of 229 man-hours of work per hectare and little or no capital input.[8]

Combining these findings with the farm survey input data on the production of cassava roots, rice, maize, and plantains, the estimates of labor and capital requirements per hectare of each crop are derived (Table 1). The data show that the production of cassava roots and leaves, like that of rice, is a labor-intensive activity.

Table 1--Labor and capital requirements in the Zairean Basin, by crop

Crop	Labor Requirement	Capital Requirement
	(man-hours/hectare)	(Z/hectare)
Cassava (roots and leaves)	1,388	117.14
Rice (paddy)	1,547	215.58
Maize (grain)	921	119.21
Plantains (in bundles)	525	34.25

Sources: Tshikala B. Tshibaka, "Food Production in a Land Surplus, Low Labor Productivity Economy: The Zairean Basin", International Food Policy Research Institute, Washington, D.C., 1988 (mimeographed); and Tshikala B. Tshibaka and M. M. Kalala, "Exploitation Rationnelle d'un Champs de Manioc," Institut Facultaire des Sciences Agronomiques, Yangambi, Zaire, 1983 (mimeographed).

Taking the amount of labor per hectare allocated to the production of plantains as a numeraire, the survey data indicate that cassava (roots and leaves) requires 2.6 times the labor input per

[8]Tshikala B. Tshibaka and M. M. Kalala, "Exploitation Rationelle d'un Champs de Manioc," Institut Facultaire des Sciences Agronomiques, Yangambi, Zaire, 1983 (mimeographed).

hectare of plantains, while rice requires 2.9 times and maize requires 1.8 times.

As for capital, cassava and maize have practically the same capital intensity. These crops are second to rice whose production turns out to be the most capital-intensive. Cassava requires 3.4 times the capital input per hectare of plantains, whereas rice and maize claim 6.3 and 3.5 times more capital per hectare, respectively. In sum, in resource requirements (labor and capital), cassava is second to rice in the Zairean Basin.

The productivities of resources, expressed as average products of inputs, in the production of cassava (roots and leaves), rice, maize, and plantain are reported in Table 2. From these data, it is clear that, in physical terms, cassava is the most productive of all. It is followed by plantains while maize and rice are last.

Table 2--Productivities of resources in the Zairean Basin, by crop

Crop	Yield	Average Product of Labor	Average Product of Capital
	(kilograms/ hectare)	(kilograms/ man-hour)	(kilograms/Z)
Cassava (roots and leaves)	8,592.90	6.19	73.36
Rice	901.83	0.58	4.18
Maize	1,121.42	1.22	9.41
Plantains	1,665.00	3.17	48.61

Sources: Tshikala B. Tshibaka, "Food Production in a Land Surplus, Low Labor Productivity Economy: The Zairean Basin," International Food Policy Research Institute, Washington, D.C., 1988 (mimeographed); and Tshikala B. Tshibaka and M. M. Kalala, "Exploitation Rationnelle d'un Champs de Manioc," Institut Facultaire des Sciences Agronomiques, Yangambi, Zaire, 1983 (mimeographed).

Notes: The figures in the table are given in cereal equivalents. The conversion factors used to convert crop output were 1.000 for cereals, 0.303 for fresh cassava roots, 0.184 for cassava leaves, and 0.220 for plantains.

To give a complete picture of the potential of cassava to add to household income, the returns to labor and capital inputs as well as the benefit-cost ratio are computed. These parameters are estimated from producer and input price data recorded during the 1982/83 year in the surveyed area. The average producer prices for cassava roots and leaves were Z 0.97 and Z 0.50 per kilogram, respectively, while average paddy rice and plantain producer prices were Z 3.71 and Z 1.29 per kilogram respectively.[9]

Since most maize in the study area is used for the production of a local alcoholic beverage, the value of the average product of maize in the production of this drink, which amounted to Z 10.59 per kilogram during the 1982/83 year, is considered to be the implicit producer price of maize. The average product of maize from the production of the drink is about 1.05 liters per kilogram of maize, and the average price was Z 10.09 per liter. The minimum wage rate that prevailed during the survey was Z 0.50 per man-hour per year. The rate of interest on agricultural credit was 12 percent per year.

On the basis of the price and input/output data reported in Tables 1 and 2, the returns to labor and capital inputs, including the benefit-cost ratio, are computed. Table 3 shows that cassava and plantain are potentially the most profitable crops. This result confirms the singular importance of cassava in the production mix in the Zairean Basin.

CONTRIBUTION OF CASSAVA TO NUTRITION

One of the main concerns about cassava is its low nutritional value, particularly because it contains cyanide and the nutrient content of its roots is low. If properly conducted, the current processing methods used in Zaire help to reduce the cyanide content of cassava to a harmless level. As for nutrients, Table 4 shows that when the leaves and roots are both consumed, the content of various food nutrients including proteins improves significantly. Table 4 also shows that dried cassava is a major source of calcium, iron, and phosphorus as well as of some vitamins including vitamin A, riboflavin, niacin, and folic acid (see also the Appendix, Table 17).

In nutrient output per unit of input, Table 5 shows that cassava is the most productive and hence the cheapest source of food crop nutrients. One hectare of cassava generates about 12 times the energy of rice, 9 times the energy of maize, and 7 times that of plantains. Cassava roots and leaves produce nearly 3.0 times the protein of rice, 2.5 times that of maize, and 7.5 times that of plantains per

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[9]The currency of the country is also called the zaire (Z). US$1.00 was equal to Z 5.75 in 1982.

hectare of cultivated land. In addition, the mineral and vitamin outputs from one hectare of cassava are much higher than those for rice, maize, and plantains. It is evident that this analysis could have serious implications for the poor in terms of food consumption and nutrition.

Table 3--Returns to labor and capital and the profit margin

Resources and Output	Cassava	Rice	Maize	Plantain
Labor				
Labor time (man-hours/hectare)	1,388.00	1,547.00	921.00	525.00
Cost of labor (Z/hectare)	694.00	773.50	460.50	262.50
Capital (Z/hectare)				
Value of tools and seed	117.14	215.58	119.21	34.25
Implicit financial charge	14.06	25.87	14.31	4.11
Cost of capital	131.20	241.45	133.52	38.36
Total cost of production (Z/hectare)	825.20	1,014.95	594.02	300.86
Output				
Volume of output (kilogram of cereal equivalent)	8,592.90	901.83	1,121.42	1,665.00
Value of output (Z/hectare)	27,063.41	5,576.32	11,875.84	9,762.95
Returns				
Labor (Z/man-hour)	19.40	3.45	12.75	18.52
Capital	200.99	19.89	85.50	247.67
Profit margin				
Net benefit (Z/hectare)	26,238.21	4,561.37	11,281.82	9,462.09
Benefit-cost ratio (Z/Z)	31.80	4.49	18.99	31.45

Sources: Tshikala B. Tshibaka, "Food Production in a Land Surplus, Low Labor Productivity Economy: The Zairean Basin," International Food Policy Research Institute, Washington, D.C. 1988 (mimeographed); and Tshikala B. Tshibaka and M. M. Kalaia, "Exploitation Rationnelle d'un Champs de Manioc," Institut Facultaire des Sciences Agronomiques, Yangambi, Zaire, 1983 (mimeographed).

Table 4--Nutrient composition of 100 grams of edible portion of foods in dry weight

Nutrient	Unit	Cassava			Rice (Milled)	Maize (Grains)	Plaintain (Edible)
		Roots	Leaves	Roots and Leaves			
Calories	calories	401.91	349.32	751.23	399.55	406.35	354.75
Protein	grams	2.39	3.42	5.82	10.33	10.10	2.23
Fat	grams	0.48	5.14	5.62	0.68	5.22	0.84
Carbohydrates	grams	94.74	83.90	178.64	86.27	82.86	94.41
Fiber	grams	2.87	6.22	11.09	1.02	2.16	1.96
Ash	grams	2.39	7.53	9.93	0.91	1.70	2.51
Calcium	grams	229.67	938.36	1,168.02	77.19	7.38	27.93
Phosphorus	milligrams	50.24	359.59	409.83	272.42	239.50	106.15
Iron	milligrams	10.05	58.22	68.27	2.27	4.31	3.91
Vitamin A	international units	7.18	109.59	116.77	0.00	40.86	544.69
Thiamine	milligrams	0.14	0.27	0.42	0.48	0.45	0.14
Riboflavin	milligrams	0.07	0.72	0.79	0.09	0.11	0.11
Niacin	milligrams	1.44	4.45	5.89	5.90	1.82	1.96
Folic acid	milligrams	90.91	849.32	940.22	0.00	5.11	69.83

Sources: Computed from V. A. De Groote, "Table de Composition Alimentaire de la République du Congo," Office National de Recherche et de Développement, Kinshasa, Zaire, 1970.

Table 5--Food nutrient output per hectare

Nutrient	Unit	Cassava			Rice (Milled)	Maize (Grains)	Plantains (Edible)
		Roots	Leaves	Roots and Leaves			
Calories	calories	32,757,967	5,100,000	37,857,967	3,174,442	4,014,612	5,190,274
Water	grams	11,348,296	3,540,000	14,888,296	116,336	133,447	2,623,745
Protein	grams	194,988	50,000	244,988	82,067	99,805	32,695
Fat	grams	38,988	75,000	113,998	5,411	51,584	12,260
Carbohydrates	grams	7,721,521	1,225,000	8,946,521	685,391	818,622	1,381,349
Fiber	grams	233,985	120,000	353,985	8,116	21,307	28,608
Ash	grams	194,988	110,000	304,988	7,215	16,821	36,781
Calcium	grams	18,718,838	13,700,000	32,418,838	613,244	72,891	408,683
Phosphorus	milligrams	4,094,746	5,250,000	9,344,746	2,164,392	2,366,154	1,552,995
Iron	milligrams	818,949	850,000	1,668,949	18,037	42,613	57,216
Vitamin A	international units	584,964	1,600,000	2,184,964	0	403,704	7,969,319
Thiamine	milligrams	11,699	4,000	15,699	3,788	4,486	2,043
Riboflavin	milligrams	5,850	10,500	16,350	721	1,121	1,635
Niacin	milligrams	116,993	65,000	181,993	46,895	17,942	28,608
Folic acid	milligrams	7,409,540	12,400,000	19,809,540	0	50,463	1,021,708

Sources: Computed from data in Tshikala B. Tshibaka, "Food Production in a Land Surplus, Low Labor Productivity Economy: The Zairean Basin," International Food Policy Research Institute, Washington, D.C., 1988 (mimeographed); and V. A. De Groote, "Table de Composition Alimentaire de la République du Congo," Office National de Recherche et de Développement, Kinshasa, Zaire, 1970.

Note: The output per hectare of the individual crops was converted into edible parts using the following conversion factors: 0.77 for cassava roots, 1.00 for cassava leaves, 0.60 for paddy rice (assuming that a traditional method of processing was used), and 0.54 for plantains.

4. CASSAVA IN THE FOOD SECTOR

In the mid-1980s, cultivated area in Zaire was about 2.5 percent of the geographical area of the country. Cassava occupied 30 percent of the cultivated area, followed by maize with 12 percent and groundnuts with 7 percent.[10] Historical data show that cassava remains the biggest source of carbohydrates, minerals, and vitamins in the country.

Cassava's overwhelming position as a primary source of food crop nutrients in Zaire is portrayed by its share of cultivated area devoted to major carbohydrate-based food crops, its contribution to food output derived from these crops, and its contribution to total vegetable output. Table 6 shows that during the entire 1971-84 period the cultivated area allocated to cassava was continuously above 60 percent of the total area devoted to cassava, rice, and maize, the three major carbohydrate-based food commodities (also see the Appendix, Table 18). For the period as a whole, cassava production claimed 65 percent of the total area allocated to these three basic foodstuffs.

The contribution of cassava (roots and leaves) to food output derived from the three staple food crops is striking, as Table 7 shows. During the 1971-84 period, cassava output expressed in cereal equivalents represented 84.9 percent of the total output from rice, maize, and cassava together. The contribution of maize did not exceed 12.9 percent, while that of rice was 3 percent. Cassava is also the leading source of minerals and vitamins in the country. The contribution of cassava leaves to total vegetable output remained well above 65 percent during the entire 1971-84 period. In fact, the share of cassava leaves in total vegetable output for the period as a whole was 68 percent (Table 8; see also the Appendix, Table 19).

These data strongly suggest that cassava is the most important foodstuff in Zaire. Since cassava is a major source of employment, food, and income for smallholder farmers, particularly women, in most parts of the country, policies aimed at improving the production, processing, and marketing of this commodity will have important equity implications in rural Zaire.

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[10]Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa, Zaire: INS, 1984).

Table 6--Allocation of cultivated area between cassava and other major food crops in Zaire, 1971-84

Period	Cultivated Area	Cassava	Maize	Rice
(annual average)	(1,000 hectares)		(percent)	
1971-75	2,502.4	64.3	25.5	10.2
1976-80	2,767.8	64.4	25.6	10.1
1981-84	3,192.0	65.8	24.3	9.9
1971-84	2,794.1	64.8	25.1	10.1

Sources: Computed from data in Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); and Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse de Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, 1986).

Table 7--Contribution of cassava to major staple food crop output, 1971-84

Period	Total Staple Food Crops in Cereal Equivalents	Share of Main Staple Food Crop Output		
		Cassava Roots and Leaves	Maize	Rice
(annual average)	(1,000 metric tons)		(percent)	
1971-75	3,949.9	85.3	11.7	3.0
1976-80	4,413.2	85.2	11.8	2.9
1981-84	5,216.1	84.1	12.9	3.0
1971-84	4,477.1	84.9	12.1	3.0

Source: Computed from data in Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); and Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, 1986).

Table 8--Contribution of cassava leaves to vegetable output, 1971-84

Period	Total Vegetable Output	Cassava Leaves Output	Cassava Leaves Share of Total
(annual average)	(1,000 metric tons)		(percent)
1971-75	443.0	301.4	68.0
1976-80	504.7	334.1	66.2
1981-84	547.0	379.2	69.3
1971-84	494.8	335.3	67.8

Sources: Computed from data in Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); and Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, 1986).

REGIONAL DISTRIBUTION OF CASSAVA IN ZAIRE

Although the production of cassava remains important throughout the country, its relative importance varies substantially between regions. In absolute terms, the data reported in Table 9 show that Kivu, followed in a decreasing order by Bandundu, Shaba, and Kasai Occidental, allocated more land to cassava and had a higher output of cassava roots during the 1981-83 period than the other regions did (see Appendix, Table 20). But when the area under cassava in each region is related to the geographical area of the region and cassava output is related to the population of the same region, a different picture emerges (see the Appendix, Table 21). This picture gives the weight of cassava in the food sector in the region, a useful piece of information for regional planning and policies.

In this connection Table 9 shows that the degree of regional diffusion of cassava, measured by the amount of land allocated to cassava production per square kilometer of the geographical area of the region, varies widely between regions. Cassava occupies more land per square kilometer of geographical area in the Kinshasa metropolitan area than in any other region of the country. The overriding position of cassava in the food sector in Kinshasa region is ascribed to the fact that the crop is primarily cultivated to provide the bulk of vegetables consumed in Kinshasa. Bas-Zaire region takes the second position. It is followed by Kasai Occidental, Kasai Oriental, and Kivu.

Table 9--Distribution of cassava area, output, and output per capita, by region, 1981-83

Region	Distribution of Area Under Cassava	Contribution to Cassava Root Output	Area Allocated to Cassava	Per Capita Cassava Root Output in Cereal Equivalents
	(percent)		(hectares/ square kilometer)	(kilograms)
Kinshasa	4.00	3.10	7.94	57.12
Bas-Zaire	6.00	4.60	2.20	121.72
Bandundu	15.99	16.80	1.07	203.42
Equateur	10.20	10.30	0.50	150.52
Haut-Zaire	11.10	11.50	0.44	128.25
Kivu	16.70	17.10	1.29	161.05
Shaba	13.53	13.00	0.54	153.04
Kasai Occidental	12.40	13.00	1.56	289.96
Kasai Oriental	10.10	10.60	1.19	236.43
Zaire	100.00	100.00	0.85	162.99

Sources: Computed from data in Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, 1986).

In output per capita, Table 9 indicates that Kasai Occidental, followed in a decreasing order by Kasai Oriental and Bandundu, produced more than 163 kilograms of roots per capita (expressed in cereal equivalents), the national average, during the 1981-83 period. This variable gives the weight of cassava in food consumption and security in these regions. In this regard, cassava seems to be less important in Bas-Zaire, Haut-Zaire, Equateur, Shaba, and Kivu. One should recall that the Kinshasa region does not produce most of its food but depends on other regions of the country and world food markets.

CASSAVA RESEARCH AND EXTENSION

Recognizing the crucial importance of cassava in the food basket of most Zaireans, the government of Zaire created the Cassava National Program (Programme National Manioc, PRONAM) in 1974 to conduct

research on cassava with the help of the International Institute of Tropical Agriculture (IITA), whose headquarters are located in Ibadan, Nigeria.[11] However, one should stress that this recognition was prompted by a widespread bacterial blight that destroyed cassava production across the country earlier in the 1970s. Cassava still faces a number of diseases and pests. These natural enemies represent a serious constraint to the expansion of cassava production in the country. The principal diseases and pests are given by region in Table 10.

Table 10--Principal cassava diseases and pests in selected regions

Region	Bacterial Blight	Mosaic Disease	Anthracnose Disease	Mealy Bug	Green Spider
Bandundu	x	x	x	x	x
Bas-Zaire	x	x	x	x	x
Equateur	x	x	x	...	...
Kasai (Occidental and Oriental)	x	x	x	...	x
Kinshasa	x	x	x	x	...
Kivu	x	x	x	...	...

Sources: G. J. Persely, et al., Cassava Bacterial Blight (Ibadan, Nigeria: International Institute of Tropical Agriculture, 1976).

The objectives of PRONAM are to identify and develop cassava varieties with high yield potential and resistance to major diseases and pests; to develop a package of cultural practices that will allow yields to reach economic optimum; and to train young Zaireans to work on cassava research. The significant achievements of PRONAM include the improved variety 5097, which is resistant to diseases, pests, and insects, and identification of local clones "Kinuani" and "Mpelolongi" cultivated in Bas-Zaire, and of varieties F100 and F162, which have a high yield potential, in Bandundu. Owing to a lack of adequate extension, these varieties had not spread widely in the country.

[11]Zaire, Programme National Manioc, Rapport Annuel (Myuazi, Zaire: PRONAM, 1975).

In addition to research and training, efforts have also been started to introduce high-yielding varieties of cassava, fertilizers, pesticides, and improved agricultural techniques among peasant farmers. In 1970, the Fertilizer National Program (PNE) was established with the technical and financial assistance of the Food and Agriculture Organization of the United Nations (FAO) to handle the diffusion of fertilizers, other agricultural inputs, and improved agricultural practices through trials and demonstrations among farmers.[12] With the help of these programs, a few peasant farmers have increased yields to 20 tons of fresh cassava roots per hectare.

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[12]Zaire, Programme National Engrais, Rapport Annuel (Kinshasa: PNE, 1972).

5. PROCESSING, MARKETING, AND UTILIZATION OF CASSAVA

Cassava roots are processed by several traditional methods because the use of cassava and the food consumption habits differ among the regions of the country. In the rural areas of Zaire, the main processed product is cossettes (dry roots), which are converted into flour. The methods of processing vary, and the quality of the end product depends upon the technique adopted. The different techniques adopted are briefly described below.[13]

In one method the roots are peeled and soaked in water for two to four days. The retting time varies with the water temperature. This fermentation process eliminates cyanide from the roots. When the roots are soft, yet still firm, they are dried in the sun after they are cut into thin slices.

The initial steps of a second method are the same as in the first, but the fermented roots are not cut into slices and are not dried in the sun, but over fire. The roots are spread on a grill above the fire. This process is common in Bandundu and Haut-Zaire. The product of this process has a smoky odor, which is liked by some people and disliked by others. The black thin layer is removed before the dried roots are powdered into flour. This process constitutes an additional burden on the woman. In some areas where this process is adopted, the thin black layer is not wasted, but is used to make alcohol when mixed with germinated maize.

In a third method, the nonpeeled roots are steeped in water. After fermentation, only the external thin layer is removed and the skin (peel) is kept on the root. The drying is done over fire. The cossettes obtained by this process last longer than those obtained from tubers that are peeled before retting. A major problem with this method is that the skin adheres closely to the cossettes and is difficult to remove before the cossettes are ground.

In a fourth method, the roots are peeled and dried without going through the retting process. One of the advantages of this method is that the cossettes last longer. They can be kept for six months

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[13] M. Nkiere, "Contribution à l'Etude Agro-économique de la Culture du Manioc au Zaire," Institut Facultaire des Sciences Agronomiques, Yangambi, Zaire, 1974 (mimeographed); and A. Bazi, "Contribution à l'Etude du Remissage et d'Extraction d'Amidon du Manioc," Faculté d'Agronomie, Yangambi, Zaire, 1983 (mimeographed).

without rotting. Because of their density they undergo fewer attacks by insects. These cossettes dry well in the sun. In the rainy season, when sun-drying becomes difficult, some molds develop on them, depreciating their quality.

Cassava can also be converted into cossettes before drying. The Bambala people of the Bandundu region crush the retted roots before they are dried. The paste thus obtained is converted into small lumps about the size of the fist, which are then dried. In this case, the drying process is faster, the grinding process is easier, and the flour is lighter in color. But this process is not widely used because it requires additional labor to crush the pulp.

DIFFERENT FORMS OF CONSUMPTION OF CASSAVA

Cassava Roots

Fresh cassava roots are mainly transformed into cossettes and cassava bread (chickwangue). Cossettes are converted into flour before final consumption. After grinding (which is often done with a mortar and pestle in the villages and at a mill in the urban areas), the flour is mixed with boiling water and is served with other foods. Certain tribes in Kasai and Bandundu mix cassava flour with maize flour in proportions varying between 60:40 and 50:50 to prepare "fufu," also known as "bidia" or "nshima." The addition of maize enriches the protein content of fufu.

Chickwangue is the most common form in which cassava is consumed in Zaire. Preparation of chickwangue varies from region to region and in different seasons. Peeled or unpeeled roots are crushed after retting and kneaded into a paste according to the type of chickwangue desired. The paste is then divided into lumps that are wrapped in banana leaves or wild leaves, and boiled until well done. The odor, taste, and texture of chickwangue vary considerably. The taste varies from sweet to pungent. Chickwangue usually cannot be kept for more than five days, after which it hardens and starts to rot.

Fresh cassava roots are also consumed in other forms, such as boiled or grilled cassava, and in different combinations of cassava and maize or boiled bananas.

Cassava Leaves

Cassava leaves are also used extensively as vegetables in the country. They are the most important vegetable and a major source of different food nutrients (Table 8).

Efforts in this direction would stabilize prices and promote the consumption and the production of cassava in the country.

UTILIZATION OF CASSAVA

Reliable national data on the utilization of cassava for food and other purposes are not available. It is widely believed that 90 to 95 percent of cassava roots are consumed as food, and that the balance is made up of feed, industrial raw materials, and illegal exports to neighboring countries. This estimate does not provide for any allowance for wastage. On the other hand, estimates by FAO put domestic food use at 79 percent and feed use at 1 percent, with the balance representing waste and other uses of cassava roots. As for cassava leaves, their utilization is primarily limited to human consumption. Cassava leaves are also used in negligible amounts as feed, mostly for pigs and are also exported to neighboring countries. However, no estimates of the uses of cassava leaves have been made.

Cassava leaves are boiled before eating. The most common method of preparation involves the following steps. The leaves are soaked in warm water for not more than five minutes. After water is squeezed out, the leaves are pounded. Palm oil, salt, onions, and sometimes pepper, dry, smoked, or salted fish, and eggplant are also added to improve the taste and to produce a much richer menu. This mixture is then boiled until well done, and served with fufu or rice.

MARKETING OF CASSAVA PRODUCTS

The distribution, marketing, and pricing of cassava products have never been controlled by the Zairean government. The demand and supply of cassava products were and continue to be regulated by domestic market forces. Other root crops, tubers, and plantains were and continue to be under the same policy regime as cassava. But crops such as rice, maize, groundnuts, cotton, coffee, tea, palm oil, and cocoa were subject to government control until September 1983, when the prices of all the agricultural commodities were liberalized, and the restrictions imposed on domestic regional trade were lifted.[14]

The distribution and marketing of cassava products is carried out by a large number of small transporters and petty traders, most of whom are women. The number of marketing functions carried out by these traders and the size of the domestic market in terms of geographical coverage depend on the nature of the cassava product being marketed and the state of infrastructure. In Zaire, the cassava products most often offered for sale are fresh roots, dry roots, chickwangue, and leaves.

Because the infrastructure, such as roads and other transportation facilities, is inadequate in most of the country, leaves, fresh roots, and chickwangue have a limited marketing area. Being the most perishable, they are generally sold in rural markets. When the infrastructure is adequate, these cassava products can be carried over a longer distance. Kinshasa, the largest consuming region in the country, receives the bulk of its fresh cassava roots, leaves, and chickwangue from Bas-Zaire. These two regions are relatively well connected. When the road network is poor, dry cassava roots become the cassava product that flows in the largest quantities between the producing and consuming areas.

The above description implicitly portrays the critical role of infrastructure in the distribution and marketing of cassava products. It also points to the need to promote the processing of cassava into products that can be stored and marketed over long periods of time.

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[14] T. B. Tshibaka, The Effects of Trade and Exchange Rate Policies on Agriculture in Zaire.

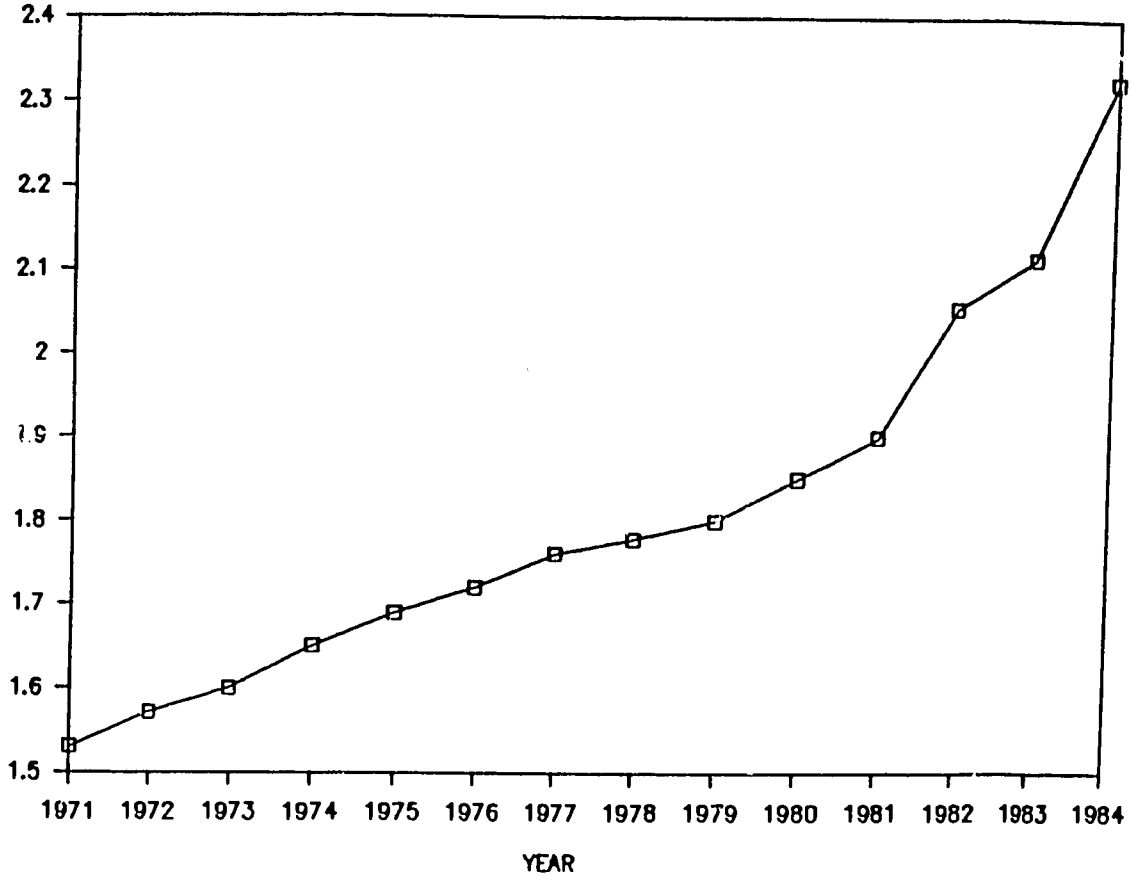
6. PRODUCTION AND CONSUMPTION OF CASSAVA: SITUATION AND PROJECTIONS

TRENDS IN AREA, YIELD, AND PRODUCTION

The area under cassava in Zaire increased rapidly from less than 1.6 million hectares in the early 1970s to 2.3 million hectares in the early 1980s (Figure 1). This expansion of area proceeded at an annual average rate of 3.3 percent during the 1971-84 period. Most of the increase in area under cassava occurred during the 1981-84 subperiod when the annual growth rate was as high as 5.9 percent (Table 11).

Figure 1--Area under cassava, 1971-84

(million hectares)



Source: Computed from data in Table 18.

Table 11--Area, yield, and production of fresh cassava roots and leaves, 1971-84

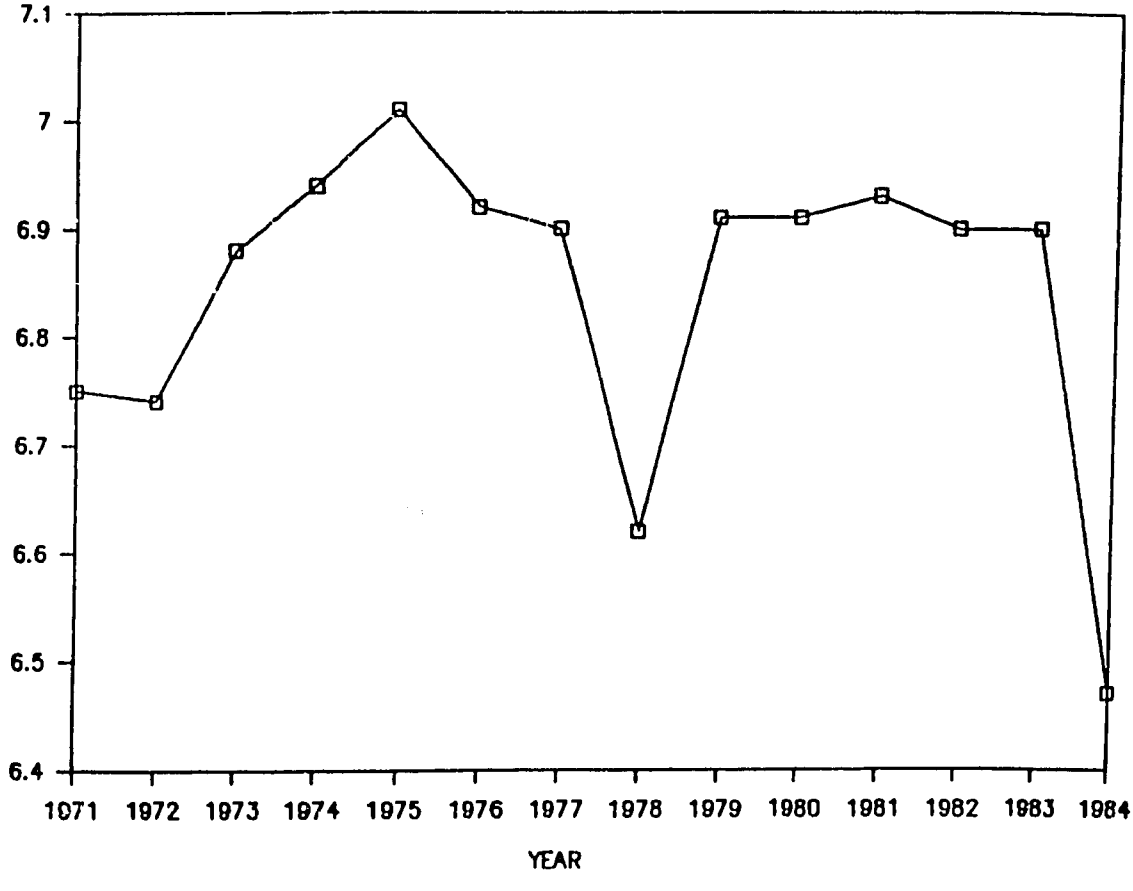
Period	Area	Annual Average				Average Annual Growth Rate				
		Roots		Leaves			Roots		Leaves	
		Yield	Output	Yield	Output	Area	Yield	Output	Yield	Output
	(1,000 hectares	(metric tons/ hectare)	(1,000 metric tons)	(metric tons/ hectare)	(1,000 metric tons)	(percent)				
1971-75	1,608.02	6.86	11,044.4	0.19	301.4	2.52	0.95	3.49	0.72	3.26
1976-80	1,781.6	6.85	12,207.7	0.19	334.1	1.83	-0.25	1.57	0.50	2.34
1981-84	2,098.8	6.80	14,245.7	0.18	379.2	5.93	-1.59	4.17	-3.22	2.42
1971-84	1,810.3	6.84	12,374.5	0.19	335.3	3.30	-0.29	2.96	-0.58	2.65

Sources: Computed from data in Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, Synthèse des Statistiques Agricoles, (Kinshasa: Département de l'Agriculture et de Développement Rural, 1986).

For fresh cassava roots, the available historical data reveal that the all-Zaire cassava roots yield is lower than in other major cassava-producing countries, namely Brazil, Thailand, India, and China. The average yield was only 6.8 tons of fresh roots per hectare during the 1971-84 period. In all, it exhibited a slightly declining trend (Figure 2). The average rate of decline was about 0.3 percent a year during the period. Three distinct phases can be identified. During the 1971-75 subperiod, cassava yield increased at an annual rate of 1.0 percent. During the 1976-80 subperiod, this rate became negative and the cassava yield declined at an annual rate of 0.3 percent. During the 1981-84 subperiod, the rate of change in yield became substantially negative, and cassava yield fell at an annual rate of 1.6 percent.

Figure 2--Yield of fresh cassava roots in Zaire, 1971-84

(tons of fresh roots/
hectare)

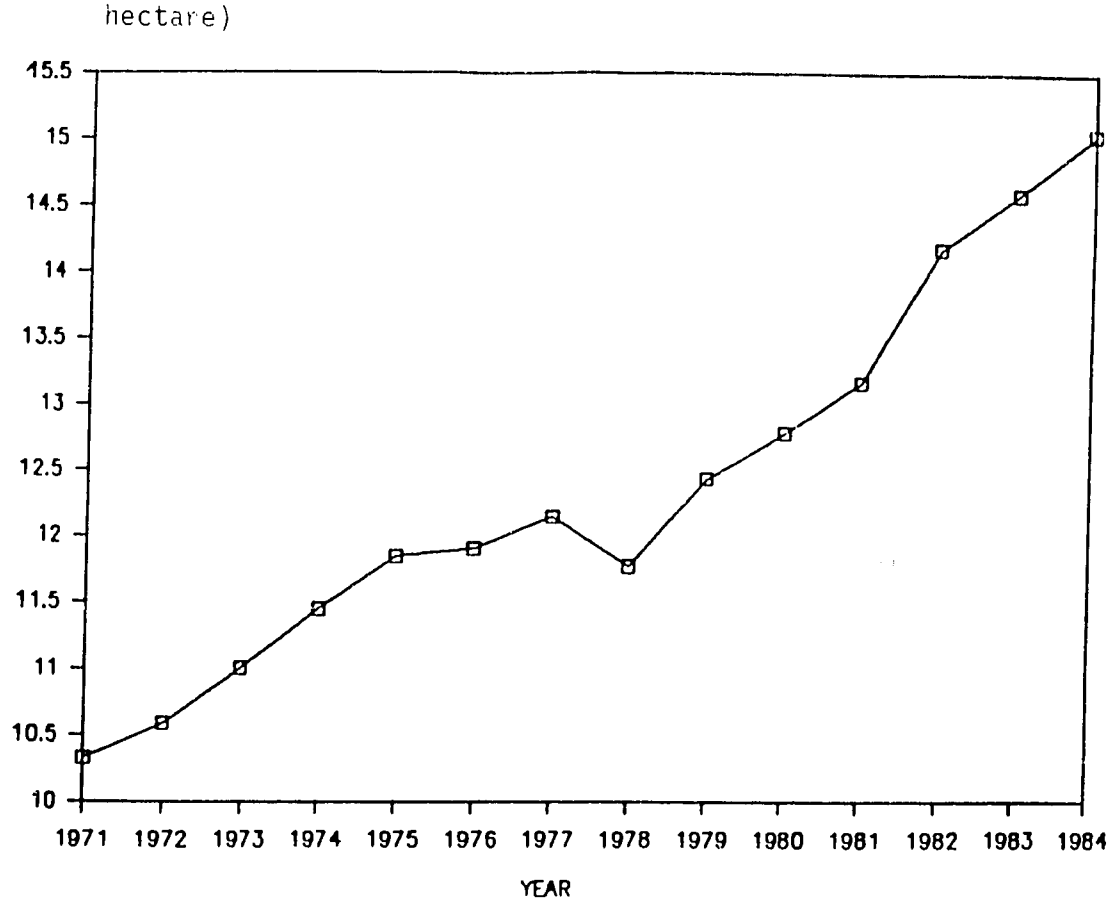


Source: Computed from data in Table 18.

The decline in yield of cassava roots observed during the last two subperiods is largely associated with the outbreak of cassava bacterial blight in many parts of the country, which prompted the creation of PRONAM. It is unfortunate that efforts to promote widespread use of high-yielding cassava varieties, other yield-enhancing technologies, and the improved agricultural practices developed by this program and other research stations in the country have remained largely inadequate.

As for output, the production of fresh roots grew at an annual rate of 3.0 percent during the 1971-84 period. Most of the increase in root production occurred during the 1981-84 subperiod when the annual average growth rate was as high as 4.2 percent (Figure 3, Table 11, and for per capita output, the Appendix, Table 21). It is also important to note that, with an average annual production of 14.2 million tons of fresh roots during 1981-84, Zaire is the largest cassava-producing country in Africa, and the third largest in the world after Brazil and Thailand.

Figure 3--Production of cassava roots in Zaire, 1971-84



Source: Computed from data in Table 18.

With respect to cassava leaves, the yield of this cassava product declined at an average annual rate of 0.6 percent during the period under study. The combination of changes in yield and in area caused the output of cassava leaves to grow at an average annual rate of 2.7 percent during the same period.

A comparison of area and yield data reveals that the change in area has been the only source of growth in cassava output in the country. This is a strong indication of the type of food policies adopted in Zaire during the period. The role of yield-increasing technologies in the production system was not properly perceived by the policymakers.

PROJECTED SUPPLY OF CASSAVA

One of the main concerns of this study is to project, on the basis of past trends, the supply-demand situation for cassava in Zaire in the year 2000. This exercise is based on a number of assumptions. First, it is expected that cassava (roots and leaves) will continue to be a major source of carbohydrates, minerals, and vitamins. Second, the population growth rate in Zaire is expected to remain the same through the year 2000. Third and finally, it is expected that the existing shortages in cereals are likely to continue in the next 10 to 15 years, as technological progress and policy reforms are slow to come.[15]

Under this set of assumptions, it is expected that the change in area under cassava will continue to be the main source of growth in cassava output, and that the trend rate of growth of area under cassava, 2.8 percent a year, will continue up to the year 2000. As for yield, no significant increase in the all-Zaire yield by the year 2000 is expected, since a widespread use of high-yielding cassava varieties, fertilizers, pesticides, and other technical innovations is not foreseen. The resultant projections of area, yield, and production of cassava are given in Table 12.

TRENDS IN PER CAPITA CONSUMPTION OF CASSAVA

Figure 4 shows that the per capita consumption of cassava (roots and leaves) declined during the 1971-84 period. A close look at this figure shows that the per capita consumption of cassava went through three distincts subperiods (see Table 13: and the Appendix, Table 22).

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[15]Zaire, Institut National des Statistiques, Annuaire Statistique.

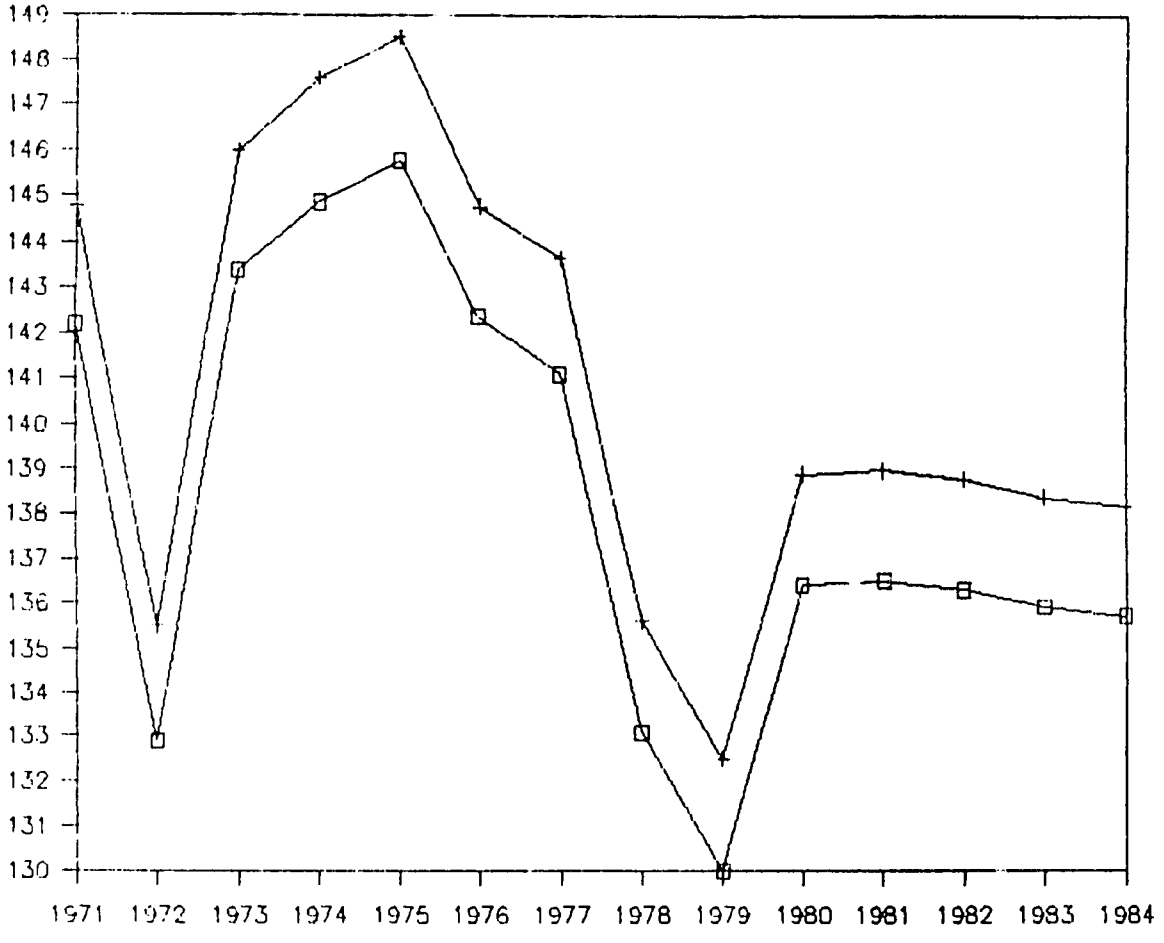
Table 12 - Area, yield, and production of cassava projected to 1990 and 2000, using trend values to 1984

Year	Area	Yield		Output		
		Fresh Roots	Leaves	Fresh Roots	Leaves	Roots and Leaves in Cereal Equivalents
	(1,000 hectares)	(metric tons)		(1,000 metric tons)		
1984	2,151.05	6.80	0.18	14,627.14	392.47	4,504.24
1990	2,538.17	6.77	0.18	17,183.41	456.13	5,290.50
2000	3,344.30	6.71	0.18	22,440.25	585.99	6,907.22

Source: Computed from United Nations, World Population Prospects (New York: UN, 1986); Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, 1969-77) and Banque du Zaire, Rapport Annuel 1975, 1986) (Kinshasa: Banque du Zaire, 1975); and Banque du Zaire, Rapport Annuel 1986 (Kinshasa: Banque du Zaire, 1986).

Figure 4--Per capita consumption of cassava, 1971-84

Kilograms/Year



Source: Computed from data in Table 22.

Table 13--Per capita consumption of cassava roots and leaves and growth rates, 1971-84

Period	Roots		Leaves		Roots and Leaves	
	Per Capita Consumption	Growth Rate	Per Capita Consumption	Growth Rate	Per Capita Consumption	Growth Rate
	(kilogram/ year)	(percent/ (year)	(kilogram year)	(percent year)	(kilogram/ year)	(percent/ year)
1971-75	141.8	0.76	2.6	0.41	144.4	0.75
1976-80	136.6	-1.27	2.5	-0.55	139.1	-1.26
1981-84	136.1	-0.13	2.5	-0.53	138.6	-0.14
1971-84	138.3	-0.29	2.5	-0.25	140.9	-0.29

Sources: United Nations, World Population Prospects (New York: UN, 1986); and Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: Institut National des Statistiques, various years).

The 1971-75 subperiod was marked by a positive rate of growth in the per capita consumption of cassava products. During the 1976-80 subperiod, the per capita growth rate was negative, and during 1981-84 it declined but only negligibly at a rate of 0.1 percent per year. In sum, for the entire period, the per capita consumption of cassava decreased at an annual rate of 0.3 percent.

PROJECTED DEMAND FOR CASSAVA

In the absence of precise information on per capita consumption and the income elasticity of demand, projections for future demand can only be made with certain assumptions. The available data on consumption show that at the trend value the per capita consumption of cassava roots is declining at the annual rate of 0.4 percent and that of cassava leaves at the annual rate of 0.2 percent. The estimated demand for cassava roots and cassava leaves in 1990 and in 2000 can be estimated with two assumptions. First, that the per capita consumption will continue unchanged at the 1984 trend level. Second, that the past rates of decline for consumption of both cassava roots and leaves will continue into the future. For the population of Zaire, the projected estimates provided by the United Nations, reported in Table 14, are also considered in this study.

The 1984 trend consumption of cassava roots in cereal equivalents was 134.5 kilograms. For leaves, the 1984 trend consumption was 2.5 kilograms per capita. At this level, and taking into account the projected population, the aggregate demand for human consumption in 1990 would be 4,689,000 metric tons of roots and 86,780 tons of leaves. In 2000 it would be 6,401,000 metric tons of roots and 118,500 tons of leaves. On the other hand, if the trend decline in per capita consumption continues, projected per capita consumption in 1990 would be 131.2 kilograms of roots and 2.4 kilograms of leaves. Per capita consumption would drop further to 125.8 kilograms of roots and 2.4 kilograms of leaves, all expressed in cereal equivalents, in the year 2000. Multiplying by the projected population, the total cassava demand for direct human consumption under this assumption would be 4,572,800 metric tons of roots and 85,000 metric tons of leaves in 1990. The projected human consumption would amount to 5,986,500 tons of roots and 111,800 metric tons of leaves, all expressed in cereal equivalents, in 2000 (Table 14).

With regard to other uses, there is scope for increased use of cassava for animal feed, particularly for pigs. In addition, it is expected that wastage can be reduced through improvements in harvesting and processing techniques. It is assumed that 10 percent of cassava root output will continue to be disposed of as feed, industrial raw material, and wastage. FAO's estimate of 21 percent seems to be too high. For cassava leaves, it is assumed that 5 percent of

Table 14--Projected per capita and total human consumption of cassava projected to 1990 and 2000 using trend values to 1984 and with the declining trend continued

Roots or Leaves/Year	Per Capita Consumption 1984 Trend	Per Capita Consumption Declining Trend Continued	Total Consumption 1984 Trend	Total Consumption Declining Trend Continued
	(kilograms)		(1,000 metric tons)	
Roots				
1984	134.5	134.5	3,909.3	3,909.3
1990	134.5	131.2	4,688.5	4,572.8
2000	134.5	125.8	6,401.0	5,986.5
Leaves				
1984	2.5	2.5	72.4	72.4
1990	2.5	2.4	86.8	85.0
2000	2.5	2.4	118.5	111.8
Roots and Leaves				
1984	137.0	137.0	3,981.7	3,981.7
1990	137.0	133.7	4,775.3	4,657.8
2000	137.0	128.2	6,519.5	6,098.3

Sources: Computed from United Nations, World Population Prospects (New York: UN, 1986); Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, various years); Banque du Zaire, Rapport Annuel 1975, (Kinshasa: Banque du Zaire, 1975); and Banque du Zaire, Rapport Annuel 1986 (Kinshasa: Banque du Zaire, 1986).

Notes: All figures in this table are given in cereal equivalents.

the output will be used as feed (mostly for pigs) and wastage during the entire period being examined.

On this basis, the gross demand for cassava roots, expressed in cereal equivalents, will range from 5,093,400 metric tons to 5,209,100 metric tons in 1990. The range in 2000 will be from 6,666,400 metric

tons of roots to 7,080,900 metric tons. For cassava leaves, the range will be from 89,200 metric tons to 91,000 metric tons of cereal equivalents in 1990, while in 2000 the range will be from 117,200 metric tons to 123,900 metric tons. These estimates are summarized in Table 15.

SUPPLY-DEMAND BALANCES

Comparison of the projections of supply and demand given in Tables 12 and 15 show that there will be a deficit of 10,100 metric tons of roots and leaves, expressed in cereal equivalents, in 1990 and 297,600 metric tons in 2000 under the assumption that the 1984 trend for consumption continues. However, if the decline in per capita consumption continues, supply will exceed demand by about 107,300 metric tons of cassava (roots and leaves), expressed in cereal equivalents, in 1990 and 123,600 metric tons in 2000 (Table 16). This indicates that scope exists for encouraging more use of cassava as feed and industrial raw materials. Consideration also has to be given to the possible legal export of cassava to neighboring countries. However, if the demand for it does not develop, the increase in area assumed in the projections will not materialize. Unless alternative crops can be grown, employment and income in the smallholder agriculture in most areas of the country would be adversely affected.

Table 15--Demand for cassava in cereal equivalents projected to 1990 and 2000 using trend values to 1984 and with the declining trend continued

Roots or Leaves/Year	Human Consumption		Livestock, Industrial Use, and Wastage	Total Demand	
	1984 Trend	Declining Trend Continued		1984 Trend	Declining Trend Declining
			(1,000 metric tons)		
Roots					
1984	3,909.3	3,909.3	443.3	4,252.6	4,352.6
1990	4,688.5	4,572.8	520.6	5,209.1	5,093.4
2000	6,401.0	5,986.5	679.9	7,080.9	6,666.4
Leaves					
1984	72.4	72.4	3.6	76.0	76.0
1990	86.8	85.0	4.2	91.0	89.2
2000	118.5	118.8	5.4	123.9	117.2
Roots and leaves					
1984	3,981.7	3,981.7	446.9	4,428.6	4,428.6
1990	4,775.3	4,657.8	524.8	5,300.1	5,182.7
2000	6,519.5	6,098.3	685.3	7,204.8	6,783.6

Sources: Computed from United Nations, World Population Prospects (New York: UN, 1986); Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, various years); Banque du Zaire, Rapport Annuel 1975, (Kinshasa: Banque du Zaire, 1975); and Banque du Zaire, Rapport Annuel 1986 (Kinshasa: Banque du Zaire, 1986).

Notes: All figures in this table are given in cereal equivalents.

Table 16--Supply-demand balances for cassava roots and leaves, 1990 and 2000, using trend values to 1984 and with the declining trend continued

Year	Supply	Demand		Supply-Demand Balance	
	1984 Trend	1984 Trend	Declining Trend Continued	1984 Trend	Declining Trend Continued
	(1,000 metric tons)				
Roots					
1984	4,431.6	4,352.6	4,352.6	79.0	79.0
1990	5,206.1	5,209.2	5,093.4	-3.1	112.6
2000	6,792.7	7,080.9	6,666.4	-288.2	132.3
Leaves					
1984	72.2	76.0	76.0	-3.8	-3.8
1990	83.9	91.0	89.2	-7.1	-5.3
2000	107.8	123.9	117.2	-16.1	-9.4
Roots and leaves					
1984	4,504.2	4,428.6	4,428.6	75.6	75.6
1990	5,290.0	5,300.1	5,182.7	-10.1	107.3
2000	6,907.2	7,204.8	6,783.6	-297.6	123.6

Sources: Computed from United Nations, World Population Prospects (New York: UN, 1986); Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, various years); Banque du Zaire, Rapport Annuel 1975, (Kinshasa: Banque du Zaire, 1975); and Banque du Zaire, Rapport Annuel 1986 (Kinshasa: Banque du Zaire, 1986).

Note: All figures in this table are given in cereal equivalents.

7. IMPLICATIONS FOR AGRICULTURAL POLICY AND CONCLUSIONS

IMPLICATIONS FOR POLICY

In general, cassava does not receive adequate attention in national policy. It is, however, important that cassava not be viewed in isolation but in the context of the entire cropping system, including crop rotation and intercropping, in which the crop is grown. As cassava is cultivated mostly by small-scale farmers, increases in production and yield per hectare can be achieved through the adoption of new technology as well as through improvements in the system of harvesting, processing, storing, distributing, and marketing cassava products. The adoption of new technology by the farmers requires financial resources for purchase of improved cuttings, fertilizers, and so forth for which adequate credit and supply arrangements need to be made.

In the area of research, the government should continue its cooperation with IITA for all matters relating to the selection of varieties, the fight against different diseases, and the improvement of harvesting, processing, and storage. With regard to infrastructure, improvements in the means of transportation and communications would permit reduction of the cost of distribution of cassava and contribute to increased human consumption and to cassava's use as animal feed and as an industrial raw material.

CONCLUSIONS

Since its introduction into Zaire more than a century ago, cassava has played a major role in preventing famines in certain regions of the country. Cassava is now the most important carbohydrate-based food commodity and a leading source of minerals and vitamins. It provides more than 80 percent of the total energy produced by rice, maize, and cassava combined, the three major staple food crops in the country. Cassava (roots and leaves) is becoming an important cash crop because of the fast rate of urbanization. Farmers in some regions of the country, Bas-Zaire and Bandundu, derive most of their farm cash income from cassava.

Human consumption accounts for about 90 percent of the cassava produced in Zaire. The rest goes into animal production, industrial use, illegal exports, and waste. Figures from FAO, however, show that food use accounts for 79 percent of domestic output. Although

these estimates are not based on precise statistical information, it must be stressed that cassava will continue to be the major source of food for most Zaireans by the year 2000.

Given the current state of agricultural technology, the production of cassava can be expanded more easily than that of cereals in order to provide cheap foods of acceptable nutritional value to the poor and to meet some of the nutritional needs of the fast-growing population, at least in the short-to-medium terms.

To sum up, one has to note that despite its high potential, the expansion of cassava production, like that of plantains in the Zairean Basin, implies efforts to fully integrate the Zairean Basin into domestic food markets, to promote industries using cassava as a raw material, and to enhance the processing of cassava into products that can be easily stored and marketed over a long period of time for human and animal consumption, and for industrial use and exports.

APPENDIX: SUPPLEMENTARY TABLES

Table 17--Composition of food per 100 grams of edible portion

Nutrient	Units	Cassava		Maize (Grains)	Rice (Milled)	Plantains (Edible)
		Roots	Leaves			
Calories	calories	168.00	102.00	358.00	352.00	127.00
Water	grams	58.20	70.80	11.90	12.90	64.20
Proteins	grams	1.00	1.00	8.90	9.10	0.80
Fat	grams	0.20	1.50	4.60	0.60	0.30
Carbohydrate	grams	39.60	24.50	73.00	76.00	33.80
Fiber	grams	1.20	2.40	1.90	0.90	0.70
Ash	grams	1.00	2.20	1.50	0.80	0.90
Calcium	grams	96.00	274.00	6.50	68.00	10.00
Phosphorus	milligrams	21.00	105.00	211.00	240.00	38.00
Iron	milligrams	4.20	17.00	3.80	2.00	1.40
Vitamin A	international units	3.00	32.00	36.00	0.00	195.00
Thiamine	milligrams	0.06	0.08	0.40	0.42	0.05
Riboflavin	milligrams	0.03	0.21	0.10	0.08	0.04
Niacin	milligrams	0.60	1.30	1.60	5.20	0.70
Folic acid	milligrams	38.00	248.00	4.50	0.00	25.00

Source: V. A. De Groote, "Table de Composition Alimentaire de la République du Congo," Office National de Recherche et de Développement, Kinshasa, 1970.

Table 18--Major staple foodcrop production, 1971-84

Year	Cassava Output			Maize (Grains)				Total Cultivated Area
	Fresh Roots	Leaves	Area	Output	Area	Output	Area	
	(1,000 metric tons)		(1,000 hectares)	(1,000 metric tons)	(1,000 hectares)	(1,000 metric tons)	(1,000 hectares)	
1971	10,329.0	282.4	1,530	435.8	608	110.3	250	2,388
1972	10,014.8	289.4	1,571	451.6	617	117.7	252	2,440
1973	11,014.9	301.2	1,600	459.1	634	119.4	257	2,491
1974	11,447.4	313.0	1,650	476.8	656	120.7	261	2,567
1975	11,844.1	321.0	1,690	495.4	675	124.6	261	2,626
1976	11,909.7	300.4	1,720	503.6	702	127.6	272	2,694
1977	12,138.7	335.6	1,760	509.6	705	128.2	276	2,741
1978	11,778.9	328.5	1,778	500.8	708	120.0	278	2,764
1979	12,430.0	348.8	1,800	536.7	711	132.4	280	2,791
1980	12,784.0	357.0	1,850	562.3	714	139.9	285	2,849
1981	13,172.0	365.5	1,900	638.7	720	147.2	288	2,908
1982	14,184.5	374.6	2,055	666.3	793[a]	150.6	314[a]	3,162
1983	14,600.0	383.6	2,115	673.1	792[a]	162.8	339[a]	3,246
1984	15,037.5	392.9	2,325	704.0	800[a]	171.6	325[a]	3,450

Sources: Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); and Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, various years).

[a]These figures are from Food and Agriculture Organization of the United Nations, FAO Production Yearbook, 1983-85 (Rome: FAO, various years).

Table 19--Production of vegetables, 1971

Year	Total Vegetables	Cassava Leaves	Cassava Leaves as Share of Vegetables
	(1,000 metric tons)		(percent)
1971	400.0	282.4	70.6
1972	434.3	289.4	66.6
1973	460.3	301.2	65.4
1974	449.7	313.0	69.6
1975	470.7	321.0	68.2
1976	473.1	300.4	63.5
1977	480.6	335.6	69.8
1978	515.0	328.5	63.8
1979	524.0	348.8	66.6
1980	531.0	357.0	67.2
1981	539.0	365.5	67.8
1982	550.0	374.6	68.1
1983	562.0	383.6	68.3
1984	537.0	392.9	73.2
Annual Averages			
1971-75	443.0	301.4	68.0
1976-80	504.7	334.1	66.2
1981-84	547.0	379.2	69.3
1971-84	494.8	335.3	67.8

Sources: Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); and Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, various years).

Table 20--Distribution of cassava production, area, and yield, by region, 1981-83

Region	Total Area	Average Annual Population	Average Annual Cassava Root Output	Average Annual Area Under Cassava	Average Yield
	(square kilometers)	(millions)	(1,000 metric tons)	(1,000 hectares)	(metric tons/ hectare)
Kinshasa	9,965	2.3	433.5	79.2	5.48
Bas-Zaire	53,920	1.6	642.7	118.8	5.41
Bandundu	295,658	3.5	2,349.5	316.8	7.42
Equateur	402,293	2.9	1,440.5	201.9	7.13
Haut-Zaire	503,239	3.8	1,608.3	219.8	7.32
Kivu	256,662	4.5	2,391.5	330.7	7.23
Shaba	496,965	3.6	1,818.1	268.0	6.78
Kasai Occidental	156,967	1.9	1,818.1	245.5	7.40
Kasai Oriental	168,216	1.9	1,482.4	200.0	7.41
Zaire	2,343,885	26.0	13,984.6	1,980.6	7.06

Source: Computed from data in Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Département de l'Agriculture et de Développement Rural, 1986).

Table 21--Population and per capita cassava output, 1971

Year	Population	Per Capita Output			Growth Rate		
		Roots	Leaves	Total	Roots	Leaves	Total
		(kilogram/year)			(percent/year)		
1971	20.03	156.3	2.6	158.9			
1972	20.60	147.3	2.6	149.9	-5.72	-0.36	-5.64
1973	21.18	157.6	2.6	160.2	6.97	1.23	6.88
1974	21.78	159.3	2.6	161.9	1.06	1.05	1.06
1975	22.40	160.2	2.6	162.9	0.60	-0.28	0.59
1976	23.05	156.6	2.4	159.0	-2.28	-9.06	-2.39
1977	23.72	155.1	2.6	157.7	-0.96	8.56	-0.81
1978	24.40	146.3	2.5	148.8	-5.67	-4.84	-5.65
1979	25.11	150.0	2.6	152.6	2.54	3.18	2.55
1980	25.85	149.9	2.5	152.4	-0.10	-0.58	-0.10
1981	26.61	150.0	2.5	152.5	0.09	-0.54	0.08
1982	27.40	156.9	2.5	159.4	4.58	-0.47	4.50
1983	28.21	156.8	2.5	159.3	-0.03	-0.54	-0.03
1984	29.06	156.8	2.5	159.3	-0.02	-0.57	-0.02
Annual Averages							
1971-75	21.20	156.1	2.6	158.8	0.73	0.41	0.72
1976-80	24.43	151.6	2.5	154.1	-1.29	-0.55	-1.28
1981-84	27.82	155.1	2.5	157.6	1.16	-0.53	1.13
1971-84	24.24	154.2	2.5	156.8	0.08	-0.25	0.08

Sources: United Nations, World Population Prospects (New York: UN, 1986); Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years); Zaire, Département de l'Agriculture et de Développement Rural, Division des Statistiques Agricoles, La Synthèse des Statistiques Agricoles (Kinshasa: Départment de l'Agriculture et de Développement Rural, various years); Banque du Zaire, Rapport Annuel, 1975, (Kinshasa: Banque du Zaire, 1975); and Banque du Zaire Rapport Annuel 1986 (Kinshasa: Banque du Zaire, 1986).

Note: All figures in this table are in cereal equivalents.

Table 22--Per capita consumption of cassava roots and leaves and average annual growth rates, 1971

Year	Roots		Leaves		Roots and Leaves	
	Per Capita	Growth Rate	Per Capita	Growth Rate	Per Capita	Growth Rate
	(kilograms)	(percent/ year)	(kilograms)	(percent/ year)	(kilograms)	(percent/ year)
1971	142.2		2.6		144.8	
1972	132.9	-6.56	2.6	-0.35	135.5	-6.44
1973	143.4	7.91	2.6	1.21	146.0	7.78
1974	144.9	1.08	2.6	1.06	147.6	1.08
1975	145.8	0.62	2.6	-0.27	148.5	0.60
1976	142.4	-2.34	2.4	-9.06	144.8	-2.46
1977	141.1	-0.89	2.6	8.58	143.7	-0.73
1978	133.1	-5.69	2.5	-4.87	135.6	-5.68
1979	130.0	-2.36	2.6	3.18	132.5	-2.26
1980	136.4	4.95	2.5	-0.56	138.9	4.84
1981	136.5	0.09	2.5	-0.55	139.0	0.08
1982	136.3	-0.15	2.5	-0.46	138.8	-0.16
1983	135.9	-0.27	2.5	-0.56	138.4	-0.28
1984	135.7	-0.20	2.5	-0.56	138.2	-0.21
1971-75	141.8	0.76	2.6	0.41	144.4	0.75
1976-80	136.6	-1.27	2.5	-0.55	139.1	-1.26
1981-84	136.1	-0.13	2.5	-0.53	138.6	-0.14
1971-84	138.3	-0.29	2.5	-0.25	140.9	-0.29

Sources: United Nations, World Population Prospects (New York: UN, 1986); Zaire, Institut National des Statistiques, Annuaire Statistique (Kinshasa: INS, various years).

Note: All figures in this table are in cereal equivalents.

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