ROLE OF ROOTS AND TUBERS IN NIGERIAN NUTRITION AND AGRICULTURAL DEVELOPMENT

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SUMMARY

Production and consumption of root and tuber staples such as cassava, yams, cocoyams and sweet potatoes can furnish large quantities of food energy per unit area of land under climatic conditions that do not favour dry land cereals production. It is now being increasingly realized that inadequacy of food calories in diets, as well as protein deficiency, contributes to malnutrition in Nigeria. Root and tuber crops are in demand in trade between Nigeria and neighbouring West African countries and also overseas, and they therefore contribute to foreign exchange earnings.

There is therefore a strong case for giving greater prominence to root and tuber crops development in the national agricultural planning in Nigeria to meet both nutritional and economic needs.

RESUME

La production et la consommation de denrés à base de racine et de tubercule telles que le manioc, l'igname, le tarot et la patate douce peuvent fournir une grande quantité d'énergie alimentaire par unité de parcelle de terrain en conditions climatique qui ne favorisent pas la production de céréales en terrain sec. On se rend de plus en plus compte que l'insuffisance de calories dans les régimes alimentaires, de méme que le marque de protéine contribuent à la malnutrition au Nigéria. Il y a une demande commerciale des plantes à racine et à tubercule entre le Nigéria et les pays voisins de l'Afrique Occidentale, et aussi d'Outre-mer, et elles constitutent par conséquent des sources de devises.

Il est donc d'une nécessité impérieuse d'accorder une part importante au développement des plantes à racine et à tubercule dans la planification agricole au plan national pour que le Nigéria puisse satisfaire ses besoins aussi bien dans le domaine de la nutrition que de l'économie.

RESUMEN

La producción y el consumo de raíces y tubérculos básicos como la yuca, ñame y el camote** pueden proveer grandes cantidades de energía alimenticia por unidad de superficie bajo condiciones climáticas que no favorecen la producción de cereales de tierras mas secas. Se ha incrementado ahora la atención, en cuanto a que la dieta calórica de los alimentos, así como la deficiencia de proteínas, contribuyen a la malnutrición en Nigeria. Se observa una demanda en el comercio de cultivos para raices y tubérculos entre Nigeria y los países vecinos de Africa Occidental y también con ultramar, lo cual por lo tanto, contribuye a la obtencion de genancias por intercambio con el extranjero. Es cuestión portanto de dar mayor importancia al desarrollo de raíces y tubérculos en la planeación agrícola nacional en Nigeria para subsanar necesidades, tanto nutricionales como económicas.

INTRODUCTION

Seasonal food shortages causing hunger and malnutrition and important health and social problems impede economic progress in Nigeria and many other developing countries. It is increasingly being recognized that an inadequate quantity of food, with an insufficiency of calorie or energy intake, and not merely protein deficiency, is the cause of widespread protein-calorie malnutrition, since, with insufficient food calories protein is used to supply energy instead of fulfilling its body-building role. Calculations show that cassava or manioc (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), yam (*Dioscorea* spp.) and cocoyam

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**Nota del Traductor: el camote (sweet potato) es conocido en diversos paises de habla hispana como batat dulce, batata o boniato.

(*Colocasia* spp.) are all good and cheap sources of energy, and produce high amounts of food calories per acre of land*[9].

Root and tuber crops have a long history of consumption in many Nigerian communities[3,10] which we shall review.

History of root and tuber crop cultivation and consumption in Nigeria

Root crops in West African culture:

In general, the people living in the Southern Province of Nigeria are 'root eaters', and it can be taken for granted that the traditional inhabitants of Benin in Mid-Western Nigeria and the people of Ilesha in Western State of Nigeria eat 'fufu' made from yam three times in a day.

The harvesting of wild roots and tubers was probably one of the earliest methods of food procurement in ancient Africa. Root and tubers feature prominently in Nigerian folklore and traditional ceremonies, and this is considered to provide evidence that roots and tubers have been eaten in the respective communities since the earliest times.

Today the cultivated edible roots and tubers in Nigeria include cassava, yam, cocoyam, sweet potato and Irish potato, of which however only the yam is probably indigenous and traditional. Cassava originated in South America and was perhaps introduced into Nigeria late in the 19th century. Many old people still alive in Nigeria remember times when cassava was not eaten in their home areas. Now, however, both sweet and bitter cassava are extensively grown and consumed in many parts of Nigeria.

Indigenous and introduced yam species:

About 70 percent of the world's yams are produced in Africa[4] and about half of the world's yams are produced in Nigeria. According to Phillips[16] some yams are indigenous to West Africa and some are introduced. Coursey[3] and Irvine[12] both agree that the white yam (*Dioscorea rotundata*) and the yellow yam (*Dioscorea cayenensis*) are indigenous to West Africa. A wild form of the yellow yam occurs in West Africa[2]. The writers support these, but also consider that the water yam (*D. alata*) the bitter yam (*D. dumetorum*) and the potato yam, or air potato (*D. bulbifera*) are indigenous. We have ourselves seen wild forms of these species in Nigeria, and there are local names for both the cultivated and edible yams and for their wild forms. The Chinese yam however, also known as the 'lesser yam' (*D. esculenta*) is an alien in Africa and is believed to have originated in the Indo-Chinese region. The Chinese yam is now grown and eaten, particularly in the Western State of Nigeria.

According to Irvine[11] who has reviewed evidence for the origin and distribution of cocoyams, the wild ancestor of cultivated cocoyams has never been traced, and cocoyams are considered to be one of man's earliest food crops. Evidence suggests that cocoyams originated in Asia, were grown in India for centuries, taken to Egypt at the time of Christ, then to Europe, and then back to North Africa and reached West Africa across the desert[12]. Two species of cocoyam (*Colocasia esculenta* and *Xanthosoma saggitifolia*) are now grown in Nigeria and many other parts of tropical Africa.

The Spaniards found the Indians of Central and South America already growing sweet potatoes in the fifteenth and sixteenth centuries. They are now an important crop in Northern Nigeria. Three recognized market categories are 'white', 'red', and 'yellow'.

Irish potatoes originated in the Andean highlands. They were first introduced into Nigeria during World War II. Their cultivation is increasing in small-scale farms, particularly in areas of Northern Nigeria.

Coleus potatoes are thought to have originated in the Ethiopian region. There are two species, the 'Hausa potato' (*Solenostemon rotundifolius*) and the 'Rizga' (*Coleus dazo*). Both are grown and consumed in Mali and the Upper Niger Basin and are likely to diffuse into Nigeria and other parts of Africa. Average yields of root and tuber crops are given in Table 1. Estimated acreages and production of staple root and tuber crops in Nigeria from 1959 to 1970 are given in Tables 2 and 3.

CURRENT CULTIVATION METHODS FOR ROOTS AND TUBERS IN NIGERIA

Cassava is grown from stem cuttings and cultivated both as a sole crop and mixed with other crops. It has become ubiquitous and a popular staple crop in many parts of the country because of its hardiness. Cassava may mature for harvesting from 6 months to 2 years under the range of possible growing conditions. Sweet cassava yields are generally lower than those of bitter cassava. Low yields, which are general, are partly due to poor agricultural extension services. Cassava products include gari, sun-dried cassava flour and starch.

Yam production is expensive in terms of planting materials and labour. The crop is propagated by yam

*But at much higher moisture content than cereals. (Ed.)

setts which are mainly the tops of yam tubers which, if not used for propagation, could have been eaten. About 1,680 lbs per acre of planting setts are required. Average time of maturity is 8 months and during the whole growing period the yam vines have to be supported above ground by wooden poles. Soil fertility, the amount and distribution of rainfall, the size of the setts used, crop management, the cultivar of yam and whether it is grown as a sole crop or in mixed stands all affect yields. Recently yam yields have tended to decrease mainly due to indiscriminate use of poor soils to grow yam and poor management practices.

Sweet potato receives systematic planting and proper crop management in the North, but not in the Southern parts of the country. In the South the crop is found growing on refuse heaps around dwellings and not in well-ordered plots.

Both *Colocasia* and *Xanthosoma* cocoyams are widely grown in Southern Nigeria either as sole crops or mixed with others. Substantial cocoyam production is from roadside plots, and from palm oil and cocoa plantations since they can thrive without proper crop management. Yields are generally low.

Irish potatoes are grown mainly in Benue-Plateau State and Kano and North-Central State.

CONTRIBUTION OF ROOTS AND TUBERS TO THE DAILY PER CAPUT AVAILABILITY OF ENERGY AND PROTEIN

The diet of the 'average Nigerian' is composed of cereals, starchy roots tubers and fruits, oils and fats, legumes, fish and livestock products, oilseeds and nuts, sugars, beverages, vegetables and fruits.

The contribution of roots and tubers to the total per capita supply of 2,083 kilocalories (8713 kJ) and 53.83 g of protein in Nigeria for the 1968/69 agricultural year, is shown in Table 4. Roots, tubers and plantain together provide 24.1 percent of calcium and 51.4 percent of ascorbic acid of the total daily per capita supplies[14] and these figures do not include the nutrients available from the leaves of cassava, cocoyams and sweet potatoes, all of which are used as green vegetables.

For the Southern States of Nigeria data in Tables 5,6,7,8 show that starchy roots, tubers and fruits taken together can provide between 50 to 90 percent of the daily per capita energy intake and from 20—28 percent of the daily protein intakes[5,6,13,18]. Although the Southerners' consumption patterns of predominantly starchy roots, tubers and fruits are not ideal and indeed are inconsistent with national nutritional targets, nevertheless, the data provide evidence that roots and tubers are at present indispensable in the Nigerian diet and this emphasizes the need to give greater prominence to their production in the national agricultural development plan.

ROOT AND TUBER CROPS IN INTERNATIONAL TRADE

Dried cassava roots are being exported to Europe for making starch and the roots have been suggested as raw materials for manufacturing glucose or power alcohol. Cassava chips are also used for animal feeds.

In recent years there has been increased exportation of gari, yams and sweet potatoes to England and other overseas countries for sale to immigrant populations. As well as becoming a useful source of foreign exchange earnings, the growth of international trade in roots and tubers increases effective demand for farm food produce and this needs to be matched by an increase in production if it is not to effect adversely the availability of produce for internal consumption.

SUPPLY AND DEMAND FOR ROOTS AND TUBERS IN NIGERIA

Data from a recent study (Table 9) indicate that substantial marketable surplusses in rural areas which have sometimes been considered by planners to exist are in fact not produced. Policy makers, believing in the existence of surplusses, gave no prominence to programmes for increasing the production of staple food crops in the national development plans. However, both the Federal and the State Governments have now come to realize that the first obligation of the national agriculture is to provide adequate food for the people. Current thinking is that food production and general agricultural development must be considered as one of the topmost priorities in the national development plans[1]. However, mere plans and project proposals do not themselves constitute solutions to the existing gap between food supply and demand. Realistic strategies for implementing the expansion of production and consumption of root, tuber and other food crops in the country must include the following measures.

Reinforcement of research to improve root and tuber crops

Because the traditional species of roots and tubers are generally low in yields and protein value, they have been largely neglected in research and development programmes. There are promising indications now that protein content and possibly yields of root and tuber crops could be increased significantly over present low levels by the selection of better planting materials and the improvement of cultural practices. For example, recent findings by Martin and Thompson in Puerto Rico show that the protein content of 40 collections of yams varied between 6.3 and 13.4 percent. These protein levels compare favourably with the

1–6 percent protein in cassava, 4–6 percent in sweet potato, and the 3–5 percent protein in taro[15]. If the protein content of root and tuber crops could be increased by over 50 percent then their production and consumption would certainly eliminate both calorie and protein shortages, and the incidence of protein-calorie malnutrition in those parts of Nigeria and other tropical and subtropical countries where millions of people depend almost entirely on these staple foods. Already, selection for protein content in root and tuber crops is in progress in a number of national and international institutions including the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, the International Potato Centre (CIP – in Peru and the Federal Experimental Station, Mayaguez, Puerto Rico.

Intensification of agricultural extension services

Agricultural extension services in Nigeria are not at present effective. Peasant farmers tend to use land of poor soil fertility for crop production and this limits yields. Also, they tend to plant their crops without any regard to optimum cropping patterns and seasons, so that poor harvests and crop failures are usual in many Nigerian farming communities. There is a need for general education of Nigerian farmers in improved crop cultivation.

Incentives to farmers

Realistic and aggressive agricultural food production programmes would necessitate a transformation of the existing traditional production practices. Farmers would need fertilizers, now crop cultivars, crop protection chemicals, machinery, etc. Farmers must be able to get credit to buy these inputs, and hence they need extra returns to be able to undertake the repayment of credits. This implies in turn the need for effective markets for at least some of their produce.

Elevation of food crops into cash economy

Major progress in food crop production cannot be achieved and perennial food shortages in the communities will persist as long as a large part of the national food crop production is produced only for subsistence and does not pass through organized market economy and hence contribute to the farmers' cash economy. There is therefore a need to elevate root, tuber and other food crops into the cash or market economy, a position currently enjoyed only by traditional export crops. This would confer a prestige which food crops at present lack as well as justifying the use of the inputs required to raise production.

Technological measures

Root and tuber crops are very perishable. Current wastage for root and tuber crops in Nigeria seem to range from about 15–25 percent of production and this represents a value of several million Naira[11].

Bitter cassava contains glucosides which forms poisonous hydrocyanic acid on hydrolysis. The two genera of cocoyam, (*Colocasia* and *Xanthosoma*) both contain poisonous saponins. Bitter yam contains dioscorine which is also a poisonous substance. These poisonous substances could be removed by suitable food processing techniques. The tendency however is to grow and consume sweet cassava whose edible portion of the root is free from hydrocyanic acid, while the bitter yam is usually only eaten during the hungry season when other foods are scarce and expensive.

ROOT CROP PROCESSING

The establishment of food processing plants that can use root and tubers as raw materials at strategic areas in the country would overcome some of the major obstacles to increased root and tuber crop production. It would reduce food waste, make foods of better quality available, and hence would permit fuller and better utilization of root and tuber crops in the national dietaries. Improved food processing facilities should aim to produce foods of high quality which would meet international standards. Such a development could increase the incomes of farmers and therefore create incentives for increased food production which could lead to higher nutritional standards and general national socio-economic development.

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TABLE 1

Yield of root and tuber crops per acre by States, 1968/69 (1,000 lbs)

States	Cassava	Potato (Irish)	Potato (sweet)	Yams	Cocoyams
Benue-Plateau	8.985	6.720	6.720	7.215	1.617
East-Central	8.420	-	-	5.824	5.154
Kano	5.444	6.720	+	+	+
Kwara	5.160	-	+	7.051	1.344
Lagos	9.166	-	+	4.305	2.298
Mid-West	14.819	-	+	6.143	3.394
North Central	3.632	6.720	+	2.005	1.537
North-Eastern	21.573	+	+	5.311	4.260
North Western	3.302	+	+	3.345	+
Rivers	8.420	-	+	3.149	5.040
South-Eastern	8.420	-	+	5.824	7.459
Western	8.179	-	+	8.115	2.977
Potential: yield of best cv. (fresh)	35.840 (bitter cassava)	10,480	10,480	14,400	10,460

+ = positive unknown yield
- = no information as to whether the crop is cultivated or not.

Source: Olayide, S.O., Olatunbosun, D., Idusogie, E.O. and Abiagom, J.D. (1972); Idusogie, E.O. (1971).

TABLE 2

Estimated acreages of roots and tubers in Nigeria, 1959/60–1969/70 (Million acres)[13]

	Cassava	Potato (Irish)	Potato (Sweet)	Yams	Cocoyams
1959/60	1.802	0.005	0.032	2.164	0.410
1960/61	1.861	0.005	0.032	3.132	0.421
1961/62	1.925	0.005	0.032	3.486	0.446
1962/63	2.137	0.005	0.032	3.208	0.726
1963/64	1.979	0.005	0.032	3.855	0.633
1964/65	2.149	0.005	0.034	4.006	0.699
1965/66	2.048	0.005	0.034	3.777	0.694
1966/67	2.248	0.005	0.037	3.319	0.608
1967/68	2.366	0.005	0.037	3.388	0.712
1968/69	2.226	0.005	0.037	4.195	0.601
1969/70	2.238	0.005	0.039	3.191	0.700

TABLE 3

Estimated production of roots and tubers in Nigeria, 1959/60–1969/70 (Million metric tons)[13]

	Cassava	Potato (Irish)	Potato (Sweet)	Yams	Cocoyams
1959/60	6.882	0.018	0.149	8.910	0.643
1960/61	6.682	0.018	0.149	12.109	0.652
1961/62	7.400	0.018	0.150	13.474	1.150
1962/63	7.600	0.019	0.155	13.102	1.549
1963/64	7.800	0.020	0.160	15.885	1.555
1964/65	8.000	0.021	0.165	14.563	1.625
1965/66	8.200	0.022	0.170	14.736	1.606
1966/67	8.400	0.025	0.175	11.963	1.437
1967/68	8.600	0.023	0.180	10.670	1.625
1968/69	8.820	0.024	0.185	12.392	1.308
1969/70	9.040	0.025	0.190	15.155	1.793

TABLE 4

Contribution of Nigerian foods to the daily per capita supplies of calories and protein[13]

Food	Contribution to total	
	Calories	Protein
Cereals	42.1	48.7
Starch roots, tubers and fruits	34.4	19.6
Oils and fats	10.9	0.0
Legumes	4.9	11.7
Fish and livestock	4.1	15.5
Oil seeds and nuts	1.4	1.8
Sugars	0.8	0.0
Beverages	0.7	0.3
Vegetables and fruits	0.6	2.3

TABLE 5

Mean calorie and protein intakes in Western State of Nigeria

Calorie sources %	ILESHA, Western State	
	Igun Village	Abebeyun Village
Starchy roots	53.8	59.1
Cereals	15.5	10.4
Pulses and other seeds	8.0	5.4
Fruits and vegetables	1.9	3.6
Oils and fats	8.9	12.6
Animal products	6.6	6.8
Others	5.3	2.1
	100.0	100.0
Calorie intake/head/day	1,947.0	2,111.0
Crude protein intake g/head/day	49.0	51.0

Condensed from Dema, I.S. (1965)[4]

TABLE 6

Mean calorie and protein intakes in four villages of Eastern Nigeria[4]

Calorie sources %	Adiasim 1962	Maku 1962	Idembia 1962	Uboma 1963-64
Starchy roots (yams, cocoyams, cassava)	78.0	64.5	81.2	48.7
Cereals	0.8	0.8	0.2	5.5
Pulses and other seeds	2.2	5.6	6.1	10.8
Fruits and vegetables	3.8	4.4	1.5	0.8
Oils and fats	7.2	18.4	5.3	19.7
Animal products	3.0	2.9	4.3	5.8
Others	5.0	3.4	1.4	8.7
	100.0	100.0	100.0	100.0
Calorie intake/head/day	1,686	1,651	1,587	2,881
Protein intake g/head/day	33	34	31	60

TABLE 7

Calorie and protein sources in three Mid-Western Nigeria dietaries[17]

	Ewu village		Unoghovo village		Ibusa village	
	Calorie % total	Protein % total	Calorie % total	Protein % total	Calorie %total	Protein % total
Cereals	20	20	3	4	7	7
Roots and tubers	37	20	62	23	69	28
Sugars	1	-	-	-	-	-
Pulses, nuts, seeds	17	36	2	5	5	10
Fruits and vegetables	2	-	1	4	1	4
Meat	1	4	4	32	2	13
Fish	3	20	3	32	5	38
Oils and fats	19	-	23	-	11	-
Others	-	-	2	-	-	-
	100	100	100	100	100	100
Calorie intake/head/day	1,344		1,489		2,210	
Crude protein intake g/head/day	33		27		42	

TABLE 8

Energy (kilocalories) per caput per day contributed by major foodstuffs in the Ibibio, South-Eastern State of Nigeria.[12]

Foodstuffs	House-hold 2	House-hold 3	House-hold 5	House-hold 7	House-hold 9	House-hold 14
Cassava and cassava	1,823	795	1,198	867	716	1,303
Yams	410	485	280	307	641	510
Bananas and plantains	34	15	57	12	26	40
Meat	22	27	4	-	6	12
Local fish	164	152	94	87	167	222
Imported fish	66	35	12	-	26	10
Total calories contributed by the six foodstuffs	2,469	1,509	1,646	1,273	1,682	2,092
% calories contributed by starchy roots, tubers and fruits	92	86	93	93	82	89

TABLE 9

Projected supply and demand of roots and tubers, 1968/69 – 1985 in Nigeria. (1,000 metric tons)

		Cassava	Potato (Sweet)	Potato (Irish)	Yam	Cocoyam
1968/69	Base year supplies	7,521.667	136.141	13,939	7,239.028	802.173
	% trend growth of supplies	2.5E	2.5A	2.5A	-0.2SL	2.5A
1975	Projected demand	8,439.310	152.750	15.640	8,122.189	900.038
	Projected supply	8,940.899	161.829	15.622	7,138.288	953.532
	Surplus	+ 501.589	+ 9.079	-0.018	- 983.901	+53.494
1980	Projected demand	9,183.955	166.228	17.020	8,838.853	979.453
	Projected supply	10,115.806	183.095	17.675	7,067.189	1078.833
	Surplus	+ 931,851	+16.867	+0.655	-1,771.664	+99.380
1985	Projected demand	10,191.859	184.471	18.887	9,808.883	1086.944
	Projected supply	11,445.106	207.156	19.998	6,996.799	1220.601
	Surplus	+1,253.247	+22.685	+1.111	-2,812.084	+133.657
Suggest compound annual rate of growth of supplies(%)		3.50	4.50	4.50	4.50	3.50

\+ = positive surpluses that could enter the African and/or international market
\- = negative surpluses that would have to be imported unless there is increased production
L = log function: E = Exponential function; SL = Semi-log function;
A = Assumed growth rate.