THE SIGNIFICANCE OF ROOT CROPS IN THE TROPICS

— *by* —

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Numerous reports have told of malnutrition, undernourishment and even starvation occuring in widespread tropical areas. Today, the tropics is perhaps the world's principal food deficit region. This current situation represents one of the striking paradoxes of our times, for in the tropics, perhaps as much as 80 per cent of the inhabitants are engaged in agriculture. By contrast, in many developed temperate countries, with less than 20 per cent of their population engaged in agriculture, their peoples are reportedly overfed, and surpluses of basic food accumulate. These contrasts emphasise at once the primitive technology, and low agricultural productivity of tropical agriculture, as well as the low nutritional values of many tropical foods.

Yet, only in recent years have the quality and quantity values of tropical food supplies become subjects of serious study. In these circumstances it is not surprising that such limited agreement exists as to the nature and magnitude of tropical food deficiencies. The supplies of domestic foods have never been satisfactorily assessed.

The present paper will no doubt throw some light on the supply situation for it deals with the significance of a group of foods which have for centuries been basic in the diets of millions of tropical peoples. In particular, the paper reviews the relative importance of tropical root crops and in terms of food-supply, resource allocation, national product and in trade, both domestic and international. It seems appropriate to set this analysis against the background of tropical food deficiency.

FOOD SUPPLY

Root crops are important suppliers of calories and in the tropics they contribute substantially to the daily calorie intake. In some areas, notably in Africa and South America (see Tables I and Ia), they contribute nearly as much to the calorie supply as do cereals. Indeed, in some Nigerian villages, for example, their contribution is likely to be greatly in excess of the national average.

Table 1. Comparison of Starchy Roots with Cereals, in terms of Calorie Intake for Selected Countries, 1959—61 (Av.)

Country	Starchy Roots	Rice	Wheat	Other Grains	Total
	(................calories per		day	................)	
Argentina	160	40	1,100	—	2,900
Brazil	430	400	250	40	2,700
Ceylon	90	1,060	200	20	2,100
Chile	120	90	1,170	20	2,500
China (Taiwan)	190	1,350	210	10	2,400
Colombia	230	170	120	310	2,200
Cuba	220	480	280	190	2,600
Ecuador	90	200	160	300	1,900
Indonesia	390	880	10	220	2,100
Japan	90	1,070	240	90	2,300
Korea	120	970	190	470	2,000
Malaysia	110	1,220	210	10	2,300
Nigeria	740	30	20	930	2,200
Paraguay	670	70	300	450	2,500
Peru	290	190	320	350	2,000
Philippines	110	890	100	220	1,900
Venezuela	140	80	370	460	2,400
West Africa	590	230	30	1,100	2,400

Source: Abstracted from F.A.O., 'The Economic Relationships Between Grains and Rice', *Commodity Bulletin Series No. 39*, Rome, 1965.

Table Ia. Percentage Contribution of Starchy Roots and Cereals to Total Calorie Intake, Selected Countries, 1959—61 (Av.)

Country	Starchy Roots	Rice	Wheat	Other Grains	All Cereals and Roots
	(..........per cent	of total	calorie	intake	........)
Argentina	6	1	38	–	45
Brazil	16	15	9	1	41
Ceylon	4	50	10	1	65
Chile	5	4	47	1	57
China (Taiwan)	8	56	9	–	73
Colombia	10	8	5	14	37
Cuba	8	18	11	7	44
Ecuador	5	11	8	16	40
Indonesia	19	42	–	10	71
Japan	4	47	10	4	65
Korea	6	49	9	23	65
Malaysia	5	53	9	–	67
Nigeria	34	1	1	42	78
Paraguay	27	3	12	18	60
Peru	15	9	16	17	57
Philippines	6	47	5	12	70
Venezuela	6	3	15	19	43
West Africa	25	10	1	46	82

Source: Derived from F.A.O. 'The Economic Relationships Between Grains and Rice', *Commodity Bulletin Series No. 39*, Rome, 1965.

But although root crops may furnish a sufficient number of calories to sustain life, they are insufficiently balanced to prevent malnutrition. Typically, root crops are deficient in vitamins, protein and fat. The unbalanced nature of their food supply becomes at once apparent when they are compared with other sources of carbohydrate, for example, the cereals, or when measured against some recognised dietary standards.

Typically, as can be seen in Table 2, water accounts for over 65 per cent of the weight of a fresh tuber, carbohydrate for between 18.9 to 34.7 per cent

Table 2. Food Composition of Irish potatoes, Sweet potatoes, Manioc, Yams and Taro, Per 100 Grams (Edible Portion)

Item	Unit	Irish potatoes	Sweet potatoes	Manioc	Yams	Taro
Food energy	calories	82	117	146	105	104
Water	g	78	70	62.5	72.4	72.5
Carbohydrate	g	18.9	27.3	34.7	24.1	24.2
Protein	g	2.0	1.3	1.2	2.4	1.9
Fat	g	0.1	0.4	0.3	0.2	0.2
Calcium	mg	8	34	33	22	23
Iron	mg	0.7	0.1	0.7	0.8	1.1
Vitamin A	I.U.	traces	500	traces	traces	traces
Thiamine, B_1	mg	0.10	0.10	0.06	0.09	0.15
Niacin (nicotinic acid)	mg	1.4	0.6	0.6	0.5	0.9
Riboflavin, B_2	mg	0.03	0.05	0.03	0.03	0.03
Vitamin C	mg	10	23	36	10	5

Source : 'Tropical Root Crops', *Green Bulletin*, No. 19, Germany, 1965.

Table 3. Food Composition of Maize, Wheat and Rice Per 100 Grams (Edible Portion)

Item	Unit	MAIZE		WHEAT (medium)		RICE	
		Whole Meal	Fine Meal 85% Extractions	Whole Meal	White Flour 72% Extractions	Husked 80% Extractions	Milled 65% Extractions
Water	g	12.0	12.0	12.0	12.0	13.0	13.0
Protein	g	9.5	8.4	12.2	10.9	7.5	6.7
Fat	g	4.3	1.21	2.3	1.1	1.8	0.7
Carbohydrate	g	72.9	77.3	71.8	75.5	76.7	78.9
Fibre	g	2.1	0.5	2.1	0.3	0.8	0.4
Ash	g	1.3	0.6	1.7	0.5	1.0	0.7
Calcium	mg	21(a)	5	36.0	16.0	15.0	10.0
Iron	mg	2.3	1.2	4.0	1.0	1.4	0.9
Vitamin A	I.U.	450(b)	300.6	0.0	0.0	0.0	0.0
Thiamine	mg	0.45	0.18	0.41	0.13	0.33	0.08
Riboflavin	mg	0.11	0.08	0.10	0.04	0.45	0.03
Niacin	mg	2.0	4.6	4.6	1.1	4.6	1.6

a For Maize from the U.S.A. and South Africa; for Latin America 7 mg; and for other areas 10 mg.

b For yellow varieties; white maize contains only little Vitamin A.

Source : Y. R. Chadha, 'Maize', *Tropical Science*, Vol. 4, No. 1, 1962.

and protein, for less than 3 per cent. By contrast (see Table 3) the water content of cereals stands at less than 12 per cent, with their carbohydrate and protein contents being two and four times respectively the equivalent weights for the starchy tubers.

Comparisons of the food-supply of root crops with a given dietary standard are likely to invite some dispute, for few are agreed on nutritional standards. Yet even allowing for possible differences, it seems clear from Table 4 that a daily diet consisting of about 1,000 grams of any of the starchy staples would show deficiency in important food elements — the magnitude of the deficiency varying from one root to another.

Table 4. Food Composition of a diet of 1,000 grams of one of five starchy roots[a] *compared with estimated nutritional requirements for Adult Male*

Item	Unit	Irish potatoes	Sweet potatoes	Manioc	Yams	Taro	Adult Male daily requirements
Food energy	Calories	820	1170	1460	1050	1040	2500
Water	g	780	700	625	724	725	
Carbohydrate	g	189	273	347	241	242	
Protein	g	20	13	12	24	19	65
Fat	g	1.0	4	3	2	2	
Calcium	mg	80	340	330	220	230	500
Iron	mg	7	1	7	8	11	8
Vitamin A	I.U.	traces	5000	traces	traces	traces	2500
Thiamine, B_1	mg	1	1	0.6	0.9	1.5	1.2
Riboflavin, B_2	mg	0.3	.5	0.3	0.3	0.3	1.2
Niacin (nicotinic acid)	mg	14	6	6	5	9	15
Vitamin C	mg	100	230	360	100	50	25

a Food values for the roots are calculated from Table I.

Source: Derived from data presented in 'Tropical Root Crops', *Green Bulletin*, No. 19, Germany, 1965.

But obviously, the significance of these deficiencies to the nutrition and health of tropical man is dependent, among other things, on the foods which complete his diet. While the statistics might not be available, the evidence would suggest that necessary supplementary foods are often consumed in inadequate quantities. For this, there would seem to be great need to breed improved varieties of the starchy staples in an effort to alleviate, if not remove, tropical nutritional problems.

This, however, is not to say that improved varieties are entirely the answer to the nutritional problem. For, taking protein requirements for example, it is certainly a much debated question whether satisfactory nutrition does not require a sizeable percentage of animal protein. Perhaps the more promising avenue might well be to develop some processing and to enhance the nutritional value of roots by adding then, the necessary food elements.

RESOURCE ALLOCATION

It has been possible to illustrate the food-supply of root crops with a few relevant statistics. But a discussion on resource allocation will necessarily involve a heavy reliance on qualitative evidence, for the data on factor-inputs for root crop production are extremely sketchy.

Table 5. Area under Irish Potatoes, Cassava, Sweet Potatoes and Yams in Selected Tropical Countries, 1963/64,

Continent and Country	Irish potatoes	Cassava	Yam and Sweet potatoes
	(..............	'000 acres	............)
North & South America			
Bolivia	282.5b	10.0a	10.0a
Brazil	500.0	4,042.5	380.0
Colombia	252.5a	202.5a	n.a.
Costa Rica	5.0a	—	—
Cuba	20.0b	137.5a	157.5b
Ecuador	80.0	60.0	10.0
Jamaica	2.5c	10.0b	92.5
Mexico	125.0	—	35.0
Paraguay	5.0	230.0	22.5
Peru	575.0c	70c	40.0c
Venezuela	37.5	62.5	30.0
Asia			
Burma	37.5	—	—
Ceylon	—	167.5	40.0
India	995.0	627.5	340.0
Indonesia	—	3,730.0	1,115.0
Japan	520.0	—	782.5
Korea	115.0	—	230.0
Pakistan	175.0	—	—
Philippines	7.5	235.0	380.0
Taiwan	2.5	42.5	567.5
Thailand		347.5	65.0c
Africa			
Cameroon	5.0b	145.0c	152.5
Central African Rep.	—	500.0	40.0
Dahomey	—	570.0	177.5
Ivory Coast	—	525.0	687.5
Madagascar	40.0	792.5c	150.0c
Malawi	n.a.	15.0	50.0
Mali	—	25.0	12.5
Mozambique	5.0a	2.5a	—
Niger	—	40.0	5.0
Rvanda-Urundi	32.5a	250.0b	362.5b
Rwanda	65.0	117.5	205.0c
Senegal	—	85.0	5.0
Sierra Leone	—	50.0	7.5c
Togo	—	345.0	125.0a
Uganda	5.0	715.0	592.5
Upper Volta	—	12.5	80.0
Zambia	—	100.0a	5.0a
Oceania	150.0	25.0c	50.0b

a Average for 1948/49 and 1952/53; b Average for 1961/62; c Average for 1962/63.

Source: F.A.O., *Production Yearbook 1964* Vol. 18, Rome, 1965.

Of the 16.8 million square miles of land reportedly capable of producing major food crops in the tropics,[1] roughly seven thousand square miles are under root crops.[2] The area estimates presented in Table 5, reveal that a high proportion of this acreage is devoted to cassava production, with the acreages in Irish potatoes being least in importance. Further, it is evident that the relative importance of individual crops varies widely among the various countries.

The relative importance of a crop in a country is dependent on a number of factors. While topography, soil and climate place certain agronomic limitations on production, economic and social factors often determine the extent to which potential for production will be exploited. Yet in not a few instances, the continued dominance of a food crop particularly in a tropical country, reflects not so much an economic choice as it does reflect the conservatism of food habits, for usually a high proportion of domestic production is geared to meet family requirements.

Characteristically, the production of root crops has almost exclusively been the concern of the local peasantry. The situation in Jamaica, for example (see Table 6), may not represent an extreme case.

Table 6. Acreage of Cocoe (Tannia), Yam Hills, Sweet Potatoes, Badhoo & Dasheen by size Group; Jamaica, 1961

Farms by Size Group	Cocoe (acres)	Yam (hills)	Cassava (hills)	Sweet potatoes (acres)	Badhoo & Dasheen (acres)
0 to under 5 acres	6,031	10,505,483	4,093,376	9,019	2,299
5 to under 25 acres	4,392	7,158,358	3,399,934	7,595	1,761
25 to under 100 acres	811	780,132	724,421	922	431
100 to under 500 acres	67	111,329	118,511	145	20
500 acres and over	10	15,355	213,195	4	—
All Farms	11,311	18,570,657	8,549,477	17,658	4,511

Source: *Survey of Agriculture 1961–62,* Department of Statistics, Jamaica, *1966.*

In terms of resource allocation the dominance of peasant production has meant that possibly apart from the primary factors in production — land, labour and planting material — supplies of such supplementary factors as are usually associated with scientific farming do not in general play an important part in the production process. Thus irrigation, disease and pest control and fertilizer applications are oft-times unknown, with shifting cultivation and intercropping assuming great importance.

A second factor in root crop production which is related to the dominance of peasant production is the small scale of individual production units. In general,

1 See D. T. Edwards, and A. M. Morgan Rees, 'The Agricultural Economist and Peasant Farming in Tropical Conditions', **International Explorations of Agricultural Economics,** Iowa, U.S.A., 1964.

2 Approximate calculation based on area statistics in **Production Yearbook 1964,** Vol. 18, F.A.O., Rome, 1965.

root crops require large quantities of labour[3] and clearly there are early limits to the size of farm a peasant can cultivate when his main tools are the fork, the hoe and the cutlass.

A striking fact which, therefore, emerges from a study of the resource allocation for root crops is the limited usage of certain production factors. This is part and parcel of the problems of peasant production and they are not relieved by the virtual indifference with which the cultivation of the starchy roots has been regarded in many official circles.

THE NATIONAL PRODUCT

Traditionally, tropical agriculture has emphasised the production of crops for export. The value of export crops has thus tended to overshadow the contributions of food crops to local economies, and the situation may not infrequently be exaggerated because of rather poor statistical coverage of food crop production.

While trade statistics usually provide a reasonably good basis for assessing the production of export crops, estimates of production of root crops must invariably rest on less reliable sources for few relevant records are kept either by the farmer or public bodies. This, as Edwards and Rees[4] point out, places the burden of providing information on the farmers' judgment and on their recollections, and on what the investigators can see for themselves, and although the farmer may remember fairly well the amount of crops he sold in the last season, his memory of the amount harvested for family consumption is likely to be hazy. Further, the units in which quantities of produce are harvested and marketed are apt to be in measures that cannot be easily translated into standard ones. Then too, from the point of view of the investigators, the system of intercropping and successional farming, and of irregular and incomplete harvesting, present serious problems in estimating food crop production.

In spite of these hazards, the F.A.O. of the U.N. has been able to collate some statistics on production, and in Table 7 data for selected tropical countries are presented. Some striking limitations of the statistics are seen in the combination of yam and sweet potato production, and the large number of countries for which production statistics are not available.

It would not be convenient, even if it were possible, to show the contribution of root crop production to the Domestic Product of 'individual' tropical countries. Therefore it is proposed to illustrate the importance of root crops by reference to their place in the Jamaican economy.

In 1961 the contribution of agriculture to the Gross Domestic Product of Jamaica was just under 13 per cent, the proportion of total working population engaged in agriculture approximately 40 per cent.[5] Over the last seven years (see

3 The labour requirements for the cultivation and preparing for consumption of a crop of cassava in the Belgian Congo, for example, are reported to be between 121 — 124 man days per acre. See Gordon Wrigley, **Tropical Agriculture**, Cambridge, 1961.

4 Edwards and Rees, **op. cit.**

5 **A Digest of West Indian Agricultural Statistics**, Occasional Series No. 2, Department of Agricultural Economics and Farm Management, University of the West Indies, St. Augustine, Trinidad, 1965.

Table 7. Production of Yams and Sweet Potatoes, Cassava, and Potatoes in Selected Tropical Countries, 1961—1964 (Av.)

Continent and Country	Yams and Sweet potatoes	Cassava	Irish potatoes
	(............	'000 metric tons	............)
North & Central America			
Cuba	240[a]	n.a.	113[a]
Jamaica	576	22[b]	17[b]
Mexico	279	n.a.	1,058
Brazil	4,356	60,150	3,382
Paraguay	230	3,279	n.a.
Venezuela	257	965	n.a.
Colombia	n.a.	1,532[b]	1,422[b]
Dominican Republic	n.a.	288[b]	n.a.
Honduras	n.a.	46	n.a.
Peru	n.a.	n.a.	2,476[b]
Asia			
India	2,980	5,665	8,354
Indonesia	9,138	33,917	n.a.
Philippines	2,200	1,549	41
Thailand	355[b]	5,914	n.a.
Burma	n.a.	n.a.	164
Pakistan	n.a.	n.a.	1,386
Ceylon	n.a.	871	n.a.
Africa			
Dahomey	1,732	3,510	n.a.
Ivory Coast	5,467	2,600	n.a.
Madagascar	873	2,503	190
Nigeria	n.a.	n.a.	n.a.
Ethiopia	n.a.	n.a.	262[b]
Rwanda	n.a.	n.a.	206
Ghana	n.a.	1,982[c]	

a 1961/1962.
b 1961/62 — 1962/63.
c 1962/63 — 1963/64.

Source: F.A.O., *Production Yearbook 1964*, Vol. 18, Rome, 1965.

Tables 8, 8a, and 8b), the contribution of root crops to the total agricultural product was generally in excess of 11 per cent, and the contribution to product for home consumption in excess of 34 per cent.

These statistics may invite some generalization but here one must be careful, for among other things, the ratio of price levels between root crops on the one hand and the rest of the agriculture on the other, is likely to be dissimilar, and so too the ratio of production. Any generalization must therefore take due cognizance of these factors.

Yet, judging from fragmentary data and general comments, the relative importance of the roots in the economies of some tropical countries, particularly in Africa, would seem to be of even greater importance than it does in the Jamaican economy.

Table 8. Contribution of Export and Domestic Agriculture to total Agricultural Product[a]*, Jamaica, 1959—1965*

Type of Agriculture	1959	1960	1961	1962	1963	1964	1965
	(.................			£ J '000			.................)
Export Agriculture							
Sugar Cane	6,884	7,333	7,999	8,394	12,814	11,669	9,258
Other Main Exports	4,644	3,830	3,922	4,048	4,533	4,506	4,503
Domestic Agriculture							
Root Crops	3,849	3,087	2,855	3,139	3,048	3,330	3,783
Other Products	4,848	5,059	5,374	5,471	6,123	6,383	7,302
Total Agriculture	20,225	19,309	20,150	21,052	26,518	25,888	24,851

a Excludes livestock and hunting, fishing, and forestry and logging.

Sources: *National Income and Product of Jamaica,* Dept. of Statistics, Kingston, Jamaica, 1965; and *Economic Survey of Jamaica, 1965,* Central Planning Unit, Gov't. of Jamaica, 1965.

Table 8a. Percentage Contribution of Export and Domestic Agriculture to total Agricultural Product, Jamaica 1959—1965

Type of Agriculture	1959	1960	1961	1962	1963	1964	1965
Export Agriculture							
Sugar Cane	34.0	38.0	39.7	39.9	48.3	45.1	37.3
Other Main Exports	23.0	19.8	19.4	19.4	17.1	17.4	18.1
Domestic Agriculture							
Root Crops	19.0	16.0	14.2	14.9	11.5	12.9	15.2
Other Products	24.0	26.2	26.7	26.0	23.1	24.6	29.4
Total Agriculture	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 8b. Value of Root Crops as Percentage of Value of Total Domestic Agriculture, Jamaica, 1959—1965

Type of Agriculture	1959	1960	1961	1962	1963	1964	1965
Domestic Agriculture							
Root Crops	44.3	37.9	34.7	36.4	33.2	34.3	34.2
Other Products	55.7	62.1	65.3	63.6	66.8	65.7	65.8
Total Domestic Agr.	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TRADE

Tropical root crops have never assumed much significance in international trade. While the F.A.O. trade yearbooks do record some trade in potatoes, it is for the 'Irish' variety which is relatively unimportant in the tropics.

An important limitation on a sizeable export trade in root crops is associated with the high water content of fresh tubers. This, apart from making them extremely vulnerable to bruising and hence decaying, makes the cost of transport, in relation to their food values, extremely high. Trade is therefore limited to nearby foreign markets and to the producer's domestic market. Further, the high water content of the fresh tuber also means that the storage of roots presents serious problems which in turn affect the regulation of trade. And, in the absence of any really advanced processing periods of gluts must continue to alternate with periods of scarcity and give rise to wide price variations.

Another factor limiting any sizeable international trade in roots is related to the generally low productivity of root crops. In Sierra Leone, for example, the yield per acre of sweet potatoes may be as low as .5 tons per acre (Table 9).

Table 9. Average Yields of Sweet Potatoes in Selected Tropical Countries

Country	Yield (tons per acre)
Ceylon	7 — 9
Congo	10 — 20
India	3.6 — 10.8
Malaya	4 — 5
Sierra Leone	0.5 — 2
Trinidad	1 — 7
Uganda	7 — 20
Zanzibar	3 — 4

Source: Y.R. Chadha, and J. Dakshinanurthy, 'Sweet Potatoes', *Tropical Science* Vol. 8, No. 2, 1965.

For cassava, the yield sometimes drops as low as two tons per acre in Northern Nigeria (Table 10). These low yields mean that production is often just sufficient to supply local needs (see Table 11).

Table 10. Average Yields of Cassava in Selected Tropical Countries

Country	Yield (tons per acre)
Ghana	5
Eastern Nigeria	3 — 5
Northern Nigeria	2 — 3
Northern Kenya	3 — 4
Southern Kenya	4 — 5
Mauritius	4 — 5
Malaya (on good soil)	4 — 5
Indonesia (on good soil)	10 — 25
Brazil	15 — 19
India	5

Source: Y.R. Chadha, 'Cassava', *Tropical Science,* Vol No. 3, 1961.

Table 11. Estimated Production and Consumption of Sweet Potatoes and Yams, Cassava, and Potatoes in Selected Tropical Countries, 1959—1961 (Av.)

Country	Sweet Potatoes and Yams			Cassava			Potatoes		
	Prod.	Cons.	Bal.	Prod.	Cons.	Bal.	Prod.	Cons.	Bal.
	(......................................				'000 tons				.....................................)
Argentina	372	290	82+	251	60	191+	1,966	1,140	826+
Brazil	1,234	1,150	84+	17,175	n.a.	n.a.	1,060	—	1,060+
Ceylon	36	40	4—	204	210	6—	n.a.	50	n.a.
Chile	n.a.	—	n.a.	n.a.	470	470—	760	—	760+
China (Taiwan)	2,937	700	2,237+	153	10	143+	6	10	4—
Colombia	n.a.	—	n.a.	n.a.	520	n.a.	685	310	375+
Cuba	212	250	38—	n.a.	190	n.a.	103	120	17—
Ecuador	41	20	21+	232	30	202+	287	120	167+
Indonesia	2,793	2,890	97—	11,920	9,650	2,270+	n.a.	30	n.a.
Japan	6,629	1,630	4,999+	n.a.	—	n.a.	3,423	1,620	1,803+
Korea	422	370	52+	n.a.	—	n.a.	303	250	53+
Malaysia	n.a.	100	n.a.	n.a.	270	n.a.	n.a.	30	n.a.
Nigeria	n.a.	6,900	n.a.	n.a.	3,500	n.a.	n.a.	n.a.	n.a.
Peru	76	140	64—	319	310	9+	1,217	950	267+
Philippines	783	690	93+	495	380	115+	9	10	1—
Venezuela	68	20	48+	279	250	29+	97	100	3—
West Africa	n.a.	2,260	n.a.	n.a.	2,390	n.a.	n.a.	10	n.a.

Sources: Derived from F.A.O., *Production Yearbook, 1961*, Rome, 1962 and F.A.O., 'The Economic Relationships Between Grains and Rice', *Commodity Bulletin Series, No. 39,* Rome 1965.

A striking feature of the domestic marketing of root crops is the unorganised nature of the marketing process. In the West Indies and in West Africa, the 'higglers' and the 'mammies' respectively, are the major handlers of domestic foods. Of these there are usually thousands. Some higglers are farmers or farmers' wives, who market their own produce plus that of their neighbours; others purchase their entire supply. These latter, in particular, usually assemble small diverse lots from remotely-located farms using trucks, carts, donkeys, or sometimes even carrying their supplies on their heads, and distribute their products to numerous small and large markets. Their system of distribution has often been described as inefficient. In recent times in the West Indies, many State-operated marketing agencies, designed to improve the marketing of food crops (including the starchy roots) have come into being. This is in recognition of the fact that the failure of many small farmers to respond to efforts made to increase productivity and production has been in large measure due to the absence of assured markets and an efficient marketing system. Yet the problems of storage and processing have not yet been adequately tackled and wide price variations still obtain.

CONCLUDING OBSERVATIONS

The significance of root crops in terms of food-supply, resource allocation, national product and in trade, has been briefly presented. It now remains to make a few concluding observations.

Against a background of widespread consumption of roots and of tropical food deficiency, three problem areas are of particular interest. The first, that root crops are deficient in important food elements; the second, that yields are low; and the third, that in the absence of proper processing and storage arrangements, periods of glut and scarcity alternate depending on the 'in' and 'out' season of the crop.

None of these problems allows an easy solution. They involve technical as well as economic, social and political issues. For instance, raising the nutritional level of roots — either by breeding new varieties or by enriching during processing — presents certain technical problems, but that is not all. There are also the likely problems of consumer acceptance. Or again, attempts at raising yields might in some areas involve land reform with its financial and political implications.

What needs to be done seems clear; what is still vague is how it should or indeed, may be done.

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