

COMPARATIVE PERFORMANCE: LARGE-SCALE PRODUCTION vs. SMALL-SCALE PRODUCTION OF YAMS AND SWEET POTATOES IN THE CARIBBEAN

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SUMMARY

Sample surveys in the islands of Barbados, St. Vincent, St. Kitts-Nevis and Jamaica have shown that yam and sweet potato production are financially very unattractive. At the present time small farm production achieves higher productivity to land than that on large farms. Improved technology is not adopted and yields are far below those achieved in experiments. Analyses are provided for each island of the costs and returns for each crop under different farming systems.

RESUME

Des résultats d'enquêtes menées dans les îles de Barbados, de St. Vincent, de St. Kitts-Nevis et de la Jamaïque indiquent que la production d'igname et de la patate douce n'a pas d'attrait du point de vue financier. Actuellement la production obtenue dans les petites fermes ont une productivité plus élevée que celle des grandes fermes. Les techniques améliorées ne sont pas adoptées et les rendements sont de loin en dessous de ceux qu'on obtient sur les parcelles expérimentales. Les coûts et les bénéfices pour chaque culture selon des systèmes adoptés ont été analysés par île.

RESUMEN

La producción de ñame y camote es muy poco atractiva desde el punto de vista financiero según nuestras encuestas en las Islas de Barbados, St. Vincent, St. Kitts-Nevis y Jamaica. Actualmente la producción en las fincas pequeñas alcanza una mayor productividad de la tierra que en las fincas grandes. La tecnología mejorada no se adopta y los rendimientos se encuentran muy por debajo de los que se alcanzan en los experimentos. Se proveen análisis de costos y utilidades para cada cultivo bajo diferentes sistemas agrícolas.

INTRODUCTION

Root crop investigations using satisfactory experimental techniques in the English-speaking Caribbean countries have included agronomic, physiological and bio-chemical studies. Little attention however has been paid to economic and social aspects of root crop production although these crops are staples in the diet of most of the population and contribute to an important extent to the growth and development of their economies. Domestic consumption of root crops is estimated at about 80 percent of production with 20 percent being exported to the growing markets in North America and Europe. Domestic consumption has increased rapidly because of recent shortages of other foods in many of the Caribbean countries. Many people preferred other foods to root crops because of their high starch content and the form of their presentation in the market. Today the situation is gradually changing, not only because of the apparent food shortage but also because of the tight monetary situation.

A recent review of agricultural policies by Edwards and Cropper¹ of many Caribbean countries has shown heavy emphasis on programmes to stimulate the production of food crops and programmes designed to encourage the consumption of more locally produced foods in order to reduce the national food import bill. However, production is not keeping pace with demand. This has resulted in price increases for these commodities.

Two major reasons for the failure of supply to keep up with demand is the lack of knowledge or application of the techniques appropriate for large-scale commercial production. These crops are still considered as 'peasant crops' despite efforts to stimulate their production on large farms. Large-scale farmers have not yet shown much interest in root crops, some because they are preoccupied with other crops, and others who resent the fact that they are required by law to change their pattern of land utilization to accommodate these crops. Other farmers are enthusiastic but lack sufficient knowledge to make a success of the crop. Because of the numerous problems which have reduced the effectiveness of the Food Crop Laws, at least one country is contemplating repeal of the laws.

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That the small farms carry the bulk of root crop production has origins dating back to the days of slavery. Small farm lands are usually situated on the fringes of the large sugar estates or in inaccessible, often steep areas of the country. However, they have managed to continue their production from year to year. Very little assessment has previously been made of their performance in relation to that of the large producers now being required to grow root crops. Should development be aimed at large-scale producers or small-scale producers? Should a strategy be adopted which would lead to the development of specialized producers along the lines of the more traditional crops such as sugarcane, coffee, citrus and bananas? We have lacked statistics necessary even to begin to be able to answer these questions. In this paper I shall try to present some data relevant to the development of an appropriate strategy for root crop production in the Caribbean.

INDICES OF PRODUCTION

In this paper yam and sweet potato production on large farms is compared with their production on small farms, using four indices: labour utilization, productivity to land, productivity to labour and relative profitability.

By labour utilization is meant the number of hours or man-day equivalents required to produce one crop. Total labour used is converted to man-day equivalents by simply dividing the total number of hours by 8 (the standard working day) to get the required coefficient.* Productivity is measured as the average saleable yields per acre per crop and as the number of pounds of the crop produced per hour of labour used. It was not possible to derive marginal productivities because the data are at present too incomplete. Profitability is measured as net return per pound of produce.

SAMPLING METHOD FOR THE SURVEY

Between 1969 and 1971 some 700 farms, both large and small, were visited for collection of data. These comprised 116 farms in Barbados, 88 farms in St. Kitts-Nevis, 261 farms in St. Vincent and 241 farms in Jamaica. Farm size ranged from under one acre to several hundred acres. The primary concern was with root crops rather than on the entire farm even though some information on other farm activities was registered. This survey was later supplemented with smaller selected observations on the crops during the same period.

Few sophisticated sampling techniques were adopted. Other surveying consisted of marshalling the forces of the Ministries of Agriculture, informed individuals, other University personnel, marketing boards and other relevant bodies to ensure that the farms covered were representative of the area in which they were located. The structural features of the countries' agriculture were a significant factor in the selection of the farms. The four countries of the survey are the major ones producing root crops in the English-speaking Caribbean both in terms of acreage devoted to the crop and quantity produced.

The data collected from the survey and subsequent additional studies have been analyzed. Several conclusions resulting from this survey are currently being used as the basis for more advanced studies on the root crop industry.

RESULTS

Systems of production – general

In the Caribbean, yams are generally planted between May and June, just before the onset of the rains. Very little attention is given to which species or cultivar to plant, except where special clones are known to be best suited to the specific areas e.g. of *Dioscorea rotundata* in parts of Jamaica and of *D. alata* in parts of Barbados. Lands are usually forked or ploughed where possible, mechanically or otherwise, then rows, hills or banks are formed at varying distances from 3 – 5.5 ft. Two pieces of yam heads or setts, varying in size from 4 ounces to 4 pounds, are inserted in holes dug on the hills or banks. The crop is weeded two or three times between planting and harvesting which takes place some 8–9 months later, depending on the variety. Very few producers apply fertilizer.

The technology adopted on sugar plantations or estates is similar to that described above for the small farm except that planting distances are standardized to meet the requirements of the coming sugar cane crop, and a little fertilizer is applied. Yams may be staked, as in Jamaica and some parts of St. Vincent, or left to run along the ground, as in Barbados and St. Kitts-Nevis.

For sweet potatoes, the land is prepared in a similar manner. Row spacing may differ depending on the amount of planting materials available or whether they are being produced on estates or small farms — dis-

*A full working day (agric. or industrial) is now however considered to be 5–6 hours in many parts of the Caribbean.

tances vary between 2'6" – 4'. Vines used in planting vary between 6–9 inches in length. Generally two to four vines are planted in each hole. Fertilizer application is rare. Two weedings are generally carried out for the 3–4 month crop.

It is clear from the variety of methods used that no scientifically determined system of production has been developed and passed on to farmers for use in the production of these crops. What has been described briefly above are largely the habits that have been formed and evolved by the farmer himself over the years. As a result there is a very wide difference between the yields reported from experiments and those obtained in the field. It is largely because of this that efforts have begun in the Faculty of Agriculture of the University of the West Indies to try and extend, or at least to test, experimental findings under commercial conditions in several of the Caribbean countries.

Labour utilization, productivity and relative profitability

This section contains data on labour use, productivity, profitability and costs for various farming situations in the four countries of the survey. Yam and sweet potato production in Barbados and St. Kitts-Nevis are largely on sugar plantations or estates but also on small farms while in St. Vincent and Jamaica they are produced largely in the small farm sector.

Barbados:

Data in Table 1 shows an acre of yams produced on small Farms in Barbados required approximately 430 hours or 54 man days for the duration of the crop – divided almost equally between help from within the family and outside help. A 3–4 month sweet potato crop requires about 300 hours of labour or 27 man-days. On the other hand, production of these crops on estates or plantations demands less labour, only 233 hours or 29 man-day equivalents for yams and 159 hours or 20 man-days for sweet potatoes. The reason for this difference is that small farmers depend heavily on hand labour to carry out most of the cultural practices while on estates several of these operations are done mechanically. These include land preparations, transporting of planting materials and haulage of produce at harvest.

Table 2 presents productivity to land and labour for yams and sweet potatoes in Barbados.

As shown in the Table, yield per acre, the crude indicator of land productivity was significantly higher on small farms than on plantations/estates both for yams and sweet potatoes. Small farms produced over 3,000 pounds more yams and about 2,500 pounds more sweet potatoes on the average than their counterparts on the estates. Yield per hour of labour used showed the reverse trend. Plantations/estates produced 50 percent more yams and over 100 percent more sweet potatoes per hour of labour used than small farmers. Small farmers produced only between 28 and 30 pounds of produce per hour of labour used while plantations averaged between 46 and 62 pounds of produce.

Table 3 presents data on relative profitability as measured by net returns per pound. With few exceptions, yam production appears profitable but margins were extremely low on both small farms and estates. Sweet potatoes were much more profitable particularly when produced by small farmers. On the other hand, small farmers tended to have higher production costs for both crops than those on plantations. It costs between 5–13 cents to produce a pound of yams on small farms and between 5–7 cents per pound on the estates. Sweet potatoes cost 3–6 cents to produce on small farms and 2–5 cents per pound on plantations/estates.

The structure of the production costs as indicated by percentage of total cost is presented in Table 4. Costs are broken down into variable and fixed components. For yams, expenditure on labour ranged between 55–65 percent of total costs on the small farms but only 46–47 percent on plantations/estates. Expenditures on materials and equipment varied from 30–39 percent on small farms and 35–47 percent on plantations. Marketing costs were relatively small in both circumstances, and in neither case exceeded 10 percent, but they were higher on plantations. Fixed costs – mainly land tax and rent – were relatively small on both small and large farms.

St. Kitts-Nevis:

Data on labour used (family and hired labour) in producing yams and sweet potatoes in St. Kitts-Nevis are presented in Table 5.

Data on yield per acre and yield per hour of labour used are presented in Table 6. The yam yields obtained on small farms were more than twice the yields obtained on plantations/estates, while sweet potato yields were more than three times the average quantities produced on estates.

Yam yields per hour of labour were similar on both small farms and estates.

Data presented in Table 7 show positive net returns to yams on small farms and on estates in St. Kitts-Nevis. Both yam and sweet potato production were more costly on plantations/estates than on small farms in St. Kitts-Nevis.

Distribution of the costs among production inputs again showed a high proportion for labour in relation to other inputs (Table 8). For yams, the labour component of cost was considerably higher on small farms than on estates.

St. Vincent:

The data for St. Vincent is tabulated according to areas in which the sampled farms were located, different agricultural districts having different rainfall patterns. Those in the Windward part of the island usually receive more rainfall than those on the Leeward side.

Table 9 present information on the number of hours used in producing an acre of yams and sweet potatoes in St. Vincent on small farms.

Farms in the Windward section of the island use approximately 193 man-days to produce one acre of yams, while those on the Leeward side use 139 man-days. Sweet potato production requires about 68 man-days on the Windward, but only 45 man-days on the Leeward side of the island. There is heavy dependence on hired labour.

Table 10 presents data on yield per acre and yield per labour hour. Productivity to land for yams appears from our sampled farms to be higher on the Leeward side than it is on the Windward side, while the reverse is true for sweet potatoes. Yield per hour of labour used for yams was about 6 pounds for all farms, but there was an apparent difference of about 1 pound per hour in favour of the Leeward side of the island for production of sweet potatoes.

Table 11 presents returns on yams and sweet potatoes produced in St. Vincent. Both crops appear to be unprofitable in the Leeward areas but sweet potatoes showed profits in the Windward areas.

The distribution of costs is presented in Table 12.

Labour costs were much higher than costs of materials used in producing sweet potatoes, while marketing costs amounted to 11 and 10 percent in each producing area. Fixed costs were low.

Jamaica:

Data are stratified according to land authorities. Agriculture is administered 'independently' in each authority.

Labour used for yams and sweet potatoes is presented in Table 13. Considerably less labour was used in producing sweet potatoes than yams.

Yield per acre per hour of labour are presented in Table 14.

Net returns to yam are presented in Table 15. It is apparent that there are very few instances of profit.

Labour costs (Table 16) represented between 68 and 85 percent of total costs for sweet potatoes and 33–60% for yams. Expenditure on materials varied between 11 and 20 percent, while fixed charges were only between 1 and 2 percent of total costs.

DISCUSSION

The high and costly labour inputs are noteworthy, especially on the small farms. Small farms would be unable to take advantage of many mechanical devices because of the steep slopes on which the majority of the farms were located especially in Jamaica and St. Vincent. Labour costs were also high, partly because small farms had to compete in the same labour market as the large farms and plantations. The situation is aggravated by the present shortage of labour and the unwillingness of labour to work on eight hour days. Family labour provided a higher proportion of work in Barbados, St. Kitts and Jamaica, whereas farmers in St. Vincent used more hired labour.

Small farms achieved higher production per unit of land, but lower production per hour of labour than large farms in Barbados. In St. Kitts small farmers produced more both per unit of land area and per unit of labour. Small farmers in Jamaica achieved high land productivity, but their labour productivity was significantly lower than in Barbados.

Land and labour are relatively unproductive in St. Vincent.

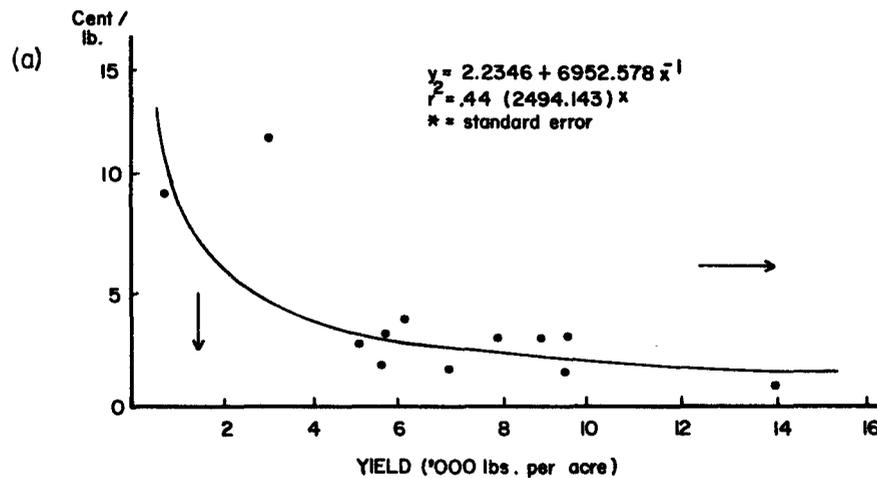
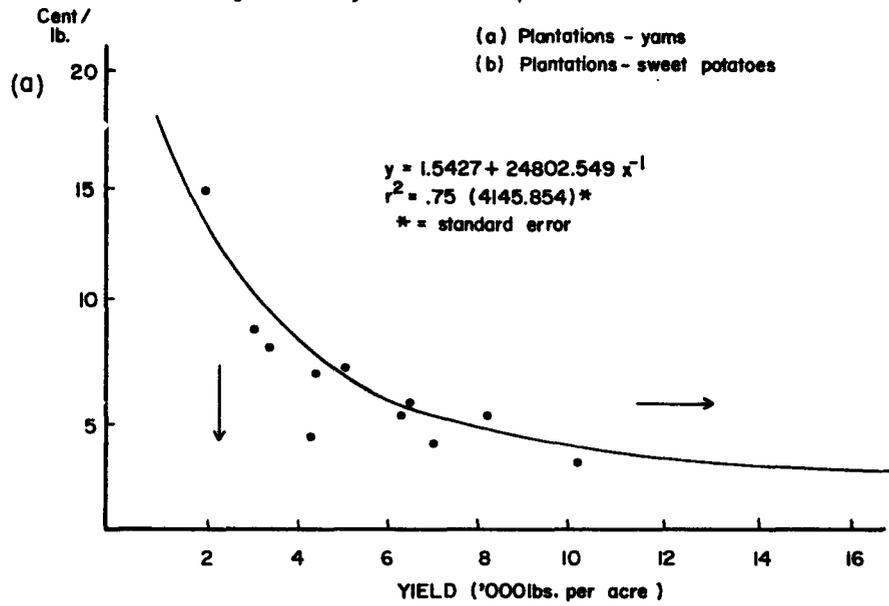
It is clear that neither yam nor sweet potato production in the four countries studied were very profitable operations. Production costs were much higher in Jamaica and St. Vincent than in Barbados and St. Kitts-Nevis because of the labour component necessitated by the steep terrain.

Expenditure on marketing was higher on plantations than on small farms in both Barbados and St. Kitts-Nevis. This was associated with the use of 'well-defined' marketing channels.

However, there are indications that the situation for production and marketing of root crops can be improved. The first problem that should be tackled concerns efforts to increase yield per acre to a level more nearly approaching those achieved in experimental stations, since this has a direct bearing on the overall returns from production. The present relationship between yield and costs is remarkable in that farms with higher yields also had much lower production costs (Figs. 1, 2). A shift in the production functions should be possible to achieve.

But how can this be done? From these preliminary findings it would be obvious to suggest paying greater attention to small farmers; but how long will these farmers remain with us? Will they be able to

Fig 1. Cost - yield relationships



make the most effective use of new technology required to bring about the required overall shift in the production function? The production function *must* be shifted if supply is to be able to satisfy demand and in order in the future to keep 'processing plants' operating at full capacity.

REFERENCES

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Fig 2. Cost - yield relationships

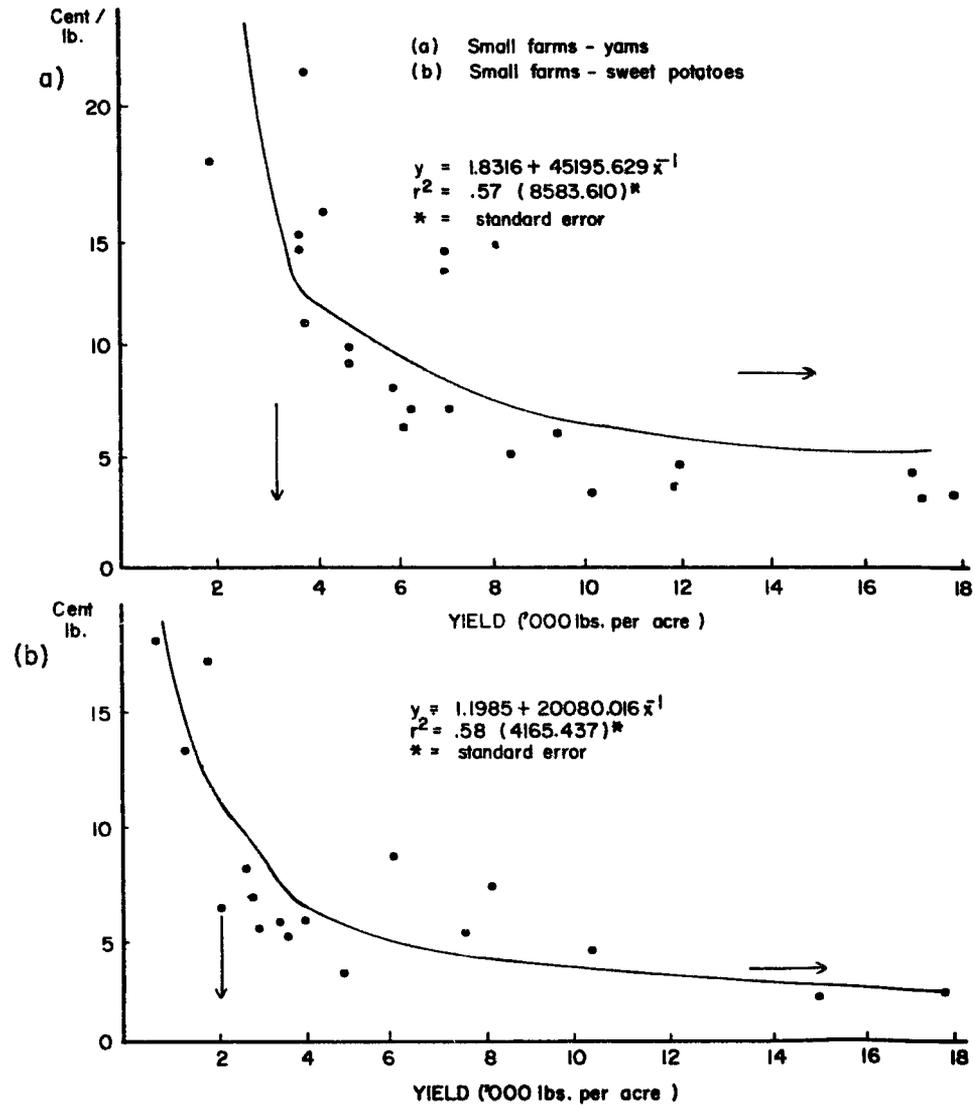


TABLE 1

Number of hours used for acre: yams and sweet potatoes, Barbados

SMALL FARMS (less than 2 acres)			
<u>Yams</u>		<u>Sweet potatoes</u>	
Hired labour	Family labour	Hired labour	Family labour
hrs	hrs	hrs	hrs
315	80	122	80
266	157	127	123
89	380	102	232
Av. 224	206	154	145
Man-day equiv.28	26	19	18
PLANTATIONS/ESTATES (more than 10 acres)			
188	-	134	-
237	-	139	-
274	-	203	-
Av. 233		159	
Man-day equiv.29		20	

N.B. The three entries in each column in this and all tables for Barbados indicate data for each rainfall zone - low, intermediate and high respectively.

Source: Rankine (1972)

TABLE 2

Land and labour productivity on farms producing yams and sweet potatoes in Barbados

	Yield per acre			
	Small farms		Plantations/estates	
	Yams lbs.	Sweet potatoes lbs.	Yams lbs.	Sweet potatoes lbs.
	5,331	7,073	4,181	6,154
	15,378	9,877	6,862	9,782
	10,441	13,091	7,574	7,053
Av.	10,383	10,014	6,216	7,663
Yield per man hour of labour used				
	17	27	38	46
	43	30	30	86
	23	34	80	53
Av.	28	30	46	62

Notes: Figures are rounded off for computation ease.

Reported yields are saleable yields.

Source: Rankine(1972)

TABLE 3

Relative profitability — net returns and costs of production for yams and sweet potatoes in Barbados

Farm types	Yams		Sweet potatoes	
	NR	CP	NR	CP
Small farms	-5.3	13.0	3.3	6.3
	0.7	6.3	3.3	3.3
	5.6	5.3	5.0	5.0
Plantations/ estates	0.3	6.3	1.6	2.3
	1.6	5.0	0.6	2.6
	-0.6	7.0	-	4.6

NR = net returns per pound (cents)

CP = cost of production per pound (cents)

Source: Rankine(1972)

TABLE 4

Structure of production costs – yams and sweet potatoes Barbados

Cost factors	Small farms						Plantations/estates					
	Yams			Sweet potatoes			Yams			Sweet potatoes		
<u>Variable cost</u>	(percentage of total costs)											
Labour	63	55	65	86	65	65	46	47	55	54	45	55
Materials and equipment use	30	39	32	13	32	29	47	44	35	42	45	38
Marketing	1	2	2	-	2	4	5	8	8	5	9	6
<u>Fixed costs</u>												
Rent, tax and sundries	6	4	1	1	1	2	2	1	2	1	1	1

The data in the columns reading from left to right in each section represent low, intermediate and high rainfall zones respectively.

Source: Rankine (1972)

TABLE 5

Number of hours used per acre in producing yams and sweet potatoes in St. Kitts-Nevis

	SMALL FARMS (under 1-5 acres)			
	Yams		Sweet potatoes	
	Hired labour hrs	Family labour hrs	Hired labour hrs	Family labour hrs
St. Kitts	255	189	178	88
Man-day equivalents	32	24	22	11
Nevis	501	97	339	190
Man-day equivalents	63	12	42	24
	PLANTATIONS/ESTATES			
St. Kitts	217	-	84	-
Man-day equivalents	27	-	10.5	-

Source: Rankine (1972)

TABLE 6

Land and labour productivity of farms producing yams and sweet potatoes in St. Kitts-Nevis

<u>Productivity</u>	<u>Small farms</u>		<u>Plantations/estates</u>	
	Yams	Sweet potatoes	Yams	Sweet potatoes
<u>Yield per acre</u>	lbs.	lbs.	lbs.	lbs.
St. Kitts	6,576	2,741	2,538	839
Nevis	5,237	2,046	-	-
<u>Yield per hour of labour used</u>				
St. Kitts	15	10	12	10
Nevis	9	4	-	-

Source: Rankine(1972)

TABLE 7

Relative profitability — net returns and cost of production for yams and sweet potatoes in St. Kitts-Nevis

	YAMS		SWEET POTATOES	
	NR	CP	NR	CP
Small farms				
St Kitts	4.0	6.0	2.0	6.0
Nevis	6.0	8.0	-7.0	17.0
Plantations/estates				
St Kitts	2.0	9.0	-*	9.0

* Breakeven point
 NR = net returns per pound (cents)
 CP = cost of production per pound (cents)

Source: Rankine (1972)

TABLE 8

Structure of production costs — yams and sweet potatoes — St. Kitts-Nevis

<u>Cost factor</u>	Small farms				Plantations/ estate	
	Yams		Sweet potatoes		Yams	Sweet potatoes
<u>Variable</u>						
Labour	71	67*	82	85*	53	61
Materials and equipment use	23	24	13	10	36	30
Marketing	4	6	3	3	6	7
<u>Fixed</u>						
Rent, tax and sundries	2	3	2	2	5	2

* Data in these columns refer to Nevis, others are for St. Kitts.

Source: Rankine (1972)

TABLE 9

Number of hours used per acre in producing yams and sweet potatoes in St. Vincent

<u>Agricultural districts</u>	YAMS		SWEET POTATOES	
	Hired labour hrs.	Family labour hrs.	Hired labour hrs.	Family labour hrs.
<u>Windward section</u>				
No. of hours	1,254	294	452	94
Man-day equiv.*	157	36	56	12
<u>Leeward section</u>				
No. of hours	863	248	278	72
Man-day equiv.	108	31	36	9

* Man-day equivalents: 8 hours day
Source: Rankine (1972)

TABLE 10

Land and labour productivity — yams and sweet potatoes — St. Vincent

Productivity	YAMS	SWEET POTATOES
<u>Windward section</u>	lbs	lbs
Yield/acre	4,424	3,983
Yield/hour of labour used	6	8
<u>Leeward section</u>		
Yield /acre	5,554	3,096
Yield/hour of labour used	6	9

Note: Figures are rounded off for computational ease.
Indicated yields are saleable yields.

Source: Rankine (1972)

TABLE 11

Relative profitability — net returns and cost of production — yams and sweet potatoes — St. Vincent

Agricultural districts	YAMS		SWEET POTATOES	
	NR	CP	NR	CP
Windward areas	-6.0	18.5	1.0	5.0
Leeward areas	-4.0	14.5	-1.5	6.5

NR = net returns per pound (cents)
CP = cost of production per pound (cents)

Source: Rankine (1972)

TABLE 12

Structure of production costs — yams and sweet potatoes — St. Vincent

<u>Cost factors</u>	YAMS		SWEET POTATOES	
<u>Variable</u>	Windward	Leeward (% of total cost)	Windward	Leeward
Labour	50	48	76	73
Materials	43	45	11	16
Marketing	6	6	11	10
<u>Fixed</u>				
Rent, tax, sundries.	1	1	2	1

Source: Rankine (1972)

TABLE 13

Number of hours used per acre — yams and sweet potatoes — Jamaica

Land Authorities	YAMS		SWEET POTATOES	
	Hired hrs	Family hrs	Hired hrs	Family hrs
Santa Cruz	-	-	232(29)	162(20)
Grange Hill	801(100)*	416(52)	-	-
Cambridge	705(88)	298(37)	-	-
Falmouth	482(60)	597(74)	241(30)	527(66)
Claremont	507(43)	226(28)	230(29)	118(15)
Linstead	669(83)	341(43)	-	-
May Pen	596(73)	237(29)	-	-
Mandeville	548(68)	287(36)	276(24)	115(14)
Christiana	325(41)	503(63)	-	-

* Refers to man-day equivalents

TABLE 14

Land and labour productivity — yams and sweet potatoes — Jamaica

Agricultural districts	YAMS		SWEET POTATOES	
	Land	Labour	Land	Labour
Grange Hill	7,123	6	-	-
Cambridge	12,254	12	-	-
Falmouth	5,409	5	1,886	2
Claremont	6,997	10	2,440	7
Mandeville	9,616	11	3,782	10
Christiana	5,623	7	-	-
Linstead	6,157	6	-	-
May Pen	10,314	12	-	-
Santa Cruz	-	-	4,898	12

Note: Land productivity lbs./acre
Labour productivity lbs/hour

Source: Rankine

TABLE 15

Relative profitability — net returns and cost of production — yams and sweet potatoes — Jamaica

Agricultural districts	YAMS		SWEET POTATOES	
	NR	CP	NR	CP
Grange Hill	-9.0	14.0	-	-
Cambridge	2.0	4.0	-	-
Falmouth	-3.0	9.0	-10.0	13.0
Claremont	-1.0	7.0	- 2.0	4.0
Mandeville	-1.0	6.0	- 1.0	5.0
Christiana	-2.0	6.0	-	-
Linstead	-2.0	7.0	-	-
May Pen	1.0	4.0	-	-
Santa Cruz	-	-	1.0	3.0

Note: NR = Net returns per pound (cents)
CP = Cost of production per pound (cents)

Source: Rankine (1972)

TABLE 16

***Structure of production costs — yams and sweet potatoes — Jamaica**

<u>Cost factors</u>	YAMS								SWEET POTATOES			
	GR	Ca	F	C1	L	MP	M	C	F	C1	M	S
<u>Variable</u>												
Labour	33	51	42	38	54	43	40	60	85	72	80	68
Materials	64	42	51	54	43	50	58	37	11	20	16	20
Marketing	2	6	6	6	1	6	1	1	3	6	2	1
<u>Fixed</u>												
Rent, tax sundries	1	1	1	2	2	1	1	1	1	2	2	1

Note: Gr = Grange Hill C1 = Claremont M = Mandeville
 Ca = Cambridge L = Linstead C = Christiana
 F = Falmouth MP = May Pen S = Santa Cruz

Source: Rankine (1972) * Percentage of total costs.