

THE DEVELOPMENT OF THE IRISH POTATO INDUSTRY IN JAMAICA

— by —

I. E. Johnson

Division of Economics & Statistics, Ministry of Agriculture and Lands, Jamaica.

The production of Irish potatoes in Jamaica dates back to 1897. In that year two varieties of "seeds" were imported from the United Kingdom and 'tried out' at elevations of about 3,000 ft. The results were encouraging; and in 1900 the Jamaica Agricultural Society imported other varieties for further trials. At the same time efforts were made by the Society and the early pioneer farmers to popularise the production and consumption of the crop. Soon local demand began to respond favourably, and as a result, production was progressively extended into new areas.

But the expansion of the crop was to receive an early set-back. Local production depended (and still depends) on imports of seeds and thus it was that the lack of shipping space during World War I caused a reduction in the supply of seeds. Supply of 'seeds' was inadequate to meet demand and prices rose from 14/- per barrel (of 150 lb.) in 1913 to 42/- in 1917.

High prices for seed potatoes threatened the survival of the industry. In response, farmers requested government to provide credit assistance to enable them to continue production. In addition, they initiated discussions on regulating the market for Irish potatoes. At the same time, the Department of Agriculture conducted a series of experiments in an effort to establish the crop on a more viable basis. (A summary of the more important experiments is given in the Appendix.)

The later development of the Irish potato industry may conveniently be divided into three periods, namely :— an exploratory period, a period of expansion, and the attainment of self-sufficiency. The exploratory and expansion periods overlap to a certain extent as some exploratory work continued through the expansion period and in fact, is still continuing.

THE EXPLORATORY PERIOD

The main exploratory activities of the industry may be regarded as having taken place during the period prior to 1950 and particularly during the 1940's with which period was associated most of the field experimentation. However, it was during the period 1950 – 1954 that there was a greater drive towards commercial field operations. During this period there were noticeable increases in the demand for Irish potatoes. Due to the fact that import data over that period did not differentiate precisely between 'seed' and 'table' potatoes, and the fact that nearly all the seed potatoes are imported, it is difficult to give as accurate an estimate of the local production of table potatoes as otherwise would have been the case. However the total value of imported Irish potatoes (see Table 1) increased from £9,832 in 1950 to £52,794 in 1954.

Table 1. *Quantity and Value of Irish Potato Imported, Jamaica, 1950 – 1954*

Year	Imports (’000 lb.)	Value (£)
1950	965.3	9,832
1951	3,067.0	37,790
1952	2,445.9	33,688
1953	2,805.8	30,688
1954	5,627.7	52,794

Source : *External Trade Statistics*, Department of Statistics, Jamaica.

In 1942 a subsidy scheme was introduced by Government. During that year seeds were sold at 40/- per barrel of 150 lb., but this price was subsidized to growers to the extent of 17/- per barrel. In order to facilitate growers, control depots were established at convenient points throughout the potato growing area. Each farmer had to take delivery of seeds from the nearest depot, and he could only obtain seeds on the presentation of a *Certificate of Recommendation* signed by the Agricultural Instructor for his area. This, it was hoped, would prevent resale of seed potatoes at “black market” prices.

During the period 1947 to 1949 the rate of direct subsidy paid by Government was of the order of 10/- per barrel. Indirect Government assistance was also provided to encourage local production. In this respect seed potatoes were exempted from the *1d per lb.* import duty payable on table potatoes. There had also been in existence a Government Guaranteed Purchase Scheme for potatoes. The guaranteed prices for potatoes delivered in Kingston to the Department of Commerce and Industries (succeeded by the Marketing Department and finally by the Agricultural Marketing Department) for the period 1947 to 1949 were :

Year	Price (per 100 lb.)
1947	13/2 – 15/-
1948	16/6 – 18/-
1949	20/-

However, only a small fraction of the crop was sold to the Government since prices obtainable elsewhere were higher than the guaranteed price. Protection was offered to the grower to enable him to dispose of his crop readily. Importations of table potatoes could only be made on special permits and from specified countries only, importations being severely curtailed during months when the locally produced crop is on the market.

The subsidy continued uninterrupted until it was terminated during the 1961/62 crop year. Accurately recorded subsidy figures are not available for the period before 1950. The largest rate of subsidy as can be seen from Table 2, was paid by Government to growers in 1952 and this was due primarily to the disastrous effects of the 1951 hurricane.

Table 2. Subsidy on Irish Potatoes, Jamaica, 1950 – 1961

Year	No. of Crates of 100 lb.	Amount of Subsidy			Av. Subsidy Per Crate		
		£.	s.	d.	£.	s.	d.
1950	16,004	6,433	13	4		8	1
1951	16,251	2,830	9	10		3	6
1952	15,000	17,357	6	8	1	3	2
1953	15,700	7,336	8	4		9	4
1954	10,628	2,760	0	0		5	2
1955	11,691	6,300	0	0		10	9
1956	15,000	4,500	0	0		6	0
1957	16,100	7,884	0	0		9	9
1958	16,100	6,911	0	0		8	7
1959	18,500	19,348	0	0	1	0	11
1960	25,000	4,000	0	0		3	2
1961	20,535	2,000	0	0		2	0

As the production of Irish potatoes expanded, problems arose with pests and diseases. In 1950 the Department of Agriculture carried out investigations into the losses due to infestation with eel-worms. Heavy losses were sustained in that year due to a serious infestation by the root knot nematode, *Heterodera marioni*. An investigation-cum-demonstration project was laid down in relation to :

- (i) inconsiderate agricultural practices ;
- (ii) field sanitation ;
- (iii) judicious crop rotation ; and
- (iv) application of nematocides, and the practice of bare fallowing.¹

During the period 1950-1954 there were clear indications that there was scope for increasing local production advantageously, but that there was the necessity to stabilize farmers' position. This led to the paying of more earnest attention to planning, organization, crop rotation and efficient practices. These activities developed largely within the frame-work of the Irish Potato Growers' Association which was formed for the purpose of rationalizing and expanding the industry. As production increased, problems associated with storage developed, and the Department of Agriculture carried out investigations into storage losses due to shrinkage, rotting and excessive sprouting.

THE PERIOD OF EXPANSION

The period 1955-65 may be regarded as one of expansion. Interested farmers in their endeavour to make potato growing a business continued in their quest for better techniques and cultural practices. Indeed, so great was the development in the industry that Government discontinued the payment of a subsidy for seeds in 1962. It was during this period that an Irish potato Advisory Committee

¹

Investigations 1949-1950, Bulletin 47, Department of Agriculture, Jamaica.

was set up within the Ministry of Agriculture and Lands. More precise and up-to-date information relating to all aspects of the industry was made available. This included information on the quantity of seeds planted, and the break-down of import data into table and seed potatoes. This latter in particular made it possible to obtain more reliable estimates of production.

The fact that Jamaica does not produce certified seeds indicated clearly that increased quantities of seed would have to be imported for the expansion of local production. Thus except for 1961 the quantity of seed potato imported increased every year since 1955. Indeed, the quantity of seeds imported more than trebled during the period 1955-66. The most marked increases in the importation of seeds were made during the period 1964-66.

Increased planting resulted in increased production and progressively reduced the need for substantial imports of table potatoes. The data presented in Table 3 indicate a somewhat erratic pattern in the quantity of table potatoes imported up to 1962, followed by a continuous decrease and finally by a cessation of imports in 1966.

Table 3. Quantity and Value of Irish Potato (Seed & Table) Imported, Jamaica, 1955 - 1966

Year	Table Potatoes	Seed Potatoes	Total Imports	
	(m. lb.)	(m. lb.)	(m. lb.)	(£'000)
1955	4.8	1.5	6.3	74.6
1956	5.2	1.6	6.8	83.2
1957	5.3	1.6	6.9	95.6
1958	10.9	1.8	12.7	164.4
1959	10.7	2.2	12.9	156.9
1960	5.4	2.5	7.9	115.3
1961	9.2	2.1	11.3	141.1
1962	11.9	2.6	14.5	132.6
1963	8.0	2.8	10.8	128.7
1964	3.5	3.5	7.0	88.2
1965	1.9	4.7	6.6	51.3
1966	0.6	5.7	6.3	n.a.

But these were not the only important developments of the period. In March 1959 the Christiana Potato Growers' Association was registered as a Co-operative Society under the Co-operative Societies Law. The Society's main aim was to improve the economic welfare of its members and pledged itself to :

- (i) initiate, develop and encourage more economic and better methods of production and marketing ;
- (ii) make arrangements for the pooling, curing, grading and transporting of Irish potatoes for its members ;
- (iii) make arrangements for the most profitable disposal of potatoes for its members ;

- (iv) act as agent for its members in procuring seed, implements, fertilizer and other necessary supplies ; and
- (v) raise funds on loan to meet other objectives of the Society and for making credit advances to members.

This was a great step forward by which farmers gained new confidence in the industry. They were now able to bargain as a group to the advantage of members of the Association.

ATTAINMENT OF SELF SUFFICIENCY

The annual local production of Irish potatoes nearly trebled between 1955 and 1966 (see Table 4).

Table 4. Quantities of Irish Potatoes available for Consumption, Jamaica, 1955 - 1966

Year	Import	Local Production	Total Available	Local Production as % of Total
	(m. lb.)	(m. lb.)	(m. lb.)	(%)
1955	4.8	11.6	16.4	71
1956	5.1	8.9	14.0	64
1957	5.3	9.3	14.6	64
1958	10.9	11.1	22.0	50
1959	10.7	15.4	26.1	59
1960	5.4	15.0	20.4	74
1961	9.3	15.6	24.9	63
1962	11.9	14.1	26.0	54
1963	8.0	18.8	26.8	70
1964	3.5	21.5	25.0	86
1965	1.9	26.1	28.0	93
1966	0.6	32.9	33.5	95

Source: *External Trade Statistics*, Dept. of Statistics; Estimates by Dept. of Agriculture and Ministry of Agriculture and Lands.

In that period, not only did Jamaica become self-sufficient in Irish potatoes for table consumption but in 1966 had problems mainly in relation to storage of surpluses above the immediate demand. As a consequence attempts were made to find export markets. The achievement of self-sufficiency depended particularly on the extension of the planting seasons. Table 5 indicates the quantity of seed planted in each of the three seasons during the period 1960-1966.

Table 5. Yearly Seasonal Planting of Irish Potato, Jamaica, 1960-1966

Year	Total Planted (100 lb. bags)	Spring Planting (Quantity) (100 lb. bags)	(% of total)	Summer Planting (Quantity) (100 lb. bags)	(% of total)	Fall Planting (Quantity) (100 lb. bags)	(% of total)
1960	25,000	17,376	69.5			7,624	30.5
1961	20,535	17,172	84.6			3,363	15.4
1962	26,000	17,171	66.0			8,229	34.0
1963	27,785	20,943	75.4	2,162	7.7	4,680	16.9
1964	35,180	23,705	67.3	5,200	14.8	6,275	17.9
1965	47,388	35,125	74.1	2,600	5.5	9,663	20.4
1966	56,890	44,140	77.6	1,580	2.8	11,170	19.6

ECONOMICS OF PRODUCTION AND DISPOSAL OF IRISH POTATOES

The story of Irish potato production in Jamaica must be regarded as a success story in terms of the achievement of self-sufficiency. A programme of selection of varieties, fertilizer experiments, storage trials, *inter alia*, has led to the achievement of one of the desired end results, namely that of almost replacing imports of table potatoes. Other results which are desirable relate to satisfactory returns both to the growers and to those responsible for marketing potatoes.

(i) *Environmental Conditions of Production*

(a) *Climate*. Irish potatoes thrive best under relatively cool conditions and in Jamaica production is therefore concentrated in areas where the elevation is over 1,000 ft. A rainfall of about 10 inches, well distributed during the growing season is normally required for the production of good yields. On heavier soil the rainfall need not be as high.

(b) *Soils*. Usually, Irish potatoes grow best on deep well drained soils, but in Jamaica heavier soils are sometimes used. Soils used for growing potatoes in the main potato producing areas include the free draining *terra rossa* soils, clay loams, and even some of the heavier clay soils.

(c) *Growing Seasons*. The production of Irish potatoes is seasonal, there being two well defined seasons in Jamaica. The main crop is planted during February-April and is reaped during the period June-August. The other crop is planted during the period November-January and is reaped during the period February to April. In the past, locally grown potatoes were available for the period February through August, the period September to January being that for which imports were allowed by Government. This led to steps being taken to find areas in which Irish potatoes could be grown to bridge this gap in the local production. Since 1963 a small crop has been planted during the Summer (June to August) for reaping during the period October to December. Exploration for new areas for growing this summer-planted crop is continuing.

The main areas of production and the growing seasons are listed below.

<i>Area</i>	<i>Time of Planting</i>	<i>Time of Reaping</i>
Devon) Chudleigh) Christiana)	February to April	June to August
Darliston) Guy's Hill) Lucky Hill)	November to January	February to April
South Manchester) North Eastern St.) Andrew)	June to August	October to December

Varieties. Many varieties of Irish potatoes have been tried in Jamaica. They vary greatly in appearance, yield, time of maturing, resistance to diseases and pests, and eating quality. Some of the varieties tried in Jamaica and their origins are set out below.

<i>Canada:</i>	<i>Ireland:</i>	<i>Scotland:</i>
Up-to-date	Up-to-date	Arran Victory
Burbank	Craig's Snowwhite	Arran Consul
Sebago	Arran Banner	Kerr's Pink
Cobbler		
Green Mountain		
Kathadin		
Kennebec		
Red Pontiac		

The most important of those which are now grown commercially are: Arran Consul, Sebago, Kennebec and Red Pontiac.

In the past, there has been a tendency for growers in different areas to favour particular varieties. Today, farmers while selecting varieties which are suitable for their areas also look for heavy bearing varieties and for seeds which are not too costly. It sometimes happens, however, that the high cost of seed is related to the demand and supply situation at the source of the purchase. In this respect the cost of Sebago, a popular variety which was reported at 65/- per 100 lb. as compared with 42/- to 47/- per 100 lb. previously, has largely resulted in this variety not being used in 1967. In this respect it should be pointed out that due to the necessity for us to import seed we are at some disadvantage particularly in relation to our ability to obtain the particular varieties required. The average yields for current varieties being used in different areas are as shown in Table 6.

Table 6. *Origin, Varieties of Potatoes grown, Areas of Production and Ratios of Yields to Quantities of seed planted, Jamaica*

Origin of Seeds	Varieties of Potatoes	Areas of domestic production	Yield Ratios
U.K.	Arran Consul	(N. Manchester)	10 : 1
		(S. Manchester)	11 : 1
Canada	Kennebec	(N. Manchester)	9 : 1
		(S. Manchester)	9 : 1
		(Darliston)	6 : 1
		(Guy's Hill)	7 : 1
		(N.E. St. Andrew)	8 : 1
Canada	Sebago	(N. Manchester)	7 : 1
		(S. Manchester)	7 : 1
		(Darliston)	5 : 1
		(Guy's Hill)	6 : 1
		(Portland)	
		(Sherwood Forest)	6 : 1
Canada	Red Pontiac	(N.E. St. Andrew)	6 : 1
		(S. Manchester)	8 : 1
		(Darliston)	6 : 1
		(Guy's Hill)	7 : 1
		(Portland)	
	(Sherwood Forest)	7 : 1	

(ii) *Cost of Production*

Irish potatoes are grown on farms of varying sizes, ranging between 0.10 acre and 70 acres. The distribution of acreage by size group of farms is not available but on the basis of the quantity of seed planted the estimated area under production increased from about 2,300 acres in 1963 to 4,650 acres in 1966. In the major producing area mechanical tillage is possible in some instances. For most of the land in other producing areas manual tillage must be used and this automatically increases the cost of production. Growing conditions vary as to areas of production, soils and seasons. In addition, there is the question of the particular varieties which are suited to these varying conditions. There are also variations in terms of the cultural practices employed, and there are important aspects related to management. As a consequence of all these factors costs of production have varied widely. For the purpose of this paper costs of production data will be presented for each of the three main Irish potato growing areas.

The cost of production study carried out by the Division of Economics and Statistics of MAL in 1957 (details are shown in Appendix II) indicates very little percentage variation between the broad items of cost as the levels of yield increased.

Table 7. Percentage Distribution of Cost of Production of Irish Potatoes at Four Levels of Yield, Jamaica, 1957

Cost Items	7,000 lb. Yield (%)	10,000 lb. Yield (%)	12,000 lb. Yield (%)	14,000 lb. Yield (%)
Labour Operations	40.8	41.6	42.0	42.4
Planting Materials	25.4	25.0	24.8	24.5
Other Materials	24.0	23.5	23.3	23.1
Miscellaneous	9.8	9.9	9.9	10.0
Total	100.0	100.0	100.0	100.0

Margins based on the 1957 costs of production varied from one of -£3.14.0 per acre for a 7,000 lb. yield (the ratio of yield to quantity of seed planted being 5 : 1), to £96. 1. 3 where the ratio of yield to seeds planted was 10 : 1. The significant feature of these costs was that sizeable increases in yields are obtainable with relatively small increases in costs of production. Another important feature associated with the returns per acre is the fact that only 85% of the potatoes produced were of top market quality, 10% of lower quality and 5% had no market value. Thus on the basis of the cost/returns data there are three main areas in which returns could be increased, namely :

- (i) use of improved cultural practices;
- (ii) more efficient production; and
- (iii) reduction of the percentage low quality tubers.

Cultural practices have changed since 1957 and are continuing to change. More farmers are adopting improved practices. On the expenditure side these changes have affected not only the total costs of production but also the percentage distribution of these costs among the major items of cost. The main increases are related to increased labour rates and to heavier applications of fertilizer, the unit costs of which have been increasing over the years. These increased costs have to some extent been held in check by a change from manual to mechanical tillage in some areas of production. In some instances high seed cost is a factor which increases production costs but the resultant higher yields per acre sometimes offset these higher costs. It should be pointed out that the seed rate per acre varies considerably, the range being between 10 and 23 bags per acre.

On the revenue side increases in yields per acre as well as increased prices to the farmer have led to significant increases in the margins per acre. There are now three recognized planting periods namely Spring, Summer and Fall. Table 5 shows the distribution of the quantity of seeds planted according to seasons. In view of the fact that Christiana is the main Irish potato (Spring planted) growing area, detailed costs of production in this area for the period between 1957 and 1966 are shown in Appendix Table II to this report. Relevant details from this Table are shown in Table 8.

Table 8. Changes in Cost of Production and Returns from Irish Potato in the Christiana Area, 1957, 1962 and 1964-1966

Items	1957 (£)	1962 (£)	1964 (£)	1965 (£)	1966 (£)
Labour Charges	43. 7.0	41.16.0	49.10.0	68. 2.0	49. 3.0
Materials	53. 1.0	71.16.0	63. 8.0	58.10.0	65.16.0
Other Charges	8.16.0	6.10.0	9. 3.0	11.11.0	10. 0.0
Interest	4. 4.0	4.16.0	4.18.0	5.10.0	5. 0.0
Total Cost of Production	109. 8.6	124.18.0	126.19.0	143.13.0	129.19.0
Value of Yield	148.11.0	178. 0.0	178. 0.0	192.10.0	210. 0.0
Margin	39. 2.6	53. 2.0	51. 1.0	48.17.0	80. 1.0
Estimated Yield (lb).	10,000	10,000	10,000	9,800	11,200
Ratio of Yield to Seed	7 : 1	7 : 1	7 : 1	7 : 1	8 : 1
Cost of Production per lb.	2.6d	3.0d	3.0d	3.0d	2.8d

Over the period 1957 to 1966 the significant features were :

- (i) increasing yields per acre ;
- (ii) increasing costs of production in absolute terms ;
- (iii) maintenance of, and in some cases a reduction in, the cost of production per lb ;
- (iv) increasing margins per acre; and
- (v) absolute increase in price to farmer.

Table 9. Comparative Costs of Production of Irish Potatoes in Four Areas, Jamaica, 1966

Items	(. Christiana)			S. Manchester	Darliston	Guy's Hill
	(Large farm) (£)	(Medium farm) (£)	(Small farm) (£)			
Labour Operations	84.12.0	49. 3.0	52. 8.0	27.16.0	77.13.0	60. 2.5
Materials	96. 6.0	65.16.0	47.10.0	88.19.6	81.10.0	65. 0.6
Other Charges	16.15.0	10. 0.0	7.10.0	11.10.0	24. 9.0	10.10.0
Interest	8. 0.0	5. 0.0	4. 6.0	6. 0.0	5. 0.0	5.17.6
Total Cost of Production	205.13.0	129.19.0	111.14.0	134. 5.6	188.12.0	141.10.5
Value of Yield	300. 0.0	210. 0.0	150. 0.0	302. 1.0	179.11.0	183.15.0
Margin	94. 7.0	80. 1.0	38. 6.0	168. 9.0	-9. 1.0	42. 4.7
Estimated Yield (lb.)	16,000	11,200	8,000	16,150	9,000	8,400
Ratio of Yield to seed	8 : 1	8 : 1	8 : 1	9.5 : 1	6 : 1	7 : 1
Cost of Production per lb.	3.1d	2.8d	3.4d	2d	5d	4d

Summer planting has been undertaken only within recent years, but Fall planting has had a longer history. Appendix Table IV shows the relative detailed costs of production for selected farming situations in each of the three growing areas. Relevant summarized data are presented in Table 9. On the basis of these data it is clear that the costs of production per lb. for Fall planted potatoes in both Guy's Hill and Darliston are higher than for Spring planted and Summer planted potatoes. These higher costs of production are associated mainly with the terrain of the area. However, uncertainty of the rainfall tends to limit production from the Summer planted crop.

(iii) *Disposal of Irish Potatoes*

In two of the recognized Irish potato growing areas there are co-operative organizations serving farmers' interests. These are:—

- (i) The Christiana Potato Growers' Co-operative ; and
- (ii) The Darliston Potato Growers' Co-operative.

The Christiana Potato Growers' Co-operative Association (CPGCA) is a co-operative society, *sensu stricto*, while the Darliston Co-operative operates on a limited co-operative basis only, as it merely purchases seeds in bulk for its members. The CPGCA has a close working relationship with the Agricultural Marketing Corporation (AMC) which is the main purchaser of potatoes. In 1966 the AMC handled 9,500 short tons, equivalent to 57.6% of the total production for 1966, and it is of more than academic interest to examine the related transactions in the purchasing, storing and marketing of these potatoes.

The AMC purchases potatoes both from the CPGCA and from other farmers in the Christiana producing area. It also buys directly from farmers in the other producing areas. It keeps most of these potatoes in storage at its Coleville Storage Plant (within the Christiana area), Zero Processing and Storage Ltd. in Kingston, Lydford in St. Ann, the AMC Headquarters in Kingston and the AMC's Branch Office in Christiana. In 1966 members of the CPGCA received 40/- per 100 lb. for potatoes delivered at the Coleville Storage plant (capacity 3,500-4,000 short tons). A cess of 6d per 100 lb. is retained by the CPGCA to assist in meeting its operating costs. The CPGCA is advanced money by the AMC to purchase potatoes from farmers. The storage plant is owned by the AMC but operated by the CPGCA under conditions agreed on between the AMC and the CPGCA. The main services performed by the Association are :

- (i) selecting and purchasing potatoes from growers ; and
- (ii) storing and/or bagging potatoes for transfer to designated points as is necessary.

Once purchased by the CPGCA, potatoes become the property of the AMC. The AMC pays the CPGCA a fee of 3/9d per 100 lb. purchased, to cover charges for the various services rendered. The AMC supplies bags and twine, and is also responsible for providing and maintaining the cold storage facilities.

On the above basis the AMC's trading transactions on the Spring planted crop may be summarized thus :

AMC pays	40/- per 100 lb. for Spring planted potatoes
	3/9d per 100 lb. to the CPGCA for services
	1/6d per 100 lb. for transportation cost from Coleyville to Kingston
Total	45/3d per 100 lb.

In addition, the AMC meets the costs for the following :

- (i) servicing and maintaining cold storage facilities ;
- (ii) handling and sorting of potatoes leaving the storage plant ;
- (iii) covering losses due to spoilage, shrinkage, excessive sprouting etc. estimated at 15% of the quantity placed in storage ; and
- (iv) packaging and transportation to supermarkets.

These additional costs are estimated to total 10/9d per 100 lb., and when added to the 45/3d direct payment, give a cost of 56/- per 100 lb. for trading in Irish potatoes. When weighed against a sale price of 50/- per 100 lb., it would appear that the AMC is losing a minimum of about 6/- per 100 lb. on trading transactions for Spring planted Irish potatoes.

The Fall planted crop although producing only slightly above one-fifth the volume of the main crop (Spring planted) is adequate for about 3 months' supply and requires storage. As already indicated the AMC has to provide the storage facilities and this results in new potatoes and old potatoes being in storage at the same time. The AMC therefore has a problem in terms of disposing of the older potatoes. Because of the very nature of the crop and particularly because all the potatoes planted during any one season are reaped over a relatively short period (say 4 weeks), the volume of potatoes handled is always greater than immediate consumption. However, when production from Spring planted potatoes is as high as it was in 1966, production falls more out of step with consumption than ordinarily would have been the case. The longer period required for storage means that the AMC ends up bearing a heavier loss for storing potatoes.

Although the retail prices which are fixed by the Ministry of Trade have been relatively static over a period of years actual prices paid by consumers have varied, sometimes considerably from those fixed prices especially in the parochial markets. One reason for this is the fact that new potatoes often fetch a higher price than old potatoes. Table 10 shows recent farm gate, wholesale and retail prices for Irish potatoes.

Table 10. Farm Gate, Wholesale and Retail Prices for Spring Planted Irish Potatoes, Jamaica, 1963-1967

Year	Farm Gate Price ¹ (per 100 lb.)	Wholesale Price ² (per 100 lb.)	Retail Price ² (Per lb.)
1963	32/- & 33/-	40/-	6d
1964	35/-	40/-	6d
1965	40/-	46/-	6d & 7d from 13/2/65
1966	40/-	50/-	7d; 7½d from 3/3/66 7d from 18/5/66
1967	40/-	50/-	7d

¹ Prices fixed by the Ministry of Trade and Industry.

² Prices ex-Marketing Department, new AMC.

In 1947-48, it was recorded² that due to high production costs and poor yield, farmers received prices of 50/- to 60/- per 100 lb., while retail prices at Christmas were as high as 1/2d per lb. Currently the supermarkets in the Corporate Area retail Irish potatoes at 7d per pound after purchasing at 6d per pound – these are prices fixed by Government. Retail prices in parochial markets reach 10d per pound. Supermarkets regard the margin of 1d per lb. as being too small. At the same time, the margin between farmers' prices for the Spring planted crop and the wholesale selling price is not high enough to cover all the marketing and storage costs of the AMC which is the major handler of Irish potatoes.

On the basis of a yield of 11,200 lb. per acre (for 1,400 lb. seed planted) and at a farm gate price of 40/- per 100 lb. for the Spring-planted crop, farmers who are reasonably efficient can obtain a margin of £80 per acre for a 3-4 month crop. By comparison the returns from the Fall-planted crop are on the over-all not as remunerative due to higher costs of production and lower yields per acre. The main features of the Spring-planted crop are :

- (i) production is much in excess of that needed to satisfy current annual consumption;
- (ii) the quantity of seeds planted in Spring exceeds that needed to obtain the production which would satisfy the annual requirements for table potatoes ;
- (iii) the heavy production which ensues requires storage over long periods and this in turn leads to (a) heavy financial loss to the AMC; and (b) consumer resistance to potatoes stored for a long period, which leads to longer storage and therefore further losses to the AMC;
- (iv) stored Spring-planted potatoes overlap production from Fall-planted potatoes.

The main steps to be taken in rationalizing the Irish potato industry would seem, therefore, to be related to the phasing of production so as to reduce the heavy losses suffered by the AMC in handling the main crop and at the same time to improve storage and distribution. The heavy production is largely due to the quantity of seed planted during the Spring, and to the attractive prices paid for Spring planted potatoes.

Unless local consumption rates increase and suitable export markets can be found then there is little merit in continuing to increase the quantity of seeds planted during the Spring. There is clear evidence that the quantity of seeds planted should be reduced on a basis which also takes into consideration the increased yields per acre which are being produced as a result of the adoption of improved cultural practices and the exercise of improved levels of management. Since rationalization will also involve consideration of efficient production, questions will arise in relation to farmers who would be displaced as well as those who would have to face up to a reduced quantity of seeds. Finally, the degree of variability in conditions affecting production leads to annual variations in yields per acre and ultimately to variations in production. Thus it is important that this factor be borne in mind when attempting to rationalize production.

The price mechanism could be used as an additional deterrent to over-production in the industry once questions relating to the quantity of seeds to be planted, a fair price to producers, and improved storage and distribution of table potatoes have been settled. By the same token the price mechanism could be used to stimulate production from Summer and Fall plantings.

In taking steps to rationalize the industry it would be necessary to look more closely into the efficiency, cost and actual volumes of production in existing producing areas. While there is economic justification for out-of-season crops being higher priced, it would be necessary, for example, to examine the justification or otherwise for fostering production in the Darliston area in which very high costs of production as well as low yields per acre obtain.

Looking at the hard core of the economic implications of present performance in the Irish Potato industry, the following are the more striking factors :—

- (i) the high costs incurred
- (ii) the comparative prices of locally produced and of imported potatoes;
- (iii) increasing costs of seeds and fertilizer; and
- (iv) price incentives, if any, which would be necessary to stimulate expansion of production from Summer and Fall plantings.

This paper on Irish Potatoes would be incomplete without reference to questions concerning substitution of and by other starchy foods. Although a detailed examination of this aspect is of more than academic interest, it is beyond the scope of the paper. Suffice it to say that Jamaicans obtain their starches from a varied number of products which include rice, flour, cornmeal, yams, sweet potatoes, Irish potatoes, cocoas, dasheens, cassava, breadfruit, plantains and green bananas. The per capita consumption of Irish potatoes is very low by comparison with that of rice, flour, cornmeal, breadfruit, yams, green bananas and sweet potatoes, and without going into details the retail price (actually paid by the consumer despite the existence of fixed prices) of Irish potatoes is often higher than those of the other locally produced starches.

CONCLUSIONS

An attempt has been made in this paper to trace the development of the Irish potato industry. Reference has been made to the various problems which were involved and the measures taken to overcome them.

Many experiments were conducted largely with fertilizers, storage, varietal trials, pest control measures, etc., and these are continuing.

Cultural practices have improved considerably and yields per bag of seed planted and per acre have also improved. Returns to reasonably efficient farmers producing under good soil and water conditions have increased and are very satisfactory.

The high production from the Spring-planted crop which is associated with the planting of too large a quantity of seeds as well as with the attractive prices paid to farmers has pointed up the necessity for controlling the quantity of seeds

planted and for phasing production. In this respect, the search for new areas of production to assist in the rationalization of production is continuing.

Production of potatoes in excess of current demand has led to the necessity for the AMC to meet additional costs for storage and distribution. In turn, problems of distribution are partly related to the perishable nature of Irish potatoes and this ultimately leads to the unwillingness of some supermarkets and other retailers to handle large quantities of the crop.

The use of the price mechanism can play an important role in rationalizing production and also in improving the rates of distribution of table potatoes.

The history of the development of the Irish potato industry could point the way for the development of other crops, both in relation to the approach used, the successful measures applied and also to the pitfalls which should be avoided. Future work in stabilizing the industry should include :

- (i) an over-all rationalization of production and marketing (including distribution);
- (ii) improved storage facilities;
- (iii) a continued search for high yielding varieties;
- (iv) a search for new production areas;
- (v) exploration of export markets; and
- (vi) exploration of the possibility of producing seed locally.

*APPENDIX**Investigations on Irish Potatoes*

(a) 1936-39

The sustained development of the industry resulted in greater demands being made on Government for assistance largely by way of the provision of advisory services. In order to facilitate the provision of such services Government resorted to a number of experiments. The earlier experiments carried out in 1936 were laid down (a) to compare yields of different varieties; and (b) to determine the effects, if any, of fertilizers on these yields. The varieties used were: Up-to-date, Kerr's Pink, Arran Consul, Green Mountain and Cobbler. An area of typically infertile soil in the main potato producing area was selected for the experiment. The area selected had given such poor yields of Irish potatoes in the past that it was considered advisable to apply a small dressing of pen manure over the whole area before commencing the experiment.

The results obtained were summarized as follows :

- (i) Two of the six varieties of potatoes namely Up-to-date and Kerr's Pink gave yields which were 20-50% greater than those from the other varieties, while Cobbler gave yields which were significantly greater than those for the other 3 varieties.
- (ii) Application of fertilizers at the selected rate of 4.5 cwt. per acre resulted in an increased yield of approximately 50 per cent for 3 of the 6 varieties while the yields of the other three varieties were not increased significantly.
- (iii) Germination was not materially affected by the use of fertilizer.
- (iv) The differences in yields (due to varietal factors) were apparently not dependent on the differences in varietal germination.

(b) 1940-48

A series of eleven experiments with Cobbler and Green Mountain varieties were laid down during the period 1940-1948 on the chief potato-growing soils of Manchester, St. Ann, St. Elizabeth and St. Mary. The experiments were largely factorial ones designed to ascertain the quantitative requirements of potatoes for nitrogen, phosphorus and potassium and to compare local phosphate with 18% superphosphate.

No yield response was obtained from application of nitrogen, regardless of soil type. Since most Jamaican soils are deficient in nitrogen it appears that under local environmental and cultural conditions Irish potatoes have a low requirement for nitrogen. This low crop requirement for nitrogen appears to be more important than the ability of the soil to supply this nutrient.

In contrast to nitrogen, the response to phosphate and potassium was closely associated with soil type. Good yield responses were obtained from application of phosphorus on soils developed over tuffs and acid limestone shales (Wirefence Clay Loam and Wait-A-Bit Clay) and on the red bauxite soil, St. Ann Clay Loam. Phosphorus, however, did not increase yields on the brown bauxite soil, Chudleigh

Clay, and gave a variable response on the colluvial limestone soil, Lucky Hill Clay Loam.

Residual phosphorus increased the yields of follow-on crops of corn.

Potatoes responded well to applications of potassium on both bauxite soils, gave a variable response on the limestone colluvial soil, and did not respond at all on soils developed over tuffs and acid limestone shales. The benefit of Humber Fish manure on brown bauxite soils was shown to be due entirely to the potash it contained.

Residual potassium increased the yields of follow-on crops of corn, peanuts and red peas.

(c) *1949-55*

During the period 1949-55, eleven experiments and two series of observation trials were carried out in Manchester, St. Ann and St. Mary. The main varieties used were Cobbler and Green Mountain.

In contrast to previous trials, a response to nitrogen was obtained on Wire-fence Clay Loam and Carron Hall Clay. A variable response was obtained on Chudleigh Clay. Two series of observation trials were therefore designed to test the effect of including nitrogen in the fertilizer mixture normally recommended for potatoes. It is perhaps unfortunate that all the observation plots were situated on the brown bauxite soil, Chudleigh Clay. The first series of trials showed no significant yield increase from the inclusion of nitrogen, while combined analysis of the second series revealed a significant yield response to nitrogen.

Apparently the fertility of the main potato-growing soils had decreased sufficiently by the early 1950's for a positive response to nitrogen to be obtained fairly consistently.

During this period two series of experiments were carried out testing up to five methods of placement of fertilizer. The results from both series showed that the best yield response was obtained from placing fertilizers in a continuous line along the base of the furrow before planting. The second series also indicated that the higher yield obtained from fertilizer placement was due to higher availability of phosphorus.

(d) *1958-63*

Up to 1957, all fertilizer investigations had been confined to the central potato-growing districts of the island. The period 1958-1961 represented a shift in experimentation to the western potato soils around the Darliston Area of Westmoreland. The main varieties used in the NPK fertilizer trials laid down were Arran Consul and Sebago.

On the chief soil type in the Area, Windsor Stony Clay, excellent responses to phosphorus and potassium were obtained in two out of three trials while a moderate response was given to nitrogen in only one of the three trials.

In 1959 initial steps were taken by the then Marketing Department of the Ministry of Trade and Industry to provide storage (a) in trays and (b) by bulk-piling. The loss from shrinkage and spoilage for bulk-piled potatoes was

less than 4% but when the Co-operative tried this in 1960 a 17% loss was recorded. Existing storage practices applied in 1959 and 1960 were examined by an entomologist loaned to the Jamaican Government by the United States Overseas Mission (USOM) to investigate *nematode infestation*. A recommendation was made for the reduction of temperature by ventilated storage. The Irish Potato Advisory Committee of the Ministry of Agriculture and Lands (MAL) working closely with the USOM entomologist recommended that MAL should assist the Co-operative to install a forced air ventilation system in the storage house and evaluate its efficiency. MAL requested from USOM/Jamaica the services of a potato storage specialist for a month to :

- (i) observe the reaction of Jamaican grown potatoes under forced air ventilation;
- (ii) consider the usefulness of the necessity for sprout inhibitors; and
- (iii) set up guide lines for the future improvement of storage.

Two varieties were selected for the tests using forced air ventilation. A total quantity of 365 tons of potatoes was put into storage units (14' x 106'). The pile was built 6' deep. (The varieties were treated separately.) Ventilation was provided by a fan nightly during the period 9.00 p.m. to 6.00 a.m. As a result the temperature fell to 66°F with one or two nights' ventilation. The potatoes retained fairly good condition, there being little shrinkage. Loss due to rotting was relatively small and it was apparent that rotting during storage was confined to potatoes which had been infested before being placed in storage. The spread of rot from these was practically nil.

Subsequent tests carried out indicated that potatoes could be stored for periods of over 4 months. Changes have been made in the cooling facilities provided. Existing storage temperature is 45°F and on the basis of experience elsewhere consideration is being given to reducing this temperature to 38°F, in an attempt to reduce storage losses.

Apart from the experimental work carried out in the above-mentioned three time periods, other work of an investigatory nature carried out on Irish potatoes included work designed to reduce the high cost of seed potatoes all of which had to be imported. Large seeds were cut into 2 or more bits and treated with chemicals to prevent rotting. These bits were then used as seed. The labour costs involved appeared to be too high and the investigations were discontinued as it was felt that the use of small whole seeds was more economical.

Concluding Observations

As a result of a large number of experiments laid down since 1940, the nitrogen, phosphorus and potassium requirements of Irish potatoes are reasonably well-known for the major potato soils in Jamaica. The standard fertilizer mixtures recommended and also the standard methods of fertilizer placement appear to be generally satisfactory. Further experimentation along these lines cannot be regarded, therefore, as urgent, although expansion of potato-growing in new areas, e.g., Yallahs Valley, might alter the present picture.

Considering the low incidence of potato scab in Jamaica, perhaps liming experiments should be considered for the very acid soils over tuffs and acid shales of the Yellow Limestone Formation.

No information is available on the use of foliar analysis in the diagnosis of the nutritional status of potatoes. In view of the increasing but variable response to nitrogen, and the low levels of this nutrient normally recommended, foliar analysis may be particularly useful in diagnosing a deficiency early enough for a side-dressing of nitrogen to be beneficial. It has been suggested that an internal brown spot in potato tubers is due to boron deficiency or copper toxicity, and a leaf analysis survey might serve to locate possible trace element deficiencies or toxicities.

Considerable information might be obtained, therefore, from a leaf analysis survey of Irish potatoes growing on a variety of soil types. Leaf analytical data should also be obtained from any fertilizer experiments laid down in the future.

APPENDIX TABLE I

Estimated Cost of Production Per Acre of Irish Potatoes, Jamaica, 1957

Items	7,000 lb. Yield			10,000 lb. Yield			12,000 lb. Yield			14,000 lb. Yield		
	Man Hours	£	s d	Man Hours	£	s d	Man Hours	£	s d	Man Hours	£	s d
Labour Operations												
Land Clearing	80	4	5 0	80	4	5 0	80	4	5 0	80	4	5 0
Forking and Refining	240	12	15 0	240	12	15 0	240	12	15 0	240	12	15 0
Furrowing	64	3	8 0	64	3	8 0	64	3	8 0	64	3	8 0
Billing and Planting	40	2	2 6	40	2	2 6	40	2	2 6	40	2	2 6
Applying Fertilizer	16		17 0	16		17 0	16		17 0	16		17 0
Weeding and Moulding	120	6	7 6	120	6	7 6	120	6	7 6	120	6	7 6
Spraying	200	10	12 6	200	10	12 6	200	10	12 6	200	10	12 6
Reaping	48	2	11 0	72	3	16 6	84	4	9 3	96	5	2 0
Assorting	16		17 0	24	1	5 6	28	1	9 9	32	1	14 0
Total — labour	824	43	15 6	856	45	9 6	872	46	6 6	888	47	3 6
Planting Material (14 crates)		27	6 0		27	6 0		27	6 0		27	6 0
Other Materials												
Manure (Fly Penning)		2	0 0		2	0 0		2	0 0		2	0 0
Fertilizer (1,400 lb.)		21	5 0		21	5 0		21	5 0		21	5 0
Spraying Material (500 gal.)		2	10 0		2	10 0		2	10 0		2	10 0
Total Materials Cost		25	15 0		25	15 0		25	15 0		25	15 0
Miscellaneous												
Tools and Equipment		2	3 9		2	5 6		2	6 3		2	7 3
Overheads		4	7 6		4	11 0		4	12 6		4	14 6
Rent		4	0 0		4	0 0		4	0 0		4	0 0
Total Cost of Production		107	7 9		109	7 0		110	6 3		111	6 3
Value of Production		103	13 5		148	11 0		177	15 0		207	2 6
Margins Per Acre												
Estimated Cost of Production		107	7 9		109	7 0		110	6 3		111	6 3
Estimated Value of Production		103	13 9		148	11 0		177	15 0		207	7 6
Estimated Margins + or -		-3	14 0		+39	4 0		+67	8 9		+96	1 3

APPENDIX TABLE II

Cost of Production of Irish Potatoes per acre, Christiana, Jamaica, 1957—1962

Items	1957 (£)	1962 (£)	1964 (£)	1965 (£)	1966 (£)
<i>Labour Charges</i>					
Land Clearing	2. 2. 6	2. 0. 0	2. 0. 0	2. 10. 0	2. 0. 0
Ploughing	12. 15. 0	5. 0. 0	10. 0. 0	10. 0. 0	12. 10. 0
Harrowing		3. 0. 0	4. 0. 0	10. 0. 0	
Furrowing	3. 8. 0	1. 10. 0	5. 0. 0	3. 12. 0	7. 10. 0
Fertilizer application	17. 0	18. 0	10. 0	1. 15. 0	18. 0
Planting	2. 2. 6	6. 0. 0	5. 0. 0	4. 5. 0	3. 5. 0
Moulding	6. 7. 6	10. 10. 0	8. 0. 0	10. 0. 0	5. 0. 0
Spraying	10. 12. 6	7. 10. 0	6. 0. 0	12. 0. 0	5. 10. 0
Reaping	5. 2. 0	5. 8. 0	9. 0. 0	14. 0. 0	6. 10. 0
Transportation	—	—	—	—	6. 0. 0
Total Labour Costs	43. 7. 0	41. 16. 0	49. 10. 0	68. 2. 0	49. 3. 0
<i>Materials</i>					
Seeds	27. 6. 0	40. 16. 0	29. 12. 0	28. 14. 0	31. 10. 0
Fertilizer	23. 5. 0	23. 0. 0	23. 0. 0	22. 8. 0	23. 16. 0
Fungicide and Insecticide	2. 10. 0	8. 0. 0	10. 16. 0	7. 8. 0	10. 10. 0
Total Material Cost	53. 1. 0	71. 16. 0	63. 8. 0	58. 10. 0	65. 16. 0
<i>Other Charges</i>					
Overheads	4. 11. 0	3. 0. 0	5. 3. 0	7. 1. 0	5. 0. 0
Depreciation	2. 5. 6	1. 10. 0	1. 10. 0	2. 0. 0	2. 10. 0
Land Charges (Rental 6 mth.)	2. 0. 0	2. 0. 0	2. 10. 0	2. 10. 0	2. 10. 0
Total other charges	8. 16. 0	6. 10. 0	9. 3. 0	11. 11. 0	10. 0. 0
Interest @ 8%	4. 4. 0	4. 16. 0	4. 18. 0	5. 10. 0	5. 0. 0
Total Costs	109. 8. 6	124. 18. 0	126. 19. 0	143. 13. 0	129. 19. 0
Estimated Yield	10,000 lb.	10,000 lb.	10,000 lb.	11,200 lb.	11,200 lb.
Value of Yield	£148. 11. 0	£178. 0. 0	£178. 0. 0	£210. 0. 0	£210. 0. 0
Gross Margin	£ 39. 2. 6	£51. 1. 0	£53. 2. 0	£66. 7. 0	£80. 1. 0
Cost per lb.	3d	3d	3d	3d	3d

APPENDIX TABLE III

Cost of Production of Irish Potatoes per acre on Large, Medium and Small Farms, Christiana, Jamaica, 1966

Items	Large (£)	Medium (£)	Small (£)
<i>Labour Charges</i>			
Land Clearing	1. 0. 0	2. 0. 0	2. 0. 0
Ploughing	14. 0. 0	12. 10. 0	11. 5. 0
Harrowing	10. 0. 0	—	—
Furrowing	7. 0. 0	7. 10. 0	8. 10. 0
Fertilizer application	12. 0	18. 0	1. 14. 0
Planting	1. 16. 0	3. 5. 0	3. 0. 0
Re-forking	7. 4. 0	—	—
Moulding	3. 0. 0	5. 0. 0	7. 0. 0
Spraying	20. 0. 0	5. 10. 0	6. 0. 0
Reaping	6. 0. 0	6. 10. 0	8. 0. 0
Transportation	14. 0. 0	6. 0. 0	4. 19. 0
Total Material Costs	84. 12. 0	49. 3. 0	52. 8. 0
<i>Materials</i>			
	(20 bags)	(14 bags)	(10 bags)
Seeds	47. 0. 0	31. 10. 0	23. 10. 0
Fertilizer	34. 0. 0	23. 16. 0	17. 0. 0
Fungicides and Insecticides	15. 6. 0	10. 10. 0	7. 0. 0
Total Material Costs	96. 6. 0	65. 16. 0	47. 10. 0
<i>Other Charges</i>			
Overheads	8. 5. 0	5. 0. 0	5. 5. 0
Depreciation	6. 0. 0	2. 10. 0	5. 0
Land Charges (Rental 6 mth.)	2. 10. 0	2. 10. 0	2. 0. 0
Total Other Charges	16. 15. 0	10. 0. 0	7. 10. 0
Interest @ 8%	8. 0. 0	5. 0. 0	4. 6. 0
Total Costs	205. 13. 0	129. 19. 0	111. 14. 0
Estimated Yield	16,000 lb.	11,200 lb.	8,000 lb.
Value of Yield	£300. 0. 0	£210. 0. 0	£150. 0. 0
Gross Margin	£94. 7. 0	£77. 2. 0	£42. 12. 0
Cost of Production per lb.	3d	3d	3d

APPENDIX TABLE IV

*Comparative Cost of Production of Irish Potatoes
in Southern Manchester, Darliston, and Guy's Hill*

Items	Southern Manchester (£)	Darliston (£)	Guy's Hill (£)
<i>Labour Operations</i>			
Land Clearing	2. 10. 0	1. 0. 0	4. 0. 0
Ploughing	5. 0. 0		
Forking		17. 10. 0	21. 17. 6
Refining		12. 10. 0	
Harrowing	2. 10. 0		
Furrowing	2. 10. 0		7. 13. 0
Drains			3. 16. 8
Fertilizing			5. 6
Planting	4. 0. 0		4. 2. 0
Moulding & Weeding	4. 0. 0	(26. 13. 0)	9. 13. 0
Spraying	2. 10. 0	(20. 0. 0)	1. 3. 9
Reaping	4. 16. 0		4. 8. 0
Transportation			3. 3. 0
Total Labour Costs	27. 16. 0	77. 13. 0	60. 2. 5
<i>Materials</i>			
Seeds	36. 19. 6	35. 5. 0	32. 18. 0
Fertilizer	34. 0. 0	34. 10. 0	24. 6. 6
Poultry Manure	7. 10. 0		
Dithane	10. 10. 0	8. 9. 0	
Dieldrin		2. 11. 0	
Spray Material			6. 15. 0
Gas Pump		15. 0	
Transportation of seeds & fertilizer			1. 1. 0
Total Materials Costs	88. 19. 6	81. 10. 0	65. 0. 6
<i>Other Charges</i>			
Overheads	3. 0. 0	7. 15. 0	6. 0. 0
Pump	6. 0. 0	11. 14. 0	2. 0. 0
Land Charges	2. 10. 0	5. 0. 0	2. 10. 0
Total Other Charges	11. 10. 0	24. 9. 0	10. 10. 0
Interest @ 8%	6. 0. 0	5. 0. 0	5. 17. 6
Total Costs	134. 5. 6	188. 12. 0	141. 10. 5
Estimated Yield	.9:5:1-6,150 lb.	.6:1 - 9,000 lb.	7:1 - 9,800 lb.
Total Value of Yield	£302. 14. 0	£179. 11. 0	£183. 15. 0
Margin	168. 9. 6	-£ 9. 1. 0	£ 42. 4. 7
Cost of Production per lb.	5d	5d	4d

REFERENCES

- Agricultural Chemistry Division, (1966): **Report on Fertiliser Research on Food Crops and Vegetables**, Ministry of Agriculture & Lands, Jamaica, W I.
- Croucher, H.H., et al, (1936): **Bulletin No. 12**, Dept. of Agriculture, Jamaica, W.I.
- Department of Statistics, (1955-66): **External Trade Statistics of Jamaica**, Government of Jamaica, Kingston, Jamaica, W I
- Ellis, T.O., (1947-48): **Bulletin No. 40**. Dept. of Agriculture, Jamaica, W.I.
- Ministry of Agriculture, (1949-50): **Bulletin No. 47**, Dept. of Agriculture, Kingston, Jamaica, W I.