THE ARROWROOT INDUSTRY IN ST. VINCENT:
A CASE STUDY OF A UNIQUE ROOT CROP INDUSTRY

— *by* —

C. I. Martin

Ministry of Trade and Production, St. Vincent

The Commonwealth Caribbean has so far found it difficult if not impossible to produce agricultural commodities under competitive conditions. Indeed, the survival of particular crop industries has, for the most part, depended on one of two conditions: either the product has been accorded preferential treatment in the metropolitan countries, or the producing territory has a monopoly on the production of the particular crop. The commodities that have been accorded preferential treatment (sugar, bananas) play a much greater role in Caribbean economies than those that are produced under monopoly conditions (arrowroot, nutmeg, pimento, sea island cotton) and hence the problems associated with the former have, quite naturally, been more widely discussed than those associated with the latter group of crops.

This paper deals with a 'root' crop, arrowroot, that has been produced under monopoly condition. The theme of this case study is the limited technological progress in the Arrowroot Industry, and the absence of adequate arrangements for supply control and for marketing, which have left an important industry in a vulnerable state. A brief description of the arrowroot plant and of the history of the industry introduce the paper.

THE DEVELOPMENT OF THE INDUSTRY

Arrowroot *(Marunta arundinacea)* is a herbaceous perennial, growing usually to about 3 feet and bearing oval leaves. The root stock forms cylindrical rhizomes below the soil surface. It is these rhizomes, which are about 9 –12 inches long and 1 inch thick, that provide the starch that has made cultivation of the crop commercially feasible. The two varieties of arrowroot native to St. Vincent, the 'Banana' and the 'Creole' do not set seed, and propagation has so far been by means of rhizome bits. The plant is extremely resistant to adverse weather conditions and has hitherto been subject to only one disease, the 'arrowroot burning disease' *(Rosillinea bunodes)* and one pest, the arrowroot leaf roller *(Calpodea ethleus)*: even these have been relatively minor in their effect. Less yield uncertainty has, therefore, been associated with arrowroot production than with most other crops grown in St. Vincent. This has undoubtedly been partly responsible for the crucial role that arrowroot has played in the economy of St. Vincent for over a century.

Commercial production of the crop began about the middle of the nineteenth century, when a decline in price made sugar production unfeasible on some plantations and alternative crops had to be sought. In many respects arrowroot proved an excellent substitute.

In the first place, the plant thrives well in all the soil types of the island, though apparently, it does best in well drained sandy loams. Large quantities of

clean fresh water are necessary for processing this starch and this St. Vincent has in the numerous streams originating in the island's mountainous interior.[1]

Secondly, an inspection of the data shown in Appendix Table I reveals that the labour requirements of arrowroot are very similar to those of sugar-cane. The crop is reaped every twelve months and the harvesting demands a great deal of labour so that, as in the sugar industry, there is a seasonal pattern of employment, a great deal of work being provided between November and April when the roots are being reaped, and comparatively little being available at other times of the year, except for gangs of women who are needed to weed the crop three times annually. The substitution of arrowroot for sugar, therefore, affected the agricultural labour force little except insofar as the hoe replaced the machete as the implement for reaping.

Thirdly, the capital required to convert the numerous small muscuvado factories then engaged in sugar manufacturing into arrowroot factories was relatively small. The building that housed the sugar factory and the wheels that powered it could be used in arrowroot manufacture. Changes were, however, necessary in the plant, but even these could be carried out with relatively little expense. The major items required were a saw-grater to crush the rhizomes, sieves to strain the starch and racks for drying purposes. These could be made locally.

Finally, since the main market for arrowroot starch was the United Kingdom, the same marketing arrangements that had been used to market sugar could be used in the case of arrowroot starch. Each large holder consigned his starch to a broker in London, who undertook to dispose of it and remit the proceeds less expenses.

From these rudimentary beginnings the crop increased in importance and for the first half of the twentieth century arrowroot exports accounted for about 50 per cent of the island's total gross agricultural income (see Figure 1).

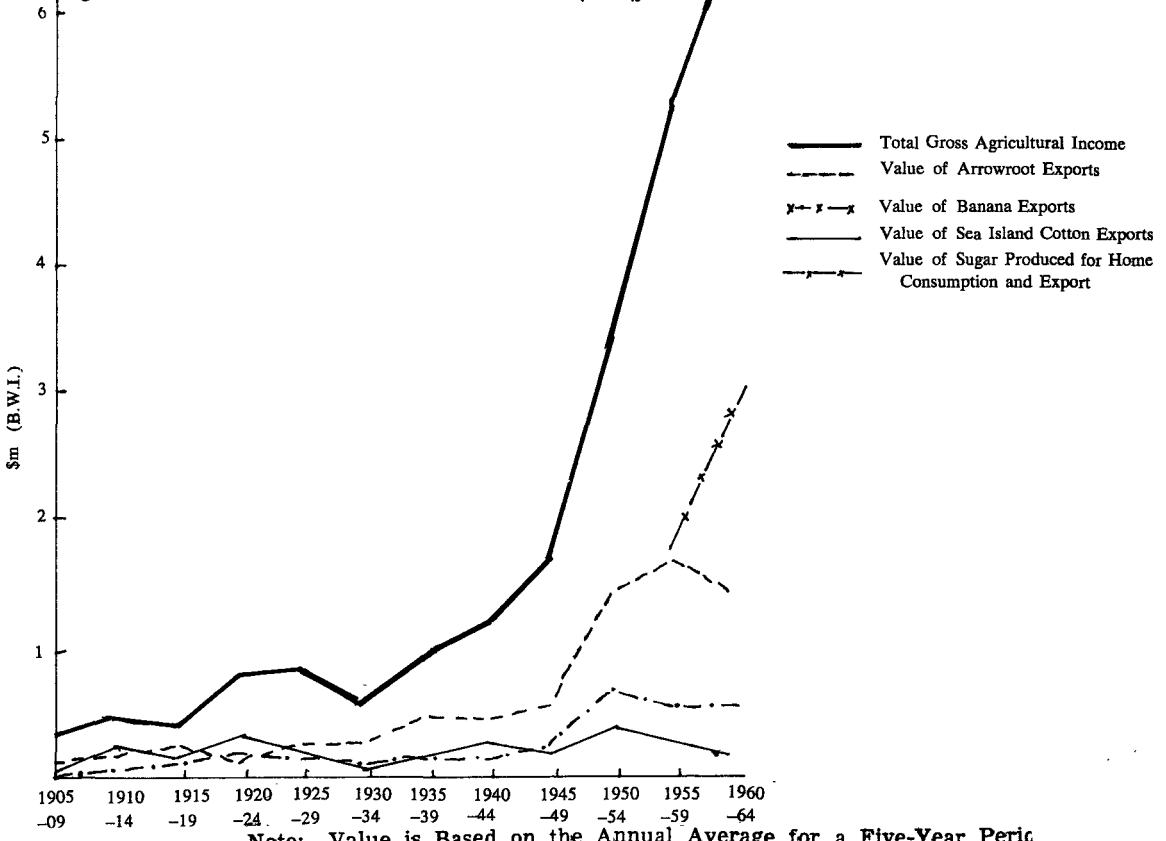
In the process of evolution two adjustments had to be made; one on the production side and the other in the marketing of the commodity.

The salient feature of the pattern of land tenure in St. Vincent in the second half of the nineteenth century was the small number of large holdings and the almost complete absence of small holdings. In the first half of the twentieth century, however, there was a marked tendency towards fragmentation (see Appendix Table II), and adjustments had to be made within the structure of the arrowroot industry to accommodate the peasantry that emerged. The manner in which this was accomplished is relatively straight-forward. The peasants produced the rhizomes and the plantation owners who operated factories in the vicinity processed them for a share of the starch yield. The proportion charged tended to vary from factory to factory ranging from 20 per cent in some to 25 per cent in others. The remainder of the peasants' starch was disposed of through the factory-owner who either bought it outright or sold it through his agent in London on the peasants' behalf. Since at least a year elapsed between the planting and reaping of the crop and since, moreover, a great deal of capital was often required to finance the reap-

1 It is significant that in Antigua where some attempt has been made to develop the industry on a commercial scale, one of the major limiting factors has been the salinity of the water used in processing, which seriously affects the viscosity of the starch.

Figure 1

Total Gross Agricultural Income and the Contribution of Different Crops to Total Income, St. Vincent, 1905–1964



Note: Value is Based on the Annual Average for a Five-Year Peric

Sources: *Report of the Department of Agriculture*, St. Vincent, 1905 1961 and *Digest of Statistics No. 12*, St. Vincent Statistics Unit, 1965.

ing of the crop, the factory owners often made advances to peasants to finance their living expenses and the harvesting of his roots.

On the marketing side the major development that occured was the establishment of the Arrowroot Growers Co-operative Association. Under the system whereby individual large growers consigned their starch to different agents in the United Kingdom there was persistent tendency for the market to become glutted. All efforts to form a voluntary co-operative failed and in 1930 the Government was forced to set up a statutory body to market the commodity. The specific powers granted to this organisation under ordinance are :

(a) to market and control all arrowroot produced in the colony of St. Vincent and intended to be exported therefrom;

(b) to undertake and promote research in the cultivation of the plant and in production, processing and marketing of the crop;

(c) to erect and operate central factories for the processing of arrowroot.

Management of the Association is vested in a Board consisting of eleven persons; the Director of Agriculture, the Financial Secretary, and nine other persons elected by and large from among the members of the Association.

Most of the capital required by the Association to commence operations was provided by the Government ; $144,000 as an interest-free loan and $14,400 as a grant. The funds were used mainly to purchase equipment for pulverizing the starch. Since there were so many different factories involved in starch processing, the quality of the starch received by the Board tended to vary widely: some 26 different grades having been recognized. By pulverizing the starch it receives, the Board has been able to standardize the product into five grades.

Thus in the mid 1950's the industry consisted of :
(i) *Peasants and Planters* who cultivated the rhizomes. According to the agricultural survey of 1956 there were 2,675 acres planted to the crop. Of these, 930 acres were on holdings of less than 10 acres, 215 on holdings of between 10 and 100 acres, and 1,470 acres on farms of over 100 acres.

(ii) *Thirty different factories* engaged in the processing of starch, each factory employing on the average 33 persons, and producing on average 300,000 lb. of starch valued at approximately $54,000.

(iii) *The Arrowroot Board or Pool* as it is commonly called, where starch was assembled, graded and shipped abroad. During the harvesting season this body employed about 160 persons, and out of season, 80.

THE LEVELS OF TECHNOLOGY IN THE INDUSTRY

The technological changes that occured in the sugar industry in most Caribbean islands in the century 1850 – 1950 had no counterparts in the arrowroot industry in St. Vincent. There are two possible explanations for this. As will be shown later, the Arrowroot Association was placed in an unusually strong position for a marketing agency operating in an undeveloped country. It is possible that the ability of the Association to obtain annual increases in prices, blinded the members to the need for increasing the level of efficiency in the industry. There is always

the tendency for this to happen in a monopolistically organised industry. The tendency will, of course, be accentuated in a small community in which there is no monopolies commission, where there is no financial journalism and where the community is trading in a commodity about which very little is published in the established trade journals.

Secondly, it is possible that the cost of innovation was so high as to be almost prohibitive. .Since the industry had no counterpart elsewhere, there was little scope for imitation in technology. Changes, therefore, required basic research and this is usually expensive especially for small islands. The extent to which either factor affected the rate of change in the industry can best be brought out by examining the scope there was for increasing efficiency and the efforts that were in fact made to do so, in cultivation and in processing.

1. *In Cultivation*

In the arrowroot industry as in any other industry, the level of efficiency is determined by the ratio of input to output: changes can be brought about either (a) by reducing the amount of inputs required to produce a given output, or (b) by increasing the output from a given amount of inputs.

(a) *Reducing Inputs* — It is difficult to obtain statistical data which would indicate the level of efficiency prevailing in the industry, but insofar as the data shown in Appendix Table III can be regarded as reliable estimates then it is clear that labour which accounts for over 50 per cent of the cost of rhizome production is the singly most important input. Since the harvesting of the crop requires more labour than any other operation then naturally there have been proposals for mechanizing this operation. But as has been the case in these Caribbean islands, where sugar industry has provided a great deal of employment, there was the policy issue as to the extent to which an island with a capital-short, labour-abundant factor endowment ought to substitute capital for labour. It had to be borne in mind that primary agricultural production provides employment for 35 per cent of the labour force in St. Vincent, and even in normal times the rate of unemployment in the island runs as high as 16 per cent. Mechanization of the country's most labour-intensive industry could therefore lead to serious unemployment difficulties.

Even if the employment issue were ignored and the policy had been to use the most efficient technique available, the evidence that mechanization of harvesting would have led to significant economies is not conclusive. Harvesting machines could not be simply imported as has been the case with the sugar industry in some Caribbean islands. For arrowroot production being peculiar to St. Vincent there are no such machines in existence. Nor did it seem feasible to have machines specially designed for harvesting arrowroot. Since the market for the machine would be small, being confined to St. Vincent, the cost of producing the machines would have been high. Attempts were made to adapt available machinery to the harvesting of arrowroot. The machines tried included a single furrow reversible mould-board plough fitted with digger bodies, a mounted potato-spinner, and a mounted elevator digger. The potato spinner gave the best results but even this posed problems.

The two varieties of arrowroot grown in St. Vincent display different characteristics. The rhizomes of the 'creole' variety tend to develop in large rambling strands which penetrate the soil to great depths. The 'banana' is of a more bunched

habit and rarely penetrates the soil to any great depth. Thus the 'banana' variety would have been more amenable to harvesting by the potato spinner than the 'creole'. The 'banana' variety is, however, a poor yielder of rhizomes as compared to the 'creole' and moreover, it tends to deteriorate much more rapidly after ripening than does the 'creole', hence if production were concentrated on the 'banana' variety so as to facilitate mechanization there would have been a reduction in yields.

Nor is it certain that the use of the potato-spinner would necessarily have reduced the overall cost of harvesting. In the first place, the greater portion of farmland in St. Vincent is mountainous and arrowroot is grown both on the flat land and on the hillsides. It is likely that harvesting on the hillsides would still have to be done manually even if the operation were mechanized on the flat lands. Secondly, mechanization of harvesting would have required certain changes in cultural practices which would have increased the number of cultivation operations or increased the amount of labour required to perform certain operations. Traditionally, arrowroot has been planted by simple dibbling; mechanization would have entailed planting in ridges. Further, under the traditional system there is no need to replant annually; the bits that are left in the ground during reaping spring up to provide the next crop. Mechanization would have required annual replanting. Finally, there was the question of getting rid of the bush before the harvester could operate and of collecting the roots once the machine had dug them out of the ground. Both of these operations would have required a certain amount of manual labour. It is not surprising, therefore, that arrowroot harvesting operations were in fact never mechanized in St. Vincent.

(b) *Increasing Output*— Yields per acre could have been increased by the usual methods, either by improvement in cultural practices or by the introduction of high-yielding varieties; perhaps even better by a combination of both. Fertilizer and spacing trials involving arrowroot have been carried out since the 1930's and these have had some impact. For whereas in 1948 yields of 8000 lb. of rhizomes per acre were regarded as good, the corresponding figure in the 1960's was between 10,000 lb. and 12,000 lb. and in some rare cases 24,000 lb. have been obtained from an acre.

The introduction of high yielding varieties, however, poses a greater problem. This required basic research and the problem was of course made no easier by the fact that the two varieties of arrowroot produced in St. Vincent do not produce seeds. St. Vincent, like most of the smaller islands of the Commonwealth Caribbean, has never been able to finance basic agricultural research from local resources. Funds to do so, however, could have been obtained under the Colonial Development and Welfare Acts. But St. Vincent made no effort to do so until 1959 when a geneticist was employed to investigate the possibility of developing a high yielding variety that could be reaped mechanically. As is to be expected in a situation where a single scientist is working in isolation without the moral or technical support of his peers, progress has not been very rapid. At present the research has reached the stage where seeds have been obtained from varieties imported from other parts of the world and some work is now being done on hybridization.

2. *In Processing*

As mentioned earlier, arrowroot factories in St. Vincent have been mainly

local contrivances, former muscuvado factories having been converted into arrowroot processing plants. Given the small output of each factory and variations in the quality of starch produced by the different factories, the path to modernization obviously lay in establishing large central factories, as has been the case in the sugar industry.

But here again there was no model of factory that could simply be imported into St. Vincent and put to processing arrowroot. Innovation necessarily involved a great deal of preliminary investigation, and since the private sector either individually as farmers, or collectively as the Arrowroot Association, was unwilling to undertake the responsibility to carry the research, the Government did so.

In 1955, the Government engaged a German firm to establish an experimental central factory. In setting up the factory the firm engaged sought to adapt the techniques used in processing white potatoes to the processing of arrowroot. The finished product differed in several significant respects from that of the old factories. While the old factories used mainly paddle-washers, the Central Factory used a barrel-washer. In the old factories the roots are crushed and sieved only once, in the Central Factory, they are crushed twice and sieved thrice. Whereas in the old factories the starch is separated from the 'fruit water' by means of settling tables, in the Central Factory, a centrifugal separator is used. The old factories are powered by man, water and in the odd case diesel oil; the Central Factory by electricity. Finally, while the starch is air-dried in the old factories, in the new, a mechanical steam-heated drier is used

The initial cost of the Central Factory was $335,000 (W.I.) and as can be seen from Appendix Table IV, the factory has experienced losses totalling over $200,000 in its 11 years of operation. Several factors have been responsible for this.

In the first place, before the manufacturing process begins, arrowroot rhizomes require more washing than do potatoes, hence to the barrel-washer installed by the Germans, a paddle-washer had to be added. Once the washing apparatus had been altered the centrifugal separator proved inadequate and another had to be obtained. The new washer and separator alone cost an additional $45,000. In addition, several minor adjustments had to be made such as the use of perforated copper sheets instead of bronze wire cloth to strain the starch. Consequently the rate of depreciation and the cost of maintenance of the plant and machinery, tended to be high.

Next the cost of power proved extremely high. Perhaps, in a labour-short Germany the substitution of electricity for man and water power might have led to economies, but in St. Vincent where electricity is expensive and labour abundant, the cost proved extremely high.

Finally, the factory attempted to revolutionize the relationship between the peasant and manufacturer. Individuals who operate private processing plants usually deduct a percentage of the peasant's starch as the cost of processing, but the Central Factory sought to purchase rhizomes directly from the peasants. This method represented an improvement over the traditional approach, since many factory operators had become notorious for deceiving the peasants both as regards the quantity and quality of the starch yielded by their rhizomes. However, for the new system to operate effectively, it was necessary for the management of the Central Arrowroot Factory to know :

(a) the total throughput of the factory in any given year, and
(b) the price the starch was likely to fetch.

It was difficult to predict the former since, as Appendix Table IV shows, the throughput varied from year to year. As for the latter, it was possible before 1960, given the instalment basis on which the Arrowroot Board purchased starch from producers.

The losses experienced by the Central Factory, however, are no indication that the industry has not benefited from its establishment. The manufacturing process in at least two of the older factories has been altered on the basis of the information derived from the Central Factory. While the centrifugal separator, the mechanical drier and the use of electricity have been considered too expensive to adopt, these two factories have initiated the Central Factory's technique of crushing the rhizomes twice and sieving them thrice.

Appendix Table V attempts to give some indication of the magnitude of the Central Factory's impact. Factory A is one of the factories in which the manufacturing process was altered as a result of the experiences of the Central Factory; (data on the other is not available). Factories C and D were in operation prior to the establishment of the Central Factory and were not in any way affected by its establishment.

Since the Central Factory is less labour-intensive than factories C and D, the wage cost per barrel of starch tends to be substantially higher in these factories than in the Central Factory. Factory A is still powered by man, wind and water, and not by electricity. This explains not only the difference in wage-cost per barrel of starch between Factory A and the Central Factory, but also, to a considerable extent, the difference in 'other expenses' between the Central Factory and the other factories. Of 5.18 cents shown under 'other expenses' for the Central Factory, 1.08 cents was for electricity, and 3.86 for depreciation and maintenance.

But most important of all is the much higher rate of starch extraction that obtains in the Central Factory and Factory A, as compared to the other factories, 8 per cent as compared to 14 per cent and 16 per cent. It seems then, that the Central Factory has benefited the industry insofar as its rate of extraction exceeds the factories it has superseded, and also insofar as the other factories have been modernized as a result of the lessons learnt from the Central Factory. It is likely, too, that the industry would have benefited even more, as more and more of the older factories were either superseded or modernized. Marketing difficulties, however, seemed to have forestalled this.

THE MARKETING OF ARROWROOT STARCH

The creation of the Arrowroot Board undoubtedly had a dynamic impact on the industry. As can be seen from Figure 1, the value of arrowroot exports tended to rise markedly after its establishment in 1930. There are two possible explanations. In the first place, the standardization of functions performed by the Board probably gave clients a greater guarantee of a homogenous product and so induced more orders. Perhaps, even more important has been the scale on which the Board has operated. This has enabled it to fulfil orders that individual producers could hardly have met. For instance, in its second year of operation, the Board received an order for 2.4 million pounds of starch, at the time the largest

single order ever received for arrowroot starch in St. Vincent.

The very strength of the Board's position, however, tended to stifle its initiative. Since the Board was granted powers of sole exporter and up to the mid-fifties farmers preferred to concentrate on arrowroot production because the crop required little skill and involved little yield uncertainty, the Board has little difficulty in obtaining supplies. In fact, far from taking any positive steps to encourage production, the Board adopted a policy that could have had a disincentive effect. Producers were not paid cash-on-delivery but were given a first advance some eight months and a final payment after a further six months. Since the crop is annual, under this system of payment two and one half years elapsed between planting date and final payment !

On the sales side, too, it seems that the Board had little reason to take positive action. Arrowroot starch has a high maximum viscosity, yields a smooth jelly and is completely bland in taste. These qualities were sufficient to ensure that it enjoyed precedence over other starches in the manufacture of food for babies and invalids and since St. Vincent is the only country that produces the commodity in significant quantities dealers came to the Board to look for it.

No advertising nor marketing research was done. About 60 per cent of total exports were sold in the United States through a monopoly agent, 16 per cent in the United Kingdom through another monopoly agent and the remainder through sub-agents in the various islands of the Commonwealth Caribbean. Sales activities were confined to demanding increases in price on the ground that the industry was labour-intensive and the cost of labour was rising. The Board was apparently very successful in obtaining these increases for, as is shown in Figure 2, the price of arrowroot starch has tended to rise very markedly in comparison with that of the main starches produced in the United States.

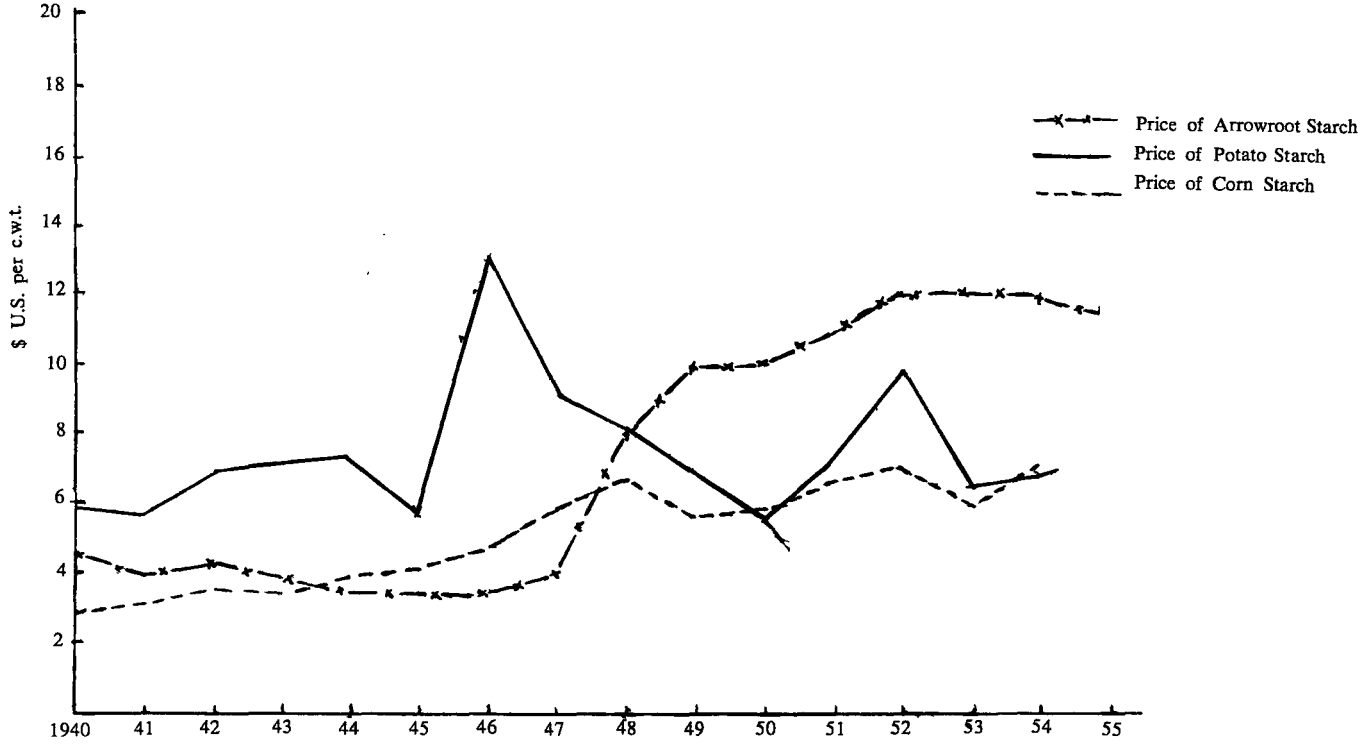
The weaknesses inherent in both the sales and purchasing policies of the Board did not become fully apparent until the rise of the Banana Industry in the late 1950's when there was some competition between the banana and arrowroot industries for producers' resources.[2] Banana production has certain natural advantages over arrowroot, particularly for the small growers.

The production of bananas is non-seasonal and the labour requirements are not as great as arrowroot, so that not only are returns spread more evenly through the year but also family labour is sufficient to carry out most of the cultivated tasks. In addition, the Banana Board took certain steps to encourage farmers to plant more bananas. Not only were growers paid cash on delivery but the Association also undertook to provide fertilizer and pesticides on easy credit terms to growers. Consequently, there was a marked shift in resources from arrowroot to bananas, between 1958 and 1961, as is reflected in the decline in arrowroot production shown in Appendix Table VI.

Consumers in the United States, unable to obtain adequate supplies at this time, reacted in two ways. Kraft Industries, the major consumer, needed a sub-

2 In the late 1950's the Banana Industry developed very rapidly in the Windward Islands (Dominica, Grenada, St. Vincent, and St. Lucia) after a British fruit firm undertook to purchase the fruits on a long term contract. In each of the Islands a Banana Board was established to assist in marketing the crop.

Figure 2 *Relationship Between the Price of Arrowroot Starch Exported from St. Vincent to U.S.A. and Prices of the Main Starches Produced in U.S.A.*



Sources: NF Starch: Raw Material Sources and Economics, *Industrial and Engineering Chemistry* Vol. XLVII No. 7 (July 1555) and *Annual Trade Report, 1963,* Kingston, St. Vincent.

stitute desperately since arrowroot starch was the chief ingredient in one of their main lines 'Miracle Whip'. They, therefore, began to research into the possibility of treating corn starch, so as to make it a reasonable substitute. Not only did corn starch prove to be good enough after some treatment, but the final product turned out to be 4 cents (U.S.) per lb. cheaper than arrowroot starch. The small consumers for their part changed their formula and used less arrowroot.

The Arrowroot Board was not aware of these developments, and decided in 1960 to imitate the Banana Board by paying growers cash-on-delivery and providing fertilizer on easy credit terms. Partly because of this change in policy and partly because of the cessation of the sugar industry in 1962,[3] lands normally devoted to sugar-cane switched to arrowroot, and the production of arrowroot in St. Vincent doubled between 1962 and 1964. But since the American consumers no longer wanted a large volume of the commodity and the other markets had been neglected, the starch could not be sold. The Association has, therefore, been forced to stock-pile the commodity.

The cost of storage, of course, has not been simply confined to the cost of renting warehouses. The Board has been financing purchases by advances from the commercial banks, so there is also the question of bank charges. It has been estimated that the Association's indebtedness to the banks is in the vicinity of $2m. (W.I.).

PROSPECTS

Since most of the underdeveloped countries have their own sources of starch, the market for St. Vincent arrowroot starch will most likely be restricted to the North American continent, Western Europe and the neighbouring West Indian islands.

It has already been shown that the firms in the United States which originally purchased most of the arrowroot starch are no longer interested in the commodity. It is doubtful whether new outlets can now be found for the starch in that country. As Kennedy has pointed out, in 98 per cent of all the end uses, the prime considerations now governing the selection of any given starch are price, availability and stability of supply.[4] Starches imported into the United States on the whole compare unfavourably with domestically produced starches as regards availability and stability of supply. For in addition to the normal hazards associated with all agricultural production, supplies of imported starches can be disrupted by dock strikes, wars, and a breakdown in shipping facilities. As regards price, it has already been shown that the price of arrowroot starch now far exceeds that of the two main starches (corn and potato) produced in the United States. Moreover, given the technological gap between agriculture in the United States and agriculture in St. Vincent, it is doubtful whether St. Vincent can in the very short run reduce prices to a level that would make them competitive with the starches produced in the United States.

---

3 The sugar industry in St. Vincent collapsed in 1962 after a protracted dispute between labour and management.

4 Kennedy, N. H., "Starch : Raw Material, Sources, and Economics", **Industrial and Engineering Chemistry,** Vol. xlvii, (July 1955), p. 1407.

Nor do the prospects seem very good in the United Kingdom. At best it has been estimated that the market there could have absorbed about 20,000 barrels. But it is felt that the substitute developed by Kraft Industries will make heavy inroads into the British market. On the Continent, there is likely to be similar competition from corn starch if arrowroot is at all let to enter the market there, for not only is the commodity completely unknown in European countries, but arrowroot starch is likely to be subject to heavy import duties.

Statistical data on the demand for starch in the islands of the Commonwealth Caribbean is not available but it is significant that in the early fifties, about over 6,000 barrels were being sold in the area, though this subsequently declined to 4,000 barrels. However, as a result of a recent advertisement campaign, there has been an increase in sales of about 1,000 barrels. But even if the Caribbean Market is exploited to the full, it is doubtful whether the demand will be suffiiciently great to off-set the loss of the American market. In these circumstances, the arrowroot industry will no longer be able to make as great a contribution to the economy as it did in the past. Processing of starch will have to be confined to the more efficient factories and the crop cultivated only on lands in the immediate vicinity of the factory.

APPENDIX TABLE I

Number of days employment provided by an acre of Arrowroot and an acre of Sugar cane : St. Vincent 1954

Operation	Arrowroot		Sugar cane	
	(Man days)	(Woman days)	(Man days)	(Woman days)
Preplanting	16	3	29	—
Planting	—	16	3½	3½
Weeding	—	34	—	42
Fertilizing	—	2	—	2
Reaping	36	2	16	2
All	52	57	48½	49½

Source : Labour Department, St. Vincent

APPENDIX TABLE II

Area of land in farms of different sizes : St. Vincent, 1896, 1946 and 1961

Year	Farms in different size groups					
	10 acres		10-100 acres		100+ acres	
	(No.)	(Acres)	(No.)	(Acres)	(No.)	(Acres)
1896	46	311	123	3,942	129	50,584
1946	n.a.	1,056	n.a.	7,578	n.a.	22,114
1961	10,828	15,954	390	7,650	32	15,871

Sources: *Report of the West India Royal Commission, 1897,* Her Majesty's Stationery Office, (p. 85)
Census of Agriculture in Barbados, the Leeward Islands, the Windward Islands and Trinidad and Tobago, West Indian Census, 1946 Jamaica, The Government Printery, (p. 28)
West Indies Census of Agriculture, 1961, St. Vincent, (Interim Report), (p. 10)

APPENDIX TABLE III

Estimated expenditure per acre of Arrowroot Rhizomes: St. Vincent, 1964

Items	Cost	Proportion of total cost
Labour	($)	(%)
Harvesting	82.24	30.0
Other operations	80.84	29.5
Sub Total	163.08	59.5
Planting Material	55.00	20.1
Fertilizer	56.00	20.4
Total	274.08	100.0

Source : Labour Department, St. Vincent

APPENDIX TABLE IV

Total Starch Output and Losses Realized by the Experimental Central Factory : St. Vincent 1956 – 1965

Year	Total Starch Output	Losses
	Barrels	($)
1956	5000	
1957	4000	
1958	4000	123,887
1959	3000	
1960	4000	
1961	4000	11,679
1962	6000	44,389
1963	6000	13,913
1964	6000	17,713
1965	4000	2,232

1 barrel – 200 lb.

Source : Annual Financial Statements of the Central Arrowroot Factory, 1956 – 1965.

APPENDIX TABLE V

Levels of efficiency, measured in terms of rate of extraction and cost of production in four arrowroot factories : St. Vincent, 1962

Performance and processing costs of the factories	Factories			
	(A)	(C.A.F.)	(C)	(D)
Production				
Throughput per factory in Barrels	3,976	6,195	1,771	987
Rate of Starch Extraction as % of Rhizomes processed	16%	14%	8-10%	8-10%
Cost per barrel : (cents per pound)				
Wages	1.99	1.93	4.00	2.14
Other Expenses	97	6.18	2.21	1.01
Overheads	2.07	1.79	5.25	4.42
Total Cost	5.03	9.90	11.46	7.57

Source : Financial Statements of the Respective Factories, 1962.

APPENDIX TABLE VI

Arrowroot Production : St. Vincent, 1956 – 1965

Year	Production
	Barrels
1956	42,000
1957	44,000
1958	38,000
1959	34,000
1960	32,000
1961	31,000
1962	37,000
1963	50,000
1964	65,000
1965	33,000

Source: *The St. Vincent Five-Year Draft Plan, 1966 – 1970*