AN ECONOMIC VIEW OF THE DEVELOPMENT OF NEW PRODUCTION SYSTEMS

WITH PARTICULAR REFERENCE TO ROOT CROPS IN THE WEST INDIES

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Root crops comprise an important element in the West Indian diet. The dependence on root crops varies from territory to territory and the kind of root crop consumed also varies appreciably, not only between territories but also within some of the territories. Sweet Potatoes and Yams are the most widespread of locally grown root crops : Cassava (Manioc) tends to be restricted to drier conditions and Cocoes to more humid conditions. Irish Potatoes (*S. tuberosum*) are grown, in any quantity, only in Jamaica — which has become virtually self-sufficient for this crop[1] — and are imported from outside the Area to a growing extent, even when measured in per capita terms.[2]

The traditional West Indian root crops are characteristically grown on a small scale, by farmers using fairly primitive techniques.

The yields per acre tend to be low (even allowing for an appreciable extent of mixed cropping), and the use of labour per acre high, since most of the cultivation is undertaken with simple hand tools often under difficult natural conditions.[3]

Most of the root crops produced in the West Indies are consumed in the Area, mainly within the producing territory and to an appreciable extent by the producers and their families. Montserrat and St. Vincent do, however, export substantial quantities of sweet potatoes to Antigua and Trinidad and Tobago, while virtually all Arrowroot is exported as starch to North America and Europe.[4]

The roots are commonly consumed in a narrow range of dishes which do not exploit the range of possible forms. Persons unaccustomed to local roots often find them unattractive in customary dishes. Any 'storage' which occurs is due almost entirely to delayed reaping, except in the case of Irish Potatoes in Jamaica ;

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1 I. Johnson, **Development of the Irish Potato Industry in Jamaica,** (a paper presented at the Tropical Root Crop Symposium, St. Augustine, April 1967), 1967.

2 D. T. Edwards, and J. Cropper, **Agricultural Research in the West Indies : the economic background to programmes of livestock and crop investigations,** Department of Agricultural Economics and Farm Management, U. W. I., St. Augustine, Trinidad, 1967.

3 D.T. Edwards, **An Economic Study of Small Farming in Jamaica,** I.S.E.R., Kingston, Jamaica, 1961.

4 C. I. Martin, **The Arrowroot Industry in St. Vincent,** (a paper presented at the Tropical Root Crop Symposium, April 1967), 1967.

while virtually no large-scale processing is undertaken of the traditional root crops grown for local consumption. (Arrowroot is, of course processed and stored locally prior to export.)

As a consequence of the pattern of production (which tends to be highly seasonal), the pattern of consumption, and the largely unorganised marketing system, scarcity alternates with gluts in the local market. Indeed, scarcity may co-exist with surpluses even in a small territory, due to market imperfections.

In view of the circumstances outlined, it is not to be expected that the prevailing, traditional systems of root crop production will continue to be viable. They do not have the capacity to provide adequate remuneration to the small farming community with its growing aspirations, even were the market to be developed and the marketing system highly organised.

This paper is particularly concerned to point to the need for formulating new and improved systems of production which can be widely applied with benefit to the nation's economy., It seems appropriate to discuss this problem in relation to the conditions obtaining in the West Indies.

AN APPROACH TO DEVELOPING A NEW SYSTEM OF PRODUCTION

In the West Indies, as elsewhere in the Tropics, data on the economics of producing the traditional root crops are scarce. Those available do, however, illustrate the high labour requirements and low yields achieved.

Thus in Jamaica – which produces a substantial proportion of the root crops grown in the (British) West Indies – the following estimates were presented in 1943 by an official committee of inquiry.[5]

	Labour requirement per acre of crop (in eight-hour working days)
White Yams	151 – 247
Other Yams	122 – 136[a]
Sweet Potatoes	53 – 67[b]
Cassava	32 – 37

a In 1954-55 a small number of small farms in Jamaica producing mainly Yams, used the equivalent of more than 160 days of labour per acre of Yams and other food crops. (Derived from Edwards, D.T., 1961).

b An estimate presented in 1957 for one of the main Sweet Potato Producing islands, St. Vincent, was 56 days per acre, assuming an eight-hour working day. (See Team of Experts, **Report and Recommendations for the Development of St. Vincent**, Barbados, Advocate Printer, 1957.)

More estimates are available for yields than for labour requirements but these are possibly even less reliable. It would seem, however, that the yields of the

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5 Cost of Production of Food Crop Committee, **Report of Committee on the Cost of Production of Certain Local Food Crops**, Jamaica, The Government Printer, 1946.

common root crops for the various territories generally average no more than two tons per acre.[6]

Given an unsatisfactory existing or projected system of production, various means suggest themselves for improving the profitability of the system. The more significant of these may be summarised as follows.

I *Reducing cost of production, by* :
- (a) omitting unnecessary practices,
- (b) eliminating the use of excessive inputs,
- (c) replacing more costly by less costly methods of production.

II *Raising marketable yield, by* :
- (a) using superior varieties,
- (b) making optimum use of seasons,
- (c) using improved disease and pest control,
- (d) reducing damage in reaping and handling,
- (e) using other improved technology.

III *Increasing prices, by* :
- (a) using varieties preferred by consumers,
- (b) improving quality,
- (c) finding more lucrative market outlets,
- (d) timing production for seasons of high prices.

These means have simply been stated, so as to indicate the range of decisions open to the person responsible for making a system of production more profitable. But even this brief statement indicates the large number of possibilities to be considered. The choice of method is further complicated by the incomplete state of knowledge of the effect of techniques and of their interactions with each other. Thus some of the means by which marketable yields and product prices may be increased, involve increasing the cost of production : on the other hand, lowering the costs of production may, in turn, reduce the marketable yield or the product price.

A few examples of the application of these means are drawn from the experience of the Texaco Food Crops Demonstration Farm during the first three years of its operation, 1964–66.

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See, for instance, the data collated from large-scale sample surveys, Department of Agricultural Economics and Farm Management, **U.W.I., A Digest of West Indian Agricultural Statistics,** (Occasional Series No. 2) St. Augustine, Trinidad, 1965. The few estimates available from intensive field surveys also indicate very low levels of yields. See, for instance, Edwards, D.T., and Ministry of Agriculture, (Division of Economics and Statistics), Jamaica, **The Economic Organisation of Small Scale Farming in the Brokenhurst Area of Southern Manchester, 1959–1960, Jamaica,** The Government Printer, 1962.

Experience at the Texaco Food Crops Demonstration Farm

The Texaco Food Crops Demonstration Farm was established on the Field Station of the University of the West Indies, to formulate, test and demonstrate systems of production for individual crops, on scale comparable to prevailing commercial conditions. The approach employed falls between the highly controlled technical experiments which are concerned mainly with a single or small number of practices, and the 'Unit' farm approach, which is intended to combine enterprises ('systems of production') into an integrated 'system of farming'.[7]

When a crop is grown for the first time the best technical practices are combined to form a system of production. The results of this first crop and successive crops are recorded and analysed, and changes made to the system in the light of the analysis.[8] The experience with the first crops of Yams and Sweet Potatoes, and some of the changes made to the initial production systems, are discussed below.

The first crops of Yam and Sweet Potatoes grown and costed on the Texaco Food Crops Demonstration Farm differed in important respects from the customary pattern, as the figures below reveal. Thus the labour used in producing Yams was 90 days per acre, as compared with over 120 days using traditional methods ; the yield also was far higher than was reported for farms in the Area. But in the case of Sweet Potatoes neither the labour used nor the (marketable) yield per acre were different from the general levels prevailing.

The Yam crop cleared the total variable expenditure, giving an appreciable surplus or Gross Margin, while the Sweet Potato crop failed to cover even the variable expenditure.[a]

Table I. Economic Observations of Yam and Sweet Potato Crops : Texaco Food Crops Demonstration Farm, 1964

	Yams	Sweet Potatoes
	(Per Acre)	
Marketable Yield	4.5 tons	1.7 tons
(Gross Yield)	(8.3 tons)	(3.1 tons)
Total returns	$1,374	$310
Total variable expenditure	$ 669	$412
Gross Margin	$ 705	– $102
Labour – used (eight-hour man days)	91 days	59 days
– expenditure	$ 358	$237
– expenditure, as a proportion of total expenditure	54%	58%

[a] Labour is costed at the local commercial rate (of 50c. per hour), rather than at the substantially higher Government rate which has to be paid at the Texaco Food Crop Demonstration Farm.

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[7] A. L. Jolly, 'The Unit Farm as a Tool in Farm Management Research', **Journal of Farm Economics**, 39, 3, 1957.

[8] D. T. Edwards, **The Economics of Food Crop Production** (mimeo.), 1965.

Examples of Reducing Cost of Production

Since payment for labour accounted for a substantial proportion of the cost of growing the first crops of Yams and Sweet Potatoes – see Table 1 – it was to be expected that attempts would be made to reduce costs by mechanising some of the practices using appreciable labour.

Planting Yams.[9] The use of a ridging plough and 48 hours of hand labour to plant an acre of Yams, was replaced in the next crop by a tractor-mounted potato planter and only 10 hours of labour per acre. (The extent of the net saving in cost would depend on the change in cost for machinery as well as for labour.)

Weed Control in Sweet Potatoes [10] In the first crop a contact spray was applied by a knapsack sprayer at a cost of $28 for materials and $32.50 for 65 hours of labour. But in the next crop pre-emergence weedicides were applied from a tractor mounted sprayer immediately after the crop was planted, and supplemented later by a limited amount of 'spot' applications of contact weedicides. The cost of both materials and labour was reduced to $14.50 for materials and $9.50 for labour.

Examples of Raising Marketable Yields.[11]

Various methods may be used to raise yields. One adopted was to concentrate future production on the variety which emerged with the highest yields in the first crop. To avoid the complications caused by comparing crops over time, it may be pointed out that the highest yielding variety in the first crop gave 4.2 tons of marketable Sweet Potatoes, as compared with the average for all five varieties of 1.7 tons. Given the conditions obtaining for the first crop, the use of only the highest yielding variety could have provided a Gross Margin of $237, rather than the negative Gross Margin of $102.

Example of Increasing Prices.[12]

The approach adopted for increasing the price for the product was to produce 'out of season' crops, to be sold during a period when prices were appreciably higher than during the normal reaping season. Thus the 'out of season' Sweet Potato crop realised (on average) 8.4 c. rather than 6.9 c. per pound, while the 'out of season' Yam crop was sold for 12c. rather than 8c. per pound. In the case of Yams the total variable costs per acre were far higher for the crop which received the higher price, so much higher in fact that a smaller Gross Margin was made. However, in the case of Sweet Potatoes not only were prices higher, but

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9 P. H. Haynes, 'The Development of a Commercial System of Yam (**Dioscorea alata L.**) Production, **Trop. Agric. 44, (3) 215–221, 1967.**

10 J. Cropper. **The Prospects for Commercial Production of Irish and Sweet Potatoes** (D.T.A. Project Report Series, No. 2) Department of Agricultural Economics and Farm Management, U.W.I., St. Augustine, Trinidad, 1967.

11 H. V. Walker, and P. H. Haynes, 'Prospects for Sweet Potatoes in Trinidad and Tobago', **Texaco in Agriculture,** 1965.

12 J. Cropper, **op. cit.**

the cost was substantially reduced and a larger Gross Margin was earned for the 'out of season' crop.

In due course means of increasing profitability, other than those already employed, will, no doubt, be introduced into the systems of production now being evolved.

APPLICABILITY OF A NEW SYSTEM OF PRODUCTION

Given that a new system of producing a root crop is evolved locally : can it be reasonably assumed that the present producers in the West Indies will adopt a new system in a substantially unchanged form ? There are, commonly, problems of introducing innovations in agriculture, but is there any reason to believe that new systems of root crop production may involve unusually severe problems ? These questions may be approached by considering the salient differences in the characteristics of new systems in relation to the features of the environment under which root crop production now occurs.

It may be anticipated that new systems of production will make considerably greater use of chemicals, both for the supply of nutrients and to provide plant protection (against weeds, pests and diseases), and will involve a high degree of mechanisation. These characteristics require a greatly increased cash outlay per acre, (with the concomitant demand for increased finance), and a quality of management with knowledge and skills adequate to the new, far more complex, systems of production. We shall limit discussion to the problems posed by a mechanised system of production since this is the feature which seems least compatible with the existing system.

Two aspects of a mechanised system are worth distinguishing : spraying, and mechanical cultivation (including planting and reaping). Much of the root crop productior in the West Indies takes place on steep slopes. Such slopes need not prevent spraying of crops, as the banana industry illustrates,[13] but they do seriously prejudice mechanised planting and reaping. The typically small acreage controlled by the individual root producer compounds the difficulty of cultivating the land mechanically. This is especially true if medium and large tractors – which comprise most of the tractor force in the Area – were to be used, but there is little reason why appropriate small power units should not be used more widely. The problem may also be tackled by the provision of mechanical equipment through contract services, and by the formation of machinery co-operatives amongst small producers. In such ways the problem of the 'lumpiness' of investment for the individual producer may be overcome ; other problems posed by numerous small, scattered holdings would not, however, be entirely solved.

It is quite probable that the conclusion reached would be that the needs of the mass of traditional producers for a more competitive system of production are not likely to be met by a system which depends to a great extent on mechanical cultivation. Such a conclusion would, however, not imply that all the elements

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13 G. Ordish, and R. Houghton, **Disease Control in Bananas — Windward Islands, West Indies**, London, Ministry of Overseas Development, 1965.

of a new system would be totally inapplicable to the conditions of the typical producer. For example, the use of improved varieties, appropriate fertilisers and plant protection methods are all feasible and could well result in increased profitability.

But under what conditions could a new system be most fully applied : on large scale, well financed and well managed units, with land suitable for mechanical cultivation ? The question seems to answer itself, although the decision to produce root crops on a large scale would also require satisfactory conditions in the market. It would be necessary to have either a guaranteed market with an acceptable price or, at least, a far more highly organised marketing system than has generally obtained hitherto.

Discussion above, of the conditions under which a new system of production can be applied, raises issues of national policy. Which is the primary purpose, to produce root crops cheaply or to try to maintain small scale producers ? If large scale, low cost producers meet the market needs, how is the future of the traditional producers to be provided for ? It is not intended to deal with these problems here, but raising them serves to draw attention to the link between the attempt to provide production systems for general adoption and the consequences of their widespread use in an economy.

THE AGGREGATE EFFECTS OF WIDESPREAD INTRODUCTION OF A NEW SYSTEM

The primary interest of those concerned with the development of a new production system is its commercial attractiveness to the individual producer. Persons concerned with national economic policy must, however, be alert to the more remote but equally important impact of the widespread introduction of a new system on the whole economy.

It is common for attention to be focussed on the effect of increased output on price and income. In countries with substantial unemployment (such as the West Indies) the effect of extensive mechanisation on employment must also be considered. (Since this latter topic is the subject of the following paper the treatment here will be particularly brief.[14])

Mechanisation and employment

Increased unemployment under conditions where unemployment is substantial, and is costly and difficult to reduce, must necessarily be considered a threat to the society : though there may be cases where decreased employment has to be accepted. An example is provided by a case where the cost of producing a crop is so uncompetitive that the alternative to reduce employment, consequent on the increased mechanisation of the system, could be no employment – due to the collapse of the industry.

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14 See B.F. Johnston, **The Discrepancy between Social and Private Returns to Mechanisation in the Early Phase of Economic Development, (T.R.C.S., April 1967), 1967.**

The outcome of the calculations of political economy are, however, clear-cut and simple. Thus the economist has to provide in his analysis for the possible conflict between the individual producer's gain from reduced costs (by increasing unemployment), and the society's loss by having to provide for the unemployed. While it is conceivable that if the competitive position of the industry is improved sufficiently, production might increase to such an extent that employment in the production of the crop could have increased despite the lower labour requirement per acre. Greater employment would also tend to be generated in supplying increased goods and services to the industry, in the marketing and production processes. Against these sources of increased employment would have to be set any decreases in employment due to withdrawal of resources from other industries.

Mechanisation is not simply 'good' or 'bad' : desirable or undesirable. The involved effects of an increased degree of mechanisation have to be traced carefully in the particular circumstances to arrive at a judgement consistent with national objectives.

Output, Price and Income

If production is increased by the general introduction of improved systems, the consequence could be a substantial decrease in price – sufficiently great to result in lower gross revenue and even net revenue. As an alternative to simply allowing producers to respond by decreasing production, through diversion of land and other resources to the production of other products, an attempt to expand the market for the product might well be more desirable in the first instance.

The market might be expanded in several ways within the country of production, as well as by opening up export markets. Hitherto, the traditional root crops have been used in a few, conventional ways. They have been confined largely to home use — often in excessive quantities in relation to nutritional standards — by the poor members of the population, and served in a very limited range of dishes. Surpluses and inferior products have been fed to pigs kept, generally, under poor systems of management. If the supply of roots could be made less seasonal, by reducing the seasonality of production or by storing the crop for longer periods than hitherto, a substantial increase in consumption could be provided for, either in the natural or in a processed form.

The low prestige accorded to the traditional root crops is not without some justification by any objective standards, as they are generally :

(i) inconvenient to use in their prevailing forms – being irregular in shape, difficult to peel, and often excessively large ;

(ii) not cheap per pound of usable material, in relation to some other sources of carbohydrates ; and

(iii) served in a few, unimaginative forms.

This appraisal, if sound, points the way to increasing the attractiveness of these crops for human consumption. An attempt to improve their natural form should be considered. It is not a matter of coincidence that the Hawaiian pineapple fits into a standard sized can, any more than it is that modern turkeys fit into small modern ovens. The production of small, regular and conveniently shaped yams, for instance, would seem attractive not only for marketing but would also

facilitate harvesting. It must be admitted that knowledge of consumer preferences in this field is so limited that even establishment of appropriate grades for buying and selling existing varieties cannot yet be undertaken with any confidence.

Other avenues of investigation might seek new uses for root crops. Three uses seem particularly worth consideration : replacing cereal flour in part, by incorporating root crop flour ; using locally produced roots in natural or processed form as a substantial ingredient in rations for the expanding livestock industries ; and seeking industrial uses for root crop starches.

Explorations of the market are significant for the development of systems of production of root crops, because the nature and extent of the market should influence the system of production devised. Thus a system of production to provide a very cheap and, by human standards, poor quality animal feed, may need to be very different from one geared to a discriminating and distant export market.

It is conceivable that the conclusion might be reached that the prospects for the expansion of root crop production are poor, because of the severe limitations of demand. This possibility indicates, more clearly than any other, the importance of exploring all the conditions under which a system of production would be operating, before committing substantial resources to formulating such a system.

CONCLUSIONS

This paper has dealt with a problem which is not peculiar to root crops or to the West Indies, though it is certainly important for root crops, and there is advantage in discussing it in relation to a particular area, such as the West Indies. The problem concerns the basis on which a system of production is to be formulated.

Increasing the profitability of an isolated 'pilot' system of production seems at first sight to be quite reasonable. But when account is taken of the farming conditions as they relate to the application of a system, and the national economic conditions as they will influence and be influenced by the effects of the widespread employment of a system, it becomes apparent that informed views about these conditions need to be arrived at before devising a new system of production. In short, the process commonly followed needs to be reversed. In as far as it is intended that systems should be put to widespread use, they should be devised to have characteristics that render them applicable to the farming conditions they can realistically be expected to serve, and they should be geared to a pattern of resource use and demand that are in the national interest.

If this view is accepted, there are important implications for the approach to be adopted. The problem is not just how technically superior practices can be modified and combined to produce a profitable system of production for the kind of conditions under which the system is being evolved. But rather, what farming conditions should they be created for : those prevailing for the mass of producers, or those – which may be very different – under which the bulk of production may necessarily take place in the future ? What system will meet the needs of the prospective markets ? Is it possible to produce a profitable system which uses the resource combinations appropriate to the resource endowment of the economy and to national policy ?

These questions imply a council of perfection. However, while it is not possible to anticipate with certainty all the relevant circumstances which will prevail when a system is ready for general application, lack of certainty about the future is not sufficient reason to avoid making and using informed judgements about prospective conditions. For unless adequate regard is paid to the conditions likely to obtain when a system is ready for distribution it may not find general application or, if applied, may create more problems than it solves.

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