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AN EVALUATION OF ONE APPROACH TO
THE PROMOTION OF AGRICULTURAL DEVELOPMENT IN
TRINIDAD AND TOBAGO : THE TEXACO FOOD CROPS FARM

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INTRODUCTION

The Texaco Food Crops Farm (TFCF) is a joint project of the University of the West Indies, the Government of Trinidad & Tobago and Texaco Trinidad Inc. - the major oil company in Trinidad and Tobago. The Farm was established in 1963 and has been in operation since that time.

This paper examines the changing objectives of the Farm over time and the approaches adopted for meeting them. The work undertaken on the Farm is next reviewed and an attempt is made to assess the reasons for the success or failure of this work. The paper then examines the work of the Farm in relation to developments in the agricultural sector in Trinidad & Tobago. Finally, suggestions are made for future operation of the Farm.

The discussion of the case study has relevance beyond the case itself since the issues involved relate also to the approaches adopted to research and development activity in general and to the operation of research stations in particular. Too often, research is undertaken without consideration of how it will be applied by farmers who are, after all, the 'consumers' of this work.

AIMS AND OBJECTIVES

Trinidad and Tobago became a fully independent country in 1962, having formerly been a British colony.

"It was clearly recognised by all concerned with planning the future economic well-being of the country, that agriculture presented tremendous scope for development, particularly if such development were to be aimed at increasing production of local food crops, in order to reduce the heavy expenditure on imported food, which was estimated at more than \$ 90 million per annum.

The paradoxical situation existed that, with relatively large areas of idle land available, a rapidly growing population creating a serious unemployment problem, and a world-famous institution of teaching and research in tropical agriculture located in Trinidad, the country was producing relatively little food for home consumption and importing more and more foodstuffs, many of which, or acceptable substitutes for which, could be grown locally.

Consultations between representatives of the Ministry of Agriculture the university, and Texaco revealed that, while excellent "small-plot" research work had been done, both by government and the University, on the development of new and improved varieties of food crops and cultivation techniques, little or none of this work had been adequately tested or assessed on a 'field' or commercial scale. Consequently, the information derived from this research was not sufficiently conclusive for practical application. Moreover, there were no facilities for demonstrating the results of this work on a sufficiently large scale for it to be of significant benefit to the practical farmer. Here was a gap between research and production which urgently needed to be filled, and thus the idea of the Texaco Food Crops Demonstration Farm was born."

"Operations on the farm were to be carried on to help achieve Government's objectives of encouraging local food production."

"Briefly, the original objectives of the Farm were to test and Demonstrate, on a field scale, new varieties of food crops and cultivation techniques which have been developed on a research scale, and to distribute planting material of proven varieties to local farmers."(1)

It was not long before the last part of this objective - distribution of planting material to farmers - was modified, since the farm was not equipped to handle the volume of requests received. Thereafter surplus planting material was passed to the Ministry of Agriculture for distribution to farmers.

In 1971, following general dissatisfaction with the performance of the Farm, it was agreed that :

"Specific objectives (of work at TFCDF) should be established which was more relevant to the needs of the small farmer. Emphasis should be placed on (a) the development of farming systems suitable for the small farmer, and (b) diversification of sugarcane farming in order to profitably occupy the cane farmer's 'off-season' time." (2)

Subsequently, it was agreed to drop the word "Demonstration" from the title of the Farm since less emphasis was to be placed on this aspect of work in future.

APPROACH

(i) Size : The Farm comprises 22 hectares, of which approximately 20 are usable farm land and the remainder are occupied by roads, traces, drains, buildings, etc.

(ii) Location : The Farm is situated on the University Field Station in St-Joseph in an area which is becoming increasingly in demand for urbanisation. (Six hectares are to be taken away for construction of a hospital during the year.)

The land is essentially flat and is comprised of two major soil types

- (a) River Estate series. There are 6 hectares of this Class I soil, which is easily cultivated, having free internal drainage. The soil is, however, susceptible to drought and to capping after heavy rainfall.
- (b) Streatham Series. There are 13 hectares of this Class IV soil which requires intensive conservation and management practices. The soil has imperfect drainage and tends to become desiccated in the dry season. Capping occurs after heavy rainfall. All nutrients are in low supply and the soil is extremely acid. (3) Soil fertility status has not been monitored since the inception of the Farm.

Table 1 shows the monthly averages for rainfall, maximum and minimum temperatures, sunshine duration and open pan evaporation over a number of years. The period December to May is the dry season and it is mainly during these months that irrigation is applied to some crops, for example papaw, tomato. Temperatures vary little throughout the year and sunshine averages 7 hours daily. There are very few sunless days through-out the year. Day length varies from 12.75 hours in June to 11.5 hours in December and is an important factor in the cultivation of crops sensitive to photoperiodicity like pigeon pea and sorrel.

TABLE 1

Monthly Averages for Rainfall, Maximum and Minimum Temperatures, Sunshine Duration and Open Pan Evaporation

Month	Rainfall	Temperature		Sunshine	Open Pan
	(54 years)	Maximum	Minimum	Duration	Evaporation
	(mm)	----- (°C) -----		(hours)	(mm)
January	67.31	29.4	20.0	7.5	104.14
February	39.87	29.4	20.0	8.1	110.99
March	29.46	30.6	20.6	8.1	140.21
April	50.04	31.1	21.7	8.2	137.41
May	107.70	31.1	22.2	8.0	134.37
June	248.16	30.0	22.2	6.7	96.01
July	218.95	30.0	22.2	7.1	93.98
August	237.24	30.6	22.2	6.9	92.46
September	187.45	31.1	22.2	6.6	95.50
October	166.62	31.1	22.2	6.9	95.50
November	188.47	30.6	21.7	6.9	81.28
December	145.03	29.4	21.1	7.2	89.41
Mean	140.53	30.4	21.5	7.1	105.92

Source : University of the West Indies Meteorological Station.

(iii) Infrastructure : The Farm is well served by roads, and there is ready access to all fields throughout the year.

Prior to the inception of the Farm, the land was graded and open drains were constructed in order to improve infield drainage. In addition, it has been found necessary to grow all crops on cabered beds. In spite of these precautions, however, the soil lies extremely wet during periods of heavy rainfall. Localised flooring can also occur as a result of water from neighbouring land moving onto the Farm.

The Farm has an overhead sprinkler irrigation system with water supplied to the fields from an underground main. Water is stored in a reservoir originally rated at approx. 4.5 m. litres which can be replenished from a near-

by river. From the inception of the Farm to 1972, irrigation was applied to all crops at the request of the consulting agronomist. Subsequently, irrigation has been restricted to vegetable crops, papaw and to special experiments. This change was the result of the modification in the objectives of the Farm which required greater attention to the needs of the small farmer. (Typically, the only small farmers with irrigation are those growing vegetables.)

Farm equipment, other than the usual range of hand tools, has included a small van, a small tractor (35 - 50 h.p.), cultivation equipment, 2-row semi-precision seeder, tuber-planter, simple root crop harvester. It is not known why an elaborate root crop harvester, especially imported by the Farm from the U.S.A. could not operate at TFCF. A proto-type solar drier was also constructed but has been very little used, in part, because emphasis has been shifted away from crops requiring drying.

Farm buildings include an office, tool store, seed store and a general purpose open-sided shed. A house is provided on the Farm for the Farm Supervisor.

(iv) Labour : No workers are employed directly by the Farm, rather, workers are drawn from a 'labour pool' at the University Field Station. A core of workers do, however, work regularly at TFCF.

Workers are unionised and labour relations are governed by industrial agreements signed by the University and the Union. Perhaps because neither the University nor the Union (National Union of Government and Federated Workers) is primarily concerned with agriculture, the agreements have tended to become increasingly restrictive, and suited more to repetitive manufacturing activities rather than to the flexibility necessary in agriculture.

Labour productivity has declined over time principally because labour is now employed on a daily basis (7 a.m. to 4 p.m.) with little scope for re-dress. Previously, labour was employed on a task basis.

Labour disputes over details of the industrial agreement have occasionally led to 'go-slows' and work stoppages which have disrupted work on the Farm for a short time. Wages are at about the level of daily-paid unskilled labour employed by Government.

In spite of the above it generally agreed that the labour force on the Farm exhibits above-average skills for agricultural workers in Trinidad, while their productivity, although low, is higher than on the University Field Station and Government projects.

(v) Management : The executive authority for the Farm is a three-man Management Committee comprising one representative of each of the three participating institutions. The University representative is Chairman of the Committee.

The Head of the Department of Crop Science was Chairman of the Committee from the inception of the Farm to 1971. From 1971 to 1974, the Chairman was the Head of the Department of Agriculture Economics and Farm Management,

while since that time the Dean of the Faculty of Agriculture has held this position. Changes in the Chairmanship represented changes, not so much of personality, but rather of emphasis in the development of the Farm. Thus, the early emphasis of the Farm was technical, later becoming more concerned with the commercial feasibility and applicability of the technology developed, and finally with the role which the Farm could play in the agricultural development process in the country.

The representative of the Government of Trinidad and Tobago has usually been the Technical Officer responsible for Crop Research in the Ministry of Agriculture : at least five individuals have held this post since the inception of the Farm. The Superintendent of Agricultural Operations at Texaco Trinidad Inc. has been that company's representative, with one person serving unchanged until 1976, and thus helping greatly to maintain continuity in the work of the Committee.

The Management Committee exercised fully its powers of co-option in the period up to 1971 with almost all persons interested in the work of the Farm being co-opted. Since 1971 this power has been used infrequently, although recently the trend has been to increase the size of this policy-making body once more.

Technical Sub-Committees with responsibilities for Agronomy, Marketing and Extension were envisaged at the beginning of the Farm, but only in Agronomy was there continuity of work. The Agronomy Sub-Committee was principally responsible for the formulation of the cropping programme. This Sub-Committee ceased to function in 1973 due to an absence of active food-crop agronomists, both in the University and in the Ministry of Agriculture.^o The work of the Sub-Committee therefore fell principally upon the Research Fellow in Farm Management (see below).

The Marketing Sub-Committee functioned for a few years in a desultory manner, but it was found impractical to involve part-time voluntary Committee members in the marketing of generally perishable commodities. Marketing therefore fell fully upon the Farm Supervisor, acting under general policy guidelines from the Management Committee. This approach to marketing continues to the present time.

The Extension Sub-Committee was only operative in the early life of the Farm. Thereafter, the Ministry of Agriculture Extension Service which was meant to spearhead the work of this Committee failed to provide leadership. Consequently, there was a decline in the 'Démonstration' aspect of the Farm which was eventually reflected in the change in Farm objectives and name.

Under the agreement establishing the Farm, the University and the Government of Trinidad & Tobago agreed to provide technical expertise and supervision of Farm operations. Thus, the crops produced at the Farm have been grown under the guidance of agronomists acting as consultants for these crops.

^o Persons who had previously been active on the Sub-Committee either left the country or took up full-time executive positions leaving them no time for technical participation in the work of the Farm.

Consultants submitted written guidelines for the production of each crop and were then expected to monitor the growing of the crop to ensure that the recommendations were being followed. Working at the Farm was an additional responsibility for these agronomists, many of whom already had heavy work-loads, and they received no financial reward for this extra work in spite of being designated as consultants. Not surprisingly, therefore, there was a variable level of involvement in, and commitment to, the work of the Farm. Many consultants also complained about the failure of Farm staff to perform operations at the correct time.

Promotions, transfers and emigration have led to a fairly heavy turnover of consultants. At the same time increasing specialisation has reduced the number of persons willing and capable of handling all aspects of production of individual crops.

In an attempt to mitigate the effect of this last-mentioned problem two levels of responsibility for agronomists were defined in the 1970's : (a) active involvement in the production of the crop, i.e. similar to the previous style of operation, and (b) consultant, i.e. being called in for advice only when specific problems arose.

A further solution to the 'agronomist problem' is being tried in 1977. The Department of Crop Science at the University has accepted responsibility for the technical operation of the Farm. The only food crop agronomist in the Department^o - who has a heavy teaching commitment - has been put in charge, with the assistance of a young graduate on secondment from the Ministry of Agriculture.

A Farm Supervisor is responsible for the day-to-day operation of the Farm drawing on the crop production recommendations made by consultants. One individual has filled the post since the beginning of the Farm and has thus provided continuity in Farm operations against a background of changing agronomists.

The role of Farm Supervisor has been under debate since the Farm was started. It was reasoned and eventually accepted that since the Farm was to demonstrate crop production techniques appropriate for adoption by farmers, a Farm Supervisor with practical experience but little formal agricultural training would be most appropriate. It was felt that the capabilities of such a person would act as an in-built deterrent to the development and demonstration of production techniques which were too sophisticated for adoption by farmers.

The counter-argument, which was raised initially, was that operation of a 20 hectare farm growing a range of crops, was a task calling for a high level of skills, particularly as some of the crops and many of the production techniques had never been attempted previously.

In the early years, many agronomists visited almost daily, the crops for which they were responsible. In this situation the need for initiative on

^oOne of the authors of this paper - R.A.I. Brathwaite.

technical matters by the Farm Supervisor was very limited. For reasons explained above, the involvement of agronomists in the operations of the Farm has diminished, also the objectives of the Farm have been changed from demonstration to development. In this changed situation the need for a more technically qualified Supervisor, able to participate fully in the development of production systems and techniques has become increasingly apparent. Failure to effect a change of personnel has become a major limitation to the operation of the Farm in the 1970's. The change has not been made because the post of Farm Supervisor is not controlled by the Management Committee, but by Texaco Trinidad Inc. who appear to be constrained in their action by trade union agreements.

The first full-time professional appointment was made in 1971 when a Research Fellowship in Farm Management was funded at the University by Texaco Trinidad Inc.^o This appointment coincided with the change in the policy - to concern with commercial feasibility and applicability - and reflected an awareness that the effectiveness of the Farm had declined in recent years.

The Research Fellow worked closely with the Management Committee, of which he was a co-opted member, in effecting the new objectives. Principally this involved (a) concentrating work on fewer crops in order to achieve greater impact, (b) choosing crops which appeared to have processing possibilities for concentrated work, since markets for fresh produce were limited, (c) investigating cropping combinations (systems) which might be suitable for small farmers, (d) learning more about small farmer cropping systems and (e) investigating new crop production techniques on small farms.

At the same time efforts have been made to improve the operational efficiency of the Farm. Also the production techniques and cropping systems have been subject to systematic economic analysis, complementing the technical analysis.

The new direction in the work of the Farm has been severely constrained by the declining number of agronomists. As a result, the agronomic analysis of crops at the Farm and commercial cropping systems has been considerably less than optimum. In fact, for some time the Research Fellow had to act as an agronomist in formulating crop production practices.

(vi) Finance : The Farm is financed from two sources (a) the sale of produce, and (b) subventions from Texaco Trinidad Inc.

As far as the authors are aware, at no time has the Farm programme been restricted by financial considerations. This freedom has enabled the work programme to concentrate on priorities within the specified objectives. Principally this has meant that crops could be grown for which no present market exists and that the development of processing techniques could be supported.

Some inconvenience has been caused, however, by the financial procedures of Texaco Trinidad Inc. and the University (through which some of the fi-

^oOne of the authors of this paper - J. Cropper - has held this post since that time.

nancial transactions are made). For example, the purchase of supplies has sometimes been delayed, also the marketing of produce cannot be carried out through the more important commercial channels open to farmers.

(vii) Marketing : For most of the life of the Farm, marketing has been performed by the Farm Supervisor, acting under the policy guidelines of the Management Committee and under the financial restraints of the University. Goods are sold to supermarkets and institutions, as well as to private traders and the few consumers who come to the Farm to purchase. For crops which are particularly expensive to harvest and for which suitable buyers can be found, produce is sold 'in the field' to be harvested by the purchaser : examples include cassava and sorrel. The Farm is not permitted to trade in the wholesale market in Port-of-Spain.

Difficulty has sometimes been experienced in selling crops produced in quantities larger than the normal traded amounts. This indicates that the marketing system is geared only to relatively small quantities of goods at any one time. This problem was one reason for the policy decision to concentrate on crops which have potential for processing.

At present there are few food crops being locally produced for processing - reasons for which have been discussed elsewhere (4) - therefore, the Farm has sought to assist in solving some of the problems associated with producing for the processing market. Thus, co-operative efforts have been made with institutions working on the technology of processing, such as the University of the West Indies and the Caribbean Industrial Research Institute.^o

(viii) Economic Evaluation : Concern with the economics of the crop production techniques and systems being explored at the Farm has been evident from the beginning. Texaco Trinidad Inc. supported the appointment of a Graduate Assistant in Farm Management at the University until 1971, when the Research Fellow was appointed. The work of the Graduate Assistant and part of the work of the Research Fellow has been to monitor the economic performance of crops produced. Records are therefore maintained of all operations carried out at the Farm, and of all produce which is sold. (Some of the early crop records are incomplete).

Results of the economic analysis should be used to modify subsequent crop production practices. It is evident, however, that this has not always been the case, since the records show certain 'unprofitable' crops being grown for several years without change in the production system, e.g. slung wire system for support of yams. In other cases, however, economic evaluation has led to the search for different production practices : for example, mechanical harvesting of pigeon peas and sorrel.

(ix) Extension : Records show that there was a steady stream of visitors in the first few years. Perhaps this was due to the novelty for both ex-

^oSee, for example, the paper to be given at this Conference by S. Thomas.

tension officers and farmers of seeing relatively large acreages (for Trinidad) of food crops being produced in pure stands. As the novelty wore off and there was nothing new to demonstrate, interest in visiting the Farm waned. In the early part of the 1970's only the occasional person and group visited the Farm. More recently, however, special interest groups have been organising visits, when items of particular interest were to be seen, for example pigeon pea farmers, sorrel farmers.

Drawing heavily on work done at the Farm, a number of extension leaflets and bulletins were published by the Ministry of Agriculture in the 1960's. (5) Texaco Trinidad Inc. assisted in this exercise by paying for their printing. More recently, in spite of expressed interest in these publications, the Ministry of Agriculture has not sought to update and re-issue these bulletins.

In spite of the large amount of work done in the 1960's very little has been reported. Technical bulletins were produced on a few crops - yams, Irish potato, sweet potato, corn and pigeon peas - but these were far from comprehensive. (6) A brief review was, however, published on the first ten years of operations (7), and since 1972 Annual Reports have been published. (8)

(x) Outreach : Concern with the applicability of the techniques and systems developed at the Farm, while always present, has only found formal expression in recent times. Studies have been made to better understand the nature of commercial farming systems, particularly cane farming (in keeping with the Farm's objectives).^o Crop production techniques in the process of development have also been tried out by a few cooperative commercial farmers - with yellow mature blackeye beans for processing, and late planted row-crop production of sorrel. This is still, however, a very modest part of the work of the Farm.

(xi) Crop Selection : The Farm has always sought to contribute to the national goals for agriculture. The expression of these goals has not always been clear, and the stated goals have also changed over time. This led to the identification of certain (changing) crops.

There have, however, been other factors determining crop choice. It was desirable to obtain an agronomist with sufficient knowledge and experience of the crop to be able to serve as a consultant - problems of which have already been discussed. Secondly, since the Farm was intended to test and demonstrate new technology, if no new technology was coming forward after a time the continued production of the crop could not be justified. Also if a crop could not be produced profitably, and there appeared to be no possibility of this being achieved this was an added reason for not producing the crop.

The interplay of these various factors has caused a changing emphasis in the crops grown at TFCF since its inception.

In the early years, the main crops grown were the "basic" food crops

^oStudies of cane farming were done as student projects under the supervision of the Research Fellow.

which were at that time either imported in large quantities or were only produced locally using traditional small-farm techniques. These crops included : field corn, sweet potato, dry beans (blackeye and red kidney) and pigeon peas. Other root crops (yams, eddoe, tannia and the exotic Irish potato) and some vegetables (especially carrot, onion, sweet corn, and tomato) were also grown although on a much lesser scale. Appendices I and II show the areas and number of plantings of each crop since 1966-67.

In the 1970's root crops have progressively declined in importance, although more interest is now being taken than ever before in cassava - part of a world-wide trend. Dry beans (particularly blackeye) received considerable attention early in the 1970's but subsequently interest has shifted to production of blackeye for canning and to the production of (dwarf) bodie. Interest in pigeon peas has also intensified with the introduction of dwarf types suitable for row crop production.

Field and sweet corn have been produced regularly throughout the life of the Farm, but interest has declined of late in both crops. With field corn (and soyabean) the reason is the inception of the Chaguaramas Agricultural Development Project for which large-scale mechanised production of these two crops is the priority. The Farm has not been able to develop a continuing co-operative programme on the processing of sweet corn, as had been hoped, and therefore this crop has become less important of late.

Vegetables became a priority in the early 1970's - principally tomato, cabbage and sweet pepper, but only work on tomato has been continued. An intensive vegetable programme could not be sustained because of the high level of management which is required.

Plantain and papaw were grown from early in the life of the Farm, but interest has been sustained only in papaw, which continues to claim considerable attention in spite of only one crop being grown at any one time. Physical wind damage appears to be the major constraint to successful production of plantain.

The only completely new crop, in recent times, which is an important part of the Farm programme is sorrel.

The cropping programme for the 1977 wet season is given in Appendix III.

It is worthy of note that although the total area of crops grown has been approximately halved since 1966-67 the intensity of investigation, as measured by the total number of plantings, has been maintained. (Appendices I and II).

(xii) Cropping Systems : When the Farm was started an attempt was made to institute a rotation based on cereals, root crops and legumes, following in a general way a pattern established in temperate countries. This was not found to be practical because of the varying duration of crops and the possibilities of almost year-round growth. (9) Subsequently, one-year rotations based on corn and soya bean were investigated for several years.

In the early 1970's there was considerable interest in mixed cropping

and combinations of corn and cassava, and corn and pigeon peas were examined. (10) There has been no sustained mixed cropping programme since that time, but occasionally combinations have been observed, e.g. corn and yams, ochro and ginger, sorrel and bodie. More recently and up to the present time, intensive sequential cropping combinations are being examined, using a variety of crops. The most ambitious of these systems attempts to grow four crops in one year without irrigation. Sequential cropping systems involving the late planting of sorrel preceded by other crops are also under study.

SUMMARY OF CROP PERFORMANCE

Production of many crops has been profitable, but since the work programme has been concerned, especially in the 1970's, with solving the problems of the selected crops, the difficulties are represented in the results achieved. In Appendix IV is a ranking of the main technical and cost of production constraints to the production of crops at TFCF. Weed control stands out as a major problem. Persons interested in further details, including crop costings, are referred to the Annual Reports, (8).

The minimum field size for commercial crops was 0.2 ha., though for many of the cereals, root crops and legumes, field size was usually 0.4 ha. or more. The maximum area grown of one crop at one time was 4.0 ha. - but this was unusual.

Cereals

Field Corn (Zea mays) : This has been one of the most common crops cultivated. Pioneer hybrids, X306 in particular, have been grown and yields of over 3,400 kg. of dry corn per hectare have been obtained. The crop was frequently used as a cheap and potentially profitable means of occupying and clearing lands. Dry corn production was not a profitable enterprise. A profit was readily made, however, if all or part of the crop was sold as green corn for boiling and roasting, although vendors tended to discriminate against the Pioneer hybrids when alternative supplies were available.

Sweet Corn (Zea mays) : The cultivar PR 50 was frequently grown and yields of over 25,000 ears/ha, could be achieved (38,000 ears/ha. was the highest yield). This cultivar performed better than Trop II which although producing a better canned product (studies were conducted by U.W.I.) was susceptible to corn ear worm and army worm attack during wet season production. The main problems of this crop are the need for good marketing arrangements because of the rapidity with which maturity occurs (particularly in dry weather) and varietal decline since seeds are usually retained from successive plantings. The major cost item is harvesting and cleaning the ears.

Legumes

Blackeye Bean (Vigna unguiculata) : California N°. 5 blackeye bean was produced initially for shelled dry beans with poor results averaging less than 450 kg/ha. Emphasis of the work was shifted to the production of yellow mature pods for processing in collaboration with CARIRI. The removal of seeds after planting and damage to germinating seedlings by pigeons, pest and weed

control, twining of plants and variable yields are the main problems experienced.

Bodie (Vigna unguiculata) : Yields of over 9,000 kg./ha. have been obtained with Los Banos Bush Sitao N°. 1 at planting dates throughout the year. Canning studies have indicated that an acceptable product can be produced provided that the pods are not over-ripe. Problems experienced in the production of the crop include ; pigeon damage to seeds and germinating seedlings, post and weed control and the high cost of harvesting.

Gug Gub (Vigna unguiculata) : Poor results were recorded with Texas Cream N°. 40 for dry seed. There is probably scope for the production of this crop for processing yellow mature beans. Untimely weed and pest control are known to significantly affect the performance of the crop.

Mung Bean (Phaseolus aureus) : A relatively new crop which has only been grown at the Farm since 1972. It appears to be a good catch crop with good commercial potential. A package of practices is still being developed for its production. Harvesting can be troublesome since the crop matures unevenly. Mechanical harvesting and threshing trials are being undertaken.

Pigeon Pea (Cajanus cajan) : This has continued to be one of the more important crops grown. During the early years of the Farm yields of 2,000 - 3,000 kg/ha. green pods were obtained with indeterminate cultivars but the crop was not considered profitable since hand-picking was very costly. The introduction of the row cropping system using the semideterminate cultivars planted in December and January, gave disappointing results, never living up to its reported potential of 4500 kg. per ha. (11) (12) The recently released day neutral-type developed in the breeding work of the Grain Legume Programme of the Faculty, however, appears to be promising. Weed control and harvesting remain the main problems. Mechanical harvesting studies have been conducted and a pro-to-type harvester produced.

Red Bean (Phaseolus vulgaris) : Several crops were grown in the early years, but average yields were only 450 kg. per ha. The highest yield obtained, on a small plot, was 1400 kg. per ha.

Snap Bean (Phaseolus vulgaris) : Crop performances have been variable with yields ranging from 300 - 8,000 kg./ha. Results indicate that better returns were normally achieved when planted in the late wet season. Cultivar Top Crop was a better performer than Contender, although it is less preferred by vendors.

Soyabean (Glycine max) : This crop has been cultivated commercially in rotation with corn with disappointing results. Poor plant stand, late and improper weed control and lack of seed inoculation were the main factors which resulted in the low yields recorded. Experimental results, however, were the basis for adoption of this crop at C.A.D.P.

Root Crops

Cassava (Manihot esculenta) : Cassava has not been an important crop. Average yield has been about 4,000 kg./ha. using local varieties. Harvesting is a major problem and studies on mechanical harvesting are being con-

ducted. The unavailability of a ready market frequently results in the crop being sold 'in the field'.

Irish Potato (Solanum tuberosum) : This crop was cultivated during the initial years but low yields - from 4,000 to 9,000 kg. per ha. made it unprofitable. Consideration is being given to a re-examination of this crop since new cultivars are now available from I.P.I.

Sweet Potato (Ipomoea batatas) : The 049 cultivar has been cultivated annually with variable results. Yields as high as 16,000 kg. tubers/ ha. have been recorded but are more commonly 5,000 - 10,000 kg./ha.. Weed control, Megastes infestation and the high cost of semi-mechanised harvesting are many constraints.

Yams (Dioscorea spp.) : Variable results have been obtained with Lisbon. Attempts to reduce cost of staking and harvesting, have met with little success. Yields are normally less than 10,000 kg./ha. but occasionally up to 15,000 kg./ha. was obtained. Often, small and damaged tubers made up 50 per cent of the total harvest.

Other Root Crops, Tannia (Xanthosoma sagittifolium), Eddoes (Colocasia esculenta var. antiquorum) and Dasheen (Colocasia esculenta var. esculenta) were cultivated occasionally in the early years but no records are available.

Vegetables & Other Crops

Cabbage (Brassica oleracea) : Only one good crop with a yield of 13,000 kg./ha. was produced. At least four crops were unprofitable because of ineffective control of looper worm by Lannate and low plant population density. An attempt at direct seeding was abandoned because of poor germination and heavy weed growth.

Carrots (Daucus carota) : This has not been an attractive commercial crop because of the high risk of establishment. Yields varied from 1,000 to 10,000 kg. per ha.

Hot Pepper (Capsicum annum) : A crop of red hot and red bird peppers was cultivated but was not profitable because of a poor plant population which resulted in reduced yield and increased weed control cost, improper fertilizer management and difficulty in marketing some of the harvested fruits. Harvesting costs were very high.

Onions (Allium sepa var sepa) : Initial attempts at onion culture with cultivar Texas Early Grano were not profitable since almost 40% of the total cost per acre was incurred in nursery preparations and another 40% in transplanting, weeding and harvesting combined even though average yields were 16,000 kg./ha. Direct seeding was adopted in subsequent plantings but only one such crop was profitable giving a yield of approximately 14,000 kg./ha. Weed control was a major problem but soil capping, flooding and poor seed quality often led to crop failure at time of germination.

Papaw (Carica papaya) : Variable results have been obtained in the cultivation of Solo Sunrise (open-pollinated) over the years. This has resulted mainly from varying levels of crop management. Invariably, infrequent and irre-

gular spraying against bunchy top, inadequate roguing and the limited application of fertilizers have led to poor crops.

More recently, better crop management has been practised and two extremely profitable crops were grown. However, the crop is susceptible to a wide variety of pest and disease problems, all of which cannot adequately be controlled and the crop must be considered to be risky. The most financially successful crop had sales of almost \$27,000 per hectare and a gross margin of more than \$12,000 per hectare. Some 50,000 kg. per ha. of fruit were harvested.

Plantains (Musa paradisiaca) : This crop was cultivated up to 1973. High establishment and maintenance costs and poor yield, as well as poor overall management (heavy infestation of stools by borer, inadequate sucker pruning and inadequate fertilizing), led to the crop being uneconomic. Average yields of only 5,000 kg./ha. were recorded, with the highest being 14,000 kg./ha.

Pumpkin (Curcubita pepo) : Disappointing results were frequently obtained with the culture of this crop, the cost of production of which was usually extremely high. Yields were normally low ranging from 3,000 to about 4,500 kg./ha., the maximum yield was 11,000 kg./ha. Pre-germinated seeds in polybags apparently have no advantage over direct seeding in terms of better land utilization and improved yield.

Sweet Pepper (Capsicum annum) : Most cultivations of this crop were extremely poor, having low yields and negative gross margins. The main cause was inadequate and untimely weed control. However, one extremely profitable crop which was established early in the dry season yielded approximately 14,000 kg. of saleable fruit per hectare.

Tomato (Lycopersicon esculentum) : This has been the most important vegetable crop to be grown. In many instances only the dry season crops have been profitable. Yields for the wet season have varied from 300 - 9,000 kg. per ha., whereas yields were from 11,000 to 40,000 kg./ha. in the dry season. Attempts at direct seeding were abandoned because of poor germination and weed growth. Staking and tying can represent as much as 40% of the total cost but it was found that the use of wire trellis was somewhat cheaper than wooden stakes although yields were also lower. Staking in the dry season has been found to be less profitable than leaving the crop unsupported. Floralou has been the traditional cultivar grown but Floradel and the determinate Walter have been cultivated. Inadequate pest and disease control and improper handling have contributed to significant losses of fruit. Within the past two years the newly-released cultivar, Calypso, has been under test with encouraging results.

Sorrel (Hibiscus sabdariffa) : An initial planting with cultivar dwarf early red using the traditional system resulted in an average yield of about 10,000 kg./ha. The main problems were weed control, inefficiency of harvesting labour and the occurrence of a fungal collar rot. In an effort to overcome the weed problem intercropping with bodie was tried. Untimely weed control in the early life of the crops resulted in increased weed control cost and a low bodie yield, but the mixture was not a complete loss. A subsequent crop planted late as a row crop, being sown mechanically in 50 cm. rows thinning to 10 - 15 cm. along the row, gave a yield of 20,000 (manual harvesting once a week appeared optimum) and collar rot occurred in only one or two isolated plants. Further plantings have confirmed that high yields can be obtained by planting in the middle of the wet season. Harvesting has been recognised as a serious pro-

blem in the production of this crop and studies are being conducted on the development of a mechanical harvester.

Other crops, cucumber (Cucumis sativus), okra (Abelmoschus esculentus), eggplant (Solanum melongena), peanuts (Arachis hypogaea), sesame (Sesamum indicum) and watermelon (Citrullus lunatus) were also cultivated occasionally, mainly on small plots.

THE PLACE OF TFCF IN AGRICULTURAL DEVELOPMENT

The agricultural sector in Trinidad and Tobago has declined in relative terms to the rest of the economy, and probably in absolute terms also if measured in constant prices. Poultry and vegetables have been the only two sub-sectors in which output has consistently increased. Important vegetables which are locally grown are tomato, cabbage, bodie, pumpkin, melongene, cucumber, while onion, garlic and carrot, are the most important imported vegetables. Production of food crops has either declined or remained about constant : statistics are extremely poor, but the lack of growth in output is apparent to all. Yet the demand for food crops, as measured by the volume of imports, is high and is growing. Major items of imported food crops are corn, soya bean (meal and oil), dry beans, Irish potato, while wheat flour - another major import - could be replaced in part by locally-produced flour (either cereal or root crop).

During the time that these changes have taken place, Government has had a stated policy of increasing self-sufficiency in food production, and has sought to promote this by distributing approximately 2,000 hectares of State lands to approximately 1,000 farmers, and establishing an Agricultural Development Bank and a Central Marketing Agency. Subsidies and minimum guaranteed prices were also offered.

Failure of this policy of self-sufficiency appears to lie in the continued importation, without duty, of foodstuffs which could be produced locally or for which local substitutes exist. (At present, some imports are even subsidised.) Local farmers had no incentive to produce crops to replace these imports because at the prices at which the competitive products were imported they were unable to earn an adequate return for their labour because of small farm size. Only in vegetable production where there were no competing imports and where output per acre was sufficiently high to compensate for small farm size did total output increase.

Against this background of the agricultural sector it can now be seen why the techniques and systems of food crop production from TFCF have not gained widespread acceptance. (Adoption of vegetable technology has been more commonplace.) The Farm has contributed substantially to the fund of agricultural information and has demonstrated the potential for improvement of a number of crops, but this alone was far from sufficient to bring about an increase in food crop production in the country. However, it is possible to use the information provided by the Farm to calculate the likely costs and benefits to the economy of attempting to induce increased food crop production.

The resources devoted to the Farm have not been wasted. The future of agriculture in Trinidad and Tobago need not necessarily continue as it has in the past - in the doldrums. Change can come about through awareness within the

country, such as the recognition of the potential contribution of agriculture to the creation of income and employment. Alternatively, change may be induced from outside of the country by rising prices and/or unavailability of currently imported foodstuffs. If any of these situations occur, then the experience gained at the Farm over the years can be the starting point for further food crop development.

SUGGESTIONS FOR THE FUTURE OF TFCF

(i) Objectives

(a) Crop Selection : Since self-sufficiency is a stated goal of Government policy in agriculture, and since the major imported items are food staples, the Farm should concentrate on these crops. Present (un) profitability of these crops, even with the best technology, should not impede further work.

(b) Target Group of Farmers to be Served by the Farm : In order for present small farmers to earn a "reasonable" living, agricultural prices (or taxpayers), alternatively farm sizes have to increase in order for farmers to enjoy economies of scale including access to technology which increases labour productivity. In the absence of guidelines from Government on the future direction of policy in this regard, technology developments should be for both the existing small farmers and for a possible future group of larger farmers using a greater degree of mechanisation.

(c) Appropriateness of Technology : Technology which remains unused represents a waste of scarce resources in its development. As such technology which is in the process of development should bear a relationship to the resources of one or more of the farm types referred to above, including the capacity of the farmers to adopt the technology.

(ii) Approach

(a) Location : The Farm is located on above average soils which are not typical of the soils on which food crops are likely to be grown in the future. The Farm is about to lose approximately 6 hectares to urban development and pressures are likely to increase because the Farm is in a prime development area. If the land can be preserved for agriculture, and it should be, it should be devoted to commercial vegetable farming for which it is best suited. The Farm should be relocated on a suitable food crop soil - e.g. Cunupia series.

(b) Agronomic Input : The Farm has been limited for too long by insufficient agronomic input. Fortunately, the Ministry of Agriculture is again building its capability in this area. The programmes of the Crop Research Division at Centeno, Chaguaramas A.D.P., CARIRI and TFCF should be integrated, in order to maximise the returns to scarce resources. Research should be initiated to support and advance the development of commercially feasible cropping systems for staple food crops. Technical resources at U.W.I. and CARDI should continue to be drawn upon.

(c) Labour Relations : Greater flexibility in the use of labour would ease the problems of management. Direct discussions with the workers's Union would help to clarify the issues limiting the performance of labour. Both

the University and the Union need to be made aware of the peculiar nature of agricultural systems and of what the Farm is trying to achieve, in order that incentives for workers and their fuller participation in the running of the Farm can be realised.

(d) Day-to-Day Management : The person in charge of day-to-day operations at the Farm ought to be capable of intimate involvement in the development of production systems and of exercising initiative meaningfully, especially where agronomic inputs are limited.

(e) Marketing : Existing constraints on the marketing of Farm produce should be removed to allow the full exploration of existing, as well as new marketing outlets. Improved methods of handling, storing, preserving and presenting produce should be undertaken with appropriate technical assistance.

(f) Level of Technology : Some technology is appropriate for farms of any size - e.g. new varieties, new agricultural chemicals - while some are limited in their application to farms of different sizes - e.g. size of machines. If systems have to be developed for both small and large farms the production systems therefore need not be entirely different.

(g) Systems Developed : The development of packages of practices for individual crops, for individual crops, for the fresh and processed markets should continue to be a major thrust of work at the Farm. The combination of crops into cropping systems should be the other important area of activity. Factors to be considered in the choice of crop combinations will include : profitability of production, soil preservation, ease of management, weather patterns, and risk.

(h) Outreach : The performance of individual crops and cropping systems should be examined on commercial farms. This would result in a better understanding of commercial farming and of the systems developed, and therefore to the subsequent development of systems and production practices more applicable to farmers.

(i) Information Dispersal : It is desirable that information generated by the work programme be available to a wide audience, including farmers, planners, financiers, processors, research workers and extension workers. A variety of methods, not necessarily limited to the written word, should be used.

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APPENDIX I. Area (hectares) of Crops Grown at Texaco Food Crops Farm : 1966/7 - 1976/7

	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7
<u>Root Crops</u>											
Sweet potato	3.7	3.3	7.3	4.1	2.5	0.8	2.1	1.7	0.8	0.4	0.6
Yams	1.7	1.7	2.1	2.1	2.5	3.7	2.5	0.4	-	0.4	-
Irish potato	2.7	0.6	-	-	-	-	-	-	-	-	-
Cassava	-	0.4	0.2	0.2	0.2	-	1.2	0.4	0.8	0.4	0.8
Eddo	0.2	0.4	-	-	-	-	-	-	-	-	-
Tannia	0.4	0.8	0.2	-	-	-	-	-	-	-	-
Cush-cush	-	0.2	-	-	-	-	-	-	-	-	-
<u>Legumes</u>											
Dry beans	B.E. 8 4.1	3.5	-	0.2	2.5	2.7	1.3	-	-	-	-
Snap beans	R.K. 0.2	-	-	-	-	1.5	0.8	0.2	-	0.2	0.6
Bodie beans	-	-	-	-	-	-	-	0.8	1.3	1.5	1.3
Blackeye beans (proc.)	-	-	-	-	-	-	-	1.7	0.6	5.9	-
Pigeon Pea	2.5	3.5	4.1	4.1	0.8	2.9	2.7	2.5	1.5	1.3	0.4
Mung bean	-	-	-	-	-	-	0.6	-	-	-	0.6
Peanut	-	0.4	-	-	-	-	-	-	-	-	-
Soya bean	0.8	-	0.8	0.6	0.8	1.3	0.8	0.2	-	-	-
<u>Cereals</u>											
Field corn	3.5	5.1	5.1	4.7	4.7	4.5	4.3	2.5	0.6	0.4	0.8
Sweet corn	1.5	2.7	2.9	2.1	1.3	2.7	0.8	1.5	0.6	1.9	1.5
Sorghum	-	-	-	-	-	-	-	-	-	-	0.4

B.E. = Blackeye
R.K. = Red Kidney

APPENDIX I (Cont'd)

1966/7 1967/8 1968/9 1969/70 1970/1 1971/2 1972/3 1973/4 1974/5 1975/6 1976/7

Vegetables, etc.

Sesame	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumpkin	0.2	1.7	1.5	1.5	1.3	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tomato	0.2	0.4	0.2	0.2	1.3	1.5	1.3	0.8	1.3	0.8	1.3	0.8	1.3	0.8	1.3	0.8	1.3	0.8	1.3	2.1
Sweet pepper	0.2	-	-	0.2	1.1	1.3	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-
Carrot	0.4	0.4	0.2	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cabbage	0.4	-	-	0.2	-	0.4	0.8	0.2	-	0.2	-	-	-	-	-	-	-	-	-	-
Onion	0.2	0.2	0.2	0.5	-	-	0.2	0.6	0.2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.2
Shallot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4
Cucumber	-	-	-	-	0.4	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4
Melongene	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ochro	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.2
Watermelon	-	-	-	-	0.2	-	-	1.3	-	-	-	-	-	-	-	-	-	-	-	-
Hot pepper	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-
Sorrel	-	-	-	-	-	-	-	1.7	-	-	-	-	-	-	-	-	-	-	-	1.7
Ginger	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4
Plantain	0.4	-	0.8	0.2	2.1	-	0.8	-	0.8	-	-	-	-	-	-	-	-	-	-	-
Paw paw	0.2	0.4	0.8	-	2.1	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Total 24.0 26.3 26.4 20.9 24.6 25.5 21.4 16.9 10.3 15.4 12.8

APPENDIX II. Number of Plantings of Crops Grown at Texaco Food Crops Farm: 1966/7 - 1976/7

	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1976/6	1976/7	Total n°, of Plantings
<u>Root Crops</u>												
Sweet potato	9	5	7	5	3	2	4	2	3	2	2	44
Yams	1	3	3	2	3	6	2	1	-	2	-	23
Irish potato	4	2	-	-	-	-	-	-	-	-	-	6
Cassava	-	1	1	1	-	1	1	1	-	1	1	8
Eddo	1	1	-	-	-	-	-	-	-	-	-	2
Tannia	1	1	1	-	-	-	-	-	-	-	-	3
Cush-cush	-	-	1	-	-	-	-	-	-	-	-	1
<u>Legumes</u>												
Dry beans	2	3	-	1	6	5	4	-	-	-	-	21
B.E. & R.K.												
Snap beans	1	-	-	-	-	1	2	1	-	1	2	8
Bodie beans	-	-	-	-	-	-	-	4	6	6	5	21
Blackeye beans (proc.)	-	-	-	-	-	-	-	5	3	5	-	13
Pigeon pea	1	1	1	1	1	4	4	3	4	1	1	22
Mung bean	-	-	-	-	-	-	2	-	-	-	3	5
Peanut	-	-	1	-	-	-	-	-	-	-	-	1
Soya bean	1	-	1	2	2	2	2	1	-	-	-	11
<u>Cereals</u>												
Field corn	3	4	3	4	5	6	11	4	3	2	3	48
Sweet corn	5	5	6	2	3	6	2	4	3	9	6	51
Sorghum	-	-	-	-	-	-	-	-	-	-	2	2

B.E. = Blackeye
R.K. = Red Kidney

APPENDIX II (Cont'D)

Total
n° of
Plantings

	1966/7	1967/8	1968/9	1969/70	1970/1	1971/2	1972/3	1973/4	1974/5	1975/6	1976/7	
<u>Vegetables, etc.</u>												
Sesame	1	-	-	-	-	-	-	-	-	-	-	1
Pumpkin	1	1	2	1	2	1	-	-	2	-	2	12
Tomato	1	2	1	1	3	3	3	3	6	5	7	37
Sweet pepper	1	-	-	1	3	3	1	-	-	-	-	9
Carrot	2	2	1	-	2	-	-	-	-	-	-	7
Cabbage	2	-	-	-	-	1	2	1	-	-	-	7
Onion	1	1	1	1	-	1	1	1	2	-	1	8
Shallot	-	-	-	-	-	-	-	-	-	-	2	2
Cucumber	-	-	-	-	1	2	-	-	-	2	-	5
Melongene	-	1	-	-	-	-	-	-	-	-	-	1
Ochro	-	1	-	-	-	-	-	-	-	2	-	4
Watermelon	-	-	-	-	1	-	-	1	-	-	-	2
Hot pepper	-	-	-	-	-	1	-	-	1	-	-	2
Sorrel	-	-	-	-	-	-	-	1	2	4	7	14
Ginger	-	-	-	-	-	-	-	-	-	1	1	2
Plantain	1	-	1	1	1	1	1	-	-	-	-	5
Paw paw	1	1	1	-	1	1	1	1	1	1	1	10

N° of Plantings/year	41	35	32	24	37	46	44	34	36	44	47
N° of Crops per year	20	16	16	14	15	15	17	16	12	15	17

APPENDIX III. Cropping Programme Wet Season 1977

	Planting Date	Area
		(ha)
<u>Continuation of Existing Programmes</u>		
Pigeon peas		
Seed Multiplication of new day neutral cultivar	May	0.4
Technical Evaluation of mechanical harvester	May	0.2
Tomatoes		
Evaluation of variety Calypso	mid-July mid-October	0.4 0.4
Papaya		
Evaluation of Solo (to be intercropped with 1st crop Mung, 2nd crop - Pumpkin)	early September	0.4
Blackeye		
CARIRI processing project	early July	2.0
Sorrel		
Evaluation of time of planting	mid-August to mid-December	0.2 ha at each planting
1. (Planting at monthly intervals starting mid-August until mid-December.)		
2. Crops to be planted before sorrel at each planting date are Bodie, Sweet Corn, Pumpkin, Hill Rice and Sweet potato.		
Evaluation of mechanical harvester (CARIRI)	June-July	0.2
Intensive Cropping		
Continued Evaluation from 2-4 crops (pure stand) in cropping systems	June	0.2 ha/system
1. 4 crops - Contender beans, Sweet Corn, Bodie/Okra, Pigeon pea		
2. 3 crops - Bodie, Cucumber, Pigeon pea		

APPENDIX III (Cont'd)

	Planting Date	Area (ha)
3. 2 crops - Pigeon pea, Onions or Sweet potato		
4. 2 crops - Dry Corn, Sweet potato		
<u>Re-Evaluation of Crops Previously Grown on Small Scale</u>		
Mung Bean		
Evaluation of pure stand and investigation of harvesting methods	early August	0.4
Cassava		
Initial Evaluation of new high yielding cultivars		
<u>New Crops</u>		
Hill Rice		
Evaluation of 1R5 cultivar	June	0.2
<u>Commercial Crops</u>		
Pioneer Hybrid Corn (green)	mid-July	0.4
Bodie (seed)	October	0.2
<u>Experimental Work</u>		
Tomato		
Evaluation of new cultivars	End May/June	0.2
Corn		
Insect control	End May/early June	0.2
CIMMYT trial	June	1
Weed control		
Sorrel		
Bodie		
Corn		
Phaseolus Beans		
Evaluation of dry bean cultivars		

APPENDIX III (Cont'd)

	Planting Date	Area
		(ha)
Intercropping - Ginger and Blackeye	May/June	0.2
Grain and Forage Sorghums		
Evaluation of time of planting in grain and forage sorghums	September	1
Cultivation of 2 TFCF vars for livestock feeding (foilage)		

Outreach Programmes

These programmes involve the TFCF with other agencies or institutions. In most instances the TFCF is the core for the programme.

Blackeye

CARIRI Processing Project/
Blackeye being cultivated during the wet season at Redlow Manor Farm, CADP (Fiarco) and small farmers in Bejucal area.

Sorrel

In Co-operation with Orange Grove National Sugar Co. - crops being produced for processing at sorrel plant.

Pigeon Pea

In collaboration with Faculty of Agriculture Grain Legume Programme - involving small and large scale farmers.

APPENDIX IV. Technical and Cost of Production constraints to the Production of Crops Grown at TFCF

	Seasonality of production	Low yield	Variable yield	Spacing	Fertilizer	Poor taste	Poor storing	Poor processing	Pest & disease control	Weed control	Post harvest handling	Cultivar	High cost - planting	- weed control	- pest & disease control	- harvesting	Practical larceny
Field corn	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	2
Sweet corn	0	0	0	1	0	0	1	2	2	2	1	1	0	0	0	1	2
Blackeye bean	0	3	2	0	1	0	0	0	2	2	1	1	0	2	2	3	1
Bodie (yellow mature)	0	0	1	0	1	0	0	0	2	2	1	1	0	2	3	3	2
Gub gub (dry)	0	2	2	1	2	0	0	0	2	2	1	1	0	2	0	3	0
Mung bean	0	3	1	1	1	0	0	0	2	2	0	1	0	2	1	2	0
Pigeon pea	1	3	2	0	1	0	0	0	2	2	0	1	0	2	3	1	0
Red bean	2	3	2	0	1	0	0	0	2	2	0	1	0	2	1	3	0
Snap bean	1	1	2	0	1	0	0	0	2	2	0	1	0	2	2	1	0
Soya bean	0	3	3	0	0	0	0	0	2	2	0	0	0	2	1	3	0
Cassava	1	3	3	1	1	0	2	0	3	1	2	3	1	3	2	3	0
Irish potato	3	3	3	0	0	0	1	0	3	1	2	0	3	1	2	3	0
Sweet potato	1	2	3	0	0	0	2	0	3	1	2	0	2	3	2	3	0
Yams	2	2	3	0	0	0	0	0	3	2	1	0	2	1	2	3	0
Paw paw	1	1	2	0	1	0	2	1	3	1	3	0	2	1	2	3	1
Plantains	1	3	1	0	1	0	0	0	3	1	3	0	2	0	3	1	1
Cabbage	0	2	3	1	1	0	1	1	3	1	3	1	2	3	2	0	1
Carrot	0	2	2	1	1	0	1	1	3	2	0	1	2	2	2	3	0
Hot pepper	0	1	2	0	1	0	1	1	3	2	0	0	1	2	2	3	1
Onions	0	1	2	0	1	0	1	1	3	2	0	0	1	2	2	3	1
Pumpkins	2	1	2	0	1	0	3	0	3	3	2	2	1	3	0	2	1

APPENDIX IV (Cont'd)

	Seasonality of production	Low yield	Variable yield	Spacing	Fertilizer	Poor taste	Poor storing	Poor processing	Pest & disease control		Post harvest handling	Cultivar	High cost - planting	- weed control	- pest & disease control	- harvesting	Practical larceny
Sweet pepper	0	2	2	0	1	0	1	0	2		0	0	1	2	1	3	0
Tomato	2	1	2	1	1	0	2	2	2		2	1	1	2	1	2	0
Watermelon	2	2	2	0	1	0	0	0	1		0	1	0	2	1	0	3
Sorrel	3	1	1	2	2	0	2	0	1		1	1	0	1	1	3	0

Score : 0 = no problem 3 = major limiting problem