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TOWARDS THE RATIONALIZATION OF LAND USE IN TRINIDAD AND TOBAGO

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The primary purpose of this paper is to discuss the research being undertaken in Phase II of the Land Capability Studies and its importance to the rationalization of land use in Trinidad & Tobago. The implications of the exercise for rationalization of agriculture in the wider Caribbean context is also discussed. We first present as background material some of the key problems in Trinidad's agriculture. These problems are similar for the region as a whole.¹

The Problem

Tremendous changes have taken place in Trinidad and Tobago since 1940. Population has nearly tripled. Industrialization and tourism have developed at an accelerated pace. With the population, industrial and commercial expansion have come attendant pressures on the nation's agricultural economy. Pressure on land and water resources are among the foremost problems in Trinidad's agriculture. Urbanization and industrialization in the Diego Martin area, along the Eastern Main Road, along the Churchill-Roosevelt Highway, and other central and southern areas have removed large blocks of high quality land from agricultural use.

The values of land formerly under agriculture have sky-rocketed as new housing and industrial estates are developed. While urban and housing development threaten the very existence of our traditional *food baskets*, population growth and the increasing per capita incomes have caused sharp increases in the demand for food, resulting in a consistently increasing import bill for both final and intermediate products. The consumption of beef and beef products, milk and dairy products, vegetables, root crops, pulses, fruits, cereals, and processed items has been rising steadily in the face of declining production of most of these items. The notable exceptions are dairy and poultry products. Considerable gains in the production of these items have been experienced over the last 10 years.²

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1 The problems summarised here are spelled out in the unpublished papers of the recently concluded National Consultation on Agricultural Development.

2 The profitability of the pig, poultry and dairy industries is now being seriously affected by the rising prices of corn and soya bean on the world market. Feed costs make up approximately 60-70% of the total unit production costs in all these items. The high prices, which are expected to increase even further in the future, demand drastic action in finding local food ingredient substitutes from existing crops, and investments in enterprises aimed principally at import substitution in the animal feed sub-sector.

While imports rise, our production of sugar, cocoa, coffee, bananas, oranges, grapefruits, limes, and coconuts continue to contract, resulting in our inability to satisfy both the local and export markets, including those that are protected by international agreements. The added effects of increasing imports and declining exports have had serious ill-effects on our balance of visible trade and hence our balance of payments position.¹

To be more competitive with urban employment and employment on public works projects, farm-labour wage rates have been forced above levels considered economic by many farmers. Estates engaged in the production of these crops have been allowed to deteriorate through their inability to pay high wages through poor management, absentee ownership, and the use of estates as tax shelters, to the extent where large sums of capital are now needed to rehabilitate them. There is evidence of dissatisfaction in the agricultural sector with producers crying out for subsidies, price supports and guaranteed prices in the face of declining earnings, while the consumers continue to complain about rising prices, poor quality, and the general unavailability of items on the markets.

In spite of the efforts of the Government to overcome the problems of under-employment and to create new employment with the Crown Lands Development Programme, the unemployment problem is still very pronounced, not only in the agricultural sector, but in the nation as a whole. Table 1 summarises the achievements up to December 1972.

Table 1. A Summary of Achievements to Data on Crown Lands Farms

<i>Type of Farm</i>	<i>Type of Development*</i>	<i>Targets</i>		<i>Number Established as at Dec. 31st, 1972</i>
		<i>Number</i>	<i>Acreage</i>	
Dairy	Full	260	4,710	250
Pig Breeding & Fattening	Full	70	350	70
Tree Crops	Full	65	650	54
Vegetables & Root Crops	Basic & Partial	1,160	5,800	834
Tobacco	Basic	35	350	22

Source: Ministry of Agriculture, Lands & Fisheries, Trinidad & Tobago, W.I.

* Full, Basic and Partial refer to the types of development. Full is the case where house, land and stock are loaned to the settler; Partial is the case where the land and infrastructure are developed and Basic is the case where the land alone is provided.

¹ For more detailed discussion on all these crops, the unpublished reports of the Ministry of Agriculture on cocoa, copra, coconuts, citrus and sugar prepared for the National Consultation on Agriculture may be consulted.

Farmers and consumers seem to be constantly plagued by problems brought about by an inefficient marketing system, the more problematic areas being that of fresh fruits, root crops, vegetables, and pulses. The system is characterised by violent price fluctuations, lack of facilities, and widespread waste. The inadequacy of personal amenities, traffic congestion, and improper sanitation tax very severely the patience of both consumers and farmers.

Even though there has been considerable progress in the field of agricultural credit over the last three years, its impact on increasing the earning capacity of farmers has been somewhat nullified through inadequate ancillary extension and marketing services. Table 2 shows the breakdown of loans to individual farmers and members of Agricultural Credit Societies of the Agricultural Development Bank.

Table 2. A Breakdown of the Loans of the Agricultural Development Bank

Loans to:	1973 B		1972 E		1971 A		1970 A	
	No.	(\$'000)	No.	(\$'000)	No.	(\$'000)	No.	(\$'000)
Individual farmers	1,209	15,700	654	8,100	308	3,100	226	1,900
ACS Members	4,580	2,900	3,870	1,500	3,200	1,000	1,600	400
Total	5,789	18,600	4,524	9,600	3,508	4,100	1,826	2,300
% of increase with 1970 as base year	217%	708%	148%	31%	92%	78%	0%	0%

Source: Agricultural Development Bank of Trinidad & Tobago.

Notes: A = actual; E = estimated; B = budgeted

Although some technological improvements have been made in sugar, dairy, and poultry, the practices employed in the all important domestic sub-sector, are just as backward as they were thirty years ago, despite mounting budgets for research, extension and university training. Findings at the experimental level are very slow in getting to the farmer.¹

Within the context of the wider overview of problems facing the agricultural sector, we must seek answers to the following specific questions:-

¹ The unpublished Ministry of Agriculture paper entitled *Some General Problems in Agriculture* presented at the National Consultation on Agriculture lists on page 3 the problems of Domestic agriculture as lack of supervised credit, unsatisfactory marketing facilities, unstable system of guaranteed prices, low levels or even lack of adequate infrastructure, ignorance on the part of farmers of technological innovations and improvements, uneconomic sizes of parcels of land, unsatisfactory land tenure systems, weakness in the administration plans and policy objectives, and the orientation away from indigenous supply.

- (a) In what way can the land and water resources in Trinidad & Tobago be best utilised to meet the food requirements of the people?
- (b) What changes in the cropping and livestock production systems must be made to satisfy these demands?
- (c) What are the implications of these adjustments in terms of increasing the earning capacity of existing farmers, reducing under-employment, and providing additional employment in the farming sector?
- (d) What are the changes needed in revitalising the production of our traditional crops such as sugar, cocoa, coffee, and citrus, in the light of declining production and the increasing deficit in the balance of visible trade?
- (e) What changes do we need to develop our domestic sub-sector crops and increase our new export-oriented crops in the context of the uncertainties surrounding the future markets of our traditional export crops?
- (f) What kind of activities should be initiated that will permit maximum development of secondary and tertiary industries using local agricultural raw material as a base?
- (g) Along what lines should our marketing and credit institutions be developed to permit the orderly marketing and financing of crops and livestock activities with special reference to the marketing of fruits, root crops, vegetables, and pulses?
- (h) What changes are needed with respect to zoning of land for use by the agriculture, housing, highway, industrial, and commercial sectors and zoning of land use within the agricultural sector itself?
- (i) What is the current impact on the rest of the economy including the consuming, manufacturing, and commercial sectors? What is this likely to be in the future?

These are the kinds of questions, that we in Trinidad, and the region as a whole, must seek to answer in order to aid decision making in the rationalization process.

The Significance of Phase II of the Land Capability Studies

Whether we interpret rationalization of West Indian agriculture to mean production according to comparative advantage (a concept loaded with notions of economic efficiency) or simply planned regional specialization of production, the research work under Phase II of the Land Capability Studies of Trinidad & Tobago is extremely relevant.¹ In this exercise we are seeking answers to some of the questions raised and these we feel must be answered for the region as a whole. There are no easy overnight solutions to these problems; they require very careful planning. It will also take a long time

¹ Phase I of the Land Capability Studies is now in the process of completion. Five reports have been published. They contain an inventory of the physical and chemical characteristics of the soils of Trinidad & Tobago. The sixth report is ecological in its approach. The reports are accompanied by maps and charts showing the distribution of soil types, land use and land capability classes which have been defined, taking into consideration the physical and chemical characteristics of the soils and their slopes.

to bring about some of the needed changes. For example, in the case of zoning land use within the agricultural sector, we have to consider among other things the demand for the products of the agricultural sector, the existing and potential supply, the acreage to be allotted towards the production of various crops and livestock, the location of these based on land capability classes, etc. Within this broader framework we have to consider the structure and organization of farming enterprises, systems of land tenure, methods of input and output distribution, etc. Apart from zoning within the sector, we have to consider zoning between sectors, for example, what areas should be left for housing, industrial estates, roads, and recreation centres.

We now discuss the scope and content of the land capability exercise and the approaches followed. We should state that in the absence of any information which can demonstrate any single empirical model uniquely relevant to Trinidad & Tobago, we drew heavily upon the insights of those models which appeared most relevant. Thus economic models constituted an implicit frame of reference for our exercise. While not stated directly, or developed in detail, these theoretical influences as well as the experience of other developing countries have been considered.

The Demand Analyses

The first series of studies deals with:

- (a) An analysis of current demand and demand projections of the various food groups up to 1985;
- (b) The patterns of consumer expenditure;
- (c) Existing patterns of trade and the prospects for new and existing export crops in regional and metropolitan markets;
- (d) The marketing of agricultural products with emphasis on fresh fruits, root crops, vegetables, and pulses; and
- (e) The potential for agro-industrial development in Trinidad & Tobago.

A knowledge of the nations' current and projected food needs provides us with an information base for working out policies of import substitution, for setting medium and long-term targets for the agricultural sector, and for making estimates of the volume of food that we must cater for in the distribution system. We believe that the long-run needs of the society must be considered in the way land is used today.

In estimating the current and future demand for foods two approaches were tried. However, only one was found to be acceptable in our circumstances.

The Use of Income Elasticities

The first approach involved the use of income elasticities for the various food groups. A knowledge of current per capita consumption, current and projected per capita income, income elasticity of demand for the particular item, permits calculations of increases in per capita consumption for any year we wish to project. To compute the elasticity coefficients, the semi log equation:--

$$y = a + b \log x + u,$$

where y is household expenditure of a particular item

x is disposable income

u is the error term --

was fitted to data obtained from a survey of 177 households. Appendix I shows the several forms of the consumption function which may be used. We rejected this approach not because of any lack of confidence in the coefficients *per se*, but because of our inability to project the other parameter, with any degree of confidence. As seen in Appendix I, standard computational methods require projected increases in per capita income as a key parameter. In the Trinidad case it is difficult to project the per capita income since the economy is undergoing some very rapid changes at the moment, and it is difficult to predict the effect of these on per capita income. For example, when the liquid natural gas plant and petro-chemical complex come into production, these should affect incomes significantly. Per capita income projections also assume that income distribution will remain constant in the future. This assumption, however, is unacceptable in the Trinidad context in that the existing skewed pattern in the distribution of income is expected to change in the future.

In using income elasticity coefficients in projections, one has to assume as well that price relationships in the projection period are the same as those in the base period. This assumption is also hard to accept in Trinidad's case, since the relationship between food groups in particular are expected to change rapidly in the future, given the present patterns of production and consumption, and the fact that we rely very heavily on imports to meet our requirements. For example, the prices of livestock products which are influenced by imported animal feeds, are expected to go up considerably. Similarly, the price of flour, onions, butter, cheese and all other imported items are expected to increase because of increasing costs of raw materials and finished products in exporting countries, increasing freight rates, high port charges, high internal transportation costs, low productivity and high wages in the agricultural sector of the exporting country, and retailers and wholesalers mark-up. Prices in 1973, for example, are expected to be about 40 per cent higher than those in 1972. For a highly open economy, subjected to structural inflation, rising costs in the factors of production, pests, diseases, and weather conditions of the exporting country, it is very difficult to predict movements in prices and price relationships.

The problems of projecting consumption are also compounded because of the effect of high-powered advertising to which the region is subjected, and the increasing trend towards North American consumption patterns. For example, advertising has been very effective in increasing the consumption of processed milk, canned temperate fruits, vegetables and their extracts, and processed meats.

The Use of Per Capita Nutrient Requirement

In view of the difficulties in projecting per capita income and consumption, we adopted the approach based on the per capita nutrient requirements of the population. We feel this is also more realistic, in that it facilitates planning in the agricultural sector to meet the basic calorie, protein, vitamin, and mineral requirements of the population. To project demand using this method, it was necessary to make projections of the population and to have a knowledge of the per capita nutrient requirements, and the nutrient content of the various food groups. These were worked out in conjunction with the Caribbean Food and Nutrition Institute.

Projections of the nutrient requirements up to 1985 were made. The major advantage in presenting the projected requirements in terms of nutrient requirements is that it allows for flexibility in planning

production. For example, several cereals and root crops provide calories. We can plan for different combinations and varieties of cereals and root crops to meet this need. At the national level, such a plan provides a useful hedge against pests, diseases and adverse weather and allows more scope for diversification. At the consuming level more variety can be introduced in the diet. Projections were also made on the basis of weights.

Detailed County Studies

The next set of studies were done on a county basis and include for each of the eight counties in Trinidad & Tobago:

- (a) a description and analysis of the existing land use,
- (b) an examination of the characteristics of farming,
- (c) an analysis of the farm business income for domestic, tree crops and livestock, and
- (d) the cost of production per unit of the range of crops, tree crops and livestock products.

These studies allowed us to establish for each county:

- (a) the supply and supply potential of crops and livestock,
- (b) the soil type and slopes, and the acreages under each soil type and slope,
- (c) the land use on each slope and each soil type,
- (d) the profitability of existing farming systems and the factors affecting it, and
- (e) the present costs and the technology employed in agriculture.

Approach Followed in the County Studies

The major part of the exercise at the county level involved the collection, analysis, and interpretation of agricultural data. In the absence of published production function data for the different land capability classes, and improper farm records and accounting except in very few cases, extensive use was made of the farm management survey method. For the survey, we divided agriculture into six classes, namely: domestic, livestock, domestic and livestock, traditional export, traditional export and livestock, and unallocated. Domestic in the Trinidad context refers to fresh fruits, root crops, vegetables, pulses, and tobacco. Traditional refers to sugar, cocoa, coffee, citrus, and coconuts. As an example of the sampling frame and methodology used, we discuss domestic agriculture.

Sampling Frame and Methodology for Domestic Agriculture

The principal sample frame for domestic agriculture, that is, those farmers producing only for local consumption, was compiled from the records of subsidy applications, membership of agricultural credit societies, Crown Lands Development Programme, Land Settlement Schemes, and the Central Marketing Agency's register of farmers. Every available source of information was tapped in order to achieve as comprehensive a frame as possible. The domestic sector was further subdivided into pure domestic, domestic plus livestock, domestic plus tree crops, domestic, livestock and tree crops, and unallocated. The population of each of these subdivisions (N_1 N_5) is shown below.

From the principal frame a stratified simple random sample was drawn as follows:

$$\begin{array}{lll}
N_1 = 4,935 & n_1 = 516 & f_1 = .10 \\
N_2 = 1,310 & n_2 = 116 & f_2 = .09 \\
N_3 = 447 & n_3 = 116 & f_3 = .26 \\
N_4 = 1,362 & n_4 = 233 & f_4 = .17 \\
N_5 = 2,960 & n_5 = 326 & f_5 = .11 \\
\sum N = 11,014 & \sum n = 1,307 & f = \frac{\sum n}{\sum N} = .12 \\
1 & 1 &
\end{array}$$

where N = population
n = sample size,
f = sampling ratio.

Having selected the sample, the survey, was carried out through field visitations on a regional basis. Trinidad was divided into eight regions as defined on maps prepared by the Valuation Division of the Ministry of Finance. Each region was represented in the sample as shown in the table.

Table 3. Population, Sample and Sampling Ratio by Region

Region	N	n	f ₁	f ₂	f ₃	f ₄	f ₅
1	254	35	.10	.09	.62	1.00	.10
2	724	89	.12	.08	.56	.13	.50
3	216	41	.16	.15	.58	.17	1.00
4	780	94	.11	.18	.17	.16	.04
5	2,497	319	.14	.07	.34	.14	.11
6	1,028	145	.12	.11	.75	.18	.13
7	2,710	340	.12	.09	.22	.17	.11
8	2,805	244	.13	.08	.20	.18	.09

Response to the sample averaged 80 per cent. The lowest response of 70 per cent occurred in Region 8 while the highest of 94 per cent was in Region 1. The quality of returns was relatively satisfactory. Approximately 14 per cent of returns were rejected after editing, so that the final sample was approximately 9 per cent of the population and 0.71 per cent of the original sample size.

Preliminary Pilot Survey

In the course of the exercise questionnaires were designed to cover all aspects of farming and several visits were made to collect and verify data. In order to minimise the errors that might have arisen through communication between the interviewer and the farmer, the field officers were trained and asked to do a pilot survey, the purpose of which was essentially to test the design of the questionnaires, the field officers' ability to conduct interviews, the applicability of the questionnaire itself and the time it would take to complete a questionnaire. One hundred and forty-three farms were selected for the pilot survey.

Determining Existing Land Use

To estimate the land use in each county, aerial photographs and land use maps were used to supplement the census method. The level of accuracy of the eye estimation of acreages of crops and pastures was tested by studying a large district in County Caroni.

Resource Productivity Measurement and Optimal Farm Size

The last set of studies dealt with, (a) the measurement of the productivity of resources engaged in the production of crops and livestock, and (b) an analysis of the minimum land, labour and capital necessary to obtain specific income levels. The income levels were based on the needs of a survey of 1,200 farm families. The survey took into account housing, education, food, clothing, and entertainment.

Method Used

To estimate resource productivity, production functions of the Cobb-Douglas type --

$$y = x_1^{b_1} x_2^{b_2} \dots x_n^{b_n},$$

where y denotes gross farm earnings,

x_1, x_2, \dots, x_n are the various factors of production, and

b_1, b_2, \dots, b_n are production co-efficients to be estimated --

were fitted to cross-section data for domestic agriculture, and tree crop and livestock farmers.

In analyzing the resources required to meet specific income levels, the question of *optimal* farm size is being considered. The methods employed include partial and complete budgeting, linear and dynamic programming.

Conclusion

In concluding, we note that the results of the exercise should enable decision-makers to set targets for the agriculture sector, to establish the incremental production necessary to reach these targets, to zone land use, to plan at the farm, project, and national levels, to assist credit, marketing, and extension personnel in developing and planning their work programmes, to set guaranteed and contract prices, to allocate quotas in contract farming, to compute the contribution of the agricultural sector to gross national product, and to set research priorities.

Appendix I. The Forms of Functions for Computing Income Elasticities and Future Demand

<i>Consumption Function</i>	<i>Increase in Demand</i>
1. Linear: $y = a + bx$	$\frac{y^1}{y} - 1 = n \left(\frac{x^1}{x} - 1 \right)$
2. Logarithmic: $\log y = a + b \log x$	$\log \frac{y^1}{y} = n \log \frac{x^1}{x}$
3. Semi-log: $y = a + b \log x$	$\frac{y^1}{y} - 1 = 2.3026 n \log \frac{x^1}{x}$
4. Log Inverse: $\log y = a - \frac{b}{x}$	$\log \frac{y^1}{y} = .43403 n \left(1 - \frac{x}{x^1} \right)$
5. Inverse: $y = a - \frac{b}{x}$	$\frac{y^1}{y} - 1 = n \left(1 - \frac{x}{x^1} \right)$

where x = per capita income

y = per capita consumption

n = elasticity coefficient

x^1 = projected income at end of period

y^1 = projected consumption at end of period