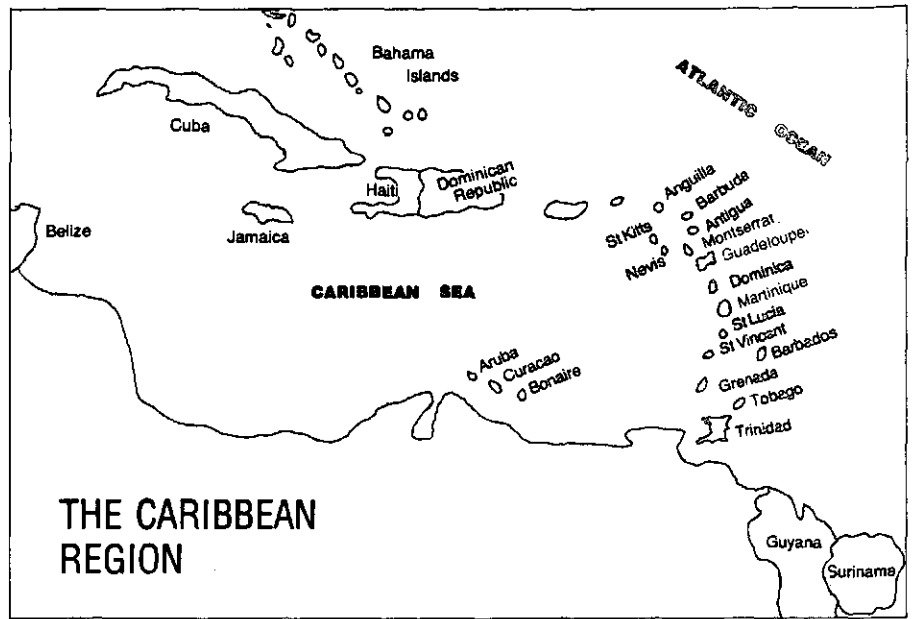


CARIBBEAN
DEVELOPMENT
 AND
CO-OPERATION
COMMITTEE



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CONSEQUENCES OF THE DEVELOPMENT OF
 ENERGY CROPS IN FOOD SUPPLY IN THE CARIBBEAN



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CONSEQUENCES OF THE DEVELOPMENT OF
ENERGY CROPS ON FOOD SUPPLY IN THE CARIBBEAN

by

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CONSEQUENCES OF THE DEVELOPMENT OF ENERGY CROPS ON FOOD SUPPLY IN THE CARIBBEAN

INTRODUCTION

The region will be taken to comprise broadly the chain of islands encircling the Caribbean Sea, together with the three mainland countries of Suriname, Guyana and Belize. These countries constitute a heterogeneous group in terms of size, effective land area, population and population density, economic organization, level of economic development, actual and potential resource base and historical and cultural experiences.

These countries, which are listed in Appendix A are classified by ECLA as constituting the Caribbean Development and Co-operation Committee (CDCC) grouping. Moreover, there has been some degree of economic integration among certain members of the group. For example, the countries that were formerly, or still are, British colonies belong to the CARICOM group, while the smaller members of that group, have organized themselves into a smaller economic union, viz. the Eastern Caribbean Common Market.

In spite of obvious differences, the countries share certain common characteristics: Firstly, they are highly open economies and in particular are heavy importers of food, especially basic items such as cereal and wheat products.

Secondly, having broadly the same ecological profiles, the food types they are able to produce domestically, either for home consumption or export, are essentially the same and become available at roughly the same times of the year. This similarity has two main implications for the regional food supply situation:

- (i) it prevents complementary product specialization over a range and on a scale great enough to meet the varied food demands of the population; and
- (ii) it also prevents effective rationalization geared to the reduction of seasonal variation in domestic food supplies.

Thirdly, with a single exception, they depend almost exclusively on imports to meet their requirements for fuel.

Finally, they have a limited technological capability in the production, installation and operation, and management of highly capital-intensive enterprises. The establishment and operation of such enterprises therefore necessitates the expenditure of foreign exchange for the purchase of imports of capital goods and of technical (and possibly, managerial) expertise.

THE PROBLEM

During the mid-seventies, the economies of several countries within the region, in common with many developing ones outside it, were seriously disadvantaged by two events. One was the OPEC-induced increases in the price of fuel and the second was the significant increase in the price of imported food which was induced directly by world shortages, particularly in cereals, and indirectly by the increase in fuel prices. The balance-of-payments in many countries deteriorated sharply and have not yet recovered, since the prices of fuel and imported food have continued increasing relatively to the prices of their traditional exports. The situation has been further aggravated by a declining trend in the output of these exports.

The economies of industrialized countries also suffered the ill-effects of the increases in the price of fuel which intensified the inflationary pressures in these economies and aroused fears regarding the security of fuel supplies. Goaded by these fears, the industrialized countries initiated action to increase their self-sufficiency in fuel. They developed and implemented a series of conservation measures whilst simultaneously accelerating the search for alternative sources of energy, including distillation from certain types of agricultural output. The recent softening of fuel prices on the international market occasioned partly by the continuing worldwide recession has not affected this thrust towards enhanced self-sufficiency.

Many developing countries, some of them within the region have also developed programmes to increase their self-sufficiency in energy. For example,

at the regional level, Technology and Energy Units have been established by the Caribbean Development Bank (CDB) and the CARICOM Secretariat to assist member countries in the identification and exploitation of alternative sources of energy. At the national level, matters relating to energy are now being accorded higher priority in the portfolio of relevant government ministries. There have also been recent reports that some CARICOM countries are availing themselves of Brazilian expertise to determine the feasibility of converting part of their sugar-cane and cassava production into fuel.

Since the security of fuel supplies is seen as a problem for the major oil-importing countries, it remains, ipso facto, a problem for the oil-importing countries of the region. It can also be argued that since the current recession has resulted in the softening of oil prices, it can be expected that an economic recovery will be accompanied by some escalation of prices, thus maintaining the vicious circle of ongoing pressure on the external accounts of regional states.

While it seems that the advanced countries are now, and will for the foreseeable future, be preoccupied with the question of the price and security of fuel, developing countries in the region will have to concern themselves not only with this issue but would also need to devote equal attention to the price and security of food supplies. This latter issue is currently being addressed as one of the major elements in the CARICOM Regional Food and Nutrition Strategy, which is designed to achieve increased self-sufficiency in food supplies and improved nutritional status for the population.

The prevailing security of food supplies is likely to be undermined by at least three different factors. The first is the initiatives taken by various governments by way of subsidies and other incentives to induce the transfer of substantial quantities of agricultural output from food production to fuel production. To the extent that these attempts are successful, the result may be a widening of the existing gap between the world supply of, and the demand for, food.

A second factor is the very real possibility mentioned in certain quarters, that the important food surplus countries, e.g. United States, New Zealand, are currently approaching the limits of their production potential in certain com-

modities important in the World Food Trade. If this is indeed the case, then too rapid and too massive a reallocation of traditional agricultural output to fuel production will have to be largely at the expense of food production. However, this reduction in food production may not materialize if the thrust towards fuel production is reoriented towards the use of cellulosic materials and agricultural wastes.

Finally, the insecurity is further accentuated by the very real probability of poor harvests in surplus-producing countries and the high frequency of adverse weather conditions in the region.

The foregoing analyses provide justification for the high priority accorded by regional governments to issues of food and fuel security within their economic strategies. This is amply illustrated by the following extracts from the communique issued after the Summit Meeting of CARICOM Heads of Government at Ocho Rios, Jamaica, 16-18 November 1982.

"FOOD STRATEGY

Heads of Government also agreed to accord high priority to the implementation of the proposals under the Regional Food and Nutrition Strategy (RFNS), and that a special meeting of the Standing Committee of Ministers responsible for Agriculture be convened to examine the operations of the Caribbean Food Corporation (CFC) and the Caribbean Research and Development Institute (CARDI).

OIL

... The conference agreed that Ministers of Energy should, on the basis of adequate and expeditious preparation involving both the CARICOM Secretariat and energy officials within the region, and as a matter of the utmost priority, meet with a view to agreeing on a comprehensive regional energy plan of action to:

- (i) Promote security of intraregional supplies and markets for petroleum products; and
- (ii) Develop feasible alternate sources of energy within the region".

The ongoing concern with these two issues is further reinforced by the incorporation, within the work programme of the Caribbean Council for Science and Technology (CCST) of studies on the consequences of the development of energy

crops on food supplies. The current exercise represents preliminary exploration of some of the major implications for the region.

OBJECTIVES OF THE STUDY

The above discussion highlights the urgency with which regional governments should proceed to provide for the greater security of food and fuel supplies. It is imperative that any decisions regarding the precise steps to be taken to this end should, however, be informed by a sound economic and technical analysis of the available options. The aim of this study, is to generate the relevant information and to provide an analytical framework for rational decision-making in these issues.

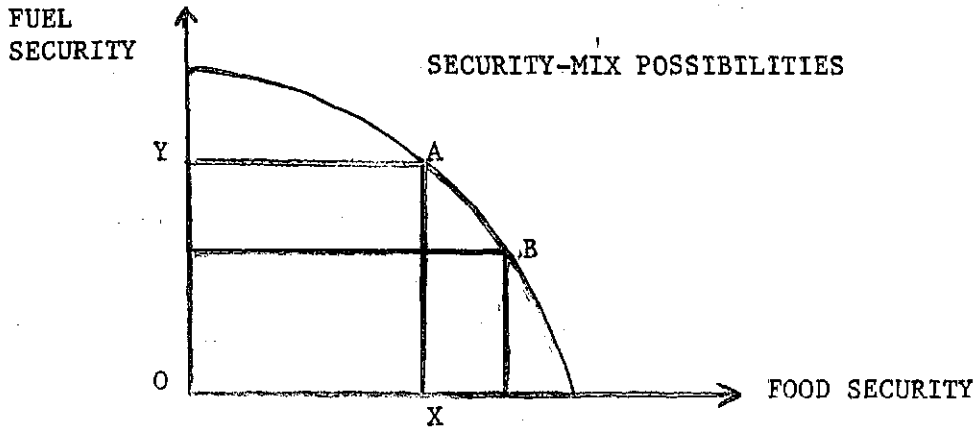
More specifically, the following issues have been identified as critical for the decision-making process. Firstly, high priority must be given to assessing the scope for augmenting domestic output in the individual countries, within the various economic groupings and in the region as a whole. Such an assessment would need to be made within the context of the current and potential agricultural production possibilities.

Secondly, there is the need to determine clearly the optimal allocation of increased output to fuel production, food production or some combination of the two. For example, the allocation problem may well be influenced by two factors:

- (i) the relative flexibility of the crops chosen to meet/satisfy both competing uses; and
- (ii) the extent cellulosic and biomass material provides the basis for fuel production.

Thirdly, there is the need to evaluate the costs and benefits associated with increased security at the regional and national levels. For this purpose it will be necessary to establish objectively verifiable indicators of levels of food and fuel security. The range of optimal security mixes will then be determined, again at the country and regional levels, by current and potential production possibilities based on the given resource endowments. Thus, for example, given a chosen food security level of X%, the highest level of fuel security possible may be Y%. Moreover, a one percent increase in the former may be achievable only at the expense of a much greater reduction in

the latter. The possibilities and trade-offs may be aptly illustrated by the following diagram.



The diagram, while useful in illustrating the proposed approach, represents a gross over-simplification of a much more complex relationship. For example, the trade-off curve would be distilled from a mass of information, including data on different crops and crop-mixes as well as a determined level of resource endowment. Similarly, several diverse elements underlie the notion of security and the weights attached to each by various countries and groups may well differ. Indeed, as indicated earlier a major problem will be to construct meaningful indices of the "level of security".

One important category of costs is likely to be the foreign component of capital, as well as recurrent expenditures involved in achieving the desired mix (e.g. the expenses of constructing or redesigning distilleries, possible mechanization of certain agricultural processes, etc). Other costs, some of which may not be readily quantifiable, include the dislocation inherent in any necessary structural changes as well as any undesirable effects on the environment.

It is also expected that the choice will be influenced by differences between the international and domestic terms of trade relationships implied in the various security mixes. Foreign exchange saving and income and employment generation, both in the agricultural sector as well as the macro-

economy, are also factors to be considered in calculating the benefits associated with the choice of a security mix.

METHODOLOGY

The methodology proposed for the study is based on three major activities which can be separated analytically but not operationally.

One activity involves the construction, in greater detail of analytical and explanatory models along the lines adumbrated in the previous sections. Another is the collection of relevant data and, on the basis of these, the generation of input requirements for the models. Finally, there is the analysis and interpretation of the outputs and their translation into alternative strategies that may be pursued by regional governments.

Operationally, this approach involves the following series of steps:

Step 1:

Undertake an extensive review of the economies of the region and of the agricultural sectors in particular:

- (a) noting the performance of the latter;
- (b) obtaining information on current and potential land use and effective land area available for agriculture;
- (c) examining agricultural development plans for programmes likely to impinge on the exercise;
- (d) identifying initiatives already being taken or suggested in the area of alternative energy sources.

Step 2:

- (i) Undertake an indepth analysis of the food consumption patterns for individual countries and the region as a whole with a view to:
 - (a) identifying the major components of the various food groups;

- (b) determining the extent to which the demand for them is satisfied by domestic production and by imports, both intra- and extra-regional, and possibilities for substitution of the latter;
- (c) analysing past trends in quantities, prices and incomes to enable projections to be made about the demand for major food groups;
- (d) translate each of these demands into resource requirements (land, labour and possibly capital) at the national and regional levels.

(ii) Undertake a similar analysis of fuel consumption. In particular it would be necessary to:

- (a) obtain information on two things:
 - (i) current consumption levels for fuel;
 - (ii) the extent to which the demand has been satisfied by domestic production (e.g. Trinidad) and imports;
- (b) derive the demand for fuel as a function of certain variables such as price, population, vehicle prices and per capita income;
- (c) translate these demands into resource requirements at the national and regional levels.

(iii) Compare the quantity of arable land obtained in (1)(b) with the derived demand for land resources based on both (a) projected food consumption levels; and (b) different degrees of substitution of gasohol for gasolene.

Step 3:

Collect and analyse information on production costs of energy crops. More specifically it will be necessary to:

- (a) identify those traditional energy crops which are currently being produced, or can be produced economically, within the region. These are

known to include sugar-cane, corn, cassava, sugar beet and sweet potatoes as well as trees from which charcoal could be efficiently produced;

- (b) determine the input coefficients, (i.e. the resource requirements per unit of production) of these crops in the different ecological zones of the region;
- (c) determine the social and private cost per unit of output of each of these crops as functions of the inputs (i.e. of labour, land and capital).

Step 4:

Obtain information on the technical parameters of production of gasohol from these energy crops, particularly:

- (a) the conversion ratios of these crops into gasohol and other by-products;
- (b) the translation into hectare requirements of different levels of replacement (e.g. 5%, 10%) of gasoline by gasohol; in other words, the determination of the yield of gasohol per hectare of land devoted to the production of various traditional crops.

Step 5:

A similar exercise to (4) above would need to be undertaken for the production of gasohol from cellulosic material and biomass.

Step 6:

Obtain relevant technical information regarding the process of distilling gasohol from both crop types, traditional and cellulosic: more particularly, information about:

- (a) the possibility of using existing or modified plant, machinery and equipment (e.g.

- sugar refineries and rum distilleries) for producing gasohol or whether the process requires entirely new and different plans;
- (b) whether the professional, technical and managerial skills now employed in existing refineries and distilleries are transferable to these energy-producing units;
 - (c) the type of infrastructure required to support these units and whether it is already in place;
 - (d) the optimal operating capacity of these units;
 - (e) the cost of establishing a plant of optimum scale and the foreign exchange component of that cost.

Step 7:

Analyse secondary data on trends and projections of global demand, supply and price of fuel and major food items.

In the final analysis, the following conditions and criteria may be expected to determine the choice of available options in terms of the objectives discussed earlier:

(a) The possibility that adequate resources (particularly land and foreign exchange) will be available to enable the pursuit, to the fullest extent desirable, of both options, i.e. production of crops for energy purposes and the expansion of indigenous food supplies. This availability will have to be examined from the point of view of the individual state, the various economic groupings as well as the region as a whole. In this connection, strategies will have to consider possible conflicts between national, group and regional interests in the likely event that some degree of specialization is involved. Moreover, in the case of each option, criteria like those at (c) below will have to be applied to the choice of the particular crops to be grown. Consideration would have to be given, in the context of any strategy, to the possible role of Trinidad and Tobago as a supplier of fuel to the region.

(b) In the more probable case where the options are found to compete for the limited resources available, then some trade-off will have to be accepted between the two objectives - food security and fuel security. It would then be necessary to devise meaningful measures of the degree of security of food supplies and of fuel and determine the substitution possibilities between the two goals, again at the national, group and regional levels in the case of each crop or crop mix;

(c) Given the transformation possibilities in terms of security-mix, the implications for each mix would then be examined on the basis of the comparative advantages and disadvantages from the point of view of:

- (i) employment and income generation;
- (ii) social rates of return based on the projected expenditure, earning and saving of foreign exchange;
- (iii) the difficulty of inducing, and the extent of resistance to, any required changes in consumption patterns;
- (iv) the extent of dislocation inherent in the mix;
- (v) the transportation problem involved in location of activities, in cases where specialization is indicated; and
- (vi) other structural constraints of sociological, cultural or political nature.

The success of the above approach will depend heavily on the generation of an adequate data base. An attempt will be made to collect both primary and secondary data where appropriate. These will be supplemented by personal interviews and consultations with individuals, bodies and other relevant institutions throughout the region.

Proposed Chapter - Outline
(Summary)

I. INTRODUCTION

- (i) Statement of Problem and Terms of Reference
- (ii) Objectives:
 - (a) General
 - (b) Specific
- (iii) Scope and Limitations

II. REVIEW OF THE ECONOMIES

- (i) Country profile
- (ii) Regional profile
- (iii) Clarification of existing food and energy policies in development plans
- (iv) Analysis and summary

III. FOOD DEMAND ANALYSIS AND PROJECTIONS

- (i) Major components of food groups - (classification)
- (ii) Sources of supply - domestic, intraregional, extraregional
- (iii) Analysis of trends - prices, incomes, populations
- (iv) Projections of demand for food groups
- (v) Derived demand for resources (land, labour, possibly capital) national regional level

IV. FUEL DEMAND ANALYSIS AND PROJECTIONS

- (i) Fuel consumption levels
- (ii) Sources of supply - domestic, intraregional, extraregional
- (iii) Analysis of trends
- (iv) Projections of demand for fuel
- (v) Derived demand for resources (crop land)

V. PRODUCTION FUNCTION ANALYSIS

- (a) Food
 - (i) identification and description of food and energy crops
 - (ii) determination of input coefficients
- (b) Fuel
 - (i) technology of gasohol distillation and other by-products (biomass)
 - (ii) conversion ratios of different energy crops
- (c) Projection of derived demand for resources (land, labour and capital)

VI. ANALYSIS AND EVALUATION OF EXISTING DISTILLATION INFRASTRUCTURE

- (a) Inventory of existing refineries and distilleries
- (b) Determination of adequacy of supportive infrastructure
- (c) Determination of possible plant sizes
- (d) Costs of establishment or modification

VII. ANALYSIS AND PROJECTIONS OF GLOBAL SUPPLY, DEMAND AND PRICES

- (a) Food
- (b) Fuel

VIII. MODEL CONSTRUCTION AND ANALYSIS

- (a) Determination of levels of security desired by various countries
- (b) Construction of security indices
- (c) Derivation of trade-off functions
 - (i) for various countries
 - (ii) for various groupings
 - (iii) for the region as a whole
- (d) Evaluation of costs and benefits of alternative security mixes.

IX. TOWARDS AN APPROPRIATE STRATEGY FOR THE
DEVELOPMENT OF ENERGY CROPS IN THE
CARIBBEAN

- (a) National
- (b) Regional

X. SUMMARY OF RECOMMENDATIONS

XI. REFERENCES

Appendix A

LIST OF COUNTRIES IN THE CARIBBEAN DEVELOPMENT AND CO-OPERATION
COMMITTEE GROUP

(1) Antigua and Barbuda	* +
(2) Barbados	*
(3) Bahamas	
(4) Belize	*
(5) Cuba	
(6) Dominica	* +
(7) Dominican Republic	
(8) Grenada	* +
(9) Guyana	*
(10) Haiti	
(11) Jamaica	*
(12) Montserrat	* + //
(13) Netherlands Antilles	//
(14) St. Kitts/Nevis	* + //
(15) St. Lucia	* +
(16) St. Vincent and the Grenadines	* +
(17) Suriname	
(18) Trinidad and Tobago	*

Note:

* Members of the Caribbean Community (CARICOM)

+ Members of CARICOM comprising Organization of Eastern
Caribbean States

// Associate Member

Appendix B

List of References

1. BROWN, Lester R.: Food or Fuel: New Competition for the Worlds Crop Land. World Watch Institute, Washington, D.C. USA.
2. BRUCE, C.J. + RANKINE, L.B.: "Model for the Development and Implementation of the Regional Food and Nutrition Strategy - An Operational Framework". Caribbean Community Secretariat, Georgetown, Guyana, October 1980.
3. CUMMINGS, Jnr. Ralph W. + WORTMAN, Sterling: "To Feed the World - The Challenge and the Strategy". The John Hopkins University Press, Baltimore, USA, 1981.
4. LIPINSKY, E.S., JACKSON, D.R., KRESOVICH, Arthur + LAWHON, W.I.: "Carbohydrate Crops as a Renewable Resource for Fuels Production". Vol. 1, Battle, Columbus Division, 505 King Ave., Columbus, Ohio, USA.
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6. _____ "Alcohol Fuels". Proceedings of a Conference held in Sydney, Australia, 1978. Institution of Chemical Engineers. NSW Group.

Appendix C

RESOURCE REQUIREMENTS

I. RESEARCH PERSONNEL

(i)	One Agricultural Economist (6 months))	
(ii)	One Economist (6 months))	
(iii)	Other specialist consultation (1 month))	- US\$110,000
(iv)	Two Research Assistants (12 months))	
)	

II. RESEARCH EXPENSES

(i)	Travelling and per diem	US\$10,000)	
(ii)	Library search and data collection	8,000)	
(iii)	Model building, data analysis and tabulation	4,000)	- US\$25,000
(iv)	Computer analysis, etc.	3,000)	

III. PREPARATION OF REPORTS

(i)	Typing, printing paper, binding etc.	4,000)	
(ii)	Miscellaneous (100 copies)	1,000)	- 5,000

IV. ESTIMATED DURATION

25 man-months
(Simultaneous Activities)

TOTAL:- US\$140,000

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