Nº 62

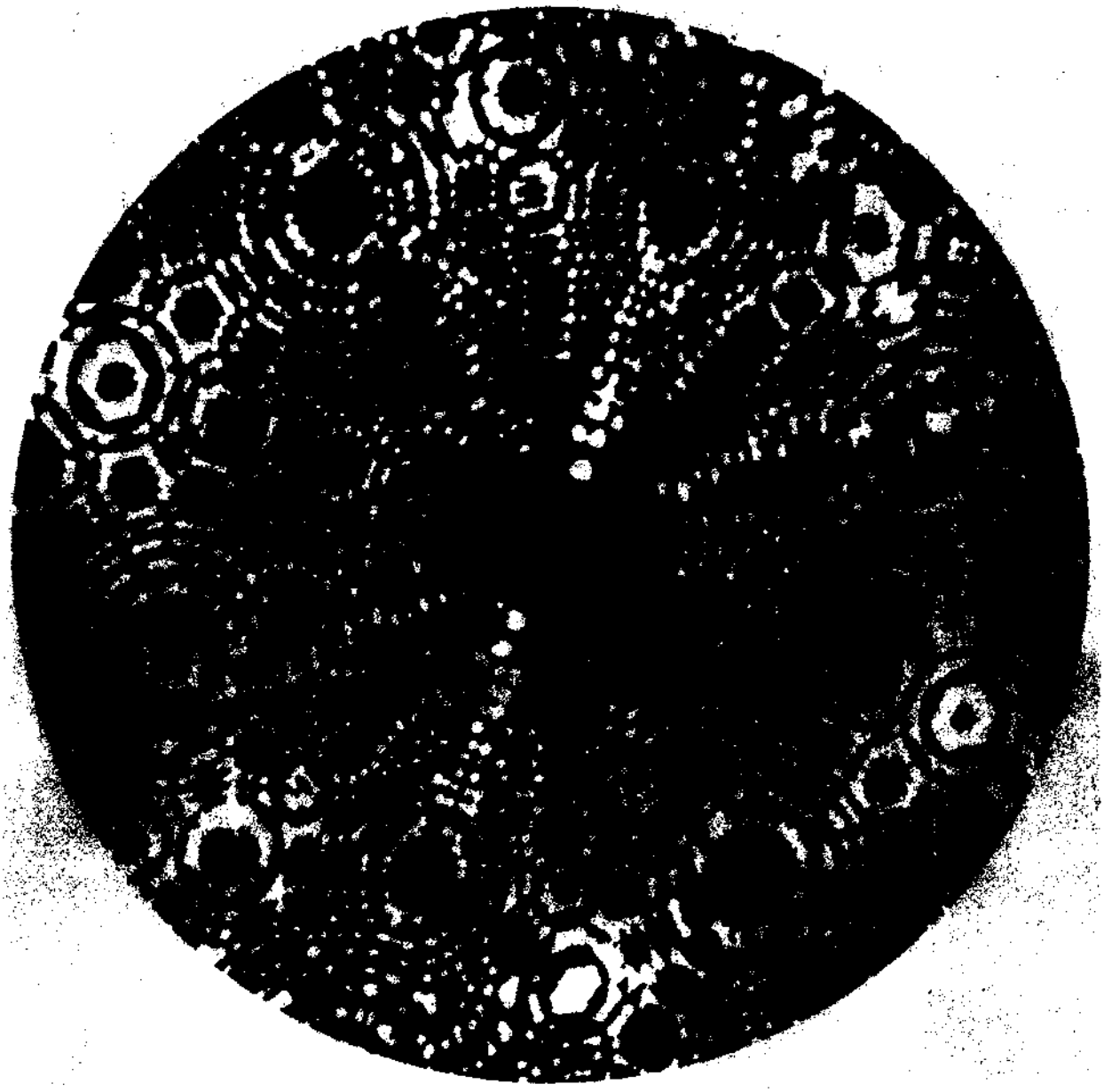
National and sub regional reports on science and technology policies in Latin America and the Caribbean (Part II)

Antigua and Barbuda, Barbados, Dominica, Grenada, Guyana, Jamaica, St. Lucia, Suriname, Trinidad and Tobago

Caribbean Council for Science and Technology (CCST)

Caribbean Development Bank

Science policy studies and documents



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ISBN 92-3-102277-6

Published in 1985 by the
United Nations Educational,
Scientific and Cultural Organization
7, place de Fontenoy, 75700 Paris, France

Printed by ROSTLAC

PREFACE

The Unesco series "Science policy studies and documents" forms part of a programme initiated by the General Conference of Unesco at its eleventh session in 1960. It aims at making available factual information concerning the science and technology policies of the Organization's Member States, as well as technical studies of interest to science policy-makers and research managers.

The country studies are carried out by the government authorities responsible for policy-making in the field of science and technology in the Member States concerned.

The technical studies cover planning of science and technology policy, organization and management of scientific research, and other questions relating to science and technology policy.

This same series also includes reports of international meetings on science and technology policy convened by Unesco.

As a general rule, the country studies are published in one language only, either English, French or Spanish, whereas some of the technical studies and the reports of meetings are published in several official languages of the Organization.

The present publication contains national and sub-regional reports for the countries in the Latin America and Caribbean Region that usually use English as a medium of expression at international meetings convened by Unesco.

The volume is a direct complement to Vol. N° 54 in the same series, which contains similar reports for thirteen Spanish-speaking countries of the Region, as well as for Brazil and Haiti.

The concepts formulated in the reports are those of their authors and are not necessarily shared by Unesco.

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PART ONE

NATIONAL REPORTS

ANTIGUA AND BARBUDA

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

Antigua and Barbuda is an independent state in the Caribbean with a total area of 442 km^2. It consists of Antigua, an island with an area of 280 km^2, Barbuda 161 km^2, lying 25 miles north of Antigua, and Redonda, an uninhabited rock (2.59 km^2).

Antigua is situated 17° N latitude and 62° W longitude, approximately in the centre of the West Indies archipelago. The total population (1981) was 76,200 people 1,200 of these residing in Barbuda. St. John's, the capital city, has about 25,000 inhabitants. The annual rate of population increase in 1976-81 was 1.3% (1).

The south-western part of Antigua is volcanic in origin with hills rising to 296 m, Boggy Peak the highest point being 405 m. The north and east are separated from the south-west by a plain consisting mainly of limestone and marl. The coastline is indented with several beautiful beaches which are protected by coral reefs. The climate is dry and sunny with mean annual temperatures ranging from 84° F (29 °C) in August to 74° F (23 °C) in January and a mean relative humidity of 72 to 69%. The north-east trade winds have a moderating influence on the heat and humidity thus making the climate quite comfortable for the greater part of the year.

The average rainfall is 114.3 cm and drought is sometimes a problem due partly to an uneven distribution of rainfall. The main supply of water is from dams and wells, the largest dam (at Potworks) having a capacity of 1,000 million gallons. Plans are under way for the installation of a desalinisation plant to augment the present water supply which is often limited during the dry season.

There are about 14,569 hectares of arable land (2) of which about 60% is owned by the Government. About 50% of the agricultural land is estimated to be abandoned or uncultivated (1). Sugar cane cultivation, once the mainstay of the economy, has declined but is now being resuscitated to provide sugar for local consumption. Efforts are also being made to revive the sea-island cotton industry which was once the second cash crop.

The main resources of Antigua and Barbuda are its land, sea and people. Tourism plays a vital role in the economy but increased agricultural production is a necessity.

Internal and external communications are good. There is a fairly good telephone system which is now being expanded and international calls can be made to many parts of the world. A deep-water harbour in St. John's services international shipping lines and a modern airport at Coolidge facilitates travel throughout the Caribbean, North America and the United Kingdom of Great Britain and Northern Ireland. The estimated traffic in 1981 as indicated by total visitors (1) was:

Cruises (tourist ships)	113,357
Arrivals by air	84,724
Other arrivals by sea	10,000
Total	208,081

Antigua and Barbuda, an independent nation, is a member of the British Commonwealth. Under its Constitution, the Governor-General is the Queen's representative and thus Head of State. Day-to-day running of the country lies with the Government consisting of a Prime Minister, a Cabinet or a Minister acting under the general authority of the Cabinet. Parliament consists of the Queen (or her representative), an elected House of Representatives and an appointed Senate. Members of the House of Representatives remain in office for a maximum of 5 years after which elections must be held. There is an independent judiciary.

1.2. Socio-cultural and economic setting

The population is predominantly of African descent, but Arabs, Europeans, Indians and North Americans are represented. English is the language spoken, (both pure and in a dialect form). Christianity is the only religion practised in various denominational forms represented by Anglican, Methodist, Moravian, Roman Catholic, Seventh Day Adventist, Baptist and other evangelical churches.

In 1981 the sectoral contribution to the Gross Domestic Product (GDP) as % of total (1) was:

	% (1981)
Agriculture, livestock, forestry and fishing	7.6
Manufacturing	9.2
Construction	7.6
Hotels and restaurants	11.8
Others	63.8

According to a recent study by the World Bank, an estimated one quarter of the total labour force was employed directly or indirectly by the tourist sector in 1981. There are some 34 hotels with a capacity of 3,642 beds, 20 guest houses and 32 cottages and apartments. Barbuda has one hotel with 64 beds. There has been a decline in the agricultural sector -7.6% of GDP in 1981 compared with 9.8% in 1976.

Major export commodities include paper products, stoves, refrigerators, garments, rum, lobsters and sea island cotton. The cotton industry has declined in recent years but as previously stated the Government is doing everything possible to revive it.

Unemployment stands at about 20% and the current account deficit of the balance of payments increased from 2.2 million dollars (U.S.) in 1978 to 56.1 million dollars in 1981. This was due to large increases in the food import bill and capital goods and slowdown in tourist earnings (1).

1.3. Development scene

The major problems retarding development appears to be the lack of adequate finance, trained manpower, reluctance of young people to work in the agricultural sector and, on the whole, low productivity due to poor work attitudes. Paradoxically, although there is a high percentage of unemployment there is a shortage of certain types of labour, e.g. to service the sugar cane industry, and labourers have to be recruited from abroad. Many of the workers, especially women who previously worked in agriculture, are now enjoying more lucrative employment in the tourist industry.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1.Development policy framework

The Government is taking steps to strengthen the sectors of industry and agriculture although the major thrust is towards tourism. The recession in the more developed economies of North America, Europe and the United Kingdom is, however, adversely affecting economic growth. Inflation in 1981 stood at about 12.4% (1)

Planning is carried out mainly by the Planning Division of the Ministry of Economic Development after consultation with appropriate Ministries such as Finance, Education, Agriculture, and Public Works.

Major undertakings planned for the coming 5 years as revealed by the Government's Five-Year Plan (4) are:

1) Agriculture

- Complete rehabilitation of the sugar industry.
- A corn/sorghum project as part of an integrated beef production project.
- Establishment of tree crops.
- Installation of a food processing plant.
- Construction of mini-dams to assist with irrigation.
- Establishment of a dairy industry to reduce imports of milk and milk products.
- Expansion of pineapple and sea-island cotton production.
- Full implementation of a fisheries project to increase catch of fish.

2) Tourism

Construction of 2 large hotels.

3) Industry

- Reactivation of an oil refinery with capacity of 15,000 barrels/day.
- Development of a chemical lime industry.
- Clay, bricks and tile production.

4) Education

- Construction of schools and library/museum/archives.
- Laboratory equipment - State College.
- Expansion of the Engineering Department. State College.

5) Health

Improvements to the General and Mental Hospitals.

6. Infra-structural Development

- Wind power project.
- Road development.
- Telephone expansion.
- Water development.
- Re-surfacing of the airport runway.

2.2. Development policy and science/technology policy

To date no clearly defined Science and Technology policy has been enunciated by Government, though this does not necessarily mean that interest in science and technology is or has been lacking as is perhaps shown by the following:

(1) Efforts have been made to establish laboratories at schools and the State College in order to improve science education.

(2) The teaching of engineering and allied subjects has been in progress at the State College for a few years.

(3) Scholarships have been provided to nationals to study scientific subjects in the region and further afield.

(4) A Government chemical laboratory has been established in the Ministry of Agriculture and scientific advice is provided from time to time based on analytical work carried out e.g. on soil, water, food, animal feed, fertilizer and pesticides. More recently, R&D work has been done on local raw materials having possible potential for economic exploitation. A pilot food processing plant is in operation where fruits and vegetables are processed in order to minimize waste. Forensic work is also done to aid in scientific crime detection. The establishment of a Bureau of Standards is in the pipeline.

(5) There is an appropriate technology group and a few persons are active in the area of wind and solar energy. There is a proposal to install a 500 kw wind turbine generator which could possibly be linked to the national grid and there is an on-going pilot project at the Antigua State College where wind energy is being harnessed for production of ice.

(6) In the Agricultural Division, work is in progress in the growing of *Leucaena leucocephala* as a source of energy. Traditionally the Research Section has employed scientific practices for solving various agricultural problems. In the private sector some work is in progress in solar heating and some industries employ techniques involving technology transferred from outside the region.

2.3. Policy-making machinery for science and technology

The various efforts have been largely due to departmental initiatives rather than a coherent government policy *per se*, linking science and technology with development policy. No national science and technology policy-making body has been set up, but advice is sought on an *ad hoc* basis as required from time to time from appropriate Government Departments and Ministries such as Economic Development, Education, Public Works, Agriculture, Chemistry and Food Technology, Health - to name a few.

The Antigua and Barbuda Government is an Associate Member of the Caribbean Council for Science and Technology (CCST) and it is anticipated that a National Science and Technology Council will be set up in due course. This could be the main focal point for providing advice on science and technology matters to the Government.

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

The following gives an indication of the range of institutions which perform scientific and technological activities and describes briefly the work carried out in the area of research and development and science and technology services.

1) Agriculture

Agricultural research activities are carried out mainly by the Research Section of the Ministry of Agriculture. Investigational work is proceeding on horticultural crops with emphasis on the improvement of yields. Fertilizer and spacing trials, weed control with the aid of herbicides, other forms of pest management using insecticides, nematicides and fungicides are also under study. A pilot plant project in the processing and preservation of fruits and vegetables has been in progress in recent years. Drip irrigation for certain tree crops in the south-western part of Antigua is under investigation. Consideration is now being given to the carrying out of research in aquaculture and marine biology.

Much research work has been previously done on sugar cane, in collaboration with the Sugar Cane Breeding Station in Barbados. Currently, most of the work is limited to variety trials on various soil types and also to pest control by chemical and biological methods.

There is a Central Cotton Station which is now mainly involved in cotton seed multiplication work to ensure good quality planting material of the West Indian sea island cotton. Pest control work aimed at eradicating the pink boll worm -a major cotton pest- is also in progress.

Research work on the world famous Antigua Black pineapple with a view to improving its size and yield all year round is planned for the future. The Government Chemical Laboratory will be involved in the analyses of soil, pineapple and leaves.

The Caribbean Agricultural Research and Development Institute (CARDI) has a branch in Antigua which carries out research work on grasses and legumes for animal feed and on peas, beans and peanuts.

2) Health

There is one main government-run General Hospital and a small private hospital in Antigua plus a cottage hospital in Barbuda. These together with small district clinics are manned by well-trained doctors and nurses to provide health services. These institutions are supported by a government pathological laboratory and two private laboratories. Most of the necessary routine tests are performed although modern and sophisticated equipment would expand their scope. Work of a research nature is carried out mainly at the (regional) University Hospital of the West Indies located in Jamaica.

3) Education

Science subjects are taught in most of the Secondary Schools, and laboratories for General Science, Chemistry, Physics and Biology up to the General Certificate of Education, Ordinary Level, have been established in many cases. There is, however, room for improvement in the quality and quantity of the equipment available in some cases. Laboratories have also been established at the Antigua State College for teaching students up to the General Certificate of Education, Advanced Level. Here there is an even greater need for improved facilities. Despite the limitations, a reasonable number of students succeed in passing science subjects.

At the Antigua State College, much progress is also being made in the teaching of technical subjects such as mechanical and electrical engineering, plumbing, metalwork and woodwork. These various efforts are contributing to the increase in the number of graduates at the technical and professional levels in S & T. In the area of R & D as was mentioned earlier, an experiment on the harnessing of wind energy for production of ice is being investigated.

Under its Adult Education Programme the Extra-Mural Department of the University of the West Indies contributes to the State's Science Education programme by organizing classes in Chemistry, Physics, Biology and Mathematics.

The entire post-graduate training in science and technology is conducted at campuses of the regional University in Jamaica, Trinidad and Tobago, and Barbados, as well as at institutions of higher learning abroad.

4) Meteorology

An up-to-date Meteorological Unit has been established at Coolidge International Airport in Antigua. Important data with respect to temperature, relative humidity, rainfall, barometric pressure, wind-speeds, etc., are recorded and, in collaboration with other international centres, weather forecasting is done on a daily basis.

5) Seismology

Seismographic data are recorded on a seismograph located in Antigua. The information is fed to the seismographic Unit at the University of the West Indies, St. Augustine, Trinidad and Tobago.

6) Energy

A National Energy Commission has been established to develop the use of alternative sources of energy so as to minimize reliance on imported fossil fuels. At least two private companies have been set up for manufacturing solar water heaters. Experiments are also in progress with photovoltaic cells for the production of electricity. Studies have been carried out on the production of energy from biomass and on the manufacture of charcoal kilns and local stoves.

7) Libraries

The local public library is a national focal point for information on science and technology. It is part of a regional network for information on technology and energy with headquarters at the Caribbean Development Bank in Barbados. An Archive has also recently been established in Antigua.

8) Archaeology

Some local enthusiasts have been carrying out archaeological explorations which focus attention on the Caribs and Arawaks, the indigenous Indian inhabitants in Antigua. Their discoveries are on display in a local museum.

9) Bureau of Standards

There is no Bureau of Standards at the moment, but the Government has expressed its commitment to establish one in the near future. Some food quality control work is done at the Government Chemical Laboratory. A limited amount of work on patents and licences is supervised by the Registrar of the Court.

10) Statistics

Apart from the records kept at the Meteorological Unit, very little statistical information as such is recorded on science and technology. There are assurances that this will be done in the future. However, population censuses and social and cultural statistics are collected periodically.

3.2. Human Resources

Table 1 summarizes, in quantitative terms, the state and trends of human resources development in science and technology in 1983. Figures for years prior to 1983 are not available but there has been a gradual increase in the number of graduates over the years. However, a constant "brain drain" to the more developed countries, especially the United States of America and Canada, creates a shortage of manpower. It is necessary, to further intensify efforts in training to make up for reductions caused by emigration. More attention is now being given to the adequacy and relevance of training. It is now being recognized that middle management skills need to be upgraded in the various scientific disciplines. More graduates for example are needed at the Diploma Level to work along with graduates with degrees.

3.3. Financial Resources

Funds spent on science and technology are spread throughout various Ministries, in particular Agriculture, Education, Health, Public Works and Public Utilities. The figures appearing in Tables 2 and 3 are only approximations.

Table 1

Scientific and technological manpower

Year	Population (mlns)	Total stock (000)	Scientists and engineers						Technicians	
			Total number (in units)	of which working in R & D					Total stock (000)	Of which working in R & D (in units)
				Breakdown by field of educational training (in units)						
				Natural Sciences	Eng. & Techn.	Agr. Sc.	Med. Sc.	Social Sc.		
1983	0.076	0.366	366	25	62	23	184	72	0.298	50

Table 2

R & D Expenditure in 1982:
Breakdown by source and sector of performance
($EC, millions)

Source	National		Foreign	Total
Sector of performance	Govt. funds	Other funds		
Productive	0.050 *	0.100 *	0.250	0.400
Higher education	0.200 *	0.300	0.650 **	1.150

* Estimated
** Grants from Donor Agencies

Table 3

Trends in R & D expenditures

Year	Population (millions)	GNP ($EC, millions)	Total R & D Expenditures ($EC, millions)	Exchange rate 1 US: =
1965	0.060	N.A.	N.A.	$ 1.70 EC
1970	0.065	N.A.	N.A.	$ 1.70 EC
1975	0.070	N.A.	0.900	$ 2.70 EC
1979	0.074	165.9	1.587 *	$ 2.70 EC
1980		176.2	1.763 *	
1985	0.080	226.0 **	2.644 **	
1990	0.085	280.0 **	4.000 **	

* Estimated
** Projection
N.A. = Not available

They include, in addition to funds spent locally, amounts paid to regional and international organizations such as CARDI, the Commonwealth Agricultural Bureau, the Caribbean Pesticide Control Unit, the Regional Virus Research Laboratory, the Regional Drug Testing Laboratory, the Caribbean Epidemiological Research Centre, the Caribbean Food and Nutrition Institute and the University of the West Indies.

3.4. Information resources

The availability of informational material on science and technology has been rather haphazard in the past. Efforts on a regional basis have, however, improved the situation somewhat. Plans are afoot to improve the system at the local level.

3.5. Surveying of the scientific and technological potential

Little institutional and organizational arrangements exist for collecting and analysing numerical data and other factual information on the resources available for national scientific and technological activities. As in other areas, help is provided whenever possible, on an *ad hoc* basis by individuals in relevant departments. For instance, officers in the Ministries of Economic Development, Education and Agriculture are at present assisting in a survey being carried out by the Caribbean Council for Science and Technology (CCST).

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

Over the past ten years the major area of development in Antigua and Barbuda has been tourism. As a result it has been necessary for more attention to be paid to the construction of houses and hotels, the repair of roads and expansion of other infrastructural facilities such as the airport, water, electricity and telephone.

In addition, certain factories have been established e.g. for the assembly of refrigerators, stoves, electronic equipment, and for the manufacture of paints, galvanized metal and plastics. An oil refinery has also been in operation. All of these activities involve some aspects of science and/or technology. There have been proposals for the possible prospecting of oil in and around Antigua, and for the establishment of petro-chemical industries.

4.2. Achievements and problems

Achievements have been mainly in the area of training, although, as mentioned earlier, this has been partly nullified by emigration. There is need for more training and this will require more teachers and equipment. These requirements will, in turn, necessitate a greater allocation of funds for science and technology.

4.3. Objectives and Priorities

Objectives and priorities in the field of science and technology are still to be clearly established, a task perhaps best suited to a National Science and Technology Council. The setting up of such a Council has arisen as an urgent matter.

4.4. International scientific and technological co-operation

Scientific and technological co-operation exists between Antigua and Barbuda and many countries such as the United Kingdom and other Commonwealth countries, the United States of America and Canada. For example, Technical Assistance is provided by international agencies such as the Commonwealth Fund for Technical Assistance, U.S. AID, the Canadian International Development Agency (CIDA), the British Development Division, Voluntary Service Overseas (V.S.O.), the American Peace Corps, and Unesco.

Research and Development priorities are presently established after appropriate *ad hoc* discussions. Recently, Antigua and Barbuda has participated in a meeting of Caribbean officials and ministers responsible for science and technology.

It is hoped that in this way regional and international co-operation will be maintained.

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BARBADOS

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

Barbados is located between latitudes 13°02' and 13°20' N and longtitudes 59°25' and 59°35'W. Its area is about 431 km^2, with a land surface which is undulating, but not hilly. The highest point is 336 metres high. Its population (in 1982) was 270,000. The capital city is Bridgetown.

The climate is tropical, although extreme temperatures are exceptional owing to the influence of fairly steady trade winds. Maximum temperature values are approximately of 30°C with minimum around 24°C. The annual rainfall depends on location, varying from about 1100 mm to 2000 mm. There is a marked dry season, from January to May (1). The Island is in the hurricane zone, but severe damage from this cause is, fortunately, rare.

The west and south coasts of the Island have good beaches, and these, combined with a favourable climate, have resulted in a thriving tourist industry. In 1978 there were 11,000 hotel beds (2), all being in establishments with less than 200 rooms. Since the Island is small, and is composed almost entirely of porous coral, there are no permanent rivers or lakes. Numerous "gullies" run for an hour or two after heavy and prolonged rains, but all water for domestic, industrial or agricultural purposes must be pumped from the aquafer. The depth varies with location, but some of the wells supplying water to the public supply are as deep as 260 metres.

Most of the arable land is cultivated for sugar cane. About 14% of the total land is in the "Scotland" district, in which geological conditions are such that soil slippage occurs very easily. Considerable work has been done by the Soil Conservation Division of the Ministry of Agriculture, and the affected land is protected by various measures, including the prohibition of animal grazing, reforestation, the planting of special covers to prevent soil movement, and improvements in drainage.

Bridgetown has a deep water harbour, built in 1961, which can accommodate up to eight ocean-going vessels at a time. An international airport, with a modern terminal, can handle jumbo jets. In 1979 there were 1965 shipping arrivals in the port, representing a total net registered tonnage of 13,262,000. 11,072 cruise passengers were registered (3). In the same year, there were 27,300 aircraft movements at the airport. 4,1 million kg of freight were loaded and 7,0 million kg unloaded, together with 0,3 million kg of mail loaded and 0,4 million unloaded (4).

There are no railways, but communications are very good. There is a network of some 1,300 km of paved roads, mostly in fairly good condition, though they are narrow and winding. Mains water is available to almost all buildings, as is electricity. Telephone services are excellent. There are two local radio transmitters, and one television station.

The country has a nominated Governor-General representing the British Crown, and an elected Parliament of twenty-seven members, together with a Senate. The members of the latter are nominated by the Prime Minister, the Opposition and by the Governor-General. The Cabinet is nominated by the Prime Minister, and is responsible for the day-to-day running of the country. There is universal suffrage for all adults eighteen years of age or over.

1.2. Socio-cultural and economic setting

The population of the Island is largely of African origin, descendants of the large numbers of slaves brought into the country by European settlers after sugar cane began to be cultivated on a large scale, from 1640 onwards. About 5% of the population is of Caucasian origin. The religion is Christian, mainly Anglican, and the language is English.

The economy is based principally on the cultivation of sugar cane, and on tourism, with a small, but growing, industrial section. The area of cane harvested by estates (as distinct from small-holdings) declined from 14,800 ha in 1960 to 12,720 ha in 1975 (the corresponding areas under cane *cultivation* were 19,200 and 16,000 respectively). However, the efficiency of production has increased considerably in this time. In 1960, one estate worker produced, on average, 6.2 tonnes of sugar per season, whilst in 1975 the figure was 15.4 tonnes (5). In 1980, (a record year, owing to favourable weather), the earnings from sugar exports amounted to U$S 56 million. In 1981, on the other hand, a very wet "dry" season, together with a late start in harvesting, caused the figure to drop to less than U$S 36 million.

In 1970, 156,400 visitors were estimated to have spent about U$S 40 million during an average stay of 5.3 days (6). Ten years later, there were 369,915 visitors, whose average stay had increased to 10.2 days and whose expenditure increased to U$S 251 million (7).

The Industrial Development Corporation offers incentives for industry (such as the provision of factory premises and fiscal inducements). The textiles trade, food, beverage, and tobacco manufacture, leather and plastic products, furniture, paper, pottery, solar water heating, building materials, steel buildings, vehicle bodies, electronics components, sporting goods and data processing industries are all represented. Exports from the manufacturing sector totalled an estimated U$S 107 million in 1980 (8).

There is a small oil refinery which processes indigenous and imported crudes. The total production of local crude oil in 1980 was 305,000 barrels. Seventeen million cubic metres of natural gas were produced in the same year, with the local electricity generating company using some 5,700 cubic metres per day from October, 1980, when extensions to the distribution system and modified burners allowed this to be done for the first time (9). Exploration for oil continues.

1.3. Development scene

The problems hindering development in the country may be briefly described in the sectorial areas of agriculture, tourism and industry. In agriculture,declining areas of sugar planting, the difficulty of obtaining labour and its high cost, the rising costs of imported materials such as fertilizers, machinery, and agricultural chemicals, inadequate storage, processing and distribution of products (except sugar), and the general trend "away from the land" all contribute to the difficulties of improving the output from this sector.

Tourism is very largely dependent on the general prosperity of the overseas clients. Thus, recession in North America and Europe leads inexorably to depressed tourist earnings. Increases in the price of travel, due to fuel price increases, also tend to reduce tourism.

In the development of local industry, which requires investment either from local or foreign sources, the depressed economy of the world is acting as a deterrent. The availability of markets for products, and of local skilled labour at competitive wage-rates are also constraints.

One of the Island's principal asset is its people. They are in general well-educated (the literacy rate is at least 97%), healthy, hard-working and adaptable. There is however a shortage of workers with training and skills in such areas as the construction, electrical, civil, chemical and mechanical engineering industries, at both the middle and upper levels. Management skills are also scarce. The schools, Community College, Polytechnic, the University of the West Indies and the Barbados Institute of Management and Productivity all help to cope with these problems, without being able to completely overcome them.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1. Development policy framework

The Barbados Development Plan, 1979-83 (10) states that planning strategy will seek to achieve:

(a) A marked increase in employment opportunities and output from the productive sectors;

(b) a reduction in the rate of inflation;

(c) a substantial improvement in the balance of payments;

(d) an increase in the opportunity for the population to satisfy its basic needs;

(e) a greater self-sufficiency in the economy;

(f) a marked improvement in resource management efficiency, and

(g) a continued income re-distribution process.

Public sector projects planned or under consideration include:

(a) The development of export agriculture;

(b) integrated rural agricultural developments;

(c) the development of irrigation;

(d) fisheries development;

(e) a land settlement/land lease scheme;

(f) tourist development;

(g) the expansion of industrial estates;

(h) a cement plant;

(i) energy resource development.

In the case of the private sector, local or foreign investors are encouraged to start new projects (usually in the industrial sphere). The Industrial Development Corporation, a statutory body within the Ministry of Trade and Industry, is empowered to give assistance to approved projects. Certain guidelines have been formulated to ensure that Government policies are complied with. If the Industrial Development Corporation is satisfied that the project is viable and complies with these guidelines, certain incentives are offered. These include "tax holidays", subsidised factory space, duty-free importation of necessary materials, etc.

An entrepreneur does not have to avail himself of the services of the Industrial Development Corporation, and provided he does not wish to have the benefit of the incentives, is free to engage in any lawful entreprise. It is, however, possible for indirect control to be exerted, since permission to import needed materials may be refused. Exchange control is also exercised over profits which a firm may wish to repatriate. In practice, however, industrial operations in the private sector are usually unhampered by Government interference.

Development planning in the sphere of Government follows a process in which the need for a course of action which will, it is hoped, be of some benefit to the country, is first identified. Depending on the sector in which this action is required, the appropriate Ministry begins to formulate its ideas. The justification and basic background to the proposal are elaborated and, if possible, a pre-feasibility study is prepared. This material is written up in the form of a paper for comment.

The paper is circulated, for evaluation and criticism, to all the Ministries which may be in a position to make an input. Appropriate meetings are held, in which all aspects of the proposal are discussed and any modifications which appear necessary are made. The final report is then prepared in the form of a "Discussion Paper". This is sent, via the appropriate Ministry, to a sub-committee of the Cabinet known as the "Planning and Priorities Committee". This Committee, which at present consists of 12 members, five of whom are Cabinet Ministers, may take one of three courses of action.

It may recommend to Cabinet that the proposal be rejected. It may, without further action, recommend that it be implemented. Or it may call for further information and advice.

Except in very minor matters, the third course of action is usually adopted. In this case, a consultant is often employed, very often from outside the country, but certainly independent of the originating Ministry. At this stage, also, the advice of the National Council for Science and Technology may be called for, especially if the proposal is within its field of competence. The services of a consultant are almost invariably required in the case of proposals which, if implemented, will be financed from external sources, such as the international agencies. When this process has been completed, the Planning and Priorities Committee is again approached. The Committee has the power to consider proposals on behalf of Cabinet, except in a few cases covered by specific legislation (as, for instance, in the case of land acquisition proposals). A recommendation is made to Cabinet that the proposal be accepted (or otherwise). Cabinet reserves the right to refuse to act on the recommendation, but in practice this right is very rarely exercised. If approval is given, the Ministry of Finance and Planning is instructed to arrange the necessary financing. This may be done either from Government's own resources, or with the help of bilateral or multilateral assistance from overseas agencies (Governments, United Nations, International Banks, etc.).

If Government is to finance the proposal from its own resources, the necessary provisions must be made for inclusion in the country's annual Budget in the following financial year. Proposals made in the Budget are subject to the overriding approval of Parliament. The responsibility for inclusion of Cabinet-approved proposals into the Budget rests with the Ministry of Finance and Planning.

In the case of externally-financed schemes, provisions for their inclusion in the Estimates must be made, with a corresponding note to indicate the source of finance. Usually, such financing will involve some component which must be found by Government from its own resources. In any case, Parliament must ultimately approve the expenditure.

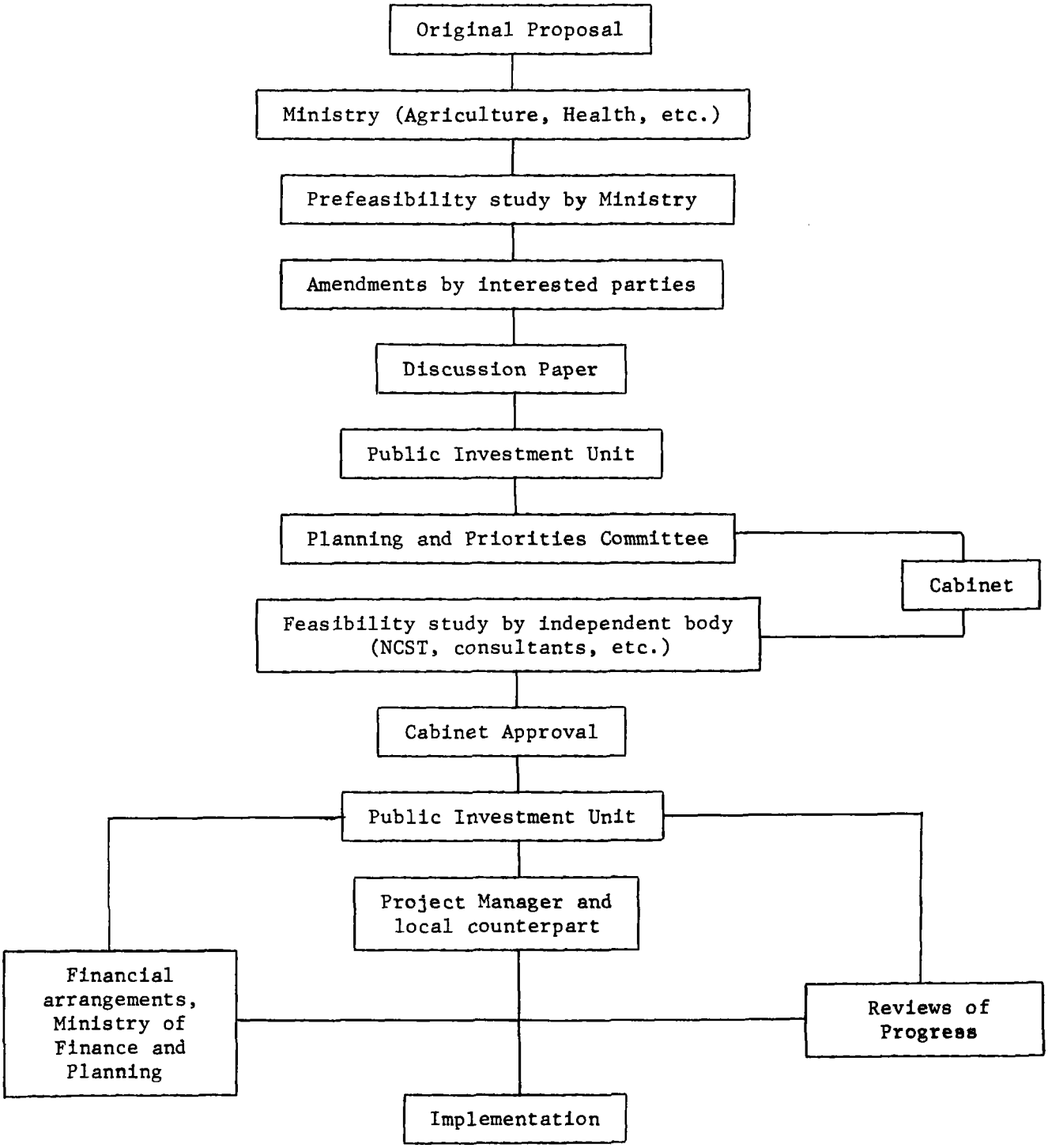
The "Public Investment Unit" (a division of the Ministry of Finance and Planning) acts as the Secretariat to the Planning and Priorities Committee. It assists in the preparation of papers to be submitted to the Committee. It appoints (where necessary) suitable consultants to give expert advice. It reviews the progress of on-going programmes and makes recommendations to the Committee for thier successful implementation.

Flow-chart 1 shows these processes in schematic form. It must be pointed out, however, that the processes by which a project in conceived and brought to completion are not necessarily divided into clear-cut steps, each separate from the other. For instance, arrangements may be being made for financing whilst a consultant may be reviewing a proposal.

The above-described procedures have been in operation in Barbados since early 1978. They were initiated as a result of a study conducted by a firm of business consultants, engaged to make recommendations to Government on more efficient administration in the public sector.

It should be noted that what has been written above applies only to programmes and projects involving a capital expenditure of U$S 50,000 and over. For smaller schemes, finance is provided under various headings within the budgets of individual Ministries.

Flow Chart 1



PROCEDURES BY WHICH A PROJECT IS BROUGHT TO COMPLETION

As an example, in the Barbados Estimates for 1980/81, in the section devoted to the Ministry of Agriculture, Food and Consumer Affairs, the following provisions are made under the sub-heading "Animal Nutrition":

Other personnel emoluments	BDS.$ 80,142
Travel	2,400
Utilities	5,000
Supplies and materials	51,000
Maintenance of property	8,300
Purchase of vehicles	20,000
Plant, equipment and furniture	34,000
Total	200,842

If during the course of the year, a particular instrument is needed for the work of this unit, it may be bought from the provision either for $ 51,000 for "Supplies and Materials" or from the $ 34,000 allocated to "Plant, equipment and furniture". This pre-supposes that its cost is relatively low. No further authority is required before going ahead with purchase.

On the other hand, if it was decided that a very expensive instrument was needed, a proposal would have to be made to the Planning and Priorities Committee, as explained in previous paragraphs.

It could not be bought immediately, since even if the Committee recommended its acquisition very strongly it would have to be included in the Budget for the following year. Permission to purchase would only be given after Parliamentary approval of the entire Budget.

2.2. Development policy and science and technology policy

Barbados has no well-defined national policy on science and technology as yet. Except perhaps in the field of agriculture, most activities are carried out on an *ad hoc* basis, as the need is perceived from time to time.

Until 1976, science and technology was incorporated into the Ministry of Agriculture, which was officially designated the Ministry of Agriculture, Science and Technology. In that year, responsibility for these subjects was transferred to the Ministry of Finance and Planning.

2.3. Policy-making machinery for science and technology

In November 1977, Government established the National Council for Science and Technology (NCST) to function as an advisory body to Cabinet, reporting through the Minister responsible for Planning, who is at present the Prime Minister. It has fairly broad terms of reference (*), but has no mandate to do anything but offer

(*) The full terms of reference are given in Appendix 1.

advice. It has a full-time Executive Secretary, together with a clerical assistant, who are administratively members of the staff of the Ministry of Finance and Planning.

The NCST has a Membership of 13 and meets once a month. At present, the funds at its disposal are largely provided by the Organization of American States, and amount to about U$S 20,000 per year. In addition a small sum is available from the Ministry of Finance and Planning. The Council was responsible for the preparation of the National Paper for the UNCSTD Conference held in Vienna in August, 1979. This Paper represents the nearest approach which the country has to a national science and technology policy planning document.

So far the Council's activities have been largely restricted to advising Government on matters of science and technology, either on request by a Ministry or (more usually) on its own initiative. Using OAS funds it has also produced a comprehensive report on the Library Resources of the Island in so far as they relate to science and technology, a report on all the R & D being carried out in institutions in Barbados, and a number of studies on various subjects which have seemed to the Council to be of importance.

Before advising on a course of action the Council carries out an in-depth study by commissioning prefeasibility reports using local consultants. An example is the use of limestone, found abundantly on the island, as a building material. The report of a local consultant (11) showed that it appeared quite feasible to modernize existing operations and suggested ways in which this should be done. It was circulated quite widely for comments to the building industry. As a result, one of the local quarry operators decided to form a new company, with a capital of U$S 250,000 to produce the blocks in accordance with the consultant's recommendations. In this case, no action was required from Government, and no recommendations were made to it by Council. The study was not made as the result of a request by Government, although it was in keeping with a section of the National Paper for UNCSTD entitled "Some areas of needs identified for early study, action and/or intensification of current work".

The Council in 1984 approached Government with a proposal that all projects under consideration by the Planning and Priorities Committee, which have a science and technology component, should be referred to the Council for its advice. It further proposed that funds be provided annually to enable it to continue work with other small projects in certain agreed areas. An amount of U$S 100,000 has been suggested for the first year of operation. These proposals have not yet been considered by Government.

Until recently the field of energy (including petroleum and natural gas) was the responsibility of an "Energy Unit" in the Ministry of Trade and Industry. The Unit has now been transferred to the Ministry of Finance and Planning. There is a (part-time) Director of Petroleum and Natural Gas, with a geologist and a petroleum officer. The responsibility of this section of the Unit is wholly in the exploitation of oil and natural gas resources of the Island, both existing and potential. Commercial production and exploration are contracted to the Mobil Oil Corporation. The distribution and sale of natural gas are in the hands of the Natural Gas Corporation, a wholly-owned Government statutory body. Two economists, with support staff, are moreover responsible for all other forms of energy. This section, set up recently, has conducted energy budgeting studies (12). In cooperation with overseas consultants,

it has drafted suggestions for an energy policy. Not yet considered by Cabinet, these proposals have not been publicly released.

From the above it will be evident that, as yet, there is no overall policy for science and technology in Barbados. Each Ministry is responsible for formulating its own programmes as it sees the need for them. Cabinet, through the Planning and Priorities Committee and the Public Investment Unit, approves or rejects them and, when approved, arranges their financing and exercises control over their implementation.

There are also a number of organisations in the Island which conduct S & T programmes and which are not directly controlled by Government. These include the Sugar Technology Research Unit (STRU) which is financed, and has its policies determined by, the Barbados Sugar Producers Association. The West Indies Central Sugar Cane Breeding Station (WICSCBS) is supported by a membership which includes not only regional sugar manufacturers but also those from several extra-regional countries. The University of the West Indies (UWI) is a regional organization. It has a campus in Mona, Jamaica, St. Augustine in Trinidad and Tobago, and Cave Hill in Barbados. At Cave Hill there are faculties of Law, Arts, General Studies, Natural Sciences and Social Science, together with a branch of the School of Education. Although research is encouraged by the University, the Faculty of Natural Sciences finds it difficult to obtain finances, and work done is limited, partly for this reason. The Caribbean Meteorological Institute (CMI) located in the Island, is also a regional organization. It, too, has concentrated largely on teaching, mainly because of a lack of financial resources for research.

The Bellairs Research Institute is a field station of McGill University, Canada. It specializes in marine biology at the post-graduate level. All its funds are provided by external sources, but much of the research done is of interest to Barbados and the Caribbean generally.

The Caribbean Agricultural Research and Development Institute (CARDI) is an organization devoted to the improvement of regional agriculture and has evolved from the long-established Regional Research Centre. It has some association with the University of the West Indies, especially with the Faculty of Agriculture in Trinidad and Tobago. It has a branch in Barbados and is financed by regional governments. It has also received funds from international organizations such as FAO. It has at least three officers in most of the English-speaking Caribbean territories, including Barbados, in which it has a staff of ten.

The overall situation is summarized in Table 1.

Table 1

Nomenclature and networking of
Science and Technology Organizations

FIRST LEVEL - POLICY MAKING

Organ	Function	Linkages		
		Upstream	Downstream	Collateral
Cabinet	Decision making, overall policy making	Parliament	Ministries, Planning & Priorities Committee, NCST	
Ministries	Planning, execution of projects	Cabinet	Planning divisions of Ministries	Consultants
NCST	Advice on science and technology	Cabinet	Ministries, Private Sector University	Consultants

SECOND LEVEL - PROMOTION AND FINANCING

Organization	Function	Linkages	
		Upstream	Downstream
Government	Parliament	Ministries, Statutory bodies, BNSI	Bilateral, multilateral, international
Sugar research organizations	Sugar manufacturers (regional and local)	STRU and WICSCBS	WICSCBS has extra-regional members
Regional Governments	Regional Parliament	CARDI, CMI and UWI	

Table 1 - (Cont.)

THIRD LEVEL - EXECUTION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES

Establishment	Function	Linkages	
		Upstream	Other
Government Ministries', technical divisions	R & D	Ministries, Planning Divisions, Cabinet	
Sugar research units	R & D	Sugar Manufactures' Association	
CMI	Data collection, Meteorological training to B.Sc. level R & D	Regional Governments	WMO
UWI (Barbados)	Under-graduate and post-graduate teaching. Some research by academic staff	Regional Governments	
Consulting firms (local)	Feasibility studies Some R & D	Client	

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

The range of institutions performing scientific and technological activites (STA) has been indicated in the preceding section. A survey (13) carried out by the NCST in 1979/80 indicated that the largest sector is agriculture, which accounted for 80% of the money spent on STA in that period.

The total amount spent in all aspects of science and technology was found to be U$S 556,000, which represented about 0,1% of the GNP. If under the heading "Agriculture" work in genetics, veterinary science and other closely-related subjects is included, the amount spent rises to 88% of the total. The survey indicated that some 82 separate research projects were under way during the period, though this is probably an underestimate.

The Ministry of Agriculture (as the Department of Agriculture) is the longest established research organization in the Island and began work in the early 19th century. In 1887 it was discovered, in Barbados, that breeding of sugar cane was possible, and work in this subject was carried out under the auspices of the Imperial Department of Agriculture until 1932. The Cane Breeding Station was created specifically for this purpose in that year, and gradually increasing financial contributions were received from the other Caribbean territories. In 1962 it ceased to be a government organization and its running was left in the hands of the private sector. It now receives support from both regional and extra-regional sources.

UWI finds difficulty in obtaining funds for research work in the Faculty of Science. Its resources are used mainly in teaching to B.Sc. standards, although research is officially encouraged. Subject to permission (which is usually given), University staff may undertake consultancy work.

Barbados is the site of one of the three main campuses of UWI (the others are in Jamaica and Trinidad and Tobago). The Faculty of Natural Sciences has twenty-four graduate staff with adequate laboratory facilities for teaching, but little suitable for research. It was established (at a temporary site) in 1936, and moved to its present site at Cave Hill in 1967.

There is little science and technology in private industry. Recently established enterprises, such as those in electronics, largely rely on imported technology, materials and tools. The local component is middle-level management, plus the skilled workers. The one exception to this is in sugar technology. One notable example of this has been the local development of a successful cane harvesting machine by the Sugar Technology Research Unit.

3.2. Human Resources

There is no accurate data on scientifically-qualified persons in the Island. As far as is known, no complete census including such information has ever been undertaken. Thirty-six names are listed in "Research in Barbados, 1979/80" (13), but these are only "project-leaders". Others have not been separately listed.

A sample of 991 adults aged 17 or over revealed that 1.4% of those surveyed had a University degree (14). In 1980, there were 119,600 persons between the ages of 20 and 60 in the Island. This would indicate that the stock of University graduates was about 1,670. If half of these were qualified in science and technology, the total number trained in these disciplines would be about 835.

In the 1970 population census, 4,743 males and 3,091 females (a total of 7,834 persons) gave their occupations as "Professional or Technical" (15).

In another volume of the same publication (16), 1,057 males and 500 females (1,557 persons) were stated to have University degrees, but there was no break-down into what types of degrees these were. A population census was carried out in 1980 but the results of the analyses are not yet available.

Tables 2 and 3 give statistics of the output of graduates from the three campuses of UWI. Since the University started giving degrees in 1952, 464 Barbadians had graduated in science-based courses by 1980. In this context, "Science" includes Medicine, Natural Sciences, Agriculture and Engineering. It is not known how many have qualified at other Universities nor how many have been lost through the "brain-drain". Persons receiving government scholarships are bonded for a period equal to the term of their awards, but afterwards they are free to emigrate if they wish. The National Paper for UNCSTD suggests that, in the case of medicine, 40% of graduates from UWI are lost by the "brain-drain", and this figure may perhaps also be similar for other scientists.

Table 2

Trends in R & D expenditure

Year	Population (millions)	Gross Domestic Product (1)	Total R&D Expenditure (1)	Exchange rate 1 U$S =
1971	0.25	629.8	N.A.	(2)
1975	0.25	627.0	N.A.	$ 2B
1980	0.25	803.8	1.1 (3)	$ 2B

Notes:

(1) In millions of Barbados dollars at current prices.
(2) Until 5 July 1975 the Barbados dollar was tied to the pound sterling at £ 1 = $ 4,80B. Thereafter, it was tied to the U$S at 1 U$S = $ 2B.
(3) Approximate. Probably low.
N.A. Not available.

Table 3

Total graduates (from all territories) of UWI in science-based faculties *

Year	Total science graduates	Year	Total science graduates
1952	11	1964	132
1953	15	1965	165
1954	24	1966	166
1955	35	1967	182
1956	26	1968	219
1957	43	1969	273
1958	40	1970	297
1959	51	1971	389
1960	46	1972	399
1961	64	1973	441
1962	75	1974	454
1963	85	1975	433
		1976	521
		1977	533
		1978	519
		1979	551
		1980	594

(*) Science includes, for the present purposes, Medicine, Natural Sciences, Agriculture and Engineering.

3.3. Financial Resources

Information on the way in which finances are allocated for R & D purposes is severely lacking. Past, present and future trends are therefore impossible to give. The only (very approximate) figures for total expenditure are those given in the survey previously referred to (13) and are reproduced in Table 2.

Table 4

Science-based degrees awarded to Barbadians by UWI *

Year	First degrees	Higher degrees
1972	29	N.A.
1973	25	N.A.
1974	27	N.A.
1975	27	1
1976	27	0
1977	37	0
1978	23	2
1979	30	2
1980	38	0
1952-1980 Cumulative	464	N.A.

* Science includes, for the present purposes, Medicine, Natural Sciences, Agriculture and Engineering.

3.4. Information Resources

A survey (17) of the library resources of the Island, as far as science and technology is concerned, was undertaken in 1980. The resources of 21 libraries both public and private, were surveyed. The author, commissioned by the NCST, makes the comment: "The field of science and technology in its research and development aspects and in its library resources is one that is comparatively neglected in the Caribbean. The situation in Barbados, where neither agriculture or science boasts an organized library (except for the scientific fields covered in the UWI Main Library), while banking, finance and economic and social development are generously represented, is probably typical of the Caribbean".

Access to information from outside the Island is available through the American National Technical Information System via the Technology and Energy Unit of the CDB. Bona fide research workers can also enlist the help of UWI.

The important library in the Ministry of Agriculture is inadequately organized. There is no trained librarian in charge, and although there is a run of about 1,000 feet of published works, no classification has been attempted and no catalogues exist.

3.5. Surveying of the scientific and technological potential

As far as is known there are no arrangements for collecting or analysing numerical data or factual information on the resources available for national scientific or technological activities. Nor are such arrangements in the planning stage.

PART 4 - POLICY ISSUES IN SCIENCE AND TECHNOLOGY DEVELOPMENT

4.1. Major developments

Probably the most significant development in science and technology policy was the formation of the National Council for Science and Technology (NCST) in November, 1977. This body gives advice on science and technology matters to government, either on its own initiative, or at the request of government Ministries. Unfortunately, it has not been used as effectively as it could have been, partly because of a lack of finance and (until May, 1979) because it had no full-time staff.

Recommendations for improvement have been made to government by the Council, but these (at the time of writing) have not been put into effect. Funds amounting to about U$S 20,000 per year have been supplied by the OAS, specifically for the "Science and Technology Policy Planning" project. These were mainly used to finance reports by consultants on various science and technology matters which seemed to the Council to be of importance to the Island.

4.2. Achievements and problems

One of the principal problems in applying science and technology to national development has been the lack of an overall policy. How much of GNP should be spent on R & D, and what priorities should be given to various topics? Should, for instance,the development of new and renewable sources of energy take precedence over exploration for oil or natural gas?

One major achievement in the energy sector has been the application to IDB for a grant for an experimental 200 kw wind turbine, which would be connected to the national grid. Concurrent with this is a survey of the Island's wind-power resources, presently being conducted by CMI, with funds provided by USAID, through CDB.

Again in the energy field, the Island is actively investigating the possibility of using wave energy by a "Lagoon" system. There is a potential for generating 20 MW of electricity by this means (18). A consultant contract was financed by the Government to study the feasibility of this project. The report was completed and its recommendations are under review.

4.3. Objectives and priorities

With the virtually complete lack of science and technology policy in the Island, no attempt has been made at defining the objectives to be pursued, nor at fixing any priorities. The Barbados National Paper written for UCSTD outlines several possibilities, but there have as yet to be taken up by government. As suggested in the UNCSTD National Paper the NCST doubtless has a role in developing such a policy but requires additional funds and staffing if it is to fulfil a significant role in this respect.

4.4. International scientific and technological co-operation

Barbados participates in a number of international co-operation programmes in science and technology. Amongst these may be mentioned the OAS Science and Technology Policy Planning Project, which at present provides most of the money spent by the NCST for pre-feasibility studies. The OAS also finances, through the Barbados Government, projects in animal husbandry operated by the Ministry of Agriculture, and in marine biology, which is being undertaken by UWI. An IDB grant has been requested to enable a 200 wind turbine to be installed as an experiment, and a loan of some U$S 4.4 million from the same bank has recently been raised to deal with soil conservation problems.

In the field of medicine, PAHO/WHO is conducting an investigation into drug metabolism in the local populace, the Medical Research Council of the United Kingdom is assisting in the research into leptospirosis, and a health and nutrition survey is being made with overseas assistance.

A project funded by UNDP, aimed at improving the indigenous production of oil and natural gas, is expected to come into operation shortly.

In addition, the CDB is financing studies aimed at controlling Velvet monkeys, the production of biogas, and a biomass resources assessment.

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* * *

APPENDIX 1

TERMS OF REFERENCE OF THE NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY (AS AMENDED ON 29 APRIL 1980)

1. The Council shall be advisory to Cabinet, through the Ministry of Finance and Planning, either on request or on its own initiative, in respect of the functions set out below. To that end, the Council from time to time will make recommendations to the Ministry for financial and other provisions considerd necessary to enable it to carry out any or all of those functions, and, if such provision is approved, the Council shall have immediate responsibility for directing the relevant programmes.

2. The function of the Council shall be:

   a) To collect, collate and review information concerning scientific research schemes or programmes relevant to the development of local resources whether such scientific research schemes are being or have been undertaken in Barbados or not;

   b) to co-ordinate scientific research schemes and programmes undertaken by departments and agencies of the government by statutory bodies or authorities, and, subject to their consent, by any other persons or organizations engaged in scientific research and investigation relating to:

      i) the development and utilization of local resources;

      ii) the improvement of existing technical processes and methods;

      iii) the development of new technical processes and methods for application to the expansion or creation of industries and to the utilization of waste products;

   c) to encourage persons engaged in any industry to undertake scientific research in connection with such industry on a co-operative basis;

   d) within the resources that may be recommended and that may be made available, to establish and maintain a scientific information centre for the collection and dissemination of scientific and technical information;

   e) to consider any request from any Minister for advice in connection with any matter within the Council's terms of reference, and to give such advice as the Council is able to give within its competence.

* * *

DOMINICA

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

The official name of this Caribbean island is Commonwealth of Dominica. It is situated between the islands of Martinique and Guadeloupe in the Eastern Caribbean. It is a rugged mountainous island with an area of 751 km^2 and a population of 90,000 (1982) with an annual growth rate of 1.2%.

In the north, the isolated mass of Morne au Diable (860 m) a volcanic pile of intermediate age, forms a blunt peninsular ending in high northward facing cliffs. There is little flat land in this region apart from that behind the town of Portsmouth which is swampy. In the centre of the island the land rises to about 250 m and is dissected by the gorges of many streams. On top of the plateau there are two young inactive volcanoes. In the south there is the well-preserved cone of Morne Trois Pitons (1,424 m) south of which is the basin of the Roseau river.

Hardly any non-volcanic rocks have been found. There are numerous fumeroles and hot springs which indicate volcanic activity as does the famous Boiling Lake in the Valley of Desolation. There are good sandy beaches in the north (Prince Rupert and Douglas Bay). Dominica has the distinction of having 365 rivers.

Rainfall varies from place to place. Over 80% of the Island has at least 2,500 mm of rainfall a year. The eastern coast, which fronts the Atlantic Ocean, has greater rainfall than the western coast facing the gentler Caribbean Sea. June to October are the wettest months while February to May are the driest.

Roseau (20,000) the capital, is situated on a small alluvial fan created by the Roseau River on the western coast. Other major towns are Portsmouth in the north, Grandbay in the south-east and Marigot in the north-east. 90% of the Island's population lives within a mile of the sea. A considerable amount of fishing takes place.

There is a medium-range airport at Melville Hall in the north-east, some 36 miles from Roseau, and an airstrip at Canefield near the city. Two good deep-water harbours are Woodbridge Bay (Roseau) and Portsmouth.

Constitutionally, Dominica is a parliamentary democracy based on the United Kingdom Westminister model. The Governor-General is the Queen's representative and Head of State but the real executive power lies with the Government, headed by a Prime Minister. Parliament consists of an elected legislature presided over by the Speaker of the House.

1.2. Socio-cultural and economic setting

Most of the population falls within the lower income groups, although in recent years there has been considerable increase in the percentage of the middle class. Over half of the population of Dominica is literate. The predominant religion is Roman Catholicism, but recent years have witnessed a rise of other christian forms - Baptist, Pentecostal, Church of Christ and Jehovah's Witnesses.

Whilst 90% of the population is of African descent, Dominica is the only Island in the West Indies which still has a significant Carib population. English is the major language but a French patois is also spoken and greatly valued as a cultural heritage.

Agriculture is the mainstay of the economy. Banana is, by far, the most important export product contributing about 60% (1), of the total value of exports. It is easily the largest user of agricultural land, (60% of total crop area) and is grown by some 11,000 farmers out of a total of 14,000.

Other contributors to export GDP are toilet and laundry soap, coconut and coconut products, citrus and citrus products. The GDP in 1980 was EC$ 85.8 million with sectoral inputs from agriculture, manufacturing etc.

The tourism sector is at an early stage of development and attracts some 20,000 stay-over visitors in a normal year. It contributes about 15% of the country's foreign exchange earnings. The Island has real potential for development in this sector, based on the natural beauty of its mountain environment with spectacular scenery and many attractive waterfalls and hot springs.

Dominica is reasonably endowed with natural resources, and there is considerable potential for hydro-power and geothermal development. A number of projects are contemplated for the full exploitation of these resources for industrial growth.

Labour is relatively abundant in Dominica. The most recent employment-by-sector data (1982) shows that 36.3% of the labour force is employed in Agriculture, 10.5% in Industry and 53.2% in Services (mainly Government). The size of the labour force is about 25,000 accounting for about 33% of the population.

1.3. Development scene

The economy contracted sharply between 1972 and 1975 and only partly recovered in 1976 and 1977. GDP at factor cost was EC$ 101 million in 1979, some EC$ 9.6 million less than in 1978. This was a direct consequence of natural disasters (Hurricane David in August 1979 and Hurricane Allen in August 4, 1980). These devastating hurricanes destroyed the main economic base of the Island. Entire banana cultivations were destroyed by 280 km per hour winds and most of the citrus crops were lost.

Economic recovery began in 1981 based on the resurgence of bananas, the main income earner. Banana prices to Dominica declined sharply, however, with the weakening Sterling/EC$ exchange rate, mitigating the general impact of the output gains. With the implementation of strong economic policies, GDP (2) grew in 1981 by about 8%. Central Government finances improved substantially in 1981/82 as a consequence of stricter financial disciplines leading to an improvement in the public sector current account deficit from 12% of GDP in 1980/81 to 3% in 1981/82.

Development efforts have been directed toward restoring and expanding the capacity of the economy so as to generate increased output and exports and expand opportunities for employment. Government action has created a healthy economic climate for industrial growth. Investment and development opportunities thus now exist in the following industrial sectors:

- Labour-intensive export industries: (garment, leather goods, toys, electronic assembly, etc.).
- Energy-intensive industries: (alumina, conversion to aluminum, caustic soda production from sea water, rolling of steel pellets into steel products, etc.).
- Resource based industries: (pre-fabricated houses, furniture manufacture, processing of pumice for building material, fish farming, etc.).

Government has identified a number of obstacles to development and efforts are continuing to remedy constraints such as problems of entrepreneurship/management, of technology inputs and market outlets, and inadequate infrastructure. Climatic factors adversely affect infrastructural facilities. Roads are very difficult to maintain, especially in the rainy months. The topography of the land also exerts its own negative effect. The mountainous nature of the country makes it increasingly difficult to cut new roads into the interior. With very limited flat land, large-scale agricultural development is a very expensive undertaking.

Like nearly all the other Caribbean countries, Dominica's economy is open and sensitive to external factors e.g. fluctuation in currency exchange rates, prices and inflationary patterns. These are constraints which cannot be addressed locally.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1. Development policy framework

In a message to prospective investors the Hon. Prime Minister stated, among other things, "Government's role in the economic advancement of the Country is one of leadership". Government policy has sought to fulfill this role by concerning itself with providing the infrastructure for growth and development such as roads, communications, education, health and other social services. It has attracted inputs of outside technology to complement and supplement indigenous technology, and capital and managerial skills to help utilize available resources towards more productivity. New policies are being implemented to create an environment for healthy industrial and economic growth.

A major undertaking of Government is the creation of a new Industrial Development Corporation (IDC) charged with the responsibility of assisting in the establishment of productive enterprises, particularly labour intensive assembly operations for export. The next step will be the establishment of an Export Promotion Agency to complement the country's productive activity. An Economic Development Unit (EDU) has been established within the Prime Minister's office with the special responsibility of co-ordinating the public investment programmes and ensuring that these programmes are consonant with national development priorities. The EDU is expected to work closely with other Government bodies in the preparation, implementation and monitoring of projects and programmes.

2.2. Development policy and science technology policy

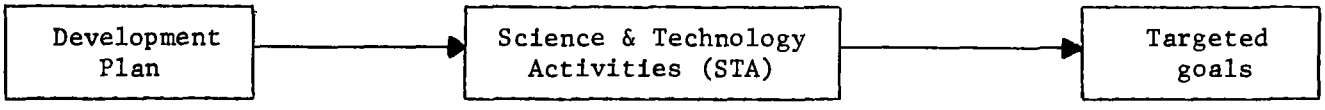
There is great awareness on the part of Dominica's policy-makers of the vital role that science and technology play in the advancement of national socio-economic

development goals. Science and technology are seen as vehicles for achieving many of these objectives. Aware that the successful use of imported technology depends on an availability of indispensable infrastructure and institutional facilities, including trained manpower at different levels, Government policy has encouraged the utilization of technologies best suited to the country's socio-economic and cultural conditions.

Policy statements give due weight to the appropriateness of technology as an overriding consideration in the identification and selection of and bargaining for foreign technology. A National Committee on Appropriate Technology has been set up to promote technology adaptation.

At a policy level the Government recognizes the need to devote significant resources to the application of S & T. Emphasis is placed on generating scientific awareness in the community at large through popularization of science projects. It is stressed that the successful application of science and technology to development presupposes a certain level of scientific knowledge in the community, and that in the absence of a scientific environment, apathy or even resistance to technological change may result. Policy priorities are mass literacy and the active promotion of science awareness.

National scientific and technological activities (STA) are being made consonant with development objectives by careful structuring of those activities to produce the targeted results.



Anticipated outputs:

- Improved environment.
- Improved economy.
- Improved infrastructure, etc.

To foster greater interaction between socio-economic development policy and science and technology policy a member of the Economic Development Unit (EDU) heads the Secretariat (in the capacity of Executive Secretary) of a national advisory body, the Dominica Council of Science and Technology (DCST). This institutional linkage seeks a greater coherence in policy interpretation and understanding, and allows the scientific and technological innovation potential of the country (as perceived by the appropriate science body) to be taken into account in the very setting of national socio-economic development objectives.

2.3. Policy-making machinery for Science and Technology

The Cabinet is the policy-maker in all matters of relating to the State's development, including science and technology application. It is properly advised in certain matters by bodies which it has set up with specialized functions. In the

sector of science and technology,Cabinet had established, in 1980, by Act of Parliament, a statutory body, the Dominica Council of Science and Technology (DCST), whose main function is to provide the Government with advice in all matters of science and technology. Thus the DCST is the national official organ influencing Cabinet decisions on science and technology policy.

Before the institution of the DCST, advice on matters of S & T policy was largely left to the Ministry of Education, and the Ministry in turn relied on the expert advice of a professional scientist (the Science Advisor) in one of the institutions under its purview, on an *ad hoc* basis. The advice produced by the Science Advisor was restricted rather to pure science and to applications in Education. The needs of S & T in other contexts were not pondered.

In the pre-1980 period an Association for the Advancement of Science existed and usefully generated support for science activities. To some extent it also influenced scientific thinking in the community. But it was not an official organ for policy matters.

The DCST is now well established. Its Chairman is appointed by Cabinet through the channel of a Minister made responsible for science and technology. The Chairman selects, from scientific and technological personnel available locally, persons of outstanding ability and credibility and recommends, to the Minister, their appointment to membership of the Council. Upon appointment a Councillor is assigned to one of the Divisions of the Council in keeping with his/her preference and speciality. The Council maintains a Permanent Secretariat under the supervision of an appointed Executive Secretary (a qualified scientist).

When fully constituted, the Permanent Secretariat will comprise, in addition to the Executive Secretary, a Technical Information Officer at professional level and other supporting staff. At present the Executive Secretary and the Chairman carry out the plethora of activities of the Permanent Secretariat.

There are four main dependencies of the Council:

- The Division of Natural Resources.
- The Division of Alternative Energy.
- The Division of Marine Resources.
- An Economic Evaluation Unit.

Projects originating from the three subject-oriented Divisions are evaluated by the Council's Economic Evaluation Unit as to their likely impact on economic development. The Economic Evaluation Unit is headed by a senior Economist drawn from the central Economic Development Unit of the Government, this being the central planning agency. Thus a very close liaison is maintained between the organ for science and technology policy and the organ for national socio-economic development policy.

The DCST has, at the direction of Cabinet, established a National Appropriate Technology Centre. A committee of 8 persons actively involved in the transfer and promotion of appropriate technology has been appointed to oversee this aspect of science and technology activity. The Committee reports on its work directly to the Council.

The Council maintains a close upstream linkage with the Caribbean Council of Science and Technology (e.g. the regional S & T policy body), and downstream linkages with technical Government Ministries, associations, research establishments and industries. The Council also fosters major collaboration with the Caribbean Science and Technology Co-ordinating Committee (CSTCC) of the OAS.

The private sector, through the mechanisms of the Industrial Development Corporation (IDC), has made its impact on science and technology policy in Dominica. As a user of technology, this sector expresses demands and bargains for appropriate technology, and is constantly attracting inputs of outside technology, capital and managerial skills. It has considerably influenced legislation governing industrial and economic activity, which has been restructured so as to develop an environment for healthy growth.

A number of Dominican institutions/organizations actively provide services related to the transfer of technology at the national and international levels. These are, namely:

- the Caribbean Agricultural Research and Development Institute (CARDI);
- the Save the Children Institute;
- Caraibe Alternative Energy;
- Management Consultants Ltd.;
- Partnership for Productivity;
- Small Projects Assistance Team Ltd.

By way of contracts and subventions, some of these entities exercise functions related to the promotion and financing of R & D and scientific and technological services.

Table 1

Nomenclature and networking of
Science and Technology Organizations

FIRST LEVEL - POLICY MAKING

Organ	Function	Linkages		
		Upstream	Downstream	Collateral
Dominica Council of Science and Technology (DCST)	Planning, programming general policy advice	1. Minister responsible for S & T policy 2. Caribbean Council of Science and Technology (CCST)	Technical Government Ministries Research Institutes Appropriate Technology Centre	IDC UWI CSTCC (OAS)

Table 1 - (Cont.)

SECOND LEVEL - PROMOTION AND FINANCING

Organization	Linkages		
	Upstream	Downstream (Executing organization concerned)	Other linkages
IDC	Ministry of Trade	Individual research groups	
OAS	Secretary General	Ministries, Government agencies	
Caribbean Appropriate Technology Centre (CATC)	Caribbean Development Bank (CDB)	National Committee on Appropriate Technology	CIDA

THIRD LEVEL - EXECUTION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES

Establishment	Function	Linkages	
		Upstream	Other major linkages
CARDI	R & D STS	Ministry of Agriculture	S & T Council
Save Children Federation	R & D STS	Relevant Government Ministries	S & T Council
Small Projects Assistance Team	R & D STS		
Medical Laboratory	R & D	Ministry of Health	Regional Linkages
Produce Chemist Laboratory	R & D STS	Ministry of Agriculture	
College of Science and Technology	R & D Advisory Service		

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

Dominica considers that the national scientific and technological potential (STP) is an inter-active complex of human, financial, material, informational and managerial factors. As such the STP covers all the organized resources that a country has at its disposal for the purposes of discovery, invention, and technological innovation and for the study of national and international problems involved in the application of Science and Technology (3).

This is a key operational concept behind Dominica's policy-making in the science and technology field. Hence, one of the principal policy objectives, and an increasing national priority, is to rationalize and foster growth of the national STP, and to optimize the effectiveness of its impact on socio-economic development.

3.1. Institutional network

The need to provide an adequate "material base" comprising an operational network of institutions in which scientists and technologists can work productively has attracted favourable Government policy. A few well-established institutions exist and are being strengthened constantly through appropriate Government inputs. These are, mainly, institutions which perform R & D and offer scientific and technological services, including those relating to technology transfer, both vertical and horizontal. Examples are CARDI, the Produce Chemist Laboratory and the Medical Laboratory. These institutions, described further below, liaise to ensure information-sharing and technical complementarity, and to avoid costly duplication.

The Caribbean Agricultural Research and Development Institute (CARDI) is a regional organization established in 1975. It serves the agricultural and research needs of Dominica and the Eastern Caribbean, and provides technical support to national research efforts. The Institute's funding comes from a core budget provided by its Member States and from project funds. Donor agencies include USAID, CIDA, the European Development Fund, and CDB. Its work programme is developed in consultation with the Ministry of Agriculture and it is concerned with advancing regional integration of agricultural R & D. CARDI has a wide range of scientific expertise; a total of 60 professionals (drawn from the disciplines of Agronomy, Plant Pathology, Entomology, Nematology, Virology, Integrated Pest Management, Soil Science, Genetics and Plant Breeding, Animal Sciences, Weed Science, Economics, Forage Agronomy, Engineering, Farming Systems) support the field team based in Dominica. The CARDI - Dominica Unit is staffed by four Scientists (Plant Protection, Genetics and Plant Breeding/Agronomy, Bio-chemist and a Horticulturist) and three supporting staff members.

CARDI - Dominica enjoys linkages with international R & D institutions the world over: e.g. UWI, IFAS (Florida), CATIE (Costa Rica), IICA (Caribbean), FTC (Caribbean), CIMMYT (Mexico), CIP (Peru), etc. It is estimated that between 1975, the year of its inception, and 1982, CARDI-Dominica invested U$S 1 million on a wide range of science and technology activities. Major achievements include:

a) The routine supply of planting materials (legumes, cereals, root crops), and of information on crop and livestock technology (4).

b) The joint funding by CARDI/USAID of a special project to develop "Small Farming Systems" specially suited for Dominica. This project began in 1979 and is to end in 1988. Expected result: improved models of "Small Farming Systems" permitting improved nutrition, increased income, accrued productivity of inputs,etc. Alternate models will be designed for each of Dominica's distinct agroecological zones.

c) The joint funding by EDF/CARDI of the "Aroid/Arrowroot" project, for the Aroid farmers of Dominica. This project started in 1982 and is to conclude in 1986. It aims at improving the Aroid industry in Dominica mainly by determining effective methods to control the Tannia Leaf Burning Disease, by genetically improving the cultivars of Dasheen and Tannias, and by designing improved Aroid farming systems.

d) General action of CARDI as a guide and as a source of agricultural information available to the general public, agricultural extension workers and farmers. CARDI-Dominica has accelerated local agricultural R & D activities.

The Produce Chemist Laboratory (PCL), was established in 1972 by the United Kingdom Government as a part of its technical assistance to the Government of Dominica. Its principal objectives are:

- to resolve post-harvest problems of agricultural produce such as storage and processing at laboratory and pilot scale levels;
- to provide technical advisory services particularly to agro-industry.

The Laboratory continues to play a major role in R & D. For example, it has developed a number of processed foods and commercialized some (dehydrated sorrel, banana vinegar). Its work in the production of essential oils has attracted much local and regional attention. The lab has stimulated expanded production of certain fruits throughout the Island with resulting economic benefit. It plays a significant role in advising Government on policy matters relating to food standards. It has a staff of three headed by a qualified scientist.

The Medical Laboratory is located at the Princess Margaret hospital complex (area of 4,048 sq.ft.). It is a modern facility built in 1975 with funds from the United Kingdom Government. Moreover, it has received considerable inputs of modern equipment from CIDA and private individuals in the United States. It has five major Divisions: Microbiology, Histopathology, Clinical Chemistry, Haematology and Blood Banking. All Divisions are performing at an optimum level and 95% of the tests requested by physicians are successfully performed locally. The remaining 5%, which cannot be performed at the lab itself, are however processed by it for onward transmission to specialized centres in Barbados (thyroid function tests), Trinidad and Tobago (virology and immunology), and CDC Atlanta,Georgia, United States of America (for highly sophisticated haematological investigations).

Proficiency testing and quality assurance/control programmes entered into with other laboratories in the Less Developed Countries of the Caribbean rank the Laboratory highly.

It is envisaged that the lab will undertake, within the next few years, several epidemiological studies, particularly investigation into the Typhoid problem and the control of diarrheal diseases in Dominica. Other research activities planned are the establishment of normal values that would establish parameters for the population and the development of a unit system of productivity to assess utilization rates and patterns.

The Medical Laboratory is currently staffed by 5 professionals, 7 technicians, 3 trainee technicians and 1 blood bank executive. Also housed in the physical facility is the office of the Project Manager for PAHO/WHO's on-going project for upgrading medical laboratory services in the Caribbean LDC's. The Project Manager, a qualified pathologist, performs the Anatomical Pathology work for the laboratory in lieu of a resident pathologist.

3.2. Human resources

The Table 1 gives information on human resources in the area of Science and Technology (stock of scientists and engineers). The total stock for the reference year 1980 was about 340. The country's population that year was approximately 75,000. The ratio of scientists and engineers per 10,000 of population was thus

$$45 \times \text{total stock}$$

This ratio compares favourably with that for the vast majority of developing countries, which is well below 60 and often does not reach 25 (according to United Nations analysis)(5). The thrust in economic and industrial growth has only begun in the past few years and has resulted in greater opportunities for higher training in the areas of science and technology. An upward trend is anticipated in the total stock, as the pace of industrialization will accelerate.

The ratio of R & D scientists and engineers per 10,000 of population is 4. This again compares well with the general pattern for developing countries which in most cases is significantly less than 5. An upward trend is predicted for the coming years in spite of the negative consequences of migration problems likely to be experienced (brain drain). The majority of the scientists, about 90% in fact, are of first degree category. Post-graduate training opportunities are limited and are generally reserved for the very able on a scholarship basis.

A breakdown of the areas of specialization of the total stock of scientists indicate the following: 45% in medical sciences, 20% each in social and natural sciences, 9% in the engineering field, and about 6% in the agricultural sciences. However, the 6% in the agricultural field are usually supplemented by a significant number from the natural sciences.

For R & D the agricultural sector tops the list in the number of researchers involved. This is not surprising since agriculture is the backbone of the economy. R & D activities are projected to increase in that sector as the agro-processing industries develop to full potential.

Equal opportunities are available to both men and women to pursue careers in S & T in Dominica. Available statistics indicate that women make up 54% of the Medical scientists.

On the question of migration of S & T personnel, it is generally recognized today that this phenomenon is the result of two forces which together make up for the irreversible outflow of S & T personnel. One is the so-called "pull effect" whereby countries that are short of scientists exert economic pull on foreigners, and the other is the "push effect" which compels jobless, under-employed and under-paid scientists to emigrate.

In Dominica the "push effect" arises from structural causes, notably the lack of limited national openings for scientists. In addition some of the returning scientists have very narrow specialization and the opportunities for fulfillment in these specific fields cannot be readily found. However, by broadening the economic base and spurring industrial growth, and encouraging civic commitment, the Government hopes that the talent outflow phenomenon can be reduced.

No recorded statistics on the yearly loss has been kept but it is generally believed that about 70 Dominican scientists and technicians leave annually.

Table 2

Scientific and technological manpower

Year	Population (mlns)	Total stock (000)	Scientists and engineers						Technicians	
			Total number (in units)	of which working in R & D					Total stock (000)	Of which working in R & D (in units)
				Breakdown by field of educational training (in units)						
				Natural Sciences	Eng. & Techn.	Agr. Sc.	Med. Sc.	Social Sc.		
1965	63.04	140				6			170	
1970	69.548	250				8			280	15
1975	78.008		17	1	2	10	2	2	350	25
1980	74.92	340	30	4	6	14	4	2	500	45
1985	79.00	400	40	4	8	18	6	4	750	60
1990	88.00	500	50	4	10	24	6	4	950	80

Projected from past trends (constant 1980 currency)

In full time equivalent (FTE).

3.3. Financial resources - Budgetary practices

In 1971 Dominica decided to introduce a programme and performance budget system on a gradual basis. In June of that year a United Nations expert arrived to assist in the work. Pilot studies were undertaken and a programme and performance budget for the Agricultural Division was prepared. Working groups were constituted, one for each Ministry, to design the programme structure. As a result of the deliberations, Programme/activity classifications were drawn up for all Ministries. An Accounting Team was formed to modernize the Accounting structure and to formulate suitable budget heads to fall in line with the new classification. The 1973 budget was in the new form reflecting the programme/activity of each Ministry (5).

Thus the programme budgeting concerned with the categorization of the entire range of operations of Government into functions, programmes and activities has been put in place. Additionally the work relating to performance analysis i.e. laying down workload data, physical targets, performance indicators, etc., to assess the performance of programme/activities was taken up in 1973 and has been completed in respect of all Ministries.

Under each programme the objectives of the programme, the staffing required for the execution of the programme, and the workload data indicative of the performance of the programme have been shown. In some cases goals to be achieved during the year have been set.

While the programme/activity classification gives the purpose of expenditure, the object classification indicates the goals and services purchased with appropriate funds to perform the programme/activities. In other words, it gives the inputs of the programme/activities, i.e. how the money will be spent. Thus a uniform object classification now being used is helpful in analysing budgeting inputs in all sectors of the economy.

The above budgetary practices apply in the case of national science and technology activities. The central Government's budget for these activities is usually supplemented by grants from donor agencies, mainly foreign.

When R & D projects have been identified by the relevant Institution, financial assistance is usually sought to implement the programme from the Government and/or foreign sources. Given the limited capacity of Government to respond to large R & D financial demands, recourse is usually made to funding and donor foreign agencies. Response has in most cases been gratifying where the proposed project objectives are consonant with the operational objectives of the donor agencies.

S & T activities of paramount importance invariably receive priority in budgetary allocations.

It is estimated that in 1980 the Government spent approximately U$S 100,000 in R & D of which U$S 25,000 in Higher Education and U$S 75,000 in the Services Sector. Foreign contributions to R & D in Dominica represented approximately U$S 150,000.

3.4. Information resources and surveying of the scientific and technological potential

The Office of Statistics within the Ministry of Finance supplies quarterly statistical information relative to socio-economic parameters and maintains a small but growing documentation centre. Information on science and technology matters is however still rather difficult to obtain in Dominica.

Nevertheless, the various S & T organizations and institutes collect and classify information relative to their particular areas of interest, and collaborate with other Agencies (local and foreign) with similar interests and activities in information-sharing and data processing. A formal centralized service to co-ordinate data collection and processing does not yet exist.

The Dominica Council of Science and Technology (DCST) has the responsibility to survey the national S & T potential. It has undertaken S & T manpower studies as a start. It is soon to collaborate with the Caribbean Council for Science and Technology in carrying out a full regional survey of the STP. Methodology already devised include printed structured questionnaires for use with target groups: research institutes, associations promoting and financing S & T activities, and relevant Government Ministries.

The Permanent Secretariat of the DCST when fully established will at professional level have the services of a Technical Information Officer, and through that Officer a centralized arrangement might be worked out to handle all information processing for S & T activities.

The need for centralized S & T information and documentation centre has been felt for quite some time and it is hoped that Government policy will soon address a project in this sphere. Currently CARICOM is undertaking a feasibility study for the establishment of a regional centre for information collection and processing. The Industrial Development Corporation (IDC, Dominica) assists with disseminating industrial information, particularly for the benefit of the private sector (7)

The Central Public Library has a section devoted to S & T information. The DCST collects a few scientific journals and to a limited extent carries out information processing in S & T particularly in the aspects of technology transfer.

A full-fledged data-bank has not been developed but some filing of information is currently being undertaken. Each of the major research Institutes (CARDI, Produce Chemist Laboratory, Medical Laboratory) has its own library facility in its respective specialization.

A current practice is for the research centres to exchange data and publications with regional/international bodies so as to be involved in the international network of users and disseminators of scientific and technological information.

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments, Achievements, Problems and Issues

One of the major strategic developments influencing development in Science and Technology in Dominica is the creative vitalization of the Industrial Development Corporation (IDC). Since 1983 the IDC has exerted tremendous influence in S & T through stimulation of industrial growth resulting in accelerated demand for technologies both new and adapted. As the Government's Statutory Corporation, financed from yearly budgetary allocations from central funds, it has established clear areas of priority and targeted specific sectors (Agriculture and Industry) for investment promotion activities. Some of these activities directly involve scientific and technological innovations and are geared to provide short-term results, while others seek to chart a long term objective.

The areas specifically covered are:

- Labour intensive enclave type Industries manufacturing for the export market. In this sector garment and electronic (low technology) comprise the principal areas of thrust.
- Agro based Industries with emphasis on wood products, essential oils, and the processing of exotic fruits and exploitation of ornamental plants.
- Energy Intensive (High technology) Capital Intensive projects

These efforts aim at reducing the dependence of the economy on agriculture, by spreading out sectorial contributions to the GDP. Considerable efforts have been made to increase the extent and efficiency of secondary industries utilizing local products. As a result of these efforts significant growth has taken place in the coconut processing industry which produces toilet and laundry soap from local coconut oil. Soap production has grown hugely, from slightly over 1 million pounds in 1975 to an estimated 8 million pounds in 1980. Soap has become the second largest export produce in Dominica.

Other industries include the processing of citrus juices and canned fruits, manufacture of oils and fats, copra and coir fibre products, distillation of laurel oils.

All of these industries need the back-up of all appropriate Scientific and Technological Activities. Quality products require support of an R & D nature from institutions able to provide such services.

Until quite recently Dominica's forest resources were under-exploited, resulting in ever increasing imports of lumber. A change has occurred with the establishment by Government of a Timber Company, a substantial amount of whose assets are owned by the State. Government pursues a policy of systematic and orderly utilization of the country's tremendous forest reserves. A sawmill complex, attached to the Timber Company, is expected to venture into charcoal production before long. Long-term plans include diversification into other industries utilizing timber, such as low-cost housing technology. At present this industry produces products of uniform quality and kiln dried.

Bold new policies are being implemented to ensure diversification of the economic base, particularly in the agricultural sector. (This is of crucial importance in view of the lessons from the recent hurricanes and the outbreak of leaf spot disease which exposed the fragility of the economy based on a single agricultural product : banana). (8)

The diversification programme has two facets. One aims at diversifying the agricultural sector, so as to develop other crops for export (e.g. mangoes, avocadoes), plus R & D induced improvements in livestock and fishing. The second aspect involves diversifying the *form* of the product for marketing (high-technology, input bordering on appropriate technology transfer). This includes processed and semi-processed products (particularly juices, condiments, canned and dried fruits).

This entire exercise is to be supported by selected R & D and development of appropriate technology. Research continues to find appropriate production methods, establish optimum storage conditions, and development of disease resistant varietal strands of plant species.

Scientific and technological Manpower is being asked to provide for industry the "know how" to bargain for and select appropriate technology to facilitate industrial objectives. R & D institutions are fully engaged in the plethora of activities that must be undertaken to provide the needed back-up for the thriving industrial climate.

Great emphasis is also placed on the development of social infrastructure. In Education, for instance, the aim is to adapt the traditional academically oriented education system to make it more responsive to the economic development needs of the country. This is to be achieved by increasing the capacity for technical and vocational training through the recently initiated Junior Secondary Programme, the establishing of a College of Arts, Science and Technology, as well as curriculum reforms at the secondary level. There is also a new focus on adult education, educational planning and administration. The policy in Education is to increase the scientific and technological potential (STP) of Dominica, particularly as regard manpower resources.

In the Health sector emphasis is placed on Community and Rural Health-Care. This includes upgrading clinics, as well as the training of new personnel to facilitate the primary health-care strategy. There are parallel attempts to improve the water supply system, the liquid and solid waste disposal system, and general sanitary facilities.

A major development in the field of Telecommunications is the Design and Planning of Microwave National Telephone Trunk routes. When fully operational, telephone junction lines will be increased resulting in more efficient service. Overseas calls will be channelled directly through Microwaves instead of the present Tropospheric scatter system now being used which is more susceptible to noise.

The overall development strategy foresees that women play an essential role in the socio-economic development of the country, participating fully in all aspects.

Issues of policy revolve around:

1. - New uses of available resources;
   - new industrial products with new technology;
   - new agricultural products;
   - upgrading traditional technologies.

2. Mechanisms for generating ideas (a specially trained and highly informed scientific and technological team within the Dominica Council of Science and Technology.

3. Dissemination of R & D results (to include abstracts and journals and data banks attracting research results from various institutions). R & D co-ordination through the DCST and setting up a mechanism for dissemination of up-to-date information of technologies appropriate for national development. Exposure of non-scientific community and users to matters of technology choices.

4. Policy-makers interacting more closely with the DCST to determine S & T inputs to national programmes for development. In this way the possible suppliers of the knowledge required by different development activities can be identified with the participation scientific and technological community. These suppliers could be drawn from higher-education institutes, vocational training schools, R & D units, etc., in the public and private sectors.

5. Government's continued efforts to minimize constraints or bottlenecks to institutional capabilities to effectively tackle S & T problems by, among other things, bolstering the managerial and technological resources of those institutions. For instance, the Produce Chemist Laboratory needs to be strengthened in its capability to respond to diverse requests in the field of agro-processing through personnel upgrading and more financial support and greater input in capital equipment.

6. There is no question that Government's continued commitment to appropriate development policies and sound management has done much to stimulate industrial growth and consequently created a demand for a range of technological activities. Methods of limiting constraints to execution of specific S & T policy will continue to be addressed.

7. One of the most pressing issues in science and technology is the challenge to viability of the banana industry from longstanding problems of low yields, inadequate input supplies, poor cultural practices and declining competitiveness. Appropriate R & D will address the question of soil fertility due to rapid loss of soil nutrients through leaching and restoration of productive capacity of soil through quantitative and qualitative use of chemical and organic fertilizer practices (determination of fertilizer formulations suitable for different soil and crop applications).

8. Medium-term development of the electricity sector focuses on further exploitation of Dominica's hydro-electric potential. The Island recently initiated a prefeasibility study in Geothermal potential, believed to be considerable (9). To properly pursue these alternative energy prospects the institutional capability

within the competent Ministries would have to be reinforced, for instance the Energy Unit within the Ministry responsible for Alternative Energy prospects.

9. Forestry development is at a very early stage and technical problems of timber extraction and processing pose critical constraints that need to be resolved.

10. A newly identified (idea-stage) resource with potentially significant commercial possibilities is Dominica's river water. Technical feasibility studies should be carried out to establish the viability of full exploitation of this water, for example by collecting fresh water for export to drier neighbouring countries.

11. A major constraint in the educational sector is the lack of adequate budgetary resources, which affects availability of school supplies and the adequacy of teacher training. Substantial technical and financial assistance will be needed to carry out the appropriate development objectives envisaged by Government.

12. Appropriate agricultural tools and equipment for small farmers are important as a means of increasing the viability of the small farm. The need exists for the design of quality tools and equipment that are affordable and suited to the scale of operations of the small farmer.

13. Finally, to properly develop S & T capabilities in the State for the purpose of furnishing viable support for growing industries, a programme to upgrade technical skills of S & T personnel should continue to be addressed. Full use must be made of opportunities under technical assistance such as those of United States AID and OAS, and the United Nations system. A worthwhile specific area is the rapid development of the capability within the DCST to prepare and maintain an adequate pipeline of bankable projects in relevant S & T, for review by potential donors, as well as definition of priority projects for support to scientific and technological activities that can be executed without external technical assistance.

Project priorities

A list of priority projects is presented below and in Table 3. These have been identified in the major sectors of the economy, in consonance with the present policy of fostering the growth of all sectors so as to upgrade the social and economic conditions of the population and allow development to reach the rural communities.

List of priority technologies

Agriculture

I. Small Farming Systems Research Project;
II. Development of agro-processing techniques for specific application to local foods;
III. Development and commercialization of edible oils;
IV. Varietal selection and multiplication of food plants e.g. Aroids.

Education	I. Establishment of tertiary institutions better adapted to emerging development needs; II. Educational technology.
Food	I. Protein studies; II. Fish and prawn farming; III. Post-harvest food losses minimization.
Industry	I. Canning technology; II. Development of appropriate technologies for: a) low cost housing and b) utilization of local materials.
Energy	Exploitation of alternative energy resources: - Mini and Micro hydro-technology - Geothermal potential (feasibility studies)
Health	I. Primary health care in rural development; II. Study in pharmaceutical properties of local plants.
Road	I. Exploitation of sulphur in road technology (10) II. Limestone utilization in cement manufacture.

Table 3

Policy indications of priority technologies

Title of technology	Type of policy on which the technology is dependent			
	Scientific and Technological Policy		Economic / Social/ Cultural policy	
	A	B	C	D
Small Farming Systems Research Project	XX		XX	
Development of locally processed foods		XX	XX	XX
Varietal selection and multiplication	XX		XX	
Development of essential oils		XXX	XX	XX
Popularization of science	X			X
Establishment of Tertiary broad-based institutions	XXX			XXX
Primary Health Care	XXX	XX		XXX
Canning technology		XX	XX	
Post harvest losses minimization	XX		XX	
Low cost housing		X	XX	XXX
Alternative energy sources	XXX	XXX	XX	X
Sulphur in road technology		X	X	
Fish and prawn farming	XX		XX	

Notes:
A: Science and technology policy relating to a specific technological field
B: Science and technology policy for scientific development in general
C: Economic development policy
D: Development Policy of a social and cultural nature
XXX: Policy of paramount importance
XX: Important Policy
X: Policy of appreciable importance

International scientific and technological co-operation

Dominica pursues an active policy of regional and international co-operation in R & D and dissemination activities. Its institutions liaise closely with regional counterparts in the solutions of many common problems in S & T. Such policy particularly aims at advancing regional integration of, for example, agricultural R & D. It is recognized that the scientific data and information base which must be gathered, analyzed and disseminated by STA (including R & D) often extends beyond the national frontiers. It is thus judged indispensable to exchange data on scientific investigations with other countries.

The Government therefore gives high priority to R & D co-operation particularly with CARICOM neighbours. Mutually advantageous fields of co-operation are selected and usually involve bilateral and multilateral negotiations around very specific considerations, both as regards substance of the proposed co-operation and the modality (technical, financial, administrative) for its execution.

At the policy level Dominica is an active member of the CCST. At the level of execution of R & D and STS projects, co-operation in S & T has been achieved by and large through regional institutional networks and organizations with regional and multinational interests and functions. A notable example is the OAS which pursues a policy whereby 80% of its S & T allocations are devoted to regional projects (thus fostering regional co-operative efforts and integration in problem-solving). In executing the regional projects use is made of *Centres of Excellence* existing in the region and in some cases the OAS has assisted in establishing such centres.

The OAS has in place a number of on-going multinational and regional co-operative projects in which Dominica is an active participant. These include:

1. Aquaculture
2. Mini Hydrotechnology
3. Leucaenia (a fast growing plant for feed, fuel and fertilizer)
4. Post harvest food losses
5. EBUTROP (Exploitation of Biologically Underutilised Tropical Plants)
6. Activities in Oil Spill Control
7. Solar and wind energy utilization
8. Science and technology policy planning

Table 4 provides a more detailed listing of countries participating in these co-operative endeavours.

Other regional research bodies involved in fostering co-operative research are:

Windward Islands Banana Growers' Association (WINBAN): specializes in R & D and dissemination activities in Banana utilization.

Caribbean Agricultural Research and Development Institute (CARDI): specializes in agricultural R & D and maintains agricultural information service providing needed information to agricultural technicians and planners, drawing upon regional and international sources of published information.

Table 4

Eastern Caribbean - Examples of common research areas of regional co-operation (11)

Country/ Institution	Post Harvest Physiology and Technology	Multiple Cropping Systems	Farm Mechanization Adaptability of machinery for small farm	Varietal Selection and Multiplication	Irrigation systems	Mini-Hydro Technology	EBUTROP	Aquaculture	Utilization of solar and wind energy	LEUCAENIA
Antigua and Barbuda	X		X	X	X				X	
Barbados	X		X	X	X				X	X
Bahamas	X									
Dominica	X	X	X	X	X	X	X	X	X	X
Grenada	X	X	X	X	X	X	X	X	X	X
St. Lucia	X	X	X	X	X					
Suriname	-	-	X	X	X	X				
St. Vincent and the Grenadines	X	X	X	X						
St. Cristopher and Nevis	X				X					
Trinidad and Tobago	X	X	X	X	X			X	X	X
UWI	X	X	-	X	-		X			
WINBAN	X	X	X	X	X	-	-	-	-	-

Table 5 presents ongoing public sector investment projects requiring S & T components.

Table 5

Public sector investment programme 1982/83 - 85/86 - Ongoing projects (EC$ 1000)

Title	Total	External				Local			
		82/83	83/84	84/85	85/86	82/83	83/84	84/85	85/86
Tree Crop Diversification (United Kingdom)		1038	1000	961	-	-	-	-	-
Reforestation and Plant Nursery (ILO)		206	-	-	-	-	-	-	-
Fisheries Development (CFC)		200	200	200	199	16	15	15	16
Essentials Oil Dev. (EDF)		132	241	240	-	-	-	-	-
Coconut Expansion (CIDA)		1955	1380	1865	1863	401	39	382	382
Geothermal Energy Study (France)		470	-	-	-	-	-	-	-
TOTAL		4001	2821	2266	2062	417	54	397	398
		New Projects							
Lime Development		200	300	1550	2000	-	-	-	-
Ornamental Plant Dev.		86	167	422	-	17	33	85	-
Fresh Water Prawn Farming (Pilot)		109	243	377	-	12	21	42	-
TOTAL		392	710	2349	2000	29	54	127	

Table 6 lists organizations working on appropriate technology issues.

Table 6

Organizations active in the promotion of appropriate technologies in Dominica

Caraibes Alternative Energy (Alternative energy technologies - hydro, biogas, solar,wind)
National Appropriate Technology Committee (Energy conservation/housing/water supply)
Management Consultants Ltd. (Food preservation/processing)
Partnership for Productivity (Energy Studies)
Save the Children Federation (Agricultural wastes utilization, low-cost housing, Manufacturing)
Organization of American States (Energy, utilization of local materials, etc.)

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GRENADA

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

The State of Grenada, Carriacou and Petit Martinique lies in the Caribbean Sea at 12° 07' N latitude and 61° 40'W longitude. The total area is 344 km^2, the population 110,000 in 1982. The capital, St. George's, has an estimated population of 7,500.

The climate is tropical, with a distinctive rainy season. Average daily temperatures are generally about 28°C, lowest recorded at Pearl's Airport for 1979 being 16.1°C and the highest 32.2°C. Arable land measures approximately 5,166 hectares (1975); the terrain is mountainous. There are three lakes and three major urban centres. The major seaport is St. George's with 939 ship calls in 1979 and the airport had approximately 5,000 aircraft landings and an average yearly passenger arrival of 55,000 in the last few years. A new international airport is being built in the southern tip of the island.

The Head of State is the Governor General.

1.2. Socio-cultural and economic setting

The population is predominantly negro/black (78,226 - 1970 census) mixed (10,332); East Indian (3,183); white (668); and small numbers of Chinese, Portuguese, Syrian/Lebanese, Ameridian and others. The language spoken is English and there is a remnant of French Patois (creole) spoken by some of the older people.

The 1970 census gives the population as 97.4% Christian, the predominant religions being Catholic (64%) and Anglican (22%).

The economy is based mainly on agriculture, the main exports being Cocoa (40%), Bananas (24%), Nutmegs (19%), Mace (4%) and fruit and vegetables. The other foreign exchange earners are tourism (there are 18 hotels and 6 guest houses) and remittances from migrants.

Balance of trade figures given for 1980 are

Imports	EC$ 135,893,267
Exports	EC$ 45,813,836
Deficit	EC$ 40,079,431

1.3. Development scene

The major problems hindering further development are:

- the lack of mineral resources
- the high population density
- the extreme hilliness of much of the country
- shortage of capital for development

Assets can be considered as:

- physical attractiveness
- an equitable climate out of the Caribbean hurricane belt
- a healthy population with a fair standard of education

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1. Development policy framework

The basic development policy is to raise the standard of living of the population and reduce unemployment. Areas studied include:

- infrastructural development - provision of international airport, roads, improved telephone service, electrification which should lead to an enlarged tourist sector and improvements in trade;
- educational improvement, including increase in political and cultural awareness;
- development of the agro-industrial sector;
- development of a primary health care system;
- development of a co-operative sector.

2.2. Development policy and science and technology policy

The relationship between development policy and science and technology policy is being established. A National Science and Technology Council (NSTC) has been formed, consisting of representatives of the various Ministries, Statutory bodies, Commodity Boards, Academic disciplines and Professional, Industrial and Service Organizations elected from the National Assembly of Science and Technology. (However, no major issues have been referred to the Council for study or comment up to the present Time).

To date the Secretariat of the Council is used mostly as a repository of national plans developed by several sectors.

R & D is largely financed by the Ministries of Industrial Development and of Agriculture, as well as by international organizations.

There is as yet no developed methodology for the harnessing of local innovation potential.

2.3. Policy-making machinery for science and technology

Science and technology policy is fairly new to Grenada. The traditional emphasis was on export agriculture and mechanisms supportive of the activities in that sector. A national science and technology policy-making body was first formed in 1978 by the Government. It was re-organized into a National Science and Technology Council by Law N° 28 of 1981. In addition, a Food and Nutrition Council was formed in 1980, and a National Environmental Conservation Council in 1983. Proposals from these various bodies, as well as cabinet initiatives, form the basis of national science and technology policies.

A listing of bodies more actively involved in science and technology policy-making, is given below:

Ministry of Planning Development and Training	- National Science and Technology Council
	- Energy Unit
	- Physical Planning Unit
Ministry of Agriculture	- Food and Nutrition Unit
	- NACDA
Ministry of Health	- Environmental Conservation Council
Ministry of Industrial Development & Fisheries	- Grenada Agro-Industry Research Development Centre
	- Mt. Hartman Genetic Centre
Ministry of Finance	- Grenada Development Bank
Ministry of Mobilization	- Mass organizations

Linkages amongst the above institutions are being established through the National Science and Technology Council. However, no policy document has as yet been written, nor are there any clear relationships between the various bodies mentioned. Promotion and financing of R & D and of Scientific and Technological Services are arranged locally through Ministries and Statutory bodies and external funding is sought via the Ministry of Planning.

The Agency for Rural Transformation helps in raising funds for projects. The National Science and Technology Council also operates in this role, as does the Local Development Fund Committee, an organ of the Caribbean Council of Churches.

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

A number of institutions perform scientific and technological activities. As indicated in Table 1, at the execution level most of these offer S & T services, but a few also carry out R & D work. Most of these are small, have not achieved critical mass, and so far there is no major inter-linking. The R & D areas include agro-industry, agriculture, medicine, educational technology, fisheries and alternative energy.

The largest such unit is the Grenada Agro-Industrial Research and Development Centre which has six professionals. This institution was previously called the Produce Chemist Laboratory and was under the authority of the Ministry of Agriculture but is now administered by the Ministry of Industrial Development and Fisheries. It has developed several products (Agro-Industrial) which have been commercialized, and is also performing the role of providing national quality control and metrology services.

The extent of Science and Technology Services (STS) is relatively limited but includes:

- libraries and documentation
- computer
- national museums
- cadastral surveying
- land-use surveying
- demographic and trade
- quality control for water and food
- agricultural extension
- micro and macro economic planning
- physical planning (town and country planning)
- agricultural research and development

Transfer of Science and Technology is both vertical and horizontal and largely results through ministerial contacts and projects handled by the Ministry of Planning.

3.2. Human resources

A rough check of the national stock of scientists and other professionals in 1982 gives a break-down as follows:

	Number	Of which in research
Natural Sciences	38	4
Engineering	17	1
Agricultural Sciences	16	2
Medical Sciences	42	
Social Sciences	17	

Human resource development has concentrated recently on the following:

- Agriculture
- Economics and Economic Planning
- Engineering
- Medicine and Dentistry

Table 1

Nomenclature and networking of
Science and Technology Organizations

FIRST LEVEL - POLICY MAKING

Organ	Function	Linkages		
		Upstream	Downstream	Collateral
Cabinet	Decision-making, Interministerial co-ordination	-	Ministries, Statutory bodies, mass organizations	-
Ministry of Planning	Micro-economic planning, Macro-economic planning, Programming, Interministerial co-ordination	Cabinet	Other Ministries Statutory bodies	
Food and Nutrition Council	Programming, General policy advice	Ministry of Agriculture	Mass organizations General public	-
National Science and Technology Council	General policy advice, Interministerial co-ordination	Ministry of Planning	General public Private sector	
Environmental Conservation Council	General policy advice, Interministerial co-ordination in area of environment	Ministries of Health and Agriculture	-	-
Commondity Boards	General policy advice, Marketing	Ministry of Agriculture	Producers	
Mass Organizations	General policy advice	Parish Council Cabinet	Masses	Cabinet

Table 1 - (Cont.)

SECOND LEVEL - PROMOTION AND FINANCING

Organization	Linkages		
	Upstream	Downstream	Other (if any)
Ministries	Cabinet	Departments of the various Ministries	-
National Science and Technology Council	Ministry of Planning	Project co-ordinators	-
OAS	CIECC	National Science and Technology Council	-
Appropriate Technology International	-	National Science and Technology Council	-
Eastern Caribbean Natural Area Management Programme	-	Environmental Conservation Council	-
Agency for Rural Transformation	-	-	-

THIRD LEVEL - EXECUTION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES

Establishment	Linkages	
	Upstream	Other major
Ministry of Planning, Planning Unit, Energy Unit, Physical Planning Unit, Documentation Unit	Cabinet	-
Public Library	Ministry of Education	
National Museum	Ministry of Education	Advisory board
Pearls Airport	Ministry of Civil Aviation	
Lands and Surveys Department	Ministry of Agriculture	
Land Use Division	Ministry of Agriculture	
Rabies Research Unit	Ministry of Health	
Grenada Agro-industrial Research and Development Centre (*)	Ministry of Industrial Development	
National Science and Technology Council (*)	Ministry of Planning	OAS, CSC, ATI, CCST, CCC, CADEC
Grenada Food and Nutrition Council (*)	Ministry of Agriculture	Advisory board
St. George' University School of Medicine	-	-
National Conservation Council	Ministry of Health	-
Central Statistical Office	Ministry of Finance	
Inter-American Institute for Co-operation in Agriculture (*)	C.I.E.C.C. (OAS)	Ministry of Agriculture
UNDP/FAO		Ministry of Agriculture
CARDI (*)	Ministry of Agriculture	Advisory Committee
Extension Division, Ministry of Agriculture	Ministry of Agriculture	
Research Division, Ministry of Agriculture (*)	Ministry of Agriculture	
Public Health Division, Ministry of Health	Ministry of Health	

(*) Also does R & D work

The brain drain constitute a serious impediment to human resource development in Grenada. By way of illustration, of 28 graduates in Medicine from the University of the West Indies only 1 is currently resident in Grenada; of 16 science-based Ph.Ds. that readily come to mind only 5 are resident.

3.3. Financial resources

Allocations for national scientific and technological activities are made within the budgets of the various Ministries. Some finance for scientific and technological activities is provided by international agencies or through bilateral agreements. This applies particularly to the areas of post-graduate training in science and technology and to the provision of technical manpower or equipment for scientific and technological services.

No reliable figures are available on R & D expenditure.

3.4. Information resources

These are being developed via:

- a National Documentation Centre based at the Ministry of Planning which has concentrated on Social Sciences and Development Planning; and
- an embryonic science and technology Documentation Centre within the National Science and Technology Council.

The National Documentation Centre is linked to CARISPLAN operated out of ECLA, Port-of-Spain, Trinidad and Tobago.

3.5. Surveying of the scientific and technological potential

A Capability Survey is presently being carried out by the National Science and Technology Council and information on human resources and institutions is being gathered. The results will become part of a Caribbean Survey initiated by the Caribbean Council for Science and Technology (CCST).

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

The most significant development occuring in the last 10 years was the change in the planning system to one which is more centralized (at least in theory). There is considerable governmental drive to increase scientific and technological inputs into the productive system.

4.2. Achievements and problems

On the achievement side there is an expected increase in trained manpower in agriculture, economics and economic planning, engineering and medicine and dentistry.

Major problems are:

- lack of readily available scientific and technological information to planners and
- finance for implementation of projects.

4.3. Objectives and priorities

The formation of the National Science and Technology Council is seen as an attempt to address the problem of information and transfer of technology and improve technological planning.

The priorities presently set by the administration are:

- development of agro-industry
- development of a co-operative production system
- mechanization and diversification of agriculture

* * *

GUYANA

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

The Co-operative Republic of Guyana occupies an area of 214,969 km^2 on the north coast of South America, approximately between latitute 1° - 9° N and longitude 52° - 56° W. It is bounded on the east by Suriname, on the west by Venezuela and on the south and south-west by Brazil. On the northern side is the 435 km long Atlantic seaboard which is cooled by the north-east trade winds.

Parallel along the seaboard is a flat coastal plain, of mainly fertile clay, approximately 4,144 km^2 in area and ranging in width from 3.2 km at its western extremity and 64.4 km in the east. This coastal plain is below high tide level.

Immediately behind the coastal belt is an area of swampy, spongy, pegasse soils, parts of which have naturally developed into water conservancy areas which satisfy coastal irrigation requirements and is the main supplier of the domestic water needs of the city of Georgetown.

This pegasse area is the proximal portion of the largest topographical region of the country, known as the inner low land of approximately 181,000 square kilometres. This dissected peneplain with rolling hills is covered with extensive valuable tropical rain forest broken by three separate areas of grasslands, namely the intermediate savannahs and the North and South Rupununi Savannahs.

The soil consists of mainly white and brown sands which are underlain by rich deposits of bauxite, kaolin and in some areas good clay for ceramic work. These porous sandy soils are the recharge areas for the water which is tapped by artesian wells on the coastal belt.

The highland area of the Kanaku and Pakaraima Mountains stretch away on the west towards Venezuela. In this area is Mount Roraima. A great portion of the country is still inaccessible, especially the southern highlands.

The climate is tropical, with temperatures ranging from 27° to 32°C, and an average rainfall of 2,280 mm per annum distributed over two wet seasons separated by two dry seasons, unevenly distributed over the geographical regions. The population of Guyana at the 1970 census was given at 699,848. The estimate for 1982 is 920,000.

From the projected rate of increase the population should double the 1970 figure by the year 2001 except insofar as these figures will be affected by a significant emigration pattern and the accompanying "brain drain". Life expectancy in 1967 was at 66.3 years and the age structure showed in 1970 that 60% of the population was under 21 years. The voting age has been reduced to 18 years.

Georgetown, the capital city, is the centre of trade and administration with an extent of some 40 km^2. Over the past 20 years the city has grown rapidly both as a result of rural-urban migration and the extension of its boundaries to include immediate suburbs and the development of new housing areas.

Other urban centres are New Amsterdam and the Bauxite town at Linden. Two former villages, Corriverton and Rose Hall, have been raised to the status of towns.

The natural resources of the country include its rich forests and minerals such as bauxite, gold, diamonds, manganese; and there are indications of uranium and petroleum deposits both inland and offshore. The rich alluvial soils of the coastal belt, on which 90 per cent of the population can be found, produce export crops of rice and sugar, and the local food producing potential is extensive.

The country is divided longitudinally by large rivers flowing down to the Atlantic. The river-reaches above 60 miles are studded with falls and rapids which provide ample possibility for hydropower development.

Politically the Country is socialist in thrust with over 80 per cent of its resources and industries state owned and state controlled. Both the private and co-operative sectors are small.

The highest executive authority in the country is vested in a President who is Head of State and who with a National Assembly of 65 constitute Parliament, the legislative body of the country.

The country is divided into ten administrative regions designated as The Regional Democratic Organ each with a Council and Chairman. This Organ is responsible for local government and regional administrative matters. Each region is represented by two members in the National Assembly which normally has 53 members elected from the political parties on the basis of proportional representation (See Table 1).

1.2. Socio-cultural and economic setting

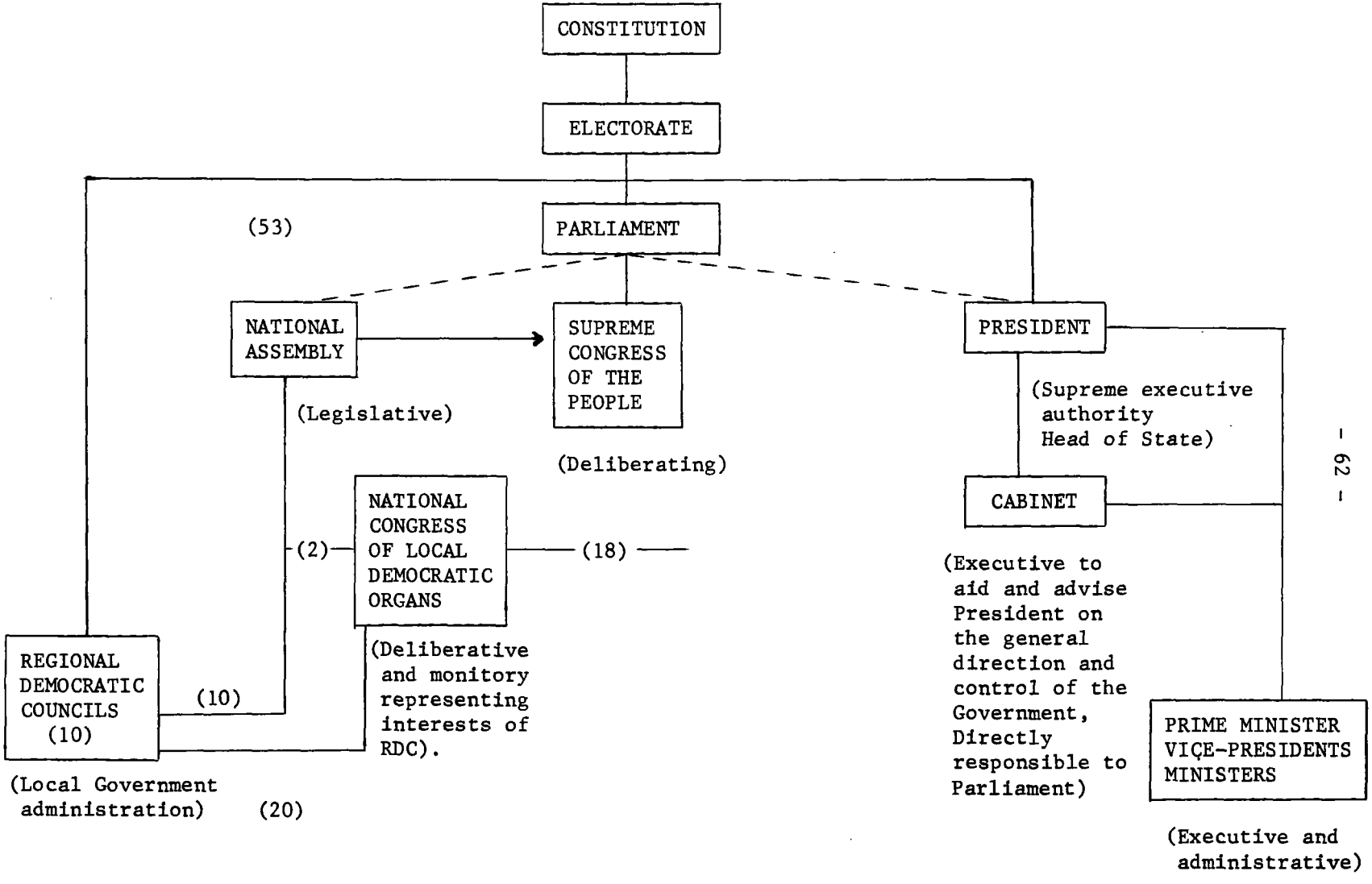
In Guyana no fees are required from students for education from Kindergarten to University, as Government promotes a free education policy. There are hundreds of primary and secondary schools scattered throughout the country and these take care of the formative and early years of training. There are a small number of technical colleges for technician and apprenticeship training and two teacher-training colleges.

Within the school system, the Community High School caters for the non-academic stream. High emphasis is placed on agriculture in schools and the school farm is gradually taking the place of the school garden.

The Univeristy of Guyana, the only University, provides Third Level training and its enrolment of about 1,500 is distributed in Faculties of Natural Sciences, Technology, Agriculture, Health Sciences, Education, Social Sciences and Arts. Adult education is handled both by the University and by a Government supported Adult Education Association.

In this English-speaking country there is no truly Guyanese cultural amalgam and some traditional customs and practices are still observed by the six ethnic groups that form the population. In some cases these are in the original or "pure" state but a significant amount of local influence has been exerted over the years, giving a distinct Guyanese flavour to several cultural practices. In addition

Table 1 - Political administrative structure in Guyana



national festivals and observances have transcended racial boundaries while embodying strains of all the diverse cultures and traditions. In respect of religious practices, Christianity, Islam and Hinduism persist with a sprinkling of other sects all of which are allowed freedom of worship.

The major productive sectors in the national economy include agriculture, forestry, mining, construction, garment manufacture, pharmaceutical, food technology (instant cereals, ham; bacon, flour). Major agricultural products are sugar, rice, ground provisions and market gardening crops. Sugar, rice, bauxite, gold and timber are the major export commodities. The country strongly emphasizes export promotion and import substitution in its strategy of national self-reliance.

A combination of low prices, limited markets and high prices for imported technology and machinery has led in recent years to a marked adverse trade balance, and Guyana, like many other countries in similar positions, has a serious foreign exchange problem.

1.3. Development scene

Apart from sugar, rice, bauxite and a steadily growing forestry and wood work industry there is hardly any other value-added activity. In the areas of leathercraft, handicraft, food industry (preservation, processing, etc.), and pharmaceutical and chemicals, though,there is an identifiable increase in growth of productive activity. There is continued exploration for minerals and petroleum and an all-out effort to achieve self-sufficiency in edible oils.

Many hindrances however stand in the way of development in these areas, the greatest of these being the existing International Economic Order which adversely affects the balance of trade position. This perpetuates a system where foreign reserves are low, cost of production is high, and there is general decline of economic viability.

The economic situation has had an adverse effect on research and development. R & D activities are currently at a low level and many sectors, particularly agriculture, are deprived of the benefit of modern technical developments.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

The framework of the development policy is fashioned by the following objectives:

(a) Development of a strong agricultural base to ensure self-sufficiency in food, the generation of surpluses for export and the development of agro-industries.

(b) The promotion of industrialization and the introduction of an energy policy to reduce the crippling effects of rising oil prices on the economy.

(c) The development of a manufacturing capability based on the utilization of indigenous resources.

(d) The promotion of a balanced geographical development by means of a system of decentralization. Ten administrative regions have been created to enable greater popular participation in the decision-making process.

The global objectives and priorities can be encompassed in nine categories - Nutrition, Health, Education, Housing, Recreation, Culture, Utilization of Human Resources and Production Capacity, Income Investment and National Security (Budget Speech 1093, H.D. Hoyte, Vice President, Economic Planning and Administration). In 1983 the role of agriculture is pivotal and inputs for agricultural activity are to be of the highest priority, but in the area of non-agricultural activities emphasis is being laid on the reorganization and restructuring of the gold industry, mineral oil exploration, textile production and export, clay brick production for export, timber and wood products, pharmaceutical products.

As a consequence of its socialist thrust and large public sector, the economy is centrally planned and various political systems and strategies have been effected to ensure participation from as wide a cross section of the population as is possible. From the deliberations of these specialized bodies the following sectoral objectives and policies have been identified:

Agriculture-- Food crop development, livestock development, storage and distribution facilities, improvement of drainage and irrigation facilities.

Fisheries - Conservation (including orderly exploitation of marine fishing resources) major projects being: expansion of the national fleet; storage and distribution facilities.

Manufacturing - Concentration on industries which promote the utilization of domestic resources, especially agro-industries.

Mining - Large scale investment in the bauxite industry, exploration for and exploitation of other minerals, notably uranium.

Power and Energy - Hydro-electric development in the Upper Mazaruni to provide power for the smelting of aluminium. Government's energy policy to be guided by:

(a) conservation of energy consumption;

(b) construction of mini-hydro systems; and

(c) R & D on other sources of fuel.

Transportation - Co-ordination of the three sub-sectors of air transport, water transport and road transport.

Other important sectors include Telecommunications, Social services, Education and training.

2.1. Development policy and science and technology policy

Table 2 shows the linkages which operate in the national network of institutions concerned with science and technology.

The need to formulate a proper programme and policy for science and technology has been recognized; but so far the work in this area has remained rather rudimentary. Efforts are gradually being made to change this state of affairs but various factors tend to militate against progress in this direction.

Table 2

Nomenclature and networking of
Science and Technology Organizations

FIRST LEVEL - POLICY MAKING

Organ	Function	Linkages		
		Upstream	Downstream	Collateral
National Science Research Council	General Policy advice on Science & Technology	Ministry of Manufacturing and Processing	Environmental Information Research Unit, Science and Technology Policy Unit, Institute of Applied Science & Technology	
State Planning Commission	Budgeting	Ministry of Economic Planning and Finance	All Government Departments	
Ministry of Agriculture	Planning, Programming, Budgeting, decision-making and general policy advice	The Cabinet	Central Agricultural Station, Hydraulics Division, Ministry of Fisheries, Veterinary and Livestock Science Division, Guyana Sugar Corporation, Guyana Rice Board, Mahaica-Mahaicony-Abary Agricultural Development Authority, Guyana Forestry Commission, Guyana Timbers Ltd.,	
Ministry of Energy	Planning, Programming, Budgeting, Decision-making and general policy advice	The Cabinet	Guyana Geology and Mines Commission Guyana Electricity Corporation, Hydropower Division, Guyana National Energy Authority	
Ministry of Health	Planning, Programming, Budgeting, Decision-making and general policy advice	The Cabinet	Government Analyst Dept., Central Medical Laboratory, Dental Dept., Medex Public hospitals	Private medical institutions
Ministry of Housing	Planning, Programming, Budgeting, Decision-making and general policy advice	The Cabinet	Central Housing and Planning Authority, Town and Country Planning Department	
Bauxite Industry Development Company Ltd.	Planning, Programming, Budgeting and general policy advice	Ministry of Economic Planning	Guyana Mining Enterprise Linden, Berbice Mining Entreprise	Ministry of Energy
Guyana National Engineering Corporation	Planning, Programming Budgeting and General Policy Advice	Guyana State Corporation	Aluminium Products of Guyana, Bel-Lu Claybrick Factory Coverden Clay Works, Guyana Tractor and Equipment Company	

Table 2 - (Cont.)

THIRD LEVEL - EXECUTION OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES

Establishment	Function	Linkages	
		Upstream	Other major
National Science Research Council	R & D / STS	Ministry of Manufacturing and Processing	General Council Funding Agencies
University of Guyana	R & D / STS	Ministry of Education	Academic Board
Central Agricultural Station	R & D / STS	Ministry of Agriculture	Other departments of the Agriculture Ministry, Guyanese public
Veterinary Diagnostic Laboratory	R & D /STS	Ministry of Agriculture	Same as above
Guyana National Energy Authority	STS	Ministry of Energy	Institute of Applied Science and Technology Other Government Departments, Funding agency
Government Analyst Department	R & D /STS	Ministry of Health	All government departments, private businesses and the Guyanese public
Guyana Pharmaceutical Coporation	R & D	Guyana State Corporation	Advisory Board, Funding Agency
Guyana Liquor Corporation	R & D	Guyana State Corporation	Advisory Board

The National Science Research Council (NSRC) which was established by Act of Parliament in 1974 was charged, among other things, with advising Government on the formulation of a national science and technology policy. While its work has not reached the point where all its projected objectives have been realized, a number of notable achievements have been made in the area of science and technology policy. Thus there are in existence a State Paper on a National Science Policy and a Document on Technology Transfer Policy. Owing to internal inadequacies (staff and finance shortage) and other factors, these policies have only been partially implemented and to a large extent the documents have remained mere scholarly works.

The NSRC has also produced a study on technological capability, as reflected by R & D institutions and their projects. This now falls under the Council's Science and Technology Statistics Programme which includes also manpower surveys, registers, surveys on expenditures on R & D, and surveys of the science and technology institutions themselves. This is all part of a programme to quantify the indices of technological progress, and the intention is to maintain up-to-date data on an annual basis, or other appropriate period. The Council is now attempting to formulate Sectoral policies, and is working on some aspects of the country's energy policy.

2.2. Policy-making machinery for science and technology

2.2.1. National Science Research Council

In 1972 Government decided to establish a National Science Research Council. It was only in August 1974, however, that it became a legal entity by parliamentary Act No. 26 which established it as a Corporate Body with a Chairman, Ruling Council and a Secretary General. Its functions were to:

(a) assist in the formulation of and to advise Government on a national science policy;

(b) determine priorities for scientific and technological activity in Guyana;

(c) promote research and ensure the application of the results of scientific and technological activities to the development of agriculture, industry and social welfare in Guyana;

(d) advise on, without prejudice to the generality of the above,

  (i) the application of science and scientific research to issues of national importance;

  (ii) priorities in the national research programme, allocation of funds for scientific research, recruitment and utilization of research staff, encouragement of training, maintaining an adequate supply of scientific and technical personnel with regard to the needs of Guyana from time to time;

  (iii) suitable arrangements for planning, management and co-ordinating scientific activities at various levels including the establishment of R & D institutes; also to

(e) review generally, and advise on the programmes and budgets of R & D Institutes;

(f) collect and disseminate information relating to scientific and technical matters; and

(g) publish reports, papers, and hold conferences on scientific and technical matters.

2.2.2. Role of the private sector

The private sector plays a very small role, if any, in the making of a local national science and technology policy. The Guyana Association of Professional Engineers (GAPE) and the Guyana Manufacturers Association (GMA) are particularly

vocal as to what they would like to see accomplished; especially with respect to technology transfer, and to basic science teaching. A number of small industries have moderate R & D facilities or purchase technology wholesale; and some university research, mainly in the Faculty of Technology, may be said to have some relationship to industry.

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

A number of institutions perform R & D activities in the fields of natural science, medical and agricultural science, engineering and technology. There are some 25 institutions of various sizes involved in and performing scientific and technological activities on a continuos basis. These can be categorised into 10 sectors:

Agriculture (6)
Construction Engineering and Industrial Operations (3)
Research and Educational Training in Science and Technology (6)
Energy (3)
Environment (1)
Food Technology (1)
Geology and Mining (2)
Health (1)
Meteorology and Hydrology (1)
Pharmaceuticals and Chemicals (1)

The Institute of Applied Science and Technology (IAST) stands apart as non-sectoral, and is a broad-spectrum national R & D institution, working in areas which include ceramics, edible oil, food technology, putty and blackboard chalk, among others.

The major institutions that are involved in science and technology activities are the Ministries of Agriculture and Health, the Guyana Pharmaceutical Corporation and the Government Analyst Department. The Ministry of Agriculture is by far the largest, employing approximately 101 scientists and engineers and some 818 technicians. It is responsible for co-ordinating and monitoring all public sector agencies directly involved in agricultural production, forestry and fisheries.

The Guyana Pharmaceutical Corporation, which is approximately 7 years old, has established an R & D unit for full-time research with approximately 16 scientists and engineers and a number of technicians. Over the years the Corporation has expanded steadily to handle various aspects of the pharmaceutical and chemical industries, breakfast cereals, edible oil and paints.

3.2. Human resources

Table 3 provides information on the stock of scientific and technological personnel in Guyana in 1979.

Post-graduate training in science and technology, when available locally, does not go beyond the stage of the Masters degree.

Table 3

Scientific and technological manpower

Year	Population	Total stock (*)	Scientists and engineers					Technicians
			Total number (in units)	of which working in R & D				Of which working in R & D
				Breakdown by field of educational training (in units)				
				Natural Sciences	Eng. & Techn.	Agric. Sciences	Medical Sciences	
1979	840,000	1,356	94	31	19	30	-	282

(*) Excluding the Social Sciences, for which statistics are not available.

3.3. Financial resources

Tables 4 and 5 provide information on R & D expenditures.

Table 4

Breakdown by source and sector of performance of R & D expenditures in 1980

Sector of performance	National		Foreign	Total
	Government funds	Other funds		
Productive	819,366	-	297,213	1,116,579
Higher education	74,361	-	131,650	206,011
General service	-	-	434,251	434,251
Total	893,727	-	863,114	1,756,841

Table 5

Trends in R & D expenditures
(in U$S)

Year	Population	G.N.P.	Total R & D expenditures
1970	840,000	424,900.000	705,301
1975		1,056,400,000	1,196,904
1979		1,091,800,000	1,756,927

3.4. Information resources

There are ample Science and Technology information and Documentation services provided by libraries (e.g. the National and the University of Guyana Libraries), archives, documentation centres and reference departments, natural history and archaeological museums, botanical and zoological gardens, topographical, geological and hydrological survey departments. Also there are:

(i) Documents on soil science surveys, wildlife control, and the exploration for oil and other mineral resources.

(ii) Information-gathering units for statistics on population, fertility index, market consumption studies, cultural and social statistics.

(iii) A Bureau of Standards and a Metrication Board.

(iv) Agricultural extension activities, environmental awareness, industrial advisory services.

Most patents have external origins. There are few local patents.

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JAMAICA

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

Jamaica is an island in the Caribbean Sea, positioned at or around 18° N and 77° W. It is 30 miles south of Cuba and 100 miles west of Haiti.

Jamaica has a maximum length of 146 miles and widths varying from 22 to 51 miles, with a total area of 10,991 km^2. To the south-west of the island a large area of shallow seas extend for a hundred miles over the Pedro Banks with their associated cays. The island is divided into three counties which contain fourteen parishes. The counties (going from west to east) are Cornwall, Middlesex and Surrey. The county of Surrey contains the parishes of Kingston, including Port Royal, St. Andrew, St. Thomas and Portland, a total area of 820.10 square miles.

The county of Middlesex contains the parishes of St. Catherine, St. Mary, Clarendon, St. Ann and Manchester, a total area of 2,025.04 square miles. The county of Cornwall contains the parishes of St. Elizabeth, Trelawny, St. James and Westmoreland, a total area of 1,565.07 square miles.

Minerals

The most important economic mineral is bauxite, which occurs in large deposits associated with the tertiary white limestone formation. Large deposits of bauxite occur in the parishes of Manchester, St. Elizabeth and St. Ann. Large scale mining operations were set in motion shortly after the Second World War.

Another mineral which occurs in commercial quantities in eastern St. Andrew is gypsum. The largest deposits lie in the area of Brooks, near Bull Bay, within a mile or two of the coast. The major portion of the output is exported to the United States. The remainder is sold locally to cement producers.

Metalliferous mineral deposits, such as ores of copper, lead, zinc and manganese, occur in the form of smaller veins in andesites and other igneous rocks, at several localities in upper Clarendon, Portland and St. Andrew. Several lodes of high-grade iron ore (magnetite and hematite) have been discovered in the parishes of St. Andrew and Portland.

Limestone is largely used in rock construction, as building material, and for the manufacture of Portland cement.

Climate

Jamaica has a maritime tropical climate mainly distinguished by warm trade winds, generally blowing from east to east -north-east in the Caribbean on the south-western edge of the sub-tropical Atlantic Anticyclone, and usually prevailing throughout the year. However, modifications are caused by easterly waves changing atmospheric stability conditions, weak convergencies and troughs. During the winter months, from November to February, cold fronts coming from the North American

continent affect Jamaica with sometimes northerly winds and, particularly in the northern and central areas, with heavy rainfall.

Located outside the main track of tropical storms, Jamaica is, nevertheless, occasionally affected by hurricanes which cause serious damage. Rainfall and temperature patterns are very much influenced by the mountainous character of the island.

The Cities and Towns of Jamaica

Kingston (population, with Metropolitan St. Andrew, 494,227 estimated) is the capital of the island, and the largest English-speaking city in the Caribbean and South America. It is the political, economic and financial seat of the island, and its main port has a natural harbour that is the seventh largest in the world. It is served by the Norman Manley International Airport, located on the spit of land that encircles the harbour. Kingston is a prosperous city, built on the broad Liguanea Plains at the base of the famous Blue Mountains. It is the main manufacturing centre of the island, shipping headquarters, chief distribution centre, and the headquarters for all government and sub-government organization. It is one of the two main ports of entry for visitors to the island, and with its excellent ships, clubs, hotels, theatres and facilities for sports, recreation and social pleasure, enjoys great popularity with tourists.

Montego Bay (population 59,614) in the western part of Jamaica's north coast, is celebrated as the playground of the international set during the winter season. Its Doctor's Cave Beach is one of the best-known in the West Indies, and forms the centre of one of the most fabulous tourist development areas in the Caribbean. Montego Bay is served by the Donald Sangster International Airport.

Ocho Rios (population 6,034) is located in the middle area of the island's North Coast. One of the six resort areas of the island, it possesses fine hotels, beautiful scenery and an equable climate. St. Ann's Bay to the west and Port María and Oracabessa (from Ora Cabeza or Golden Head) to the east are regarded as part of this area. To the west of Ocho Rios are Runaway Bay and Discovery Bay. Both are now developing into major resort centres.

Port Antonio (population 17,201) is the chief town in the island's north-eastern region. Located in an area of lush tropical vegetation it is noted for its beautiful scenery.

Mandeville (population 30,485) is a hill community. Situated at an elevation of 2,000 feet, its cool, mountain climate makes it popular with settlers from the temperate zone.

Negril (population 1,166) on the extreme western end of the island, is the latest developing resort area in the country. Its chief attractions are its seven-mile strip of the purest white sand, and the blue and blue-green waters that wash this incredible beach.

Spanish Town (population 81,416) as its name implies, was the Spanish capital of the island. It was known as Santiago de la Vega.

Government

In 1962 Jamaica became an independent member of the British Commonwealth of Nations. It enjoys a democratic form of government with a House of Representatives of 60 members, chosen every five years in general elections held under universal adult suffrage. The government is headed by a Prime Minister who is assisted by a Cabinet of fellow ministers. There is also a Senate of 21 members, nominated by the Government and by the Opposition and appointed by the Governor General, who represents the Queen and whose duties are purely formal and ceremonial.

1.2. Socio-cultural and economic setting

The people of Jamaica

Jamaica has a population of approximately 2.1 million, the overwhelming majority being of African origin, descendants of slaves brought there between the 17th and 18th Centuries. There are also small minorities of Whites, Chinese, East Indians, Jews, Syrians and nationals of neighbouring republics.

Churches

Persons of all faiths form congregations in churches throughout Jamaica. In addition to large bodies of Anglicans, Methodists, Roman Catholics and Baptists, there are flourishing groups of pentecostal and evangelical sects. There is a Jewish Synagogue in Kingston. There are also small groups of Hindus and Muslims.

Education

Educational facilities in Jamaica provide for the student from kindergarten to university level. There are many free public primary schools as well as a fair number of private ones. Secondary education is now free to all students who are successful at the Common Entrance Examination, taken at the end of the period of primary schooling. As of September 1974, tuition and board and lodging at the University of the West Indies became free for all Jamaican nationals. There are six teachers' training colleges; a College of Arts, Science and Technology; a College of Agriculture; a School of Music; a School of Art; a School of Drama and a School of Dance.

In 1973 the Government launched an intensive programme aimed at stamping out illiteracy throughout the country. The programme is organized by the Jamaica Movement for the Advancement of Literacy (JAMAL).

Music

Contemporary music, notable Reggae, has caught the imagination of the world. Other musical development is fostered through such institutions as the Jamaica School of Music, which has various departments for study, from classics to Afro-American.

Arts and Culture

Indicative of the importance which Jamaica places on cultural development is the National Training Centre which incorporates the Schools of Dance, Drama, Art and Music. The School of Art, which dates back to the 1930's has produced a large number of outstanding painters, sculptors and ceramists whose works can be seen in the National Collection at Devon House, Kingston, as well as in individual galleries in several major towns. Horticultural arts are presented in the annual exhibition of the Jamaica Horticultural Society and in numerous floral shows throughout the year.

Theatre

Theatrical productions abound all year round, especially in Kingston. These vary from small productions performed in mini-theatres attached to major hotels (e.g. the New Kingston and Pegasus), to more elaborate productions in centres like the Ward Theatre, the Little Theatre, the Barn Theatre and the Creative Arts Centre of the University of the West Indies.

Economic setting

The two main employment-generating areas in the productive sector are manufacturing and construction. It is the view of the government however, that neither of these sectors can provide the amount of employment needed, particularly in the rural areas, and that only agriculture offers the possibility of high net foreign exchange earning and high labour employment at a low per capita cost. Hence, there are plans for large scale expansion of the agricultural sector.

1.3. Development scene

The continuing recession being experienced in the economics of the major industrialized countries has severely lessened the demand for bauxite and related products of alumina and aluminium. As a result of this, massive out-backs in production have been undertaken by the major bauxite/alumina companies operating in Jamaica.

A critical foreign exchange situation exists notwithstanding the substantial amounts mobilized by the Government since its assumption of office.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1. Development policy framework

A recent policy statement has emphasized that the economic strength of Jamaica must be based on a proper balance of emphasis between the important sectors of the economy. "Jamaica's emphasis over the past 21 years (since independence in 1962) has mainly been on industry, mining and to an extent on tourism, with far less emphasis on agriculture. Unless Jamaica's exports and hard currency earning capacity is large enough to pay for what we must import, the economic strength of our nation will continue to be eroded" (1)

Renewed emphasis on agriculture has resulted in the launching of Agro 21, with the declared aim of:

- putting land in Jamaica to work;
- placing people to work;
- earning more foreign exchange.

"Agro 21 is a new national approach to agriculture that combines the implementation of modern technology with proper planning and targeted markets to deal with agriculture on a businesslike basis" (1).

2.2. Development policy and science/technology policy

"It is recognized that if attention is focused on eradicating the problems of unemployment, underemployment and in redressing other social ills, greater priority will need to be given to the process by which indigenous innovation is generated as well as the adaptation of foreign technology to ensure a greater use of abundant factors such as labour and a conservation of scarce factors such as capital" (2)

The above statement typifies the new thrust to apply science and technology to Jamaica's development. In order to bring about changes in the Science and Technology system as it exists, the Government has recognized the need to provide firm guidelines which will effectively integrate, co-ordinate and promote indigenous (R & D).

The realization that Science and Technology must play an extremely prominent role in National Development has existed for some time. The Nation has not, however, obtained maximum benefit from its 35 Government Departments and Statutory Bodies which are engaged in Technical Services and Research. For this reason the Government has set as a priority, the formulation of a National Science and Technology Policy. It is the hope of this Policy to fulfil the primary aims of:

(a) being responsive to the socio-economic, cultural, educational and foreign policies of the Nation;

(b) seeking to influence National goals by establishing priority areas for the application of science and technology to development (3).

The Government of Jamaica sees its National Science and Technology Policy as one which must seek to:

(a) Formulate Science and Technology plans with a view to determining the sectorial priorities arising from National development objectives, establishing targets for each Science and Technology sector, critically evaluating the resources required, and effectively monitoring the performance of each sector.

(b) Encourage, promote and sustain through the appropriate means Scientific and Technological research, assigning projects to the institution most capable of carrying them out; facilitate the development and subsequent application of technological innovations; upgrade Traditional Technology and stimulate the demand for indigenous research, technology and other services.

(c) Encourage the promotion of Traditional Technology that is particularly important to rural development.

(d) Establish a National capacity for the assessment, selection, acquisition and adoption of foreign technology, the terms under which such technology is acquired, and its application to local conditions; provide the avenues through which creative talents of the individual may be encouraged, and find full scope in scientific and technological activities by ensuring that all levels of the educational system possess the infrastructure and the personnel to develop scientifically aware individuals.

(e) Develop and implement an effective system for the collection,processing and dissemination of information, along with an industrial extension service to promote links between R & D and the productive sector.

(f) Mobilize the necessary financial resources needed to fund relevant R & D activities (this will include fiscal, monetary and taxation policies designed to encourage the users of Technology to allocate large internal resources of R & D, to practise energy conservation and to utilize local materials); promote innovations and inventions through awards and, where necessary, make appropriate arrangements to finance their development through joint ventures and other appropriate mechanisms.

(g) Establish the appropriate legal, administrative and institutional machinery to deal with the registration of professionals, the deposition in the National Archives of locally generated Science and Technology material, the relationship to foreign investment and transnational corporations, and royalty payment; continue to forge links and interchange ideas and knowledge not only with the Caribbean Basin but also with the world-wide international scientific community through international agencies, bilateral and multilateral agreements.

(h) Ensure that in any development all relevant bodies recognize the need to protect and conserve the environment and the country's limited national resources.

In recognition of the fact that the success of any Science and Technology Policy must be dependent on continuous feedback from all relevant sectors, the monitoring and regular assessment of all R & D endeavours, the Government of Jamaica sees the need for a central institutionalized mechanism which will perform the following functions:

(i) be advisory to the Minister under whose portfolio the subject of Science and Technology falls;

(ii) co-ordinate and monitor all levels of S & T nationally;

(iii) continually review and update the plans and strategies for R & D in consultation with Ministries, government agencies, professional societies, private sector institutions and overseas bodies.

To this end the Government is in the process of establishing a National Council for Science and Technology to be drawn from the Scientific and Technological community, but with provisions for representation from the Productive Sector and other relevant bodies (3).

2.3. Policy-making machinery for science and technology

Traditionally, Jamaica's technological development has been externally generated. This has mainly been in the form of transferred technology in basic infrastructure. During the colonial and post-independence period, technology was transferred through direct foreign investment, whereby whole plants were brought from the former colonial power and other industrialized countries complete with project know-how and their own skilled personnel. Through the aforementioned means, Jamaica has attained its current stage of technological development. There is a paucity of genuine research institutions and a yawning gap exists between the activities of these institutions and the productive sector of the economy.

To overcome this problem, the Government of Jamaica in 1960 formulated an Act which established the Scientific Research Council (S.R.C.) to "undertake, foster, and co-ordinate Scientific Research on the Island and to encourage the application of the results of such research to the exploitation and development of the resources of the Island" (4).

In the past, policies pertaining to S & T were fragmented (i.e. they were not grouped together and called a National S & T Policy). Five S & T related policies were formulated in the areas of Health, Energy, Information, Food and Nutrition, and Population.

Health policy

This policy indentified four concepts:

(1) the fundamental human right to health;

(2) all health activities must reflect a strong sense of participation;

(3) there should be equal access to health care for all;

(4) workers in the health system should strive for greater efficiency and effectiveness and at the same time they should be given the requisite remuneration for their labour.

Energy policy

The National Energy Plan has sought:

(1) to reduce dependency on imported energy and to diversify the mix of present energy supply;

(2) to promote the efficient and effective utilization of energy while seeking to sustain economic growth;

(3) to accelerate exploration for and development of indigenous energy supply sources;

(4) to cushion the impact of continually increasing energy prices on the low-income groups of the society while adopting pricing policies appropriate to achieve the aforementioned three objectives (5).

The Energy Action Programme has focused on: (a) investigation of potential indigenous energy resources; (b) search for alternative energy options; (c) conservation.

Food and nutrition policy

The 1974 Food and Nutrition Policy sought to:

(1) ensure adequate supplies of essential commodities to maintain good nutrition and dietary well-being of all segments of the population;

(2) ensure annual increases in the proportions of energy and protein requirements supplied from local production;

(3) eliminate malnutrition in vulnerable groups of the population (6).

The Five-Year Development Plan 1978-82 stated that the "long-term objectives of Government's nutrition programme are the elimination of malnutrition in the vulnerable groups of the population, particularly serious protein-energy deficiency and anaemia in young children, and nutritional deficiencies in pregnant and nursing women" (7) The three main areas of this programme are:

(a) surveillance;

(b) supplementary feeding;

(c) education and training. (8).

The Nutrition Council had conducted a review of the 1974 Food and Nutrition Policy in order to develop a Food and Nutrition Programme for the 1978-82 period in light of existing economic conditions and the health and nutrition needs of the population. Modifications to the policy were made on this basis.

Population policy

Population policy objectives have been specified in terms of certain indices of well-being or in terms of general social indicators clearly linked to certain facets of demographic change:

- achievement of specified improvements in income per family member in the general population or in some subgroups of special interest, e.g. in families headed by women;
- achievement of economic indicators specified in per capita terms (e.g. consumption, housing space), or in terms of proportions within an approximately specified population (e.g. percent literacy, malnutrition, living in poverty, etc.)(9).

Some of the goals of this policy incorporate:

(1) sustained mortality decline;

(2) reduction of maternal mortality;

(3) maintenance of fertility decline, particularly among young women;

(4) slowing the rural-to-urban migration rate;

(5) decline in migration to other countries, particularly of persons with high attainment or scarce technical skills.

Science and Technology Information Policy

The Science and Technology Information Policy has sought to promote an awareness and interest in S & T Information. This Policy also mainly seeks to encourage:

(1) the use of modern technology for storage and retrieval;

(2) Government (the decision-maker) and the private sector to seek and act on the advice of Science and Technology personnel;

(3) the establishment of a central agency to deal with information pertaining to Science and Technology.

Two seminars (the first in May 1981 and the second in December 1981) were held, discussing the "Development of a Science and Technology Policy". The purpose of these seminars was to generate recommendations for consideration by the political directorate for inclusion in the science and technology policy.

The National Council for Science and Technology

The National Council for Science and Technology, as indicated earlier will have members drawn from the science and technology community, but with provision for representation from the productive sector and other relevant bodies. The function of the Council will be to:

(a) Establish, maintain and monitor an inventory of science and technology programmes in Jamaica.

(b) Select areas for priority treatment for funding in the field of research and development.

(c) Establish the needs of science and technology and advise the Government, the private sector, and other agencies on training requirements to meet those needs.

(d) Advise the responsible Minister on developments in science and technology at the national and international levels, and monitor and review the National Policy on science and technology in the light of new changes and developments which may dictate changes in policy.

(e) Promote science and technology by advising on the issuing of scholarships and the monitoring of awards and prizes for achievements in science and technology.

(f) Designate appropriate agencies to carry out specific functions in R & D, whether this is basic, pure or applied.

The Council will comprise persons appointed by the Minister on the advice of the Science and Technology Community, and a number of ex-official members representing impact areas within the government service. There will be adequate representation form the business, industrial and professional sectors.

Professional societies in Science and Technology

The two dominant professional bodies involved in science and technology activities are:

i) The Jamaican Society of Scientists and Technologists (J.S.S.T.). This society is involved in the promotion of science and technology in the community through activities such as seminars, workshops and talks. The society also functions in an advisory capacity. Membership in this society can be obtained in either of three capacities:

(1) full membership;

(2) associate membership;

(3) student membership.

ii) The Institution of Engineering of Jamaica. The Institution of Engineers of Jamaica came into existence in 1966 as an independent body. Members represent every facet of the profession, e.g. Government, contracting, consulting and private organizations. This gives the institution a very broad background of training and experience. It is widely consulted for advice and planning.

One of the main objectives of this Institution is to make sure that its members will be accepted professionally anywhere in the world, hence, it is very strict about qualification for membership.

A few other science and technology societies exist under the umbrella of the Professional Societies of Jamaica.

Table 1

Some public sector/University
Research and Development Entities

Entity	Scientific disciplines
1. Institute of Jamaica	Botany, Zoology, Archeology
2. Geological Survey Department	Geology, Geochemistry, Hydrogeology
3. Crops and Soils Department (Ministry of Agriculture)	Agronomy, Chemistry, Plant Pathology, Entomology Nematology
4. Livestock Research Department	Veterinary Medicine, Animal Husbandry, Animal Nutrition
5. Fisheries Division	Marine and Fresh-water Biology (Ichthyology)
6. Banana Board Research Department	Agronomy, Pathology, Haematology, Biochemistry
7. Sugar Research Department - Sugar Cane (Mandeville)	Agronomy, Plant breeding, Plant Nutrition, Pathology, Plant Biochemistry
8. Sugar Research Department Factory Operations (CAST)	Chemistry, Sugar Technology Engineering
9. Forestry Department	Silviculture, Plant Pathology, Forestry
10. Food Technology Division Jamaica Industrial Development Corporation (JIDC)	Chemistry, Food Science, Food Technology
11. Bureau of Standards	Metrology, Physics, Chemistry, Microbiology, Food Science, Electrical Engineering, Materials Science, Technical and Standards Information
12. Storage and Infestation Division - Ministry of Industry and Commerce	Entomology, Botany (Bio-chemistry and Physiology), Plant Pathology
13. Coconut Industry Board	Botany/Genetics, Agronomy, Plant Physiology, Chemistry
14. Meteorological Service	Meteorology, Agronometeorology, Physics, Chemistry
15. Energy Division - Ministry of Mining and Energy	Chemistry, Physics, Engineering
16. National Resources Conservation Department	Ecology, Hydrology
17. Petroleum Corporation of Jamaica	Geochemistry, Geophysics
18. Jamaica Bauxite Institute	Chemistry, Chemical Engineering Mineralogy, Geochemistry
19. Government Chemist	Chemistry, Toxicology
20. Bacteriological and Pathological Laboratory	Bacteriology, Chemistry Pathology (Medical)
21. Mosquito Control and Research Laboratory	Entomology
22. Nutrition Division (Ministry of Health)	Nutrition, Dietetics
23. Environmental Control Division (Ministry of Health)	Medical, Biological
24. Tropical Metabolism Research	Clinical Nutrition
25. Caribbean Food and Nutrition Institute	Multidisciplinary
26. Botany Department (Research) UWI	Taxonomy, Plant Physiology, Plant Genetics
27. Zoology Department (UWI)	Taxonomy, Entomology, Physiology
28. Caribbean Agricultural Research and Development Institute	Agronomy, Plant Genetics, Pathology
29. Physics Department (UWI)	Physics, Mathematics, Seismology, Computer Science, Nuclear Physics
30. Department of Geology (UWI)	Chemistry, Nuclear Chemistry, Applied Chemistry
31. Department of Geology (UWI)	Stratigraphy and Paleontology, Petrology, Structural Geology
32. Department of Pharmacology (UWI)	Pharmacology
33. Biochemistry Department (UWI)	Medical Biochemistry
34. College of Arts, Science and Technology	Engineering
35. Scientific Research Council	Chemistry, Physics, Engineering, Food Science and Dietetics, Technical Information

Table 2

Government organizations willing to carry out contract research with the scientific research council

Organization	Type of Research Activity
Ministry of Agriculture - Livestock Division	1. Research in nitrogen fixation 2. Assistance with certain aspects of feed studies
- Plant Protection Division	1. Indexing of citrus virus - diseases in Jamaica and classification of virus - free budwood for distribution 2. Equipment testing and calibration 3. Development of suitable spraying equipment for use in different types of terrain 4. Research in apiculture 5. Research in herbicides 6. Research in kola nuts (medicinal properties)
- Crop Research Division	1. Research in pesticides 2. Research in castor bean oils and other derivatives
- Rural Physical Planning and Chemistry	1. Information and data for utilization in planning
- Forestry and Soil Conservation Division	1. Undertake specific research on forestry products 2. Evaluation of watershed management 3. Identification of wood-decaying fungi
- Fisheries Division	1. Process testing (e.g. canning) 2. Fish gear testing and design 3. The propagation of sea weeds 4. Laying of artificial reefs and study on effectiveness in increasing fish population
The Agricultural Development Corporation (ADC)	1. Research into urea/molasses feed for livestock 2. Local feeds from by-products 3. Improved pasture research - grass/legume mixes
Sugar Industry Research Institute	1. Development of fermentation/distillation technology for rum and alcohol production
The Coconut Industry Board	1. Disease analysis in coconuts 2. Data/Information collection
Jamaica National Investment Promotion (JNIP)	1. Assessment of Jamaica's capabilities in producing spirulina 2. The provision of analytical services
The Urban Development Corporation (UDC)	1. The development of local building materials 2. Conduction of field tests
Ministry of Industry and Commerce - Consumer Affairs and Metrication Division	1. Utilization of indigenous raw materials in product development 2. Data information
- Training and Industrial Property Division	1. Processing of application for patents
- Industry Division	1. Advisory services to the Ministry in relation to processes for the manufacturing of new products 2. Assistance with certain quality control problems
Ministry of Construction	1. R & D fostering the use and testing of indigenous materials in construction 2. Testing of locally produced cement, steel and aggregates 3. Research on road surfaces 4. The processing of applications for patents
Ministry of Youth and Community Development	1. The development of formulae and specifications involving the use of food additives 2. Improvement of the shelf-life of flour from local products 3. Research into the protein content of locally produced flour 4. Development of recipes from locally produced flour 5. Development of work on locally produced flour

Source: SRC

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

Organized scientific activity in Jamaica dates back to the establishment of a Botanical Department in 1773 and the gardens at Bath in the same year. This initiative, along with the establishment in 1873 of the Institute of Jamaica, of various departments of Government dealing primarily with agriculture and geology in the 1940's and 1950's, and the teaching of medicine and natural sciences in 1948 at the University of the West Indies, laid the foundation for the Science and Technology sector of the society.

The University of the West Indies (UWI) offers training in practically all aspects of science and technology (S & T) (10). The UWI has had an active research and development (R & D) programme, and the great bulk of Jamaica's scientific research is carried out by Departments and/or Units situated on the Mona Campus.

The College of Arts, Science and Technology (CAST), originally the Jamaica Institute of Technology, was established by Government in 1958. The College was originally designed to provide technicians and middle-management personnel. It provides training in computing, engineering, health and food sciences, and undertakes scientific research in various areas including food preservation, solar energy, sewerage treatment and building technology.

In Jamaica, today, there are roughly 35 organizations actively engaged in the carrying out of technical services and Research and Development. These organizations are mainly in the city of Kingston and there is little or no co-ordination among them as they compete with each other for scarce resources. The Appendix to the present report gives a summary picture of the nature of the main organizations engaged in scientific and technological activities in Jamaica.

The main areas of R & D activity in Jamaica are: Alternative Energy, Agro-industry, Building Materials, Industrial Fermentation, Crop Research with emphasis on pest and disease control, the development of technological testing facilities, and activities related to standards development (11).

3.2. Human Resources

The National Planning Agency's Manpower Survey has identified over 29,000 science and technology personnel in the island. The breakdown is as follows:

Table 3

1980 Estimates (NPA Manpower Survey)

Engineers and Engineering Technicians	2,645
Architect and Technical Assistant	700
Physical Scientists	970
Life Scientists	1,295
Health Diagnosing and Treating	5,320
Technical Occupations	18,550
Total S & T personnel	29,560

Output of high-level manpower, 1974 and 1981

Comparing the output of high-level science and technology manpower from departments responsible for tertiary training, the total output in the 1981 period was less than that in the 1974 period. This decline in output was the result of lower output in medical, dental and related areas of engineering and technology.

The medical, dental and related areas of training incorporated nurses, diagnostics radiographers, food and nutrition technicians, pharmacists, physiotherapists, dental auxiliary staff and others. The decline in this area was the result of low output from the areas of diagnostic radiography, food and nutrition technology and pharmacy.

In the Engineering and Technology area of training, overall, the number of engineers and engineering technicians trained has been on the decline.

The areas of Biological and Physical Sciences have, on the whole, experienced an increase in the numbers which have been trained.

The majority of emigrants from Jamaica in the 1970's went to the United States of America, and the professional and technical occupational group in 1979 accounted for 7.4% of the total number of emigrants in the United States of America.

Table 4

Output of high level manpower, 1974-1981

Areas of training	Output	
	1974	1981
Medical, Dental and Related	686	643
Engineering and Technology	251	225
Biological and Physical Sciences	103	141
Architecture and Surveying	59	68
Mathematics	7	-
Total	1,112	1,077

Source: Economic and Social Surveys of 1974 and 1981 (NPA)

Table 5

Registration of Jamaicans for first degrees, certificates and diplomas by faculty, 1979-80 and 1980-81

Faculty/Course	1979-80			1980-81		
	Full Time	Part Time	Total	Full Time	Part Time	Total
First Degree						
Agriculture	62	-	62	59	-	59
Arts and General Studies	625	309	934	607	331	938
Education	58	-	58	63	-	63
Engineering	163	-	163	149	-	149
Law	107	-	107	104	-	104
Medicine						
Pre-clinical	100	-	100	49	-	49
Clinical	162	-	162	206	-	206
Natural Sciences N1	184	104	288	201	-	201
Natural Sciences N2-N4	699	-	699	690	99	789
Social Sciences	475	96	571	481	111	592
Sub Total	2,635	509	3,144	2,609	541	3,150
Certificate						
Education	63	-	63	64	13	77
Social Work	40	-	40	37	-	37
Public Administration	25	-	25	29	-	29
Nursing Education/ Administration	23	-	23	13	-	13
Management Studies	-	137	137	-	129	129
Sub Total	151	137	228	143	142	285
Diploma						
Construction Management	-	-	-	11	1	2
Mass Communication	18	-	18	11	-	11
Community Health	12	-	12	12	11	12
Public Administration	21	-	21	5	-	5
Management Studies	2	222	224	-	156	156
Education	28	63	91	25	38	63
Library Studies	3	-	3	4	-	4
Engineering	-	-	-	-	-	-
Food Technology	5	-	5	-	-	-
Applied Physics	-	8	8	-	8	8
Public Health	2	-	2	-	-	-
Sugar Cane Processing	6	-	6	3	-	3
Specialized Medicine	10	-	10	3	-	3
Hotel Management	-	-	-	2	-	2
Sub Total	107	293	400	66	203	269
GRAND TOTAL	2,893	939	3,832	2,818	886	3,704

Source: UWI

Table 6

Registration for courses at the
College of Arts, Science and Technology

Department	1979-80				1980-81			
	Full Time	Part Time	Evng.	Total	Full Time	Part Time	Evng.	Total
Building	289	98	-	387	275	100	-	375
Commerce	437	399	596	1,432	509	424	549	1,482
Computing	5	23	-	28	10	35	-	46
Engineering	299	316	85	700	287	288	85	660
Inst. Mgmnt.	112	67	56	235	128	90	63	281
Science	192	-	53	245	171	-	43	214
Technical	292	25	-	317	257	32	-	289
Total	1,626	928	720	3,344	1,637	970	740	3,347

Source: Economic and Social Survey Jamaica - 1981

An examination of the above table shows that the overall enrolment for courses pertaining to science and technology has dropped. For instance, the number registered for courses at the UWI in Agriculture, and in the First Natural Science Courses (N.I.) fell between the 1979-80 and the 1980-81 academic year. The Diploma course in Food Technology did not witness any new entrants in 1980-81; the Diploma courses in Sugar Cane Processing, Specialized Medicine and Public Health were also plagued with a decline in the number of registrants for courses.

3.3. Financial resources

Table 7

Allocation to research and development (R & D)
according to probable field of application 1971, 1973 and 1981

Field of Application	1971	1973	1980-81
Agriculture	Breakdown of this Unavailable	3,876,870 (*)	29,100,000 (+)
Mineral and Natural Resources		3,475,140	2,500,000 (+)
Health and Nutrition		14,021,180	2,700,000 (+)
Energy		75,910	700,000 (+)
Manufacturing		7,504,020	3,411,481 (±)
Miscellaneous		17,253,620	14,700,000 (+)

(*) Source: Economic and Social Survey - 1974
(+) Source: Estimates of Expenditure - Government of Jamaica Year Ending March 31,1982
(±) Source: 1981 Science and Technology Survey. Base year: 1980

Expenditure in agriculture has increased more than seven times since the last survey was undertaken. This sector, as well as energy, have been the greatest recipients of increases in allocations to R & D, and reflects the Government's priorities.

Table 8

Foreign exchange payments for royalties, rental, commissions and fees: 1971, 1974 and 1981
Millions of J Dollars

Year	Royalties and Rentals	Commissions and Fees	Total
1971	3.666	27.3	30.966
1974	8.246	39.810	48.058
1981	6.0	20.3	26.3

Source: Economic and Social Survey - 1974 and 1981. Base Year: 1980

Inspection of the Table shows that total payments for acquiring overseas technology have gone down since the last science and technology survey was done. Whether this reduction is the result of a number of government regulations, which must now be satisfied before the importation of foreign technology takes place, or of a rise in the level of local innovative activity, is impossible to say without further study.

3.4. Informational resources

There are approximately 200 specialized libraries and collections in Jamaica, and about 100 of them are in the area of science and technology.

A "Plan for a National Documentation Information and Library System for Jamaica" was addressed by the National Council on Libraries, Archives and Documentation Services (NACOLADS) in 1977. This plan was accepted by the Government and a National System was proposed for Jamaica.

Previous to this Plan, the situation was one of inadequate staffing and scant collections. There were duplications of holdings, a lack of co-ordination and a number of gaps.

An important component of the Plan was the establishment of the Science and Technical Information Network (STIN). The Scientific Research Council (SRC) was designated the focal point for STIN, and a Union Catalogue of the science and technology information holdings in the island is to be maintained there.

In keeping with the recommendations of the Plan, NACOLADS established a standing Committee with the following terms of reference:

(i) to organize the co-ordination of libraries in science and technology into an effective network so as to facilitate access to Science and Technology Information as needed;

(ii) to encourage the application of standards in the publication of science and technology information and to promote the dissemination of such information;

(iii) to promote the education of information handlers and users;

(iv) to promote the improvement of bibliographic and documentation services and to encourage the development and eventual automation of data banks.

Regular meetings are held and network members are currently engaged in the compilation of a National Union List of Serials patterned on London University Union List of Serials.

3.5. Surveying of the science and technology potential

The 1971 and 1974 Science and Technology Surveys were undertaken to assess the state of Jamaica's science and technology capacity in terms of:

(a) Human resources

(b) Financial resources

(c) Institutional resources

(d) Scientific activities

The conduct of the surveys and the analysis of the data were attended by a number of shortcomings such as:

(a) evidence of significant bias in the reporting of data, particularly regarding financial data;

(b) a number of omissions on the part of organizations covered by the surveys;

(c) inaccuracy of some of the information.

In an effort to establish some degree of continuity with the former surveys, the 1981 Science and Technology Survey has up-dated information in the former surveys. All three surveys have been joint undertakings of the Scientific Research Council, the Department of Scientific Affairs of the Organization of American States (OAS), and the National Planning Agency (NPA).

New aspects of the 1981 survey:

The 1981 survey sought to include not only institutions involved in R & D but other areas as well.

New aspects addressed in the 1981 Science and Technology survey were:

1. The analysis of the Institutions' technological capabilities;

2. components, needs, and problems of the productive enterprises and government organizations responsible for investment projects;
3. the technological features of the specialized sector in the fabrication of tools and spare parts.

Directories, with particular application in the activities of the Scientific and Technological Information Division, are in the process of being compiled. These include:

Skill Bank - listing of expertise in science and technology

Inventory of science and technology equipment

Directory of R & D Projects

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

4.1.1. An Energy Division at the Ministry of Mining was established a few years ago to help with the energy crisis.

4.1.2. Directories, with particular application in the field of science and technology, have been compiled or identified for compilation.

These include:

- a Skill Bank listing the science and technology expertise in the island;
- an inventory of science and technology equipment in the island;
- a list of available equipment in the science and technology information network (STIN);
- a Jamaican Packaging Directory.

4.1.3. In 1976 the Jamaica Bauxite Institute (JBI) was established in order to enlarge the government's role in the exploitation of the country's most important mineral resource, bauxite.

4.1.4. In 1979-81, with the help of the United Nations Industrial Development Organization (UNIDO), the Packaging Research, Testing, Development and Information Centre was established as a new part of the Jamaica Bureau of Standards.

4.1.5. A Ministry responsible for the Environment, Science and Technology has recently been created. The Ministry is in the process of finalizing the draft of the National Science and Technology Policy.

4.2. Achievements and problems

"The Science and Technology system that has evolved in Jamaica has been developed to serve the interests of relatively small minority groups starting with the traditional professions and certain traditional agricultural sectors" (13)

Encouragement needs to be given to the fostering of more indigenous R & D, especially within the private sector. This could be in the form of tax incentives and subsidies. At the moment the private sector is not as involved as it might be in either promoting or utilizing local R & D efforts.

The importance of technical manpower development and the promotion of scientific consciousness cannot be over-emphasized. Researchers, technologists, technicians and support staff are the manpower components of the science and technology system and consequently the science and technology system should be such that its manpower is provided with proper incentives to remain in the field, rather than be enticed away by the prerequisite offered by the Commercial World. Jamaica has lost quite a number of potentially good science and technology personnel as a result of employment outside their area of training and also as a consequence of migration (the "brain-drain").

"Jamaica's energy research programme has concerned itself mainly with attempting to discover, develop and exploit sources of energy alternative to oil. Scientific investigation has been going on in the area of solar energy, biogas, and to a lesser extent, wind and water power. The Energy Division of the Ministry of Mining and Energy, the SRC, the Physics Department - UWI, and CAST have been involved in these investigacions" (14).

"The efforts at improving the nation's scientific and technological capabilities are on-going. Research and development work has created some new and alternative technologies. However, the greater contribution at present has been the creation of a reservoir of scientific and technical knowledge and its application in the various fields, especially agriculture" (15).

4.3. Objectives and priorities

Interest in a National Science and Technology Policy has come about as a result of the need to (1) satisfy the requirements of sustained growth and (2) furnish firm guidelines so as to effectively integrate, co-ordinate, and promote Research and Development.

Approval of the National Science Policy by Parliament is now eagerly awaited, since the Policy is seen as essential to the country's development, based on industrialization utilizing indigenous raw materials.

4.4. International scientific and technological co-operation

Jamaica is committed to a policy of regional and international co-operation and enjoys active co-operative relationships with the following agencies or organizations:

- Caribbean Council for Science and Technology (CCST)
- World Intellectual Property Organization (WIPO)
- Commonwealth Science Council (CSC)
- International Foundation for Science (IFS)
- Technology and Energy Unit (TEU)
- Caribbean Development Bank (CDB)
- Caribbean Committee for Science and Technology Co-ordination
- Caribbean Alternate Energy Programme
- United Nations Agencies
- Organization of American States Agencies
- Inter-American Development Bank
- Delegation of the Commission of the European Communities
- International Bauxite Association

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APPENDIX

OVERVIEW OF ORGANIZATIONS ENGAGED IN SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES IN JAMAICA

Organization	Purpose	Scientific Discipline	Head of Organization	Address
1. Ministry of Agriculture	The main purpose is to plan, promote, develop and control agricultural production and rural development programmes within the country.		Permanente Secretary, who is responsible to the Ministry.	Hope Gardens, Kingston 6 Jamaica, W.I.
1.(a) Agricultural *Planning Unit*	(a) To formulate agricultural development policies, plans, strategies and programmes consistent with overall national plans. (b) To provide the Ministry of Agriculture and various agro-industrial and Government planning agencies, with agro-economic and socio-economic data and performance evaluation of agricultural programmes and projects.		Director reports to Permanent Secretary	Hope Gardens, Kingston 6 Jamaica, W.I.
1.(b) Marketing and Agro-Industrial Development Division	To promote the production and marketing of Agricultural products and to administer the Agricultural Produce law of 1953.		Director	Hope Gardens, Kingston 6 Jamaica, W.I.
1.(c) Plant Production Division	To propagate and multiply improved varieties of planting materials for distribution to farmers			
1.(d) Livestock Development Division	(a) To improve the standard of livestock throughout the island; (b) To increase significantly the production of milk; (c) To render the island self-sufficient in livestock products.	Veterinary Medicine, Animal Husbandry, Animal Nutrition,etc.	Director of Livestock Development	
1.(e) Veterinary Services Division	To protect the health of livestock within the island by planning and implementing programmes to prevent and control diseases affecting livestock.	Veterinary Medicine	Director	

Appendix (Cont.)

Organization	Purpose	Scientific Discipline	Head of Organization	Address
1.(f) Fisheries Division	This division is responsible for carrying out marine and fresh water research on fish life.	Marine and fresch water biology (Ichthyology)	Director	
1.(g) Agricultural Engineering Division	To increase crop production and to improve the infrastructure and structures on farms.	Soil conservation and drainage	Chief Engineer	
1.(h) Forestry Department	The main purposes of this department is to manage the existing and potential forest plantation of the island, and to conserve the natural forest resource of the island.	Soil culture, plant pathology, forest	Director	
1.(i) Crops and Soils	The main purpose of this department is to determine the best crop/soil mix throughout the island.	Agronomy, Chemistry, Plant Pathology, Entomology, Nematology		
2. Institute of Jamaica	A cultural organization to further the development of art, literature and science.	Botany, Zoology, Archaeology	Director	East Street, Kingston
3. Geological Survey Department	To investigate the geology of the country and the deposits of economic minerals e.g. marble, limestone.	Geology, geochemistry, hydrogeology	Director	Hope Gardens, Kingston 6
4. Banana Company of Jamaica	Deals with the general development of the banana industry including research, packaging and marketing.	Agronomy, pathology, haematology, biochemistry	Director	East Street, Kingston 4
5. Forestry Industry Development Corporation (FIDCO)	Stimulates, facilitates and undertakes the development of industry in the island. The JIDC services new industries and assists the expansion of existing enterprises.			4 Winchester Road, Kingston 10

Appendix (Cont.)

Organization	Purpose	Scientific Discipline	Head of Organization	Address
6. Jamaica Industrial Development Corporation (JIDC)	Stimulates, facilitates and undertakes the development of industry in the island. The JIDC services new industries and assists the expansion of existing enterprises.	Food science, garment and leather.		4 Winchester Road, Kingston 10
6.(a) Food Technology Department (JIDC)	To develop formulations utilizing indigenous foods and to provide consultancy to agro-industrial operations.	Chemistry, Food Science and Food Technology		4 Winchester Road, Kingston 10
7. Jamaica Bureau of Standards	(i) To promote and encourage the maintenance of standardization in relation to commodities, processes and practices (ii) To promote research in relation to specifications and to provide for examination and testing of commodities, processes and practices. (iii) To provide for the examination, testing and calibration of instruments, appliances and apparatus in relation to their accuracy.	Metrology, Physics, Chemistry, Microbiology, Food Science, Electrical Engineering, Material Science, Technical and Standards.	Director	6 Winchester Road Kingston 10
8. Coconut Industry Board	Promotes the interest and efficiency of the industry, encourages the production of coconuts and regulates the purchase, sale and exportation of coconuts.	Botany/Genetics, Agronomy Plant Physiology, chemistry		18 Waterloo Road Kingston 10
9. Cocoa Industry Board	Promotes the interest and efficiency of industry. Secures the most favourable arrangements for the purchase, handling, marketing, sales, importation and exportation of cocoa.		Director	Marcus Garvey Drive Kingston 15
10. Coffee Industry Board	Regulates the growing, processing, purchase, sales and export of coffee and encourages the development of the industry.			Marcus Garvey Drive Kingston 15

Appendix (Cont.)

Organization	Purpose	Scientific Discipline	Head of Organization	Address
11. Scientific Research Council	Undertakes, fosters and co-ordinates scientific research in Jamaica and encourages the application of the results of such research to the exploitation and development of the resources of Jamaica.	Chemistry, Physics, Engineering, Food Sciences and Dietetics, Technical Information	Executive Director	Hope Gardens, P.O. Box 350 Kingston 6
12. Jamaica Bauxite Institute	(i) To monitor the local bauxite industry so that all revenues due under the Bauxite Production levy are paid promptly. (ii) To evaluate Jamaica's bauxite ore reserves, qualitatively and quantitatively. (iii) To look into the management of bauxite lands before mining. (iv) To carry out research and development related to the island's bauxite industry. (v) To prepare all recommendations required in negotiating with bauxite alumina operations and at meetings of the International Bauxite Association.	Chemistry, Chemical Engineering, Mineralogy, Chemistry.		
13. Petroleum Corporation of Jamaica	Explores, develops and manages the resources of petroleum in Jamaica.	Geochemistry, Chemical Engineering, Geophysics		
14. Botany Department UWI	Involved in teaching and research at the tertiary level.	Taxonomy, Plant Physiology	Head of Department	UWI, Mona Kingston 7
15. Zoology Department UWI	As above	Taxonomy, Entomology, Physiology	As above	As above
16. Physics Department UWI	As above	Physics, Mathematics, Seismology, Computer Science, Nuclear Physics	As above	As above
17. Chemistry Department UWI	As above	Chemistry, Nuclear Chemistry, Applied Chemistry		As above

Appendix (Cont.)

Organization	Purpose	Scientific Discipline	Head of Organization	Address
18. Geology Department UWI	As above	Stratigraphy and Paleontology Petrology, Structural Geology		As above
19. Biochemistry Department UWI	Involved in teaching and research at the tertiary level.	Medical Biochemistry		UWI, Mona Kingston 7
20. Pharmacology Department UWI	As above	Pharmacology		As above
21. College of Arts, Science and Technology	Involved in technical education beyond the secondary level	Engineering, Building, Pharmacy, Laboratory Technology, Chemical Technology, Food Science, Computer Studies	Principal	Old Hope Road Kingston 6
22. Government Chemistry Department	Advises the Government on matters relating to Chemistry. It has statutory, regulatory and advisory functions.	Chemistry, Toxicology	Government Chemist	Hope Gardens Kingston 6
23. Storage and Prevention Office	Concerned with storage of infestible commodities, grains, cereals etc., and the prevention of infestation in those areas where commodities are stored, e.g. Government warehouses. It also assists private persons in an advisory capacity.	Entomology, Botany (Biochemistry and Physiology) Plant Pathology	Chief Food Storage Officer	Gordon Town Board

SAINT LUCIA

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

Like all the Windward Islands and many others in the Caribbean chain, St. Lucia is volcanic in origin, with a central mountain spine which divides the island longitudinally into east and west. St. Lucia lies south of the French island of Martinique and north-east of independent St. Vincent. The highest peak is Morne Gimie (959 m) but the twin volcanic cones, Gros Piton (798 m) and Petit Piton (736 m) are St. Lucia's most recognizable geographical features. Though mountainous, the island's rivers have only limited hydro-electric development potential. However a geothermal source in the south western area of Soufriere may prove suitable for power generation. The island has an area of 616 km^2. Of St. Lucia's 125,000 inhabitants (1983) approximately 45% live in the commercial and administrative capital, Castries.

1.2. Socio-cultural and economic setting

St. Lucia's population is predominantely negro, of African descent, with approximately 20% accounted for by persons of East Indian, European and Syrian lineage. The predominant religion is Roman Catholicism. The official language is English and the majority of residents also speak a French Antillean Creole intercomprehensible with those of Haiti and the French regional departments, Mauritius and the Seychelles.

Agricultural output contributed 14% to GDP in 1982 at constant factor cost as compared with the previous year's contribution of 13%.

Manufacturing activity in St. Lucia consists mainly of the processing of food and beverages, a garment and textile industry, and the production of electrical products, furniture, chemicals and cardboard boxes. Manufacturing accounted for 11.5% of GDP in 1982 and has an average rate of growth of just under 16% per annum. Up to 1980 the Construction industry was the fastest growing sector of the economy but has slowed somewhat given the liquidity constraints experienced in the financial sector. Tourism is a major foreign exchange earning industry and receipts grew by 3% or $ 3 million in 1982 (1).

1.3. Development scene

Preliminary estimates show that there was only marginal economic growth of approximately 1% in the economy for 1982 as compared with a 3.2% increase recorded for 1981. Among factors contributing to this domestic economic stagnation are the international economic recession and reduced earnings from the island's major export commodities. Banana export prices have, however, risen significantly in 1983 and St. Lucia's export performance is now the most impressive of the four Windward producers. A 20% depreciation in the value of the Pound Sterling against the US dollar-tied East Caribbean Currency somewhat depreciates this gain and emphasizes the need for further improvements in quality and quantity of fruit available for export.

Inflation currently runs at approximately 6% p.a. and government continues to aim at stabilizing wages and prices, while simultaneously boosting productivity and employment. St. Lucia faces problems characteristic of developing nations, which include high unemployment and the related urban drift. It is important therefore to develop social services and economic activity in rural areas given existing financial constraints. St. Lucia depends entirely on imported fuel for its commercial energy needs.

Constitutionally, St. Lucia is a parliamentary democracy, with an elected legislative presided over by the Speaker of the House. The Governor-General is the Queen's representative and Head of State, but the real power is in the Government headed by a Prime Minister.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1. Development policy framework

Major objectives of the central administration include the encouragement of private investment, both domestic and foreign, especially in the productive sector. Improvements in the local investment climate and prospects of global economic recovery augur well for these objectives. Improvements in infrastructure are required and major projects include: the construction of a dam and storage reservoir (U$S 15 million); the realignment and improvement of the West Coast Road (U$S 10 million); an industrial free-zone (U$S 25 million); development of a geothermal resource for power generation (U$S 6 million); and an agricultural structural adjustment project (U$S 8 million).

2.2. Development policy and science and technology policy

It is recognized that improvements in land tenure policy, availability of credit and extension services will promote agricultural output and these are currently under review. Similarly, the government of St. Lucia is in the process of formulating a five-year National Development Plan, the preparation, implementation and monitoring of which are the responsibilities of the Central Planning Unit within the recently restructured Ministry of Finance and Planning. The Central Planning Unit is also the primary centre for the formulation, articulation and implementation of government policy and programmes in Energy and Science and Technology.

2.3. Policy-making machinery for science and technology

The Energy, Science and Technology Section of the Central Planning Unit has only recently been created and provisions for equipping and staffing the Unit have not been fully realized. Technical assistance from regional organizations such as the OAS and the Organization of Eastern Caribbean States (OECS), CARICOM and the Caribbean Development Bank continue to augment the resources of this Section.

The degree of formalization of St. Lucia's science and technology policy is thus limited and efforts have only recently materialized to redress this deficiency. This is due mainly to Government's limited financial resources and the need to prioritize developmental objectives and projects into more urgent and less urgent categories.

As national participation in regional and international science and technology initiatives increases, St. Lucia'spolicy nevertheless becomes increasingly focused. Similarly, through joint venture projects the range of resources at Government's disposal widens and becomes more accessible.

St. Lucia's National Appropriate Technology and Energy Council is a recently formed non-governmental agency consisting largely of educators and technicians from related sectors. Its major achievement to date is the mounting of an Appropriate Technology Demonstration Exhibition. Though the Council is not responsible for science and technology policy formulation it may influence government policy through representation of its own policy and articulation of its major concerns regarding Agriculture, Information, Education, Energy and Environmental issues.

Since no definitive government policy outlines the role to be played in science and technology policy making, the Central Planning Unit, where applicable, liaises and confers freely with the private sector, the academic community, professional associations and technicians as necessitated by mutual involvement in specific programmes.

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

An inventory of institutions involved in scientific and technological activity is currently being undertaken by the Central Planning Unit as the local focal point of a regional project to assess the science and technology capability of individual states. This project is in its initial stages and information is only just being analysed at the secretariat of the Caribbean Council for Science and Technology (CCST) in Trinidad and Tobago.

The following classification of institutions is based on preliminary data:

1. Caribbean Agricultural Research and Development Institute (CARDI)

Services: agricultural research in conjunction with Ministries and other national institutions; provision of specialist services from a pool of scientists to assist the government and other institutions.

Objectives: support of agricultural research and development needs.

Research activity: small farming systems research and development; back-up and field station research; on-farm research; surveys.

2. Produce Chemist Laboratory - Union Agricultural Station

Services: operation of food processing pilot plant; chemical analysis of water, food stuffs, animal feed; extension and technical assistance service to local agro-projects; provision of information for agro-industry and related activities.

Objectives: assessment of processing and utilization potential of local agricultural produce; identification of raw material for commercial processing; establishment and maintenance of quality assurance scheme for food processing.

Research activity: new methods and techniques for food processing; nutritional analysis.

3. University of the West Indies Primary Health Care Centre

Services: complete primary and secondary level health care for target community; training of undergraduates and post-graduates of regional medical school; production of educational material for trained health workers; continuing education, health science and operational research.

Objectives: undergraduate and post-graduate training; innovative research in primary health care.

Research activity: effects of selective chemotherapy against trichuviasis; epidemiological aspects of toxocariasis; control implications of the population dynamics of trichuviasis; morbidity of whipworm and roundworm; infant death distribution; operational research; educational research; prenatal and postnatal growth.

4. Materials Laboratory - Ministry of Communications and Works

Services: soil testing and sampling; provision of data on new and existing construction related materials.

Objectives: quality and standards control in construction of roads, air fields, buildings.

Research activity: poor water pressure conditions in road cut slopes; physical and chemical testing of properties of materials (e.g. Dacite and Andesite punice); determining load bearing capacities, soil types; Ph values; etc.

5. Windward Islands Banana Research Centre - St. Lucia (Agricultural research)

6. Agro Industries Ltd. (commercial agro-processing development)

7. National Research and Development Foundation (General)

8. Youth Development Agro-Processing Station - (Agricultural research)

3.2. Human resources

An assessment of the current state and trends of human resources development in science and technology is the second phase of the assessment project mentioned above. As such, quantitative data is not currently available. Since the industrial base in St. Lucia is relatively small, the scope for highly trained personnel in science and technology is as yet limited. Nevertheless, St Lucia continues its financial support of human resource development in this field largely through the University of the West Indies (UWI) which is the major training centre within the region. Similarly, the government continues to absorb graduates into the civil service where possible creating posts to avail itself of new skills. Government recognizes the need to absorb such persons into various sectors of the economy and thus makes every effort to redress the effects of the "brain drain" which severely affect the cadre of locally available science and technology personnel. St. Lucia continues to lose trained technicians to higher paying jobs overseas, but a determined effort is made to recruit nationals which are residing abroad, through High Commissions in Canada, New York and London.

3.3. Financial resources

Government budgetary practices do not make specific provisions for science and technology-related activity except as may constitute contributions to the science faculty of the University of the West Indies or the Caribbean Council for Science and Technology. Other government agencies may receive funding through relevant Ministries such as the Ministry of Agriculture or Education, and the Central Planning Unit through the Ministry of Finance and Planning's budgetary allocations.

3.4. Information resources

Bibliographical data concerning disciplines in science and technology is generally available through the Extra Mural Department of UWI. In addition more specific information is available through the Technology and Energy Unit of the Caribbean Development Bank, and through such documentation as the *CARISPLAN Abstracts* circulated by the Caribbean Development and Co-operation Committee under the auspices of which the Caribbean Council for Science and Technology was established. There is, however, no centralized government agency to perform these tasks.

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

A series of major developments which have originated within St. Lucia, and others which have come as part of the general social and economic evolution of the region, will continue to have major catalytic effects upon the focus of research, and in increasing science and technology potential and conditions of application.

Major innovations have occurred in the agricultural sector where the need to maintain qualitative and quantitative standards to secure preferential market share, continue to direct and intensify research in methods of banana production. Similarly,

the need to generate increased economic returns from agriculture has stimulated research in such areas as inter-cropping, use of pesticides, soil conservation, natural fertilizers, by-product development especially in banana and coconut fibres, briquetting, etc. Major thrusts to accelerate agro-processing as an economic alternative to food importation and to capitalize on surplus production capacity have also directed research and development activities. Programmes to ensure the commercialization of science and technology research will now affect the application of findings and the dissemination of related information.

Unstable energy prices and the finite nature of traditional non-renewable energy resources have accelerated local research aimed at reducing St. Lucia's dependence on imported fuel for commercial energy generation. Increases in oil prices have also contributed to the economic feasibility of developing local geothermal resources. Research into harnessing wind, biomass and solar energies and fiscal incentives for energy conservation have also been effected as a direct result.

The deepening and widening of the Caribbean Regional Integration Movement has given rise to higher levels of functional co-operation and through such organizations as the Caribbean Development Bank, CARICOM, University of the West Indies, CCST and the Organization of Eastern Caribbean States (OECS) common policies on science and technology, energy and the application of research have been enunciated, and have given rise to beneficial regional projects in science and technology.

Through higher education levels island-wide and the willingness of science-oriented nationals to return to St. Lucia to contribute to development, increases in the level of technological sophistication within the state have brought scientific and technological innovations to everyday life both at the personal and community levels. This has fostered the introduction and acceptance of electronic equipment of the computer age for communications, education, manufacturing and industry, agriculture, biological research, and finance and planning.

In this age of conservation of resources, St. Lucia has also initiated research into the physical and chemical properties of locally occurring non-metallic minerals for development and utilization within the construction industry. These include pumice, clay and potentially, silica.

4.2. Achievements and problems

The major problems affecting the development of the science and technology potential of St. Lucia are:

- high economic cost of education at graduate and post-graduate levels as compared with average incomes;
- resultant constraints on human resource development, and inadequate knowledge of regionally available human resources;
- the small-scale operations of public and private agencies which make it difficult to justify expenditure on infrastructure, high cost technology and exclusive research areas;

- lack of definitive policy on science and technology;
- inadequate information systems, particularly at the national level, which preclude access to regional and internationally available data bases.

4.3. Objectives and priorities

Arising from these constraints a set of priorities have been generally identified as the foundation of national science and technology policy. These aim at:

(i) developing effective systems for providing direct access to information contained in external data bases and for ensuring access to technological options;

(ii) establishing mechanisms to ensure that information gathered is available to inform research and development activities;

(iii) developing human resources required to man the technological information systems and to sensitize private and public sector officials to information and information systems;

(iv) encouraging a network of technological institutions in the region to share information and develop expertise;

(v) intensifying research and development directed to exploitation of natural resources, in particular relating to agro-industry, new and renewable sources of energy, and information systems;

(vi) linking as closely as possible research and development activity to the production sector to ensure the commercialization of the results of R & D.

4.4. International scientific and technological co-operation

St. Lucia will work on a collaborative basis with organizations regionally or internationally engaged in the peaceful pursuit of common objectives in the areas of science and technology. The country is currently involved with a number of functional organizations to this effect. Major areas of co-operation include:

- assessment of national science and technology capabilities;
- establishment of science and technology journal;
- preparation and exchange of audio-visual material for education in science and technology;
- energy crops and regional food supplies;
- conservation and exchange of germplasm of crop plants;
- development of agro-industries and employment opportunities particularly in rural communities;
- assessment of newly emerging technologies;
- formulation of science and technology policy for the Caribbean.

This outline represents one in a series of introductory steps toward the formulation of a definitive and comprehensive national policy on science and technology.

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SURINAME

GENERAL REMARKS

Purpose of this section

This section is an initial outline of the state of science and technology in Suriname.

Various problems encountered in the day-to-day operations in the field of science and technology are also described. These are probably more or less the same in many other developing countries, but their presentation in this paper is still considered worthwhile, amongst other things to provoke discussion.

State of technology in Suriname

In Suriname, technology:

a. is rather well developed in the field of handicraft such as woodcarving, working with clay and stones, electric welding, maintenance and repair,etc;

b. has a modest to fair beginning in the less sophisticated industrial stages, especially in the metal-construction sector (for instance, riverboats are being built and repaired), and the agro-industries. Moreover, many factories import raw materials to manufacture final products, such as plastic and rubber articles, cement, shoes, clothing, etc.;

c. is generally under-developed at the infrastructural level. However, plans to improve matters are definitely under way: as an example mention might be made of the establishment of a "National Science and Technology Council", which has already been approved by the Government.

In the field of agriculture and fisheries the following technological activities can be mentioned:

Rice: Suriname is internationally known for its rice cultivation programmes, based on 30 years of scientific experiments and experience.

Palm-oil: about 10 years ago a large-scale oilpalm growing project was implemented. At present there is an oil-refining factory which produces edible oils. The factory supplies the local market.

Rum/Beer: rum is processed and blended from a by-product (molasses) of cane sugar. Standard quality beer is produced for local consumption using rice as raw material.

Food processing: some small to medium-sized private and semi-governmental food and fruit processing industries produce drinks, jams and preserved foodstuffs and vegetables, mainly for the domestic market.

Milk: pasteurized milk and some dairy products (as yoghurt and custard) are produced daily.

Shrimp/fish: shrimp and fish processing products find their way to the export market.

Meat: in the private sector meat-processing activities have recently been started on a modest scale.

With respect to industrial and general activities in the science and technology field, the following might serve as an outline:

- Engineering and consultancy:

There are sufficient private engineering and consultancy bureaus for standard civil works and constructions, architecture and electrical or air-conditioning installations.

- Building, constructions, wood, etc.:
  - One large-scale and many small sawmills process wood;plywood, chipboard and hardboard are also produced.
  - Metal-constructions for boats, buildings, furniture, etc., are made to meet much of the local demand.
  - Small to medium-sized factories also manufacture:
    - Cement, cement-stones, bricks, ceramic articles;
    - plastic conduits;
    - paint;
    - glass-shutters, windows, doors, etc.

- Consumption goods, e.g.:
  - Soft drinks, margarine, toothpaste, soap, detergents, cleansers.
  - Peanut butter,honey, flour.
  - Pharmaceutical products.
  - Clothing, shoes, leather articles.
  - Cigars and cigarettes.

- Cars: the activities include:
  - car-assembling;
  - manufacture/assemble batteries and radiators;
  - recapping of tires;
  - general repairs;

- Miscellaneous:
  - modern printing presses are used;
  - many plastic articles are made locally;
  - carton;
  - matresses;

- cattle-feed;
- optical lenses, mostly for spectacles, are cut.

Bauxite and mining

The two (multi-national) bauxite-mining companies use their sophisticated technological systems to produce alumina and aluminium.

Suriname has an old tradition in the mining of gold, but production has fallen drastically during the past decades.

Mining possibilities of other mineral deposits are being studied.

The rapid implementation of modern electronic equipment during the last 5 to 10 years is worth mentioning. To give some examples:

- Suriname now has two earth stations (one for telephone and telegraph purposes, one for reception only of TV signals)(Television in Suriname is in colour).
- This year (1983) computer controlled (analogue) telephone exchanges were put into operation to replace older mechanical systems.
- Apart from IBM system 360 and system 34 computers, many small (business and personal) computers are in use.
- Video-tape recorders for private use are becoming rather common.

Problems in the day-to-day operation

Generally speaking, science and technology, is used in any country for the development and improvement of production in several fields and also in the Services sector. In the field of production, four stages can in general be recognized, namely:

Stage 1 - The drawing up of basic plans (policy-making and programming).

Stage 2 - Various studies to establish the feasibility and requirements (manpower, capital, land, infrastructure, etc.).

Stage 3 - Pilot plants and/or small-scale production to test the validity of the results from the various studies.

Stage 4 - Actual production on a commercial scale.

Suriname has its own capacity and know-how to cover Stage 1, and in many instances also Stage 2. Many good, sometimes excellent, plans to increase productivity or enhance development in general, are generated. However, these plans often do not reach Stages 3 and/or 4.

If one tries to find the reasons why so many plans lead to relatively so little increase in productivity, two kinds of obstacles have to be considered:

on the one hand: obstacles generated within the country;

on the other: obstacles created by the policies of other, mainly developed, countries.

In what follows, several of the internal obstacles will be studied more closely. It should however, be borne in mind that the criteria of developed countries are applied. In comparison with other developing countries, the picture in Suriname, in the opinion of the authors of this report, certainly looks better; in some instances even quite good.

As far as the external obstacles are concerned, the authors agree with criticism regarding the negative role of developed countries towards the development of the Third World. However, since there is a vast literature on that aspect, further mention of these obstacles seems unnecessary.

With respect to the internal obstacles, the following might be mentioned:

1) Suriname still has an underdeveloped structure in the field of science and technology. This is because science and technology is not perceived as a system with interrelated aspects, which has to be managed as such. Too much is left to depend on *ad hoc* drive, action, decisions, etc., of individuals who happen to be "on the spot" when a problem has to be solved.

   Since the routing of information is very often not well-defined, this information easily comes to the wrong "desk", and then of course is not used to its full potential. The Government is aware of this problem and the need to improve matters in this field. Plans for a "National Science and Technology Council" have been approved. Furthermore, in 1981 a "Centre for Industrial and Export Promotion" (INDEX) was established to assist potential entrepreneurs in solving the problems of setting up a new industrial plant. Although INDEX generally does not work in the actual science and technology field, its activities do help to bring together the proper circumstances for industrial development.

2) The storage and retrieval of (basic) information is not well organized. This seriously hampers many studies on feasibility, etc. Moreover, existing reports are often either not known, or cannot be retrieved. This causes the duplication, even triplication, of work already done.

   The "General Statistics Office" (ABS) is doing everything possible to improve this situation. An effort to gather missing information is made on a continuous basis, within the Office's ability, and a good working relationship is maintained with other bureaus to prevent the duplication of work in the field of data-collecting, and to assist in obtaining data.

3) Suriname has a (very) small domestic market with proportionally modest purchasing power. This impedes the setting up of many factories because their output, based on the available machinery, would either flood the domestic market or be too small to be cost-effective. (The opportunities for export are generally scarce).

   In many cases, neither the expertise nor the capital is available to develop other machinery that might enable an efficient production at a much lower output rate. Besides, such machinery is not abundantly available on the market.

The domestic market is not only small because of the small population, but the consumers have the tendency to prefer the imported over the locally produced articles as well. They either lack confidence in their own Surinamese capabilities, or perhaps feel that more "prestige" is endowed when buying foreign-made goods. The Government, however, is embarking on a programme to stimulate both national production and the consumption of locally produced goods.

4) Another problem in Suriname, as compared with some of the other Caribbean countries, is the relatively high wages. This creates an imbalance between the employed and the unemployed (with hardly any income), but also reduces the possibilities for entering the export market.

5) Besides the obstacles already mentioned, all developing countries lack capital and higher-educated manpower.

These internal obstacles, to a large extent, are a result of the market policies pursued by the developed countries, and of the passively tolerated or actively encouraged "brain-drain" from developing to developed countries.

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

Suriname is located between 2° and 6° W latitude and 54° and 58° W longitude on the northern coast of South America. It borders on the Atlantic Ocean to the north, on Guyana to the west, on French Guiana to the east and on Brazil to the south. It has a territory of 163,265 km^2.

Suriname's population of approximately 354,000 is of diverse origin. Indian (Hindustani), Creole, Javanese and Maroon, descendants make up more than 90% of the population. About two-thirds of it is concentrated in the capital city of Paramaribo and its surroundings, while most of the remainder live along the coast. The interior consists mainly of dense tropical forest.

Suriname has a tropical, rather humid, climate. Annual mean temperature is 26-27°C. Minimal temperatures are reached early in the morning and are:

- along the coastal area: approx. 22°C
- in the interior ; approx. 18°C

Humidity normally is about 98% at night, falling to about 75% in the course of the day. In the dry period (September and October), very low humidities of about 30% (with temperatures around 35°C) can be measured at midday.

Land and water resources

Suriname has seven major rivers. Their water potential can be used for agricultural purposes and the generation of hydro-electric energy (estimated potential 2,400 MWatt). Of the minerals, bauxite is at present predominant. The Government

intends to stimulate the extracting of other minerals in the near future.

The major urban centres are Paramaribo, already mentioned, and Nieuw Nickerie (in the Nickerie District) (pop./30000). The major sea-ports are those at Paramaribo and Nieuw Nickerie. The international airport "Zanderij" is located about 50 km south of Paramaribo. There is also an airfield for domestic flights, the Zorg en Hoop airfield in Paramaribo.

Formerly a colony of the Netherlands, Suriname became self-governing in 1951. In 1954 the country became a member of the tripartite Kingdom of the Netherlands. The coalition that came into power by the November 1973 elections pledged to secure independence, a goal they achieved in 1975. The military force took over the power of state in February 1980.

1.2. Socio-cultural and economic setting

Despite its location over 500 miles to the Caribbean Sea, Suriname is considered a Caribbean country because of the composition of its population and its history as a plantation society under European domination. Its population, as has been said, originates chiefly from African slaves or indentured labourers from India, Java and China, who were brought to the country by the European settlers over the centuries in which the colony's plantation economy flourished.

The population of Suriname as of 1 January has evolved as follows:

1964	324,211
1977	358,480
1981	351,380

The ethnic breakdown among Suriname's seven major population groups in the 1964 and 1971 census is as follows:

Population of Suriname by ethnic groups, 1964 and 1971

Ethnic group	1964 (000)	1971 (000)
Creole	115.0	118.5
Hindustani	112.6	142.5
Javanese	48.5	58.9
Chinese	5.3	6.4
Amerindian	7.3	10.2
European	4.3	4.0
Bush Negro	27.7	39.5
Other and unknown	3.5	5.1
Total	324.2	384.9

Source: General Statistics Office (A.B.S.), Third General Census, "Suriname in cijfers" N° 33 (Paramaribo, 1967) Table 1A, m.p., and A.B.S.,"Provisional results of the Fourth General Census, Suriname in cijfers", N° 60 (Paramaribo, 1973), p. 4. The 1980 census, does not give a breakdown on basis of ethnic groups.

In the terms of religion, the population can be broken down into six categories: Protestant, Catholic, Hindu, Mohammedan, Heathen and other (including Unkown).

In terms of population settlement, there are no figures available on the urban-rural breakdown, per se. It is estimated, however, that as much as 85% of the population is settled within a 25-mile radius of the capital, Paramaribo, making urban services and amenities available to many who might otherwise be classified as "rural". Smaller urban centers include Nieuw Nickerie, already mentioned, Moengo (in the centre of the bauxite-mining region of East Suriname), Albina (on the Marowijne River on the border with French Guiana), and Paranam (in the center of the bauxite mining region on the Suriname River, south of Paramaribo).

Suriname is divided into nine jurisdictional districts: seven located along the coastal plain, the remaining two further in the interior. From west to east, the coastal plain districts are Nickerie, Coronie, Saramacca, Suriname, Paramaribo, Commewijne, and Marowijne. (Nickerie, Saramacca, Commewijne, and Marowijne also include large interior regions). The two entirely interior districts are Para and Brokopondo (to the South of Paramaribo).

Sranang Tongo and Dutch both serve as linguae francae in the Surinamese society, with large portions of the Asian groups able to use them. Sranang Tongo is the dominant language of the marketplace and on the streets, while Dutch is the language of government, education, and the communications media (press, television, and, with some exceptions, radio).

With the gradual collapse of the sugar economy, upon which Suriname's growth in the plantation era had rested, some agricultural diversification took place.

Impoldered lands were used by ex-slaves for planting cotton and then, increasingly, by former indentured labourers of Asian background for rice production. Efforts to grow cocoa, coffee and bananas were significant in the nineteenth and early twentieth centuries, but only the banana production remains significant today. Citrus fruits have become increasingly important, and efforts are being made to safeguard and develop the coconut industry. Suriname is reasonably self-sufficient in its food supply: livestock, poultry, dairy products, vegetables, cooking oils, etc. But only rice, and to a smaller extent, bananas, citrus fruits and sugar, are of potential importance for export -along with fish, timber and related wood products. Nevertheless, the country's exports basically consist of bauxite and its derivatives.

By far the most productive sector of the economy is mining, particularly the mining of bauxite, the principal source of aluminium. During the First World War, geologists from the ALuminum Company of America (Alcoa) discovered large deposits of high-grade bauxite ore close to the surface, along the Cottica River near the Amerindian village of Moengo. Alcoa quickly signed a 75 year leasehold to the area and established a subsidiary, the Surinaamsche Bauxiet Maatschappij, in December 1916. The first shipments of bauxite to the United States took place in 1922, and by 1929 it had become Suriname's leading export product. During the Second World War, the smaller Dutch Billiton Maatschappij (now a subsidiary of Shell) joined with Alcoa to develop new bauxite operations along the Suriname River at Paranam and Onverdacht. After the opening of alumina and aluminum smelters in 1965 (the first to be built in a third-world country), Suriname's export of these two products became, and has remained, a major source of government revenue and foreign exchange.

Relative importance of the export of the bauxite and agricultural sectors, 1960-1980

Year	Total export	Export of bauxite and its derivates		Export of rice, shrimp and bananas		Other	
	in Sf.mln.	in Sf.mln.	in %	in Sf.mln.	in %	in Sf.mln.	in %
1960	87.6	66.3	75.7	5.4	6.2	15.9	18.2
1965	110.3	80.6	73.1	8.3	7.5	21.4	19.4
1970	265.8	231.3	86.9	9.3	3.5	25.2	9.5
1975	495.3	378.3	76.4	62.7	12.7	54.3	11.0
1980	918.2	740.9	80.7	141.6	15.4	35.7	3.9

Source: Central Bank of Suriname

1.3. Development scene

The "Objectives of the Socio-political order" (pages 9 and 10 of "National Economic Profile" National Planning Office of Suriname, March, 1983), describes the development scene in the following terms:

"Within the Revolution of 25 February 1980 a new phase in the history of our country has started. One in which we shall not only realize our true independence, but also free the masses of our people from oppression and social subordination. The new democracy, being created by the Revolution, will therefore be a democracy in which the majority of our people will actually be able to determine their own course. The people's committees will make it possible for the people to participate actively in the decision-making process and the execution of decisions at a local level. A further organization of our people in democratic mass organizations of workers, peasants, youths and women is a prerequisite to obtain their daily participation in the process of transformation both locally and nationally, and to accelerate their political development. The revolution, which springs from our people as a whole, respects the fundamental rights of each and every citizen. These fundamental rights are laid down in the decree "Status of Fundamental Rights and Duties of the Surinamese People". The foreign policy will be one of peace and Non-Alignment, which will guarantee the national independence, sovereignty and territorial integrity".

"Diplomatic relations will be maintained with all countries irrespective of their social and political systems, on the basis of a mutual respect for each other's independence, sovereignty and territorial inviolability. Considering also the efforts to achieve a closer relationship with other Third World Countries, Suriname shall strongly support the struggle for peace, democracy and socio-economic development in all countries, as well as the national struggle for liberation, independence and economic self-reliance in the Third World Countries. Unequal treaties will not be tolerated nor shall technical and economic aid which are contingent upon political conditions be accepted".

"The new Suriname society will be:

- primarily aimed at our own wants,needs, desires and aspirations, and built on the abilities which we can actually acquire;
- grafted upon those sectors that are fundamentally controlled by the nation or can be brought under the nation's control;
- guarantee an optimum development of the Surinamese people, in real harmony with their social and physical setting and based on the proper development dynamics;
- be aimed at solidarity among the people, by which the weakest will be the most protected and the strongest will bear the heaviest burden; and finally
- be based on new, real democratic relations, by which actual influence on political decision-making and actual control of political dealings will be guaranteed to the whole nation".

"The revolution has therefore set the following political objectives:

- to fight and to eliminate all forms and remainders of colonialism, neo-colonialism, and imperialism.
  At the same time, to extinguish any form of discrimination based on differences of race, ideology or religion, with a view to promoting the unity and solidarity of the people".

"The economic policy in building up the economy independent of the foreign domination will be:

a. primarily based on the wants and needs of the society and the desires and justified aspirations of the people;

b. primarily based on own resources and own abilities;

c. primarily applied in those sectors which are actually controlled or will be under the control of the nation. In building up the national economy, the strengthening, the expansion and the efficiency of the government sector and the co-operative forms of productions will play a central role".

"An integrated socio-economic development will also be taken into account, which will lead to a balanced sectorial diversification and result in a guarantee for continuity and coherence between the sectors. Particularly the sector that can be controlled nationally will be given priority in development. Special attention will be given to the socio-cultural renewal of the society. In order to establish a real democracy, it is essential to create conditions in the socio-economic field which will enable everyone to actually participate in the social process. Adequate housing, good health, opportunities for cultural expression and education, form part of such conditions. Accordingly, one of the priorities will be the further acceleration of the literacy campaign".

"Furthermore, the educational system and the study of sciences and technology will be developed in such a way that they will serve to further the liberation of our people and the national objectives".

"The general economic development policy will consequently be developed in the light of the following policy lines:

- the consistent application of the principle of regional distribution in the development of new economic activities;
- maximum exploitation of potential export opportunities on the one hand, and a continual reform of the unfettered import on the other;
- the realization of a balanced wage, profit, price and income policy, aimed at the stabilization of the cost of living (within this framework supplementary monetary and fiscal measures will be taken accordingly);
- the increase of the private and Government savings and, more than before, the canalization of these savings to finance national production;
- reconsideration and re-allocation of the M.D.P. (Multi-year Development Projects), whereby the emphasis will be on productive investments in the controllable primary sectors, agriculture, forestry, animal husbandry and fisheries, the manufacturing industries based on these sectors, alternative mining as well as smaller and medium-sized energy supplying projects;
- the realization of a real annual growth of the GNP with at least 3 percent;
- the financing, from own savings, of at least 50 percent of the required Development investments;
- within the framework of increasing the industrial production, private enterprises, both domestic and foreign investments, will be supported in so far as they fit in with or contribute to the realization of the national objectives;
- selective trade policy measures will be adopted to stimulate and support local production and to protect the national production, taking into account the interests of the people".

PART 2 - SCIENCE AND TECHNOLOGY FRAMEWORK

2.1. Development of the framework

Global and sectoral objectives and priorities of development

The Government, amongst other things, aims at stimulating industrialization, increased productivity and the use of local natural resources where possible. This should:

- decrease imports and thus the drain on foreign exchange reserves (imports of goods and articles in 1982; ca U$S 550 million);
- increase exports and thus earning of foreign exchange;
- increase the number of available jobs.

Within the natural resources emphasis is placed on self-management of agriculture, forestry, animal husbandry and fisheries.

Major undertaking in the (near) future

A. In the energy sector, the further development of hydro-power is foreseen. At present, four projects are being studied or considered, namely:

- the Jaikreek project (average power: 14 MW)
- the Phedra project (average power: 12 MW)
- the Saramacca III project (average power: 30 MW)
- the Kabalebo Phase I (average power: 150 MW) and
- the Kabalebo Phase II (average power: 300 MW)

Oil is extracted in the Saramacca District at a rate of approximately 300 barrels/day. Exploration of possible fields on the coastal area is done in collaboration with some oil companies. Both activities are carried out or coordinated by the Staats Olie Maatschappij Suriname (Suriname Oil Company).

Furthermore, the installation of micro hydro-power stations, the use of wood-gas, bio-gas, solar energy, wind energy and other forms of non-conventional sources of energy are being considered, mainly for use in the interior.

These activities fall primarily under the energy division of the Ministry of Natural Resources and Energy.

General note

Suriname has been supplied with hydro-power from the "Afobakka-dam" since 1966.

Installed capacity: ca 180 MW

Annual production: ca 1000 Gigawatt hours

80 GWh are sold to the Government, while the rest is used by the bauxite industry for aluminum oxide and aluminum production.

Total need of the Capital city (Paramaribo): ca 250 GWh/year (electrical).

Total of oil imports (1982): U$S 140 million

B. In the agricultural sector three major projects are in progress at present:

a. the LOC-project (Agricultural Development Plan for the Commewijne District);

b. the MCP-project (Multipurpose Corentijn Project) A multi-purpose project for a better utilization of the water of the Corentijn River;

c. the Patamacca Project. The establishment of a 5,000 hectare oil-palm estate in the Patamacca area, including processing of the oil and housing of personnel.

Brief description of procedures used in development planning

Development planning, generally speaking, is carried out in the following way:

a) the new Government presents a statement outlining the ideological basis, the areas of interest, priorities, etc., for their government period;

b) all Ministries and governmental agencies then draft their own programmes and budgets, in accordance with the Government Statement;

c) the National Planning Office drafts an integrated National Programme and Budget;

d) the Council of Ministers decides on the final version of the National Programme and Budget.

Note:

Depending on the particular Ministry and the particular programme, private offices can be involved in stages b) and c) and in the stages of implementation later on.

2.2. Development policy and science/technology policy

Science and technology policy

So far Suriname has not developed any overall, nor in general any explicit, "science and technology policy". R & D (either more or less fundamental or purely applied) is carried out by various institutes (see Annex II), usually as the need arises.

Establishment of a National S/T Council

In 1981 the Government decided to establish a National Council for Science and Technology. Its draft statutes have already been drawn up.

Policy-making machinery for science and technology

General

As stated before, Suriname has neither an overall nor an explicit "Science and Technology policy", nor a coherent set of policy instruments to further develop science and technology.

First level: policy-making

There are no councils, boards, committees, commissions, agencies, etc., specifically dealing with the overall policy-making in the field of science and technology. Science and technology activities are planned and performed by various institutes, as the need arises.

Second level: promotion and financing

The "Centre for Industrial and Export Promotion" (INDEX) promotes industrial activities in general.

There are a few professional private associations (amongst others in civil engineering and in architecture), but these do not promote science and technology activities other than for their own members.

There are no research or university grants committees no research councils, no academies of science, financing agencies, foundations, etc.

Third level: execution of science and technology activities

An outline of various institutes where science and technology activities are performed is given in Annex II.

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Institutional network

See Annex II for an outline of the institutions which perform science and technology activities.

At this time no specifications can be given on their size, recent historical development, working methods, efficiency or impact on the productive sectors of the economy.

3.2. Human resources

The quantitative information that can be given at this moment is contained in Annex III.

Science and technology manpower will be supplied mainly through:

- the middle-level courses of the Institute of Natural Resources and Engineering (NATIN) (ca 100 persons/year);
- the Faculty of Natural Resources of the University of Suriname;
- the Faculty of Engineering of the University of Suriname.

There is no formal restriction whatsoever for women to enter any career they wish. In practice, cultural background, family traditions, etc., have their influence. In Engineering (middle-level and academic), ca 10% of the students are female. In Natural Resources the percentage is higher. There is no specific legislation in force or contemplated, to ensure public service status to research scientists, etc.

The "brain-drain" is, and has been for many years, a serious impediment to building up of manpower. In the past, many people who were granted a scholarship to study abroad (mainly in the Netherlands), did not return to Suriname. No figures can be given at this moment, however.

3.3. Financial resources

Since there is no formal science and technology policy, budgets are not generally allocated for specific science and technology purposes, but per institution. An item by item analysis of the various budgets would be needed to arrive at the science and technology expenditures.

3.4. Information resources

The library of the University of Suriname is open for all scientists and researchers. Many institutions also have their own (small) libraries. Unfortunately, no central catalogue has been made yet, so that the libraries do not have access to all information available.

Bibliographical data on the elaboration of policy, the decision-making and management of national science and technology activities, if needed,have to be gathered at the various Ministries and private institutions.

3.5. Surveying of the science and technology potential

Numerical data on national science and technology activities are not really collected and analysed. Many institutions have their own data-collecting networks for their own specific uses.

Centralized data-collecting, in principle on all matters, is done at the "Algemeen Bureau voor de Statistiek" (ABS) (General Statistics Office).

Data on industrial activities are also collected by:

- the Ministry of Natural Resources and Energy;
- the Ministry of Transport, Commerce and Industry;
- the "Nationale Ontwikkelingsbank" (NOB) (National Development Bank);
- the "Centrum voor Industriele Ontwikkeling en Export Bevordering (INDEX) (Centre for Industrial and Export Promotion);

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

The Faculty of Natural Resources (University of Suriname) was established in December 1976, and the Faculty of Engineering in December 1977. In 1981 the Government of Suriname in principle decided to establish a "National Council for Science and Technology". A special unit on science and technology was established recently within the National Planning Office. In 1981 the Government established the "Centre for Industrial and Export Promotion" (INDEX). The "General Statistics Office" has increased its information gathering activities in many fields, such as with regard to industrial activities, manpower requirements, etc.

4.2. Achievements and problems

Please see the "General Remarks" at the outset of the present report.

4.3. Objectives and priorities

Please see the "General Remarks".

4.4. International science and technology co-operation

Suriname at present has co-operation programmes with the following countries/ international organizations in the field of science and technology, among other things:

- Belgium
- EEC (European Economic Community)
- CCST (Caribbean Council for Science and Technology)
- UNDP (United Nations Development Programme)
- Unesco (United National Educational, Scientific and Cultural Organization)
- OLADE (Organización Latinoamericana de Energía)
- The special programme within OLADE: PLACE: Programa Latinoamericano de Cooperación Energética
- OAS (Organization of American States)
- Caribbean Science and Technology Co-ordination Committee (OAS-CIECC)
- FAO (Food and Agricultural Organization)
- PAHO (Pan American Health Organization)
- WHO (World Health Organization)

PART 5 - BIBLIOGRAPHY

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2. "National Economic Profile". National Planning Office, Paramaribo, March 1983.

3. Unesco "Sixth Session of the Standing Conference of National Science and Technology, Policy-Making Bodies in Latin America and the Caribbean". La Paz, October 1981.

4. Unesco "An Introduction to Policy Analysis in Science and Technology". Science Policy Studies and Documents, N° 46, 1979.

* * *

ANNEX I

RELEVANT MINISTRIES

1. Ministry of Natural Resources and Energy (NHE).
2. Ministry of Public Works, Telecommunication and Construction (OWTB).
3. Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry (LVVB).
4. Ministry of Transport, Commerce and Industry (THI).
5. Ministry of Education and Sciences (MINOW).
6. Ministry of Health.

* * *

ANNEX II

Name of institution	Government/Private	Function	Linkages
Agriculture, Animal Husbandry and Forestry			
1. Centrum voor Landbouwkundig Onderzoek in Suriname (CELOS) (Centre for Agricultural Research in Suriname)	University of Suriname Faculty of Natural Resources	Research regarding various crops, forestry, soils, land and water management	
2. Landbouwproefstation (L.P.) (Agricultural Experimental Station).	Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry (LVV & B)	Applied agricultural research	Ministry
3. Landsboerderij (Governmental Farm)	Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry (LVV & B)	- Research on dairy farming - Development of dairy-breed - Research on farming systems	
4. Lands Bosbeheer (LBB) (Suriname Forestry Service)	Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry (LVV & B)	Management of forests to yield the continuous maximum benefit by means of an inventory of the forest estate, forest engineering, supervision of forest exploitation collection of royalties, forest, protection, regeneration, research into possibilities of forest improvement, market development at home and abroad	
5. Landbouwnaatschappij Victoria (Agricultural Company "Victoria")	Semi-Governmental (Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry)	Growing of oilpalm and production of palmoil	
6. Praktijk Onderzoek Rijst (POR) Rice Research Centre for Smaller and Middle Size Farms	Private	Research regarding: - Wilt rice (red rice) - Land preparation	
7. Stichting Experimentele Landbouwbedrijven (SEL) (Foundation for Experimental Agriculture)	Semi-Governmental (Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry)	- Beef-Cattle research (Baboenhol) - Cattle-breeding farm (Tibiti) - Rice-farm (Bernard polder)	
8. Stichting Machinale Landbouw (SML) (Foundation for the Development of Mechanized Agriculture)	Semi-Governmental (Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry)	Activities: - large scale rice plant - drying and milling of rice	
9. Universiteit van Suriname, Faculteit der Natuurlijke Hulpbronnen (University of Suriname, Faculty of Natural Resources)	Semi-Governmental (Ministry of Education and Sciences (MINOW))	Main areas of activities: - agriculture and forestry - mining - land surveying	
Industry, Mining, Energy			
1. Bauxiet Instituut (Bauxite Institute)	Semi-Governmental (Ministry of Natural Resources and Energy)	1. Formulate and assist in the implementation of the bauxite policy on behalf of the Government 2. Inspect the activities of the bauxite companies in Suriname	

Annex II (Cont.)

Name of institution	Government/Private	Function	Linkages
2. N.V. Billiton Maatschappij Suriname (Billiton Company Suriname Ltd.)	Private	Bauxite mining and sale of bauxite and alumina	
3. Dienst Bodemkartering (DBK) (Soil Survey Department)	Ministry of Natural Resources and Energy	Soil survey, classification and research, interpretation and evaluation of collected data	
4. Energie-afdeling Ministerie van Natuurlijke Hulpbronnen en Energie (Energy Division, Ministry of Natural Resources and Energy)	Ministry of Natural Resources and Energy	Data collection and evaluation and the drafting of the Government policy in the field of energy.	
5. Energie Bedrijven Suriname (Suriname Energy Corporation)	Semi-Governmental (Ministry of Natural Resources and Energy)	Generation, transmission and distribution of electricity. Distribution of LPG gas.	
6. Geologisch Mijnbouwkundige Dienst (GMD) (Geological and Mining Service)	Ministry of Natural Resources and Energy	- Collection of all relevant geological data, to compile the necessary maps - Exploration of Mineral Resources - Supervision on the exploitation of mineral deposits - Advise on licencing of rights for exploration or exploitation of mineral deposits - Advise on the drafting of laws and regulations	
		Mining, Commerce, Transport and Industry	
7. Grassalco (Grasshopper Aluminium Company)	Semi-Governmental (Ministry of Natural Resources and Energy)	- Oil and gas exploration and production - Management of oil and production activities	
8. Staatsolie Maatschappij Suriname (State Oil Company Suriname Ltd)	Semi-Governmental (Ministry of Natural Resources and Energy)	Development of the possibilities for hydropower generation at different locations in Suriname including Jaikreek and Phedra	
9. Stichting Jaikreek en Phedra (Jaiphe) (Jaikreek Phedra Foundation)	Semi-Governmental (Ministry of Natural Resources and Energy)	Mining of bauxite, production of aluminium-oxide and aluminium	
10. Suriname Aluminium Company (Suralco) Laboratorium afdeling (Suralco, Laboratory Department)	Private		
11. Surinaamse Waterleiding Maatschappij (SWM) (Suriname Water Company Ltd.)	Semi-Governmental (Ministry of Natural Resources and Energy)	The main purpose of the company is: - the construction and exploitation of potable water supply enterprises in Suriname - the construction and maintenance of installations for the distribution of water - pursuing and undertaking water resource studies to ensure the potable water supply in Suriname	

Annex II (Cont.)

Name of institution	Government/Private	Function	Linkages
12. Telecommunicatie Bedrijf Suriname (TELESUR) (Telecommunication Corporation Suriname)	Semi-Governmental (Ministry of Public Works, Telecommunication and Construction)(OWTB)	Provision of telecommunication facilities within Suriname and between Suriname and other countries using telephone, telegraph and other telecommunication facilities, which are to be installed and maintained.	
13. Universiteit van Suriname Faculteit der Technische Wetenschappen (University of Suriname, Faculty of Engineering)	Semi-Governmental (Ministry of Education and Sciences)	Main area of activities: - building and construction - civil engineering - electrical engineering - mechanical engineering	
Medical Sciences			
1. Bureau Openbare Gezondheidszorg (BOG) (Bureau of Public Health)	Ministry of Health	Prevention of illnesses by vaccination and all other medical means and related practical research	Ministry
2. Medisch Wetenschappelijk Instituut)MWI) (Institute for Bio-medical Science)	University of Suriname Faculty of Medicine	- Research laboratories for basic sciences physicians training - research in tropical diseases - reference laboratory for public health services - medical library and audiovisual aids	University, Hospitals
Meteorology and Hydrology			
1. Bureau Waterkrachtwerken (BWKW) (Hydro-Power Office)	Ministry of Natural Resources and Energy	Systematic collection and evaluation of data regarding hydro-power potential in Suriname	Ministry, WLA
2. Waterloopkundige Afdeling (WLA) (Hydrological Division)	Ministry of Public Works, Telecommunication and Construction (OWTB)	Systematic collection and evaluation of hydrological data in Suriname	Ministry, BWKW
3. Meteorologische Dienst (Meteorological Service)	Ministry of Public Works, Telecommunication and Construction (OWTB)	Meteorological Services	Ministry

ANNEX III

STOCK OF PERSONS WITH HIGHER TRAINING (1983)

Study	Drs	Prof	Arts	Dr	Mr	Ir	Tot	
Industrial engineering	1						1	
Industrial psychology	1						1	
Biology	13	2		2			18	1
Veterinary Science	6						7	1
Economy	48			3			54	3
Ethnology				1			1	
Geology	19			4	1		24	
History	2						2	-
Indology (*)	2						2	
Engineering	1			1		85	88	1
Agricultural Science and Sylviculture				7		53	64	4
Law (general law)	1	4		1	93		117	18
(canon law)				1			1	
(fiscal law)					6		7	1
(notarial law)					3		6	3
Literature	11			2			14	1
Pedagogy	13			2			15	
Philosophy	1			2			3	
Political Science	1						1	
Psychology	4			1			5	
Social Sciences	15			3			19	1
Chemistry	5			2		3	10	
Dental Surgery	14	5		2			21	
Theology	1			2			3	
Mathematics	10	1			11		25	3
TOTAL	169	12		36	114	141	509	37

(*) Indology: Study of the history, literature and philosophy of India and Indonesia

ANNEX IV

Drs. = M. Sc. (general: A.B.D.) (*)

Prof. = Full professor

Arts = Medical doctor

Dr. = Ph. D.

Mr. = M. Sc. (in law; A.B.D.) (*)

Ir. = M. Sc. (in engineering: A.B.D.) (*)

(*) A.B.D. = All But Doctorate

TRINIDAD AND TOBAGO

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

The Republic of Trinidad and Tobago comprises two islands which are the most southerly of the Caribbean archipelago and are located at approximately 10° N latitude and 60° W longitude. Because of its location Trinidad and Tobago enjoys a tropical warmth which is tempered by the cooling north-east trade winds. Average year-round temperatures are 23°C at night and 28°C during the day. Roughly rectangular in shape, about 80 km by 59 km, Trinidad lies off the north-east coast of Venezuela, while Tobago only 300 sq km in area lies to the north-east of Trinidad. The population of 1.1 million which is cosmopolitan in nature lives mostly in the urban and semi-urban areas.

Trinidad and Tobago obtained its independence from Britain in 1962 and since 1976 enjoys Republician status. The Government of the Republic is a democratically elected one.

A very high percentage of adult literacy is the result of a well-developed primary and secondary school system.

Trinidad and Tobago profits from her physical, biological and human resources. The petroleum sector dominates the economy and accounts for approximately 80% of the total domestic exports.

The Government of Trinidad and Tobago has, for the last two decades, defined science and technology as being of paramount importance to the national development.

The Minister of Finance and Planning has formal responsibility for Science and Technology within the Government, while the Minister of Education plays an important role especially in Unesco-related activities.

Various policy advisory bodies have been established within the last two decades to assist in the process of applying science and technology to national development. The first of these, the National Science Advisory Council established in 1968 was reconstituted in 1976, as the National Council for Technology in Development (NCTD). By this instrument the state sought to obtain the advice of local experts selected from a range of scientific and engineering disciplines.

The objectives of the NCTD include the following:

a) Utilization of national resources devoted to science and technology in the achievement of national objectives.

b) Developing an awareness in the community of the role of science and technology.

c) Influencing national policies and practices as they relate to science and technology.

d) Encouraging research and development that is relevant to the needs of Trinidad and Tobago.

The major success of this Council has been in the area of determining research priorities particularly in relation to research funded by external sources such as the Regional Scientific and Technological Programme of the Organization of American States (OAS). Projects in the Programme which are being executed at the Trinidad Campus of the University of the West Indies, the Caribbean Industrial Research Institute (CARIRI) and the Institute of Marine Affairs (IMA) include research in Marine Science, Agriculture, Natural Science and Engineering.

The Government of Trinidad and Tobago has defined science and technology as an area of major concern in its foreign policy and established in the mid 1970's an Inter-Ministerial Committee on Science and Technology. To advise this Ministerial Committee a Working Group on Science and Technology was formed under the chairmanship of the Permanent Secretary in the Ministry of External Affairs. A science and technology administrative unit was also created in this Ministry.

More recently a National Institute of Higher Education (Research, Science and Technology) (NIHERST) was established. Specific terms of reference of this Institute include the following, among others:

a) to provide and promote scientific and technological services in this country;

b) to promote and develop an indigenous capability in science and technology relevant to the development needs of the country;

c) to assist national bodies in securing technology appropriate to their needs;

d) to monitor and develop the curricula of tertiary educational institutions and research institutions which fall within its purview.

The Draft Development Plan for Trinidad and Tobago 1983-86, which is also entitled "The Imperatives of Adjustments" explicitly states that it is imperative for the country to develop an indigenous capability in science and technology and to improve the diffusion of such information throughout the nation particularly in schools and in the workplace because

> "An indigenous capability enables the country to select on the most economical terms, the technology which is appropriate to its needs and circumstances".

If Trinidad and Tobago is to cope successfully with the complexities of a modern electronic age, then it is imperative that a national capability in science and technology be established. Such a capability is crucial to the development of the country.

The institutional framework for the effective promotion and development of a national science and technology policy in Trinidad and Tobago will comprise the following:

"a Minister with specific responsibility for developing and guiding the country's effort in science and technology,

a National Council on Science and Technology to advise the Minister on the broad policies which should be pursued and on priority areas for R & D and associated training. One of the very important roles which this broad-based council is expected to perform is to address longer term issues which will enable the country to take decisions on the future growth path and on the R & D effort which must be mounted locally to facilitate the pursuit of those long-term goals,

an executive body -NIHERST- to implement and promote programmes of research and training and provide a technological information service".

PART 2 - INDUSTRIALIZATION POLICY

Trinidad and Tobago has based its industrialization policy in the last decade on the utilization of its petroleum resources, in particular natural gas, as a source of cheap energy for establishing capital intensive "energy based" industries such as fertilizer, steel and methanol plants. In these industries the state as a matter of policy owns at least 51% of the equity capital in any one plant.

The process technology for operating these plants was bought from companies in industrialized countries which had established sound track records. In all cases the technology acquisition was effected with attention being paid to strategies aimed at achieving significant local assimilation. For example, during the design phase of a fertilizer plant in Trinidad and Tobago, local engineers spent up to one year in the plant of the technology supplier.

In 1970 the Government established the Caribbean Industrial Research Institute (CARIRI) to conduct industrial research and provide a range of scientific and technological services to the industrial organizations both in the private and state sectors of the economy. One important service which CARIRI provides throughout the Caribbean subregion is in the area of technology evaluation. It also provides a technology information service second to none in the English speaking subregion. CARIRI in 1984 has reorganized its operations in order to consolidate and deepen its expertise in the following areas:

- Food Technology
- Natural Products including By-products
- Construction Technology
- Energy
- Materials Technology
- Engineering Products and Design
- Industrial Automation
- Instrumentation

- Economic Analysis
- Information Analysis
- Technology Evaluation

The expansion of the Faculty of Engineering of the University of the West Indies and the continued support of the Faculty of Agriculture which ensure that Trinidad and Tobago does not have a shortage of engineering or agricultural graduates has also been a Trinidad and Tobago Government Policy.

PART 3 - RECOMMENDATIONS

In the second half of the 1980's the University and related institutions in Trinidad and Tobago need to place considerable emphasis on developing microelectronics. This is an imperative for two reasons:

- Trinidad and Tobago must prepare itself to take full advantage of the possibilities afforded by new technological developments;
- Trinidad and Tobago must strive to offset any negative impacts that these developments might bring to the national economy.

With the proliferation of microprocessor technology, mechanical and electromechanical equipment and machinery are rapidly being replaced by electronic devices. Traditional machine repair and maintenance skills are therefore becoming obsolete with implications both for increased levels of dependence on foreign service technicians and increased machinery and equipment downtimes. The need for retraining programmes by various agencies and institutions is clearly indicated.

The Agricultural Sector in Trinidad and Tobago has had to compete for labour with the modern industrial sector which pays much higher wages. With the decline in national petroleum revenues in the last two years an increase in certain aspects of agricultural activity is evidenced. Although there are significant structural problems with the decline of sugar as an export crop, research and development work aimed at re-establishing cocoa and citrus as the dominant export crops that they were in the 1950's and 60's is being conducted. Research into use of newer techniques in agriculture such as tissue culture for propagation of crops of economic importance which is in its infancy in Trinidad and Tobago will benefit from increased emphasis.

In this regard much of the research work done locally both by state agencies and the University is aimed at having a direct impact on the productive sectors.

Trinidad and Tobago has very weak patent laws that were formulated in the early 1900's with minor amendments in the 1940's and 50's. The national reality is that more than 90% of the locally registered patents is of foreign origin. The Government is currently seeking to update its patent laws with a view to providing a sound framework which will ultimately promote local innovation and local enterprise.

PART 4 - CONCLUSION

With the establishment of the several policy advisory bodies, the active participation in research programmes, and more recently the formulation of the Draft Development Plan 1983-1986, Trinidad and Tobago is applying the use of Science and Technology Policy for its development.

* * *

PART TWO

SUBREGIONAL REPORTS

CARIBBEAN COUNCIL FOR SCIENCE AND TECHNOLOGY

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

At its second session in Santo Domingo, March 1977,the Caribbean Development and Co-operation Committe (CDCC), a permanent subsidiary body of the Economic Commission for Latin America (ECLA), directed -upon the proposal of Unesco- that a joint UNESCO/ECLA feasibility study be carried out for the establishment of a Caribbean Council for Science and Technology (CCST). This study was one of the items discussed at a Unesco Consultation on Science and Technology Policies in the Caribbean Region held in Georgetown, Guyana in December 1977. The CCST was further considered at a Caribbean Subregional Seminar on Science and Technology for Development held in Kingston, Jamaica, in February 1978, sponsored by ECLA and Unesco and again at an expert group meeting in Port of Spain, Trinidad and Tobago, in December 1978. That meeting had before it the draft statutes of the CCST prepared by Unesco. The Statutes of the CCST were eventually adopted at an intergovernmental meeting in Kingston, Jamaica, on 17 April 1980, and subsequently ratified by various countries. The First Plenary Session of CCST was held in Bridgetown, Barbados from 29 June to 2 July 1981; subsequent plenary sessions have been held in Kingston, Jamaica, 3-5 November 1982, and in Curaçao, Netherlands Antilles, 27-29 July 1983.

Countries currently members of the CCST are: Belize, Cuba, Dominica, Grenada, Guyana, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago. Under the Statutes of the CCST each member country is entitled to designate two members, one of whom must be a scientist chosen by the respective government from amongst senior officials of national bodies responsible for science and technology policies, or of national science and technology research councils, or, where such bodies do not exist, from amongst leading scientists or engineers in the government sector, the universities, appropriate professional associations or the productive sector. A country may designate only one Council member if it so wishes, in which case he must be a scientist chosen in the manner described above.

The Officers of the Council are: Chairman, Vice-Chairman, elected annually at the end of the year's Regular Plenary Session; Honorary Treasurer, elected at Regular Plenary Sessions for three years and eligible for re-election; and one other member, elected annually at the end of the year's Regular Plenary Session. In electing the officers of the Council, members are guided by the principle of equitable geographic distribution. The Officers of the Council constitute the Executive Committee, which meets at least twice between Regular Plenary Sessions to review the Council's activities and to consider the draft Annual Report, the Agenda and the working documents of the next Regular Plenary Session. The ECLA Office has agreed to provide Secretariat services until the CCST is able to create its own Secretariat.

One of the interesting features of the CCST, but which is not without its problems at times is the diversity of the membership in regard to size, language, culture and political organization. The largest country, Cuba, is 115,000 square

kilometers in size and has a population of roughly 10 million; the smallest, Saint Vincent and the Grenadines is 390 square kilometers with a population of just around 100,000. The group of countries contain one Spanish-speaking, one Dutch, one French, and eight English. Four have an elected President as Head of State (one elected for life). Six (English-speaking) have a Governor-General but with real political power residing in a Cabinet of elected persons headed by a Prime Minister; and one (Suriname) is governed by a Military Council. Nonetheless, because of the common scientific and technological problems facing the countries, these differences hardly manifest themselves in the workings of the CCST.

The establishment of the Caribbean Council for Science and Technology was in direct response to a perceived need by Caribbean countries for a mechanism to make the best and most effective use of the region's scientific personnel and institutions in applying science and technology to the development of the region. The specific aims of the CCST, as set out in the Statutes, are:

(i) to implement CDCC objectives by designing and executing appropriate joint scientific and technological projects, and also advise the CDCC and its member countries on scientific and technological issues requiring attention;

(ii) to identify institutions that could participate in the projects, and to establish the mechanisms for co-operation;

(iii) where no relevant institutions exist, to propose measures for the implementation of particular projects;

(iv) to devise procedures for the effective dissemination of Caribbean R & D projects and their application in member countries;

(v) generally, to promote the establishment and strengthening of appropriate national and Caribbean organs and mechanisms for science and technology development and application.

The major function of the CCST is to enhance regional co-operation and mutual assistance in science and technology and to strengthen the thrust for self-reliance, whilst simultaneously observing the national independence and sovereignty of its member countries. The CCST must perform in a situation where most of its member countries are still technically underdeveloped and lack national policies for science and technology; and, the application of science and technology to national development is not common place.

1.2. Development scene

As an organization still very much in embryo, the CCST is concerned with promoting co-operation in the field of science and technology aimed at furthering the social and economic development of its member countries, and with the involvement of other regional organizations, such as the Caribbean Community Secretariat (CARICOM) Meetings of the CDCC provide guidelines and identification of issues of concern, as also do the various meetings of Heads of Governments of the CARICOM countries and of the Standing Conferences of Ministers. Thus, the CCST itself in co-operation with Unesco has been able to identify priority, scientific and technological activities

suitable for regional co-operation, and has initiated and implemented a number of projects towards the enhancement of national capabilities in science and technology as agreed by its member countries. These projects are representative of the programme priorities and achievements of the CCST. Also, the Council has used the device of setting up Specialist Committees/Working Groups, comprising national representatives, who have to seek solutions to pressing problems in selected areas, such as energy; transfer of technology and patents; information systems; agricultural research; marine affairs (including fisheries); health, nutrition and pharmaceuticals, universities, industrial sector and other private and public sector institutions; and newly emerging technologies.

Regional mechanisms for co-operative action in science and technology are either weak or non-existent in the Caribbean subregion -the CARICOM Ministers Responsible for Science and Technology met for the first time on 6-8 April 1983. Therefore the CCST must at least identify the priority problems and articulate the strategies for dealing with them. The Council recognizes that effective collaboration and co-ordination can be based only on information about the scientific and technological potential of the region, including on-going research activities; therefore, it has elaborated projects -in co-operation with Unesco- taking this specifically into account, despite its small budget and the lack of a permanent Secretariat of its own. By its nature, the Council is well placed to provide objective assessment of problems, and to offer impartial advice on the means of solutions. Although members of the Council are appointed by governments, they act in their personal capacities and are able, in theory, to view issues outside of the influence of purely political considerations.

PART 2 - SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1. Development Policy Framework

Among the countries comprising the CCST there is no regional development policy as such, although the CDCC has identified areas for close co-operation. These include energy, agriculture, industrial development, marine resources, tourism and environmental protection. Through the mechanism of CARICOM, the English-speaking Caribbean countries have been attempting to arrive at regional policies in key socio-economic sectors. A regional Food and Nutrition Strategy has recently been established, and regional policies are being discussed for energy and industry.

Individually all countries of the region have placed as a high priority the satisfaction of basic needs of the mass of the population -food, health, shelter and education. The accelerated development of agriculture is being pursued vigorously to combat the very high and increasing food import bill. Within the English-speaking Caribbean alone food imports now exceed U$S 1.5 billion. With the exception of Trinidad and Tobago which has substantial reserves of fossil fuel, all countries are experiencing balance-of-payments problems as a result of their high energy bill, and urgent priority has been given to the search for alternative sources of energy and the more efficient use of conventional sources of energy.

For many countries, tourism continues to play an important role in the economy, and tourism development continues to be high on the agenda of development priorities. This has inevitably led to considerations of the environment and measures for its protection. Among environmental concerns, coastal management is perhaps the one on which most attention is focused.

Of major concern both at the national and the regional level is the inadequacy, for the most part, of the skilled human resources needed to accelerate the pace of development. Development of human resources is high on the list of priorities in all countries. Countries are also placing emphasis on improving their weak information base, either individually or through co-operative efforts at the regional level. Thus, information systems were identified as one of the priority areas, (together with agro-industry), for urgent attention at the first Meeting (*) of CARICOM Ministers Responsible for Science and Technology held in Jamaica, 6-8 April 1983.

2.2. Development policy and science and technology policy

The CCST was set up to promote co-operation in the field of science and technology aimed at furthering the social and economic development of its member countries, including the implementation of provisions of the Constituent Declaration of the Caribbean Development and Co-operation Committee (CDCC) to promote efforts to co-operate in the mutual transfer of science and technology in order to facilitate the adaptation of imported technology and the development of domestic technologies and increase the bargaining power of the Caribbean countries in their relations with countries outside the area. Because of the common problems and perceptions of these countries, it is possible to identify areas that are significant to development in the Caribbean subregion. This is the strategy which the CCST has adopted in defining its own programme priorities. The convening by the ECLA/CCST Secretariat of a workshop on Agricultural Research Policy and Management in the Caribbean, 26-30 September 1983 was a response to the need for rationalization in this field. The CCST has implemented a project dealing with the development of agro-industries and employment opportunities at the rural level and one on the conservation and exchange of germplasm of crop plants. Recognizing the great significance of new technologies for Third World Development, the Council with the assistance of Unesco, UNCSTD, UNIDO and other agencies is actively preparing for a regional workshop on the potential and limitations of newly emerging technologies for Caribbean development.

Although no formal mechanism exists for linking regional development "policy" with science and technology policy, CCST's activities are being made consonant with certain ("national") development objectives through three informal mechanisms:

(i) The composition of the Council, which allows for representation at official as well as scientific level;

(*) Although this Meeting was convened by CARICOM, Suriname, the Netherlands Antilles, Bahamas and the British Virgin Islands attended as observers.

(ii) feedback from the annual meetings of the CDCC to which the CCST reports annually;

(iii) close interaction with other regional organizations such as CARICOM and the Caribbean Development Bank (CDB).

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Human resources

Under the Statutes, the Work Programme of the Caribbean Council for Science and Technology may include, among other things:

(a) action to raise the level of public awareness of the implications of science and technology for social and economic development;

(b) action to foster the education and training of specialized scientific and technological R & D personnel;

(c) promotion of measures for enhancing the status of scientific researchers, teaching personnel and other scientific and technological workers;

(d) measures to encourage talented and qualified staff to work and remain in the region;

(e) organization of symposia, seminars; workshops and conferences.

Thus, CCST's approach to human resources development in science and technology has been defined by Statutes in such a way as to prevent the duplication of work of other institutions. The Council's project on the preparation and exchange of audio-visual material for education in science and technology has great value in its efforts to develop the human resources in science and technology in the Caribbean subregion.

3.2. Financial resources of CCST

According to the Statutes of the CCST the finances of the Council shall consist of:

(i) contributions from Member Governments, with additional support from organizations within the United National System and other institutions;

(ii) funds for projects sponsored or launched by the Council, and which qualify for assistance within the framework of activities of organizations of the United Nations System, or any other appropriate international, regional or national organization.

Additionally, the Council may establish a Special Fund for Scientific and Technological Development in the Caribbean, to be used particularly to assist priority R & D projects of an intraregional nature, within the guidelines set down by the Council.

Because of the shortage of funds in the new CCST, the CDCC Secretariat was requested to provide an interim Secretariat for the CCST. CCST has been fortunate therefore to date in having the services of the ECLA Office and in particular of a senior professional officer in science and technology as its Interim Secretariat. As a result, whatever income has been received has been used solely for the holding of meetings of the Council, and for the support of projects. In 1981/82 expenditure was U$S 58,000. Arrears due from governments at the end of 1982 amounted to U$S 64,000, all of which could have been used on projects had the money been received. In 1983 projected expenditure was set at U$S 616,000 of which only U$S 242,000 could be said to have represented assured funds.

It seems unlikely that governments' contributions to CCST will exceed the current U$S 52,000 annually in the near future. However, the Council expects to receive funds from international funding agencies to match the excellence of its projects and programmes for regional collaboration. A small amount of extrabudgetary support (£ 2,000) was obtained for the consultancy on the germplasm conservation project, and a larger amount (U$S 39,000) for the September 1983 regional workshop on agricultural research policy and management. The process of setting up a Special Fund under the Statutes of the Council has been initiated, with technical assistance from Unesco.

3.3. Information Resources

ECLA provides support information services to the CCST Secretariat. ECLA is in the process of establishing a Caribbean Information System. Considerable progress has been made with the CARISPLAN project within the CEPAL/Caribbean Documentation Centre. (The CARISPLAN project is a joint CEPAL/IDRC project which concentrates on provision of advisory services and training in order to promote the development of national information centres, and the co-ordination of these and similar centres to provide greater access to developmental planning literature in Caribbean countries). The abstracting bulletin -CARISPLAN Abstracts, aims to ensure a sharing of up-to-date information among Caribbean policy-makers, planners of socio-economic development projects and programmes, researchers and teachers of development planning, and library and information specialists. The CCST is collaborating with the United Nations World Intellectual Property Organization (WIPO) in work relating to the establishment of a subregional patent information and document system with the CEPAL Caribbean Documentation Centre.

3.4. Surveying of scientific and technological potential

One of the first projects on which the CCST embarked after its establishment was the assessment of the national scientific and technological potential of its Member States. The objectives of the project was to obtain information on the quality and quantity of personnel involved in science and technology activities at the national level, and their deployment within the national framework for development. The project began in 1981 at a workshop held in Suriname when the Unesco methodology for data collection and analysis was agreed upon. The survey is about 60 percent complete.

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

It has become increasingly apparent over the years that regional co-operation in science and technology is an essential factor for national development in the Caribbean, and even more for the smaller territories. The survey of scientific and technological potential being undertaken by the CCST is a prerequisite to meaningful co-operation, providing as it will the information on which to assess the areas where co-operative efforts are feasible from the standpoint of available resources.

Science and technology has been designated a priority area since the formation of the Caribbean Development and Co-operation Committee (CDCC);and, the CCST is the second mechanism for active co-operation of a day-to-day operational nature that had emerged within the framework of the CDCC. The first was the Caribbean Documentation Centre which had the task of laying the framework for the Caribbean Information System for economic, social and technical information. The co-operation devices for both the information system and the CCST are based on the principle that by bringing the national counterparts into a working relationship which constitutes a network, it enables the national unit in any one country to supplement the similar units in the other countries, thus improving the capabilities of each to better serve the national need. Within the network, the CCST serves as the focal point for the national science and technology policy-making bodies.

Regional co-operation in science and technology was also the theme of the first meeting of CARICOM Ministers Responsible for Science and Technology, held in Jamaica in 1983, where the priority areas for regional co-operation in the English speaking Caribbean Countries, were identified. The CCST participated in that meeting, where its role *vis-a-vis* the other major CARICOM organizations, the CDB and CARICOM itself was discussed.

The CARICOM Ministers established an Interim Co-ordinating Committee (ICC), on which the CCST is represented, to:

(i) identifiy priority areas (within information and agro-industry) to be addressed in the short, medium, and long-term;

(ii) elaborate projects for implementation, including costing as well as mechanisms and strategy for implementation;

(iii) identify possible sources of financing; and

(iv) monitor and evaluate the mechanisms for projects identified for implementation.

It is anticipated that the action programme recommended by ICC will be approved by a Ministerial Sub-Committee, also set up at the Ministerial meeting, within the next few months.

In September 1983 the CCST, jointly with ECLA Subregional Headquarters for the Caribbean, organized a Workshop on "Agricultural Research Policy and Management in the Caribbean", in which the participants were Permanent Secretaries and Directors

of Agricultural Research. The Workshop agreed on the goals for national and regional agricultural research and development, and recommended measures for the attainment of these goals. The importance of regional co-operation, was re-emphasized, and the Workshop recommended that the establishment of networks for collaboration in research between countries and across the region should be encouraged.

In May 1983 the CCST participated in a small working group which was convened by Unesco to plan a subregional meeting on the implications of new technologies for Caribbean Development. The working group strongly emphasized the importance of such a meeting for the Caribbean at this time, out of which it felt should emerge:

(a) a directory of case studies demonstrating the current practical applicability of new technologies within the Caribbean context;

(b) a system for constant monitoring and dissemination of data on new technological developments. The system would evaluate the implications of the new technologies and their application to the Caribbean.

4.2. Achievements

Given the diverse characteristics of the countries comprising the CCST, its establishment alone must be considered a major achievement. The CDCC Secretariat at the ECLA Subregional Headquarters for the Caribbean as well as Unesco have concentrated on servicing the CCST,and its programme of work in this field has been implemented in co-operation and collaboration with many national, subregional and international agencies and organizations. The achievements include:

(a) convening and servicing four meetings of the Executive Committee, of three Plenary Sessions of the CCST, and of two inter-agency/CCST Meetings; and

(b) initiating work on the following eight projects in the CCST work programme:

(i) assessment of national science and technology potential of its Member States;

(ii) establishment of a Science and Technology Journal;

(iii) preparation and exchange of audio-visual material for education in science and technology;

(iv) a study of the consequences of the development of energy crops on food supplies in the region;

(v) conservation and exchange of germplasm of crop plants;

(vi) development of agro-industries and employment opportunities particularly at the rural level;

(vii) the potential and limitations of newly emerging technologies for developing countries;

(viii) a science and technology policy for the Caribbean region.

Work has proceeded farthest on two of these projects namely, The Assessment of National Science and Technology Potential, and the Preparation and Exchange of Audio-Visual Material for Education in Science and Technology. For the former project to date one subregional workshop has been held, questionnaires have been prepared and a manual has been designed for the English-speaking Caribbean. Already some countries have carried out their national assessments, and the ECLA Secretariat has been assisting the smaller countries with their assessments. These actions should lead towards a co-ordinated policy formulation to strengthen national capabilities in science and technology. Under the latter named project, two films have been prepared on videotape on important aspects of science and technology in the Caribbean, and, the showing of these films has evoked favourable responses. This audio-visual material is valuable for human resource development in improving public awareness of the importance of science and technology for social and economic development, and in training persons in the high priority areas in agro-industry and in the information systems in the subregion.

With respect to the other projects, articles have been collected for the science and technology journal. Separate consultancies were responsible for the study of the consequences of developing energy crops on food supplies in the Caribbean, and for the study of agro-industry particularly at the rural level. The reports of the consultants have been used to elaborate project proposals which have been submitted to Agencies with requests for funding. A regional survey of available facilities for the conservation of a germplasm of crop plants in the Caribbean also has been started. Seminar/Workshops have been held following initiatives by the CCST on the impacts of the new advanced technologies on Caribbean societies.

4.3. Problems

The CCST was established in 1980. But ever since that time its work has been affected by the shortage of funds and staffing; and a major challenge facing the Secretariat has been to devise mechanisms for discharging its mandate. The CCST has a very special task to achieve co-operation and mutual assistance which bridges the language and cultural differences that constitute the Caribbean. The work programme of the CCST is required to be compatible with the activities in science and technology pursued by the CARICOM and also by the non-CARICOM member countries; and, the CCST work programme must involve the non-governmental organizations such as the professional associations of the Caribbean.

PART 5 - INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL CO-OPERATION

At the request of the CCST a meeting of agencies, multilateral and bilateral, involved in supporting scientific and technological programmes and projects in the Caribbean, was convened in Kingston, Jamaica, just prior to the Second Plenary Session of the CCST, 3-5 November 1982. The meeting was called to examine how the various forms of assistance to science and technology in the Caribbean could be rationalized, and at the same time to acquaint the agencies with the work of the CCST and with the direction in which the region foresaw the development of science and technology. A second inter-agency meeting was held just prior to the Third Plenary Session of the CCST (27-29 July 1983). As a result of the discussions

many of the agencies represented at the meeting became convinced that much more could be done by the agencies themselves in co-ordinating their activities and that the process might be facilitated by the CCST. One particular area for example would be in the formulation of a regional policy in science and technology in order that projects are directed towards overall national as well as regional development goals. The inter-agency meeting is a new dimension in international scientific and technological co-operation in the Caribbean, and is an attempt to ensure for the region the optimum use of financial and other resources.

Apart from this general link with the agencies, the CCST maintains a close working link with Unesco, and the other major regional organizations, CARICOM and the CDB. The CCST has also established bilateral relationships with the International Development Research Centre of Sweden, the United Nations Financing System for Science and Technology for Development, the Swedish Agency for Research Co-operation (SAREC), the Commonwealth Science Council and the Organization of American States. It is CCST's policy to work closely with all international organizations in furthering the development of science and technology in the region.

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CARIBBEAN DEVELOPMENT BANK

PART 1 - GENERAL FEATURES

1.1. Geopolitical setting

Following the demise of the West Indies Federation in 1962 and subsequent failure of efforts to form a federation of the "Little Eight", the United Kingdom, Canada and the United States of America, in January 1966, set up a team of experts to make an economic survey of Barbados and the Windward and Leeward Islands, with a view to formulating plans for their achievement of economic viability. Among the recommendations of this team was the establishment of a regional development agency, including a development Bank division, to serve the territories. In November 1966, the sponsors of the survey and representatives of the respective Governments agreed to the recommendation for the establishment of a developing banking institution to serve all the Commonwealth Caribbean countries and territories.

With the concurrence of all countries and territories of the Region, the United Nations Development Programme (UNDP) appointed a team of experts to:

> "undertake the study of the possibility of establishing a financial institution for regional development in the Caribbean which might be used as a method of financing projects of particular interest to the smaller areas, as well as projects which would benefit the Region as a whole".

The UNDP Report, which was submitted in 1967, recommended the establishment of a Caribbean Development Bank (CDB) with an initial capital of U$S 50 million.

The Draft Agreement establishing the CDB was finally adopted after three meetings at the ministerial level. The Agreement was signed in Kingston, Jamaica, on October 18, 1969, and entered into force on January 26, 1970. The inaugural meeting of the Board of Governors was held in Nassau, Bahamas, on January 31, 1970.

The organizational structure of the Bank comprises a Board of Governors, a Board of Directors, a President, Vice-President and other officers and staff. Functionally, the Bank is divided into two main categories:

A. Operations - comprising the Projects Department and the Economics and Programming Department; and

B. Services - comprising the Bank Secretary's and Personnel and Management Services Department, the Finance Department and the Legal Department.

The Projects Department is responsible for the identification, preparation, appraisal and supervision of projects in agriculture (including fishing and forestry), industry, tourism, economic infrastructure, technical assistance and training, as well as the supervision of projects approved by the Board of Directors and advice on policy affecting project lending. The Economics and Programming Department is responsible for general economic analyses, as well as initiating action and working jointly with the Projects Department on the Bank's project identification and approval activities.

Within the category of Services, the respective Departments have responsibility for (a) corporate secretariat services, personnel, external relations and administration; (b) finance and accounting; and (c) all the legal work of the Bank.

1.2. Development scene

During the 1960s, the Region relied heavily on direct foreign investment in mining, tourism, industry and export agriculture. Considerable industrial activity, based on intra-regional trade flows, took place. An annual economic growth of between 6% and 8% occurred, although the desired levels of inter-sectoral linkages, diversification and increased production and productivity in the food-producing sector were not achieved. In addition, the multinational corporations' policies facilitated only nominal technology transfer and there was no significant national or regional development of policy in the areas of scientific research and technology.

Towards the end of the 1960s, factors such as rising unemployment, unequal income distribution, rapid population growth and falling per capita food production levels challenged the efficacy of the existing development strategies. The need for greater use of indigenous resources and greater efforts towards self-reliance and regional co-operation became more evident. Global and national policies were directed at these issues.

In the 1970s, international inflation, rapid increases in the price of oil and the consequential increased prices of imported manufactures, together with decreased income for the region's primary export commodities, resulted in high rates of domestic inflation, serious foreign exchange shortages and increasing unemployment. Public sector finances suffered and investment declined. Governments resorted to short-term international borrowing and sought to increase the flow of international aid and concessionary financing. The recession of the early 1980s adversely affected the region's major tourist markets and the debt service assumed ominous proportions. With few exceptions, the countries of the region were able to focus less on development than on day-to-day survival.

Development policy in the region in the mid- to late 1980s is premised on the need for structural adjustment in both the short and longer term. Export marketing and production, as well as import substitution through more food and other production are critical to the region's survival. Debt management and streamlining of public finances are viewed as very critical factors. Efforts at energy conservation and development and the increase of productivity through training and application of science and technology are viewed as indispensable to the region's development.

PART 2 - SCIENCE AND TECHNOLOGY FRAMEWORK

2.1. Development policy framework

The Bank's objectives and priorities for regional development are related to the problems and challenges facing its borrowing member countries. Article 1 of CDB's Charter outlines very clearly the purpose of the institution as:

"To contribute to the harmonious economic growth and development of the member countries in the Caribbean and to promote economic co-operation and integration among them, having special and urgent regard to the needs of the less developed members of the Region".

The Bank lends directly to Governments as well as to private companies and individuals and indirectly to the latter through National Development Finance Corporations (DFCs). Direct approvals to the end of 1983 totalled $ 339.8 million (78.9% of total lending) and indirect approvals amounted to $ 90.8 million (21.1%). Of the direct approvals, 92.7% ($ 315.0 million) was to Governments and public corporations, and the remaining 7.3% ($ 24.8 million) to the private sector to which all indirect lending ($ 90.8 million) was channelled. As a result, 73.1% of total lending was to Governments and public corporations and 26.9% to the private sector.

Table 1

Sectoral distribution of net approvals 1970-1983

Sector	Total	Direct (million $)	Indirect	% of Total
Agriculture, Livestock, Forestry and Fishing	71.6	34.3	37.3	16.6
Manufacturing (including Industrial Estates)	113.4	85.3	28.1	26.3
Tourism	16.2	14.9	1.3	3.8
Transportation and Communications	117.9	117.9	-	27.4
Power, Energy and Water	44.4	44.4	-	10.3
Social and Personal Services (including Housing and Education)	52.5	28.3	24.2	12.2
Multi-Sector and Other	14.7	14.7	-	3.4
	430.7	339.8	90.9	100.0

To adjust to the sharp deterioration in their terms of trade, countries of the Region must increase production for export and import substitution, making use of local and regional raw materials. At the sectoral level, the main development thrusts must be to address the energy and food problem.

For the 1980s, the major functions of the Bank will be as follows:

- Mobilising additional financial resources from within and outside the Region for the development of the Region.
- Financing of projects and programmes contributing to the development of the Region or any of the regional members.

- Providing Technical Assistance, particularly in pre-investment.
- Assisting in co-ordinating national development programmes with a view to achieving better utilization of the countries' resources and making the national economies more complementary with each other.
- Co-operating and assisting in regional efforts developed to promote regional and locally-controlled financial institutions.
- Assisting in developing national credit and savings markets and a regional capital market.
- Promoting public and private investment in development projects.

2.2. Development policy and science and technology policy

The Bank, in its role as a development agency, seeks to keep track of the future basis of development. In 1979, it responded to the urgent need to identify techniques of production more appropriate to its member countries by establishing a Technology and Energy Unit (TEU). The TEU administers a technology development programme which seeks to perform this function. The Unit is concerned with field testing of alternative applied energy technologies, practical studies on creating or adapting technologies to suit the needs of the Region,and the dissemination of technology related information. In addition, it seeks to establish mechanisms for sharing technology-related information, experiences and skills among specialists in the borrowing Caribbean member countries of CDB as a means of developing technological capabilities within the Region, promoting co-ordinated approaches to common problems and maximizing benefits to the Region from its scarce skilled manpower and financial resources. The Caribbean Technological Consultancy Services (CTCS) Network project is the principal mechanism by which the TEU works towards this objective, in collaboration with national and other regional institutions. Since 1979, the Bank has spent U$S 6-7 million towards preparing, supervising and implementing projects and studies under its Technology Development Programme.

Regional science and technology (S & T) activities are being made consonant with development objectives through the forum of the Meeting of CARICOM Ministers responsible for science and technology. Prior to their meeting in Kingston, Jamaica, on April 6-7, 1983, there was a preparatory meeting of officials which had as its objective the identification of critical areas in science and technology and to make recommendations for action in the short, medium and long-term. The Ministers, when they met, had the reports addressing these problems facing science and technology development in the Region. This provided them with a policy framework for the development of science and technology activities at the regional level.

A Regional Energy Action Programme (REAP) was adopted by the Conference of CARICOM Heads of Government in July 1983. REAP seeks to alleviate, within the shortest possible time, the adverse impact of the energy crisis on Caribbean economies while laying the basis for more co-ordinated and rational development of energy resources of the Region. The REAP places major emphasis on specific programmes and projects that can have important beneficial impacts over the short and medium term on the energy balance of individual countries and the Region as a whole, with a net reduction in the foreign exchange outlays for energy. CDB is the principal executing agency.

PART 3 - SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1. Human and financial resources

The Bank, in its approach to human resources, seeks to upgrade this at all levels. This is primarily accomplished through its Technical Assistance Fund, the Student Loan Scheme and the Project Administration Training Unit. With the Technical Assistance Fund, the Bank is able to fund expanded technical assistance activities for both project-related and general development requirements. This includes pre-investment studies, advisory services and training in its borrowing member countries and institutions serving them.

Upgrading human resources involves, first of all, the provision of managerial, organization and technical skills at all levels. The Bank, in its goal of building this capacity within member states, has established the Project Administration Training Unit (PATU). This Unit provides training for high-level and intermediate-level officials involved in all phases of the project cycle.

In addition, the Bank has developed a Student Loan Scheme under which it makes loans on concessionary terms to Governments for on-lending to students pursuing approved courses in higher technical and vocational education. In the general sphere of education, the Bank has provided assistance, from time to time, to the University of the West Indies and the University of Guyana in organizing specialized courses and seminars.

Also, the TEU is frequently involved in co-sponsoring and organizing workshops and seminars which promote awareness and sensitization to developments and issues related to science and technology and facilitate information-sharing.

3.2. Information resources

Within the Bank, the established mechanisms for providing scientific researchers and other professionals with advice and bibliographic material are:

(i) the CTCS Network; and

(ii) the Library.

The CTCS Network was established as a pilot project for the promotion of intra-regional information transfer. It was conceived as a "mechanism by which the knowledge and skills accumulated but scattered throughout the Caribbean can be mobilised and applied to the needs of Caribbean industry and, where appropriate, adapted and transferred to productive enterprises to make them more responsive to market opportunities and more self-reliant".

Based on the experiences of the pilot project, which demonstrated a need for technical assistance in the field to help users analyze and define their needs and apply information received, an extension programme was created. There are two part-time extension officers -an experienced industrial engineer and an experienced food technologist- who visit member countries of the Organization of Eastern Caribbean States (OECS) regularly to identify and define information and technical assistance needs, provide technical advice to requesters and promote the continued development of the CTCS Network.

The CTCS Network can only provide technical assistance in the field that is of short duration (3-4 weeks or less). The Network operates through the establishment of local nodes in participating countries referral centres. These serve as focal points in the country for processing and referring requests to CDB which serves as Network Co-ordinator. They also assist in identifying suitable persons in the country for solving problems referred to the Network. Resource institutions are usually research centres, e.g. the University of the West Indies (UWI), the Caribbean Industrial Research Institute (CARIRI) in Trinidad and Tobago, the Scientific Research Council (SRC) of Jamaica, the Jamaica Bureau of Standards (JBS), and the Institute of Applied Science and Technology (IAST) in Guyana. In addition, resource persons are drawn from government departments and private sector organizations, as well as private individuals.

The Library of the Bank collects and disseminates information on social and economic affairs in the Region, with special emphasis on documents originating in the Region in general, and Barbados and the Eastern Caribbean in particular. Its services, as well as those of the CTCS, are automated through a computerized data base and an on-line catalogue of all documents acquired through the system. Full bibliographic details are given for all catalogue entries and all CDB-produced documents, as well as documents acquired by the CTCS Network.

3.3. Surveying of scientific and technological potential

The TEU works on new techniques prior to their proven commercial viability in the Caribbean. They are generally small-scale techniques which show promise for replication. Through the Technology Development Programme, these techniques are tested, demonstrated and applied. Activities of the TEU may be grouped under three areas:

(a) a Communications Programme which seeks to establish mechanisms for sharing technology-related information, experiences and skills among specialists in Commonwealth Caribbean countries as a means of developing technological capabilities within the Region, promoting co-ordinated approaches to common problems and maximizing benefits to the Region from its scarce skilled manpower and financial resources in meeting its technology requirements;

(b) a Technology Development Programme (TDP) which seeks to generate reliable information on the scale and quality of indigenous energy, biological and mineral resources, to analyze opportunities for applying these resources and to demonstrate or adapt techniques for utilising these resources which potentially are widely replicable in CDB member countries and well suited to the needs and circumstances of the countries; and

(c) an Energy Conservation and Fuel Substitution Programme which seeks to accelerate the adoption of energy conservation measures and promote economic substitution of imported fossil fuels by local energy resources.

PART 4 - POLICY ISSUES IN SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1. Major developments

Three major developments occurring within the last year and expected to have significant impact on the development of science and technology are:

(i) the REAP:

(ii) the creation of a Standing Committee of CARICOM Ministers responsible for science and technology and the formulation of a Regional Plan of Action for science and technology; and

(iii) the Proposals for Structural Adjustment for accelerated development and integration in the Caribbean Community.

The Bank played an important role in each of these important developments, especially in the REAP and the Structural Adjustment Programme. The latter includes recommendations for development of science, technology and information.

* * *

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