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DRAFT
 SCIENCE AND TECHNOLOGY
 POLICY AND PLAN
 FOR THE CARIBBEAN

prepared for
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SCIENCE AND TECHNOLOGY POLICY AND PLAN FOR THE CARIBBEAN

1.0 INTRODUCTION

- 1.1 Recognising the pivotal and pervasive role which the application of science and technology plays in the development process, CARICOM Ministers with responsibility for science and technology decided at the first ministerial sub-committee meeting in Antigua on 4 May 1984, that a science and technology policy and plan for the region should be formulated.
- 1.2 Caribbean countries many of which are small island states, have very limited human financial and natural resources, but it is recognised that however small any individual country might be, there are several issues relating to national decisions and choices over which it potentially has total or substantial control. Conversely, there are many important issues which impact on national development over which there is little internal control. Within the first category, however, the potential is only realised when there exists the endogenous capacity to make informed decisions and choices. Providing a framework within which such endogenous capacity can be developed and strengthened nationally, or by co-operative action regionally, is a major objective of a science and technology policy and plan for the region.
- 1.3 Whatever the resource constraints of any country, it will derive tangible benefits from allocating resources to the systematic application of science and technology to its national development, since a greater drain on national resources results when this is not done. To derive the maximum benefits from such resource allocations, it is therefore important that adequate administrative and technical machinery be put in place to ensure that science and technology considerations are factored into national planning and decision-making on an on-going basis. The mere establishment of a national science and technology council, especially if it is divorced from the mainstream planning process, is not likely to be adequate.
- 1.4 There are certain policy issues and objectives that are common to all countries in the region. There are others which are country

specific depending on the special characteristics of the country and its particular resource endowments. One policy issue in the latter category, for example, would show optimally how to utilise or exploit a unique indigenous natural resource. A policy issue common to all Caribbean countries is how to organise internally to make full use of the many and varied programmes offered by international agencies.

2.0 POLICY OVERVIEW

2.1 For the Caribbean as a whole, a Science and Technology Policy and Plan must serve to promote the use of science and technology to accelerate the attainment of social and economic well-being of Caribbean people. It must strive specifically to:-

- a) optimise the benefits derived from available resources while protecting the environment;
- b) develop and make use of skilled human resources as the critical engine for transformation and growth;
- c) create dynamism in existing and future Caribbean industry to enable rapid adjustment to technological, market and other changes which affect competitiveness.

2.2 Central to a science and technology policy and plan for the region must be the recognition that with respect to the effective utilization of science and technology in a country's development process, the developing and harnessing of its human resources are of comparable importance to its endowment of physical resources.

2.3 At the national and regional levels decisions must be made on an on-going basis about specific areas in which a sound knowledge and skills base must be developed. Having identified these specific areas, countries working individually or collectively must formulate innovative strategies and action plans to develop the desired levels of knowledge and skills.

3.0 SPECIFIC POLICY ISSUES

3.1 LEADERSHIP AND DEVELOPMENT

The development of competent leadership and management skills among men and women of the Caribbean constitutes an indispensable element of a regional science and technology policy and plan. Investment in human resources development for the planning, management and implementation of science and technology programmes has been shown to yield countless lasting dividends. Management of R + D, in particular, appears to be an area requiring significant attention in the Caribbean as a whole.

3.2 TECHNOLOGY ACQUISITION

All Caribbean countries spend large sums of money acquiring technology in the form of equipment, plant and machinery. This technology acquisition takes place both in the state sector and in the private sector. It is important, therefore, to establish and strengthen national and regional mechanisms to facilitate the evaluation of these technology imports in order to minimise costly errors, and enhance the benefits the region derives from these considerable expenditures. Of equal importance must be the recognition that technology acquisition can be used, not only to increase productive capacity at the enterprise or sector level, but as a vehicle for the development of technological capacity. National policies and strategies need to be formulated to encourage private enterprises and state corporations to exploit the full learning potential afforded through technology imports.

3.3 SCIENTIFIC AND TECHNOLOGICAL INFORMATION SYSTEMS AND SERVICES

Scientific and technological information is universally recognised as a critical resource in the application of science and technology to national development. Each country needs to have ready access to information generated within its borders, regionally and internationally, that might impact on or influence its activities

or decisions at all levels. Various categories of personnel such as state officials, entrepreneurs, scientists and engineers, researchers, etc., need timely access to the best information available, whether initially generated in their own country or abroad. Furthermore, well developed scientific and technological information systems and services constitute an important element of the technological capacity to evaluate, select and absorb imported technology as well as to generate local technology.

3.3.1 Unfortunately, most Caribbean countries have very weak information infrastructures, that is, inadequate systems for locating, acquiring, analysing, repackaging and disseminating scientific and technological information to prime user categories. The establishment of national sectoral data bases and facilities for gaining access to external data bases are important targets to be achieved by most Caribbean countries. Additionally, the region must develop effective technological intelligence systems to enable countries to be aware, in good time, of important international developments which might impact either positively or negatively on national economies of the region. Appropriate regional and national initiatives need to be undertaken to upgrade national scientific and technological information infrastructures.

3.3.2 Many sectors of Caribbean countries are experiencing rapid erosion of their competitive position. Slowness in responding to technological changes is an important factor in this process. Recent advances in biotechnology, materials science and communications technology and the resulting upheavals in industry and agriculture worldwide, have served to dramatise the vital importance of science, technology and information for achieving rapid adjustment to change, an essential requirement for creating and maintaining national and regional prosperity.

3.4 ELECTRONIC REPAIR AND MAINTENANCE CAPACITY

Caribbean countries lose millions of dollars each year as a result of equipment and machinery downtime in both productive and non-

productive sectors of national economies. In any one country the phenomenon of long equipment and machinery downtimes is endemic, and is common to state agencies and private industry alike. The problem is currently becoming more acute because increasingly mechanical and electromechanical devices are being superceded by microprocessor controlled mechanisms, and therefore traditional repair and maintenance skills such as exists are rapidly becoming obsolete. Concerted national and regional action with respect to training and retraining to create an adequate technological capacity in this area of electronic repair and maintenance is a necessity. Development of this competence and expertise will also reduce the dependence on foreign servicemen as well as outflows of limited foreign exchange resources.

3.5 AGROINDUSTRY

Most Caribbean countries have significant potential for indigenous agroindustry, industrial extension services, fiscal incentives, information services, research and development work, marketing expertise. These all need to be provided and co-ordinated in a thrust to promote agroindustry at the cottage industry and enterprise level.

3.6 MICROELECTRONICS AND BIOTECHNOLOGY

Microelectronics, robotics, genetic engineering and biotechnology all have far reaching implications for countries of the region and pose both opportunities and threats to Caribbean industry and agriculture. The region must equip itself to make use of the opportunities provided by these developments while simultaneously taking effective measures to offset their most serious negative impacts. Research institutions in the region should allocate adequate resources to develop selective expertise in new technology fields. Caribbean countries must ensure that maximum benefit is derived for the region from international initiatives such as the establishment of the International Centre for Genetic Engineering and Biotechnology.

3.7 INDUSTRIAL PROPERTY - Patents

Patents are an important component of industrial property within the context of a science and technology policy. There are two distinct facets of the patents issue. Patents provide one of the most valuable sources of worldwide technological information and therefore Caribbean access to international patent data bases is very important. Patent legislation and administration in Caribbean countries constitute the second aspect. In every Caribbean country more than ninety percent of registered patents are of foreign origin. This is not to be unexpected in view of the large quantum of resources allocated to research and innovation in metropolitan countries. But recognising that the protection of local innovations is only a secondary objective of national patent legislation in the Caribbean, it is desirable to review patent legislation and patent practices in the region to determine whether the region's best interests are being currently served. A specific study on patent practices in certain third world countries with respect to pharmaceuticals would highlight some of the salient issues.

3.8 COMPUTERS

In the Caribbean as in many other parts of the world it is no longer a question of whether there will be widespread computerisation, but rather when and how. The critical issue of 'how' depends on our ability to prepare ourselves adequately to make discriminating judgements and choices. With the rapid development of powerful and versatile mini- and micro-computers we need to become sufficiently informed so that cost-effective decisions are made when purchasing computer hardware and software. For most applications in the Caribbean mainframe computers are not necessarily appropriate and should be acquired only after thorough analysis. The recent introduction of computer training in schools in some Caribbean countries to promote computer literacy among the young is to be encouraged and emulated. To

complement these initiatives adult computer training programmes are required particularly for state sector officials to de-mystify the computer among this important decision-making group.

3.9 TELECOMMUNICATIONS TECHNOLOGY

The advances made within the last decade in telecommunications technology particularly with respect to communications satellites and packet-switching data networks afford countries in the Caribbean both opportunities and challenges. The opportunities relate to the possibilities for enhanced international communications through electronic mail, facsimile transmission and live television broadcasts of international events. One challenge that needs to be addressed is how to maintain a country's national cultural identity while at the same time being transparent to foreign television signals.

4.0 RELATED ISSUES

In relation to the foregoing discussion some of the issues which Caribbean countries must resolve if science and technology are to contribute effectively to Caribbean development are outlined below.

4.1 OVERALL ISSUES

- a) Ensuring that science and technology considerations have due influence on the objectives of National Development plans;
- b) finding the most appropriate infrastructure, especially in the small island states, for monitoring and evaluating the science and technology policy and action plan.

4.2 R+D ISSUES

Mobilising R+D institutions separately and collectively to effectively exploit the natural resources of the region through a combination of innovative and adaptive responses. Specifically:-

- a) developing applied research and technology adaptation capabilities in biotechnology with emphasis on agricultural

application of tissue culture and nitrogen-fixing bacteria;

- b) linking R+D with the productive sector and stimulating new industries based on local raw materials.

4.3 ISSUES RELATED TO HUMAN RESOURCES

- a) Finding innovative and cost-saving strategies to fill the critical human resource gaps;
- b) stemming the outflow of skilled manpower and reversing the brain drain;
- c) addressing the specific issues of equipment/instrument repair and maintenance and design and fabrication of small-scale equipment especially for agriculture.

4.4 ISSUES RELATED TO TECHNOLOGY ACQUISITION

- a) Reducing the cost of technology imports and minimising their inappropriateness;
- b) monitoring developments in areas of rapid technological change and performing strategic planning;
- c) developing regional capability to perform technology assessments, pre-investment and investment studies for projects in areas of high priority;
- d) applying microelectronics and information technology to increase production efficiency in manufacturing and service industries, and to improve management systems.

4.5 INTERNATIONAL CO-OPERATION

Optimising the use of programmes offered by international agencies.

4.6 GENERAL ISSUE

Creating the climate necessary for science and technology to become an integral part of Caribbean culture and eradicating the notion that science and technology issues are the concern of the elite.

5.0 STRATEGIES FOR A CARIBBEAN SCIENCE AND TECHNOLOGY
POLICY AND PLAN

5.1 Optimisation of Resource Use

- a) Devise mission-oriented R+D, technical support, and information services that focus on specific problem areas in which substantial impact/benefit is possible through the rapid development and transfer of vital information to productive sectors;
- b) shift funding and human resources to priority areas, and encourage growth and development of key technological service and manufacturing activities so as to create a science and technology platform which can provide inputs (that are within the capacities of countries to generate) which are critical to achieving development objectives;
- c) specifically,
 - i) expand agribusiness in the areas of production, processing and marketing of agricultural and marine produce by improving post-harvest handling, storage and processing technology, and agricultural marketing and sales technology generally;
 - ii) develop an industrial capacity in moulding and in materials technology centred on the use of plastics and composite materials produced from regional raw materials (mainly petroleum, sugar-cane, bananas, coconuts and forest resources).

5.2 HUMAN RESOURCE USE AND DEVELOPMENT

- a) Establish network mechanisms to create the critical mass of skilled human resources and the delivery systems necessary to effectively satisfy vital technology needs of the region, through the sharing of available skills and information;
- b) emphasize flexibility and adaptability in development of productive, service and training capacities/facilities in order to facilitate rapid adjustment of changing opportunities;

- c) institute/expand training incentive schemes for firms and individuals, and establish more effective links between educational processes and systems and the science and technology training needs of industry;
- d) tap the reservoir of skills represented by Caribbean nationals overseas through TOKTEN (a UN sponsored programme to promote the "Transfer of Knowledge through Expatriate Nationals") and similar schemes.

5.3 PROMOTION OF DYNAMISM

- a) Forge a higher level of co-ordination between government, productive sectors, universities, technical colleges and technical institutions by developing more explicit policies to this end and by creating strong co-ordinating agencies to interpret, monitor, evaluate and promote implementation of science and technology policies and programmes, and to formulate policy advice and direction, as needed to respond to change;
- b) institute measures to assist established industries to vigorously pursue:
 - development of marketing progress
 - produce diversification
 - production cost reduction
 - quality improvement
 - by-product utilization
 - greater operational efficiency especially in terms of energy use;
- c) develop systems which generate feedback from and greater awareness of the changing economic and technological environment in which Caribbean enterprises must operate, and of the consequential changes in needs and opportunities through the creation of specialised data bases, technology alert systems, etc.

5.4 TECHNOLOGY ACQUISITION

- a) Devise a regional mechanism for registering, monitoring, screening and evaluating technology imports, and assisting governments in technology negotiations;
- b) strengthen consultant engineering capability in the region;
- c) establish, as a permanent feature, mission-oriented industrial and agricultural extension services, particularly to small and medium-scale enterprises, focused on specific priority areas that can be quickly improved through transfer of knowledge and skills to producers and on generating feedback on specific problems;
- d) establish a mechanism to co-ordinate technical and other forms of assistance from international agencies.

6.0 PROGRAMME OF ACTION

6.1 The Action Programme outlined below covers a 5-10 year period. The various activities that constitute the Programme attempt to achieve the following main objectives:

- a) Developing an endogenous science and technology capability, taking advantage where possible of leap-frogging opportunities offered by new technological developments;
- b) optimising the use of imported technology and increasing the efficiency with which imported goods are used, especially energy, food, pharmaceuticals and electronic equipment;
- c) exploiting the natural resources of land and sea through a vigorous programme of R+D, and concomitant economic commercialisation in agro-industry, oceanography and marine sciences in particular.

6.2 Crucial to achievement of the above objectives is the existence of the necessary infrastructure and of the critical mass of human resources. The activities set out below at 6.3-6.5 address these needs.

6.3 SCIENCE AND TECHNOLOGY POLICIES AND PLANS

- a) Training a cadre of persons associated with National Science and Technology Councils or Planning Units in science and technology policy and planning; one seminar each year for three years;
- b) improving the collection of science and technology statistics;
- c) survey of the science and technology potential of the region;
- d) establishing a Regional Training and Research Unit in science and technology policy and planning.

6.4 SCIENTIFIC AND TECHNOLOGICAL (S+T) INFORMATION

- a) Establishment of the Caribbean Network for the Exchange of Information and Experience in Science and Technology (CARSTIN):
 - i) creation and strengthening of data bases;
 - ii) creation and strengthening of specialised mechanisms for the exchange of S+T information and experience in selected subject fields (initially, Technology Importation, Energy, Agro-Industry and Marine Sciences) covering the Caribbean as a whole or parts of it, and processing bibliographic and/or non-bibliographic information;
 - iii) creation of a general framework for co-operation;
 - iv) training of information specialists and users;

- b) strengthening national S+T information systems;

NB - this activity will be undertaken in conjunction with (a).

6.5 HUMAN RESOURCES DEVELOPMENT

- a) Regional survey to identify critical gaps in areas of high priority;
- b) intensive, circuit-type short courses and technology transfer workshops;
- c) including in all other activities a component of human resource development, for example, in S+T information, training of information specialists and users (see below);

- d) preparation of comprehensive plan to link educational processes and systems more closely with the S+T training needs of industry and research.

6.6 AGRO-INDUSTRY

- a) Commercialisation of R+D and upgrading and rationalisation of Agro-labs in the Organisation of Eastern Caribbean States;
- b) specialised training for agro-industry research and technical personnel (intensive short courses, attachments, etc.)
- c) R+D, pilot studies and commercial feasibility analysis on use of local raw materials as animal feed, fertiliser and fuel. In particular, examining the feasibility of leucaena as an economic source of fuel, fertiliser and animal feed in the Caribbean;
- d) quality control and standards in agro-industry;
- e) devising systems for the reduction of post-harvest losses;
- f) fabrication of small-scale machinery and equipment.

6.7 MARINE SCIENCES

- a) Establishment of National Oceanographic Commissions;
- b) R+D network in Marine Sciences:
 - i) coastal management;
 - ii) marine pollution;
 - iii) mariculture;
- c) training in marine sciences and oceanography (intensive courses, seminars and workshops, strengthening existing institutions).

6.8 TECHNOLOGY ACQUISITION

- a) Establishment of a permanent Caribbean Technological Consultancy Services (CTCS) Network (linked to CARSTIN);

- b) regional mechanism for monitoring and evaluating new technological developments (to be linked with UNCSTD's Advance Technology Alert System - ATAS);
- c) training of a cadre of persons in technology bargaining and negotiation;
- d) establishment of a Regional Centre for the Transfer of Technology (to deal with registration of technologies, legislation, issues of technology requisition, etc.).
- e) modernization and strengthening of industrial property systems bearing in mind that in the case of patents, more than 90% of patents registered in the Caribbean are owned outside of the region.

6.9 NEW TECHNOLOGIES

- a) See 6.8 (b) above;
- b) Caribbean Seminar on new technologies: formation of regional action plan;
- c) establishment of Biotechnology Resource Centre (Network);
- d) establishment of Microelectronics Resource Centre (Network);
- e) training in biotechnology and microelectronics.

6.10 MAKING SCIENCE AND TECHNOLOGY AN INTEGRAL PART OF CARIBBEAN CULTURE

- a) Staging public awareness programmes to popularise science and technology, using:-
 - i) audio-visual and printed material, for example, magazines, comic strips;
 - ii) museums, exhibitions and science fairs;
- b) training of science educators, scientists and media personnel in science communication.



