

Promoting an Integrated Approach to Water Resources Management: The Caribbean Council for Science and Technology (CCST)

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Introduction

One of the most critical demands for SIDS is the on-going enhancement of a scientific and technological capacity which can effectively draw on traditional knowledge and, at the same time, pursue creative adaptation of R&D from imported technologies of the North. The need for information exchange and technology transfer among and between scientific institutions of the South presents a major challenge to existing forms of functional co-operation available to SIDS.

The heavy economic costs of R&D make it even more pertinent for appropriate mechanisms and national policies to foster exchanges of personnel and multi-disciplinary approaches in attempting to build S&T capacity within SIDS. In this regard, the strengthening of regional and sub-regional institutions will be expected to play an innovative role in ensuring that there is value added and concrete prospects for the scaling-up of activities by national R&D institutions.

For Caribbean SIDS, a resource of enormous potential for technical co-operation in S&T exists in the Caribbean Council for Science and Technology (CCST), with its almost twenty years of training and research experience. From the wide variety of areas in which it has promoted collaborative R&D initiatives, recent advances in approaches to water resources management from an integrated perspective, will be examined in this case-study. Given the growing awareness of the pivotal role of water in regard to the critical demands of tourism and agriculture, as well as for the social sectors of health, sanitation and consumer affairs, the issues addressed will have far reaching consequences for sustainable human development, in the Caribbean and beyond.

Background

The Caribbean Council for Science and Technology is an intergovernmental organisation for the promotion of

functional co-operation in science and technology, with the goal of furthering the social and economic development of its member countries.

Established in **1981** by member governments of the Caribbean Development and Co-operation Committee (CDCC) with the assistance of the United Nations Educational, Scientific and Cultural Organisation (UNESCO), its membership comprises sixteen countries: Antigua and Barbuda, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago and The United States Virgin Islands.

The Council functions under the aegis of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), whose sub-regional headquarters for the Caribbean located in Port-of-Spain, Trinidad, serves as the secretariat for the CCST.

The statutes of the Council indicated that the overall objective is the promotion of co-operation among its member countries in the field of science and technology. This includes efforts aimed at the effective transfer of science and technology in order to facilitate the adaptation of imported technology and the development of indigenous technologies. The CCST is also charged with the responsibility of increasing the

bargaining and negotiating power of Caribbean countries with a view to improving access to use and ownership of technological resources, while encouraging scientists to have a more applied focus to their training and research.

During the last seventeen years of its existence, the Council has undertaken:

- Design and execution of appropriate joint scientific and technological projects and advisory services to the CDCC and its member countries on research and development issues.
- Devising procedures for effective dissemination of the results of Caribbean R&D projects and their application in member countries.
- Promotion of the establishment and strengthening of appropriate national and Caribbean organisations and mechanisms for science and technology development and application.

Organisation and Activities of the CCST

The Council meets in an annual plenary Session, to review the progress of the implementation of the work programme and any other decisions taken by the

previous plenary. An executive committee, consisting of representatives of six designated member countries meets once a year, outside of the plenary session, for more detailed examination of the functioning of the secretariat and for monitoring the progress of implementation of decisions taken by the plenary.

One of the strengths of the Council is its close working relationship with its member governments. Each member country designates a focal point, usually a senior government official, who co-ordinates activities at the national level, and networks with the other member countries.

The Trinidad-based secretariat has successfully developed very close working relationships with other organisations in the field of science and technology, including UNESCO, the University of the West Indies Center for Environment and Development (UWICED), the Latin American Economic System (SELA), the United Nations Development Programme/Special Unit for Technical Co-operation among Developing Countries (UNDP/SU/TCDC), the United States Export Commission on Renewable Energy (USECRE) and private sector agencies and enterprises in the Caribbean, as well as in developed countries.

A significant demonstration of the Council's networking capacity is

evident in the technical co-operation agreements, which have been signed with the Latin American Energy Organization (OLADE) and the Latin American Commission for Science and Technology (COLCYT).

The current areas of concentration of the Council are contained in a five-year work programme approved in the plenary sessions, as well as the Plan of Action for Science and Technology, which was developed by the CCST in conjunction with government representatives, regional and international organisations and experts in science and technology. The fourteenth and fifteenth plenary sessions held in Grenada and Trinidad and Tobago respectively, formulated a strategic direction for the Council in which there would be concerted efforts at:

- Assisting focal points to develop national science and technology work programmes.
- Science popularization in the society as a whole, as well as through formal and non-formal educational institutions.
- Renewable energy and energy efficient technologies.
- Environmental management with special reference to water resources.

From an array of scientific colloquia, research meetings and training seminars, convened by the Council to address issues of environmental management, a significant contribution has been made by CCST in sensitising scientists and policymakers to the importance of a multi-disciplinary and integrated approach to water resource management. The significance of this approach will be examined as one of the most relevant areas by which the work of CCST could provide lessons for promoting more efficient management of water resources, which is a Priority Area in the SIDS POA.

Water Resources Management: a Priority Area for Caribbean SIDS

The record of research projects and training seminars supported by the Council reveals that a general orientation of CCST is the promotion of S&T as an indispensable conceptual tool and policy platform that is “cross-cutting” and not merely sector-specific. This is an innovative departure for R&D to move beyond greater economic value primarily in relation to industry and manufacturing, as its main objective. Workshops and training activities by the Council are directed at giving specific attention to the critical importance of water as a multi-sectoral resource. By this means, the management, research and development of water resources are treated as increasingly significant to the

economic and social development of Caribbean societies. Such significance was derived from the importance of freshwater resources, in regard to health, the demand for water in connection with agricultural productivity through improved irrigation systems and the growing need of water supplies in the tourism sector, industrial development, sports and recreation facilities.

These demands were explicitly recognised in the **1994 SIDS POA**, which identified Water Resources as one of the **14 Priority Areas** and outlined a “basis for action” as follows:

Freshwater resources are vital for meeting basic needs and inadequate protection of the quality and supply of fresh-water resources can set important limits to sustainable development. Many health hazards in developing countries are related to poor water quality and limited water quantity. Because of their small size and particular geological, topographical and climatic conditions, many Small Island Developing States face severe constraints in terms of both the quality and quantity of fresh water. This is particularly the case for low lying coral-based island where ground water supplies are limited and they are protected only by a thin permeable soil. Even where rainfall

is abundant, access to clean water has been restricted by lack of adequate storage facilities and effective delivery systems.

Hence, it was both insightful and quite forward-looking on the part of CCST that its policy makers decided in 1993 to commission a comprehensive review of "Water Resource Conservation" in the context of Caribbean changing conditions.[^]

The research for this review addressed general issues of water supply problems and strategies for water Conservation as well as the specific conditions in ten Caribbean small islands and low-lying coastal states: Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Dominica, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines.

The study pointed to the limited attention given to national water policy, which requires a water management system to provide a framework for the variety of water-related decisions that have to be made in order to address issues of sustainability and ensure that an integrated perspective was applied to the role of water in socio-economic development.

A growing body of research on Caribbean water conditions and discussions among scientists affiliated to the CCST, have assisted in the popularising of an integrated approach.

Defining an Integrated Strategy for Water Conservation and Development

Three issues underline a holistic approach to water resource management. First is the irregularity of water distribution in the earth's surface. Along with this are problems of wastage, as the antithesis to proper conservation, and that of pollution arising from economic and social activities.

Uneven distribution of the total volume of freshwater on earth is based on geographic conditions whereby 69% in the form of ice and snow, is located in the polar regions (Shiklomarov, 1990). Rivers and lakes account for less than 3% of the earth's fresh groundwater. Of the total volume evaporated from the ocean surface, about 90% returns by precipitation and the remaining 10% is carried to the land by rainfall. The portion of this evaporation that small island states can intercept, is considered to be infinitesimal. This is also distributed unevenly through variation in seasons and weather patterns. These physical conditions set the parameters of water availability for SIDS.

Accompanying such material conditions are perceptions by a population, whereby an abundance of water is taken for granted and fosters an attitude towards wastage. Such an attitude may be found at all levels of society and may even be reflected in policies of the country that are not supportive of judicious use of the water supply and the promotion of conservation.

Groundwater which is usually more evenly distributed than surface water, can be easily tapped and is relatively insensitive to climatic factors. But this feature of easier accessibility makes it more susceptible to over exploitation.

The impact of economic progress should also be noted whereby, world water demand has been growing rapidly, because of improved living standards (Poster 1993). Hydrologists have classified some countries as "water-stressed or water-scarce," given the increasing number that have populations that cannot be comfortably sustained by the available water. The lack of water is also a severe constraint on food production, economic development and protection of natural resource systems.

R&D Water Resources and Policy Formulation

Water supply problems in some Caribbean islands were examined in 1980 by a group of water engineers (SOWRADAM Report). The variation in water supply was recognised as a function mainly of precipitation, vegetation cover, soil texture, topography and catchment area.

A mix of measures to address the water supply problems was adopted relative to physical conditions and patterns of economic development. But a net result

of interrelated factors made it increasingly difficult for the kinds of approaches devised, to significantly improve water conservation. For example, roof catchments to harvest rainwater (Antigua); barging in of water sourced from other islands in the **Bahamas**; or curbing leakages and better presentation of forests in catchment areas (St. Lucia and St. Vincent and the Grenadines) were of limited effect.

Attention therefore has been directed at soil and land management, active rain harvesting, groundwater recharge and waste water recycling. These were found to be necessary measures for improved water supply but the role of the consumer, whether household, agricultural, commercial or industrial, needed to be given systematic attention.

To address those concerns, questions of efficiency on the part of the consumer were identified for analysis. **ECLAC** observed in its 1993 Report:

After all that the municipal water boards can do to supply potable water, ultimately the consumer has the final control over how well the water is used. While supply line leakages can account for 25% to 70% water loss there is still at least a 15% end user wastage: (ECLAC 1993: 16)

In addition to public water use efficiency, there was need to examine the

ways in which wastewater was treated and the prospects for wastewater recycling had to be assessed in the context of current developmental needs of small societies.

In this regard, the awareness of an integrated management strategy as the major and indispensable approach began to emerge on the part of engineering professionals, scientists and managers in water utilities, as well as development agencies such as ECLAC and the CCST. Implications of an "integrated strategy were increasingly recognised.

Inter-Dependence of Finance, Education, Policy and Public Attitudes

Not only would project financing have to address capital requirements, for sewerage treatment plants, desalination equipment or pumping facilities, but also, a new emphasis on public acceptance and consciousness needed to be considered in order that efficiency could be improved by changes in consumer behaviour. But none of the above could be expected to have a sustainable impact without adequate attention to public policy and legislation.

With the benefit of more than a decade of data gathering and analysis, workshops and seminars, the efforts of CCST and collaborating institutions, in the area of water resource management

were brought together in a major symposium, with a view to advancing the understanding of practitioners and policy-makers on the essential features of an integrated management approach, as applicable to Caribbean SIDS.

A review of the insights and experience of the CCST 1997 Seminar/Workshop illustrates a state-of-the-art assessment and lessons to be learnt by Caribbean and other small societies. This event and gathering of scientists, policy-makers and development agencies marked a culmination of the Council's inspired efforts at collaboration on research and policy formulation, in regard to integrated water resources management.

Organised by the CCST, the Seminar/Workshop (June 24-27/1997) was held in fulfillment of a decision of the fourteenth plenary session of the Council and marked the culmination of many years of research and reflection by some eight major institutions, which are regional, hemispheric and international.

From an extensive array of scientific papers presented at the seminar, a summary statement on the main thematic areas was prepared. These areas are at the core of the institutional and policy reform measures that are generic to natural and water resources management. They also indicate the extent to which Caribbean experiences

on water resource management, may serve as a useful repertoire of insights that can be informative for the advancement of South-South co-operation.

Prior to the CCST 1997 seminar, the need for elaboration of theoretical and policy issues on integrated water resources management was recognised at the Conference on Water Resources Assessment and Management in Latin America and the Caribbean (San Jose, 1996). From that meeting resulted the San Jose Declaration and the Second Inter-American Dialogue on Water Management (Buenos Aires, 1996) produced the Declaration of Buenos Aires. Underlying these declarations of principles is the general awareness of the importance of including several dimensions of water management in as systematic a manner as possible, giving further credence to a search for an integrated approach. Fundamental to such an approach is the interrelated nature of common concerns by major stakeholders from a disciplinary, policy and managerial perspective.

Stakeholders Collaboration

Multi-sectoral country teams were represented among the seminar participants from Water and Sewerage Authorities, Ministries of Agriculture, Environment, Health, Planning and Finance in twenty-three Caribbean

countries. Sponsorship was provided by international, hemispheric and regional bodies, with longstanding interest in water resources management as a substantive area for the application of science and technology to sustainable development. ~

The range of participating organizations illustrate the interdisciplinary character from which presentations were drawn as a means of analysing experiences in natural and water resources management in the Caribbean and Latin America. Moreover such a composition of stakeholders recognize the importance, both conceptual and practical for inter-agency cooperation. It is not surprising that among the key areas identified for action was "institutional co-ordination" (Report 19973).

By definition, SIDS are characterised by limited technological capacity. Given the very limited access and availability of the range of specialised expertise that needs to be drawn upon for adequate understanding of "water resources" issues, it is incumbent that pooling of expertise and sharing of knowledge in the specialised areas be undertaken. But awareness of such a need is only one aspect of the search for an institutionalisation of processes that can support on-going data-gathering, reflection, formulation of policy recommendations and promoting the adoption of policy changes. To complement this institution building

dimension, must be public awareness and incentives for changes in behaviour.

The economic and financial issues in conjunction with legislative and institutional areas tend to comprise the neglected aspects of water resources management. Consisting mainly of social science and legal knowledge-bases, these aspects were traditionally not given comparable attention as those related to engineering and technological problems in the management of water.

In articulating an approach that would be truly inter-disciplinary and multi-sectoral, so as to be genuinely characterised as "integrated" management, the seminar examined several instances which utilised "multi-dimensional policies," thereby attempting to deal with all aspects of management. These refer to social, economic, political, technical and cultural issues that impact on efforts at effective management.

From the several experiences reviewed in the deliberations of the seminar, for purposes of the present study, lessons can be deduced from recent research in the U.S. Virgin Islands of St. Thomas, St. John and St. Croix." These observations can serve to illustrate interactions of technical, economic, social and cultural factors in the quest for sustainable water resource management, in an integrated manner.

The Impact of Access and Cost on Water Consumption

An approach to satisfying basic human water requirements suggests that a certain estimated amount of clean water per day can be considered a fundamental human right (Smith quoting Gleick, 1996). Taking account of various purposes - drinking, sanitation, bathing, cooking and kitchen - Gleick (1996) recommended 50 litres (13.2 gallons) per person per day as an adequate amount to satisfy basic human needs.

With improved standards of living, it is recognised that per capita increases as water demand occurs. This is based on an increase in the need for drinking water, higher levels of waste water, more manufactured goods, food production and greater energy production and consumption. In addition, water requirements related to the above vary with climatic conditions, lifestyles, tradition and technology. But, while taking into account cultural variables, access to water resources has been found to be a very important variable in determining the amount of water use (Smith, 19972).

To illustrate the interplay of complex factors such as availability perceptions of society and the policy environment, recent research from the U.S. Virgin Islands can be cited as quite instructive and serves to demonstrate an integrated approach to water resource manage-

ment, as advocated by CCST. In addition, useful lessons can be derived to promote the importance of public education and training as an important means to encourage implementation of the SIDS POA.

Constraints and Challenges Encountered in the U.S. Virgin Islands.

At the northern end of the Leeward Islands in the Caribbean, are the three major Virgin Islands which receive forty-five inches of rainfall annually, concentrated in about four months. They experience an average annual temperature of eighty degrees Fahrenheit. Steep slopes and high rates of evapo-transpiration significantly reduce supplies of surface water, to the extent that, "no surface water is used for human consumption" (Ibid. 1997:3). Moreover, on one island, St. Croix, a limestone aquifer provided ground water as a small contribution to total demand, but an increasing need to discharge wastewater resulted in "contamination of the ground water supply."

Rain water harvesting has been an additional and significant source of supply, with "volumes of storage" regulated by law, without provisions for "monitoring the quality of water" (ibid. 1997:34). Concrete storage tanks with harvested water for a potable supply and firefighting purposes were at times provided.

It was observed by the researchers that "the introduction of a public distribution system was a principal contributant to increasing water demand," which underscored the principle that increase in access has a concomitant growth in water demand. Moreover, establishment of a distribution network made possible the use of other sources of water supply, as for example, high quality fresh water sourced from seawater through desalination plants. Adoption in the USVI of desalination technology, was possible through availability of capital from the US Government, mainly in grants and loans. But high cost of desalinated water prompted its use being restricted to where low quality water could not be used. For the latter, a secondary distribution network from seawater was installed, as for example, to satisfy "fire-fighting, street and gutter cleaning and toilet flushing purposes."

In addition to greater demand and increasing costs, technical and social consequences resulted from the dual distribution system. First, was a decrease in the quality of the ground water supply and a discontinuance of the use of virtually all wells in the capital city. More significantly, a social psychological effect which resulted, was "the creation of an expectation that water would be always available in demand satisfying quantities and quality independent of the occurrence of the rainfall" (Ibid., 1997:5).

With excessive demands placed on the cistern storage systems, problems with the desalination technology and increasing losses of desalinated water, as high as 60%, as well as the decline in funds from the US Government, a "glorious age" of water availability, and accompanying expectations, was brought to an abrupt end.

The situation had deteriorated so seriously that strict water rationing was introduced to the extent that "the most fortunate residents could expect only two hours of water on a daily basis," through the distribution system. As a result, a programme of water conservation became an urgent necessity and measures adopted were in keeping with the need for an integrated approach in which technical, educational and policy considerations were introduced. Some of the measures addressed were:

- (1) Rebates for installation of more efficient plumbing fixtures.
- (2) Public education in programmes aimed at changing water use attitudes and practices.
- (3) Incentives to decrease dependence on the public water supply system.
- (4) Monitoring of water consumption by meters and charging customer amount of water used.

The net effect of such an approach was a dramatic decline in per capita water consumption, which has since led to a strong consciousness of the need for water conservation. The tendency therefore for demand to increase as water availability increases and the need to practice conservation are certainly experiences with lessons learned in the U.S. Virgin Islands, that are applicable elsewhere in the Caribbean. The example set by the CCST in providing a forum for professional scientists and policy makers to exchange findings of their research contributed significantly to an accumulation of knowledge and practices by which more efficient water resource management was being adopted in national agencies with responsibilities for water supply.

Lessons Learned

- From an holistic perspective, the effective management of water resources requires an understanding of the physical conditions affecting water availability and supply and the policy measures introduced for conservation and use by consumers that optimise efficiency with cost containment. In this regard, the research by Smith reported at the 1977 Seminar as described above, is instructive in highlighting several institutional factors from which policy lessons

can be derived (see Smith 1997 5-8).

- For instance:

- (i) Granting approvals for building construction or renovations should include measures for promotion of water conservation.

- (ii) In periods of extreme shortages, ordinances can be passed to restrict practices such as car-washing, lawn watering and other less critical uses of water.

- (iii) Planning agencies or appropriate policy agencies, should implement applications for building developments (whether residential, commercial or industrial) to include water saving measures. Among these could be plumbing fixtures, provisions for recycling or multiple use of water and landscaping strategies.

- (iv) Provision of fiscal incentives by tax rebates to developers or for water saving devices in homes.

- (v) Procurement policies and practices by public agencies can influence suppliers to carry stocks of water saving devices and their use in public facilities could serve as demonstration projects to educate the public.

- (vi) More explicitly, public education on the importance of water conservation, should be nothing less than national campaigns by government agencies targeting schools, churches, utilities, NGOs, and other organs of civil society.

- (vii) Suitable pricing mechanisms that protect vulnerable groups, and differentiate rates by categories of consumers with a view to recovering the true cost of obtaining and distributing water, should be implemented.

- The proceedings of the CCST Seminar revealed that a broad consensus was shared by participants, that "public education is the most effective way of promoting water conservation." It was also acknowledged that with growth in awareness and understanding, wise usage of water can have far reaching multiplier effects, such as reduction of waste water and enhanced conservation. An integrated approach was thereby beneficial in arriving at a broader analytical framework and at the same time, enabling the achievement of results that take account of sustainability.

- The impact of education programmes will depend both on the methods and forms utilised as well as the content and substantive issues addressed by the programmes. For the latter, it is indispensable that relevant and rigorous scientific research and analysis of water resources, their supply, demand, consumption, cost, quality and policy frameworks should be continuously undertaken. Research has to be encouraged and opportunities provided for debate and dialogue on its findings - a role for which the CCST is well equipped.
- The efforts made by the Council further illustrate how a regional institution can play a pivotal role in promoting an integrated approach to finding solutions for problems in the area of water resource management, which transcend one sector or discipline.
- With limited expertise and the complexity of the issues to be analysed, there is ample justi-

fication for inter-agency collaboration and networks for co-operation (Report 1997:39-43). The mission of the CCST will therefore be expected to assume increasing importance as a regional institution serving

the Caribbean SIDS. It is also hoped that insights of these experiences in the Caribbean can benefit other SIDS as a genuine contribution to TCDC.

Recommendations

Access to freshwater has become a limiting factor to sustainable human development among developing countries and in particular SIDS. The facilitating role played by CCST in addressing this issue needs to be supported. It is recommended that wider dissemination of the results of its work should also be made through the popular media.

¹See CCST/UNECLAC/Caribbean Documentation Centre, Background Research on Water Resource Conservation in the Context of Sustained Development, 1993.

*Draft Proceedings of the Seminar/Workshop on Integrated Water Resources Management Institutional and Policy Reform, Port-of-Spain, Trinidad & Tobago, December, 1997, pp65.

9 Included as sponsors were the Caribbean Development Bank (CDB), the Commonwealth Science Council (CSC), the Economic Development Institute (EDI) of the World Bank, the Inter-American Development Bank (IDB), the Inter-American Water Resources Network (IWRN) of the Organization of American States (OAS) and the World Meteorological Organization (WMO).

"Seminar Proceeding, 1997-8 and H.H. Smith, "Interactions of Water Production, Use and Conservation," Water Resources Research Institute, UV, 1997, pp9.

"The discussion relies on material report at the CCST Seminar from the work by H.H. Smith of the Water Resources Research Institute, St. Thomas.