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**THE IMPACT OF NEW TECHNOLOGIES ON THE  
DEVELOPMENT PROCESS IN THE CARIBBEAN**

# IMPACT OF NEW TECHNOLOGIES ON THE DEVELOPMENT PROCESS IN THE CARIBBEAN REGION

## Background

Export agriculture in the region, characterized by production technologies that have not kept pace with new technologies, is under pressure. At the same time, aggressive marketing by foreign companies is drawing Caribbean peoples from some of the traditional, local staples and into increased consumption of foreign foods. Coupled with this trend is the fact that the imported products may not necessarily be of the highest quality or of the required nutritional value. As well, these products pose questions of ethics and unknown effects, arising from the very use of new technologies that are being employed in production. Caribbean governments, facing dwindling resources from agriculture as well as an increasing import food bill that may bring with it some health concerns must make critical decisions on new technology use to address economic development in the region.<sup>1</sup>

The other major foreign exchange earner in the Caribbean, tourism, is also under pressure from a number of sources, some internal and some external. New destinations, easier connections, cheaper airfares, and less expensive hotel rates are some of the major external challenges, while perceived reduction in product quality and facilities poses major internal problems in the sector. Environmental concerns, too, remain a major issue for the industry in general, while how to access maximum returns from the natural resource without pricing oneself out of the market remains the major concern to Caribbean Governments in particular.

In such a situation policy choices become challenging. In the agricultural sector, increasing export agriculture earnings; reducing food imports by promoting the use of local products and promoting environmentally sound agricultural practices are some of the policy options, not to mention the challenges. In the tourism sector maintaining the integrity of the environment, increasing the efficiency of services, improving local components of all products and delivery services and improved marketing strategies are the main challenges.

Although the above points have been enunciated by all governments, the methods for achieving the results are not as straightforward. Factors such as limited financial resources, lack of institutional capacity, and both regional and global events, are hurdles that need to be factored into the policy equation, which, even without the added factor of global uncertainty, makes implementation difficult.<sup>2</sup>

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<sup>1</sup> Miguel A. Altieri. Agricultural Biotechnology in the Developing World: The Myths, the Risks and the Alternatives. University of California, La Jolla. Paper delivered at the 52<sup>nd</sup> Pugwash Conference on Science and World Affairs. 10-14 August, 2002

<sup>2</sup> Report of the Standing Committee of Ministers Responsible for Agriculture, CARICOM. Belize City. 1997.

To a large extent, and particularly in the agricultural sector, the problem remains technological. Lack of adequate investment in research and development has meant that the technologies used in the sector have not kept pace with either market demands or with new technologies that are available. With the exception of the larger islands, introduction of new technology into the farming system, especially at the production level, remains problematic. Hilly terrain, small farm size, and land ownership problems are factors that inhibit investment. At the same time, production levels of individual crops under present farming techniques are usually insufficiently high to warrant large-scale investment given that, for the most part, outdated multi-crop farming remains the dominant practice for the majority of small farmers.<sup>3</sup>

Yet, agriculture remains the basis for employment and economic activity, especially in rural communities. Unless efforts are undertaken to transform the sector and make it more productive, the problems associated with rural-urban drift will continue to put pressure on the other sectors of economic activity and on the provision of social services which are already stretched in most of these countries.

While it is generally accepted that the introduction of new technologies can help solve many of the problems both in product development and in the provision of services, their applications pose challenges because of universality and latent effects. For example, biotechnological breakthroughs that will improve agricultural production in the region will do the same for its competitors, thus allowing them to maintain or even increase their competitiveness, vis-à-vis the Caribbean. The same is true of the tourism sector. The critical element of new technologies, therefore, is where, when and how to introduce them so that they provide some advantage, if only for a limited time, before a newer technology is available or the universality of the technology removes the competitive edge. To the extent that the region is not a major producer of technology that becomes a difficult strategy.<sup>4</sup>

In such a scenario the Caribbean has very little room to maneuver unless it can develop new and innovative products and services. In agriculture, it may be necessary to:

- (i) Employ new technologies to transform indigenous foods already in production into new products for identified niche markets;
- (ii) Minimize negative impacts on the ecosystem;
- (iii) Maintain or increase soil fertility; and
- (iv) Preserve the local water cycle.

With regard to the use of new technologies to transform foods, although that approach may just be as difficult as having to compete with similar products, it allows for the use of indigenous resources for which capital outlay may already have been made,

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<sup>3</sup> Small and Medium Sized Food Industries in the Caribbean: Transfer and Development of Technologies for Industrial Food Processing and Preservation. Report presented by Judith Francis ( IICA) for the CCST/OAS Project. December 1998.

<sup>4</sup> Richard Critchfield. Science and the Villager: The Last Sleeper Wakes. Foreign Affairs. Volume 61. Number 1. Fall 1982.

and for the tapping into the Caribbean diaspora for testing and marketing. For example, the French Caribbean islands have successfully increased the local and metropolitan use of the banana as a pre-packaged food that is easy to cook, as well as the fresh fruit. The transformed product is readily available in supermarkets. This has had the effect of stimulating new ideas into the islands' cuisine and which is now also available in the French metropolitan restaurants. The shortfall in fresh fruit export earnings is compensated by earnings from the transformed products.<sup>5</sup>

In the tourism sector, Bermuda, in the past, boosted its tourist trade and saved a substantial amount of foreign exchange by taking a simple but effective policy decision to promote short pants as casual wear on the island. At the same time it created a trademark, "Bermuda shorts", promoting a feeling of a casual relaxed atmosphere in its tourism trade. Bahamas is making a similar attempt with the slogan "It's better in the Bahamas."<sup>6</sup>

These approaches, however, whether they be in agriculture or tourism, require sustained investment, clear policy choices, good research capabilities and market and intelligence networks. They must also be holistic, to include the other leading sectors of the economy, such as energy, water resources, natural resources management, health and nutrition, fisheries, as well as the social implications of the decisions.

## **The present situation**

### *Agriculture*

The agricultural thrust in the region is still oriented towards primary production and mono-cropping, even after years of unfortunate experiences and poor policy choices, first with sugar cane, then cocoa, citrus, mangoes and more recently, bananas. The basic problem lies in the fact that while there is much talk about transformation of the sector by adding value to products through agro processing, the investments necessary to undertake this are not forthcoming. Allocations from the national budgets for research and development towards the transformation of the sector are often quite small, especially when compared to recurrent expenditure.<sup>7</sup> While donors have been willing to provide funding for agronomic and some post harvest research, they are not willing to approve funds for product development activities. The CARIFORUM Agribusiness Research and Training Fund (CARTF) project funded by the European Union is one example of the kind of assistance that donors provide. CARTF is a fund for the encouragement and support of agribusiness-controlled research and training (R&T) for Caribbean agriculture. The project aims at providing technical assistance for research and development for product improvement or new product development. However, the limit of US\$50,000 is inadequate for most needs. In addition the applicant is required to provide some matching

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<sup>5</sup> Institut National de la Recherche Agronomique (INRA). Centre de Recherches, Antilles-Guyane. Food Technology Research Institute leaflet. 1997.

<sup>6</sup> Bahamas Tourist Board Brochure. 1984.

<sup>7</sup> Belal Ahmed and Sultana Afroz. The Political Economy of Food and Agriculture in the Caribbean. Tom Randle Publishers. Jamaica. 1996.  
Industrial Policy and Caribbean Development. Dennis Pantin. University of the West Indies, St. Augustine. 1995.

funds. It is generally estimated that the development of a new product may cost in the vicinity of \$500,000 to \$2,000,000. With these limitations much of the activities of the project is usually spent on consultancies or in such limited areas as the production of juices, jams and tomato ketchup, products which are at the lower tier of agro-industrial development.<sup>8</sup>

Another problem with the development of agriculture in the Caribbean is the disjointed approach between agriculture, nutrition, health and manufacturing. To the extent that agricultural production in the region has its roots in export agriculture, there have been few linkages, with the exception of a few commodities such as rice and sugar, between what is produced and what becomes part of the diet of the population. In developed countries it is usually the surplus of agricultural production that is exported. In developing countries, the opposite occurs. It is the surplus, if any, of production that is consumed. In developing countries agriculture is seen as a foreign exchange earner mainly through primary produce and their limited research funds being spent primarily on agronomic research. In developed countries the benefits of agriculture are derived primarily from transformed agricultural products that are exported, but which also form part of the cuisine of those populations. Thus, pasta is found all over the world, as are apple juice, and mayonnaise. On the other hand, it would be almost impossible to find processed banana outside of Saint Lucia or Dominica or breadfruit balls, a dish made out of the indigenous breadfruit, on the regular menu in most hotels in the subregion.

Comparing any State University in the United States of America to the University of the West Indies (UWI), the Land Grant Universities responsible for agricultural development place equal emphasis on home economics as on agronomy, horticulture, fisheries and agricultural extension services. Together with the Department of Agriculture and the private sector, there is a Division of Home Economics that undertakes research and provides instruction on the preparation of foods, nutrition and health. The university campus serves as a microcosm of the wider community, demonstrating how production, processing and marketing take place as integrated approaches.<sup>9</sup> In the English-speaking Caribbean countries this is not the case at the institutions. Production, consumption and marketing are not integrated as a service sector. In fact, home economics is not a major subject at the regional university.<sup>10</sup>

The transformation of agriculture in the subregion will depend heavily on private sector investment to move from primary production to processed products. However, the private sector in the subregion is generally averse to taking risks associated with agro-processing, preferring instead to engage in trade of processed products. Sometimes these products may have been produced through branch plants of multinational corporations within the Caribbean, but in most cases they are imported from outside the subregion.

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<sup>8</sup> CARTF Information Brochure.

Kenneth H. Heller. Science and Technology. Foreign Affairs. Volume 69. Number 4. Fall 1990.

<sup>9</sup> B. R. Inmam and Daniel F. Burton. Technology and Competitiveness – The New Policy Frontier. Foreign Affairs. Volume 69. Number 4. Fall 1990.

<sup>10</sup> Report of the Standing Committee of Ministers Responsible for Agriculture (CARICOM). Belize City. 1997.

During the late 1980s an effort was made by a group of processors from Saint Lucia to establish an agro-processing plant. This was met with strategic resistance from importers in the private sector. The products were purchased by wholesalers and put on supermarket shelves, but not in prominent display positions. Without funding for marketing and advertising, the products were unable to penetrate the market and processing operations eventually ceased. This occurred during a period of foreign exchange control in the region and it has been suggested that this could have contributed to the demise of the enterprise. Similar cases have been noted at various regional meetings on small enterprise development.<sup>11</sup>

### *Tourism*

Most Caribbean governments look towards the tourism sector as the major vehicle for economic development. However, there remains a misconception that what the Caribbean has to offer to visitors could be developed in isolation from the activities of the population in general. Thus, the best beaches are reserved for hotels catering exclusively for tourists, the cuisine offered at many hotels and restaurants reflects foreign tastes. The items for sale at the hotel, the duty free shops, and malls are mainly imported from outside the subregion. Water, electricity and other amenities are provided to the designated tourism areas even as nearby communities and entire segments of the population are poorly served with these same amenities. The attractions of the subregion are sand, sea and sun. Efforts at eco-tourism, hiking, bicycling, horseback riding, and other similar activities are imitative of activities in developed countries. As such, both the management skills and the support services that make these successful are either lacking or need to be imported, often resulting in decreased profits from the ventures.<sup>12</sup>

Technological, managerial and general conduct of the industry are dictated outside of a country since in most cases, regulatory or policy instruments that direct the development of the industry are lacking in the region. Thus, if a hotel belonging to an international group has an established policy of, for example, using “gray” water to irrigate lawns, it is done at the local establishment. This is not because local laws or government policy require or promote the practice as a water conservation measure, but because it is a cost-effective measure practised by the hotel chain to reduce the cost of water, especially where water is a scarce commodity.

It may then be concluded that the thrust or preference for tourism over agriculture lies in the fact that the local private sector needs no investment in technology to support the industry. What is needed are marketing and the granting of tax holidays for a vibrant and economically viable sector. Tourism as an industry removes the burden of investment and development risks on the local private sector. However, at tourism and agricultural conferences held in the subregion, there is a call for integrating the two

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<sup>11</sup> Report of the Workshop on Alternative uses of Banana and Banana Products. CCST. Saint Lucia. 16-18 May 1997.

<sup>12</sup> S. Bookman and S. Spivak. Barriers to Sustainable Tourism Development. George Washington University, USA. Proceedings of the Caribbean Energy Conference and Trade Exposition. University of the Virgin Islands. 22 – 29 October 1993.

sectors, but no decisive steps have been taken to make this a reality. Such a step would require significant investment in technology and supporting institutions.

### *Nutrition and Health.*

According to the Caribbean Food and Nutrition Institute (CFNI), there is insufficient sustained attention given to the nutritional needs of the general population in the Caribbean. While the health service, with the exception of a few islands, may be considered adequate, the investment in curative health care outweighs preventative health care by a wide margin.<sup>13</sup> Diabetes, high blood pressure, and vitamin deficiencies are common problems among the Caribbean population. This is not a good indictment for a region that is blessed with an abundance of fruit, vegetables and nuts.<sup>14</sup> At an expert group meeting convened by ECLAC in Port of Spain Trinidad on food and nutrition in 1999, the Director of the School Feeding Programme of Trinidad and Tobago noted that greater efforts were made to increase the local component of the menus.<sup>15</sup> Convenience, aided by marketing strategies, seems to have redirected focus from nutrition and health to financial concerns. A soft drink manufacturer, for example, demands concessions from a government on the basis that it provides employment without consideration to the health issues associated with an over-consumption of sugar.<sup>16</sup> In one instance, a manufacturer/processor/importer of soya bean oil, was able to propagate the benefits of this product and the disadvantages of the indigenous coconut oil. There was no challenge from the University, even though the knowledge of basic organic chemistry would have sufficed to refute the claims.<sup>17</sup> The region is littered with vendors selling roast or bar-b- qued meats, especially chicken, which may be imported and below required standards.

As yet, the nutrient and nutritive values of many Caribbean food products are not widely known. The CFNI is making an effort to address the problem but it is under-funded, short-staffed and has very few linkages or even leverage with what is being served in school feeding programmes, as a start, even after the nutrient value has been determined for some Caribbean dishes. Its outreach programmes rarely filter down to the average food caterer. Government policy is sorely needed in that area.<sup>18</sup> The situation is no better in the health foods and/or pharmaceutical sector. After years of discussions and meetings, natural product development is still lacking in the Caribbean. For example, de-worming remedies obtained from a common local plant is still not manufactured in the region. Work on posology, which would bring some level of acceptance to medicinal

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<sup>13</sup> Report of the Expert Group Meeting on Agriculture with focus on the impact of new technologies on food, nutrition and health. 28 – 29 September 2000. LC/CAR/G.622. CDCC/ECLAC. January 2001.

<sup>14</sup> Report of the Standing Committee of Ministers Responsible for Agriculture, CARICOM. Belize City. 1997.

<sup>15</sup> Report of the Expert Group Meeting on Agriculture with focus on the impact of new technologies on food, nutrition and health. 28 – 29 September 2000. LC/CAR/G.622. CDCC/ECLAC. January 2001.

<sup>16</sup> Discussion with Mr. Sam Augier, Manager, S.M. Jaleel Co. Ltd. Trinidad and Tobago. April 2002.

<sup>17</sup> Jon J. Kabara, Ph.D. Professor Emeritus, Michigan State University. Health Benefits of Virgin Coconut Oil. <http://www.coconut-info.com>

<sup>18</sup> A New Vision for Caribbean Health: Caribbean Cooperation in Health. CARICOM Secretariat. Guyana. 1999.

herbs is still lacking allowing some professionals in the medical field to argue strongly against the use of herbal medication.<sup>19</sup>

### ***Manufacturing***

The indigenous manufacturing sector in the region remains weak because of lack of investment. However, to the extent that there is foreign investment in the manufacture of goods as branch plants or overseas units of foreign concerns, the situation will not improve. The banking system, too, is averse to risk-taking. It has been argued that to the extent that reliable and confidential means of verifying new indigenous technologies presented by new entrepreneurs are not at their disposal, it is safer to err on the side of caution and provide development funds for known entities.<sup>20</sup>

The public sector, which is supposed to provide the impetus for research and development, is itself constrained by limited financing and a dependence on foreign aid for critical development initiatives. A situation exists where the public sector is unable to promote research and development, a private sector that is averse to risk-taking and local entrepreneurs facing competition from imports, that are financed by their banking sector. One needs only look at the argument put forward by Caribbean Governments and institutions against farm subsidies in the United States to understand that very little will be done in the near future to change the present attitude towards investing in research and development. The same system of subsidies is used in the Common Agricultural Policy of the European Union with much less opposition from the Caribbean. Farm subsidies continue to be part of the economic landscape of developed countries. Developing countries do not have the financial means to provide direct subsidies, whether these be to the agricultural sector or the manufacturing sector. Given this position, it may be that developing countries need to devise some other method of providing assistance for the development of these sectors.<sup>21</sup>

### ***Energy***

One area in which most developing countries could have a competitive advantage if only they would change their energy programme is in the area of renewable energy.<sup>22</sup> For the Caribbean, however, this could only be favourable if there was a common regional energy policy promoting the use of renewable energy. At present over 90% of the energy needs of the subregion is supplied through hydrocarbon sources. Historically, forests provided the bulk of energy needs of developing countries. The decline in forest cover and the attendant results of poor soil fertility, erosion and reduced availability of water, coupled with development of diesel or bunker fuel engines in the developed countries, led to the introduction of these new machines into the developing countries.

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<sup>19</sup> Discussion with Dr. Gilberta St. Rose, Medical Doctor and Herbalist, Saint Lucia. 2001.

Gary J. Martin. *Ethnobotany: A People and Plants Conservation Manual*. Chapman and Hall. 1995. Page 92.

<sup>20</sup> Report of the Workshop on Alternative uses of Banana and Banana Products. CCST. Saint Lucia. 16-18 May 1997.

<sup>21</sup> Alan Tonelson. *Beating Back Predatory Trade*. Foreign Affairs. Volume 73. No. 4. Pages 123-135.

<sup>22</sup> Kulsman Ahmed. *Recent Developments in Solar Energy*. Industry and Energy Development. World Bank. Proceedings of the Meeting on Sustainable Alternatives for Tropical Island States. Satis 1994. Caribbean Solar Energy Society. Barbados, 1994. Pages 21-25.



Unfortunately, a number of institutional changes had to be made. The introduction of electricity from these fuels resulted in a number of situations including:

- hastened pace of urbanization;
- the creation of pockets of poverty within the urban areas;
- increased internal migration from the rural areas to the city;
- reduced labour available for agricultural production;
- increased cost of agricultural labour and the cost of production in the agricultural sector.

For countries that depended on agricultural export as their main source of foreign exchange, these changes were detrimental to the economy, resulting in decreased financing for a number of social programmes that would have been necessary to correct the problems associated with unplanned urbanization. While the introduction of hydrocarbon fuel electricity brought many benefits to the urban areas, and to some extent removed the pressure on the forests, it brought new problems of environmental concern. In addition, because of the high cost of operations and the high cost of fuel, the benefits to the rural areas were not felt immediately. Factors such as transmission loss and critical usage worked against the rural settings as houses were far between and in small numbers in any one locality, making grid connectivity costly and prohibitive in the rural areas. In addition, the cost of electricity vis-à-vis cost of production did not make the use of this energy form profitable for such activities as irrigation and agro-processing, which would both increase yield and provide incentives to farmers and others to industrialize agriculture.<sup>23</sup>

These very conditions, though, are ideal for the introduction of renewable energy, given that the Caribbean has an abundance of sun, wind, and in some countries, water. Technological advances in material science and engineering, though not developed in the region, have made solar panels and wind turbines competitive with hydrocarbon sources of energy. It would appear that the perceived stumbling blocks to the introduction of alternative energy sources are the investments that have already been made in non-renewable energy sources, familiarity with the technology, the initial cost of start-up. There is an urgent need for an initial mixed system and a change of policy to allow for decentralization of generation. The technical problems have already been worked out in some places in the Caribbean. Guadeloupe and Curacao, have geothermal energy and wind energy sources, respectively, in operation. The financial and policy changes seem to pose the most problems, according to the companies responsible for electricity generation. In this case, therefore, the policy instrument should precede the financial investment in order to get action on renewable energy introduction and acceptance.<sup>24</sup>

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<sup>23</sup> Allan Herbert. Opportunities in the Energy Field in Africa and how this relates to the Caribbean Nations. Africa Emancipation Foundation. Caribbean Energy Conference. United States Virgin Islands. 1993

<sup>24</sup> Karel Tujeehut. Energy for the Future: Development in Curacao. Proceedings of the Workshop on Renewable Energy in the Caribbean. Curacao. October 1996.

### *The Ecosystem*

Environmental awareness and programmes of amelioration are still relatively new to the subregion. In addition, the necessary research results that would enable policy makers to take and defend critical decisions against economic pressures are lacking. There is a mistaken belief that the natural elements were made solely for man's enjoyment. Therefore, if a secluded beach is discovered, the first thing that comes to the mind is the construction of a hotel or resort. Estuaries and mangroves are viewed as ideal spots for marinas, and the trees in the forest are seen solely as material for construction. Oceans serve as the dumping ground for waste, with the misconception that oceans replenish and clean themselves. It is unfortunate that this type of thinking and approach removes consideration of the need for the preservation of the ecosystem for its own sake, an approach which, in turn, provides more for the benefit of mankind, but which requires patience, understanding of the dynamics, and an appreciation of nature.<sup>25</sup>

Decisions based solely on economic considerations have led to the development of technologies that have provided efficiency of use, but at a tremendous cost to the environment. More efficient machines in agriculture are contributing to increasing land fertility loss, desertification and pollution. Improved fishing gear, practices and techniques are depleting ocean fisheries, creating dead nutrient zones in the oceans, altering algal compositions, intensifying reef decay, increasing beach erosion, to name a few of the consequences of "development" in the subregion where ecosystem dynamics are critical.

The situation with water, an important component in the development equation, is even more critical and disturbing. Tropical countries, having depleted most of their terrestrial water sources are resorting to desalination plants to provide water for growing populations rather than making policy choices to harness and conserve terrestrial water. The effects on and implications for the near shore discharge are many but for the moment are not considered important enough by policy makers.<sup>26</sup>

Domestic and industrial waste continue to line both the terrestrial and marine environments. Plastic bottles litter the landscape and clog up drains, resulting in flooding. Poorly maintained sewage treatment plants dump millions of gallons of polluted water into our oceans. Cesspits and septic tanks continue to pollute the ground water supply. Industrial and agricultural chemicals leach into rivers, reservoirs and aquifers and aquifers are being pumped dry allowing for salt-water intrusion. These go either unnoticed or without concern for the health of the ecosystem by both policy-makers and the general public. These problems have been identified, and call for action to arrest the trend and effects have been made in the Programme of Action of Small Island States

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<sup>25</sup> Karel Tujeehut. *Energy for the Future: Development in Curacao*. Proceedings of the Workshop on Renewable Energy in the Caribbean. Curacao. October 1996.

<sup>26</sup> M.E. Hagziolos et al. *Coral Reefs: Challenges and Opportunities for Sustainable Development*. World Bank. 1998.

(SIDS POA), adopted at a United Nations conference in Barbados in 1998. To date, though, the prognosis on implementation of the Programme is not encouraging.<sup>27</sup>

### **New technologies and their impacts**

The foregoing sought to illustrate the present situation and practices in some sectors in the subregion. The following section will examine the sectors identified and suggest how the application of new technologies can impact on the development process in the subregion. It should be noted that new technologies do not necessarily have to be advanced technologies. They can also represent different techniques and/or approaches to problem solving. They need only to meet the following requirements:

- efficiency of operations;
- maintenance of the existing ecosystem and environmental integrity;
- economic feasibility.

Of the three criteria, the second requirement, that of maintenance of the existing ecosystem and environmental integrity, is the most challenging.

#### ***Agriculture***

To the extent that a country must be able to provide food for its people, agricultural activities will not disappear from Caribbean life. However, the less importance that is given to the sector as a contributor to the economy, the less productive and more detrimental are the practices. Agriculture represents the basis of developing societies. Industrialization took a firm hold in the development process when agriculture was reformed and supported, but failed when agriculture was neglected, or faltered when the sector was not put on a sound footing. When farming methods are revolutionized, the survival and cultural adaptation of a society holds the key to the future.<sup>28</sup> Although the quote was made in respect to the United States of America, it is especially appropriate to the Caribbean and other developing regions.

The introduction of new varieties and new technologies in the subregion necessitates increases in inputs, changes in policy, institutions and financial outlay to the sector. If not properly implemented, not only will benefits not accrue, but considerable damage can be done to both the sector and the environment. In order to secure the benefits of the application of new technologies, a clear policy on agriculture and food production is needed. The policy must include:

- A clear demarcation of land capability and land use;
- Selection of crops suitable for present and changing climatic conditions, as well as for their nutritional value and export potential; and

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<sup>27</sup> Earth Summit: Programme of Action for Small Island States – Global Conference on Sustainable Development of Developing Island States. Barbados. May 1994.

<sup>28</sup> Richard Critchfield. Science and the Villager: The Last Sleeper Wakes. Foreign Affairs. Volume 61. Number 1. Fall 1982

- Promotion of agronomic and post-harvest technologies that will maintain the integrity of the environment.

To meet the above requirements a number of new technologies are available.

*Geographic Information Systems (GIS) and Global Positioning Systems (GPS).*

GIS and GPS can assist in identifying the characteristics for the land use and capability designation. Their applications can also assist in improving fishery conservation measures by identifying stocks, improving gear and improving management techniques. However, introduction of these technologies may encourage over-fishing. Informed fishing policies would be needed and enforced to prevent abuse of the technologies.

*Biotechnology* - This term covers a multiplicity of applications including the following: *Gene manipulation*, which could help reduce both the number and the amount of inorganic chemicals now employed in the agricultural sector in the subregion. This could be achieved by providing resistant varieties of plants by increasing yield and thereby increasing the productivity of depleted or unsuitable lands presently under cultivation. This will also facilitate the increased production of organic foods and capture a bigger share of the growing market for health foods. Organic produce realize a higher price on the market and will therefore compensate for the initial increase of the cost of production.

*Tissue Culture* – Tissue culture provides a reliable source of disease free planting material that can reinforce the efforts and gains derived from gene manipulation.<sup>29</sup>

*Multi-crop farming systems and agro-forestry* – Implementation of these systems as well as a comprehensive understanding can help restore soil fertility, reduce soil and water erosion, and provide a steady stream of income to the farm family.<sup>30</sup>

The need to enhance export with processed foods has been previously noted. Therefore, improved agronomic practices from the introduction of new technologies in cultivation will result in increased yields, better uniformity of product and more reliable outputs. These are some additional constraints that have affected agro-processing in the region. Removing those constraints will pave the way for investment in agro-processing.<sup>31</sup>

*Improved Fermentation Technology.* This technology allows for the production of better alcohols, reduced cost of production and produces diversified product lines from many fruits grown in the subregion.

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<sup>29</sup> Biotechnology for the 21<sup>st</sup> Century. Report by the Federal Coordinating Council for Science Engineering and Technology (FCCCSET) on Life, Science and Health. February 1992.

<sup>30</sup> Caribbean Agricultural Research and Development Institute (CARDI). CARDI/USAID Farming Systems Research and Development. Report No. 538. 0099. Castries, Saint Lucia. 1984.

<sup>31</sup> Small and Medium Food Industries in the Caribbean: Transfer and Development of Technologies for Industrial Food Processing and Preservation. Report presented by Judith Francis of IICA for the CCST/OAS Project. December 1998.

*Non toxic treatments.* These are used on fresh fruits to improve their shelf life by removal fungal of growth.

*Organic farming.* There is at present, a renewed interest in organic farming and organically grown produce. It can be argued that organic farming was practiced in the subregion before the large-scale introduction of pesticides and fertilizers. However, other practices may have been detrimental to soil fertility, so that while it may be possible to have organically grown produce without the new technologies, increasing product demand and the appearance of unknown pests and diseases will require a different approach to production and harvesting. It is in this regard that the application of the new technologies can assist in maintaining the purity of cultivars and soil fertility.<sup>32</sup>

*Information technology* – A key factor in the agro-processing sector is the adherence to the new standards regimes such as Sanitation and Phytosanitary Systems (SPS), International Standards Organization (ISO) and Hazard Analysis at Critical Control Points (HACCP) that can help promote development strategies. With increasing access to information technology, information and technical assistance on the various standards can be obtained to improve the quality of output. IT can also be effective in providing training to farmers, extension officers, entrepreneurs, marketers and consumers that will benefit the industry as a whole.

### ***Tourism***

If this sector is to replace agriculture as the main economic activity in the region it is imperative that efficiency and profitability remain watchwords and the concern of both private and public entities. A number of activities in the industry lend themselves readily to changes and adoption of new technologies and new policies that will ensure competitiveness. Foremost among these is the maintenance of water quality. There is growing concern in the region on the level of pollution in the oceans surrounding our islands. Recent tests have found very high coliform bacteria levels in the most popular beaches of the region. Much of this pollution has been traced to the discharge of improperly treated waste into the ocean.<sup>33</sup> Governments should put in place and enforce strict guidelines for treatment plants and the hotel industry should obey these, while obtaining the best technologies for their treatment facilities. There are new technologies in both *aerobic and anaerobic* treatment plants that will provide the required levels of treatment at reduced cost. These plants have been specifically designed as small stand alone units and can utilize new and renewable sources of energy required.<sup>34</sup>

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<sup>32</sup> Towards an Organic Banana Initiative in the Caribbean. Organic Banana. 2000. INIBAP. Santo Domingo, Dominican Republic. 1999.

Proceedings of the Conference on Supporting the Diversification of Exports in the Caribbean and Latin America Region through the Development of Organic Horticulture. CARDI. Trinidad and Tobago. October 2001.

<sup>33</sup> Inter-american Program for Environmental Technical Cooperation in key industry sectors. Organisation of American States (OAS). 2001.

<sup>34</sup> Creating solutions with environmental products and technology. Report on Integrated Water Resources Management in the Caribbean. CCST/IDB/WB/CDB/OAS. Trinidad and Tobago. 1997.

Another area of concern is that of potable water use in the industry. There is very little effort to conserve water either in terms of reduction of use or through reuse. The few concerns that have undertaken such programmes report huge savings but somehow have not been able to convince other businesses that that is the way to go. Unfortunately, water remains a relatively cheap commodity in the region, thus removing any incentive to conserve. If only to reduce the pressure on surrounding areas that suffer from lack of water because of the need to provide the tourism industry, this sector should take the initiative to conserve water. This can be done by taking at least three measures: (a) *reducing the amount of water per flushing*, (b) *installing timing devices on taps*, (c) *reusing properly treated water for irrigating grounds*. New equipment and technologies are available for these activities and they should be installed voluntarily or even mandated by government.<sup>35</sup>

Conservation can also take place in the electricity sector, even though the utilities do not promote it. New technologies such as *sensors on air-conditions*, *door sensitive light switches that turn lights on and off when doors are closed or opened* can significantly reduce electricity costs. A promotion to encourage guests to use natural light as much as possible is another measure that can reduce the cost of energy to the hotel industry.<sup>36</sup>

The effect of more efficient operations can mean that overall costs can be reduced and that reduction can be passed on to the guests. Already there is the concern that the region is pricing itself out of the low and middle tiers of the market, from which it derives most of its clients. Ironically, hotels in the upper end of the market already implement these measures, which help to increase their profits.

### ***Energy***

Renewable and alternative energy sources, such as *solar*, *solar-thermal*, *wind*, *Ocean Thermal Energy Conversion (OTEC)*, *biogas* and *geothermal* in the renewable energy group and *hydro* in the alternative energy group are technologies that are sufficiently mature to allow for increased use in the region. Early experiments with wind, solar and biogas in the region under the Regional Energy Action Plan (REAP) developed in 1983, were not successful because these technologies had not been sufficiently developed for suitable adaptation in the Caribbean.<sup>37</sup> The situation has since changed dramatically, with the following advances:

- *material science* that allows for better salt resistant materials;
- *gearbox technology* that allows turbines to run for at least five years without the need for servicing;

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<sup>35</sup> Report on Integrated Water Resources Management in the Caribbean. CCST/IDB/WB/CDB/OAS. Trinidad and Tobago. 1997.

<sup>36</sup> Report of the Caribbean Solar Energy Society Meeting. Kulsman Ahmed. Recent Developments in Solar Energy. Industry and Energy Development. World Bank. Proceedings of the meeting on Sustainable Alternatives for Tropical Island States. Satis 1994. Caribbean Solar Energy Society. Barbados, 1994.

<sup>37</sup> The Regional Energy Action Plan. Caribbean Development Bank (CDB) and Caribbean Community (CARICOM) Secretariat. October 1983.

- More efficient *decomposition technologies* that allow for increased efficiency of the production of methane gas;
- more efficient *solar cells* that allow for smaller and fewer panels and less utilization of space; and
- hydro-electricity generation that allows for *smaller continuous flow technologies* and removing the need for damming and the need for large volumes of water.

Research continues on both OTEC and geothermal energy to provide better and more efficient converters.

The benefits of the application of such technologies to provide energy are tremendous. For agriculture, irrigation techniques form part of the base of the drive to increase production and productivity per unit. However, to use conventional energy sources for irrigation is costly. In addition, many farms are not close to the national grid. In such cases, small motors are needed on site. The present motors are either gas or diesel and necessitate transportation of the fuel in addition to the polluting effects, though small, since these motors are poorly maintained. Either solar panel energy or wind energy, depending on location and conditions, can be employed to remove these constraints, as small stand-alone units can be erected to provide power for the pumps.

Because of the small number of consumers and the capital expenditure of the utilities, electricity and energy costs are relatively high in the region. This high cost makes small enterprise development prohibitive. Solar energy is ideally suited for these operations, since most of the activities are done during daylight hours when there is ample sunlight. For larger community-type operations, a wind generator may be more suited as it can provide more power within a limited space. However, its reliability may be suspect due to variation in wind conditions. Research continues in these areas, and there already exists small units ranging from 250 – 750 kilowatts that have shown sufficient reliability of application. A 250 kilowatt unit is in place at the Monroe College in Jamaica which provides electricity to the college community and the excess sold to the local utility provider.<sup>38</sup>

At the moment there is resistance from the utilities to use renewable energy to the extent that some of the hydro-electric plants in operation in the region have been decommissioned, because of inefficiencies of operation and the reduction in surface water. Unfortunately, once a decision and an investment is made to commission hydrocarbon plants, funds are not forthcoming for other sources of energy. But while these old hydro-electric plants should not be re-commissioned, new more efficient plants could replace decommissioned fuel plants and begin the process of the introduction of renewable energy. There will be, though, the need to put in place watershed management strategies and reforestation programmes to increase availability of water or arrest decrease, but the added benefits will more than offset the cost of the investment. While hydroplants are more suited for large-scale electricity generation, the utilities can make

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<sup>38</sup> Raymond M. Wright. Jamaica's Energy: Old Prospects and New Resources. Petroleum Corporation of Jamaica. Kingston. 1996.

limited use of both wind and solar energy. This will not only reduce the cost of imported fuels but also significantly reduce the deleterious effects on the environment as well as provide some measure of energy security.

### ***Information technology***

Notwithstanding the information provided and views expressed in the section on agriculture, information technology can only be meaningful within a clear policy on both the use and development of the technology. A paper on information technology in the Caribbean delivered in 1998 suggested that there is still no cohesive policy on the role of this new technology to the development process.<sup>39</sup> Although the technology is widely used it is not itself a driver of the development process. It has, no doubt, increased speed of operations, has served as a source of information to researchers, students and teachers, and has provided employment for those in sales, repairs, and other ancillary activities such as web site development and Internet service provision. What the new technology has not been used for is the large-scale development of products and services that can be exported or even replace imports. It is in that area that the new technology will make its greatest contribution to the development process in the region. It is, though, the area that provides the greatest challenge in terms of entrepreneurship and financing for research and development, areas in which the region has not placed sufficient emphasis.

A clear deficiency in Human Resource development is in the area of science and technology. The proliferation of courses that are now available in the region through the use of information technology is staggering. However, there is as yet no study to analyze how these graduates contribute to the overall development or whether the contents of the courses provide the type of training needed in the region. However, based on the courses offered as identified by advertisements, social science programmes dominate the market. That trend needs to be reversed, through a well-articulated policy and incentives for scientific pursuits will achieve that desired result.

### ***Enterprise development.***

The limiting factors of research and development and policy as noted under ***Information Technology*** are also at play for enterprise development in general in the subregion. Many persons have ideas but nowhere to turn to put those ideas into experiment and production. The University of the West Indies continues to defend its position as a teaching institution, with limited research capability. Other institutions such as the Caribbean Industrial Research Institute (CARIRI) in Trinidad and Tobago, The Scientific Research Council (SCR) Jamaica and the Institute of Agriculture, Science and Technology (IAST) Guyana, although established as national research and technology institutions are understaffed, under-financed and lack clear directives and linkages for promoting development. Efforts at national industrial policy remain disjointed and even non-existent in some countries and a mechanism for collaboration on regional policy remains weak or non-existent.

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<sup>39</sup> Cardinal Warde. Communication and Information Technologies for Economic Development in the Caribbean. Proceedings of the 10<sup>th</sup> Anniversary Conference of the Caribbean Academy of Science. Trinidad and Tobago. 1998.



The application of new technologies can help to overcome some of these difficulties. *Information technologies* can significantly reduce the communication and infrastructural costs of operation in the region by allowing institutions to share information and resources. This can then free up funds for more detailed product development. Renewable energies can reduce cost of operations as well as bring energy to the rural areas where raw materials are readily available. All these can have significant impact on the promotion of entrepreneurship that can provide for small and medium size enterprise (SME ) activities and reduce unemployment.

### ***Ecosystem and Environment.***

Many Caribbean countries have signed international conventions, the objectives of which are to protect the environment, manage natural resources properly, and protect biodiversity. Unfortunately, the responsibilities under these conventions are poorly understood or carried out. For example, while there are Pesticide Control Boards in many of the countries, these Boards focus more on facilitation and regulation than on development. Hence, they will approve imports of certain chemicals or try to prevent importation of banned substances. They do not, however, promote the development of biological pest control programmes that would significantly reduce the amounts and levels of pesticides in use in the countries. The same is true of the Bureaux of Standards, in that their limited budgets make them more regulatory than developmental.<sup>40</sup>

There are a number of national and regional projects that seek to address or correct poor environmental situations. Greater emphasis though, should be placed on early schooling and the education system to bring about attitudinal change in children so that they can be more environmentally aware in adulthood. Here, too, because the cost of producing teaching and educational materials can be taxing, much can be achieved through the use of information technology. In addition, material on environmentally-friendly technologies and environmental issues programmes should appear more frequently in the media, in order to inculcate awareness in both the in-school and out of school population as a whole. In the Caribbean we see more of Oprah Winfrey, the popular North American television talk show hostess than we see of United Nations Environmental Programme (UNEP) programmes.

### **Positive results on the development process**

The introduction of new technologies into the economic activities of the region will help improve efficiencies and thus provide greater choices for policy makers and entrepreneurs. Because of limited resources, Caribbean governments generally make decisions on an “either/or” basis. Tourism is competing with Agriculture, and Industrial Development does not get the boost needed to make it a major earner of foreign exchange in many islands. If the discussion on new technologies brings about a change in the policy process, then the development efforts will benefit from a more holistic approach to development in the region.

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<sup>40</sup> Cardinal Warde. *Communication and Information Technologies for Economic Development in the Caribbean*. Proceedings of the 10<sup>th</sup> Anniversary Conference of the Caribbean Academy of Science. Trinidad and Tobago. 1998.

### ***Environmental preservation***

The policy of employment at any cost and a lack of clearly defined policy on the environment has meant that governments have had to accept most proposals put forward by developers. Thus, a mangrove would easily be transformed into a marina, on the basis that such development would provide jobs. Very little, if any consideration is given to the fact that the mangrove serves as a nursery for fisheries and upon which fishing communities depend for their livelihood. Concessions are given to manufacturers who use non-recycled plastic containers without adding the cost of clean-up and of correcting the many environmental problems associated with plastic disposal. Importers are readily given licenses to import toxic substances without the necessary environmental impact assessments (EIAs) being conducted.

The use of new technologies are generating much debate and discussion, which should benefit policy makers in helping to bring about a shift in orientation based on well thought out policies and institutional set-up. The arguments presented by both proponents and opponents should be material for decision-making, especially on environmental concerns, as information is readily available on the web, in journals and other sources. This proliferation of information and information technology tools, should benefit the environment, eventually helping in the restoration process and reduction in the impact of ecosystem degradation.

### ***Less costly and more reliable energy***

For most of the islands in the Caribbean region, with the exception of Trinidad, energy cost remains a limiting factor to development. To the extent that energy sources are also foreign, security and reliability become factors that have to be considered. In addition to increasing efficiency in the agricultural sector, promoting rural development and decreasing imports of hydrocarbons, a renewable energy programme would provide some measure of energy security, especially for hospitals, police stations and some communication equipment in time of disasters and political instability. Solar panels lights can replace a larger number of conventional streetlights presently in operation. These systems are being used in navigational lighting systems but have not been employed in conventional situations. An energy system that can provide both reliability and security will invariably result in more economic activity and benefits.

### ***More water for all and health improvement***

It is a strange irony that the countries with the least rainfall are the ones with the most reliable potable water systems. A policy of promoting *individual rain harvesting units*, though not a new technology, is what has brought about this situation. Here it is not so much the use of a new technology as the enactment of policy that takes into consideration the real economic circumstances of the population. Policies that encourage judicious use of water, that promotes self reliance, that do not see water as a tradable good are what has been successful in promoting conservation and an appreciation for proper water resource management. Such policies also benefit the general environment

and the other activities that are dependent on a clean environment, especially the health of the population.<sup>41</sup>

With biotechnology, the production of more nutritious foods can reduce the amount of food needed to meet nutritional needs. This would allow for the poorer sections of the population to meet their nutritional needs at a lower cost. It will also provide more products for export.

***Increased SME development as engine of employment strategy***

Short-term employment programmes have become a feature of most Caribbean governments. In most cases, however, such programmes become permanent. An unfortunate feature of these programmes is that they promote traditional methods of production since they usually target non-skilled persons. It is therefore not unusual to see persons by the roadside clearing weeds with cutlasses, or even by hand. Invariably, the cost of running these programmes remove funding from programmes that would provide new skills to unskilled persons. It would be more beneficial, for example, to erect a building that would function as a small business incubator within a community than to give two hundred persons employment in short-term unemployment schemes. A cohesive programme of new technology use would make the choices of the incubator more attractive to the policy maker. In the long term, the community would benefit much more through increased small enterprises established after training.

***Better development options and prospects***

Caribbean countries face serious developmental challenges and need innovative and different measures to address them. However, governments prefer to make incremental adjustments, as they consider necessary, as opposed to drastic changes. This hesitancy to effect change may be the most difficult tasks for policy makers in both the public and private sectors. It might be argued that there have been some quantum leaps in the subregion, for example the proliferation of computers in use. However, the change from typewriter to computer, if the computer is primarily used for word processing, is not a drastic change in technology terms.

There has been very little change in the agricultural sector, in fisheries, in commerce and manufacturing and tourism. Equally, there has been little change in governance, and the institutions of policy making. Not that there has not been discussion and the expression of the need for change. It is the absence of experience in, or a desire to experiment with other systems and methods, that continue to generate caution. A similar attitude is also present with regard to the use of technology, especially new technologies. And yet, some influences have been able to succeed, sometimes to the detriment of the economic wellbeing of the population. Such phenomena need to be studied to determine the factors that will promote change and how these factors can be introduced for adopting new technologies.

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<sup>41</sup> Report of the Technical Working Group on Caribbean Safety Initiatives. CARICOM. Trinidad and Tobago. 2000.

Without an understanding of the need for change, the provision of the tools for change and the directing of the path of change, new technologies will not benefit the Caribbean. They will be adopted into the society, but they will not be embedded in the society in a sequential, cohesive and purposeful manner. For example, whatever the benefits and impact of *tissue culture*, a simple tool in biotechnology, will not be long lasting in the agricultural sector, if marketing arrangements are not in place to absorb the increased production. In fact, abandoned banana plantations in the Windward Islands are now major nematode breeding grounds, because of problems in the marketing of bananas. The Utilities and governments are hard pressed to get water conservation accepted by the population because of the present water use policy, which is viewed as a tradable good. Caribbean governments continue to ignore their countries' contribution to global pollution, reasoning that their amounts are so small and insignificant, forgetting that the longest chain is but a series of small links.

There are sufficient new and not so new technologies available to help solve and increase the development thrust in the region. However, the nature of these technologies must be understood, their impact ascertained, their application monitored, and the reason for their introduction clearly articulated. Only in that manner can they be beneficial to the region. In the debate on the use of new technologies, the relative small size of the subregion could be the ideal testing ground, if coordinated policy and action remain the objectives of policy makers, the public and private sectors and the population at large.

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