In the absence of robust public policy to support and entrench STI in the national development process, it is researchers themselves who are devising innovative means of driving STI.

Harold Ramkissoon and **Ishenkumba A. Kahwa**

A student prepares a tooth to receive a dental filling, 'observed' by a simulator software which can detect any incisions and compare them to an optimal one. Among the onlookers are the Hon. Portia Simpson Miller, Prime Minister of Jamaica, and Prof. Archibald McDonald, Principal of the Mona Campus of the University of the West Indies.

Photo: © University of the West Indies, Mona Campus

6 · Caricom

Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Trinidad and Tobago

Harold Ramkissoon and Ishenkumba A. Kahwa

INTRODUCTION

Low growth and high debt

Most members of the Caribbean Common Market (CARICOM) are highly indebted[1] (Table 6.1), as they struggle to emerge from the global recession triggered in September 2008, which stressed their banking system and led to the failure of a major regional insurance[2] company in 2009. After meeting their debt obligations, there is little left for the state to support socio-economic imperatives. Consequently, the 2010–2014 period can best be described as one of slow growth. GDP progressed by about 1% on average over this period, although growth climbed to 2.3% in 2013 and growth of 3% is projected for 2014 (Figure 6.1).

Apart from natural resource-rich Trinidad and Tobago, which has been able to weather the economic storm thus far, thanks to high commodity prices, unemployment remains high in the region. Both Grenada and Barbados have had delicate conversations with the International Monetary Fund (IMF), while Jamaica has signed an agreement with the IMF leading to some painful adjustments. The majority of countries are dependent on tourism but, as Table 6.1 shows, remittances from the region's diaspora are quite significant contributors to many national incomes. In Haiti, remittances even account for about one-fifth of GDP.

1. The ratio of public debt to GDP rose by about 15 percentage points in the Caribbean between 2008 and 2010 (IMF, 2013).

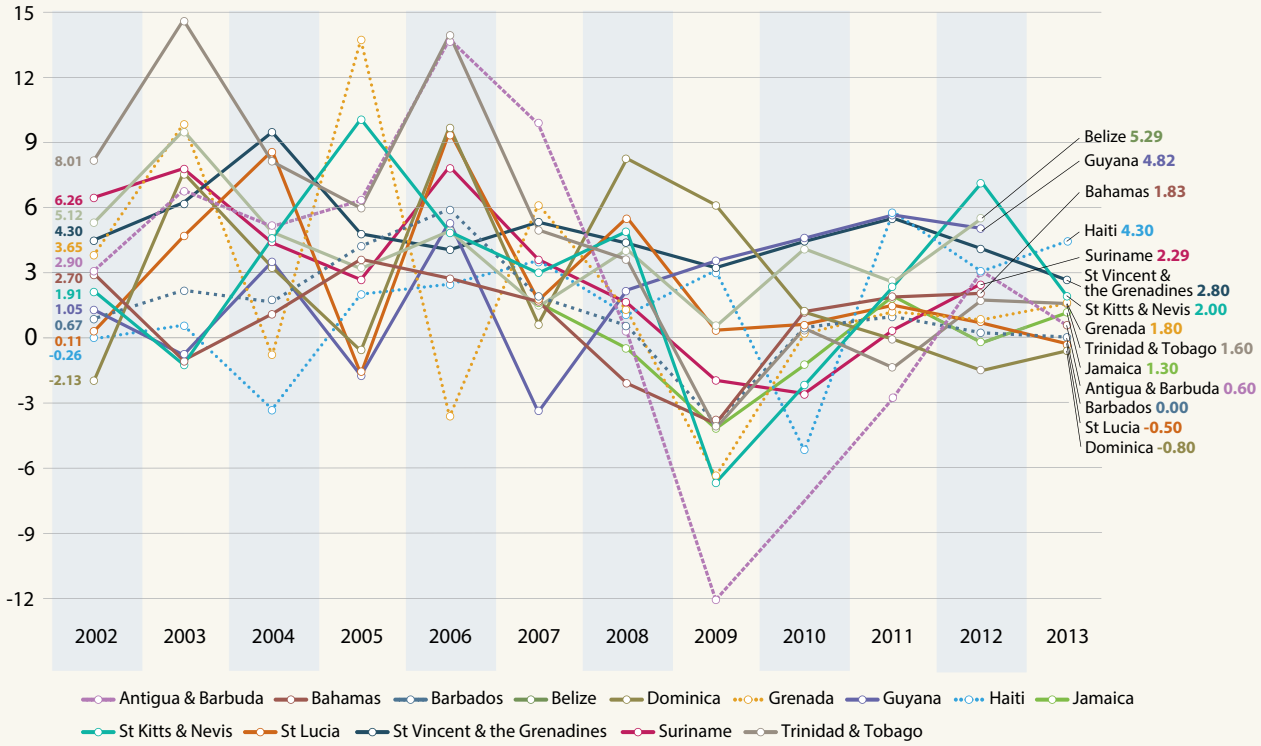
2. The region lost about 3.5% of GDP after the failure of the CL Financial Group in January 2009; this group of insurance companies had invested in real estate and other vulnerable assets in a weak regulatory environment. The group was active in all the CARICOM countries but Haiti and Jamaica. It was based in Trinidad & Tobago, where GDP shrank by as much as 12% (IMF, 2013).

Table 6.1: **Socio-economic indicators for CARICOM countries, 2014 or closest year**

	Population, 2014 ('000s)	Population growth, 2014 (annual %)	GDP per capita, 2013 (current PPP$)	Unemployment rate, 2013 (%)	Inflation, consumer prices, 2013 (%)	Debt to GDP ratio, 2012 (%)	Remittances, 2013 (US$ millions)	Key sectors	Internet access, 2013 (%)	Mobile phone subscriptions, 2013 (%)
Antigua & Barbuda	91	1.0	20 977	–	1.1	97.8	21	Tourism	63.4	127.1
Bahamas	383	1.4	23 102	13.6	0.4	52.6	–	Tourism	72.0	76.1
Barbados	286	0.5	15 566	12.2	1.80	70.4	82	Tourism	75.0	108.1
Belize	340	2.3	8 442	14.6	0.7	81.0	74	Goods export (agriproducts and oil)	31.7	52.9
Dominica	72	0.5	10 030	–	0.0	72.3	24	Tourism	59.0	130.0
Grenada	106	0.4	11 498	–	0.0	105.4	30	Tourism	35.0	125.6
Guyana	804	0.5	6 551	11.1	1.8	60.4	328	Goods export and tourism	33.0	69.4
Haiti	10 461	1.4	1 703	7.0	5.9	–	1 780	Agriculture	10.6	69.4
Jamaica	2 799	0.5	8 890	15.0	9.3	143.3	2 161	Goods export and tourism	37.8	100.4
Montserrat	5	–	–	–	–	–	–	Tourism	–	–
St Kitts & Nevis	55	1.1	20 929	–	0.7	144.9	51	Tourism	80.0	142.1
St Lucia	184	0.7	10 560	–	1.5	78.7	30	Tourism	35.2	116.3
St Vincent & Grenadines	109	0.0	10 663	–	0.8	68.3	32	Tourism	52.0	114.6
Suriname	544	0.9	16 266	7.8	1.9	18.6	7	Goods export (energy, bauxite/ alumina) and tourism	37.4	127.3
Trinidad & Tobago	1 344	0.2	30 349	5.8	5.2	35.7	126[-2]	Goods export (energy)	63.8	144.9

Source: For population data: UN Department of Economic and Social Affairs (2013) *World Population Prospects: 2012 Revision;* for GDP and related data: World Bank's World Development Indicators, February 2015; for government debt: World Bank's World Development Indicators and IMF (2013); for internet and mobile phone subscriptions: International Telecommunications Union. IMF (2013); for remittances: World Bank's World Development Indicators, February 2015; for type of economy: ECLAC.

Figure 6.1: **Economic growth in CARICOM countries, 2002–2013** (%)



Source: World Bank's World Development Indicators, January 2015

Despite financial constraints, there has been considerable investment in information and communication technologies (ICTs) in recent years. In Suriname, for instance, internet connectivity progressed from 21% to 37% between 2008 and 2013 and, in Trinidad and Tobago, from 35% to 64%. By 2013, almost three-quarters of the inhabitants of Barbados and Bahamas had access. Mobile phone subscriptions have grown at an even faster rate, including in Haiti where internet connectivity has stagnated at less than 10%. These trends offer new opportunities for businesses and are helping scientists to develop greater international and intraregional collaboration.

Vulnerable tourism-based economies

The region's fragile tourism-based economy has not diversified and remains vulnerable to the vagaries of Mother Nature (Figure 6.2). For example, winds that were well beneath hurricane strength took a toll on the small economies of St Lucia, Dominica and St Vincent and the Grenadines in December 2013. In 2012, two hurricanes struck Haiti just as its economy was beginning to recover from the devastating earthquake in January 2010 which had destroyed much of the capital city, Port-au-Prince, killed more than 230 000 people and left 1.5 million homeless. In 2014, more than 60 000 people were still living in camps; much of donor aid for rehousing has been used to build temporary shelters which are only designed to last 3–5 years (Caroit, 2015).

As seen in Figure 6.3, most CARICOM countries have at least a 10% chance of being struck by a hurricane each year and even moderate storms can reduce growth by about 0.5% of GDP, according to the IMF (2013).

The region would be hard-pressed to deal with a major meteorological disaster, which is why it should be taking climate change adaption more seriously. This is all the more urgent in that the Caribbean is both the most tourist-intensive region in the world and set to become the most at-risk tourist destination between 2025 and 2050, according to the World Travel and Tourism Council. Headquartered in Belize, the Caribbean Community Climate Change Centre (CCCCC) has received a mandate from CARICOM to[3]:

- Mainstream climate change adaptation strategies into the sustainable development agendas of CARICOM states;
- Promote the implementation of specific adaptation measures to address key vulnerabilities in the region;
- Promote actions to reduce greenhouse gas emissions through fossil fuel reduction and conservation, and switching to renewable and cleaner energy sources;

3. See: www.caribbeanclimate.bz/ongoing-projects/2009-2021-regional-planning-for-climate-compatible-development-in-the-region.html

- Encourage action to reduce the vulnerability of natural and human systems in CARICOM countries to the impact of a changing climate;
- Promote action to derive social, economic and environmental benefits through the prudent management of standing forests in CARICOM countries.

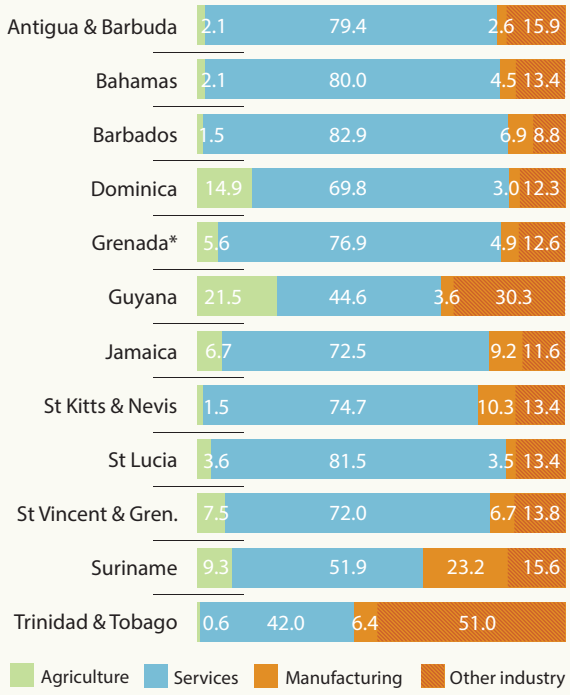
The CCCCC has produced an implementation plan for 2011–2021 and carried out work to assess and build capacity in climate change mitigation and resilient development strategies. This work has been supported by the region's specialists, who have produced models for climate change and mitigation processes in Caribbean states and who play a major advisory role to the divisions in ministries responsible for climate change, such as Jamaica's appropriately expanded Ministry of Water, Land, Environment and Climate Change[4].

Meanwhile, high energy costs impact negatively on economic competitiveness and the cost of living (Figure 6.4). In 2008, over US$ 14 billion was spent on importing fossil fuels, which are estimated to provide over 90% of energy consumed in CARICOM countries. The machinery needed to generate fossil-fuel-based electricity is also obsolete, inefficient and expensive to run. Conscious of this vulnerability, CARICOM has developed an Energy Policy (CARICOM, 2013), approved in 2013, and an accompanying *CARICOM Sustainable Energy Roadmap and Strategy* (C-SERMS). Under the policy, renewable energy sources are to contribute 20% to the total electricity generation mix in member states by 2017, 28% by 2022 and 47% by 2027. A similar policy instrument is being developed for the transportation sector.

Stakeholders participated in a resource mobilization forum for the first phase of C-SERMS in July 2013. The forum was hosted by the CARICOM Secretariat, with support from the Inter-American Development Bank (IADB) and the German Agency for International Cooperation (GIZ). The IADB has since provided the University of the West Indies (UWI) with a grant of over US$ 600 000 to develop capacity in sustainable energy technologies across the region. One area of interest is the utilization of ICTs in managing energy and training in sustainable energy technologies, with an emphasis on enhancing the involvement of women. The participation of energy giants such as General Electric, Philips and the Scottish Development Corporation augurs well for technology transfer. The region has considerable potential for hydroelectric, geothermal, wind and solar energy which, once significantly

4. See www.mwh.gov.jm

Figure 6.2: **GDP by economic sector in the CARICOM countries, 2012**

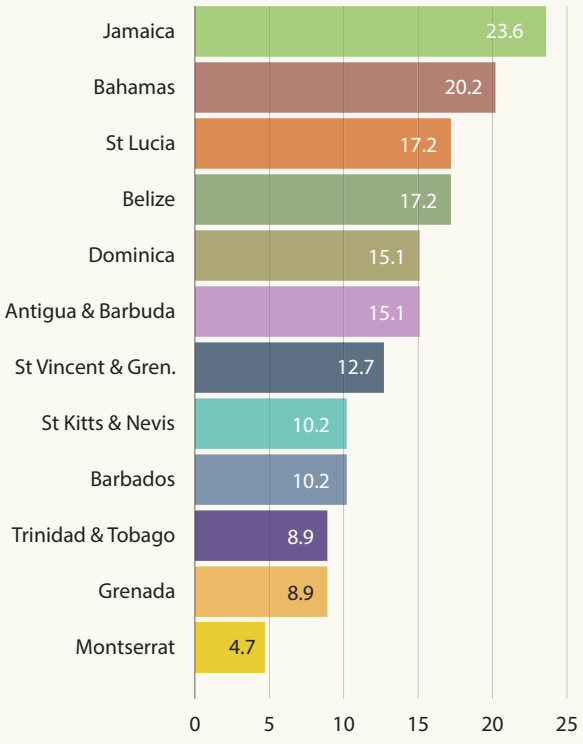


*For Grenada, data are for 2011.

Note: Data are unavailable for Haiti and Montserrat.

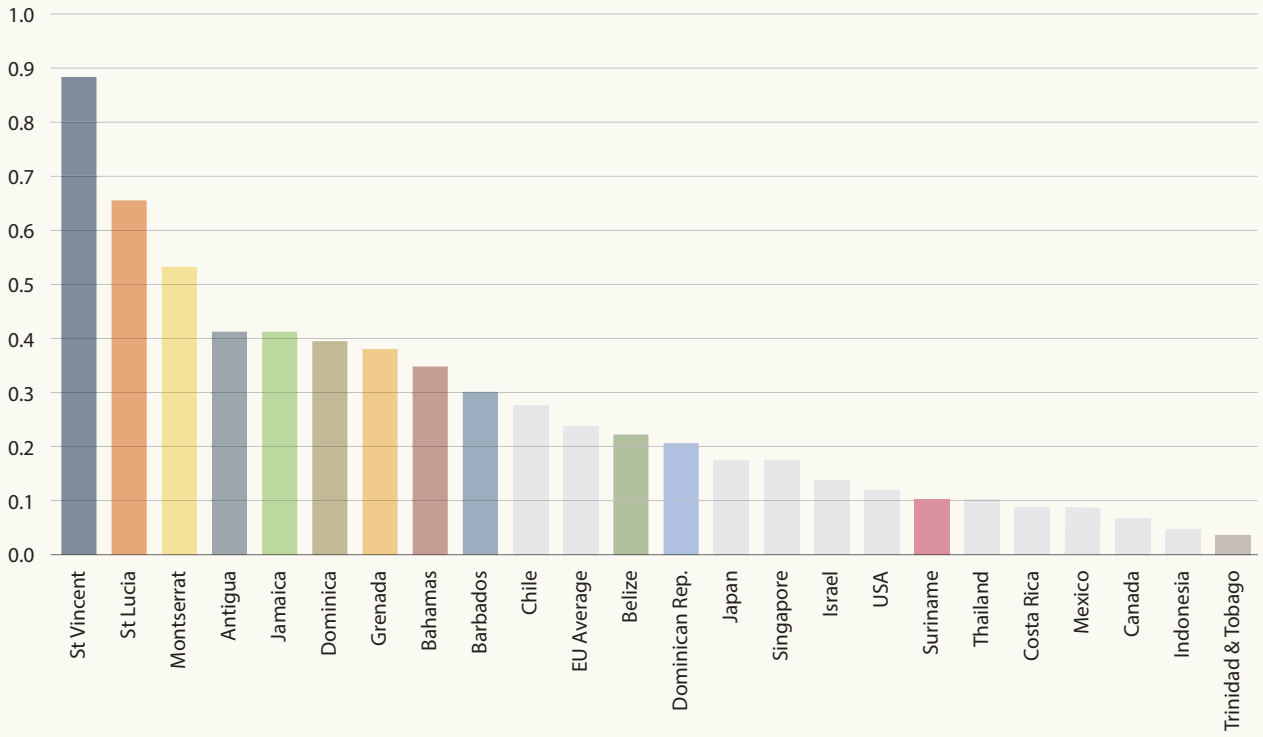
Source: World Bank; World Development Indicators, September 2014

Figure 6.3: **Probability of a hurricane striking Caribbean countries in a given year, 2012 (%)**



Source: IMF (2013)

Figure 6.4: **Electricity costs for the CARICOM countries, 2011**
Household tariffs per kWh in US$, other countries and regions are given for comparison



Source: IMF (2013)

exploited (as opposed to sporadically, at present), could make a huge difference to the energy resilience of CARICOM countries. Some of these resources are being exploited to a limited extent. One of the problems with electricity generation using petroleum sources is that the region's machinery is obsolete, inefficient and expensive to run. To deal with this problem, Jamaica has approved construction of new gas-fired electricity generation plants.

The efforts of CARICOM countries to adopt sustainable energy technologies are contributing to implementation of the Programme of Action for the Sustainable Development of Small Island Developing States. First adopted[5] in Barbados in 1994, this programme was updated in Mauritius in 2005 then again in Samoa in 2014.

Strength in numbers: a need to develop regionalism

The Caribbean is in danger of being left behind, unless it can adapt to an increasingly knowledge-driven global economy that is being shaped by convergent phenomena. The first of these phenomena is the weak post-crisis recovery of developed countries and the slowdown in growth of developing countries, which obliges Caribbean economies to reduce their dependence on traditional markets and sources of foreign capital. The second phenomenon is the fluidification of markets, driven by progress in ICTs, manufacturing and automation, as well as by the lowering of trade barriers and transport costs; this is encouraging corporations around the world to spread their production capacity across different locations in order to create global value chains: the United Nations Conference on Trade and Development estimates that 80% of the world's exports of goods and services now occur through trade among multinational enterprises. This, in turn, has spawned a fourth phenomenon, the creation of megamarkets, such as the proposed regional free-trade agreement known as the Trans-Pacific Partnership, involving countries from North and Latin America, Asia and the South Pacific[6] (CARICOM, 2014).

Where does the Caribbean fit into this new global picture? As Ralph Consalves, Prime Minister of Saint Vincent and the Grenadines and former Chair of CARICOM, put it at CARICOM's 40th anniversary in 2013, 'it is evident to all responsible persons of discernment that our region would find it more difficult by far to address its immense current and prospective challenges, unless its governments and peoples embrace strongly a more mature, more profound regionalism'.

5. See www.unesco.org/new/en/natural-sciences/priority-areas/sids

6. The countries participating in negotiations thus far have been Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, USA and Viet Nam.

The *Strategic Plan for the Caribbean Community: 2015–2019* is CARICOM's answer to the phenomena described above (CARICOM, 2014). The first of its kind in the region, the plan sets out to reposition the Caribbean in an increasingly volatile global economy. The overarching objective is twofold: to stimulate the productive capability of domestic firms and correct the current mismatch between training and the specialized knowledge and skills required by the market, in order to drive growth and combat rising levels of unemployment among the young, in particular. The plan outlines strategies for nurturing innovation and creativity, entrepreneurship, digital literacy and inclusiveness and for making optimum use of available resources.

A central aim is to reinforce the Caribbean's socio-economic, technological and environmental resilience. With the exception of Guyana, Suriname and Trinidad and Tobago, which have significant hydrocarbon or mineral reserves, most states are small with too limited natural resources to support rapid economic development. They will thus need to look elsewhere for wealth creation. The two key enablers identified by the plan for improving the Caribbean's resilience are a common foreign policy, in order to mobilize resources effectively, and R&D and innovation. The plan proposes using advocacy to mobilize funding for business R&D from state and private sources, creating an enabling legislative environment for R&D and innovation, identifying opportunities for co-operation and devising national school-based programmes that drive, enable and reward R&D and innovation.

The strategy focuses on the following areas to drive economic growth:

- Creative, manufacturing and service industries, with a special focus on tourism initially;
- Natural resource and value-added products, promoting the integration of production;
- Agriculture and fisheries and export development, to reduce dependence on food imports and foster sustainable fisheries by improving co-operative management and conservation and the development of aquaculture;
- Resource mobilization;
- ICTs;
- Air/Maritime transport infrastructure and services, to facilitate the mobility of goods and services and foster global competitiveness;
- Energy efficiency, diversification and cost reduction, including the development of alternative energy to meet CARICOM's target of 20% renewable sources by 2017, by facilitating public–private partnerships, in line with the *CARICOM Energy Policy* of 2013 and its companion *CARICOM Sustainable Energy Roadmap and Strategy* (C-SERMS).

TRENDS IN STI GOVERNANCE

CARICOM plan mirrors national aspirations

Elections are constitutionally due for eight CARICOM countries in 2015 and the remainder between 2016 and 2019. If election results do not derail the *Strategic Plan for the Caribbean Community: 2015–2019* and it is fully implemented, it should provide a good framework for developing STI in the region.

The important point here is that the collective aspirations captured in the *Strategic Plan* to 2019 are similar to those of major national plans. For example, Trinidad and Tobago's *Vision 2020* (2002), Jamaica's *Vision 2030* (2009) and the *Strategic Plan* of Barbados for 2005–2025 all share a common aspiration to achieve socio-economic development, security, resilience to environmental shocks and an engagement in STI to improve the standard of living. Like the *Strategic Plan for the Caribbean Community,* these national plans accord central importance to STI in realizing these aspirations.

The United Nations Development Assistance Facility (UNDAF) programme has complemented these efforts. There are five national UNDAF programmes for each of Jamaica, Trinidad and Tobago, Guyana, Belize and Suriname, as well as a subregional one for Barbados and the smaller CARICOM members grouped within the Organization of Eastern Caribbean States (Kahwa *et al*., 2014). The UNDAF programmes have used national strategic planning documents to develop action plans aligned with national priorities, via a consultative process at national levels.

Antigua and Barbuda, the Bahamas, Belize, Jamaica, St Lucia, Guyana and Trinidad and Tobago have all either articulated their S&T policies or identified and targeted specific priority areas, such as ICTs. In these countries, there is either a national commission or a ministry/department responsible for science and technology, with Belize[7] also having a Prime Minister's Council of Science Advisors (Table 6.2).

Some countries have developed a roadmap for STI, like Jamaica. Its roadmap builds on the national consensus of *Jamaica Vision 2030* and places STI at the centre of national development efforts. This roadmap was triggered by the need, identified by Jamaica's public sector reform, for operational consolidation of government and other publicly supported R&D institutions, in order to achieve efficiency gains and accelerate innovation to pave the way to developed country status by 2030.

An urgent need to map research and innovation

As recognized by the *Strategic Plan for the Caribbean Community: 2015–2019, Jamaica's Roadmap for Science, Technology and Innovation* and a report commissioned by the

7. See: www.pribelize.org/PM-CSA-Web/PM-CSA-Statement-Members.pdf

Table 6.2: **Overview of STI governance in CARICOM countries, 2015**

	Body responsible for STI policy	Additional relevant bodies	Strategic planning document (year of adoption)	Main objective of planning document	National award (year) and body responsible	STI policy (year of adoption)	R&D priorities of STI policy	STI action/ implementation plan
Antigua & Barbuda	Ministry of Education, Science & Technology							
Suriname	Ministry of Labour & Technology Development							
Dominica	Ministry of information, Science, Telecommunications & Technology	National Science & Technology Council						
Bahamas	Ministry of Education, Science & Technology	Bahamas Environment, Science & Technology Commission	National Development Plan Vision 2040 (under development)					
Grenada	Ministry of Communications, Works, Physical Development, Public Utilities & ICT	National Science & Technology Council	*National Strategic Development Plan* (2007)	National transformation through innovation, creativity and enterprise				
St Vincent & Grenadines	Ministry of Foreign Affairs, Foreign Trade & Information Technology	National Centre of Technological Innovation Inc.	*National Economic & Social Development Plan 2013– 2025* (2013)	Improving the quality of life for all				
Barbados	Ministry of Education, Science, Technology and Innovation	National Council for Science and Technology	*Strategic Plan, 2006–2025*	A fully developed society that is socially just and globally competitive	National Innovation Competition (2003), National Council for Science & Technology			
St Lucia	Ministry of Sustainable Development, Energy, Science and Technology	National Science and Technology Council	National vision under preparation	Job creation through 'live local – work local' and tourism development	Prime Minister's Award for Innovation, Chamber of Commerce, Industry & Agriculture	Under preparation		
Belize	Ministry of Energy, Science and Technology and Public Utilities	Prime Minister's Council of Science Policy	*Horizon 2030 Vision* (2010-2030)	Resilience, sustainable development and high quality of life for all		Yes, 2012	Energy and capacity-building in STI	
Guyana	Office of the President	National Science Research Council	*National Development Strategy* (1997)	Enhance national capacity to undertake development programmes		Yes, 2014	Support development programming in diverse sectors	
Trinidad & Tobago	Ministry of Science, technology and Higher Education	National Institute of Higher Education, Research, Science & Technology	*Vision 2020* (2002)	Developed country status by 2020	Prime Minister's Awards For Scientific Ingenuity (2000)	Yes, 2000	Enhancing industrial competitiveness & human development	
Jamaica	Ministry of Science, Technology, Energy and Mining	National Commission for Science & Technology	*Vision 2030* (2009)	Developed country status by 2030	National Innovation Awards (2005), Scientific Research Council	Yes, 1960	Effective exploitation of natural resources	STI roadmap (2012)

Source: compiled by authors

UNESCO Kingston Office (Kahwa *et al*., 2014), STI policy in the region is desperately in need of:

- Systematic STI data collection and scientometric analysis to inform policy-making;
- Evidence-driven decision-making, STI policy development and implementation;
- Mapping existing STI policies, related legal frameworks and the impact of these on all national and regional economic sectors.

In November 2013, UNESCO launched *Mapping Research and Innovation in the Republic of Botswana*, the first in a series which profiles STI in individual countries, via data and sectorial analyses, combined with an inventory of relevant institutions, the existing legal framework and national policy instruments (UNESCO, 2013). By providing an in-depth situation analysis, these mapping exercises help countries devise evidence-based strategies to correct structural weaknesses and improve the monitoring of their national innovation system. This type of mapping exercise is just what the Caribbean needs. Without a similar rigorous understanding of the status and potential of STI in their countries, Caribbean governments will be advancing in a haze. According to Kahwa *et al*. (2014), the current poor understanding of the Caribbean STI environment is compounded by weaknesses in institutional research capacity and the inadequate collection, analysis and storage of key data, including for performance indicators.

Lack of STI data: a persistent problem

As far back as 2003, the Subregional Office for the Caribbean of the United Nations' Economic Commission for Latin America and the Caribbean (ECLAC) noted the persistent paucity of STI indicators for the Caribbean and the negative impact this was exerting on policy development, economic planning and the ability of Caribbean states to assess and deal effectively with challenges requiring innovative application of STI. The same year, ECLAC addressed the STI indicators gap by developing a *Manual for the Compilation of Science and Technology Indicators in the Caribbean*[8].

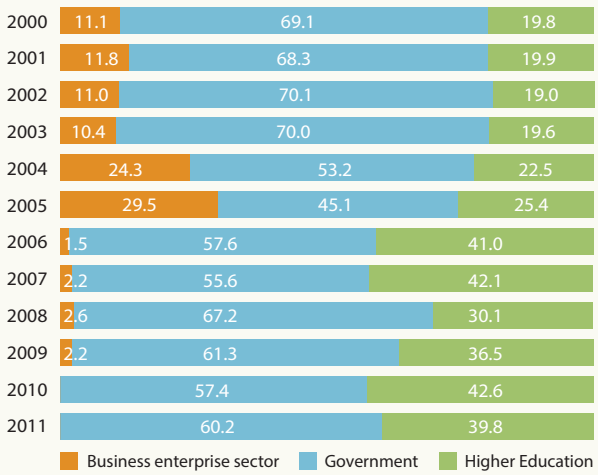
The UNESCO Institute for Statistics has also published several guides for developing countries, most recently the *Guide to Conducting an R&D Survey for Countries Starting to Measure R&D*[9] (2014). In 2011, the UNESCO Institute for Statistics ran a training workshop in Grenada to help CARICOM countries respond to STI data surveys while respecting international standards. Despite the efforts by UNESCO and ECLAC, Trinidad and Tobago was still the only CARICOM country providing data on R&D in 2014.

According to ECLAC, the collection and analysis of STI performance indicators remains a challenge for the Caribbean, despite the existence of relevant bodies, as this task is often not included in their mandate. These bodies include the:

- Scientific Research Council of Jamaica (est. 1960), an agency of the Ministry of Industry, Technology, Energy and Commerce, which has a subsidiary called Marketech Limited and a subdivision, the Food Technology Institute;
- Caribbean Industrial Research Institute in Trinidad and Tobago (est. 1970);
- Institute of Applied Science and Technology (formerly the National Scientific Research Centre) in Guyana (est. 1977), which 'is currently being resuscitated after a long period of decline,' according to its website.

It is not clear why Trinidad and Tobago is the only CARICOM country reporting R&D data but weaknesses in data collection may be at play. In Jamaica, the UWI has formed a partnership with the Jamaica Manufacturers' Association to determine the nature and level of R&D activity, as well as unmet needs, in the manufacturing sector, at least. Data-gathering got under way in 2014. It is planned to extend the study to Trinidad and Tobago, where recent reports on industrial R&D activity are not encouraging. According to the data, industrial R&D has declined markedly in recent years (Figure 6.5). This may have something to do with the drop in R&D activity in the sugar sector.

Figure 6.5: **GERD by sector of performance in Trinidad and Tobago, 2000–2011**



Source: UNESCO Institute for Statistics

8. See: www.cepal.org/publicaciones/xml/3/13853/G0753.pdf

9. see: www.uis.unesco.org/ScienceTechnology/Pages/guide-to-conducting-rd-surveys.aspx

Chronic underinvestment in R&D

The sluggish economic growth in the Caribbean in recent years has done little to boost STI, or deepen its engagement in solving economic challenges. Even the more affluent Trinidad and Tobago spent just 0.05% of GDP on research and development (R&D) in 2012.

Underinvestment in R&D is nothing new, however. As long ago as 2004, the Vice-Chancellor of the University of the West Indies, Prof. E. Nigel Harris, lamented in his inaugural address that, 'if we do not invest in science and technology, we shall not cross the ramparts in the field of sustainable development and even run the risk of perishing in the trenches of under-development'. At the time, Trinidad and Tobago was enjoying comfortable economic growth of 8% per year, which even peaked two years later at nearly 14%; despite this, the country devoted just 0.11% of GDP to R&D in 2004 and even less (0.06%) in 2006. Thus, poor economic performance alone cannot explain the extremely low commitment to STI by CARICOM governments.

A need for a more vibrant research culture

One of the greatest challenges facing the CARICOM countries is the need to develop a more vibrant and pervasive research culture. While there are certainly pockets of excellence, more people need to be encouraged to follow their passion for research. Scientists themselves need to make the quantum leap from doing good science to doing great science.

Despite limited funding, the Caribbean Academy of Sciences (est.1988) does its best to give CARICOM scientists international exposure by organizing biennial conferences to showcase research undertaken in the region. It also works closely with like-minded bodies, such as the InterAmerican Network of Academies of Sciences and the InterAcademy Panel.

The intergovernmental Caribbean Council for Science and Technology also does what it can to support the region's scientists but it continues to be plagued by the 'operational difficulties' identified in 2007 (Mokhele, 2007). The human and financial resources needed to achieve the council's objectives have not materialized.

An encouraging development is the revival of national innovation awards where contestants compete for prizes and the attention of investors, venture capital and opportunities for further product development by academic researchers and other interested parties. These contests have taken place[10] in Jamaica, Barbados and Trinidad and Tobago. The competitions are taken seriously by innovators and the exposure and prize money – between about US$ 2 500 and US$ 20 000 in Jamaica, depending on available funds – seem to be a good incentive. Senior leaders often hand out the awards at elegant galas.

To develop excellence, focus on the young

The World Academy of Sciences (TWAS) has a regional office for Latin America and the Caribbean which awards five annual prizes to the top senior scientist in the region. The Caribbean is yet to make an appearance on winner's row. TWAS also identifies the region's top five young scientists each year; to date, only one from the Caribbean has been so honoured. There is thus still some way to travel on the road to excellence.

What is critical at this juncture is to focus on our young researchers. St Lucia's Ministry of Youth Development and Sports has understood this. It runs a National Youth Awards Scheme which includes an award to an Outstanding Youth in Innovation and Technology.

Young researchers have also become a priority for two of the Caribbean's four regional organizations, the Caribbean Science Foundation and Cariscience.

Cariscience is a network of scientists set up in 1999 as an NGO affiliated to UNESCO. Cariscience remains the workhorse of the region. In the past four years, it has hosted several conferences for young scientists and a series of public lectures and summer schools for pre-university students in frontier areas such as genetics and nanoscience. In 2014, Cariscience pushed back its boundaries by running a training workshop on Technopreneurship for the Caribbean in Tobago, with the International Science, Technology and Innovation Centre for South–South Cooperation (ISTIC[11]) in Malaysia as its strategic partner. Of note is that the keynote speech was delivered by Dr Keith Mitchell, Prime Minister of Grenada, who is also the prime minister responsible for science and technology (S&T) within CARICOM.

The Caribbean Science Foundation dates from 2010. It has chosen the novel path of becoming a private company[12] with its attendant Board of Directors. In its young existence, it has already launched two programmes, both of which focus on introducing talented students to innovation and problem-solving.

The first of these is the Student Programme for Innovation in Science and Engineering (SPISE), which runs an intensive annual four-week summer school for gifted Caribbean secondary school pupils with an interest in science and engineering. The programme was introduced in 2012 and has enjoyed a noticeable measure of success.

10. In Barbados, the National Innovation Competition (est. 2003) is run by the National Council for Science and Technology. In Jamaica, the Scientific Research Council manages the National Innovation Awards for Science and Technology, established in 2005.

11. ISTIC was founded in 2008 and operates under the auspices of UNESCO.

12. It was originally intended for the Caribbean Science Foundation to focus largely on fostering university–industry linkages. However, most industries in CARICOM countries do not have an R&D unit or even invest in R&D. Economies remain primarily mercantile. To change this culture will take time, which is why the foundation is meanwhile focusing on youth.

The second programme is the Sagicor Visionaries Challenge, sponsored jointly by the Caribbean Science Foundation, Sagicor Life Inc., a Caribbean company offering financial services, and the Caribbean Examinations Council. The Sagicor Visionaries Challenge runs stimulating workshops in secondary schools for pupils and their teachers to brainstorm ideas for innovation and ways of improving the teaching of science subjects and mathematics. The aim is to encourage pupils to develop effective, innovative and sustainable solutions to the challenges facing them. The scheme includes mentorship and the organization of competitions.

Better co-ordination should avoid duplication

While four regional organizations seem an adequate number to serve a population of about seven million, there has not generally been any co-ordination of activities up to now, even though this would avoid duplication and enhance co-operation. This led Dr Keith Mitchell to launch the CARICOM Science, Technology and Innovation Committee in January 2014. The committee has a mandate to work with existing regional bodies rather than competing with them; its objectives are to:

- identify and prioritize areas of interest in science and engineering for regional development;
- formulate projects;
- work closely with all regional bodies that will be implementing the projects;
- help raise project funding; and
- advise the prime minister responsible for S&T within CARICOM.

There are currently six committee members, plus a representative of the diaspora from the Massachusetts Institute of Technology in the USA. The committee is planning to hold a high-level ministerial meeting in 2015.

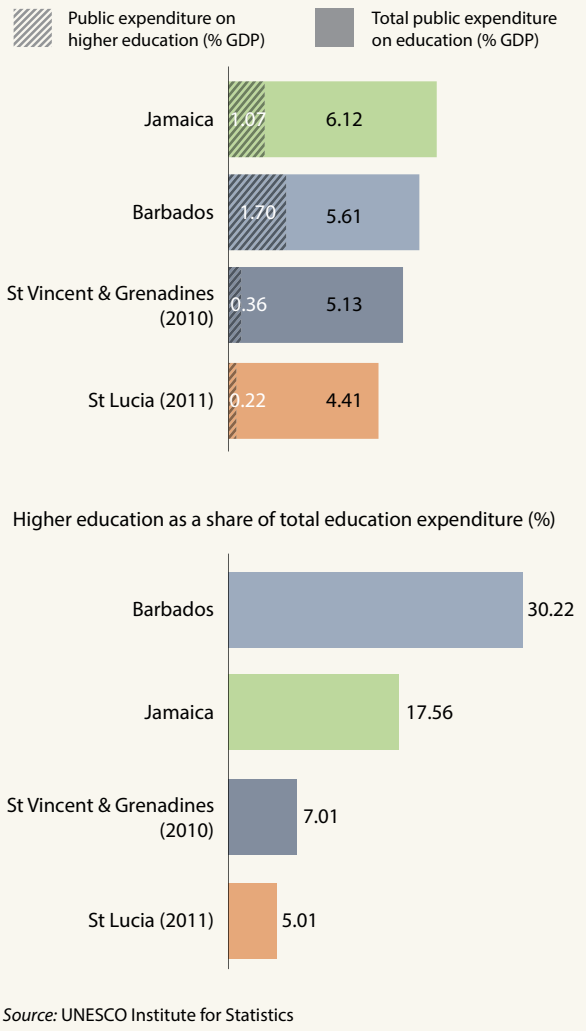
TRENDS IN HIGHER EDUCATION

A wavering commitment to higher education

The CARICOM countries spend 4–6% of GDP on education, according to available data (Figure 6.6). Those with universities to support tend to spend more than those which do not. This level of expenditure is similar to that of Brazil (5.8%), France (5.7%), Germany (5.1%) and South Africa (6.6%).

Expenditure on higher education has become a controversial topic; it is argued that it is expensive and consumes a large proportion of the education budget (18% in Jamaica and 30% in Barbados), at the expense of early childhood and secondary-level education. In rebalancing its own education expenditure, the Jamaican government has slashed its support for UWI, which has reacted by generating over 60% of its income in the 2013/2014 academic year. Barbados is heading in the same direction, despite internal opposition, and Trinidad and Tobago is expected to follow suit.

Figure 6.6: **Public expenditure on education, 2012 or closest year**



Source: UNESCO Institute for Statistics

Mona Campus: a success story

Of UWI's four campuses, the Mona Campus in Jamaica has demonstrated the greatest resilience; it is leading the way in putting innovative funding mechanisms in place for tertiary education: in 1999/2000, the 17 contributing Caribbean governments covered nearly 65% of the campus's income; by 2009/2010, this share had dwindled to 50% and by 2013/2014 to 34%. The Mona Campus has developed cost containment measures and new revenue streams based on supplementary tuition fees for high-demand teaching programmes such as medicine (since 2006), law (2009) and engineering (2012), as well as some commercial activities such as business process outsourcing and fees earned from service provision.

The campus has been able to devote 4.3% of its income to student support, over 75% of which goes to needy medical students. The campus is spending 6–8% of annual income on R&D. While this is modest compared to North American universities which spent 18–27% of their income on R&D, it should spearhead Jamaica's efforts to develop an effective national innovation system. The creation of a resource mobilization unit, the Mona Office of Research and Innovation, should help the campus to go after external grant funding and commercialize innovation from its R&D programme. Mona Campus has also engaged in public–private partnerships to deal with infrastructural challenges – the recent construction of student accommodation and the development of potable water resources are good examples. This has made the campus a more viable and competitive institution than it was a decade ago, a veritable success story.

Women marginalized as they climb the career ladder

One issue which continues to bedevil the region is the disproportionately small number of women rising to the highest echelons of academia. This phenomenon is quite evident at the University of the West Indies, where the share of women diminishes as staff move up the career ladder from low academic ranks such as lecturer, where they are the majority, to senior lecturer and professor, where they are in a small minority (Figure 6.7). This imbalance in academic progress may be resolved by giving female academic staff members ample time to focus on research. The important thing here is to recognize that there is a problem, so that the causes of this imbalance can be determined and the situation rectified.

TRENDS IN SCIENTIFIC PRODUCTIVITY

Grenada's scientific output progressing fast

For years, Jamaica, Trinidad and Tobago and Barbados have dominated scientific publishing, owing to the presence on their soil of campuses of the University of the West Indies (Figures 8 and 9). Today, however, UWI's dominance has been eroded somewhat by the impressive rise in refereed publications from Grenada. Much of this is due to St George's University, which contributes about 94% of Grenada's publications. Whereas, in 2005, Grenada produced just six articles in international journals covered by the Thomson Reuters Web of Science database, this number had risen to 77 by 2012. With this dramatic rise in output, Granada has overtaken Barbados and Guyana to become the number three producer in the Caribbean of the most internationally respected publications, behind Jamaica and Trindidad and Tobago. When publications per 100 000 inhabitants are considered (Figure 6.9), the high productivity of Grenada becomes evident. It is indeed a remarkable success story that a Caribbean country without a prior research pedigree should have made such impressive strides on the global stage.

The development of St George's University in Grenada over the past decade has been spectacular. The university was founded in 1976 by an act of parliament as an offshore medical training school, before introducing graduate and undergraduate programmes in 1993. In spite of being located in a small island country (Grenada) without a prior research pedigree, St George's University has morphed into a promising research centre in little over a decade.

The trend in Grenada should be encouraging to the Bahamas and St Kitts and Nevis, where output is also climbing steadily. The Bahamas published just five papers in 2006 but 23 in 2013. Much of this output is coming from the College of the Bahamas but there are other contributing institutions. St Kitts and Nevis can count on Ross University for veterinary medicine and related disciplines; it produced a single paper in 2005 but 15 in 2013.

Publications in the area of health are emanating from both university medical schools and hospitals, as well as government ministries and research centres (Box 6.1). By contrast, little output has materialized from agricultural research centres since 2005. In most CARICOM countries, agriculture accounts for less than 4% of GDP (Figure 6.2). The notable exceptions are Suriname (9%), Dominica (15%) and, above all, Guyana (22%) but, even here, articles on relevant topics are few and far between. Such low investment and output in agricultural R&D could be a threat to food security in a region that is still a net importer of foodstuffs.

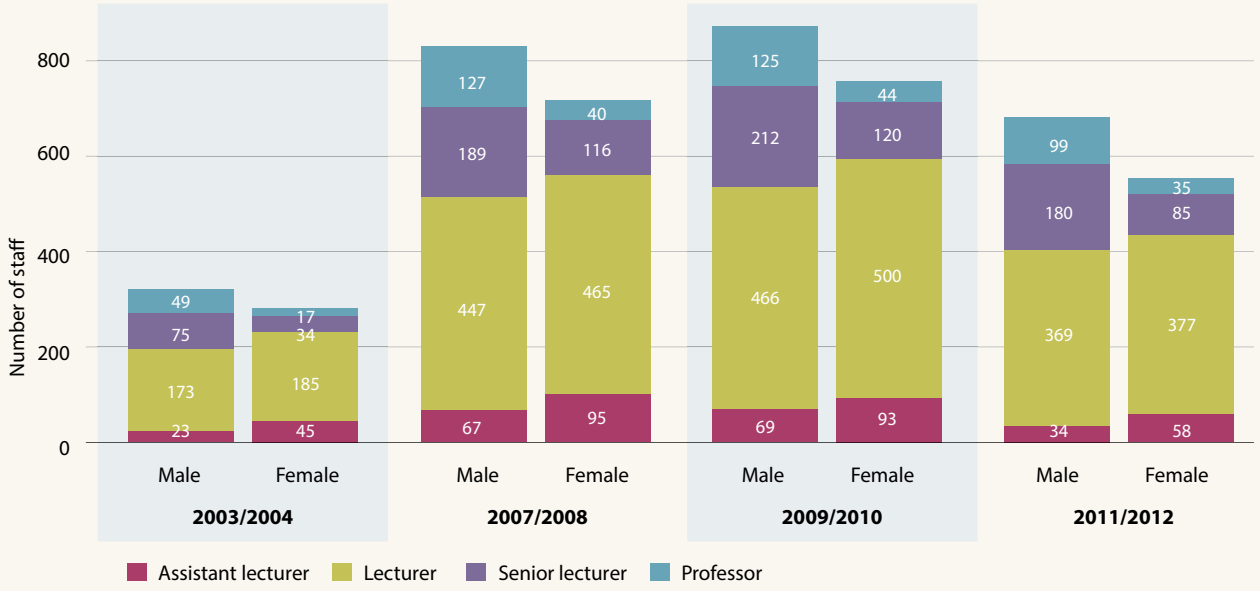
While research output from non-academic, non-health related R&D centres is not high, these entities provide critical services. The Scientific Research Council in Jamaica is active in wastewater management and provides information services on topics that include renewable energy, education, industrial support services and the development of natural products from endemic plants. The Caribbean Industrial Research Institute in Trinidad and Tobago facilitates climate change research and provides industrial support for R&D related to food security, as well as equipment testing and calibration for major industries[13]. The Bureaux of Standards in St Lucia[14] and St Vincent and Grenadines develop and manage standards and ensure product quality control and compliance, including environmental monitoring.

Another challenge is the low level of intraregional collaboration. US researchers are the primary collaborators for the CARICOM countries. Over 80% of articles from Grenada are co-authored with the USA and nearly 20% with Iranian collaborators. The highest level of intraregional collaboration is found in Jamaica, which counts Trinidad and Tobago as its number four collaborator. The CARICOM innovation framework should create a mechanism to encourage intraregional collaboration; UWI's Mona Campus has established a small grant scheme to support quality R&D proposals from such collaborators.

13. See: www.cariri.com

14. See: www.slbs.org.lc

Figure 6.7: **Gender breakdown of staff at University of the West Indies, 2009/2010 academic year**
By level of appointment



Source: UWI Official Statistics and communication from the Office of Planning

Box 6.1: **The Tropical Medicine Research Institute: an oasis in a public policy desert**

The Tropical Medicine Research Institute (TMRI) operates Caribbean-wide out of the University of the West Indies (UWI). It was born of the merger, in 1999, of the Tropical Metabolism Research Unit and Sickle Cell Research Unit* at UWI's Mona Campus in Jamaica.

The new institute fleshed out its mandate by adding a new entity, the Epidemiology Research Unit (ERU), and by taking under its wing the Chronic Disease Research Centre (CDRC) at the UWI's Cave Hill Campus in Barbados.

The Tropical Medicine Research Institute's long-term research projects are relatively well-funded, thanks to the competitive funding obtained by staff from a variety of agencies over the past decade, such as the: National Institutes of Health (USA), National Health Fund (Jamaica), Caribbean Health Research Council (now the Caribbean Public Health Agency), The Wellcome Trust, European Commission, Grand Challenges, Canada and Chase Fund (Jamaica).

All the articles published by TMRI since 2000 have been funded by these agencies. Productivity peaked at 38 articles in 2011 before falling back to 15 in 2014, the same level as in 2006. Although there are relatively few publications, these are of an excellent quality, as indicated by regular contributions to high-impact journals such as *Science*, *Nature* and the *Lancet*. The total number of TMRI's refereed publications is actually about three times that found in elite journals covered by the Thomson Reuters database, so there is potential for productivity in high-impact journals to increase dramatically.

The departure of two senior researchers has affected productivity. However, TMRI has invested in staff mentorship and is increasing cross-institute collaboration, while still attracting significant funding; this recipe seems set to reverse the negative impact of the senior researchers' departure.

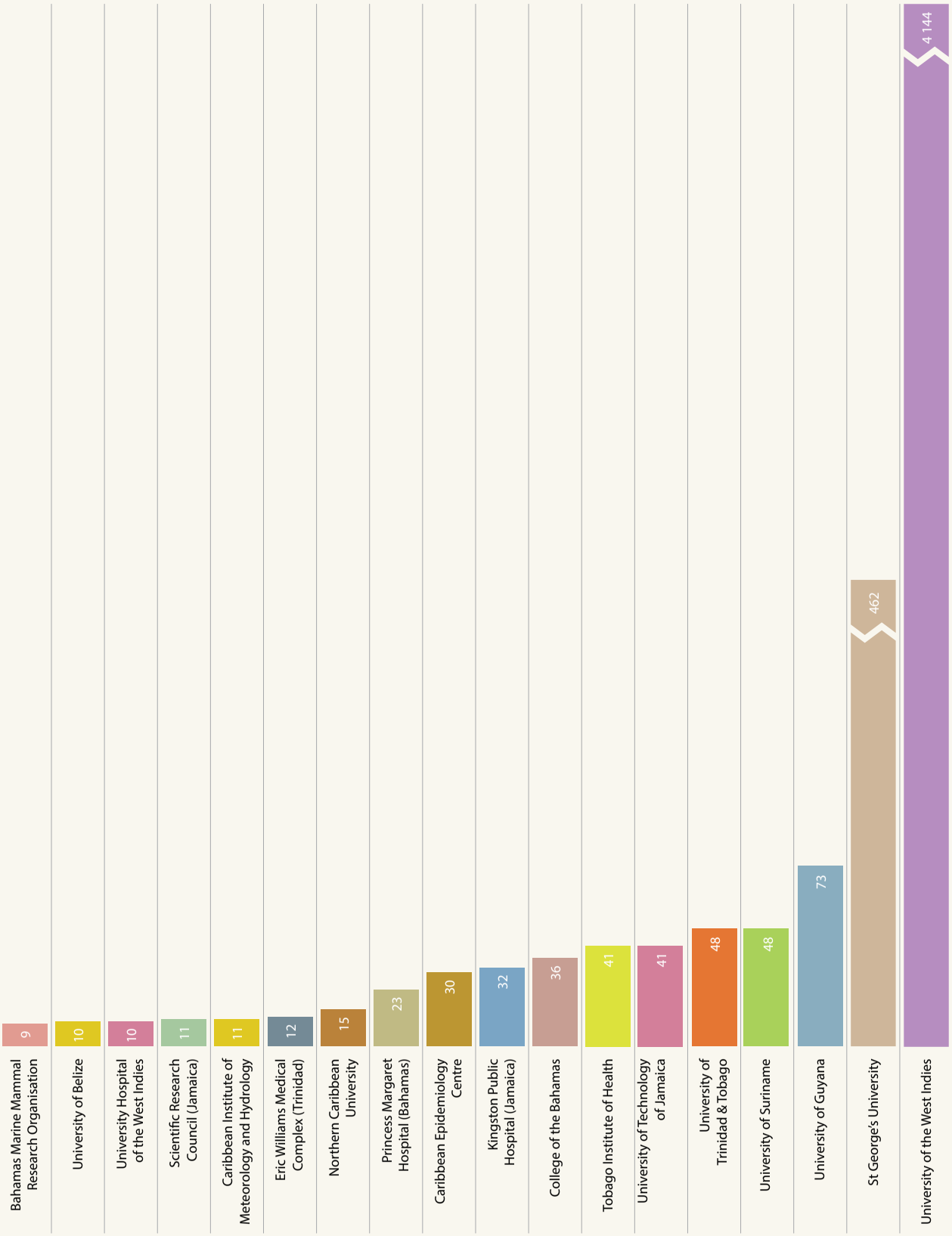
The Tropical Medicine Research Institute has built a research culture of a high standard by offering mentorship opportunities to young promising researchers (through postdoctoral positions) and competent support staff, such as research nurses, physicians, statisticians and equipment technologists. Very stringent recruitment and career advancement processes are also in place.

Clearly, the institute is an oasis of success in the desert that is Caribbean STI policy. The institute has managed to detach itself from the poor national research environment to create a competitive research programme on the global stage. Other R&D entities have not been so savvy; they will be held back as long as they continue to place all their eggs in the basket of non-functional or non-existent national R&D policy frameworks.

Source: authors

**Up until 1999, the Sickle Cell Research Unit had been funded by the British Medical Research Council (BMRC). The Tropical Metabolism Research Unit had been part of UWI since 1970, when it was transferred from the BMRC.*

Figure 6.8: **Refereed articles by Caribbean scientists, by institution, 2001–2013**



Source: Thomson Reuters Web of Science, Science Citation Index Expanded

Box 6.2: **Bio-Tech R&D Institute Ltd: adding value to local medicinal plants**

The Bio-Tech R&D Institute Ltd is a private R&D company founded by Dr Henry Lowe in 2010 with the ambition of becoming a premier biotechnology company in Jamaica and the wider Caribbean. The main research focus is on isolating pure compounds for the development of candidates for the treatment of cancer, HIV/AIDS, diabetes and other chronic diseases.

The company's research has led to the discovery and validation of several Jamaican medicinal plants and their products. These include *Tillandsia recurvata* (Old Man's Beard or Ball Moss), *Guaiacum officinale (Lignum vitae)* and *Vernonia* species. In February 2012, it began marketing seven nutraceutical products and a line of herbal teas in Jamaica. These discoveries have spawned several publications, including six in the journals covered by Thomson Reuters' database and as many patents.* The company's formulations for nutraceutical products are produced to the highest standards in a facility approved by the US Food and Drug Administration.

In October 2014, Dr Lowe and his team published a paper in the European Journal of Medicinal Plants after discovering that proprietary extracts from the Jamaican variety of Guinea Hen Weed inhibited the survival of the HIV virus. Dr Lowe told the Jamaican Observer at the time that these findings, if confirmed, might also impact the treatment of other viral diseases, such as Chikungunya and Ebola. In late 2014, he attracted international attention when he launched a company (Medicanja) to research and exploit marijuana plant varieties for potentially profitable medical applications.

The Bio-Tech R&D Institute Ltd employs about a dozen enthusiastic young PhD-holders and master's graduates, who have been able to engage in effective collaboration with established laboratories locally and overseas, especially at UWI and the University of Maryland (USA). The company has deepened its collaboration with the UWI, where it is establishing a state-of-the-art R&D facility and lending its entrepreneurial skill to the commercialization of UWI's suite of intellectual property.

Initially, the Bio-Tech R&D Institute Ltd received financial support from the Environmental Health Foundation, a not-for-profit company founded by Henry Lowe, but the BTI now lives off income from sales of its own products. No government funding flows to BTI.

BRDI has achieved remarkable success in its first five years of existence. Henry Lowe himself was awarded the National Medal for Science and Technology in 2014 by the Government of Jamaica.

This success story shows that an entrepreneur with a vision can provide a country and a region with desperately needed R&D leadership, even in the absence of effective public policy. There is hope that public policy will evolve in the near future, now that BRDI's achievements have attracted the attention of the senior political leadership.

Source: authors

**see: http://patents.justia.com/inventor/henry-lowe; www.ehfjamaica.com/pages/bio-tech-rd-institute-limited*

Private R&D companies emerging

Private indigenous research companies are also emerging, such as the Bio-tech R&D Institute (Box 6.2). Cariscience has admitted the institute as a member at a time when some university departments are finding it a challenge to meet the criteria for membership. This is an important development in the science landscape, for it means that high quality research is no longer the preserve of universities, government laboratories and foreign outfits.

'Invented by the UWI'

Jamaica, Trinidad and Tobago and Barbados all register some patenting activity. Jamaica has a small but growing cadre of local inventers seeking patent ownership through the local Jamaica Intellectual Property Office. One known local invention which has been commercialized is a collection of three patents on UWI's Cardiac Surgery Simulator Technology,[15] which has been licensed to a US company after extensive field trials at leading US cardiac surgery schools. The cardiac surgery simulator, which uses a combination of specially harvested porcine (pig) hearts and a computer controlled electromechanical pumping system to simulate a pumping heart, gives students a much better feel for real surgical circumstances. Each unit manufactured will bear the label 'Invented by the UWI', which should help improve the techno-savvy image of the region.

15. US Patent numbers: 8 597 874; 8 129 102; and 7 709 815: www.uspto.gov

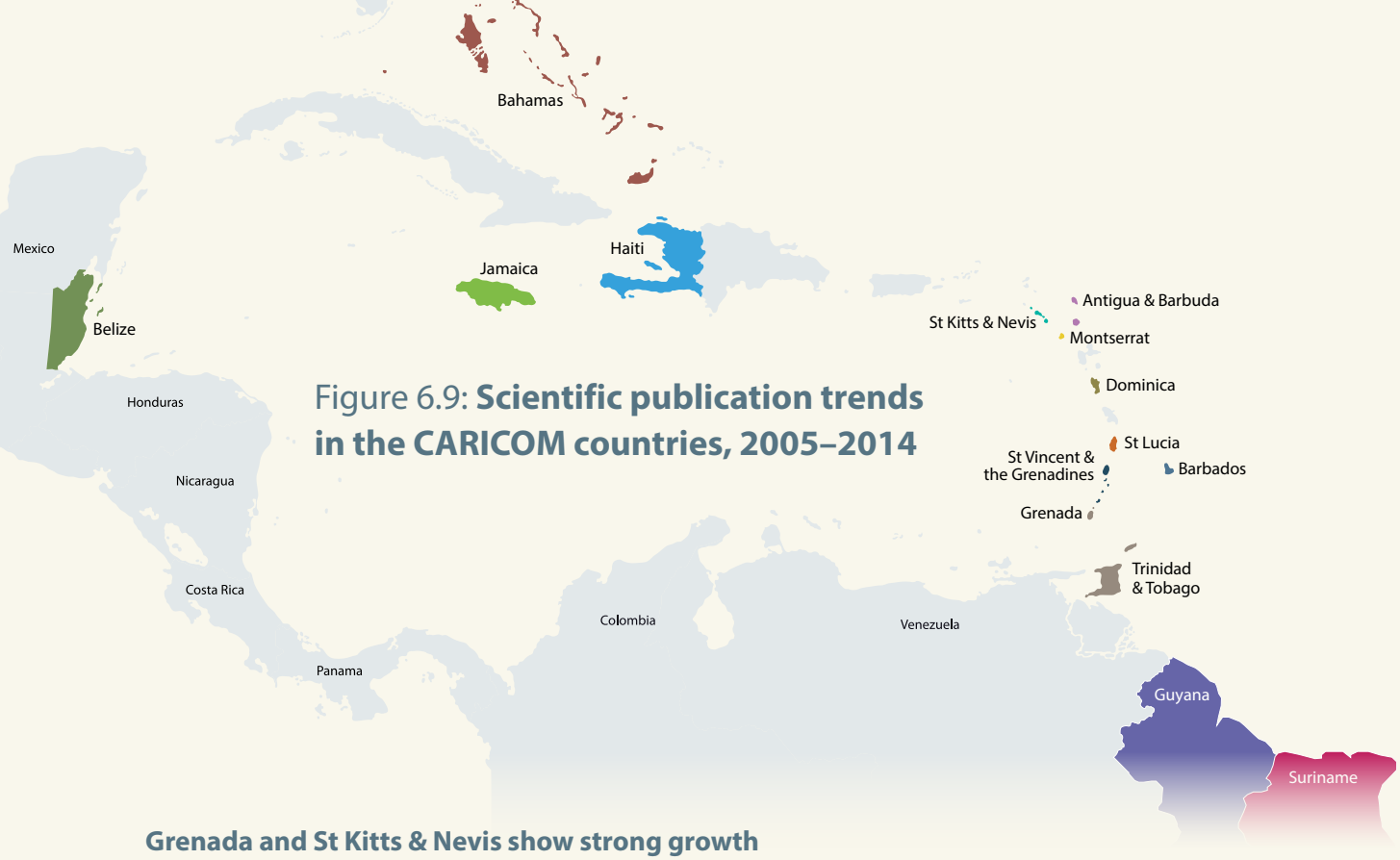
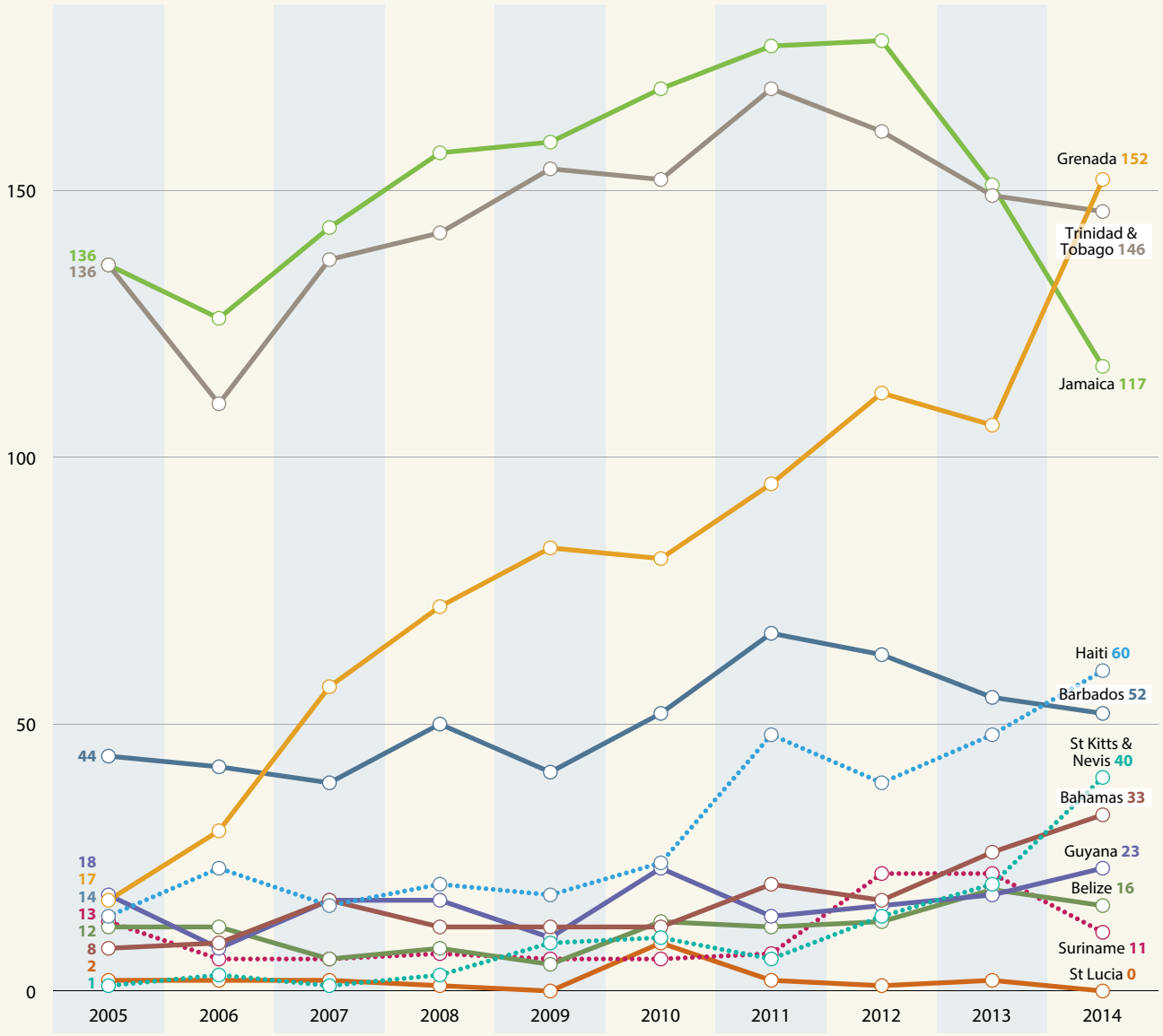


Figure 6.9: **Scientific publication trends in the CARICOM countries, 2005–2014**

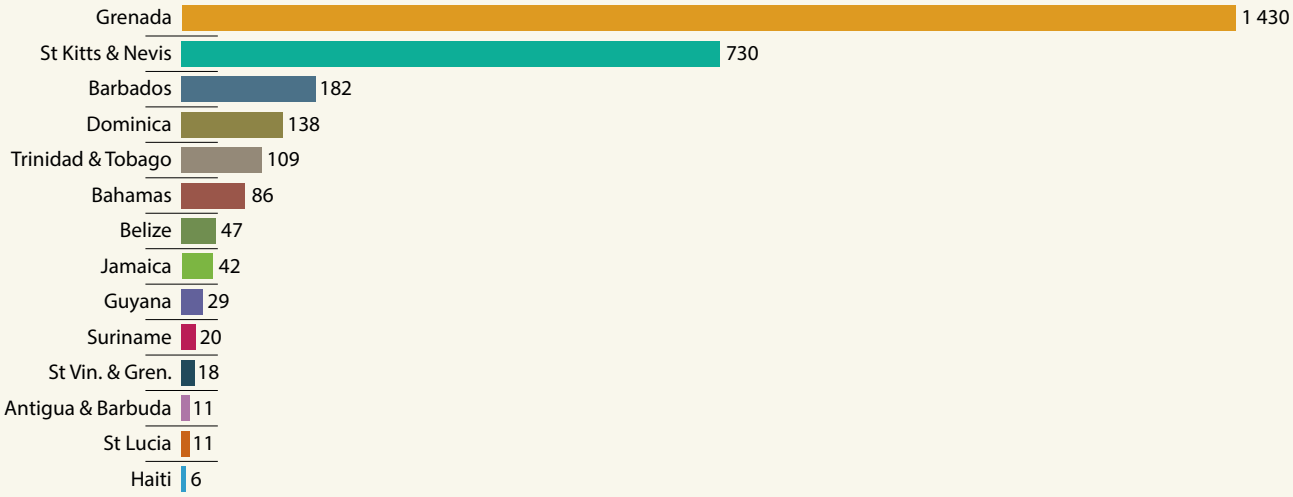
Grenada and St Kitts & Nevis show strong growth

Countries with more than 15 publications between 2008 and 2014



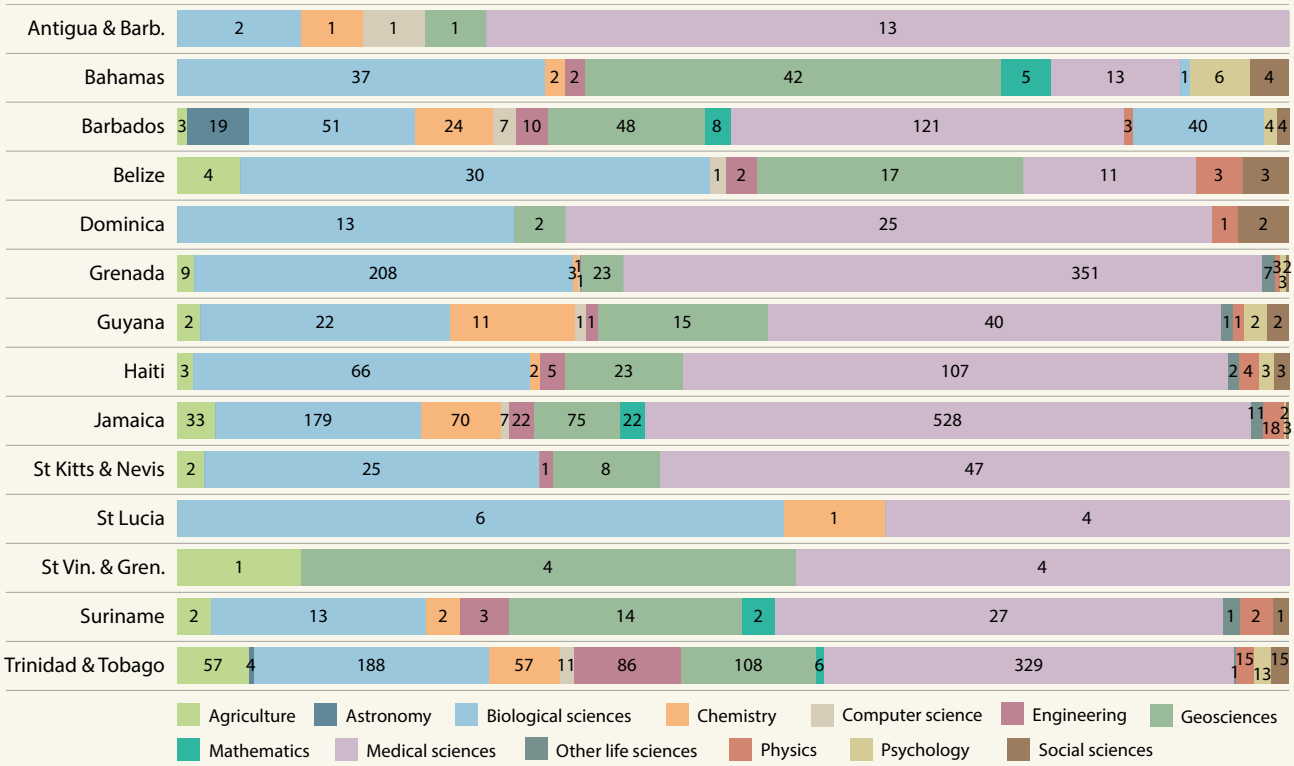
Grenada has the most intensive output

Scientific publications per million inhabitants in 2014



CARICOM countries publish most in health, led by Grenada and Jamaica

Cumulative totals, 2008-2014



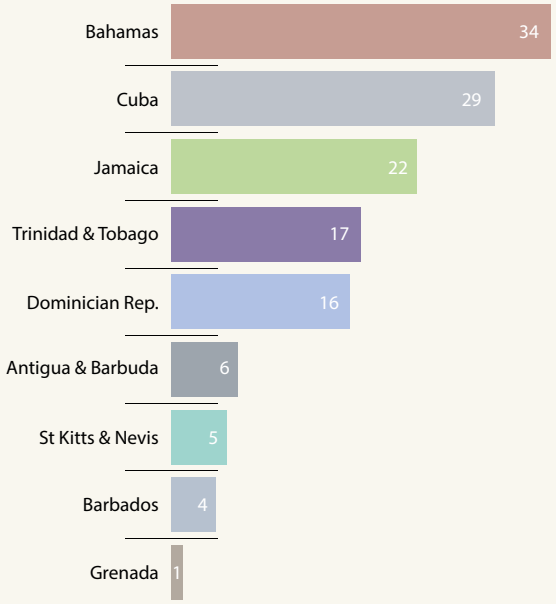
Jamaica and Trinidad & Tobago are close partners

Main partners for seven most prolific CARICOM countries, 2008–2014 (number of papers)

	1st collaborator	2nd collaborator	3rd collaborator	4th collaborator	5th collaborator
Bahamas	USA (97)	Canada (37)	UK (34)	Germany (8)	Australia (6)
Barbados	USA (139)	UK (118)	Canada (86)	Germany (48)	Belgium/ Japan (43)
Grenada	USA (532)	Iran (91)	UK (77)	Poland (63)	Turkey (46)
Guyana	USA (45)	Canada (20)	UK (13)	France (12)	Netherlands (8)
Haiti	USA (208)	France (38)	UK (18)	South Africa (14)	Canada (13)
Jamaica	USA (282)	UK (116)	Canada (77)	Trinidad & Tobago (43)	South Africa (28)
Trinidad & Tobago	USA (251)	UK (183)	Canada (95)	India (63)	Jamaica (43)

Source: Thomson Reuters Web of Science, Science Citation Index Expanded, data treatment by Science–Metrix

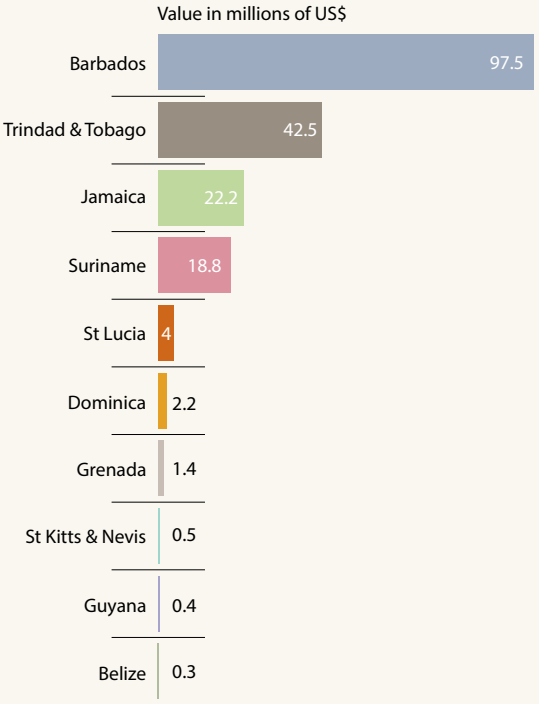
Figure 6.10: **USPTO patents granted to Caribbean countries, 2008-2013**



Note: Many patents are assigned to Barbados by companies but the inventors of these patents tend to have an address in the USA, so the patent is not attributed to Barbados.

Source: USPTO

Figure 6.11: **High-tech exports by CARICOM countries, 2008–2013**



Source: Comtrade database of United Nations Statistics Division

The US Patents and Trademark Office (USPTO) lists 134 patents from CARICOM countries over the period 2008–2013, the top contributors being the Bahamas (34), Jamaica (22) and Trinidad and Tobago (17). See Figure 6.10.

A handful of countries have high-tech exports

High-tech exports from the Caribbean are modest and sporadic (Figure 6.11). It is interesting to note, however, that Barbados not only holds a sizeable share of Caribbean patents but also has the greatest value of high-tech exports, which rose from US$ 5.5 million in 2008 to stabilize at US$ 18–21 million over 2010–2013.

Nearly eight out of ten Barbados exports over 2008–2013 concerned either scientific instruments (US$ 42.2 million) or chemistry (US$ 33.2 million excluding pharmaceuticals). Less revenue was earned from exports of electronics and telecommunications (US$ 6.8 million) and computers and office machines (US$ 7.8 million). Whereas Trinidad and Tobago led the region for high-tech exports in 2008 (US$ 36.2 million), these had plummeted to US$ 3.5 million by the following year. Jamaica's revenue has also dipped since 2008. By contrast, Suriname managed to increase its export earnings slightly over the same period.

CONCLUSION

Time for a detailed mapping exercise

The small CARICOM countries are vulnerable to a variety of environmental and economic shocks. Up until now, they have not managed to put in place and implement effective policy frameworks to propel STI. Consequently, important challenges in the region related to energy, water and food security, sustainable tourism, climate change and poverty reduction are not getting the level of input from the scientific enterprise required to make a difference.

What is encouraging is that CARICOM has promulgated a long-term development strategy for the region, the *Strategic Plan for the Caribbean Community: 2015–2019*. Moreover, engaging with STI is a pivot for this plan's success, as indeed it does in several national planning documents, such as *Vision 2020* in Trinidad and Tobago, *Jamaica Vision 2030* and the *Barbados Strategic Plan 2005–2025*. What is now required are policies that break with the implementation deficits of the past and effectively employ STI to accelerate the development process.

It is heartening to note that, in spite of a lack of effective STI policy frameworks and wavering public support for tertiary education, there are some bright spots on the horizon:

- Grenada has emerged over the past decade as a strong contributor to STI in the region, thanks largely to the growing productivity of St George's University;
- the UWI Mona Campus has managed to reduce its dependence on dwindling government funding by generating income streams of its own;
- the Tropical Medicine Research Institute at UWI continues to publish high-quality papers in top journals on the global stage; and
- a small new local private R&D company, the Bio-tech R&D Institute Limited, has muscled its way in just five years onto the global scene with papers, patents and commercial products, the sales from which are now generating a profit.

As pointed out by Kahwa (2003) a decade ago and echoed by the recent success stories above, in the absence of robust public policy to support and entrench STI in the national development process, it is researchers themselves who are devising innovative means of driving STI. It is high time that the region embarked on a detailed STI policy mapping exercise, in order to get a clear picture of the current situation.

Only then will countries be able to design evidence-based policies which propose credible strategies for raising investment in R&D, for instance. The findings of the situation analysis can be used to mobilize resources and strategic support for STI, to cultivate industrial participation in R&D by aligning efforts with industry needs, to reform or phase out underperforming public R&D institutions, to explore more politically and socially palatable means of raising funding for R&D, to align international and multilateral aid/borrowing on relevant R&D opportunities and to develop protocols for measuring and rewarding institutional and individual achievements in R&D. This cannot be too difficult a task when the leadership of the region is so highly educated.

KEY TARGETS FOR THE CARICOM COUNTRIES

- Raise the share of renewable energy sources in the electricity generation mix in CARICOM member states to 20% by 2017, 28% by 2022 and 47% by 2027;
- Raise the share of intra-CARICOM trade above the current share of 13–16% of intraregional trade by 2019.

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