

Agricultural R&D in the Caribbean

An Institutional and Statistical Profile

J. Roseboom
M. Cremers
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June 2001

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Citation

Roseboom, J., M. Cremers, and B. Lauckner. 2001. Agricultural R&D in the Caribbean: An Institutional and Statistical Profile. ISNAR Research Report No. 19. The Hague: International Service for National Agricultural Research.

AGROVOC Descriptors

Agriculture; Caribbean; research; research institutions

CABI Descriptors

Agricultural research; Caribbean; research institutes

ISSN: 1021-4429

ISBN: 92-9118-056-4

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Foreword

This research report gives an institutional and quantitative overview of the agricultural research capacity in the Caribbean. The goal of the report is to provide a sound basis of information for agricultural research policymakers in the Caribbean.

What comes through compellingly in this study is how the geopolitical fragmentation of the region places a major constraint on the effective and efficient organization of agricultural research. This is a problem not only for agricultural research, but also for most other agricultural support services (e.g., extension, disease control, credit, marketing, and export promotion) and for government services more generally. Despite relatively high agricultural research investment levels in the smaller Caribbean countries, Caribbean farmers find it increasingly difficult to be competitive in export as well as local markets. While many blame globalization and trade liberalization for this, a more fundamental problem is that technological progress is very much based on standardization and scale—factors that are at odds with the diversity and small scale of the Caribbean region.

Enhancing scale in the organization of agricultural research through regional cooperation and networking is not a new idea, but one that, we believe, should be pursued more intensively and with more conviction.

ISNAR would like to thank CARDI for its collaboration—without its support it would have been quite impossible to conduct this study.

Stein W. Bie
ISNAR Director General

June 2001

Acknowledgments

Data collection for this report began in mid-1998 and took more than a year and a half to complete. We received excellent assistance in the actual conduct of the survey from CARDI staff and collaborators in various countries. They often leaned on many others unknown to us to obtain the requested data. We thank them all very much. Caribbean countries not associated with CARDI were approached directly. In the case of the Dominican Republic, the State Secretariat for Agriculture (SEA) and the Center for the Development of Agriculture and Forestry (CEDAF) joined forces to conduct the survey. We especially thank Rafael Perez Duvergé of CEDAF for his coordinating role.

The library staff at both CARDI and ISNAR helped enthusiastically with document searches. On the secretarial front, we were assisted, always cheerfully, by Alma Torres, who worked particularly hard on completing the address database, reformatting spreadsheets, and entering reference material into our reference database. Richard Claase made the map of the Caribbean, while Oona Paredes edited and proofed the text, and Bob van Duuren desktop-published the report.

We received constructive feedback on an earlier version of this report from Dr. Compton Paul (PROCICARIBE), Dr. Arlington Chesney (Caribbean Office of IICA), Dr. M.M. Rahman (ISNAR), and Nienke Beintema (IFPRI), as well as from four anonymous reviewers. We thank them all for helping us improve the quality of this report.

Last but not least, we thank the Japanese Government for its restricted core contribution to ISNAR, which has supported this component of the ASTI project. The ASTI project is a joint initiative by IFPRI and ISNAR.

Abstract

This study surveyed agricultural R&D capacity in the Caribbean in order to gain better insight into its structure and development, as well as its potential contribution to the development of agriculture in the region.

This study has several principal findings:

- a. Agricultural research capacity in the Caribbean is highly fragmented. Of the 116 agricultural research agencies for which data were obtained, 84 employed less than 10 FTE researchers, and 62 employed less than 5.
- b. Between 1986 and 1996, the growth in agricultural research capacity in the Caribbean almost halted in terms of the number of researchers, and contracted in terms of expenditures. However, strong positive growth was still noted for the French bilateral research agencies.
- c. Agricultural research investment levels relative to AgGDP are rather high for many of the smaller Caribbean countries. This is not necessarily an indication of intensive innovation, but rather a lack of economies of scale. Such high intensities are possible because of generous donor support or a rich non-agricultural sector.
- d. For every 100 million dollars of crop, livestock, forestry, and fisheries production, the region employed, respectively, 33.5, 10.9, 13.0, and 48.9 FTE researchers. Assuming that innovation opportunities are the same for all four types of production, livestock and forestry appear neglected when compared to crops and fisheries.
- e. Lack of economies of scale in the agricultural input and processing industries, as well as in the provision of public services (including agricultural research), is a serious handicap for modern agricultural production in many of the small Caribbean countries. Commodity specialization and clustering of research activities across countries are some ways of creating enough volume of research benefits to pay for research costs.

Abrégé

Le but de l'étude présentée dans ce rapport était d'examiner l'effort de R&D agricole dans la région des Caraïbes, en vue de mieux en comprendre les structures et l'évolution, ainsi que d'examiner les contributions potentielles qu'il pourrait apporter au développement agricole de la région.

L'étude a permis de tirer plusieurs conclusions :

- a. L'effort de recherche agricole dans les Caraïbes est caractérisé par une fragmentation poussée. Pour 84 des 116 agences de recherche agricole pour lesquelles des données avaient été collectées, l'effectif de recherche en équivalent temps plein était inférieur à 10, et pour 62 des agences, il était même inférieur à 5.
- b. Entre 1986 et 1996, la croissance de l'effort de recherche dans les Caraïbes a quasiment stagné pour ce qui est des effectifs de chercheurs, et les dépenses ont décliné. Cependant, une forte croissance fut relevée pour les agences de recherche bilatérales françaises.
- c. Dans bon nombre de petits pays caraïbes, les niveaux d'investissements dans la recherche agricole sont assez élevés par rapport au PIB agricole. Ce n'est pas

nécessairement le signe d'une innovation intensive, mais plutôt d'un manque d'économies d'échelle. De tels niveaux d'intensité sont possibles grâce à la générosité des bailleurs de fonds ou bien grâce à l'existence d'un secteur non-agricole riche.

- d. Pour chaque 100 millions de dollars américains de production végétale, animale, sylvicole et halieutique, l'effectif de recherche en équivalent temps plein de la région s'élevait à respectivement 33,5 ; à 10,9 ; 13 et à 48,9. En assumant que les opportunités d'innovation sont les mêmes pour chacun des quatre types de production, il semble bien que les productions animales et sylvicoles aient été négligées, en comparaison avec les cultures et les pêcheries.
- e. Le manque d'économies d'échelle dans les industries agricoles de base et de transformation, de même qu'au niveau de la provision de services publics (y compris la recherche agricole) constitue un handicap grave pour la production agricole moderne dans bon nombre de petits pays dans les Caraïbes. La spécialisation des filières ainsi que le regroupement des activités de recherche au-delà des frontières nationales sont deux des méthodes adoptées pour atteindre un rendement de recherche suffisamment important pour pouvoir couvrir les coûts de la recherche.

Resumen

Este estudio examinó la capacidad de investigación y desarrollo en el Caribe para comprender mejor su estructura y evolución así como su contribución potencial al fomento de la agricultura en la región.

Contiene varios resultados importantes:

- a. La capacidad de investigación agrícola en el Caribe está muy fragmentada. De los 116 organismos de investigación agrícola para los cuales se obtuvieron datos, 84 empleaban menos de 10 investigadores (en equivalente en tiempo completo) y 62 tenían menos de 5.
- b. Entre 1986 y 1996, el crecimiento de la capacidad de investigación agrícola en el Caribe prácticamente se detuvo en lo que hace al número de investigadores, y se redujo con respecto a los gastos.
- c. Los niveles de inversión en la investigación agrícola, relativos al PIB de la agricultura, son bastante elevados para muchos de los países más pequeños del Caribe. Esto no indica necesariamente que haya una innovación intensiva sino más bien la falta de economías de escala. Una intensidad tan alta es posible gracias al generoso apoyo de los donantes o a la riqueza del sector no agrícola.
- d. Por cada 100 millones de dólares de producción agrícola, ganadera, silvícola y pesquera, la región empleó, respectivamente, 33,5, 10,9, 13,0 y 48,9 investigadores (en equivalente en tiempo completo). Suponiendo que las oportunidades de innovación sean las mismas para los cuatro tipos de producción, la ganadería y la silvicultura parecen recibir menos atención comparadas con los cultivos y la pesca.
- e. La falta de economías de escala en las industrias de insumos agrícolas y de elaboración así como en el suministro de servicios públicos (incluida la investigación agrícola) es una gran desventaja para la producción agrícola moderna en muchos de los pequeños países del Caribe. La especialización en productos básicos y la reagrupación de las actividades de investigación entre países son algunas de las formas de crear un volumen suficiente de beneficios, resultantes de la investigación, para sufragar los costos de la misma.

Acronyms

ACP	Africa, Caribbean, and Pacific
AgGDP	agricultural gross domestic product
ASTI	Agricultural Science and Technology Indicators
BABCO	Belize Agri-Business Company
BAMCO	Barbados Agricultural Management Company, Ltd.
BELSIL	Belize Sugar Industry, Ltd.
CABI	Commonwealth Agricultural Bureaux International
CAIS	Caribbean Agricultural Information System
CARDATS	Caribbean Agricultural Rural Development and Advisory Training Service
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community and Common Market
CARIFTA	Caribbean Free Trade Association
CARIRI	Caribbean Industrial Research Institute
CEA	Consejo Estatal del Azúcar
CENDA	Centro Norte de Desarrollo Agropecuario
CIA	Central Intelligence Agency
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CFNI	Caribbean Food and Nutrition Institute
CFRAMP	Caribbean Fisheries Resources Assessment and Management Program
CTA	Technical Centre for Agricultural and Rural Cooperation
CTAS	Caribbean Agricultural Technical Assistance Service
CTCS	Centre Technique de la Canne en du Sucre
CTFT	Centre Technique Forestier Tropical
ECLAC	Economic Commission for Latin America and the Caribbean
FAO	Food and Agriculture Organization of the United Nations
FANS	Faculty of Agriculture and Natural Sciences
FDA	Fundación de Desarrollo Agropecuario, Inc.
FTE	full-time equivalents
GDP	gross domestic product
IDB	Inter-American Development Bank
ICTA	Imperial College of Tropical Agriculture
IDA	Imperial Department of Agriculture
IFAT	Institut Français d'Amérique Tropicale
IFPRI	International Food Policy Research Institute
IICA	Instituto Interamericano de Cooperación para la Agricultura
IMA	Institute of Marina Affairs
INDOTEC	Instituto Dominicano de Tecnología Industrial
INDRHI	Instituto Nacional de Recursos Hidráulicos
INRA	Institut National de la Recherche Agronomique
IRAT	Institut de Recherche Agronomique Tropical
IRFA	Institut de Recherches sur les Fruits et Agrumes
IRD	Institut de Recherche pour le Développement
ISA	Instituto Superior de Agricultura
ISNAR	International Service for National Agricultural Research
NARS	national agricultural research system(s)
NIHERST	National Institute of Higher Education—Research, Science and Technology
NRM	natural resource management

OECD	Organization for Economic Cooperation and Development
ORSTOM	Office de la Recherche Scientifique et Technique Outre-Mer
PPP	purchasing power parity
PROCICARIBE	Program for Cooperation of Institutes of Agricultural Sciences and Technology in the Caribbean
RRC	Regional Research Center
SAES	State Agricultural Experiment Station
SIRI	Sugar Industry Research Institute
T&T	Trinidad and Tobago
UASD	Universidad Autónoma de Santo Domingo
UN	Universidad Nordestrana
UNESCO	United Nations Education and Science Organization
UNPHU	Universidad Nacional 'Pedro Henrique Ureña'
UPR	University of Puerto Rico
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USSR	Union of Soviet Socialist Republics
UVI	University of the Virgin Islands
UWI	University of the West Indies
WIBDECO	Windward Islands Banana Development and Export Company, Ltd.
WICSCBS	West Indies Central Sugar Cane Breeding Station
WINBAN	Windward Islands Banana Association
WTO	World Trade Organization

Executive Summary

The development of Caribbean agriculture depends heavily on its ability to modernize and adapt its production towards new circumstances. In recent years in particular, the sector has felt the harsh effects of losing access to protected markets, and has failed to be competitive enough in its traditional markets, both abroad and at home, as well as in potential new markets. Within this context, the authors of this study surveyed the agricultural R&D capacity in the region in order to gain better insight into its structure and development, as well as its potential contribution to the development of agriculture in the region.

Excluding Cuba and Haiti, the region employed close to 1000 FTE researchers and spent some 106 million dollars (1993 PPPs) in 1996. Reflecting the geopolitical fragmentation of the region, agricultural research capacity is also extremely fragmented. Of the 116 agricultural research agencies for which data were obtained, 84 employed less than 10 FTE researchers, and 62 employed less than 5. The largest agricultural research entity in the region employed approximately 60 FTE researchers. Broken down by institutional category, the shares of local government agencies, bilateral and regional government agencies, universities, and business enterprises (including commodity boards) were 37%, 31%, 19%, and 12%, respectively, of the human resources, and 27%, 39%, 22%, and 12%, respectively, of the financial resources.

The number of agricultural researchers in the Caribbean increased by 6% between 1986 and 1996, while agricultural research expenditures declined by 9% (in real terms). This resulted in an average decline of 15% in expenditures per researcher. The experiences of individual countries or research organizations deviated significantly from this average trend. For example, the French Caribbean countries saw a strong expansion of their agricultural research capacity during this period, which somewhat counterbalanced contractions noted elsewhere.

Funding for agricultural research in the region is also quite diverse and depends heavily on the type of organization. On average, 41% of funding comes from local governments, 39% from donors, 9% from specific taxes and levies, 7% from research contracts, 1% from sales, and 3% from other sources. Across institutional categories, however, the relative weights of the funding sources differ greatly. For example, donor funding ranges from as high as 100% for bilateral agencies to as low as 0% for business enterprises, while specific taxes and levies seem to be the almost exclusive prerogative of commodity boards.

Excluding Cuba, the Dominican Republic, and Haiti, agricultural research expenditures in the region accumulated to a level of 2.6% of AgGDP in 1996. This level is significantly higher than the developing country average (0.5% in 1991) and quite close to the investment level of the developed countries (3.1% in 1993). However, high agricultural research intensity ratios in the Caribbean are not necessarily a sign of a highly innovative agricultural sector, as it is for most developed countries. The lack of economies of scale in most Caribbean countries makes the development of agricultural technology extremely expensive. Therefore, high intensity ratios in these countries are better explained by international and local equity concerns, rather than by intensive innovation.

Cuba, the Dominican Republic, and Haiti have quite distinctive levels of agricultural research investment compared to their smaller Caribbean neighbors. The Dominican Republic invested in agricultural research at a level of only 0.2% of AgGDP in 1996. Investment intensities for Cuba and Haiti are more speculative because of incomplete data. Haiti's

investment level is probably even lower than that of the Dominican Republic. In contrast, Cuba's investment level is probably at 1–2%.

Solving a problem for 1,000 farmers or 100,000 farmers makes a lot of difference in terms of the rate of return that can be expected from a research project. Small countries have three options for overcoming this problem: (1) import technology from elsewhere; (2) specialize in just a few commodities (i.e., reduce scope and thereby increase scale); and (3) cluster research activities with other countries so that the research benefits have enough volume to pay for the research investment. (This is the idea behind CARDI, PROCICARIBE, and other collaborative research efforts in the region.)

These strategies already have a long tradition in the Caribbean. The issue is whether they have been exploited to the fullest or whether there is still significant mileage to be gained by exploiting these strategies further. Assuming the latter, it remains doubtful whether the proposed strategies are a sufficient antidote to unfavorable economies-of-scale conditions for all countries in the region.

1. Introduction

The development of Caribbean agriculture depends heavily on its ability to modernize and adapt its production towards new circumstances. Increasingly, the sector is feeling the harsh effects of losing access to protected markets, and fails to be competitive enough in its traditional markets as well as in potential new ones. Within this context, the authors surveyed agricultural R&D capacity in the region in order to gain insight into its structure and development, as well as its potential contribution to the development of agriculture in the region.

In addition to descriptive institutional information, this report summarizes and analyzes new research staffing and financial data that have been collected specifically for this study. In comparison to earlier studies,¹ the current study has progressed substantially in both geographic and institutional coverage. This report should be of interest to those involved or interested in agricultural research in the Caribbean, especially to the agricultural research managers and leaders who set the policies and allocate resources for agricultural research in the region.

The information and statistical data have been collected and presented in such a way that they are comparable across the 28 Caribbean countries, and comparable with data from other country studies under the Agricultural Science and Technology Indicators (ASTI) project. Annex 1 summarizes the methodology and definitions used by the ASTI project, while annex 5 lists all the data sources that were utilized. Country-specific data sets with time-series data per institute are available electronically and as a statistical appendix upon request from ISNAR.

Chapter 2 of this report gives an overview of the structural and economic characteristics of the Caribbean, with particular attention given to the role of agriculture. The chapters that follow provide an account of the historical development and current institutional structure of agricultural research in the region (chapter 3), and the human and financial resources invested in agricultural research (chapter 4). Chapter 5 concludes the report by exploring the future of agriculture and agricultural research in the Caribbean.

The annexes to this report provide the following information: the definitions and concepts used for the data collection (annex 1), country status (annex 2), names and addresses of institutes (annex 3), detailed institutional data (annex 4), and data sources (annex 5).

1. FAO and CARDI (1993); Lindarte (1995); Lindarte (1998); Nestel (1991); World Bank (1993).

2. Structural and Economic Characteristics of the Caribbean

General characteristics

The Caribbean² is one of the most diverse regions in the world. Its population has its roots in many corners of the globe and (former) colonial ties are quite diverse, all of which result in a great diversity of languages, culture, and political and juridical systems. The region is comprised of countries that count among the poorest (Cuba and Haiti) as well as the richest (Aruba, Bahamas, Cayman Islands) in the world (see table 1). Most Caribbean countries have very small populations (21 out of 28 countries have a population of less than half a million), but the region also includes several medium-sized countries with populations of 5 million or more (Cuba, Haiti, Dominican Republic). The three largest countries constitute 69% of the region's total population of 38.2 million in 1997.

Although the Spanish were first to invade the "New World," Spain lost its initial monopoly in the region to Denmark, France, Great Britain, the Netherlands, and the United States in the centuries that followed (see annex 1). In the 19th century, Spain lost control over its three remaining colonies in the region (Cuba, the Dominican Republic, Puerto Rico) to local liberation movements that were inspired by the developments in both North and South America. Spanish domination of the Dominican Republic came to an end in 1844, while the Spanish-American War in 1898 ended all Spanish claims on Cuba and Puerto Rico.

At that time, Puerto Rico became a U.S. territory, while Cuba became independent though strongly dominated by U.S. economic and political interests. The Dominican Republic and

Table 1: Per Capita Income and Population Size in the Caribbean, 1997

GDP per capita (PPP dollars)	Total population (in millions)				
	0.1<	0.1-0.5	0.5-1.0	1.0-5.0	>5.0
\$2,000<					Haiti Cuba
\$2,000-4,999	Dominica Grenada Montserrat	St. Vincent and the Grenadines Belize Suriname St. Lucia	Guyana	Jamaica	Dominican Republic
\$5,000-9,999	St. Kitts-Nevis Anguilla Antigua and Barbuda Turks and Caicos Islands	French Guiana Guadeloupe		Trinidad and Tobago Puerto Rico	
\$10,000-19,999	British Virgin Islands	Martinique Barbados Netherlands Antilles Virgin Islands (US) Bahamas			
>\$20,000	Aruba Cayman Islands				

2. The Caribbean region, as defined here, is comprised of 24 island states or territories and 4 coastal countries (Belize, French Guiana, Guyana, and Suriname). See annex 2 for the complete list of countries and territories, their formal government status, and membership in the Caribbean Community and Common Market (CARICOM).

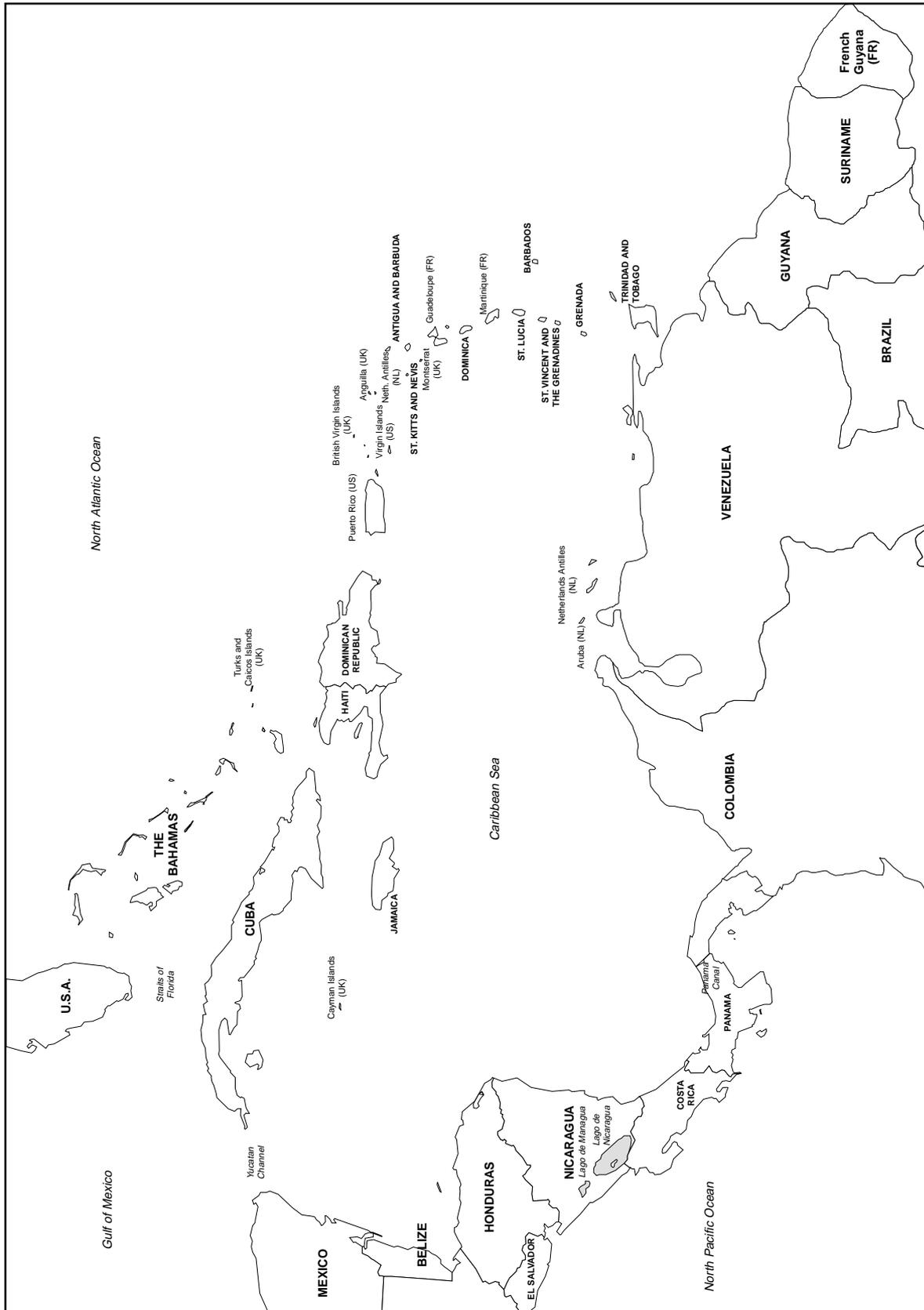


Figure 1: The Caribbean region

Haiti,³ countries with a long history of political instability, came under relatively strong U.S. domination and were invaded several times during the 20th century by American troops for the purpose of restoring law and order. For strategic reasons, the U.S. also purchased from Denmark several islands belonging to the Virgin Islands during the First World War.

A total of 17 out of 28 countries in the region have historical ties with Great Britain, making it the most common (former) colonizer in the region in terms of number of countries. In terms of population, however, Spanish speakers outnumber English speakers by about four to one. Since 1960, 13 of the 17 British colonies in the Caribbean have gained independence, although they all remain part of the (former British) Commonwealth, and most of them retain the British monarch as their titular head of state. Of the Dutch and French colonies in the region, only Suriname gained independence (in 1975).

The region's fragmentation into very small island states is often considered a major structural weakness. Despite an attempt by the British government to consolidate its Caribbean colonies into the British West Indies Federation in 1958, the two largest countries in the federation (Jamaica and Trinidad & Tobago) broke away and gained independence in August 1962. As a consequence, the federation was dissolved, but the need for regional collaboration remained. During the 1960s, several initiatives towards collaboration were launched by the heads of government of the (former) British colonies in the Caribbean. It culminated, among other things, in the establishment of the Caribbean Free Trade Association (CARIFTA) in 1968, which was succeeded by the Caribbean Community and Common Market (CARICOM) in 1973. Membership was no longer limited to (former) British colonies. Other Caribbean countries were invited to join, but only Suriname and Haiti have done so to date. A few other countries maintain observer status (see annex 2).

Agriculture within the overall economy

Most countries in the Caribbean have undergone a profound economic transformation over the past 40 years, from an essentially agricultural economy towards a predominantly service-oriented one. Traditionally, agricultural economies in the region were based on one or two major export crops such as sugar or bananas. These exports provided the foreign exchange needed to import consumer goods. Over time, tourism and offshore banking have taken over as the principal economic activities in the region, particularly in the smaller countries. The larger countries have somewhat more diversified economies and have developed some manufacturing industry. Not all countries have succeeded in this transition towards a modern economy. Agriculture still constitutes more than 25% of GDP in Dominica, Guyana, and Haiti. These are also among the poorer countries in the region.

For most countries in the region, the modernization of agriculture has significantly lagged behind the rest of the economy. This has not only resulted in a relative decline of agriculture as an economic activity but in many cases also in an absolute decline.⁴ As a consequence, many Caribbean countries nowadays run major agricultural trade deficits.⁵ A dozen countries in the region ran an agricultural trade deficit of more than US\$ 400 per capita in 1997 (table 2), notably the smaller and richer countries in the region. Some countries have even dispensed with agriculture almost entirely, as income opportunities in other sectors of the economy are far more attractive.

3. Haiti, once a French colony, had already liberated itself by the end of the 18th century.

4. This is in contrast to most developed countries that have maintained their level of agricultural production relative to population growth while expanding into other economic activities.

5. These agricultural trade statistics cover crop and livestock products (including processed products), but exclude fishery and forestry products.

Table 2: Share of Agriculture in the Caribbean Economies and the Relative Dependency on Agricultural Imports, 1997

Import dependency agricultural products:	Share of agriculture in GDP:			
	5%<	5–10%	10–25%	>25%
Agricultural export surplus		Cuba	St. Vincent and the Grenadines Belize	Guyana
Moderately agricultural import dependent (deficit per capita per annum: US\$ 0–99)		St. Kitts – Nevis Jamaica	Dominican Republic Suriname	Haiti
Highly agricultural import dependent (deficit per capita per annum: US\$ 100–399)	Trinidad and Tobago	Barbados	Grenada St. Lucia	Dominica
Extremely agricultural import dependent (deficit per capita per annum: >US\$ 400)	Antigua and Barbuda Aruba Bahamas British Virgin Islands Cayman Islands Montserrat Netherlands Antilles Virgin Islands (US)	French Guiana Guadeloupe Martinique		

Sources: CIA (1999) and FAO (1999).

Note: Anguilla, Puerto Rico, and Turks and Caicos Islands are not included due to lack of data.

The Caribbean region as a whole ran an agricultural trade deficit of US\$ 1.4 billion in 1997, or US\$ 40 per capita (FAO 1999). Food self-sufficiency is a global need, but, as the numbers show in table 2, this is not a binding constraint for the small-but-rich Caribbean countries. One could even argue that a further specialization in their niche activities (tourism and off-shore banking) makes sense from an economic point of view. However, for some of the poorer countries, even relatively small agricultural trade deficits are a major reason for concern because they lack other substantial sources of foreign exchange to pay for imports.

Cuba is a special case. It ran a huge agricultural trade surplus of about US\$ 3-4 billion throughout the 1970s and 1980s, due to its status as preferential supplier of sugar to the USSR. With the collapse of the USSR in the early 1990s, the country lost its major export market and saw its agricultural trade surplus drop from US\$ 3,700 million in 1990 to US\$ 117 million in 1995.

Time-series data on agricultural import-export for the period 1961-95 are presented in figure 2 for Cuba, as well as for 5 other Caribbean countries with populations between 0.5 and 10 million, and for 21 Caribbean countries with populations of less than 0.5 million. The agricultural trade deficit of the latter group has steadily increased from about zero in the early 1960s to US\$ 1.1 billion in 1995. The five Caribbean countries with populations between 0.5 and 10 million (Dominican Republic, Haiti, Jamaica, Trinidad & Tobago, and Guyana) have moved from a situation of a substantial agricultural trade surplus during the 1960s to a deficit in the 1990s. Of these five, only Guyana has maintained its agricultural trade surplus.

Agricultural production characteristics

Agricultural production statistics for the Caribbean are problematic. In the smaller countries in particular, the volume of output for specific commodities is often so small that they do not appear in national or international statistics. For the following five countries, no crop production was reported whatsoever: Anguilla, Aruba, Netherlands Antilles, Turks and Caicos Islands, and Virgin Islands (U.S.).

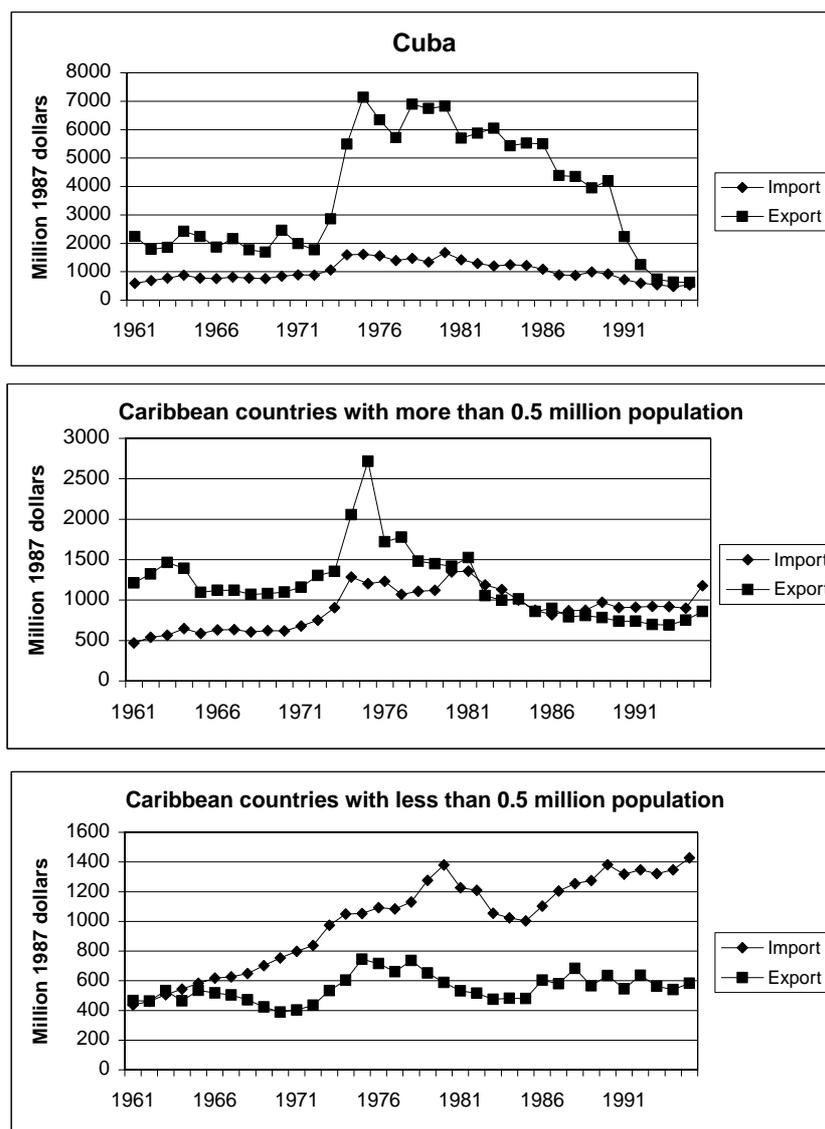


Figure 2: Agricultural import and export trends in the Caribbean, 1961–95

Source: FAO (1999).

Note: The second graph includes the following Caribbean countries (except Cuba) with a population of more than 0.5 million: Dominican Republic, Guyana, Haiti, Jamaica, and Trinidad & Tobago. The third graph includes the Caribbean countries with a population of less than 0.5 million: Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Dominica, French Guiana, Guadeloupe, Martinique, Montserrat, Netherlands Antilles, St. Kitts-Nevis, St. Lucia, St. Vincent, and Suriname.

Table 3 provides a detailed overview of agricultural production in the region. Of all crops, sugarcane is still the most important in the region, representing 27% of total crop output. Cuba is by far the largest sugarcane producer, producing some 69% of the region’s sugarcane. Despite the dramatic collapse of Cuban sugar export and production in the early 1990s, sugarcane still represents about 50% of Cuba’s crop output. Other countries with a substantial sugarcane industry are the Dominican Republic, Guyana, Jamaica, Belize, Trinidad & Tobago, and Haiti (between \$10 to \$100 million each).

A striking characteristic of crop production in most Caribbean countries is the relative specialization in one or two major crops. Bananas and plantains are the dominant crops in seven countries, sugarcane in four, citrus fruit in four, rice in three, and nutmeg in one. In the smaller countries, agricultural production typically revolves around one or two major export crops. Transportation (in particular for fresh products) and preferential access to markets

play a crucial role in specialization. For example, many of the Caribbean sugar and banana producers have preferential access to the European market, and command higher than world-market prices.

Such arrangements, however, are increasingly under threat due to the more liberal trade policies agreed upon under the World Trade Organization (WTO). The U.S.A., for example, has been fighting the preferential treatment of banana exporters from ACP countries by the European Union for quite some time and apparently with success. Losing this preferential treatment is an enormous blow to the region's agricultural sector and may destabilize some smaller islands economically. In fact, Cuba serves as a striking example of what can happen to a country that loses its preferential market access.

Livestock, forestry, and fisheries production in the region is mainly for local consumption. Livestock production, in particular, has grown quite rapidly because of a rapid growth in local demand. More than two-thirds of forestry production consists of fuel wood and charcoal. In Belize, Cuba, French Guiana, and Haiti, and to a lesser extent in the Dominican Republic and Jamaica, fuel wood and charcoal constitute an important source of energy. This is probably the case as well for some of the smaller and poorer island states for which no production data were reported. The value of marine fisheries is strikingly low, given that all the countries in the region are surrounded by sea or have access to it.

Two types of farm holdings dominate in the Caribbean: small family farms and plantations. The latter are quite significant in terms of production (i.e., sugarcane), but not in numbers. Most family farms are small (less than 2 hectares) and, on the smaller islands, are often on scattered plots in very challenging mountainous terrain.

Typical for modern agriculture is the increasing importance of agricultural input and processing industries relative to primary agricultural production. Whereas in primary agriculture, economies-of-scale effects tend to level off early (hence the predominance of family-operated farms in most countries), these effects are usually far more significant in agricultural input and processing industries. Therefore, small, local processing industries in the Caribbean have a very difficult time competing with the well-established, large-scale food processing industries of North America. By the same token, the development of local agricultural input industries is severely hampered by the lack of economies of scale. Looking for economies of scope, for example by focusing on just one or two export commodities, can compensate for the lack of economies of scale to some extent, but in most instances small countries remain disadvantaged when it comes to producing bulk products at competitive world-market prices.

Agricultural trade characteristics

Table 4 provides an overview of the region's relative trade position for specific agricultural commodities. For some commodities, the Caribbean is a net exporter, while for others it is a major importer. The rich Caribbean countries with a very small agricultural sector and a high agricultural trade deficit per capita usually import across the whole range of agricultural products. Small countries with agricultural sectors of some importance tend to specialize in one or two major export crops, but also import quite a diverse range of products.

North America and the European Union are the principal agricultural trading partners for the Caribbean. Intra-regional trade is relatively modest, while trade with Latin America, given its geographical proximity, is surprisingly low. New Zealand is an important exporter of meat and dairy products to the Caribbean.

Table 3a: Value of Agricultural Production, 1998 or Latest Year Available (in millions of dollars, international 1989–91 prices)

Country	Crop production														
	Sugar Cane	Fruit	Cereals	Bananas/ plantains	Vege- tables	Roots & tubers	Coffee	Tobacco	Legumes	Coconuts	Cocoa	Spices	Oil crops	Other crops	Total crops
Anguilla	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antigua and Barbuda	0.00	1.79	0.01	0.02	0.31	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	2.20
Aruba	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bahamas, The	0.67	5.39	0.05	0.14	3.50	0.06	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	9.91
Barbados	9.63	0.65	0.25	0.08	2.63	0.65	0.00	0.00	0.30	0.16	0.00	0.00	0.04	0.00	14.39
Belize	20.37	39.14	7.82	12.49	0.84	0.56	0.00	0.00	2.68	0.34	0.03	0.00	0.00	0.00	84.28
British Virgin Islands	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
Cayman Islands	0.00	0.02	0.00	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
Cuba	590.29	192.91	89.48	70.96	67.51	70.41	20.43	45.97	8.46	2.75	1.46	0.00	7.36	8.40	1176.39
Dominica	0.08	6.80	0.02	6.78	1.10	3.22	0.35	0.00	0.03	1.76	0.13	0.14	0.00	0.00	20.40
Dominican Republic	85.96	160.61	97.48	88.30	64.63	20.56	54.61	63.91	30.51	16.96	39.32	1.99	5.39	0.69	730.94
French Guiana	0.08	1.42	5.89	0.94	3.86	1.22	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	13.44
Grenada	0.11	3.06	0.04	0.75	0.40	0.56	0.00	0.00	0.47	0.72	0.66	7.78	0.00	0.02	14.57
Guadeloupe	10.76	3.03	0.00	22.34	3.79	1.99	0.02	0.00	0.04	0.03	0.00	0.07	0.00	0.01	42.09
Guyana	43.85	2.70	101.44	3.04	1.42	4.20	0.13	0.15	0.37	5.97	0.03	0.00	1.23	0.15	164.68
Haiti	16.87	90.44	56.68	72.34	34.91	68.36	26.12	0.82	30.81	3.18	2.98	0.00	12.69	2.05	418.24
Jamaica	40.70	51.93	0.40	23.28	32.61	40.06	2.30	3.59	2.24	12.17	0.99	23.37	1.74	0.15	235.55
Martinique	3.18	4.07	0.00	50.84	5.64	2.52	0.03	0.00	0.48	0.12	0.00	0.00	0.00	0.00	66.89
Montserrat	0.00	0.11	0.00	0.02	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.26
Netherlands Antilles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Puerto Rico	5.18	12.21	0.00	13.24	6.67	1.11	11.09	0.00	0.33	0.60	0.00	0.00	0.00	0.00	50.45
St. Kitts and Nevis	4.12	0.31	0.00	0.00	0.15	0.15	0.00	0.00	0.08	0.18	0.00	0.00	0.05	0.00	5.04
St. Lucia	0.00	7.04	0.01	11.97	0.15	0.86	0.00	0.00	0.02	1.27	0.02	0.55	0.00	0.00	21.87
St. Vincent and the Grenadines	0.34	1.06	0.25	8.58	0.67	1.67	0.15	0.13	0.11	2.43	0.11	1.19	0.00	0.00	16.71
Suriname	1.52	3.21	40.48	7.55	4.25	0.42	0.01	0.00	0.06	0.99	0.01	0.00	0.15	0.00	58.66
Trinidad and Tobago	16.87	12.34	2.43	1.30	3.94	1.37	0.92	0.00	2.44	2.12	1.19	0.33	0.00	0.00	45.24
Turks and Caicos Islands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Virgin Islands (U.S.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Total</i>	<i>850.59</i>	<i>600.27</i>	<i>402.73</i>	<i>395.04</i>	<i>239.12</i>	<i>219.98</i>	<i>116.17</i>	<i>114.58</i>	<i>79.53</i>	<i>51.77</i>	<i>46.94</i>	<i>35.43</i>	<i>28.66</i>	<i>11.54</i>	<i>3192.34</i>

Table 3b: Value of Agricultural Production, 1998 or Latest Year Available (in millions of dollars, international 1989–91 prices)

Country	Livestock production								Forestry production			Fisheries production (1996)			Total	
	Beef and Veal	Poultry meat	Milk	Pigmeat	Eggs	Goat and sheep meat	Honey	Other meat	Live-stock total	Ind. Round-wood	Fuel-wood & charcoal	Forestry total	Inland fish	Marine fish		Fisheries total
Anguilla	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.16	0.24	0.24
Antigua and Barbuda	1.17	0.24	1.54	0.10	0.15	0.14	0.00	0.00	3.34	0.00	0.00	0.00	0.09	0.23	0.32	11.40
Aruba	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.09
Bahamas, The	0.04	13.09	0.44	0.22	1.06	0.19	0.00	0.00	15.03	13.22	0.00	13.22	6.54	0.86	7.40	83.72
Barbados	1.17	14.02	2.19	5.23	0.80	0.34	0.00	0.00	23.76	0.57	0.00	0.57	0.00	2.16	2.16	79.58
Belize	3.29	9.25	1.80	1.55	1.59	0.03	0.16	0.00	17.68	6.96	6.93	13.89	1.58	0.11	1.69	233.38
British Virgin Islands	0.32	0.00	0.00	0.03	0.00	0.22	0.00	0.00	0.57	0.00	0.00	0.00	0.12	0.56	0.68	1.96
Cayman Islands	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.39	0.07	0.47	0.65
Cuba	176.03	73.64	169.80	94.64	56.28	3.14	8.31	1.89	583.73	69.04	139.76	208.80	40.86	37.28	78.14	4015.98
Dominica	1.23	0.37	1.57	0.56	0.23	0.13	0.00	0.00	4.08	0.00	0.00	0.00	0.00	0.55	0.55	49.51
Dominican Republic	180.21	207.38	92.19	85.92	50.60	5.13	2.33	0.00	623.76	0.71	53.68	54.39	5.89	8.35	14.23	2832.42
French Guiana	0.94	0.71	0.06	1.58	0.45	0.06	0.00	0.00	3.81	6.78	3.94	10.72	3.25	2.37	5.62	61.55
Grenada	0.32	0.59	0.13	0.23	0.92	0.19	0.00	0.08	2.46	0.00	0.00	0.00	0.03	1.01	1.04	35.10
Guadeloupe	8.03	0.78	0.03	1.42	1.66	0.40	0.26	0.07	12.65	0.03	0.83	0.86	0.47	5.92	6.39	117.60
Guyana	6.81	13.83	3.34	0.67	6.83	1.62	0.13	0.00	33.24	61.16	0.84	61.99	5.93	24.64	30.57	550.39
Haiti	72.29	9.38	15.27	36.06	4.28	11.66	0.94	10.25	160.12	27.01	349.91	376.92	1.57	2.63	4.20	1914.75
Jamaica	34.12	72.79	13.64	8.79	28.14	3.29	1.73	0.06	162.57	4.83	17.16	21.99	5.60	5.80	11.40	851.60
Martinique	6.04	1.16	0.53	2.01	1.51	0.68	0.00	0.16	12.09	0.23	0.55	0.78	0.10	2.10	2.20	161.72
Montserrat	1.69	0.09	0.58	0.08	0.06	0.10	0.00	0.00	2.60	0.00	0.00	0.00	0.00	0.12	0.12	5.83
Netherlands Antilles	0.02	0.47	0.10	0.17	0.51	0.16	0.00	0.00	1.42	0.00	0.00	0.00	0.01	0.65	0.66	3.50
Puerto Rico	36.88	73.50	91.87	17.70	15.22	0.32	0.08	0.22	235.79	0.00	0.00	0.00	0.38	1.28	1.66	574.13
St. Kitts and Nevis	0.24	0.19	0.00	0.26	0.30	0.18	0.00	0.00	1.17	0.00	0.00	0.00	0.04	0.12	0.15	12.57
St. Lucia	0.33	0.77	0.23	0.96	0.52	0.31	0.00	0.00	3.11	0.00	0.00	0.00	0.02	0.82	0.84	50.80
St. Vincent and the Grenadines	0.53	0.52	0.35	0.77	0.64	0.17	0.00	0.00	2.98	0.00	0.00	0.00	0.02	0.84	0.86	40.23
Suriname	4.76	3.80	4.12	1.48	3.01	0.14	0.15	0.00	17.46	20.57	1.05	21.61	0.31	8.40	8.70	204.17
Trinidad and Tobago	2.58	30.68	2.52	1.61	9.04	0.92	0.07	0.00	47.43	8.41	1.21	9.62	0.78	7.77	8.55	213.13
Turks and Caicos Islands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.20	1.02	1.02
Virgin Islands (U.S.)	1.20	0.09	0.50	0.14	0.16	0.07	0.00	0.00	2.16	0.00	0.00	0.00	0.09	0.51	0.61	4.92
Total	540.22	527.34	402.81	262.19	183.98	29.58	14.15	12.73	1973.01	219.50	575.84	795.34	74.98	115.58	190.56	12111.94

Note for Table 3: FAO usually publishes production data only. In order to construct aggregate production volumes, we multiplied the FAO production data with a set of international agricultural prices. This set was obtained from the FAO WAICENT database via the TAC Secretariat in 1997. These international prices pertain to the years 1989–91, which is the base-year period over which FAO calculates its aggregate production indices. For the calculation of these “international prices,” see Rao (1993). For charcoal and fuelwood, a shadow price was obtained from the TAC Secretariat.

Table 4: Caribbean Import-Export Profile per Commodity Group, 1998

Product group	Trade surplus / deficit	Specific comments
Sugar	Surplus: US\$ 896 million.	Sugar exporting countries are: Barbados, Belize, Cuba, Dominican Republic, Guadeloupe, Guyana, Jamaica, St. Kitts-Nevis, and T&T.
Coffee, cacao, tea and spices	Surplus: US\$ 176 million.	Cuba, Dominican Republic, Haiti and Jamaica are major exporters of coffee; the Dominican Republic of cacao; and Grenada of nutmeg.
Fruit and vegetables	Surplus: US\$ 158 million. Trade surplus due to export of bananas and, to a lesser extent, citrus fruit. Some countries import large quantities of fruit juice.	Bananas are a major export commodity for: Belize, Dominica, Dominican Republic, Grenada, Jamaica, Martinique, St. Lucia, St. Vincent, and Suriname. Citrus fruit is an important export commodity for Belize and Cuba.
Tobacco	Surplus: US\$ 83 million.	Only Cuba and the Dominican Republic export tobacco.
Fisheries products	Surplus: US\$ 16 million (1996).	Trade volumes are small, but quite volatile.
Crude materials	Deficit: US\$ 111 million.	Only the Dominican Republic has a trade surplus (sisal).
Beverages	Deficit: US\$ 153 million.	Important exporters of alcoholic beverages (i.e., rum) are Guyana, Jamaica, and T&T. The Bahamas, Barbados, Guadeloupe, Martinique, and St. Lucia are also major exporters, but this is largely based on imports and not local production.
Miscellaneous foods	Deficit: US\$ 170 million.	All countries in the region have a trade deficit.
Animal Feed	Deficit: US\$ 183 million.	All countries in the region have a trade deficit.
Animal and vegetable oils	Deficit: US\$ 284 million.	Only T&T runs a small trade surplus. Major importers are Cuba, the Dominican Republic, and Haiti.
Meat and meat products	Deficit: US\$ 484 million.	All countries have a trade deficit except the Dominican Republic. Demand for livestock products has risen faster than demand for other agricultural products.
Dairy and eggs	Deficit: US\$ 522 million.	All countries have a trade deficit. Demand for livestock products has risen faster than demand for other agricultural products.
Forestry products	Deficit: US\$ 528 million (1997).	The only three countries with a forestry trade surplus are Guyana, Suriname, and French Guiana. Most countries, however, run a forestry trade deficit of US\$ 50-150 per capita per annum.
Cereals	Deficit: US\$ 797 million.	All countries have a trade deficit, except French Guiana, Guyana and Suriname, which are important rice producers and exporters. The Netherlands Antilles and St. Vincent are also major rice exporters, but this is based on import of rice, not on local production. The Caribbean climate is not very suitable for wheat production.

Source: FAO (1999).

Agricultural input markets

Acquisition of technology through purchased inputs constitutes an important source of technological innovation in agriculture (Roseboom 1999). Some of these inputs, such as seeds and animal feed, have their origins within agriculture, while others, such as fertilizers, agrochemicals, and agricultural machinery, are produced by other industries. Given the rather small and geographically fragmented agricultural input markets in the Caribbean, local production of agricultural inputs is relatively underdeveloped. For some agricultural inputs, such as agrochemicals and agricultural machinery, the region is almost completely dependent on imports. For fertilizers, some local production capacity exists in the Dominican Republic and Trinidad & Tobago.

Establishing a local supply of good quality seeds and planting materials is problematic in many parts of the Caribbean. Well-established plant breeding programs in the region exist only for sugarcane, cocoa, and rice. For most other crops, research is limited to the screening and selection of imported materials. Vegetable production, for example, depends almost completely on imported hybrid seeds.

3. Agricultural Research Institutions

Historical development

Colonial relationships have shaped the institutional development of agricultural research in most Caribbean countries, and in many instances, they still play a major role. Only Cuba, Haiti, and the Dominican Republic were politically independent prior to the local inception of formal agricultural research in the early 1900s. However, the Caribbean was already an important experimental site for new crops and new agricultural production technologies long before formal agricultural research took off. By the 18th century, the region had become an important sugar producer within the world economy. Because disease and repression had decimated the Caribbean's indigenous population, sugar plantations and factories imported slave labor from Africa on a large scale. Being on the route between Europe, Africa, and the Americas, many new plant species were introduced to the Caribbean, giving the region an enormous variety of cultivated plant species. This process became more structured and formalized with the establishment of botanical gardens in the 19th century. It is only in the 20th century that better transport and preservation technologies allowed the region to export more of its abundant plant species, in particular bananas and other fruits.

As mentioned earlier, 17 out of 28 countries in the region have historical ties with Great Britain. As a result, the British agricultural research legacy is the most pronounced in the region.

The British agricultural research legacy

During the 19th century, a dense network of botanical gardens was established throughout the British Empire, including the British Caribbean. These gardens were not research stations as we know them today, but they laid the institutional foundation for future agricultural research activities. According to Wilson (1985) and Parasram (1990), formal public agricultural research in the British Caribbean colonies goes back to 1898, when the Imperial Department of Agriculture for the West Indies (IDA) was established at Barbados. In 1921–22, IDA was moved to Trinidad, forming the nucleus of the newly established Imperial College of Tropical Agriculture (ICTA), whose staff engaged in an integrated program of research and teaching. The major research thrusts of the College involved breeding programs for the principal plantation crops (sugar, cacao, bananas, citrus) as well as a strong soil science program. Over the 1921–51 period, ICTA was the only center in the British Commonwealth offering postgraduate training in tropical agriculture, and it played a role that went far beyond Caribbean agriculture.

Beginning around 1940, ICTA's research and teaching operations became functionally separate, and in 1955 a Regional Research Center (RRC) was founded that absorbed the research functions of ICTA. The College continued as a teaching institution until 1960, when it was closed and its assets transferred to the newly constituted University College of the West Indies (UCWI). UCWI opened on the St. Augustine campus in 1961, and in 1962 it became the University of the West Indies (UWI) with its own charter. RRC continued as an autonomous research institute until 1965, when it was integrated into UWI's Faculty of Agriculture. Subsequently, it was institutionally separated from the university to form the Caribbean Agricultural Research and Development Institute in 1975. CARDI is an autonomous institute, with a regional research and development mandate (including extension) whose budget is funded, in part, by the 13 member states of the Caribbean Community (CARICOM). CARDI's Board of Governors consists of the Ministers of Agriculture of the member states, while its Board of Directors is drawn from member governments and regional agencies.

These institutional changes reflect a transfer of control and financial responsibility for the conduct of (publicly sponsored) regional research initiatives to the respective local governments. ICTA's operations (1924–1960) were entirely in the hands of the British Colonial Office and the private commodity associations and boards that provided the institute with substantial resources. Local governments gained increasing control with the formation of RRC, and then assumed full control of the research agenda with the formation of CARDI in 1975. While initially most CARDI researchers were located at the St. Augustine campus in Trinidad, they were distributed over all member countries in the late 1970s. Although this has brought the researchers closer to their ultimate client group (the farmers) and to their paymasters (the local governments), it has also resulted in a highly fragmented research infrastructure, with researchers who have to work in relative isolation. In most member countries, the CARDI research team has less than five researchers, and, in some cases, just one researcher. This emphasis on local presence has been further strengthened with the integration of the Caribbean Agricultural Rural Development and Advisory Training Service (CARDATS) into CARDI in 1988. This has shifted the emphasis of CARDI's work in the direction of technology transfer.

The other successor of ICTA is the University of the West Indies (UWI). In addition to the campus at the old ICTA location at St. Augustine (Trinidad), UWI also established campuses at Cave Hill (Barbados) and Mona (Jamaica). The latter also serves as UWI's headquarters. Initially, UWI had a rather centralized structure, with faculties that included facilities and faculty staff across the different campuses. In more recent years, it has adopted an approach wherein each UWI campus operates as an independent university. UWI's Faculty of Agriculture has always operated from one campus only (St. Augustine), although occasionally it had one or more faculty members located at both Cave Hill and Mona. However, Faculties of Sciences or Natural Sciences can be found at all three campuses, and their life science departments are of growing importance to agricultural research. The Life Science department at the Mona campus in Jamaica, for example, houses the Biotechnology Centre (established in 1989) and the Centre for Marine Science (established in 1990). Most recently, in 1996, the Faculty of Agriculture and the Faculty of Natural Sciences at the St. Augustine campus merged to form the Faculty of Agriculture and Natural Sciences (FANS). In addition, the Trinidad branch of UWI has maintained a School of Veterinary Medicine since 1989.

In addition to CARDI and UWI, many other local and regional agricultural research initiatives have emerged in the (former) British colonies over time. While the British took a strong regional approach to agricultural research during their administration, the balance shifted to more local approaches as countries gained independence. In most countries, the Ministry of Agriculture assumed responsibility for agricultural research, by either: (a) contracting research out to CARDI, (b) attracting bilateral research support from donors, or (c) establishing their own research facilities. Given the small size of most Ministries of Agriculture in the British Caribbean, research is often not organized as a separate activity but as part and parcel of a portfolio of activities implemented by a small team of technical generalists. The emphasis is usually more on technology transfer than research, the research itself tends to be ad hoc and short-term, and the capacity to conduct research is usually very limited. Only 5 out of 17 (former) British colonies have research programs operated by their Ministry of Agriculture that exceeds 10 FTE researchers (the Bahamas, Barbados, Guyana, Jamaica, and T&T). In Jamaica and Trinidad & Tobago, the first research activities within the Ministries of Agriculture date from 1933 and 1945, respectively. In all other countries, such initiatives are considerably more recent (1960s and 1970s).

Parallel to these public research initiatives by the Ministries of Agriculture, CARDI, and UWI, the British Caribbean has a long and strong tradition of commodity boards, producer associations, and private companies conducting research on the most important export crops. The West Indies Central Sugar Cane Breeding Station at Barbados is one of the oldest such initiatives (dating back to the 1880s) and is part of the West Indies Sugar Cane Breeding and Evaluation Network. The station is financed by the regional sugar industry through its Sugar Association of the Caribbean. While basic sugar cane breeding work is done collectively, sugar companies in Barbados, Belize, Guyana, St. Kitts, and T&T also have their own research facilities to tackle local agronomic and technical problems in sugar cane production or processing. The Sugar Industry Research Institute (SIRI) of the Sugar Industry Authority of Jamaica services the Jamaican sugar industry. SIRI was the direct successor of the Sugar Research Department of the Jamaican Sugar Manufacturers' Association, which had been in operation since 1942.

For many years, the banana producer associations of Dominica, Grenada, St. Lucia, and St. Vincent banded together as the Windward Islands Banana Association (WINBAN), which operated a modest research facility on St. Lucia. It serviced banana growers on all four islands. With the transformation of WINBAN into the Windward Islands Banana Development and Export Company (WIBDECO) in 1994, its research branch was restructured into a Technical Services Division and all research activities were phased out. This decision was influenced also by the fact the St. Lucia research facilities were severely damaged at about that time by a hurricane. Given the current crisis in the banana business in the region, industry-supported banana research has come to a halt on the Windward Islands. The Jamaica Banana Board has operated its own Research Department since the mid-1950s.

Other crops that are supported by research financed and organized through producer associations or commodity boards are citrus (Belize and Jamaica), cacao (Grenada), coconut (Jamaica), nutmeg (Grenada), and tobacco (Jamaica).

The French agricultural research legacy

Agricultural research in the French Caribbean did not take place until after World War II. Therefore, Haiti, which became independent from France in the late 18th century, never inherited any agricultural research institutions. Its history of agricultural research is still fairly short and largely influenced by external donors, in particular USAID.

Since the 1950s, the three French territories in the region (French Guiana, Guadeloupe, Martinique) have been receiving substantial research support through three French organizations, namely INRA, CIRAD, and IRD (previously ORSTOM).

In 1949, the National Agricultural Research Institute of France (INRA) established a regional research center for the Antilles and French Guiana in Guadeloupe. This was despite the existence of several specialized French institutes already dealing with tropical agricultural research, creating a major political dispute between the various French agencies. INRA's ambitions to further expand into tropical agriculture were abandoned, but it kept its overseas center in Guadeloupe. Most of this center's research activities are located in Guadeloupe, but a Forest Research Unit is located in French Guiana, and there are some trial sites in Martinique.

CIRAD, a merger of a group of French institutes for tropical agricultural research, can trace its activities in the region back to the 1950s. At that time, the French Research Institute for Tropical Fruits (IFAC, later on IRFA, and now the fruit and horticulture department of CIRAD) began to undertake research on bananas and pineapple as well as other fruits. Experiment stations were set up in all three territories. CTFT, the French Tropical Forestry

Research Center, also made an early start with forestry research in French Guiana. IRAT, the French Research Institute for Tropical Agriculture, started multi-site experiments in the Antilles in the early 1960s. It focused on market crops (tomatoes, beans, lettuce) and food crops (yam, cassava, sweet potatoes, maize). In addition, the *Centre Technique de la Canne et du Sucre* (CTCS) provided research support to the sugar industry on Guadeloupe. More recently, the forestry, animal health, and food processing branches of CIRAD have also launched research activities in the French Caribbean.

IRD, the French Research Institute for Development (previously ORSTOM), established a permanent mission in French Guiana in 1949. It became the *Institut Français d'Amérique Tropicale* (IFAT) in 1954, and ORSTOM-Cayenne in 1964. It was renamed IRD-Cayenne in 1998. IRD-Cayenne's research focuses mainly on forestry, ecology, hydrology, medicinal plants, and social sciences, with a strong emphasis on basic research along disciplinary lines. IRD's predecessors began research activities in the French Antilles in collaboration with INRA, IFAC, and IRAT in the early 1960s. These activities focused mainly on soil mapping and soil analysis through the *Bureau des Sols des Antilles*, which was managed jointly by INRA and ORSTOM. Nowadays, IRD-Antilles maintains its presence in Guadeloupe and Martinique by posting staff to the research facilities of INRA and CIRAD.

The Dutch agricultural research legacy

Even in the 1930s, agriculture constituted only a minor component of the local economy of Aruba and the Netherlands Antilles.⁶ These Dutch territories do not have much of a comparative advantage in terms of agriculture, and therefore they opted early on to focus on other economic activities such as oil refining, and more recently offshore banking and tourism. As a consequence, these countries never developed an agricultural research capacity of any significance. In contrast, agriculture has always played a far more dominant role in the economy of Suriname. While experiments were conducted sporadically throughout the 18th and 19th centuries by plantation owners, it was only with the establishment of the Agricultural Experiment Station in 1903 that agricultural research took off in earnest in Suriname. During the first 45 years of the agricultural experiment station, it was staffed with only 2 to 4 scientists and focused primarily on crop production, plant diseases, and soil science.

With the independence of Indonesia in 1948, the Netherlands shifted its attention to the development of Suriname. As part of a strategy to boost agricultural production, a rapid expansion of agricultural research capacity took place between 1948 and 1975, the year that Suriname became independent. The agricultural experiment station under the Ministry of Agriculture expanded its activities and staff, and several semi-private research initiatives were also launched as autonomous foundations.⁷ Most of these foundations, however, have led a dormant existence since the early 1980s. On the academic front, the University of Suriname, in collaboration with Wageningen Agricultural University in the Netherlands, opened the Center for Agricultural Research (CELOS) in 1968. In 1975, when Suriname became independent, it inherited a rather fragmented agricultural research infrastructure that has fragmented even further. In the 1980s, political relations between the Netherlands and Suriname deteriorated sharply, and most official development assistance was frozen.⁸

6. Aruba separated from the Netherlands Antilles in 1986, and since then, has had its own government under the Dutch crown.

7. Foundation for Mechanical Agriculture (SML), established in 1949; Foundation for Experimental Farms (SEL), established in 1955; Foundation for Experimental Gardens (STIPRIS), established in 1970; Foundation for the Agricultural Development of Commewijn (SLOC), established in 1976; Foundation National Rice Research Institute (SNRI), established in 1987.

8. A new government was inaugurated in Suriname in August 2000, and there is a good chance that development relations with the Netherlands will be restored.

The American agricultural research legacy

The first recorded agricultural research activities in Puerto Rico date back to the period immediately after it became a U.S. territory in 1898. In 1901, a Federal Experiment Station opened its doors in Puerto Rico, while in 1910, the Sugar Producers' Association of Puerto Rico established its own private agricultural experiment station. In 1914, the latter station was handed over to the government, and it became part of the Department of Agriculture as the Insular Experiment Station. Higher education in the agricultural sciences began in Puerto Rico when the College of Agriculture and Mechanic Arts was established by the University of Puerto Rico in 1911.

In 1931, the jurisdiction of the Hatch Act was extended to Puerto Rico. This Act, passed by the U.S. Congress in 1887, is the legal basis for the U.S. system of state agricultural experiment stations embedded in land-grant universities. Consequently, the Insular Experiment Station was transferred to the University of Puerto Rico, and it was eventually transformed into the state agricultural experiment station of Puerto Rico in 1933. A major advantage of this change was the fact that Puerto Rico gained access to federal funding for its state agricultural experiment station.

In addition to a state agricultural experiment station, Puerto Rico also houses two federal research institutes administered directly by the U.S. Department of Agriculture (USDA), namely the Tropical Agriculture Research Station (established in 1901 as the Federal Experiment Station), and the International Institute of Tropical Forestry (established by the Forestry Service of USDA in 1939).

The University of the Virgin Islands established a state agricultural experiment station as recently as the early 1970s. The Universities of Puerto Rico and the Virgin Islands also house several other research entities dealing with water resources and marine sciences that are also of relevance to agriculture.

Cuba, the Dominican Republic, and Haiti

While colonial ties have shaped agricultural research in most Caribbean countries, this is less clearly so for Cuba, the Dominican Republic, and Haiti, as these countries gained independence before formal agricultural research really took off. Even so, external influence on the development of agricultural research has been significant in these countries. The U.S., in particular, has played an important role in establishing the first experiment stations in all three countries by providing technical expertise and training. The U.S. occupations of the Dominican Republic (1916–1925) and Haiti (1915–1934) were also significant in this regard. In both countries, the first experiment stations and agricultural schools date back to this period of occupation. In more recent years, both countries have received considerable assistance for the development of their agricultural research capacity through USAID, private foundations (e.g., Ford, Kellogg, Rockefeller), and partnerships with U.S. universities.

In Cuba, U.S. influence ended with the Revolution of 1959 and was replaced by influence from the Soviet bloc. Examples of Soviet influence include the relatively high priority given to science and technology, and the dominant position of the Academy of Sciences in the Cuban science structure. As in the former USSR, Cuba exceeds most of its developing country neighbors in terms of the number of scientists per million population⁹ and produces high-class science (e.g., biotechnology), but it has major difficulties translating this into economic advancement. Over the years, Cuba has developed an agricultural research capacity that is

9. In 1995, Cuba employed 1612 researchers per million population, Chile 445, and Mexico 214 (UNESCO 1999). Moreover, Cuba's figure increased about threefold between 1980 and 1995.

greater than that of all other Caribbean countries put together, at least in terms of scientific staff. This is in great contrast to the Dominican Republic and Haiti—number two and three in the region in terms of population—which both have rather underdeveloped research systems. Per million population, Cuba employs approximately 100–150 agricultural researchers, the Dominican Republic 25, Haiti about 20, and the other Caribbean countries, on average, about 70.

Current organizational structure of agricultural research

Due to the geographical and political fragmentation of the region, the organizational structure of agricultural research is also very much fragmented. With the exception of Cuba—which has some 60 different agricultural research agencies of its own—approximately 150 different agencies were identified as conducting research in support of crop, livestock, forestry, and fisheries production in the Caribbean. The majority of these research entities only employ between 1 and 10 (full-time equivalent) researchers. In addition, research is often organized not as a separate, stand-alone activity, but undertaken in combination with education or other agricultural service activities (e.g., extension, technology transfer).

In table 5, which provides an overview of agencies conducting agricultural research in the Caribbean, the agencies have been divided into six distinct categories.¹⁰

1. *Agencies operating within the jurisdiction of a Ministry of Agriculture.* In most countries, the Ministry of Agriculture has the primary responsibility for agricultural research, but other ministries may hold responsibility for some specific components of the agricultural research agenda (e.g., forestry, fisheries, food processing) or have overall responsibility for the Science & Technology policy of the country. In many Caribbean countries, the Ministry of Agriculture is too small to have its own research department or organization or even its own research program. In quite a number of countries the Ministry of Agriculture has instead delegated the implementation of agricultural research to bilateral and regional agencies.
2. *Agencies operating within the jurisdiction of other government ministries.* As mentioned above, other government ministries may hold the responsibility for some components of the agricultural research agenda. For example, several of the larger Caribbean countries have government-supported industrial research institutes whose research agendas are relevant to agriculture (e.g., post-harvest storage and processing, agricultural machinery).
3. *Regional and bilateral agencies.* This category includes all agencies that are controlled by supra-national bodies or by a non-local government. The first category includes agencies such as CARDI and the CARICOM Fisheries Unit, while the second category comprises agencies such as CIRAD, INRA, and IRD that have major research facilities in the French Caribbean territories, but which are controlled and mainly financed by France. This category also includes the local research facilities of the U.S. Department of Agriculture in Puerto Rico and the U.S. Virgin Islands, as well as the permanent technical missions of France and Taiwan located in several of the smaller islands states.¹¹

10. These 6 institutional groups correspond to the general Science & Technology classification of research organizations as follows: groups 1–3 fall into the category “government agencies”, group 4 into “establishments of higher education,” and groups 5–6 into “business enterprises” (OECD 1994).

11. Recently, some of the Taiwanese technical missions were closed as the host countries changed their foreign policy and established diplomatic relations with the People’s Republic of China.

Table 5: Overview of Agricultural Research Executing Agencies in the Caribbean

Country	Ministry of Agriculture	Other ministries and government agencies	Bilateral or regional government agencies	Higher education	Commodity boards or producers associations	Business enterprise
Anguilla (UK)	<i>No research reported</i>					
Antigua and Barbuda	<ul style="list-style-type: none"> · Research Division · Fisheries Division 		<ul style="list-style-type: none"> · CARDI unit 			
Aruba (NL)		<ul style="list-style-type: none"> · Ministry of Economic Affairs and Tourism – Department of Agriculture, Husbandry and Fisheries 				
Bahamas	<ul style="list-style-type: none"> · Department of Agriculture · Department of Fisheries 	<ul style="list-style-type: none"> · Office of the Prime Minister – Department of Lands and Surveys, Forestry Section 	<ul style="list-style-type: none"> · Govt. of Taiwan – Agricultural Technical Mission 			
Barbados	<ul style="list-style-type: none"> · Technical Division 		<ul style="list-style-type: none"> · CARDI unit 	<ul style="list-style-type: none"> · UWI – Faculty of Science and Technology, Department of Biological and Chemical Sciences · UWI – Centre for Resource Management and Environmental Studies · McGill University – Bellairs Research Institute 	<ul style="list-style-type: none"> · West Indies Sugar Cane Breeding Station 	<ul style="list-style-type: none"> · BAMCO – Sugar Technology Research Unit · BAMCO – Agronomic Research and Variety Testing Unit
Belize	<ul style="list-style-type: none"> · Central Farm Agricultural Research Station 		<ul style="list-style-type: none"> · CARDI unit · Govt. of Taiwan – Agricultural Technical Mission · CARICOM – Fisheries Resources Assessment and Management Program 	<ul style="list-style-type: none"> · University College of Belize – Marine Research Centre · Belize College of Agriculture 	<ul style="list-style-type: none"> · Belize Citrus Growers Association – Citrus Research and Education Institute 	<ul style="list-style-type: none"> · BelSIL – Research Centre for Sugar Cane · BABCO
British Virgin Islands			<ul style="list-style-type: none"> · CARDI unit 			
Cayman Islands (UK)	<i>No research reported</i>					
Cuba (a)	<ul style="list-style-type: none"> · Ministry of Agriculture (oversees 20 agricultural research agencies) 	<ul style="list-style-type: none"> · Ministry of Sugar (oversees seven research entities) · Ministry of Fisheries – Fisheries Research Center · Ministry of Food – Food Industry Research Institute · Ministry of Science and Technology and the Environment (oversees several research institutes, seven of which are of partial relevance to agriculture) 		<p>In addition to ISCAH, another seven universities and two university centers conduct agricultural research.</p>		

Note: Annex 4 provides more detailed institutional information.

Country	Ministry of Agriculture	Other ministries and government agencies	Bilateral or regional government agencies	Higher education	Commodity boards or producers associations	Business enterprise
		<ul style="list-style-type: none"> Ministry of Higher Education (oversees the National Center for Scientific Research (CNIC) and the Higher Institute for Agricultural Sciences of Havana (ISCAH)) 				
Dominica	<ul style="list-style-type: none"> Division of Agriculture Division of Fisheries Development 		<ul style="list-style-type: none"> CARDI unit Government of Taiwan – Technical Mission Government of France – Technical Mission 			
Dominican Republic	<ul style="list-style-type: none"> Agricultural Research Department (oversees eight research centers and one experiment station) Tobacco Department – Tobacco Institute Coffee Department – Coffee Station La Cumbre 	<ul style="list-style-type: none"> Central Bank – National Institute for Industrial Technology (INDOTEC) National Water Resources Institute (INDHRI) 		<ul style="list-style-type: none"> UASD: Faculty of Agricultural and Veterinary Sciences; Faculty of Sciences – Research Center for Marine Biology ISA (incl. CENDA) UNPHU: Faculty of Agricultural Sciences and Natural Resources UN: Faculty of Agriculture UEMH: School of Veterinary Medicine 		<ul style="list-style-type: none"> CEA – Sugarcane Research Center Central Romana – Agricultural Research Department
French Guiana (France)			<ul style="list-style-type: none"> CIRAD INRA (forestry unit) IRD – Cayenne Center 			
Grenada	<ul style="list-style-type: none"> no specific research division 		<ul style="list-style-type: none"> CARDI unit Government of Taiwan – Technical Mission Government of France – Technical Mission 		<ul style="list-style-type: none"> Grenada Cooperative Nutmeg Association Grenada Cocoa Association – Cocoa Research Board 	
Guadeloupe (France)			<ul style="list-style-type: none"> CIRAD INRA – Antilles / Guiana Research Center 			
Guyana	<ul style="list-style-type: none"> National Agricultural Research Institute 	<ul style="list-style-type: none"> Office of the President – Institute of Applied Science and Technology Guyana Forestry Commission 	<ul style="list-style-type: none"> CARDI unit 	<ul style="list-style-type: none"> University of Guyana – Faculty of Agriculture 	<ul style="list-style-type: none"> Guyana Rice Development Board – Rice Research Station, Burma 	<ul style="list-style-type: none"> Guyana Sugar Corporation – Agricultural Research Center Livestock Development Company

Country	Ministry of Agriculture	Other ministries and government agencies	Bilateral or regional government agencies	Higher education	Commodity boards or producers associations	Business enterprise
Haiti	<ul style="list-style-type: none"> · Agricultural Research and Documentation Center · Forestry Service 	<ul style="list-style-type: none"> · several regional development projects 		<ul style="list-style-type: none"> · State University of Haiti – Faculty of Agriculture and Veterinary Sciences · University Quisqueya – Faculty of Agricultural and Environmental Sciences · University “Roi Henri Christophe” – Faculty of Agricultural Sciences 		<ul style="list-style-type: none"> · Agrisupply Co. · Darbouco S.A. · Agrotechnique S.A.
Jamaica	<ul style="list-style-type: none"> · Agricultural Research and Development Division · Fisheries Division 	<ul style="list-style-type: none"> · Ministry of Commerce and Technology – Food Storage and Prevention of Infestation Department · Ministry of Commerce and Technology – Scientific Research Council (incl. Food Technology Institute) 	<ul style="list-style-type: none"> · CARDI unit 	<ul style="list-style-type: none"> · UWI – Faculty of Pure and Applied Sciences, Department of Life Sciences · UWI – Biotechnology Centre · UWI—Centre for Marine Sciences · UWI – Centre for Environment and Development 	<ul style="list-style-type: none"> · Banana Board – Research Department · Cocoa Industry Board – Research and Extension Division · Coconut Industry Board – Research Unit · Coffee Industry Board – subcontracts research · Sugar Industry Authority – Sugar Industry Research Institute · Tobacco Industry Central Authority · Citrus Growers Association Limited 	<ul style="list-style-type: none"> · Pioneer Hi-Bred International Inc. – Tropical Research Station · Jamaica Broilers Group Ltd · Alcan
Martinique (France)			<ul style="list-style-type: none"> · CIRAD · IRD – Antilles Center 			
Montserrat (UK)			<ul style="list-style-type: none"> · CARDI unit 			
Netherlands Antilles (NL)		<ul style="list-style-type: none"> · Caribbean Marine Biological Institute · Foundation for the Promotion of Agriculture in the Netherlands Antilles (SOLTUNA) 				
Puerto Rico (US)			<ul style="list-style-type: none"> · USDA – Agricultural Research Service: Tropical Agriculture Research Station · USDA – Forestry Service: International Institute of Tropical Forestry 	<ul style="list-style-type: none"> · UPR – College of Agricultural Sciences: State Agricultural Experiment Station · UPR – College of Arts and Sciences: Department of Marine Sciences · UPR – Engineering College: Puerto Rico Water Resources Research Institute 		

Country	Ministry of Agriculture	Other ministries and government agencies	Bilateral or regional government agencies	Higher education	Commodity boards or producers associations	Business enterprise
St. Kitts-Nevis	· Crops Research Unit		· CARDI unit · Government of Taiwan – Technical Mission · Government of France – Technical Mission			· St. Kitts Sugar Manufacturing Corporation – Agronomy and Research Department
St. Lucia	· Research and Development Division		· CARDI unit · Government of Taiwan – Technical Mission (closed in 1999) · Government of France – Technical Mission			· Windward Islands Banana Development and Exporting Company Ltd – Technical Services Division
St. Vincent and the Grenadines	· R&D unit · Fisheries Division		· CARDI unit · Government of Taiwan – Technical Mission · Government of France – Technical Mission · CARICOM Fisheries Unit – Regional Assessment Centre			
Suriname	· Agronomy and Horticulture Department: Agricultural Experiment Station and Palm Research Center · Livestock Department · Fisheries Department: Section Fisheries Research and Statistics	· Ministry of Natural Resources and Energy – National Forest Service		· University of Suriname — Faculty of Technological Sciences, Department of Agriculture · University of Suriname — Center for Agricultural Research in Suriname.	· Foundation for Rice Research in Suriname – Rice Research Center “Anne van Dijk” · Foundation for the Mechanization of Agriculture (SML) – Rice Research and Breeding Station + Station for Applied Rice Research	· Surland Banana Company
Trinidad and Tobago	Research Division Animal Production and Health Division – Veterinary Diagnostic Laboratory Forestry Division Fisheries Division	Office of the Prime Minister – Institute of Marine Affairs Ministry of Finance – Caribbean Industrial Research Institute	CARDI headquarters CARDI unit (local) CABI Bioscience – Caribbean and Latin American Centre CARICOM Fisheries Unit – Field Office	UWI - Faculty of Agriculture and Natural Sciences UWI – Faculty of Engineering, Dept of Agr. Engineering UWI – School of Veterinary Medicine UWI – Cocoa Research Unit		Caroni Ltd – Caroni Research Station and Sugarcane Feed Centre
Turks and Caicos Islands (UK)	<i>No research reported</i>					
Virgin Islands (US)			· USDA – ARS – Germplasm Introduction and Research Unit	UVI – Agricultural Experiment Station UVI – Water Resources Research Institute UVI – Marine Science Center UVI – Eastern Caribbean Center		

4. *Higher education.* The following Caribbean countries have one or more Faculties of Agriculture: Cuba (6), Dominican Republic (4), Guyana (1), Haiti (3), Puerto Rico (1), Suriname (1), and Trinidad & Tobago (1). The Faculty of Agriculture and Natural Sciences of the University of the West Indies, based in T&T, plays an important regional role within the English-speaking Caribbean. Most of the Faculties of Agriculture conduct research, while several have organized their research in separate research centers or experiment stations adjacent to the Faculty. In addition to these Faculties of Agriculture, several Faculties of (Natural) Sciences conduct research relevant to agriculture. They contribute in particular to research in biotechnology and marine science.
5. *Agencies belonging to commodity boards or producers' associations.* This type of research agency has a long and vested history in the Caribbean, and in the (former) British colonies in particular. In all cases, the agencies conduct research on important export crops, such as sugar, coffee, cocoa, bananas, citrus fruit, and rice. One drawback of these research schemes is that they often lack critical mass. The largest agency in this category, the Guyana Rice Development Board, employs 14 FTE researchers, but the average size of these research schemes is about 4 or 5 FTE researchers, and their emphasis is often technology transfer rather than research.
6. *R&D units belonging to private or public (state-owned) enterprises.* Most prominent in this category are the research units of major sugar companies throughout the region. They usually conduct agronomic research as well as research on sugar processing. Few other businesses in the agricultural input, production, or processing industries in the Caribbean can afford their own R&D units due to the small size of local markets.

In addition to these six categories of implementing agencies, there are several research networks that try to link research activities across different countries. Some of these networks are region-specific, while others have a larger geographical coverage. We will focus here on the region-specific networks only.

PROCICARIBE, the Program for Cooperation of Institutes of Agricultural Science and Technology in the Caribbean, brings together most of the Caribbean countries (except for the U.S. territories) to integrate and coordinate their agricultural research activities at the national and regional levels. Moreover, it takes care of linkages with international organizations and represents the Caribbean in regional and global fora on agricultural research.

PROCICARIBE was established with support from CARDI, IDB, and IICA in 1996, and is comprised of some eight commodity or thematic regional networks (table 6). Each of these regional networks consists of a regional coordinator and a group of national coordinators representing the national networks or programs. Not every country is member of every network. As such, the networks do not add to the total research capacity in the region, but they are instrumental in the exchange of information and research results, the avoidance of duplication of research efforts, and other matters that may affect research capacity.

Other network activities that do not fall under the PROCICARIBE banner are the Caribbean Agricultural Technical Assistance Service (CTAS) and the Caribbean Agricultural Information System (CAIS). The latter activity is a joint project of CARDI and CTA.

Table 6: Regional Networks Operating under PROCICARIBE

Network name	Acronym	Regional coordinator	Membership
Caribbean Fruit Network	CARIFRUIT	IICA, T&T	Antigua and Barbuda, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent, Suriname, T&T
Caribbean Rice Industry Network	CRIDNET	CARDI, Guyana	Belize, Cuba, Dominican Republic, Guyana, Haiti, Suriname, T&T
Caribbean Integrated Pest Management Network	CIPMNET	CARDI, Jamaica	Antigua and Barbuda, the Bahamas, Barbados, Belize, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Jamaica, Haiti, St. Lucia, St. Kitts, St. Vincent, T&T
Caribbean Plant Genetic Resources Network	CAPGERNET	SEA-DIA, Dominican Republic	Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guyana, Haiti, Jamaica, Nevis, St. Kitts, St. Lucia, T&T
Caribbean Loop of BioNET International	CARINET	CABI, T&T	The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Lucia, St. Vincent, Suriname, T&T, Venezuela
Caribbean Small Ruminants Network	CASRUNET	CARDI, Jamaica	Antigua and Barbuda, Barbados, Curaçao (Netherlands Antilles), T&T
Caribbean Post-Harvest Technology Network	CAPHNET	UWI, T&T	In the process of being established.
Caribbean Land and Water Resources Network	CLAWRENET		In the process of being established.

Source: PROCICARIBE (2000).

The Inter-American Institute for Agricultural Cooperation (IICA) is another important supporter and facilitator of agricultural research throughout the Americas. In the Caribbean region, its activities are implemented through a regional office in Trinidad & Tobago and country representatives in 15 of the 28 Caribbean countries.¹² With about 40 professionals working throughout the region, IICA is involved in a wide range of activities, including support of agricultural research. IICA's Regional Office provides financial support to both CARDI and PROCICARIBE, and publishes four newsletters, namely: *IICA Caribbean News*, *Tropical Fruits Newsletter*, *Quarterly Newsletter on Economic Policy and Sustainable Rural Development*, and *CARAPHIN News: Newsletter of the Caribbean Animal and Plant Health Information Network*. IICA's technological innovation activities in the region focus on the development of tropical fruits in particular as part of CARICOM's strategy to diversify agricultural exports, and on the development of agricultural science and technology capacity in general.

The FAO Regional Office for Latin America and the Caribbean (based in Chile), with a sub-regional office for the Caribbean based in Barbados, has a mandate similar to IICA. FAO's Regional Office manages several thematic networks,¹³ some of which have a research component. Spanish is the dominant working language in these networks, which precludes the participation of most Caribbean countries, except Cuba and the Dominican Republic.

12. Antigua, Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts-Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad & Tobago.

13. Such as "Red de Cooperación Técnica entre Laboratorios de Investigación y Diagnóstico Veterinario" (REDLAB), "Red en Manejo de Cuencas Hidrográficas," "Red en Parques Nacionales, Otras Areas Protegidas, Flora y Fauna Silvestre," "La Red de Cooperación Técnica sobre Sistemas de Vigilancia Alimentaria y Nutricional" (SISVAN), "Red de Cooperación Técnica en Biotecnología Vegetal" (REDBIO), and "Red de Cooperación Técnica de Instituciones y Organismos de Apoyo a la Mujer Rural."

Research focus

Agricultural research capacity in the Caribbean is extremely fragmented due to geographical and political boundaries, in addition to the usual subject-matter specialization. Most research units in the region are small (about three-quarters have less than 10 FTE researchers) and often have mandates that are substantially broader than simply research. In such cases, emphasis is usually placed on the applied end of the research spectrum. Moreover, it is our impression that, in recent years, more emphasis has been placed on technology acquisition and transfer throughout the region, as opposed to technology generation. Several agencies that were surveyed reported that they no longer conduct research.

Figure 3 provides a breakdown of research staff according to research focus. Of the approximately 1000 full-time equivalent agricultural researchers working in the Caribbean (excluding Cuba and Haiti) in 1996, about 56% worked on crops, 13% on livestock, 3% on forestry, 5% on fisheries, 14% on NRM, 5% on post-harvest, and 4% on other topics.¹⁴

About a third of crop research capacity in the Caribbean focuses on the traditional export crops: sugar, cocoa, coffee, and bananas (figure 4). Another third focuses on vegetables, fruits, and ornamentals, all of which are crops with export potential. The remaining third consists of food crops such as rice and root crops, as well as a broad range of other crops including maize, beans, soybean, tobacco, and cotton.

The relatively small capacity for livestock research in the region focuses on small ruminants (26%), cattle (24%), pigs (19%), animal health (13%), animal feed (9%), and poultry (9%). The considerable importance given to research on small ruminants is striking given the fact that it represents less than 2% of the value of livestock production in the region (see table 3). This phenomenon is also quite widespread; almost all countries undertake some research on small ruminants. In contrast, poultry production receives considerably less research attention in comparison to its economic importance, which is more than a third of livestock output. These incongruencies are due in part to the availability of foreign technology (in the case of poultry production), as well as a political agenda to focus public research on the production systems of poor farmers.

NRM research in the Caribbean focuses on marine biology and ecology. It is a relatively new research area in which universities and university-based research agencies have taken the lead. Regional collaboration in this area is quite substantial.

For every 100 million dollars of crop, livestock, forestry, and fisheries production, the region employed, respectively, 33.6, 10.9, 13.0, and 48.9 FTE researchers. Assuming that the innovation possibilities are of the same intensity across different types of production, the congruency ratio suggests that livestock and forestry production receive considerably less research support than crop and fisheries production.

The congruency ratios for specific crops (table 7) indicate that bananas, coffee, and rice are relatively neglected, while cocoa and vegetables receive above-average research support. Cocoa research is undertaken by six agencies across five countries. One agency, the Cocoa Research Unit at the University of the West Indies, represents 60% of cocoa research capacity in the region. In contrast, vegetable research is highly dispersed and undertaken by 37 agencies across 19 countries. The privatization of banana companies and the uncertain

14. In terms of research entities, out of 113 agencies sampled, 81 are involved in crop research, 34 in livestock research, 11 in forestry research, 16 in fisheries research, 23 in NRM, 22 in post-harvest research, and 10 in other research. Of these 113 agencies, 48 have research activities that cover more than one category. The most common combination is crop and livestock research.

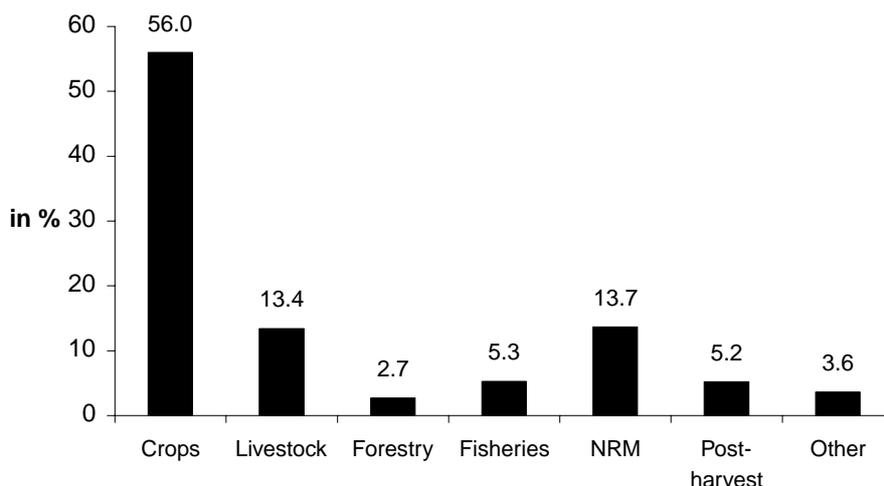


Figure 3: Caribbean research staff, according to research focus, 1996

Sources: Based on survey results, annual reports, etc.

Note: Based on the research orientation of research staff across 113 agricultural research agencies in 21 countries. Another five countries did not employ permanent research staff.

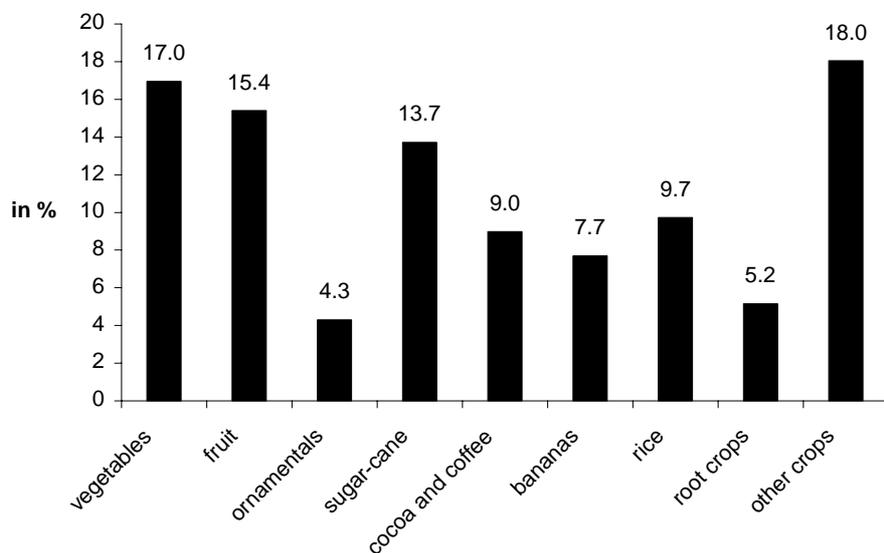


Figure 4: Foci of crop research in the Caribbean, 1996

Sources: Based on survey results, annual reports, etc.

Note: Based on research staff data.

Table 7: Caribbean Agricultural Research Congruency Ratios, 1996

Crop	Researchers (FTE)	Production (in millions of dollars, international 1989–91 prices)	Researchers per US\$ 100 million production (FTE)
Vegetables	94.9	137	69.5
Fruit	86.2	317	27.2
Ornamentals	24.1	NA	NA
Sugar cane	76.8	243	31.6
Cocoa	36.8	42	86.5
Coffee	13.5	70	19.4
Bananas	43.1	252	17.1
Rice	54.5	243	22.5
Root crops	28.9	81	35.6
Other crops	101.1	213	47.5
<i>Total</i>	<i>560.0</i>	<i>1598</i>	<i>33.6</i>

Sources: Based on survey results, annual reports, etc.

Note: Excludes Cuba and Haiti.

future of the banana export to Europe have led to a major decline in banana research in recent years. CIRAD, which represents about 40% of banana research capacity in the region, is said to have plans to hand over its banana research to a private banana company.

4. Human and Financial Research Resources

Regional overview

Table 8 is a snapshot of agricultural research staffing and expenditure in the Caribbean in 1996. It covers 26 of the 28 Caribbean countries. Cuba and Haiti are excluded due to incomplete or dissimilar data that impede cross-country comparisons.¹⁵ Together, these 26 countries employed close to 1000 FTE researchers and spent some 106 million dollars (1993 PPPs) in 1996.

Of these 26 countries, 12 had less than 10 FTE researchers, and 20 had less than 50 FTE researchers. Only the Dominican Republic, French Guiana, Guadeloupe, Guyana, Jamaica, Puerto Rico, and Trinidad & Tobago employed more than 50 FTE researchers, and none had more than 200 FTE researchers. The overall picture that emerges is one of highly fragmented agricultural research capacity due to political and geographical boundaries. In addition, there is also considerable institutional fragmentation of research capacity within countries. Of the 116 agricultural research agencies for which data were obtained, 84 employ less than 10 FTE researchers, and 62 less than 5 FTE researchers. The two largest agricultural research agencies in the region are INRA-CRAAG (based in Guadeloupe, but servicing all three French territories in the region) and the R&D Division of the Ministry of Agriculture of Trinidad & Tobago, each employing some 60 FTE researchers. CARDI might be considered in the same league, but it is physically very fragmented, being dispersed over all its member countries.

In addition to research agencies with country-specific research mandates, there are several agencies that have a regional research mandate. Together they make up close to 10% of all research capacity in the region. They include all agricultural and agriculture-related research activities by the University of the West Indies at its locations in Barbados, Jamaica, and T&T, CARDI headquarters (CARDI country units have been classified as country-specific), CABI, CARICOM Fisheries Unit, WIBDECO, and WICSCBS.

In addition to the standard classification of research agencies into government, higher education, and business enterprise categories (see OECD 1994), a further distinction can be made between government agencies controlled and financed mainly by the local government, and government agencies controlled and managed by supra-national bodies or non-local governments (table 8). Local, bilateral, and regional government agencies combined represent about two-thirds of the region's agricultural research capacity. Within this group, bilateral and regional agencies represent a major share, namely 45% of the research staff and 60% of research expenditure. Four agencies—CARDI, CIRAD, INRA, and IRD—account for most (80%) of the research capacity in this category. In most other regions of the world, bilateral and regional agencies play a far less prominent role in agricultural research.

Research activities at universities and university-related research institutes comprise about 20% of agricultural research capacity in the region. The relative importance of universities is influenced in part by Puerto Rico and the U.S. Virgin Islands, which operate state agricultural experiment stations within the premises of their local universities. The University of

15. Cuban expenditure data, for example, cannot be compared easily with data from other countries due to lack of reliable deflator and exchange rate data. Cuba's method of classifying researchers is also considerably different from that shared by other countries. Nevertheless, Cuba's research capacity may be as large as 1500–2000 FTE researchers.

Table 8: Snapshot of Caribbean Agricultural Research Capacity, 1996

Country	Agricultural Research Staff (full-time equivalents)				Total	Agricultural Research Expenditures (million 1993 PPP dollars)				Total
	Local government	Bilateral and regional government	Higher education	Business enterprise		Local government	Bilateral and regional government	Higher education	Business enterprise	
Anguilla					0.0					0.000
Antigua and Barbuda	3.0	4.0			7.0	0.188	0.389			0.577
Aruba	1.0				1.0	0.125				0.125
Bahamas, The	17.2	8.0			25.2	2.105	0.990			3.095
Barbados	26.0	5.0	(a)	4.0	35.0	1.494	0.656	(a)	0.409	2.559
Belize	2.7	2.0	0.5	9.2	14.4	0.126	0.246	0.050	1.340	1.762
British Virgin Islands		1.0			1.0		0.122			0.122
Cayman Islands					0.0					0.000
Dominica		11.0			11.0		1.356			1.356
Dominican Republic	122.0		42.0	14.0	178.0	6.313		2.173	0.724	9.210
French Guiana		69.4			69.4		8.533			8.533
Grenada	0.5	6.5		0.5	7.5	0.064	1.113		0.046	1.223
Guadeloupe		97.2			97.2		13.169			13.169
Guyana	35.0	8.0	6.0	31.5	80.5	4.113	0.979	0.600	2.941	8.634
Jamaica	38.3	9.0	(a)	33.0	80.3	3.719	1.213	(a)	2.983	7.916
Martinique		32.0			32.0		3.700			3.700
Montserrat					0.0					0.000
Netherlands Antilles					0.0					0.000
Puerto Rico		9.0	60.1		69.1		1.800	13.718		15.518
St. Kitts and Nevis	2.0	2.0		1.0	5.0	0.042	0.233		0.248	0.523
St. Lucia	6.0	2.0			8.0	0.480	0.229			0.709
St. Vincent and the Grenadines	2.0	12.0			14.0	0.160	2.448			2.608
Suriname	8.0		2.5	4.0	14.5	0.308		0.034	0.320	0.662
Trinidad and Tobago	104.5	7.0	(a)	16.0	127.5	9.301	0.875	(a)	2.181	12.357
Turks and Caicos Islands					0.0					0.000
Virgin Islands (U.S.)		1.0	8.3		9.3		0.200	1.765		1.965
Regional		21.0	72.5	10.0	103.5		2.925	5.200	1.224	9.349
<i>Total</i>	<i>368.2</i>	<i>307.1</i>	<i>191.9</i>	<i>123.2</i>	<i>990.4</i>	<i>28.537</i>	<i>41.178</i>	<i>23.541</i>	<i>12.417</i>	<i>105.672</i>

Note: Cuba and Haiti are excluded due to incomplete data. The authors estimate that Haiti has approximately 100-150 FTE agricultural researchers, and Cuba probably as much as 2000 FTE agricultural researchers.

(a) Research activities by the University of the West Indies are reported under regional agencies.

the West Indies, with campuses in Barbados, Jamaica, and Trinidad & Tobago, is an important regional player.

The business sector makes up the remaining 12% of research capacity in the region. Most of its research is on specific export commodities, and is financed either by commodity boards or growers' associations (bananas, cocoa, citrus fruit, rice) or by processing industries (sugar). Business sector activity in agricultural research in the Caribbean is concentrated mainly in Barbados,¹⁶ Belize, the Dominican Republic, Guyana, Jamaica, and Trinidad & Tobago.

Relating agricultural research expenditure to AgGDP and to population size gives some indication of the relative weight of this expenditure in the context of the agricultural sector it serves and the overall economy. As shown in table 9, agricultural research expenditure, as a percentage of AgGDP and per capita, may vary substantially from country to country. In some of the smaller countries in particular, exceptionally high intensities can be noted due to donor support or an affluent non-agricultural sector.

With the exception of the Dominican Republic, which invests relatively little in agricultural R&D but has a large agricultural sector, the group of 22 Caribbean countries, all with populations of less than 4 million, spent, on average, 2.6% of its AgGDP on agricultural research. This ratio is considerably higher than the developing country average of approximately 0.5% (1991) and only half a percentage point lower than the average intensity ratio for developed countries (3.1% in 1993, including R&D expenditure by business enterprises classified as agriculture, forestry, and fisheries).¹⁷ Intensity ratios that stand out as exceptionally high are those for Guadeloupe (5.9%) and Trinidad & Tobago (8.3%). In the case of Trinidad & Tobago, research expenditure by regional agencies located in T&T (CARDI, UWI, etc.) was excluded, so the high intensity ratio reflects local research activities that target a relatively small and shrinking agricultural sector in terms of AgGDP. The relative wealth of the non-agricultural sector (in particular its oil industry) makes it affordable. In the case of Guadeloupe, France pays most of the research expenses. Moreover, the research activities undertaken in Guadeloupe also target other French overseas departments in the Caribbean (Martinique and French Guiana).

With the exception of the Dominican Republic, the average research spending per capita was \$ 8.4 (1993 PPP) in 1996. This is about two-thirds of the per capita spending by developed countries in 1993 (estimated at \$12.4 [1993 PPP]).¹⁸ However, external donors fund a substantial portion (estimated at 39%) of research spending in the region. As a result, the actual *local* spending per capita that is paid by local taxpayers or businesses is considerably lower. As argued and documented by Pardey, Roseboom, and Anderson (1991), most measures of research intensity diminish progressively with increasing population size, especially in developing countries. This inverse relation between population size and research intensity can be attributed to two factors: (a) lack of economies of scale, which makes the provision of technology in small countries substantially more expensive, and (b) mobilization of rather

16. Housing the West Indies Sugar Cane Breeding Station, which has a regional mandate.

17. Alston, Pardey, and Roseboom (1998).

18. Pardey, Roseboom, and Craig (1999). In order to make the OECD data comparable to the Caribbean data, public and private R&D expenditure by agriculture, forestry, and fisheries was combined. Both data sets do not include private R&D expenditure by food processing industries and non-agricultural input industries (chemicals, machinery, etc.) The U.S. GDP deflator index was used to adjust the OECD expenditure from 1985 PPPs to 1993 PPPs.

Table 9: Agricultural Research Expenditures Relative to Agricultural GDP and Total Population, 1996

Country	Agricultural research expenditures (million 1993 PPP\$)	Agricultural GDP (million 1993 PPP\$)	Agricultural research intensity (%)	Total population (thousand)	Agr. research expenditures per capita (1993 PPP\$)
Anguilla	0.000	3.6	0.00	8	0.00
Antigua and Barbuda	0.577	19.6	2.94	66	8.74
Aruba	0.125	14.1	0.89	71	1.76
Bahamas, The	3.095	86.5	3.58	284	10.90
Barbados	2.559	152.3	1.60	261	9.80
Belize	1.762	160.1	1.06	219	8.05
British Virgin Islands	0.122	5.9	2.07	19	6.44
Cayman Islands	0.000	10.1	0.00	32	0.00
Cuba	NA	NA	NA	11,018	NA
Dominica	1.356	52.5	2.58	71	19.09
Dominican Republic	9.210	4439.5	0.21	7,961	1.16
French Guiana	8.533	NA	NA	153	55.77
Grenada	1.223	31.1	3.94	92	13.30
Guadeloupe	13.169	224.9	5.86	431	30.55
Guyana	8.634	702.0	1.23	838	10.30
Haiti	NA	NA	NA	7,259	NA
Jamaica	7.916	709.7	1.12	2,491	3.18
Martinique	3.700	217.8	1.70	384	9.64
Montserrat	0.000	2.8	0.00	11	0.00
Netherlands Antilles	0.000	21.2	0.00	195	0.00
Puerto Rico	15.518	415.9	3.73	3,736	4.15
St. Kitts and Nevis	0.523	13.3	3.92	41	12.75
St. Lucia	0.709	56.9	1.25	144	4.92
St. Vincent and the Grenadines	2.608	46.9	5.56	113	23.08
Suriname	0.662	215.2	0.31	432	1.53
Trinidad and Tobago	12.357	148.4	8.32	1,297	9.53
Turks and Caicos Islands	0.000	NA	0.00	15	0.00
Virgin Islands (U.S.)	1.965	NA	NA	106	18.54
Regional	9.349	—	—	—	—
Regional total / average ^a	95.799	7764.6	1.23	19,471	5.43
Regional total / average, excluding Dominican Republic	86.589	3325.0	2.60	11,510	8.38

Sources: AgGDP: World Bank (1999a), ECLAC (1998), and CIA (1999); Total population: FAO (1999) and CIA (1999).

^a Regional total / average in columns 1, 4, and 5 covers 26 countries (all Caribbean countries except Cuba and Haiti), while columns 2 and 3 cover only 23 countries due to lack of AgGDP data for three countries.

generous support from external donors or a relatively rich non-agricultural sector. Whereas in developed countries high (and rapidly increasing) agricultural research intensity ratios are mainly profit-driven (such high investments payoff handsomely both privately and socially), in small developing countries, they are probably driven more by equity arguments than expected profitability.

A major difficulty with the above comparisons is that there is no unique, optimal level of investment to which all countries should adhere. Profitable innovation opportunities differ significantly across countries, and so does the optimal level of investment in agricultural R&D. While conditions such as climate, soil, and infrastructure are relatively favorable for agricultural production in most Caribbean countries, it is the small size of the agricultural sectors in most countries that limits the profitability of local agricultural research projects in a significant way. Solving a problem for 1,000 farmers or 100,000 farmers makes a lot of difference in terms a research project's expected rate of return.

Small countries have three options for overcoming this problem: (1) import technology from elsewhere, (2) specialize in just a few commodities (reduce scope and thereby increase scale), and (3) cluster research activities with other countries so that the research benefits have enough volume to pay for the research investment. This is the idea behind CARDI, PROCICARIBE, and other collaborative efforts in the region.¹⁹

Research staffing trends and characteristics

In addition to our 1996 snapshot (table 8), we have compiled several other data sets that provide additional information on staffing characteristics such as educational qualifications, gender, and support staff ratios, as well as on the development of research staff capacity over time.

Staffing trend

The overall regional trend in research staffing is one of very slow growth (on average, less than 1% per annum between 1981 and 1996). Differentiated by institutional category, research staff in all categories stagnated or contracted during this period, except for bilateral government agencies (figure 5). This latter category experienced an annual growth in research staff of 5.9% per annum over the period 1981–96, growth that was driven almost completely by a boost in research staff employed by the French agencies CIRAD, INRA, and IRD.

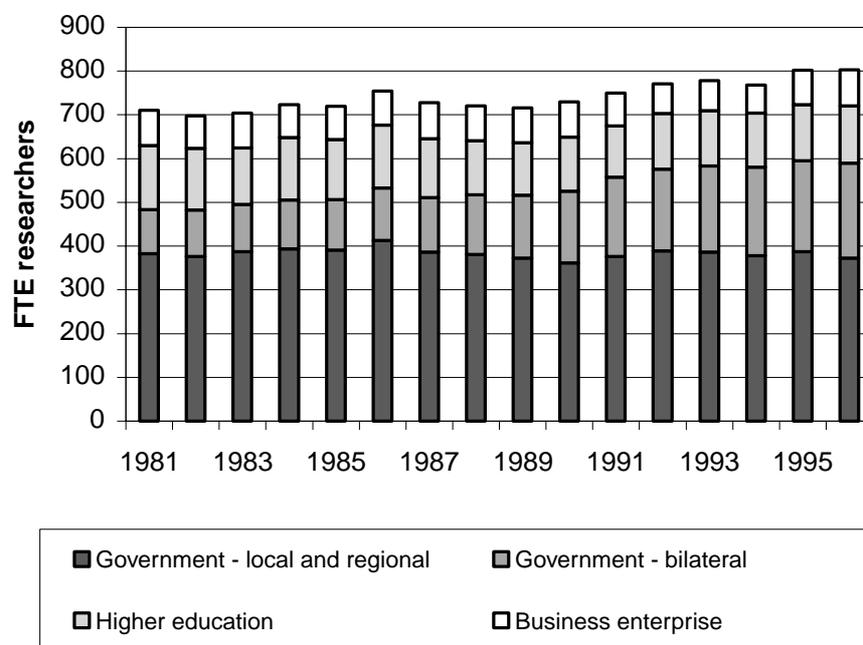


Figure 5: Development of agricultural research staff in the Caribbean, 1981-96

Note: Based on data from 81 agricultural research agencies representing 80% of research staff in 26 countries (excluding Cuba and Haiti) in 1996.

19. See Eyzaguirre (1996) for a more in-depth analysis of the specific characteristics and problems of agricultural research in small countries.

The number of FTE research staff employed by local and regional government agencies, universities, and businesses has, on average, been fairly constant throughout the whole period. Most universities in the region saw an expansion of their agricultural and agriculture-related research capacity between 1981 and 1996. However, this expansion was counterbalanced by developments at the state agricultural experiment station operating under the University of Puerto Rico which, during the same period, reduced its research staff from 91 to 45 FTE researchers.

Most research agencies in the category of business enterprises also saw their research capacity decline. Only the creation of one new entity (the Guyana Rice Development Board) in 1994 ensured that the number of research staff in this category remained about constant.

As shown in table 10, changes in research staff capacity over the period 1981–1996 also differ significantly across countries. Some countries experienced major declines in their research staff, while others experienced major increases.

Educational qualifications

Not only quantity, but also quality matters. It is for this reason that we have tried to further differentiate research staff counts according to educational attainment. Based on data for about half of all researchers in the region, table 11 provides a breakdown of local agricul-

Table 10: Percentage Increase or Decrease in Research Staff, 1981–96

Major decline (>-25%)	Relative stagnation (-25%/+25%)	Major increase (>+25%)
Jamaica (-26%)	Antigua (2%)	Bahamas (39%)
Montserrat (-100%)	Barbados (6%)	Dominica (60%)
Puerto Rico (-50%)	Belize (-20%)	French Guiana (115%)
St. Kitts-Nevis (-46%)	Dominican Republic (1%)	Grenada (413%)
St. Lucia (-59%)	St. Vincent (2%)	Guadeloupe (73%)
Suriname (-36%)	US Virgin Island (15%)	Guyana (61%)
		Martinique (260%)
		Trinidad and Tobago (42%)

Note: Between 1981 and 1996, no agricultural researchers were employed by the following countries: Anguilla, Cayman Islands, Netherlands Antilles, and Turks and Caicos Islands. No time series data are available for Aruba, the British Virgin Islands, Cuba, and Haiti. Keep in mind that small changes in research staff numbers can result in considerable percentage changes when the numbers of researchers employed are low. For example, Grenada saw its research capacity grow from 1.4 FTE researchers in 1981 to 7.0 researchers in 1996, an increase of 413%.

Table 11: Research Staff in Selected Caribbean Agricultural Research Agencies, According to Highest Educational Attainment

Agency	1986	1991	1996	Agency	1986	1991	1996
Government agencies	%	%	%	Business enterprises	%	%	%
PhD	11	9	8	PhD	17	19	21
MSc	26	29	38	MSc	25	27	34
BSc	64	62	54	BSc	58	55	45
<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>
Higher education	%	%	%	All agencies	%	%	%
PhD	37	45	46	PhD	18	20	21
MSc	35	31	25	MSc	28	29	34
BSc	28	25	29	BSc	54	51	45
<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>Total</i>	<i>100</i>	<i>100</i>	<i>100</i>

Source: Survey responses.

Note: Based on information for approximately half of all research staff in the region (except Cuba and Haiti).

tural research staff according to the highest educational qualification they obtained. All bilateral research agencies are excluded from these figures because they employ mainly expatriates.

Across the board, there are important differences in qualification profiles between the different research agency categories. Government research agencies stand out as employing relatively few post-graduates in comparison to universities. Research agencies and programs by the business sector are somewhere in between. This contrast in qualification profiles between government agencies and universities is consistent with findings elsewhere.

Despite stagnation in the growth of agricultural research staff and contracting budgets per researcher, the qualification profiles of research staff have improved over the period 1986–96. The only exception is a decline in the percentage of doctorates among research staff at government agencies. However, this is compensated for by a considerable improvement in the number of research staff with a M.Sc. degree or equivalent.

The qualification profile of agricultural research staff at government agencies in the Caribbean is more or less the same as those found in the smaller Latin American countries, but substantially lower than the qualification profiles of some of the larger Latin American countries.²⁰ Both demand and supply factors may explain these differences in qualification profiles. Large countries tend to conduct relatively more basic research, which requires better qualified and more specialized research staff. Similarly, the pool from which large countries can draw such staff is much larger than in small countries.

Gender characteristics

In the past, the participation of women in (agricultural) sciences has been abysmally low in many parts of the world. In recent years, many governments have actively sought to increase the participation of women in (agricultural) sciences as well as in senior government positions. Progress on this aspect of research staffing differs quite substantially from country to country. On average, about 31% of agricultural researchers in the Caribbean in 1996 were female (table 12). This is a relatively high score when compared to other regions, both in the South and North: 17% in sub-Saharan Africa (1991); 15% in Latin America (1991–95 average); and 17% in the Netherlands.

A large number of female researchers can be found across all institutional categories, except bilateral and regional government agencies. This may be due to the international character of these organizations, which require extensive traveling and/or relocation. Women profession-

Table 12: Research Staff in Selected Caribbean Agricultural Research Agencies, According to Gender, 1996

Type of research agency	Total researchers (no.)	Male researchers (no.)	Female researchers (no.)	Male researchers (%)	Female researchers (%)	Coverage (FTEs, %)
Government: local	332.0	218.0	114.0	65.7	34.3	90.2
Government: regional	51.0	40.0	11.0	78.4	21.6	72.9
Government: bilateral	76.0	67.0	9.0	88.2	11.8	32.1
Higher education	75.3	49.8	25.5	66.1	33.9	39.3
Business enterprise	59.0	37.0	22.0	62.7	37.3	47.9
<i>Total</i>	<i>593.3</i>	<i>411.8</i>	<i>181.5</i>	<i>69.4</i>	<i>30.6</i>	<i>59.9</i>

Source: Survey results.

Notes: Sample represents staff in selected institutes for which data were available on total research FTEs in the region. Coverage is low for bilateral agencies because the French institutes CIRAD, IRD, and INRA are not covered.

20. In 1991, 13.8, 17.8, 21.1, and 28.6% of the research staff in the principal government agricultural research agencies in Mexico, Chile, Colombia, and Brazil, respectively, held a doctorate (Cremers and Roseboom 1997).

als often find it more difficult to pursue an overseas career if they have spouses who may have professional careers of their own.

Support staff ratios

On average, agricultural research agencies in the Caribbean employ about 3.7 support staff per researcher. Support staff ratios are somewhat lower among regional and bilateral research agencies, and higher among establishments of higher education and business enterprises (table 13). The average Caribbean support staff ratio does not differ much from that of Latin America (3.6 support staff per researcher [Cremers and Roseboom 1997]). Support staff ratios tend to be somewhat lower in developed countries (e.g., 2.6 support staff per researcher in the U.S.A. in 1991 [USDA 1992]), but are, for example, substantially higher in sub-Saharan Africa (on average, 9.7 support staff per researcher [Pardey, Roseboom, Beintema, Chang-Kang 1998]).

Among the Caribbean agencies, the spread in support staff ratios is quite large, ranging from 0.3 to 29.0 support staff per researcher. This is due in part to the rather small size of many Caribbean research agencies, which may cause atypical support staff ratios. However, there are also agricultural research organizations that employ large numbers of agricultural laborers, as they are involved in agricultural production at a level that is far beyond what is needed for experimentation.

Broken down by support staff category, 28% of the support staff can be classified as technical, 14% as administrative, and 58% as other. Bilateral and regional government agencies and universities employ relatively more support staff in technical and administrative positions than do local government agencies and business enterprises.

Research expenditure trends and characteristics

It is not only important to know how much is spent on agricultural research in the region, but also to gain insight into funding sources and cost structures, and to determine whether spending is increasing or declining. In this section, a summary is presented of our major findings pertaining to these factors.

Expenditure trend

The time series on agricultural research expenditure depicted by the bars in figure 6 covers close to 60% of total agricultural research expenditure in 1996 (estimated at \$106 million, see table 8). On aggregate, it shows a rather erratic but declining trend in agricultural research expenditure over the period 1986–96. During this period, agricultural research expenditure declined by 9% in real terms. Average expenditure per researcher, represented

Table 13: Support Staff Ratios in Selected Caribbean Agricultural Research Agencies, 1996

	Support staff (FTE)	Research staff (FTE)	Support staff per researcher
Government: local	1239	323	2.0
Government: regional	145	55	2.6
Government: bilateral	376	182	2.1
Higher education	421	106	4.0
Business enterprise	562	80	7.0
<i>Total</i>	<i>2742</i>	<i>745</i>	<i>3.7</i>

Source: Survey results.

Note: Based on data obtained from 83 agencies, covering approximately 75% of all research staff in the region (except Cuba and Haiti). Coverage ranges from 56% of FTE researchers for universities to 88% for local government agencies.

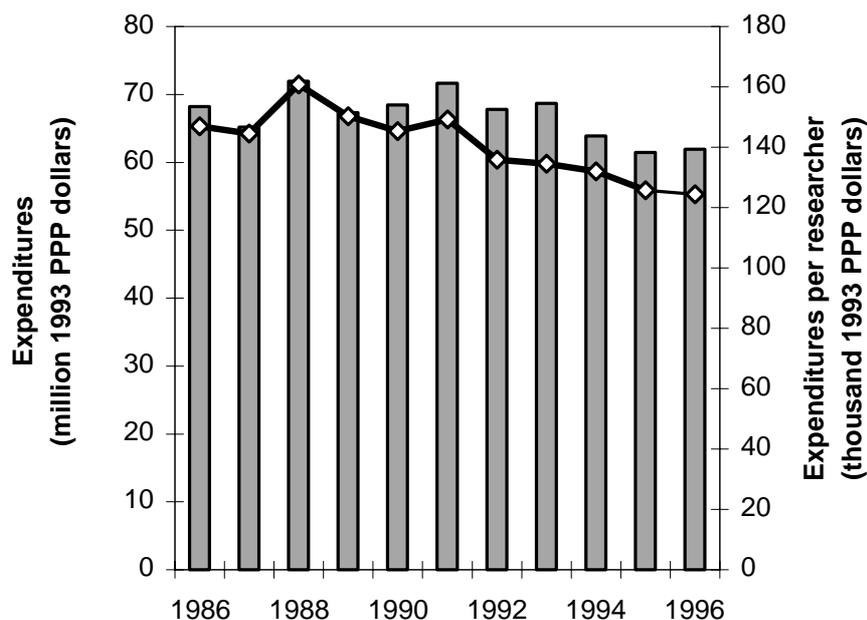


Figure 6: Trend in agricultural research spending (absolute and per researcher) in the Caribbean, 1986–96

Note: The bars represent total expenditures against the left-hand scale. The line represents expenditures per researcher against the right-hand scale. The trend is based on a subset of all agricultural research agencies and represents close to 60% of total expenditures in 1996.

by the line in figure 6, contracted even more sharply from \$147,000 to \$124,000 (1993 PPP dollars)—a decline of 15%.

Of the four institutional categories, the contraction in research expenditure between 1986 and 1996 has been most pronounced in local and regional government agencies (34%), followed by business enterprises (27%) and universities (10%). In contrast, bilateral agencies increased their expenditure by 73% over this period, which compensated to a large extent for the substantial declines observed in other institutional categories. The growth in research expenditure by bilateral agencies is almost entirely due to French research institutes working in the French Caribbean countries. In that sense, there is also a geographical dichotomy in the development of research spending between the French Caribbean and the rest of the region.²¹

Bilateral agencies saw their expenditure per researcher decline by about 21% between 1986 and 1996, as the expansion of their research staff exceeded that of their expenditure. For local and regional government agencies, the cut in expenditure per researcher was even deeper at 28%. In this instance, cuts in research expenditure were less-than-equally matched by cuts in research staff. Only universities saw a slight increase in expenditure per researcher between 1986 and 1996, but this was mainly driven by developments at the state agricultural experiment station of the University of Puerto Rico.

The average expenditure per researcher for the group of research agencies included in the trend analysis is about 20% higher than for the entire sample. This suggests a bias in the sample towards the financially stronger research organizations in the region (possibly

21. Except for the Bahamas and the U.S. Virgin Islands, all other countries with a research expenditure of 0.5 million or more saw their agricultural research expenditure decline between 1986 and 1996.

because they are better at reporting financial data), which leads us to believe that the actual decline in expenditure and expenditure per researcher may have been even more dramatic.

Funding sources

The institutional complexity of agricultural research in the Caribbean is also reflected in the diversity of funding sources for agricultural research. In table 14, different funding sources have been identified per institutional category. Each institutional category has its own distinct funding profile.

Among government agencies, the share of donor funding increases from low, to moderate, to high for local, regional, and bilateral agencies, respectively. Due to a lack of detailed data, we classified all expenditure by bilateral research agencies as donor-funded, while in reality various other funding sources may have contributed as well, although only in small amounts. Most local government agencies did not receive any donor funding in 1996. Only in a few instances did government agencies report donor contributions in excess of 25% of total expenditure.

Although we have insufficient data to construct a meaningful time series on trends in donor funding, the overall impression is one of declining donor support for agricultural research conducted by local and regional government agencies. CARDI, for example, has seen donor contributions decline steadily throughout the 1990s—donor contributions dropped from close to 50% of total expenditure in 1991 to 22% in 1998. The current emphasis of donors on poverty alleviation bypasses most Caribbean countries, as they have relatively high incomes per capita. In contrast, the two major providers of bilateral agricultural research in the region (France and Taiwan) act because of geopolitical reasons.

Research budgets at universities usually consist of two distinct components: funding from the core budget of the university (labeled here as government funding), and funding from research contracts and grants. Both funding categories most likely include some unidentified donor funding. Only in the case of the state agricultural experiment stations of Puerto Rico

Table 14: Sources of Funding for Caribbean Agricultural Research Agencies, 1996

Institutional category	Government	Donors ^a	Funding source: (percentages)			Sales	Other ^b
			Specific taxes/levies	Research contracts			
Government	45.4	52.9	0.3	0.4	0.5	0.5	
Local (19)	91.5	5.8	0.8	1.0	1.0	0.0	
Regional (1)	66.1	28.9	0.0	0.3	1.1	3.6	
Bilateral (11)	0.0	100.0	0.0	0.0	0.0	0.0	
Higher education	47.3	18.7	0.0	31.7	1.0	1.3	
SAES (2)	57.7	35.6	0.0	4.6	2.0	0.0	
Other (8)	35.8	0.0	0.0	61.5	0.0	2.7	
Business	0.9	0.2	75.8	1.6	2.6	18.7	
Commodity boards (9)	1.1	0.3	93.3	2.0	3.3	0.0	
Enterprises (5)	0.0	0.0	0.0	0.0	0.0	100.0	
<i>Average^c</i>	<i>40.6</i>	<i>39.0</i>	<i>9.2</i>	<i>7.5</i>	<i>0.9</i>	<i>2.8</i>	

Note: Based on data obtained from 55 agricultural research agencies across the region.

^a Also included in this category are funds provided by central or federal governments outside the region.

^b Unspecified; Business enterprises use their own funds.

^c Weighted by the total expenditures of each institutional sub-category.

and U.S. Virgin Islands have we been able to identify the significant (donor) contribution made by the U.S. federal government.

In the business sector, two distinct funding profiles stand out as well: private and public enterprises that operate and finance their own research, and agencies that conduct research on behalf of a particular group of producers or processors and are financed mainly through specific taxes, levies, or voluntary contributions.

Cost structure

To gain better insight into the cost structure of agricultural research, research agencies were asked to provide a breakdown of their expenditure according to the following cost categories: salaries, operating expenditures, and capital expenditures. Despite the poor response to this question (only 28 agencies provided data), the results reveal a cost structure that is relatively biased towards salaries at the expense of capital and operating expenditures (table 15).²² As pointed out by Pardey, Roseboom, and Anderson (1991), expanding agricultural research agencies spend relatively more on capital than those that have reached maturity. In the early 1980s, when most agricultural research agencies in developing countries were still growing rapidly, the share of capital in total expenditure averaged 19%. This is substantially higher than in the U.S., where agricultural research agencies spent, on average, only 8% of their expenditure on capital.

The stagnation or decline in spending experienced by most agricultural research agencies in the region between 1986 and 1996 manifests itself in a relatively low level of capital investment in agricultural research in 1996. Similarly, declining expenditure per researcher has placed major upward pressure on the share of salaries in total expenditure. This is particularly true for local government agencies which, on average, spent nearly 80% of their expenditure on salaries in 1996.

Table 15: Research Expenditures by Cost Category, 1996

Region	Salaries	Operating expenditures	Capital expenditures
Caribbean (1996)	68.9	22.9	8.2
Developing countries (1981-85)	57.0	25.0	19.0
USA (1981-85)	69.0	23.0	8.0

Sources: Pardey, Roseboom, and Anderson (1991); survey results.

22. Comparing cost structures across countries and over time is problematic because of the interaction between price and use of inputs. For example, countries with low salaries do not necessarily spend proportionately less on personnel costs as they may simply employ more staff.

5. The Future of Agriculture and Agricultural Research in the Caribbean

In most Caribbean countries, agriculture has lost its position as the dominant economic activity over the past 30–40 years. Moreover, because of sluggish modernization and productivity growth in agriculture, Caribbean agriculture has lost much of its competitiveness in world markets. Its traditional agricultural trade surplus has turned into a steadily growing deficit, reaching US\$ 1.4 billion or US\$ 40 per capita in 1997.

A common complaint by Caribbean countries is that high agricultural subsidies and other market interventions in developed countries distort and obscure the region's comparative advantage in agricultural production. In the 1970s, Sir Arthur Lewis expressed concern that Caribbean sugar and banana producers were no longer competitive and could stay in business only because of preferential access to the European market. He warned that it was unrealistic to rely on such preferential treatment indefinitely. Despite his warning, the modernization of sugar and banana production has remained sluggish, and producers dread the day that they will lose their preferential position and be forced to compete at world market prices. An alternative strategy, adopted by the CARICOM countries in the 1980s, is not to rely exclusively on traditional export crops but to diversify into non-traditional export crops such as fruits, vegetables, and ornamentals.²³ This strategy has produced some results, but not enough. Establishing new export markets is a complicated and difficult task that requires major entrepreneurial skill, as well as a supportive institutional setting. Another variant of the agricultural diversification strategy is that of import-substitution, targeting in particular the products imported by the rapidly expanding tourist industry. In this strategy, volume, quality, and year-round supply are the major stumbling blocks to local production.

Smaller countries do not necessarily have smaller farms, but in modern and industrialized food systems, external economies-of-scale are playing an increasingly important role in the provision of research, extension, and training, the procurement and distribution of inputs, and the transportation, processing and marketing of output (Griffith 1990). For example, local processing industries are finding it increasingly difficult to compete with large and well-established North American and European food companies. Small local industries not only have a difficult time gaining access to supermarket shelf space in export markets, but even in their own home markets they are continually under threat of being pushed off the supermarket shelf.²⁴ Moreover, the standard conventional processing plant is often far too big for the small and irregular amounts of raw material supplied by local farmers.

Product specialization and regional cooperation offer some scope for alleviating economy-of-scale problems (Griffith 1990; Eyzaguirre 1996). These are strategies that have a long tradition in the Caribbean.²⁵ The issue is whether they have been exploited to the fullest or whether there is still a lot of mileage to be gained from exploring these approaches further. Assuming the latter, it remains debatable whether it will be enough to offset the unfavorable economies-of-scale conditions for all Caribbean countries. The recent establishment of PROCICARIBE is a good example of enhanced regional cooperation in research, in particular because it tries to reach beyond long-standing language barriers. CARDI's declining

23. See, for example, Walmsley (1990).

24. See, for example, the homepage of the Caribbean Basin Agricultural Trade Office of the U.S. Department of Agriculture (<http://www.cbato.fas.usda.gov/>). It provides detailed analyses of consumer food markets across the region and of export opportunities for U.S. food companies.

25. The West Indies Sugar Cane Breeding Station, for example, is one of the oldest experiment stations in the world.

budget, however, indicates the opposite trend. While product specialization makes sense from an economy-of-scope perspective, it increases a country's vulnerability to changes in production and trade conditions. The WTO agreements on agriculture, which are currently being phased in, are opening up new and favorable prospects for developing country exports, but, at the same time, they threaten the region's traditional export of bananas and sugar under preferential trade schemes (Antoine 1999). While there may be new opportunities, it remains to be seen whether Caribbean countries can capture them.

Small is not beautiful when it hinders the full exploitation of the region's comparative climatic advantage in agricultural production. An alternative approach advocated by some is not to jump on the industrialization-and-globalization bandwagon, but instead to support small-scale production cum cottage industry for local consumption.²⁶ In Europe, for example, there are small but flourishing markets for regional and organic food products that largely bypass the big food processors and supermarket chains. It is an alternative that may work for some producers in certain niche markets, but it is still debatable whether such a strategy can be applied across an entire agricultural sector.²⁷ Contradictory as it may seem, the large sugar estates and industries that dominate the agricultural sectors in several Caribbean countries constitute another structural problem in reorienting agricultural production. These large, often state-owned companies lack the flexibility and entrepreneurship to diversify into new activities.

Caribbean agriculture is facing some very difficult questions regarding its future. Where does it fit in a rapidly globalizing and industrializing food system, and how will this position affect those making a living from agriculture? For some of the small and rich Caribbean countries, the answer is clear: there is no real future in agriculture (other than some home gardening) because other economic opportunities are much more promising. For most Caribbean countries, the poorer ones in particular, this is not an option as a considerable proportion of the population still depends on agriculture for its income, and, at the macro level, revenues from other economic activities are insufficient to pay for imports. Nevertheless, from the perspective of a comparative advantage, the odds are against modern agricultural production in most Caribbean countries, particularly in the smaller ones. Three policy interventions that may confront this problem come to mind: (1) reorient and restructure the economy towards other, more promising economic activities; (2) reorient and restructure agriculture towards other, more promising commodities; and (3) modernize agricultural production so that it can compete in a (more) open world market. Establishing and securing new agricultural markets both at home and abroad requires a continuous effort to stay at the competitive edge of that market. Such efforts generally include investments in agricultural R&D and technology acquisition.

Tourism seems to be the best bet for the future prosperity of the Caribbean region. It is certainly the fastest growing economic activity in the region. Several studies have pointed to the opportunities this offers to the agricultural sector. Until now, however, much of the demand for agricultural products by the tourist industry has been met by imports. In this sense, most Caribbean countries fail to fully capture the backward linkages of the tourist industry. To capture these highly demanding markets, local farmers must produce the right products, with the right quality, at the right time (preferably year-round), and at competitive prices

26. For example, by providing local producers with market space and facilities at attractive locations such as shopping malls.

27. John Vidal reported, in the British newspaper *The Guardian* (19 January 2000), that agents of Sainsbury's, a major British supermarket chain, are exploring the possibility of setting up the organic production of tropical fruits in the Caribbean. They are now considering both Grenada and St. Lucia as possible locations. Local producers will produce organically grown bananas, mangoes, coconuts, and passion fruit on a contract basis. However, there were concerns that local producers would be at a disadvantage vis-à-vis Sainsbury's when it comes to negotiating a good price.

(Springer 1999). The link between agriculture and tourism is not only one of supply. Agriculture also plays an important role when it comes to landscape, environment, and culture, all of which are important ingredients of the attractiveness of the Caribbean islands to tourists.

Recent investment trends in agricultural research give reason for concern: both research staff and research expenditure have been stagnant or declining in many parts of the Caribbean agricultural research system for the past decade. At the same time, many of the region's agricultural problems remained unresolved. Traditional export crops are not competitive enough in world markets, while diversification into new export crops develops only very slowly. Even in the local markets for food staples, local farmers are finding it increasingly difficult to compete with (cheaper) imports. As a consequence, many countries see their agricultural trade deficit widening. Policymakers in countries with relatively high R&D intensities may think that they already have more than enough invested in agricultural R&D; they may even question its profitability. At the same time, however, they need to realize that the lack of economies of scale severely reduces the impact of such investments, in terms of the technologies that are made available to farmers. The competitiveness of the agricultural sector may, therefore, remain substandard. As mentioned earlier, product specialization and regional cooperation may offset some of the economies-of-scale problems in agricultural R&D (as well as other supportive activities) encountered by smaller Caribbean countries. More important perhaps is the idea that small countries should focus on technology acquisition rather than on technology generation.

While much of the above pertains to problems that are specific to small Caribbean countries, the situation for agriculture and agricultural R&D is quite different for medium-sized countries such as Cuba, the Dominican Republic, and Haiti. Their agricultural sectors and agricultural R&D investments are less constrained by economies-of-scale factors. However, any other similarity between the three countries ends there. For Cuba, the bottleneck is not its research capacity (it has, at least on paper, the most impressive agricultural research system of the region), but how to exploit its research capacity for economic purposes. In contrast, the Dominican Republic and Haiti are both lacking in agricultural research capacity. R&D in Haiti is an uncertain and risky undertaking, given the political and economic instability of the country. Despite the enormous needs of an impoverished population, the conditions for profitable investment in R&D are very weak or nonexistent. In the Dominican Republic, the meager investment in agricultural R&D (as well as other agricultural support services) is of a different nature—it is a clear case of missed opportunities.

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Annex 1. Concepts and definitions used in data collection

Measuring National Agricultural R&D Efforts

The construction of quantitative and internationally comparable expenditure, personnel, and related measures for national agricultural research activities requires a precise idea of what is actually being measured. Since these activities are subject to a variety of interpretations, it is necessary to define very precisely the concepts used in this paper. The ASTI project's approach adheres, whenever possible, to the internationally accepted statistical procedures and definitions developed by the OECD and UNESCO for compiling R&D statistics (OECD 1994 and UNESCO 1984). For statistical purposes, we adhered to the following norms:

National. The concept of “national” research refers to all domestically targeted research activities by all public and private agencies. The research activities of supranational research agencies are excluded unless they are executed by national agencies.

Agricultural. Agricultural research includes research on crops, livestock, forestry, fisheries, the use of agricultural inputs (but not research on the development of agricultural inputs other than those originating from within agriculture), natural resources, and the socio-economic aspects of primary agricultural production. Also included is research concerning the storage and processing of agricultural products, commonly referred to as post-harvest or food-processing research. Such research usually deals with both on-farm and off-farm issues. Ideally, only the research activities dealing with on-farm storage and processing should be included, while research on off-farm issues should be attributed to the food processing industry. In practice, however, it is not always possible to make this distinction, and the off-farm component may have been included as well.

Research. Research is often performed in conjunction with other activities such as technology transfer, extension, education, and production. To the extent possible, research activities (in terms of expenditures and staff) are differentiated from these other activities. However, if non-research activities are an integral part of an institute's research activities and account for less than 20% of the resources of the institute, it is expedient to classify all the activities of the institute as research-related. Occasional or ad hoc research activities by agencies without a clear research mandate are excluded.

Institutional Classification

The Frascati Manual (OECD 1994) identifies five institutional categories of executing research agencies, three of which are relevant to this study:²⁸

Government agencies. This category includes all agencies that are controlled and financed mainly by the government. Agencies that are not directly controlled by the government, but are financed in large part by the government, are also categorized as government agencies.

28. The two institutional categories not included are “private non-profit” and “abroad.” In the 1993 version of the Frascati Manual, the former category was reduced substantially and now includes only: non-market, private, nonprofit institutions serving households; and private individuals and households. Research agencies that are not directly controlled by but receive more than 50% of their funding from government, universities, or business enterprises should be assigned accordingly. As a result, the private nonprofit category has become almost negligible as a research-executing category, although it is still a source of research funding. The institutional category “abroad” is not relevant, as the survey is restricted to “national” research.

Consequently, most national agricultural research organizations are classified as government agencies despite their “autonomous” status.

Higher education agencies. This category includes all public and private universities, colleges of technology, and other higher education institutes. Also included are all research institutes and experimental stations that are controlled directly by, administered by, or associated with higher education agencies.

Business enterprises. This category comprises the following three subcategories: (a) public enterprises, (b) private enterprises, and (c) nonprofit institutions. The first two subcategories cover all research activities undertaken within enterprises, while the third subcategory covers research activities that are undertaken in the collective interest of a group of business enterprises, and which are controlled and financed by such a collective. Within agricultural research, this subcategory includes research activities controlled and financed by commodity boards and farmer organizations. A further distinction made between private enterprises is that of national versus multinational (i.e., with at least 50% foreign ownership of capital).

Full-Time Equivalent (FTE)

A full-time-equivalent researcher is a person who holds a full-time position as a researcher during the entire year. Adjustments to full-time equivalents have been made only when (a) a research position was part-time, (b) a research position was not filled for the entire year, and (c) the position explicitly involved tasks other than agricultural research. In the latter case, an estimate was made of the time spent on agricultural research. No adjustments were made, however, for vacation or sick leave, nor for time spent on administration, meetings, travel, or other activities that form part of the normal duties required to support a research endeavor. Following this logic, professional staff in management positions were also classified as research staff. Research staff that were on study leave, but remained fully supported in terms of salaries and benefits, were also included.

The degree status of researchers is classified as follows: 3–4 years full-time university education (BSc), 5–6 years (MSc), and more than 6 years plus doctorate thesis (PhD).²⁹

Deflators and Exchange Rates

All expenditure figures were first compiled in current local currency units. In order to facilitate comparisons over time and across countries, these figures were deflated with a local GDP deflator to the base year 1993, and then converted to a common currency (U.S. dollars) using the 1993 Purchasing Power Parity (PPP) over GDP. PPPs are synthetic exchange rates that attempt to reflect the purchasing power of a country’s currency. The PPPs used here are derived from the 1999 World Development Indicators (World Bank 1999a). For additional information on currency conversion methods for the purpose of international comparisons, see Pardey, Roseboom, and Craig (1992).

Nomenclature for Tables in Text

A zero indicates an actual observation of zero, a dash indicates that an observation is not relevant (due to institutional mergers, closures, and so on), while “na” indicates an observation that is not available.

In the text, we note any marked deviations from these data compilation norms and include points of clarification when warranted.

29. Although the study programs of “ingeniero” and “licenciado” often take more than 4 years, they are classified as BSc degrees.

Annex 2. Caribbean countries, by formal status and CARICOM membership

Country	Formal status	CARICOM Membership
Anguilla	Dependent territory of the UK	Observer
Antigua and Barbuda	Independent (previously British) ^a	Member
Aruba	Autonomous status within the Kingdom of the Netherlands	Observer
Bahamas, The	Independent (previously British) ^a	Member
Barbados	Independent (previously British) ^a	Member
Belize	Independent (previously British) ^a	Member
British Virgin Islands	Independent (previously British) ^a	Associate
Cayman Islands	Dependent territory of the UK	Observer
Cuba	Independent (previously Spanish)	No
Dominica	Independent (previously British)	Member
Dominican Republic	Independent (previously Spanish)	Observer
French Guiana	Overseas department of France	No
Grenada	Independent (previously British) ^a	Member
Guadeloupe	Overseas department of France	No
Guyana	Independent (previously British)	Member
Haiti	Independent (previously French)	Provisional member
Jamaica	Independent (previously British) ^a	Member
Martinique	Overseas department of France	No
Montserrat	Dependent territory of the UK	Member
Netherlands Antilles	Autonomous status within the Kingdom of the Netherlands	Observer
Puerto Rico	Commonwealth associated with the USA (previously Spanish)	Observer
St. Kitts and Nevis	Independent (previously British) ^a	Member
St. Lucia	Independent (previously British) ^a	Member
St. Vincent and the Grenadines	Independent (previously British) ^a	Member
Suriname	Independent (previously Dutch)	Member
Trinidad and Tobago	Independent (previously British)	Member
Turks and Caicos Islands	Dependent territory of the UK	Associate
Virgin Islands (U.S.)	Unincorporated territory of the US (previously Danish)	No

Note: The Bahamas are a member of the Caribbean Community but not of the Market. Bermuda, Colombia, Venezuela, and Mexico have observer status in the CARICOM.

^a In these countries, the British monarch is still the formal head of state.

Annex 3. Names and addresses of agricultural research organizations

Antigua		
Research Division Ministry of Agriculture, Fisheries and Lands Research Station, Dunbars	St. John's Antigua	Tel: (1-268) 462-4962; 462-1213 Fax: (1-268) 462-4962
Fisheries Division Ministry of Agriculture, Fisheries, and Lands	St. John's Antigua	
CARDI - Antigua Unit	PO Box 766 St. John's Antigua	Tel: (1-268) 462-0661 Fax: (1-268) 462-1666 E-mail: cardi@candw.ag Web site: www.cardi.org/
Aruba		
Department of Agriculture, Husbandry and Fisheries Ministry of Economic Affairs and Tourism	Piedra Plat 114A Aruba	Tel: (1-297) 8-58102 Fax: (1-297) 8-55639 E-mail: dirlvvm@toaruba.com Web site: http://www.arubagricultureandfish.com/
Bahamas		
Department of Fisheries Ministry of Agriculture, Trade and Industry	PO Box N3028 Nassau Bahamas	Tel: (1-242) 393-1777; 393-1014 Fax: (1-242) 393-0328 E-mail: mbraynen@batelnet.bs
Gladstone Road Agricultural Complex, Department of Agriculture Ministry of Agriculture, Trade and Industry	PO Box N3028 Nassau Bahamas	Tel: (1-242) 361-3264 Fax: (1-242) 361-4236
Forestry Unit, Department of Lands and Surveys Office of the Prime Minister	PO Box N592 Nassau Bahamas	Tel: (1-242) 325-6581; 325-6425 Fax: (1-242) 322-5830
Caribbean Marine Research Center p/a Perry Foundation, Inc.	1501 Northpoint Parkway, Suite 101 West Palm Beach, FL 33407 USA	E-mail: cmrc@gate.net Web site: www.cmrc.org/
Barbados		
Technical Division Ministry of Agriculture, Food and Fisheries	P.O. Box 505 Bridgetown Barbados	Tel: (1-246) 428-4150 Fax: (1-246) 420-8444
CARDI - Barbados Unit P.O. Box 64	Bridgetown Barbados	Tel: (1-246) 425-1334; 425-1335 Fax: (1-246) 424-8793 E-mail: cardibds@sunbeach.net Web site: www.cardi.org/
Bellairs Research Institute McGill University, Canada	Holetown St. James Barbados	Tel: (1-246) 422-2087 Fax: (1-246) 422-0692 E-mail: bellairs@sunbeach.net Web site: www.mcgill.ca/Biology/research/bellairs.htm
Centre for Resource Management and Environmental Studies University of the West Indies	PO Box 64 Bridgetown Barbados	Tel: (1-246) 425-1310 Fax: (1-246) 425-1327
Department of Biological and Chemical Science Faculty of Science and Technology University of the West Indies	PO Box 64 Bridgetown Barbados	Tel: (1-246) 417-4322/23/24 Fax: (1-246) 417-4597; 425-1327 E-mail: bcs@uwichill.edu.bb Web site: www.uwichill.edu.bb/index.htm
Agronomic Research and Variety Testing Unit Barbados Agricultural Management Company Ltd	Groves St. George Barbados	Tel: (1-246) 433-4157 Fax: (1-246) 433-4158

Sugar Technology Research Unit Barbados Agricultural Management Company Ltd	P.O. Box 719 c Bridgetown Barbados	Tel: (1-246) 228-5005 Fax: (1-246) 426-1695 E-mail: stru@ndlc
West Indies Central Sugar Cane Breeding Station Sugar Association of the Caribbean / West Indies Sugar Cane Breeding and Evaluation Network	Groves St. George Barbados	Tel: (1-246) 433-1308 Fax: (1-246) 433-1308
Belize		
Agricultural Research Centre and Belize College of Agriculture Central Farm Ministry of Agriculture, Fisheries and Cooperatives	Cayo District Belmopan Belize	Tel: (501) 9-22131/37/39 Fax: (501) 8-22409 Web site: http://www.belize.gov.bz/
CARDI - Belize Unit	P.O. Box 2 Belmopan Belize	Tel: (501) 8-22602 Fax: (501) 8-23143 E-mail: cardi@btl.net Web site: www.cardi.org
CARICOM Fisheries Unit	PO Box 642 Belize City Belize	Tel: (501) 2-34443 Fax: (501) 2-34446 E-mail: cframp@btl.net Web site: www.caricom-fisheries.com
Marine Research Centre University College of Belize	P.O. Box 990 Belize City Belize	Tel: (501) 2-32732 Fax: (501) 2-30225 E-mail: vpalacio@ucb.edu.bz Web site: www.ucb.edu.bz/
Belize Agri-Business Company (BABCO)	P.O. Box 92 Orange Walk Belize	Tel: (501) 3-22585; 22849
Citrus Research and Education Institute Belize Citrus Growers Association (CGA)	PO Box 72; Dangriga Stann Creek Belize	Tel: (501) 5-23535 Fax: (501) 5-23511 E-mail: crei@btl.net Web site: http://www.citripro.org.bz/
R&D Unit Belize Sugar Industries Ltd	P.O. Box 29 Orange Walk District Belize	Tel: (501) 3-22150 Fax: (501) 3-23247 E-mail: bsires@btl.net
British Virgin Islands		
CARDI - British Virgin Islands Unit	PO Box 3023 Roadtown Tortola British Virgin Islands	Tel: (1-284) 495-1929 Fax: (1-284) 495-1936 E-mail: cardibvi@caribsurf.com Web site: www.cardi.org
Cuba		
Instituto de Investigaciones Fundamentales en Agricultura Tropical 'Alejandro de Humboldt' Ministerio de la Agricultura	Calle 2a esq. a 1a Santiago de las Vegas 17200 La Habana Cuba	Tel: (53) 683-4039; (53) 7-579010; 579308 Fax: (53) 7-579014 E-mail: inifat@ceniai.inf.cu
Instituto de Investigaciones en Riego y Drenaje Ministerio de la Agricultura	Apartado Postal 6090 Arroyo Naranjo Ciudad de la Habana Cuba	Tel: (53) 7-911038 Fax: (53) 7-335086
Instituto de Investigaciones en Mecanización Agropecuaria Ministerio de la Agricultura	Avenida de las 3 Palmas No. 13926 Capdevila La Habana Cuba	
Instituto de Investigaciones Porcinas Ministerio de la Agricultura	Carretera de Guatao km 1, Punta Brava Bauta La Habana Cuba	

Instituto de Suelos y Fertilizantes Ministerio de la Agricultura	Calle 150 y 21a Siboney La Habana Cuba	
Instituto de Investigaciones del Arroz Ministerio de la Agricultura	Apartado Postal 1 Bauta La Habana Cuba	Tel: (53) 7-294111 Fax: (53) 7-294275
Instituto de Investigaciones en Viandas Tropicales ('Fructuoso Rodríguez') Ministerio de la Agricultura	Apartado Postal 6 Santo Domingo Villa Clara Cuba	Tel: (53) 42-42103 E-mail: inivit@ceniai.cu
Instituto de Investigaciones de Sanidad Vegetal Ministerio de la Agricultura	Calle 110, No. 514 e/5ta B y 5ta F Municipio Playa 10600 Ciudad de la Habana Cuba	Tel: (53) 7-296189; Fax: (53) 7-240535 E-mail: inisav@ceniai.inf.cu Web site: www3.cuba.cu/ciencia/inisav
Instituto de Investigaciones en Cítricos y Frutales Ministerio de la Agricultura	La Habana Cuba	Tel: (53) 7-293585 Fax: (53) 7-246794 E-mail: iicit@ceniai.inf.cu
Instituto de Investigaciones Forestales Ministerio de la Agricultura	Calle 174, No. 1723 entre 17B y 17C Siboney, Municipio 11600 Ciudad de la Habana Cuba	Tel: (53) 7-219960; (53) 7-210501 Fax: (53) 7-335086
Instituto de Investigaciones Avícolas Ministerio de la Agricultura	Calle 15, No. 853 e/ 4 y 6 or: Loma del Cacahual Vedado/Santiago de La Habana Cuba	Tel: (53) 7-579080 Fax: (53) 7-579034; E-mail: viiacan@ceniai.inf.cu Web site: www1.cuba.cu:8084/ciencia/avicultura/
Instituto de Investigaciones de Pastos y Forrajes "Indio Hatuey" Ministerio de la Agricultura	Central España Republicana Perico Matanzas Cuba	Web site: www.mes.edu.cu/
Instituto de Investigaciones del Tabaco	Ministerio de la Agricultura Cuba	
Instituto de Investigaciones Hortícolas "Liliana Dimitrova" Ministerio de la Agricultura	Carretera Bejucal-Quivicán km 33 Quivicán Ciudad de la Habana Cuba	Tel:(53) 67-57795; (53) 66-82600 Fax:(53) 66-82601 Web site: www.2cuba.cu/POLO/centros/centros/dimitro.htm
Centro de Investigaciones para el Mejoramiento Animal Ministerio de la Agricultura	Carretera Central km 23.5, Loma de Tierra Cotorro La Habana Cuba	
Empresa Pecuaria Genética 'Los Naranjos' Ministerio de la Agricultura	Carretera Caimito a Vereda Caimito La Habana Cuba	
Grupo de Reproducción Acelerada de la Papa Ministerio de la Agricultura	Finca Torres, Carretera Aguada del Cura Boyeros Ciudad de la Habana Cuba	
Laboratorio de Investigaciones de la Nutrición y Zootecnia Aviar Ministerio de la Agricultura	Avenida 25, No.15011 e/ 150 y 152, Rpto. Barandilla Marianao Cuba	
Empresa Cubana de Productos Veterinarios Ministerio de la Agricultura	Avenida Independencia km 16 Boyeros Ciudad de la Habana Cuba	

Laboratorio de Investigaciones y Diagnóstico Avícola Ministerio de la Agricultura	Avenida. Jesús Menéndez, No. 16336, Rpto. Mulgoba Santiago de las Vegas La Habana Cuba	
Centro de Investigaciones Pesqueras Ministerio de Pesca	Barlovento, Santa Fé Playa Ciudad de la Habana Cuba	
Centro para el Desarrollo Integrado de la Caña de Azúcar Ministerio del Azúcar	Pablo Noriega Cuba	
Instituto Tecnológico de la Caña de Azúcar 'Carlos M. de Cespedes' Ministerio del Azúcar	Apartado Postal 164 Guantánamo Cuba	
Centro de Semillas e Investigaciones de Caña de Azúcar Ministerio del Azúcar	Apartado Postal 14 Jatibonico 6220055 Cuba	Tel: (53) 41-82527
Instituto Cubano de Investigaciones Azucareras Ministerio del Azúcar	Apartado Postal 10 Quivicán 33500 Ciudad de la Habana Cuba	Tel: (53) 67-55445
Instituto Nacional de Investigaciones de la Caña de Azúcar Ministerio del Azúcar	Avenida Van Troi No. 17203 Boyeros 19210 Ciudad de la Habana Cuba	
Instituto Cubano de Investigaciones de los Derivados de la Caña de Azúcar Ministerio del Azúcar	Apartado Postal 4026 San Miguel de Padrón 11000 La Habana Cuba	Tel: (53) 7-982369; 982883 Fax: (53) 7-338236 E-mail: icidca@ceniai.cu Web site: www2.cuba.cu/POLO/centros/icidca.htm
La Unión de Investigación Producción de la Celulosa del Bagazo, Cuba 9 Ministerio del Azúcar	Apartado Postal 8 Quivicán Ciudad de la Habana Cuba	Tel: (53) 67-54915; (53) 67-53455 Fax: (53) 7-333193; Web site: www.2cuba.cu/economia/bagazo/body.htm
Instituto de Investigaciones para la Industria Alimenticia Ministerio de Alimentos	Cuba	
Instituto de Investigaciones Agrícolas 'Jorge Dimitrov' Ministerio de Ciencia, Tecnología y Medio Ambiente	Apartado Postal 2140 Bayamo 85100 Granma Cuba	Tel: (53) 23-5239 E-mail: dimitrov@granma.cu
Centro de Biotecnología Vegetal Ministerio de Ciencia, Tecnología y Medio Ambiente	Apartado Postal 41 Holguín 80100 Holguín Cuba	Tel: (53) 24-481538 E-mail: cbv@cpcmho.sld.cu
Instituto Nacional de Recursos Hidráulicos Ministerio de Ciencia, Tecnología y Medio Ambiente	Monserate 258, e/Neptuno y Animas La Habana Cuba	
Instituto de Ecología y Sistemática Ministerio de Ciencia, Tecnología y Medio Ambiente	Apartado Postal 8029 Capdevila Boyeros14200/10800 La Habana Cuba	Tel: (53) 7-446927; (53) 7-446920 Fax: (53) 7-339117 E-mail: ecologia@ceniai.cu Web site: www.latinsynergy.org/inst_de_ecologia_y_Sistem
Centro de Ingeniería Genética y Biotecnología Ministerio de Ciencia, Tecnología y Medio Ambiente	Apartado Postal 6162 La Habana 10600 Cuba	Tel: (53) 7-218008; (53) 7-218675 Fax: (53) 7-218070; E-mail: postmaster@cigb.edu.cu or Web site: www.cigb.edu.cu/

Instituto de Oceanología Ministerio de Ciencia, Tecnología y Medio Ambiente	Calle 1ª No. 18406 esquina 184 y 186 Reparto Flores, Playa. 12100 Ciudad de la Habana Cuba	Tel: (53) 7-216008; (53) 7-212268; 211380; Fax: (53) 7-339112 E-mail: oceano@ceniai.cu Web site: www.ceniai.inf.cu/homepage/ciencia.html
Centro de Desarrollo Científico de Montañas Ministerio de Ciencia, Tecnología y Medio Ambiente	Matazón, Sabaneta, Cuba	
Instituto Superior de Ciencias Agropecuarias de La Habana Ministerio de Educación Superior	Autopista Nacional y Carretera de Tapaste San José de las Lajas La Habana Cuba	Tel: (53) 64-62908; (53) 64-63013; 63395 Fax: (53) 7-330942 E-mail: iscah@reduniv.edu.cu Web site: www.mes.edu.cu/
Centro Nacional de Investigaciones Científicas Ministerio de Educación Superior	Apartado Postal 6990 y 6880 Cubanacán, Playa Ciudad de la Habana Cuba	Tel: (53) 7-219446; (53) 7-336376 Fax: (53) 7-218875; E-mail: cnic@reduniv.edu.cu Web site: www.mes.edu.cu/
Instituto Nacional de Ciencias Agrícolas Instituto Superior de Ciencias Agropecuarias de la Habana	Carretera de Tapaste km 3.5 San José de Las Lajas La Habana Cuba	Tel: (53) 64-63157; (53) 64-63867 Fax: (53) 64-63773; E-mail: inca@reduniv.cu Web site: www.mes.edu.cu/
Instituto de Ciencia Animal Instituto Superior de Ciencias Agropecuarias de la Habana	Apartado Postal 24 San José de Las Lajas La Habana Cuba	Tel: (53) 62-99167; (53) 62-99433; 24773 Fax: (53) 7-335382 E-mail: ica@reduniv.edu.cu or ica@ceniai.inf.cu Web site: www.mes.edu.cu/
Centro Nacional de Sanidad Agropecuaria Instituto Superior de Ciencias Agropecuarias de la Habana	Apartado Postal 10 San José de Las Lajas La Habana Cuba	Tel: (53) 64-62752; (53) 64-63014; 63206 Fax: (53) 64-63206; E-mail: censa@reduniv.edu.cu or censa@ceniai.cu Web site: www.mes.edu.cu/
Facultad de Medicina Veterinaria Instituto Superior de Ciencias Agropecuarias de la Habana	Autopista Nacional y Carretera de Tapaste San José de Las Lajas La Habana Cuba	
Facultad de Agronomía Instituto Superior de Ciencias Agropecuarias de la Habana	Autopista Nacional y Carretera de Tapaste San José de Las Lajas La Habana Cuba	
Facultad de Mecanización de la Producción Agropecuaria Instituto Superior de Ciencias Agropecuarias de la Habana	Autopista Nacional y Carretera de Tapaste San José de Las Lajas La Habana Cuba	
Sede Universitaria del Instituto de Ciencias Agropecuarias de La Habana - Facultad de Instituto Superior de Ciencias Agropecuarias de la Habana Ministerio de Educación Superior	Nueva Gerona Isla de la Juventud Cuba	Tel: (53) 61-22409; Web site: www.mes.edu.cu/
Facultad de Ciencias Agropecuarias Universidad Central de Las Villas	Carretera de Camajuani km 5.5 Santa Clara 510100 Villa Clara Cuba	Tel: (53) 422-81178; (53) 422-81682 Fax: (53) 422-81602 E-mail: uclv@reduniv.edu.cu Web site: www.mes.edu.cu/
Sede Universitaria de la UCLV "José Martí" - Facultad de Agropecuaria Universidad Central de Las Villas	Avenida de los Mártires No. 360, esq. A Bartolomé Masó Sancti Spiritus Cuba	Tel: (53) 41-23677

Instituto de Biotecnología de las Plantas Universidad Central de Las Villas	Carretera de Camajuani km 5.5 Santa Clara 510100 Villa Clara Cuba	Tel: (53) 422-81360; (53) 422-81693 Fax: (53) 422-81410; E-mail: perez@ibp.edu.cu Web site: www.mes.edu.cu/ or www3.cuba.cu/ciencia/ibp/
Facultad Agropecuaria de Montaña Universidad Central de Las Villas	Carretera de Camajuani km 5.5 Santa Clara 510100 Villa Clara Cuba	
Centro de Estudios para el Desarrollo de la Producción Animal Universidad de Camagüey	Carretera de Circunvalación Norte km 5 Camagüey 74650 Cuba	Tel: (53) 322-61667 E-mail: uc@reduniv.edu.cu Web site: www.mes.edu.cu/
Facultad de Medicina Veterinaria Universidad de Camagüey	Carretera de Circunvalación Norte Km 5 Camagüey 74650 Cuba	Tel: (53) 322-61229, Fax: (53) 322-61126, E-mail: uc@reduniv.edu.cu Web site: www.mes.edu.cu/
Centro de Bioplantas Universidad de Ciego de Avila	Carretera de Morón km 9.5 Ciego de Avila Cuba	Fax: (53) 7-335040
Facultad de Agronomía Universidad de Ciego de Avila	Carretera de Morón km 9.5 Ciego de Avila Cuba	Tel: (53) 33-24544; (53) 33-25702; 25724 Fax: (53) 7-301365; E-mail: unica@reduniv.edu.cu Web site: www.mes.edu.cu/
Facultad de Mecanización de la Producción Agropecuaria Universidad de Ciego de Avila	Carretera de Morón km 9.5 Ciego de Avila Cuba	Tel: (53) 33-24544; Fax: (53) 7-301365; E-mail: unica@reduniv.edu.cu Web site: www.mes.edu.cu/
Facultad de Veterinaria Universidad de Granma	Carretera de Manzanillo km 17.5 Bayamo Granma Cuba	Tel: (53) 23-92130; (53) 23-92163 Fax: (53) 23-92131 Web site: www.mes.edu.cu/
Facultad de Ciencias Agrícolas Universidad de Granma	Carretera de Manzanillo km 17.5 Bayamo Granma Cuba	Tel: (53) 23-92130; (53) 23-92163 Fax: (53) 23-92131 Web site: www.mes.edu.cu/
Facultad de Farmacia y Alimentos Universidad de la Habana	Avenida 23 21425 La Lisa 13600 Ciudad de la Habana Cuba	Tel: (53) 7-213131; (53) 7-216244; 216676 Fax: (53) 7-336811 E-mail: ifal@biotec.cu or ffram@comuh.uh.cu Web site: www.uh.cu/
Facultad de Biología Universidad de la Habana	Avenida 25 455 e/ J e L Vedado La Habana Cuba	Tel: (53) 7-705896; (53) 7-783231 Fax: (53) 7-335774 E-mail: rector@red.uh.cu Web site: www.uh.cu/
Jardín Botánico Nacional Universidad de la Habana	Carretera del Rocío km 3.5 Calabazar 19230 Ciudad de la Habana Cuba	Tel: (53) 7-544096/99 Fax: (53) 7-544184 E-mail: hajb@ceniai.inf.cu Web site: www.uh.cu/
Centro de Investigaciones Marinas Universidad de la Habana	Calle 16 114 Miramar, Playa Ciudad de la Habana Cuba	Tel: (53) 7-221676 Fax: (53) 7-330807 E-mail: cim@comuh.uh.cu Web site: www.uh.cu/
Facultad de Agronomía Universidad de Matanzas "Camilo Cienfuegos"	Carretera Vía Blanca km 3.5 Matanzas Cuba	Tel: (53) 52-61013; (53) 52-61924 Fax: (53) 52-53101 E-mail: umcc@reduniv.edu.cu Web site: www.mes.edu.cu/
Facultad de Agronomía y Forestal Universidad de Pinar del Río "Hermanos Saíz"	Calle Martí 270 esq. a 27 de Noviembre Pinar del Río 20100 Pinar del Río Cuba	Tel: (53) 82-5479; 5813 Fax: (53) 82-5813 E-mail: univpr@reduniv.edu.cu Web site: www.mes.edu.cu/

Facultad de Montaña de Sabaneta Centro Universitario de Guantánamo	Guantánamo Cuba	Tel: (53) 21-325925; (53) 21-326247 Fax: (53) 21-323660 Web site: www.mes.edu.cu/
Departamento de Agronomía Centro Universitario de Las Tunas	Indalecio Pérez s/n Las Tunas Cuba	Tel: (53) 31-43362; (53) 31-45352 Fax: (53) 31-44987 E-mail: cult@reduniv.edu.cu Web site: www.mes.edu.cu/
Dominica		
Division of Fisheries Development Ministry of Agriculture, Lands and Fisheries	Dominica	Fax: (1-767) 448-0140
Research Unit, Division of Agriculture Ministry of Agriculture, Lands and Fisheries	PO Box 346 Roseau Dominica	Tel: (1-767) 448-2401; 2731 Fax: (1-767) 448-5200
CARDI - Dominica Unit	PO Box 346 Roseau Dominica	Tel: (1-767) 448-2715; 448-4715 Fax: (1-767) 448-5690 E-mail: cardi@tod.dm or cardi@cwdom.dm Web site: www.cardi.org
French Technical Cooperation Botanical Garden	Roseau Dominica	Tel: (1-767) 448-0204; 448-0456 Fax: (1-767) 448-0456
Agricultural Technical Mission of Taiwan	PO Box 362 Roseau Dominica	Tel: (1-767) 448-4250 Fax: (1-767) 449-9459
Dominican Republic		
Centro Nacional de Biotecnología Vegetal Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Santo Domingo República Dominicana	Tel: (1-809) 564-4401; 564-4402 Fax: (1-809) 564-4400 E-mail: b.castillo@codetel.net.do
Centro de Investigaciones Arroceras Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Juma Bonaó República Dominicana	Tel: (1-809) 525-2894 Fax: (1-809) 525-2893
Centro de Investigaciones Agrícolas del Sudoeste Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Apartado Postal 188 Arroyo Loro República Dominicana	Tel: (1-809) 557-3458; 696-1527 Fax: (1-809) 248-4215
Centro Nacional de Investigaciones Pecuarias Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Km 23 de la Autopista Duarte República Dominicana	Tel: (1-809) 559-8763
Centro Nordeste de Desarrollo Tecnológico Agropecuario Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Carretera Salida de Nagua, Mata Larga San Francisco de Macorís República Dominicana	Tel: (1-809) 588-8699 Fax: (1-809) 588-8699
Centro de Servicios para el Desarrollo Agropecuario Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Apartado Postal 24 San Cristóbal República Dominicana	Tel: (1-809) 528-7317 Fax: (1-809) 528-1899
Estación Experimental Hortícola de Constanza Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Calle General Luperon s/n Constanza República Dominicana	Tel: (1-809) 539-2791 Fax: (1-809) 227-1186
Centro de Investigaciones Aplicadas a Zonas Aridas Departamento de Investigaciones Agropecuarias Secretaría de Estado de Agricultura	Apartado Postal 139 El Sisal República Dominicana	Tel: (1-809) 521-3548 Fax: (1-809) 521-3094
Estación Cafetalera "La Cumbre" Departamento del Café Secretaría de Estado de Agricultura	Puerto Plata República Dominicana	
Instituto del Tabaco Departamento del Tabaco Secretaría de Estado de Agricultura	Apartado Postal 163 Santiago de los Caballeros República Dominicana	Tel: (1-809) 580-0066; 580-0038 Fax: (1-809) 580-0076

Servicios de Investigación y Desarrollo Instituto Dominicano de Tecnología Industrial	Av. Nuñez de Caceres, Esq. Oloff Palmer, Los Prados Santo Domingo República Dominicana	Tel: (1-809) 566-8121; 227-8810 Fax: (1-809) 227-8808 E-mail: indotec@codetel.net.do or indotec@aacr.net Web site: www.indotec.gov.do
Instituto Nacional de Recursos Hidráulicos	Avenida Winston Churchill, Centro de los Héroes Santo Domingo República Dominicana	Tel: (1-809) 532-3271 Fax: (1-809) 508-2741 E-mail: informacion@indrhi.gov.do Web site: www.indrhi.gov.do
Instituto Superior de Agricultura Asociación para el Desarrollo de Santiago, Inc	Apartado de Correos 166 Santiago de los Caballeros República Dominicana	Tel: (1-809) 247-2000 Fax: (1-809) 247-2626 E-mail: i.agricultura@codetel.net.do Web site: http://members.tripod.com/~isadom/index.html
Instituto Agronómico "San Ignacio de Loyola"	Calle Duarte No. 70 Dajabón República Dominicana	Tel: (1-809) 579-8229 Fax: (1-809) 579-8501
Instituto Agronómico Salesiano	Autopista Duarte Km. 3 La Vega República Dominicana	Tel: (1-809) 573-2687 Fax: (1-809) 573-3657
Instituto Polytecnico Loyola	Calle Rvdo. Padre Angel Arias 1 San Cristóbal República Dominicana	Tel: (1-809) 528-3503; 528-3504 Fax: (1-809) 528-9229
Centro de Investigaciones de Biología Marina Universidad Autónoma de Santo Domingo	Apartado Postal 191 Santo Domingo República Dominicana	Tel: (1-809) 686-3250; 698-4080 Fax: (1-809) 687-0721 E-mail: cibima@aacr.net Web site: www.aacr.net/gef/cibima/cibima.html
Facultad de Ciencias Agronómicas y Veterinarias Universidad Autónoma de Santo Domingo	Apartado Postal 1355 Santo Domingo República Dominicana	Tel: (1-809) 533-1104 Fax: (1-809) 533-1106 Web site: www.uasd.edu.do
Escuela de Medicinas Veterinarias Universidad Eugenio Maria de Hostos	Apartado Postal 2694 Santo Domingo República Dominicana	
Facultad de Ciencias Agropecuarias y Recursos Naturales Universidad Nacional 'Pedro Henríquez Ureña'	Apartado Postal 1423 Santo Domingo República Dominicana	Tel: (1-809) 562-6601; 563-1282 Fax: (1-809) 563-2529 E-mail: jespailat@unphu.edu.do Web site: www.unphu.edu.do
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Departamento de Investigaciones Agrícolas Central Romana Corporation	Oficinas Hotel Santo Domingo Sur Santo Domingo República Dominicana	Tel: (1-809) 687-7787; 689-1779 Fax: (1-809) 687-9740 E-mail: francis.redman@codetel.net.do
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División / Estación Experimental Duquesa Consejo Estatal de Azúcar (CEA)	Apartado Postal 235-9, Los Jardines Santo Domingo República Dominicana	Tel: (1-809) 533-1161; 533-2565 Fax: (1-809) 533-4822
French Guiana		
CIRAD - Guyane	BP 701 Kourou – Cedex 97387 French Guiana	Tel: (594) 327-350 Fax: (594) 327-351 Web site: www.cirad.fr

INRA - Groupe Régional de Guyane	BP 709 Kourou—Cedex 97387 French Guiana	Tel: (594) 329-300 Fax: (594) 322-318 Web site: www.inra.fr
IRD - Centre en Cayenne	IBP 165 Cayenne—Cedex 97323 French Guiana	Tel: (594) 299-261; 302-785 Fax: (594) 319-855 E-mail: postmaster@cayenne.orstom.fr Web site: www.cayenne.ird.fr
Grenada		
Agronomy Division; Pest Management Division; Veterinary and Livestock Division; Produce Chemist Laboratory Ministry of Agriculture, Lands, Forestry and Fisheries	Mt. Wheldale St. George's Grenada	Tel: (1-473) 440 2708; 440 3708 Fax: (1-473) 440 4191
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Agricultural Technical Mission of Taiwan	PO Box 740 St. George's Grenada	Tel: (1-473) 440-2391 Fax: (1-473) 440-6405 E-mail: atm@caribsurf.com
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Technical Unit Grenada Cooperative Nutmeg Association	The Carenage St George's Grenada	Tel: (1-473) 440-2312
Guadeloupe		
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INRA - Centre Antilles-Guyane	BP 1232 Pointe-a-Pitre – Cedex 97185 Guadeloupe	Tel: (590) 255-900; 942-040 Fax: (590) 255-924 Web site: www.inra.fr
Guyana		
Guyana Forestry Commission	Guyana	
National Agricultural Research Institute Ministry of Agriculture	Mon Repos Guyana	Tel: (592) 202841; 202249 Fax: (592) 204481 E-mail: nari@guyana.net.gy
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Agricultural Research Centre Guyana Sugar Corporation	LBI Estate Compound, East Coast Demerara Georgetown Guyana	Tel: (592) 273940; 266171

Haiti		
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Service de Ressources Forestales Division de Ressources Naturelles Ministère de l'Agriculture et Ressources Naturelles	Haiti	
Faculté d'Agronomie et Médecine Vétérinaire Université d'État d'Haiti	BP 1441 Port-au-Prince Haiti	Tel: (509) 222-4592; 222-4781 E-mail: famv@ht.refer.org Web site: www.ht.refer.org/haiti_ct/edu/ueh/agro/agro.htm
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Faculté d'Agriculture Université Roi Henri Christophe	BP 98 Cap Haïtien Haiti	Tel: (509) 21316
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Agricultural Research and Development Division Department of Science, Technology and Research Ministry of Agriculture	PO Box 480 Kingston 6 Jamaica	Tel: (1-876) 927-1263; 974-4714
Scientific Research Council Ministry of Commerce and Technology	P.O. Box 350 Kingston 6 Jamaica	Tel: (1-876) 927-1771; 977-2189 to 91 Fax: (1-876) 927-1990 E-mail: adminsrc@cwjamaica.com Web site: www.src-jamaica.org
Food Technology Institute Scientific Research Council	P.O. Box 350 Kingston 6 Jamaica	Tel: (1-876) 927-1771 Fax: (1-876) 977-2194 E-mail: fti@uwimona.edu.jm Web site: www.src-jamaica.org/
Food Storage and Prevention of Infestation Division Ministry of Commerce and Technology	15 Gordon Town Road Kingston 6 Jamaica	Tel: (1-876) 927-1929; 927-6816 to 20 Fax: (1-876) 977-7515 E-mail: fspid@cwjamaica.com Web site: www.mct.goc.jm/fspid/
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Centre for Marine Sciences University of the West Indies	Mona Campus, Mona Kingston 7 Jamaica	Tel: (1-876) 977-1609; 935-8276 Fax: (1-876) 927-1033 E-mail: postmaster@uwimona.edu Web site: www.uwimona.edu.jm/
Master Blend Feeds R&D Department Jamaica Broilers' Group Limited	P.O. Box 24 Old Harbour, St. Jamaica	Tel: (1-876) 983-2305; 983-2306 Fax: (1-876) 983-9241 E-mail: fhanley@cwjamaica.com
Tropical Research Station Pioneer Hi-Bred International Inc.	P.O. Box 197 Kingston 11 Jamaica	Tel: (1-876) 984-3234 Fax: (1-876) 907-1994 Web site: www.pioneer.com/
Research Department Banana Board	10 South Avenue, Kingston Gardens Kingston 4 Jamaica	Tel: (1-876) 922-2083; 5347
Citrus Growers' Association Ltd	Bog Walk Jamaica	Tel: (1-876) 708-2050/4; 985-1065; 985-1357
Research and Extension Division Cocoa Industry Board	PO Box 68 Kingston 15 Jamaica	Tel: (1-867) 923-6411/3; 923-3059
Research Unit Coconut Industry Board	PO Box 204 Kingston Jamaica	Tel: (1-876) 926-1770
Coffee Industry Board	PO Box 508 Kingston Jamaica	Tel: (1-876) 923-5850 Fax: (1-876) 923-7587 E-mail: coffeboard@jamaicacoffee.gov.jm Web site: www.jamaicacoffee.gov.jm
Sugar Industry Research Institute Sugar Industry Authority	Kendal Road Mandeville Jamaica	Tel: (1-876) 962-2241 Fax: (1-876) 962-1288
Tobacco Industry Central Authority	Jamaica	
Martinique		
CIRAD - Martinique	BP 153 Fort de France—Cedex 97202 Martinique	Tel: (596) 719-201; 511-705 Fax: (596) 600-924 Web site: www.cirad.fr
IRD - Centre Martinique	BP 8006 Fort de France—Cedex 97259 Martinique	Tel: (596) 702-872 Fax: (596) 717-316 E-mail: lordinot@outremer.com Web site: www.ird.fr
Montserrat		
CARDI - Montserrat Unit	PO Box 272 Plymouth Montserrat	Tel: (1-664) 491-4499 Fax: (1-664) 491-4485 Web site: www.cardi.org
Netherlands Antilles		
Stichting Promotie van Landbouw in de Nederlandse Antillen	Netherlands Antilles	
Caribisch Maritiem Biologisch Instituut Stichting Carmabi	PO Box 2090 Netherlands Antilles	Tel: (599) 9624-242 Fax: (599) 9627-680 E-mail: carmabi@ibm.net Web site: www.tnc.org/infield/intprograms/cdc.html
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Tropical Agriculture Research Station Agricultural Research Service United States Department of Agriculture	2200 Avenue Pedro Albizu-Campos, Suite 201 Mayagüez, PR 00680-5470 USA	Tel: (1-787) 831-3435 Fax: (1-787) 831-3386 Web site: www.ars- grin.gov/ars/SoAtlantic/Mayaguez/maya

International Institute of Tropical Forestry Forestry Service United States Department of Agriculture	PO Box 25000 Rio Piedras, PR 00928-2500 USA	Tel: (1-787) 766-5335 Fax: (1-787) 250-6924 Web site: www.fs.fed.us/global/iitf/
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Department of Marine Sciences College of Arts and Sciences University of Puerto Rico	PO Box 9013 Mayagüez, PR 00681-9013 USA	Tel: (1-787) 265-3838 Fax: (1-787) 265-5408 E-mail: cima@136.145.165.24 Web site: http://rmocfis.upr.clu.edu/~cima/
Puerto Rico Water Resources Research Institute Engineering College University of Puerto Rico	P.O. Box 9040 Mayagüez, PR 00681-9040 USA	Tel: (1-787) 265 - 3826 Fax: (1-787) 832 - 0119 E-mail: WRRRI_RUM@rumac.upr.clu.edu Web site: http://exodo.upr.clu.edu/rumhp/prwrrri/
St. Kitts-Nevis		
Crop Research Unit Department of Agriculture Ministry of Agriculture	PO Box 39 Basseterre St. Kitts-Nevis	Tel: (1-869) 465-2335; 2521 Fax: (1-869) 465-5202 E-mail: doastk@caribsurf.com
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Agricultural Technical Mission of Taiwan	PO Box 113 Basseterre St. Kitts-Nevis	Tel: (1-869) 465-2372 Fax: (1-869) 465-4356 E-mail: catmkits@caribsurf.com
Agronomy and Research Department St. Kitts Sugar Manufacturing Corporation	PO Box 96 Brassterre St. Kitts-Nevis	Tel: (1-869) 465-2337 Fax: (1-869) 465-1059
St. Lucia		
Research and Development Division Department of Agriculture Ministry of Agriculture, Land, Fisheries and Cooperatives	Waterfront, NIS Building, Block A, fifth floor Castires St. Lucia	Tel: (1-758) 452-2526 Fax: (1-758) 453-6314 E-mail: moaffl@candw.lc (min)
CARDI - St.Lucia Unit	P.O. Box 971 Castries St. Lucia	Tel: (1-758) 452-4160; 453-3317 Fax: (1-758) 453-3495 E-mail: cardi@candw.lc Web site: www.cardi.org/
French Mission for Cooperation French Embassy	Vigie Box 937 Castries St. Lucia	Tel: (1-758) 452-3988; 5697 Fax: (1-758) 453-1572
Technical Services Windward Islands Banana Development and Exporting Company Limited (WIBDECO)	Castries St. Lucia	Tel: (1-758) 452-2411; 2561; 2563 Fax: (1-758) 453-1638; 451-4601 E-mail: wibdeco@candw.lc
St. Vincent & the Grenadines		
Fisheries Division Ministry of Agriculture, Industry and Labour	St. Vincent & the Grenadines	Tel: (1-784) 456-2738 Fax: (1-784) 457-2112 E-mail: fishdiv@caribsurf.com Web site: http://www.vincy.com/fisheries/
Research and Development Unit Ministry of Agriculture, Industry and Labour	Richmond Hill Kingstown St. Vincent & the Grenadines	Tel: (1-784) 456-1410 Fax: (1-784) 457-1688
Reef and Pelagic Fishes Regional Assessment Centre CARICOM Fisheries Resource Assessment and Management Program	Tyrell Street Kingstown St. Vincent and the Grenadines	Tel: (809) 457 1904 Fax: (809) 457 2414 Web site: www.caricom-fisheries.com/

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Afdeling Visserijonderzoek en Statistiek Departement van Visserij Ministerie van Landbouw, Veeveelt and Visserij	Anton Dragsenweg Paramaribo Surinam	Tel: (597) 477-641 Fax: (597) 477-641
Departement van Veehouderij Ministerie van Landbouw, Veeveelt and Visserij	Abattoirstraat; Beekhuizen Paramaribo Surinam	Tel: (597) 402-329 Fax: (597) 404-407 E-mail: veeveelt@cq-link.sr
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Kweekafdeling / Rijstonderzoek- en Teeltstation Stichting Machinale Landbouw (SML) Ministerie van Landbouw, Veeveelt and Visserij	Hoofdweg 1 Wageningen Surinam	Tel: (597) 233-111 Fax: (597) 233-000
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Dienst 's Lands Bosbeheer Ministerie van Natuurlijke Hulpbronnen en Energie	Cornelis Jongbawstraat 10-12 Paramaribo Surinam	Tel: (597) 476-118 Fax: (597) 410-256
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SURLAND Banana Company	Surinam	

Trinidad & Tobago

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Institute of Marine Affairs	PO Box 3160 Carenage Trinidad & Tobago	Tel: (1-868) 634-4291 Fax: (1-868) 634-4433 E-mail: infocentre@ima.gov.tt or ima.carib@link.net Web site: www.unesco.org/oc/states/trinidad/ima.html
Research Division / Central Experiment Station Ministry of Agriculture, Land and Marine Resources	Arima P.O. Centeno Trinidad & Tobago	Tel: (1-868) 646-4334 Fax: (1-868) 646-1646
Forestry Division Ministry of Agriculture, Land and Marine Resources	Long Circular Road St. James Trinidad & Tobago	Tel: (1-868) 662-4521; 662-3217 Fax: (1-868) 628-5503
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T&T Field Office CARICOM Fisheries Unit	P.O. Box 3150 Carenage Trinidad & Tobago	Tel: (1-868) 634-4528 Fax: (1-868) 634-4549 E-mail: tphilips@wow.net or renton@tsst.net.tt Web site: www.caricom-fisheries.com/
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Caroni Sugarcane Feeds Centre Caroni (1975) Ltd	Trinidad & Tobago	
Caroni Research Station Caroni (1975) Ltd	Waterloo Road Carapichaima Trinidad & Tobago	Tel: (1-868) 673-0027; 673-0028 Fax: (1-868) 673-0373 E-mail: research@tsst.net.tt

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Agricultural Experiment Station University of the Virgin Islands	RR-02, Box 10,000 Kingshill St. Croix, VI 00851 USA	Tel: (1-340) 692-4020 Fax: (1-340) 692-4035 Web site: http://rps.uvi.edu/AES/aes_home.html
The William P. MacLean Marine Science Center University of the Virgin Islands	2 John Brewers Bay St. Thomas, VI 00802 USA	Tel: (1-809) 693-1381 Fax: (1-809) 693-1385 E-mail: jbattey@uvi.edu Web site: www.uvi.edu/MarSci/index.html
Water Resources Research Institute University of the Virgin Islands	PO Box 9990 St. Thomas, VI 00802-9990 USA	Tel: (1-340) 693-1020 Fax: (1-340) 693-1025 E-mail: hsmith@uvi.edu Web site: http://rps.uvi.edu/WRRI/wrri.htm
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Annex 4. Institutional overview of agricultural research organizations in the Caribbean

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
Antigua and Barbuda					
Government-local	Ministry of Agriculture, Fisheries and Lands	Research Division	crops, livestock	cotton, fruit, vegetables, small ruminants, cattle	2.0
		Fisheries Division	fishery		1.0
Government-regional	CARDI	Antigua Unit	crops, livestock	vegetables, small ruminants	4.0
Aruba (NL)					
Government-local	Ministry of Economic Affairs and Tourism	Department of Agriculture, Husbandry and Fisheries	crops, livestock, fisheries, NRM	dryland agriculture, horticulture, small ruminants, pigs, marine resources	1.0
Bahamas					
Government-local	Ministry of Agriculture, Trade and Industry	Department of Agriculture-Gladstone road Agricultural Complex	crops, livestock, post-harvest	vegetables, bananas, fruit, root crops, pigs, animal health, small ruminants	16.0
		Department of Fisheries	fishery		1.0
	Office of the Prime Minister	Department of Lands and Surveys, Forestry Section	forestry		0.2
Government-bilateral	Govt. of Taiwan	Agricultural Technical Mission	crops, livestock, fishery	vegetables, ornamentals, pigs, shrimps	8.0
Barbados					
Government-local	Ministry of Agriculture, Food and Fisheries	Technical Division	crops, livestock, NRM	cotton, vegetables, ornamentals, fruit, root crops, small ruminants, cattle	26.0
Government-regional	CARDI	Barbados Unit	crops, livestock	vegetables, ornamentals, root crops, sugar cane, small ruminants, cattle, poultry	5.0
Higher education	University of the West Indies	Faculty of Science and Technology, Department of Biological and Chemical Sciences	crops		1.9
		Centre for Resource Management and Environmental Studies	NRM		6.0
	McGill University (Canada)	Bellairs Research Institute	fishery, NRM		0.0
Business enterprises-nonprofit	Sugar Association of the West Indies	West Indies Central Sugar Cane Breeding Station	crops	sugar cane	5.0
Business enterprises-public	Barbados Agricultural Management Company Ltd.	Sugar Technology Research Unit	post-harvest	sugar products	1.0
		Agronomic Research and Variety Testing Unit	crops	sugar cane	3.0
Belize					
Government-local	Ministry of Agriculture, Fisheries and Cooperatives	Central Farm Agricultural Research Station	crops	vegetables, rice, roots crops, cattle, pigs	2.7

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
Government-regional	CARDI	Belize Unit	crops	rice, other	2.0
	CARICOM	CARICOM Fisheries Unit	fisheries		9.0
Government-bilateral	Govt. of Taiwan	Agricultural Technical Mission			na
Higher education	University College of Belize	Marine Research Centre	fishery, NRM		0.5
	Ministry of Agriculture, Fisheries and Cooperatives	Belize College of Agriculture			0.0
Business enterprises-nonprofit	Belize Citrus Growers Association	Citrus Research and Education Institute	crops	citrus fruit	4.2
Business enterprises-private	Belize Sugar Industries Ltd (BelSIL)	Research Centre for Sugar Cane	crops, post-harvest	sugar cane	2.0
	Belize Agri-Business Company (BABCO)	Research Program	crops, post-harvest	fruit	3.0
British Virgin Islands					
Government-regional	CARDI	BVI Unit	crops, livestock	vegetables, fruit, small ruminants	1.0
Cuba					
Government-local	Ministerio de la Agricultura	Centro de Investigaciones para el Mejoramiento Animal	livestock		
		Empresa Cubana de Productos Veterinarios	livestock	animal health	
		Empresa Pecuaria Genética 'Los Naranjos'	livestock		
		Grupo de Reproducción Acelerada de la Papa	crops	potatoes	
		Instituto de Investigaciones Avícolas	livestock	poultry	
		Instituto de Investigaciones de Pastos y Forrajes 'Indio Hatuey'	crops	animal feed	
		Instituto de Investigaciones de Sanidad Vegetal	crops	plant protection	
		Instituto de Investigaciones de Vandas Tropicales 'Fructuoso Rodríguez'	crops	roots and tubers	
		Instituto de Investigaciones del Arroz	crops	rice	
		Instituto de Investigaciones del Tabaco	crops	tobacco	
		Instituto de Investigaciones en Cítricos y Frutales	crops	(citrus) fruits	
		Instituto de Investigaciones en Mecanización Agropecuaria	other	agricultural mechanization	
		Instituto de Investigaciones en Riego y Drenaje	other	irrigation and drainage	
		Instituto de Investigaciones Forestales	forestry		
		Instituto de Investigaciones Fundamentales en Agricultura Tropical 'Alejandro de Humboldt'	crops		
		Instituto de Investigaciones Hortícolas 'Liliana Dimitrova'	crops	horticulture	

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
		Instituto de Investigaciones Porcinas	livestock	pigs	
		Instituto de Suelos y Fertilizantes	NRM	soils, fertilizer	
		Laboratorio de Investigaciones de la Nutrición y Zootecnia Aviar	livestock	animal feed	
	Ministerio del Azúcar	Laboratorio de Investigaciones y Diagnóstico Avícola	livestock	poultry	
		Centro para el Desarrollo Integrado de la Caña de Azúcar	crops	sugar cane	
		Centro de Semillas e Investigaciones de Caña de Azúcar	crops	sugar cane	
		Instituto Cubano de Investigaciones Azucareras	post-harvest	sugar products	
		Instituto Cubano de Investigaciones de los Derivados de la Caña de Azúcar	post-harvest	sugar products	
		Instituto Nacional de Investigaciones de la Caña de Azúcar	crops	sugar cane	
		Instituto Tecnológico de la Caña de Azúcar 'Carlos M. de Cespedes'	crops	sugar cane	
		La Unión de Investigación Producción de la Celulosa del Bagazo, Cuba 9	post-harvest		
	Ministerio de Pesca	Centro de Investigaciones Pesqueras	fishery		
	Ministerio de Alimentos	Instituto de Investigaciones de la Industria Alimenticia	post-harvest		
	Ministerio de Ciencia, Tecnología y Medio Ambiente	Centro de Biotecnología Vegetal	crops	biotechnology	
		Centro de Desarrollo Científico de Montañas	other		
		Centro de Ingeniería Genética y Biotecnología	crops	biotechnology	
		Instituto de Ecología y Sistemática	NRM		
		Instituto de Investigaciones Agrícolas 'Jorge Dimitrov'			
		Instituto de Oceanología	fishery, NRM		
		Instituto Nacional de Recursos Hidráulicos	NRM		
Higher education	Ministerio de Educación Superior	Centro Nacional de Investigaciones Científicas	biotechnology, NRM		
	Instituto Superior de Ciencias Agropecuarias de la Habana	Centro Nacional de Sanidad Agropecuaria	livestock; NRM	veterinary and human medicine, integrated pest management, biological control, diagnostics	
		Instituto Nacional de Ciencias Agrícolas	crops		
		Instituto de Ciencia Animal	livestock		
		Facultad de Agronomía	crops		

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
		Facultad de Medicina Veterinaria	livestock	animal health	
		Facultad de Mecanización de la Producción Agropecuaria	other	agricultural mechanization	
		Sede Universitaria del Instituto de Ciencias Agropecuarias de La Habana – Facultad de Agropecuaria	agriculture		
	Centro Universitario de Guantánamo	Facultad de Montaña de Sabaneta	other		
	Centro Universitario de Las Tunas	Departamento de Agronomía	crops		
	Universidad Central de Las Villas	Facultad de Ciencias Agropecuarias	crops, livestock		
		Instituto de Biotecnología de las Plantas	crops	biotechnology	
		Sede Universitaria de la UCLV 'José Martí' - Facultad de Agropecuaria	crops, livestock		
	Universidad de Camagüey	Centro de Estudios para el Desarrollo de la Producción Animal	livestock		
		Facultad de Medicina Veterinaria	livestock	animal health	
	Universidad de Ciego de Avila	Facultad de Agronomía	crops		
		Facultad de Mecanización de la Producción Agropecuaria	other	agricultural mechanization	
		Centro de Bioplantas	crops	biotechnology	
	Universidad de Granma	Facultad de Ciencias Agrícolas	crops, livestock		
		Facultad de Veterinaria	livestock	animal health	
	Universidad de la Habana	Centro de Investigaciones Marinas	fishery, NRM		
		Facultad de Biología	crops, livestock, NRM		
		Facultad de Farmacia y Alimentos	other		
		Jardín Botánico Nacional	other		
	Universidad de Matanzas 'Camilo Cienfuegos'	Facultad de Agronomía	crops		
	Universidad de Pinar del Río 'Hermanos Saíz'	Facultad de Agronomía y Forestal	crops, forestry		
Dominica					
Government-regional	CARDI	Dominica Unit	crops, post-harvest	root crops, fruit, vegetables, ornamentals	5.0
Government-bilateral	Govt. of Taiwan	Agricultural Technical Mission	crops, fishery	fruit, vegetables	5.0
	Govt. of France	French Technical Cooperation	crops, livestock, NRM, post-harvest	fruit, vegetables, ornamentals, pigs, small ruminants	1.0
Dominican Republic					
Government-local	Secretaría de Estado de Agricultura - Departamento de Investigaciones Agropecuarias	Centro Nordeste de Desarrollo Tecnológico Agropecuario	crops, post-harvest	cacao, other	13.0
		Centro de Servicios para el Desarrollo Agropecuario	crops	fruit, vegetables, bananas, root crops	38.0

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
		Centro Nacional de Investigaciones Pecuarías	livestock	animal feed	6.0
		Centro de Investigaciones Aplicadas a Zonas Áridas	crops	bananas, vegetables, root crops, fruit	9.0
		Centro de Investigaciones Agrícolas del Sudoeste	crops		12.0
		Centro de Investigaciones Arroceras	crops	rice	18.0
		Centro Nacional de Tecnología Apropriada	other	agricultural mechanization	3.0
		Centro Nacional de Biotecnología Vegetal	crops	biotechnology	1.0
		Estación Experimental Hortícola de Constanza	crops	horticulture	2.0
	Secretaría de Estado de Agricultura - Departamento del Tabaco	Instituto del Tabaco	crops	tobacco	3.0
	Secretaría de Estado de Agricultura - Departamento del Café	Estación Cafetalera "La Cumbre"	crops	coffee	3.0
	NA	Instituto Nacional de Recursos Hidráulicos	NRM	water	2.0
	Banco Central de la República Dominicana	Instituto Dominicano de Tecnología Industrial – Servicios de Investigación y Desarrollo	fishery, post-harvest		12.0
Higher education	Universidad Autónoma de Santo Domingo	Facultad de Ciencias Agronómicas y Veterinarias	crops, livestock	animal health	17.0
		Facultad de Ciencias - Centro de Investigaciones de Biología Marina	fishery, NRM		14.0
	NA	Instituto Superior de Agricultura	crops, livestock, forestry, NRM	vegetables, rice, bananas, poultry, cattle, small ruminants, pigs	6.0
	Universidad Nacional 'Pedro Henríquez Ureña'	Facultad de Ciencias Agropecuarias y Recursos Naturales	crops, livestock, NRM	fruit, vegetables, ornamentals, cattle, small ruminants, poultry	2.0
	Universidad Nordestrana	Facultad de Agricultura			na
	Universidad Eugenio María de Hostos	Escuela de Medicinas Veterinarias	livestock	animal health	na
	NA	Instituto Agronómico Salesiano	crops		na
	NA	Colegio Agrícola San Ignacio de Loyola	crops		na
	NA	Instituto Politécnico Loyola	crops	bananas, vegetables	3.0
Business enterprises-public	Consejo Estatal del Azúcar	División / Estación Experimental Duquesa	crops	sugar cane	0.0
Business enterprises-private	Central Romana Corporation	Departamento de Investigaciones Agrícolas	crops	sugar cane	14.0
French Guiana (France)					
Government-bilateral	CIRAD	Guyane Centre	crops, livestock, forestry	rice, cacao, coffee, fruit, animal feed	30.0
	INRA	Centre Antilles-Guyana – Unité de Recherches Forestières	forestry		5.0
	IRD	Centre à Cayenne	NRM		34.4
Grenada					

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
Government-local	Ministry of Agriculture, Lands, Forestry and Fisheries	No specific research units, research activities spread over various divisions			0.5
Government-regional	CARDI	Grenada Unit	crops, other	fruit, vegetables	4.0
Government-bilateral	Govt. of France	French Agricultural Mission			na
	Govt. of Taiwan	Agricultural Technical Mission	crops	fruit, vegetables, ornamentals	2.5
Business enterprises-nonprofit	Grenada Cooperative Nutmeg Association	Technical Unit	crops	nutmeg	na
	Grenada Cocoa Association	Technical Department	crops	cocoa	0.5
Guadeloupe (France)					
Government-bilateral	CIRAD	Centre Guadeloupe	crops, livestock	sugar cane, bananas, fruit, animal health	38.0
	INRA	Centre Antilles-Guyana	crops, livestock, NRM, post-harvest	vegetables, root crops, fruit, cattle, small ruminants, pigs	59.2
Guyana					
Government-local	Ministry of Agriculture	National Agricultural Research Institute	crops, livestock, NRM, post-harvest	root crops, fruit, vegetables, bananas, cattle, small ruminants, poultry	32.0
	Office of the President	Institute of Applied Science and Technology			na
	NA	Guyana Forestry Commission	forestry		3.0
Government-regional	CARDI	Guyana Unit	crops, livestock, NRM	rice, fruit, other, cattle, small ruminants	8.0
Higher education	University of Guyana	Faculty of Agriculture			6.0
Business enterprises-nonprofit	Guyana Rice Development Board	Burma Rice Research Station	crops	rice	14.0
Business enterprises	Guyana Sugar Corporation	Agricultural Research Center	crops	sugar	17.5
	Livestock Development Company		livestock		na
Haiti ^e					
Government-local	Ministère de l'Agriculture et Ressources Naturelles	Centre de la Recherche et Documentation Agronomique	other		
		Division de Ressources Naturelles, Service de Ressources Forestales	forestry		
	Organisation de Développement de la Plaine du Nord				
	Organisation de Développement de la Vallée de l'Arbonite				
	Projet de Développement Régional Intègre de l'Asille				
	Organisation de Développement de la Plaine des Gonaïves				
Higher education	Université d'État d'Haïti	Faculté d'Agronomie et Médecine Vétérinaire	crops, livestock	animal health	
	Université Quisqueya	Faculté d'Agriculture et les Environs	crops, livestock, NRM		
	Université Roi Henri Christophe	Faculté d'Agriculture			

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
Jamaica					
Government-local	Ministry of Agriculture, Department of Science, Technology and Research	Agricultural Research and Development Division			22.0
	Ministry of Commerce and Technology	Food Storage and Prevention of Infestation Division	other		1.0
		Scientific Research Council (incl. Food Technology Institute)	post-harvest		15.3
Government-regional	CARDI	Jamaica Unit	crops, livestock, NRM	coffee, small ruminants	9.0
Higher education	University of the West Indies	Faculty of Pure and Applied Sciences, Department of Life Sciences	crops, forestry, fishery, NRM	root crops, vegetables, ornamentals	12.5
		Centre of Biotechnology	crops	biotechnology	3.5
		Centre of Marine Sciences	fishery, NRM		na
		Centre for Environment and Development	NRM		na
Business enterprises-nonprofit	Banana Board	Research Department	crops	banana	4.0
	Cocoa Industry Board	Research and Extension Division	crops	cocoa	3.0
	Coconut Industry Board	Research Unit	crops	coconut	4.0
	Coffee Industry Board	(subcontracts research)	crops	coffee	0.0
	Sugar Industry Authority	Sugar Industry Research Institute	crops, post-harvest	sugar cane	13.0
	Tobacco Industry Central Authority	NA	crops	tobacco	1.0
	Citrus Growers Association Limited	NA	crops	citrus	2.0
Business enterprises-private	Pioneer Hi-Bred International Inc.	Tropical Research Station	crops	maize	1.0
	Jamaica Broilers Group Ltd	Master Blend Feeds R&D Department	livestock	animal feed	3.0
	Alcan Jamaica Company	NA	livestock	dairy	2.0
Martinique (France)					
Government-bilateral	CIRAD	CIRAD – Martinique	crops	bananas, fruit, vegetables, ornamentals	27.0
	IRD	Centre en Martinique	NRM		5.0
Montserrat (UK)					
Government-regional	CARDI	Montserrat Unit			0.0
Netherlands Antilles (NL)					
Government-local	Caribbean Marine Biological Institute Foundation		fishery, NRM		0.0
	Foundation for the Promotion of Agriculture in the Netherlands Antilles				0.0
Puerto Rico (US)					
Government-bilateral	Agricultural Research Service, USDA	Tropical Agriculture Research Station	crops	fruit, other	9.0
	Forestry Service, USDA	International Institute of Tropical Forestry	forestry		na
Higher education	University of Puerto Rico	College of Agricultural Sciences and State Agricultural Experiment Station	crops, livestock	fruit, vegetables, bananas, coffee, sugar cane, rice, ornamentals, cattle, pigs, poultry	45.1

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
		College of Arts and Sciences: Department of Marine Sciences	fishery, NRM		13.0
		Engineering College: Puerto Rico Water Resources Research Institute	NRM	water	2.0
St. Kitts-Nevis					
Government-local	Ministry of Agriculture	Crops Research Unit, Department of Agriculture	crops	vegetables, root crops	2.0
Government-regional	CARDI	St. Kitts Unit	crops	vegetables, root crops	1.0
Government-bilateral	Govt. of France	French Technical Mission			na
	Govt. of Taiwan	Agricultural Technical Mission	crops	rice, vegetables	1.0
Business enterprises	St. Kitts Sugar Manufacturing Corporation	Agronomy and Research Department	crops, post-harvest	sugar cane	1.0
St. Lucia					
Government-local	Ministry of Agriculture, Land, Fisheries and Cooperatives	Research and Development Division, Department of Agriculture			na
Government-regional	CARDI	St. Lucia Unit	crops, livestock	vegetables, fruit, root crops, bananas, small ruminants	2.0
Government-bilateral	Govt. of France	French Mission for Cooperation			na
	Govt. of Taiwan	Agricultural Technical Mission (closed in 1999)			na
Business enterprises-public/private	Windward Islands Banana Development and Exporting Company Ltd	Technical Services Division	crops	bananas	5.0
St. Vincent and the Grenadines					
Government-local	Ministry of Agriculture, Industry and Labour	Research and Development Unit			2.0
		Fisheries Division	fishery		0.0
Government-regional	CARDI	St. Vincent Unit			1.0
Government-bilateral	CARICOM Fisheries Unit	Regional Assessment Centre	fishery, NRM		
	Govt. of France	French Agricultural Mission	crops, fisheries, NRM, post-harvest	vegetables	3.0
	Govt. of Taiwan	Agricultural Technical Mission	crops, livestock	fruit, vegetables, ornamentals, pigs	8.0
Suriname					
Government-local	Ministry of Agriculture, Livestock and Fisheries	Agronomy and Horticulture Department: Agricultural Experiment Station	crops	fruit, vegetables	5.0
		Agronomy and Horticulture Department: Palm Research Center	crops	coconut	1.0
		Livestock Department	livestock	cattle	1.0
		Fisheries Department: Section Fisheries Research and Statistics	fisheries		1.0
	Ministry of Natural Resources and Energy	National Forest Service	forestry		na
	Foundation for Rice Research in Suriname	Rice Research Center "Anne van Dijk"	crops	rice	2.0

Country/Category ^a	Supervising agency	Department / Institute	Research focus ^b	Researched items ^c	Res. staff ^d
Higher education	Foundation for the Mechanization of Agriculture	Rice Research and Breeding Station	crops	rice	1.0
		Station for Applied Rice Research	crops	rice	1.0
	University of Suriname	Department of Agriculture, Faculty of Technological Sciences	crops	vegetables	1.5
		Center for Agricultural Research in Suriname	crops, forestry		1.0
Trinidad and Tobago					
Government-local	Ministry of Agriculture, Land and Marine Resources	Research Division	crops, livestock, post-harvest	vegetables, ornamentals, rice, fruit, cacao, coffee, root crops, cattle, pigs	60.0
		Animal Production and Health Division: Veterinary Diagnostic Laboratory	livestock	animal health	0.0
		Forestry Division	forestry		2.0
		Fisheries Division: Marine Fisheries Analysis Unit	fishery		8.0
	Ministry of Finance	Caribbean Industrial Research Institute	post-harvest, other	agricultural mechanization	17.0
Government-regional	Office of the Prime Minister	Institute of Marine Affairs	fishery, NRM		37.0
	CARDI	T&T Unit	crops, livestock	vegetables, ornamentals, small ruminants	7.0
	CARICOM Fisheries Unit	T&T Field Office	fishery, NRM		na

Sources: Questionnaire returns and various reports listed in annex 5.

^a Research organizations have been classified into three major institutional categories: government, higher education, and business enterprises. Government agencies have been further differentiated into local, bilateral, and regional government agencies. Research agencies owned and financed by business enterprises have been differentiated according to public or private ownership, while research agencies operating on the collective behalf of a particular industry have been classified as business enterprises- nonprofit.

^b The following broad research focus categories have been used: crops, livestock, forestry, fishery, NRM, post-harvest, and other.

^c Covers only crop and livestock research.

^d Measured in terms of full-time equivalent researchers.

^e Incomplete listing.

Annex 5. Data sources for agricultural research expenditure and staffing data

In addition to data obtained through our survey (source code 2000), we consulted and used a large number of other sources. Only references from which we actually used data are listed. The source codes correspond with the source codes reported in the electronic data files.

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Produced by ISNAR Publications Services

Text editor: Oona Paredes

Layout: Bob van Duuren

Printer: Rapporten Service Drukkerij B.V., Rijswijk, The Netherlands

ISSN 1021-4429
ISBN 92-9118-056-4

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