



Global Environmental Change and Food Systems

Caribbean Science Plan and Implementation Strategy

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Table of Contents

Executive Summary	4
1 Caribbean Food Security and Global Environmental Change.....	5
1.1 Caribbean food security, GEC and the policy context.....	5
1.2 GEC in the Caribbean.....	8
1.3 Integrating GEC science within regional development policy	8
1.4 Research challenges	9
2 Caribbean Research in the GECAFS Context	10
2.1 The need for a GECAFS Caribbean regional project.....	10
2.2 GECAFS-Caribbean project planning.....	11
2.3 GECAFS-Caribbean in relation to regional food security initiatives	12
3 GECAFS-Caribbean Goal & Research Agenda.....	14
3.1 Goal.....	14
3.2 Overarching GECAFS-Caribbean research questions and conceptual framework	14
3.3 Research questions for food security and environmental management.....	15
3.3.1 Vulnerability of food systems to GEC (re Q1)	15
3.3.2 Adaptation (re Q2)	16
3.3.3 Feedbacks (re Q3).....	16
3.4 Caribbean science in the context of GECAFS conceptual research	17
3.4.1 Research on vulnerability of food systems to GEC	17
3.4.2 Regional scenarios for GECAFS studies.....	17
3.4.3 Decision support research.....	17
4 GECAFS-Caribbean Implementation Strategy	19
4.1 Focussed Studies	19
4.2 Regional scientific networking and endorsing research.....	20
4.3 Regional Synthesis and Integration	20
4.4 Building science-policy interfaces	20
4.5 Phased Approach.....	21
4.5.1 Phase I implementation (1.5 years)	21
4.5.2 Phase II implementation (3 years).....	21
4.5.3 Phase III implementation (0.5 years)	22

4.6	Communications strategy.....	23
4.7	Capacity development	23
4.8	Linking GECAFS-Caribbean research with GECAFS international networks	23
4.9	Links to IGBP, IHDP & WCRP Core and ESSP Joint Projects	24
5	GECAFS-Caribbean Funding Strategy and Governance	26
5.1	Funding strategy and indicative budget	26
5.2	Governance.....	26
5.2.1	Regional Coordinating Committee.....	26
5.2.2	GECAFS-Caribbean regional coordinator.....	27
5.2.3	Host Institution.....	27
6	Conclusions	28
	Annex 1 Global Environmental Change and Food Systems (GECAFS): A summary	29
	Annex 2 Developing a GECAFS research agenda for the Caribbean.....	30
	Annex 3 Examples of regional research relevant to the GECAFS-Caribbean agenda.....	32
	Annex 4 Acknowledgements.....	35
	Annex 5 Acronyms and abbreviations	37
	Annex 6 References	39

Executive Summary

Social, economic and political factors are increasing food insecurity in the Caribbean. Changes in the environment (Global Environmental Change, GEC) are further complicating what is already a food insecure situation for many. The technical and policy interventions required to prevent the region's food security from worsening (and therefore becoming even more dependent on extra-regional food supplies) need to take account of GEC. Interventions must consider three issues: (i) how GEC will further complicate food security across the region; (ii) the feasibility of policy and technical adaptation options at regional, national and local levels; and (iii) the socioeconomic and environmental consequences of different adaptation options designed to improve food security.

A three-year consultation and planning exercise identified the need for, and necessary components of, an integrated research endeavour on the links between Caribbean food security and GEC. The exercise, organised by the international research project "Global Environmental Change and Food Systems" (GECAFS), involved a diverse group of regional researchers, and regional and international organisations and donors. This Plan for a GECAFS Caribbean project (GECAFS-Caribbean) represents the culmination of this effort.

Recognising and building upon ongoing national and regional GEC and food security research, the Plan provides a strategy to deliver policy-relevant information about the interactions between GEC and the food systems that underpin food security. Research to be conducted under the Plan will contribute to a number of major food security initiatives in the region and support both local interests and those of major regional activities (e.g. CARICOM Secretariat, IICA, FAO). The research will constitute an integral component of the internationally-endorsed GECAFS agenda.

GECAFS-Caribbean research will seek to identify the social and geographical distributions of vulnerability of the region's food systems to GEC in the context of other stresses. Based on these new insights research will determine how, when and where adaptations of food systems to reduce their vulnerability to GEC can be instituted in line with long-term national and regional developmental goals. It will also assess the long-term social and environmental consequences of different adaptation measures adopted to enhance regional food security.

In addition to addressing regional priorities, the research proposed in this document is also fully consistent with the

international GECAFS conceptual and methodological research agenda and will be networked with other GECAFS research worldwide.

GECAFS-Caribbean will be implemented over five years via:

- (i) designing and launching a small number of Focussed Studies, each addressing the food systems questions relating to GEC vulnerability and impacts, adaptation options and feedbacks;
- (ii) Regional Scientific Networking to link GECAFS Focussed Studies with other relevant research in the region and internationally;
- (iii) Regional Synthesis and Integration to add value to individual research endeavours; and
- (iv) building Science-Stakeholder Interfaces to link national researchers with policymakers, the private sector, civil society and representatives of regional food security programmes.

Research will be organised into defined phases with clear outputs at each stage. When integrated, outputs will provide policy-relevant information at local, national and regional levels with the communications strategy underpinned by stakeholder engagement at all research stages. Research capacity will be developed by collaborative undertakings within the international GECAFS project.

GECAFS-Caribbean Focussed Studies will apply for funding from regional and international sources, making reference to this Plan. Coordination funds will be raised to cover regional networking and synthesis activities, the science-policy interface and research management. A GECAFS-Caribbean Regional Coordinating Committee (RCC) will be established and a Regional Coordinator appointed. The RCC will provide scientific oversight of GECAFS-Caribbean, supported by the Regional Coordinator.

The GECAFS-Caribbean Science Plan and Implementation Strategy provides an innovative and timely research framework on improving regional food security in the context of environmental stress. This is an issue of growing importance for the region.

1 Caribbean Food Security and Global Environmental Change

Social, economic and political factors are increasing food insecurity in the Caribbean. Changes in the environment (Global Environmental Change, GEC) are further complicating what is already a food insecure situation for many.

The technical and policy interventions required to prevent the region's food security from becoming even more dependent on extra-regional food supplies need to take account of GEC. Interventions must consider three issues:

(i) how GEC will further complicate food security across the region; (ii) the feasibility of policy and technical adaptation options at both regional and local levels; and (iii) the socioeconomic and environmental consequences of different adaptation options designed to improve food security.

1.1 Caribbean food security, GEC and the policy context

Food security is the state achieved when food systems operate such that 'all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life' (FAO, 1996). Multiple factors converge in the Caribbean to undermine this state, creating food insecurities throughout the region. Some originate within the region while other factors are largely exogenous and beyond the immediate influence of policies invoked by Caribbean nations. The many small, often low-lying nation states (mainly islands) in the region are regularly exposed to environmental stresses including flooding, hurricanes and droughts. Many countries in the region rely heavily on staple food imports to meet food demands, and recent trends in food preferences have increased demand for non-traditional foods and highly processed foods. Overall, the region now imports about 70% of its food, exceeding US\$2 billion for 2004 (FAOSTAT, 2006). A few key export crops (mainly sugar, bananas) and, more recently, tourism are major sources of foreign currency and employment opportunities that support food purchases. However, the loss of preferential export markets and tourism's susceptibility to external shocks continually challenge food security in the region. In 2002, agricultural imports in Jamaica exceeded agricultural exports by US\$135 million; per capita, some countries (e.g. Barbados) would have a larger deficit. Furthermore, the region's diverse cultural, economic and political history has resulted in uneven

development, and weak national- and regional-level institutional connectivity also jeopardize food security in many Caribbean countries.

Key factors contributing to food insecurity in the Caribbean include: (i) declines in productivity of land, labour and management in the agricultural sector, resulting in a weakened capacity to supply food competitively; (ii) declines in earnings from traditional crops, resulting in a reduced ability to purchase food on the world market; (iii) the erosion and impending loss of trade preferences for traditional export crops; (iv) increasing incidence of pockets of poverty fuelled by rural/urban migration, which implies increasingly difficult access to food; (v) concerns over the growing incidence of food-related diseases such as obesity, hypertension, cancer and diabetes; and (vi) likely impact of important fish stocks being fully or over-exploited (e.g. conch, lobsters, shrimp, red snappers, grouper).

Food security is of primary concern to national Caribbean governments. This has also been recognised at CARICOM level, and Caribbean regional policy priorities therefore include:

- Higher levels of food security and self-sufficiency through increased productivity and diversification of agricultural and fisheries production
- Improved trade policies and competitiveness through greater export of high quality produce and process products

- Enhanced sustainability of the food and agricultural sector and poverty alleviation in rural communities, through greater opportunities for rural employment

About 25% of the region's people live in poverty, one of the primary causes of food insecurity, and the above-average poverty rates in Guyana (40%), Haiti (65%) and Jamaica (34%) have been identified as substantial impediments to future development in these countries (USAID, 2004). Food insecurity is a principal concern of the poor, especially for households that depend largely upon purchased food. Agriculture and fisheries are in decline in many Caribbean countries, resulting in fewer employment opportunities in rural areas, and consequent rural depopulation. Often women and children are left as the principal agricultural labour force. Increased migration to urban areas leads to a vicious cycle of food insecurity in rural areas, resulting in less agricultural production and the necessary consequent import of even more food to satisfy the growing food demands of urbanites (Brathwaite, 2005). While agriculture continues to be a significant economic sector in many Caribbean countries (for example in Guyana, Haiti and Belize), limitations on intra-regional agricultural trade due to the absence of both a well developed transportation infrastructure and relevant marketing institutions impose further restrictions on food provisions from within the region.

There are also close connections between rural poverty and environmental degradation (Agard *et al.*, 2004). Small-scale farming is typically conducted on steep slopes, using agronomic methods and forestry management practices that often result in soil erosion leading to damage to the watersheds and reefs. The degradation of watersheds in Haiti and Jamaica is an issue of major concern, and the impact has been felt from "ridge to reef". Over the last 50 years several projects have been introduced to mitigate this problem but large-scale success has been lacking.

At the regional level, a CARICOM Single Market and Economy (CSME¹) has been proposed for member countries of the Caribbean Community (CARICOM). The CARICOM Single Market (CSM) was launched on 1 January 2006 and the CARICOM Single Economy (CSE) is projected to come into being about mid-2007.

The CSME is anticipated to have far-reaching consequences for the region's food security, but detailed assessments and optimal implementation strategies are constrained by the lack of information and data on the structure and function of food systems across the region.

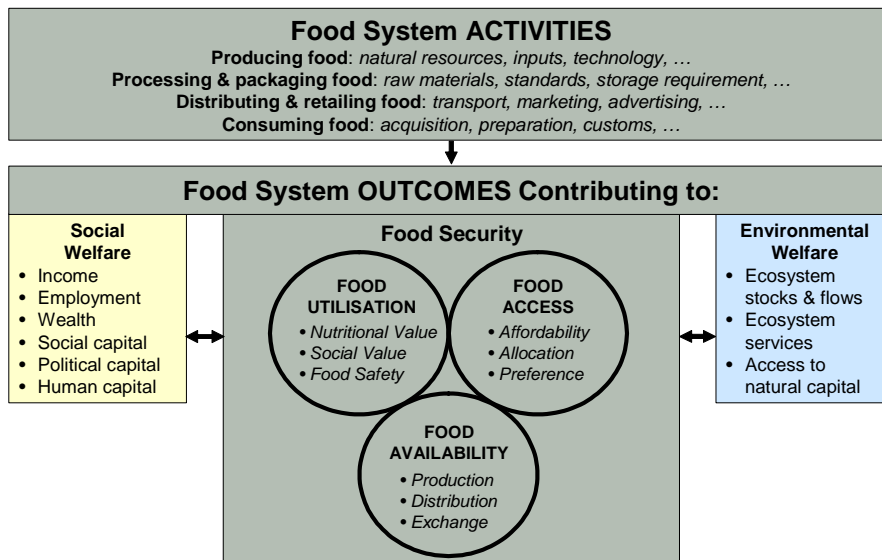
Against this background of socioeconomic-induced food insecurity, Global Environmental Change (GEC, Box 1) is adding further stress. Growing concerns about GEC make policy-making even more difficult for two main reasons. First, GEC will bring additional complications to many aspects of the Caribbean's food systems, both directly through impacts on locally-produced commodities and indirectly with the reduction of export revenues and the possible changes in availability and/or prices of imported food due to GEC impacts elsewhere. Second, limited awareness by many policy-makers of these issues reduces the capacity to consider GEC concerns in the refinement of existing policies and development of new policies aimed at addressing food security, environmental protection and conservation and economic development.

¹The Caribbean Community (CARICOM; www.caricom.org) was established in August 1973 following the adoption of the Treaty of Chaguaramas, to enhance the integration of its member states. There are currently 15 members of CARICOM. The Caribbean Single Market and Economy (CSME) seeks to provide more and better opportunities to produce and sell goods and services of its participating members and to attract investment; communally, the member states will form a stronger force in the global trading arena. The Single Market, which creates a single contiguous market for CARICOM goods and services, was launched in January 2006. The Single Economy is set to be launched in 2008.

Box 1: Definitions of GEC, Food Systems and Food Security

Global Environmental Change (GEC) includes changes in the physical and biogeochemical environment, either caused naturally or influenced by human activities such as deforestation, fossil fuel consumption, urbanisation, land reclamation, agricultural intensification, freshwater extraction, fisheries over-exploitation and waste production. GEC issues of particular relevance for the Caribbean include changes in the intensity, frequency and track of tropical storms and hurricanes, flooding, water availability and quality, land-degradation and “ridge-to-reef” issues: fisheries stocks, sea surface temperature, currents and salinity, and sea-level.

Food Systems encompass (i) activities related to the production, processing, distribution, preparation and consumption of food; and (ii) the outcomes of these activities contributing to food security (food availability, with elements related to production, distribution and exchange; food access, with elements related to affordability, allocation and preference; and food use, with elements related to nutritional value, social value and food safety). The outcomes also contribute to environmental and other securities (e.g. income). Interactions between and within biogeophysical and human environments influence both the activities and the outcomes (see Figure below, from Ericksen, 2007).



Main features of food systems

Food Security is the state achieved when food systems operate such that ‘all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life’ (FAO, 1996). Food security is underpinned by food systems and is diminished when food systems are stressed. This stress can be caused by a range of factors in addition to GEC (e.g. conflict, changes in international trade agreements and policies, HIV/AIDS) and may be particularly severe when these factors act in combination.

1.2 GEC in the Caribbean

In the short-term it is clear that land degradation (Ahmad, 2001) and changes in climate variability are the most important aspects of GEC for the Caribbean region. Of particular concern is the disruptive effects of hurricanes (Emanuel, 2005) and other extreme weather events (resulting for example in floods and drought) (Chen and Taylor, 2002; Peterson *et al.* 2002; see Box 2). Of prime importance is how these climatic changes will impact land and water resources,

and thereby effect terrestrial, marine and fresh water sources of food (Saunders and Lea, 2005; Spence *et al.* 2004).

Other key GEC issues already widely manifesting throughout the region include reduced water availability (Paul and Opadeyi, 2001), depletion of fish stocks and coral degradation (Munro, 2001; Bernal, 2004; Burke and Maidens, 2004). Further GEC issues including changes in sea surface temperature, currents and salinity, and sea-level are anticipated to manifest in the decades ahead.

Box 2: Environmental stress and hazards in the Caribbean

Severe floods in the coastal regions of Guyana in January and February 2005 caused over US\$50 million in losses in the agricultural sector and losses in the sugar industry alone amounted to 15% of Guyana's GDP (ECLAC, 2005). This was followed by flooding in December 2005 to February 2006 that caused over a further US\$20 million in damage to the sector (ECLAC, 2006). While not attributed to any tropical storm activity, January 2005 had the highest rainfall on record since 1888, coinciding with high tides. Floods from these natural phenomena were compounded by malfunctioning drainage systems, resulting in between 1-1.6 metres of flooding in some areas, and affecting 37% of the country's population.

Overall, the top 20 natural disasters over the 1990-2005 period in the Caribbean Disaster Emergency Response Agency (CDERA, 2006) member countries resulted in 110 deaths, 689 injuries, affected 822,154, left 30,323 persons homeless, and amounted to an estimated total cost of US\$5.2 billion.

1.3 Integrating GEC science within regional development policy

Recognising the additional complications that GEC will bring to food security in the region, Caribbean scientists and policy-makers have been in discussion with GECAFS² over the last three years. This has led to the establishment of a consortium of (i) development specialists and scientists representing several Caribbean agencies including CARICOM Secretariat, CARDI, CFNI, CIMH, CCCCC, CRFM and UWI (see Annex 5 for Acronyms); (ii) international organisations, including IICA and FAO; (iii) national researchers and policy makers; and (iv) researchers outside the region including the University of Florida, Carleton University and GECAFS. This consortium has collectively established the following overarching questions which bring together issues relating to food security, environmental conservation, economic development in the context of GEC:

- How will GEC (especially land degradation, and changes in rainfall distribution water availability, sea surface temperature, tropical storms, hurricanes and sea-level) affect vulnerability of food systems in the Caribbean?
- What combinations of policy and technical diversification in food harvested and traded for local consumption, in export commodities and in tourism would best provide effective adaptation strategies in light of GEC?
- What would be the consequences of these adaptation strategies for local, national and regional food security, local livelihoods and the natural resource base?

Current policy-making in the Caribbean attempts to address many of these issues, but the policy process is constrained by i) insufficient information about how food systems function, ii) inadequate institutional structures to deal with the failures of the region's food systems to improve food security and environmental integrity, and iii) fragmentation of current agricultural and environmental policy formulation processes within and between nations. Innovative GECAFS research, that builds on and integrates the wealth of regional and international studies and development projects, will identify ways to overcome these constraints. A key aspect of the project will be building and maintaining an ongoing science-policy dialogue to communicate interim results from research geared to support policy. This will also better link the GEC

² Global Environmental Change and Food Systems (GECAFS) is an international research programme involving a wide range of social, physical and biological scientists, investigating the vulnerability of human food systems to, and interactions with GEC. It is sponsored by the international GEC research community (IGBP, IHDP and WCRP) and is being developed in active collaboration with FAO, WMO and the CGIAR. See Annex 1 and www.gecafs.org for more information.

research agenda related to food security in the Caribbean with the development agenda; development goals and improved environmental management are often closely related.

1.4 Research challenges

The interactions among GEC and food systems are complex and need to be better analysed to assess the implications for food security in the Caribbean. A set of consultative meetings in the Caribbean (convened by GECAFS) identified many GEC issues and highlighted concerns that will further complicate achieving regional food security (Annex 2). In addition to concerns about changes in climate and sea conditions, further degradation of land, water, plant and animal resources is inevitable if careful and appropriate natural resource management is not in place (Gregory *et al.*, 2002). This will, in turn, further undermine the food systems upon which food security is based. Reversing this negative cycle is key to sustainable development in the region, but to date there has been limited capacity to generate policy-relevant information to address GEC effects for development agendas.

Research on three, inter-related issues is therefore needed to provide information to help decision makers and resource managers develop policy and technical adaptation options which improve food security whilst minimising further environmental degradation:

- (i) How GEC will affect the vulnerability of food systems in different parts of the region
- (ii) How food systems can be adapted using technical and policy options to cope with GEC thereby improving food security
- (iii) How various adaptation options will feedback on environmental and socioeconomic conditions.

Research on these issues needs to be based on scenarios of plausible future conditions which embody the GEC, socioeconomic and biogeophysical factors determining food security.

2 Caribbean Research in the GECAFS Context

A three-year consultation and planning exercise has identified the need for, and necessary components of, an integrated research endeavour on the links between Caribbean food security and GEC. The exercise, organised by the international research project Global Environmental Change and Food Systems (GECAFS), involved a diverse group of regional researchers, and regional and international organisations and donors, and culminated in the preparation of this Plan for a GECAFS Caribbean project (GECAFS-Caribbean). Recognising and building upon ongoing national and regional GEC and food security research, the Plan provides a strategy to deliver policy-relevant information about the interactions between GEC and the food systems that underpin food security. Research will contribute to a number of major food security initiatives in the region and support both local interests and those of major regional activities (e.g. CARICOM, FAO). It will constitute an integral component of the internationally-endorsed GECAFS agenda.

2.1 *The need for a GECAFS Caribbean regional project*

Vision: Improved food security for those most vulnerable to environmental stress in the Caribbean.

A wide range of national and international projects are already involved in studying the links between GEC and food security. Most, however, focus on the impacts of climate change on food production – certainly an important issue – but the wider implications of GEC for food security are insufficiently addressed (Gregory *et al.*, 2005). Furthermore, techniques to assess the environmental consequences of possible strategies to adapt food systems to cope with GEC are poorly developed, and tools to identify the tradeoffs between socioeconomic and environmental goals to support improved policy development are urgently needed (Ingram *et al.*, 2005). Further, the Regional Special Program for Food Security (RSPFS, spearheaded by FAO in collaboration with the CARICOM Secretariat) has determined that capacity to address national and regional food security, environmental and development issues in the Caribbean are increasingly limited by fragmented responsibilities and decision-making processes.

While many organisations are involved in the issues, the pathways of communications to make coherent and integrated decisions which simultaneously consider food security and development agendas are not present.

The Caribbean Regional Report on the Implementation of the Barbados Programme of Action (BPOA), published in January 2005, recognised the need for integrated research, and, in relation to climate change adaptation (a key aspect of GEC concerns), the report highlighted the following needs:

- Research that will address deficiencies in (i) current monitoring systems; (ii) information on greenhouse gas abatement; and (iii) the analysis of issues pertaining to vulnerability, adaptation and climate change
- Assistance from the international community for the development of appropriately-scaled models for Small Island Developing States (SIDS), relevant to planning for adaptation to climate change
- The development of collaborative relationships for researching and disseminating climate change adaptation impacts experiences and information

The BPoA Report highlighted the need for integrated research incorporating indigenous knowledge into land-use planning, and the development and enhancement of geographic information systems to improve planning. Comprehensive data collection and analysis was emphasised in relation to freshwater and wastewater management. This information is deemed necessary for the formulation of national policies and for legislative reviews, especially in relation to the region's food security.

As earlier indicated, the CSM and the CSME are anticipated to have a significant impact on the region's food security, but the effect cannot be predicted at the present time. Further, growing concerns about GEC make policy-making even more difficult for two main reasons. First, GEC will bring additional complications to many aspects of the Caribbean's food systems, both directly through impacts on locally produced commodities and indirectly with the reduction of export revenues. Second, limited awareness by many policy-makers of these issues reduces their capacity to consider GEC concerns in the refinement of existing policies and development of new policies aimed at addressing food security, environmental protection and conservation and economic development.

There is considerable food security research ongoing in the region (see Annex 3), and further research on food security/GEC issues can draw valuable lessons from the often-disparate technical, local policy and institutional adaptation approaches. Additional research needs, however, to be designed specifically to underpin improved regional and national policy formulation. Key aspects are: (i) raising awareness of, and improving knowledge about GEC issues in the policy process, particularly on how the food security status will be undermined by GEC; and (ii) improving understanding by researchers of what the key food policy goals are and the constraints on policy formulation. To this end, a new framework is needed which will:

- (i) bring together research on the vulnerability of the region's food systems to GEC;
- (ii) enhance collaboration with relevant stakeholders in food issues to identify viable options for adapting food systems to the additional stresses of GEC; and
- (iii) assess how possible adaptation options will affect development agendas, including enhanced environmental management, in the short- and long-term. However, these issues need to be analysed within existing approaches to food security so that they are not seen as a different set of problems and also so as to capitalise on, and add value to, ongoing efforts.

The international GECAFS Project has been designed to integrate all three issues by weaving together the array of cause-effects-adaptation options with feedbacks (see Annex 1). It offers a new paradigm for research that directly

addresses the issues discussed in Section 1.1 and has provided the framework for planning the GECAFS Caribbean project (GECAFS-Caribbean).

To support improved policy formulation, the scientific community needs to raise awareness within the policy community of emerging issues, and deliver, communicate and interpret assessments of the consequences of GEC for food security and potential policy responses to GEC. These assessments must address the complexity of food security issues, and no single analytical or disciplinary approach is appropriate.

Current policy-making in the Caribbean attempts to address many of these issues, but the policy process is constrained by (i) insufficient information about how food systems function; (ii) inadequate institutional structures to deal with the failures of the region's food systems to ensure food security and environmental integrity; and (iii) fragmentation of current agricultural and environmental policy formulation processes along many dimensions within and between nations. GECAFS-Caribbean will help to develop a more integrated regional approach which will have direct relevance to regional planning bodies.

2.2 GECAFS-Caribbean project planning

GECAFS/food security research to support policy development in the Caribbean must provide practical assistance to evaluate options for reducing the vulnerability of the region's food systems to GEC. It should deliver results which help the region's policymakers and development planners appropriately evaluate the necessary responses to improve the region's food systems upon which food security depends. Not all GEC research necessarily aims to be policy-relevant, but one of GECAFS' guiding principles is to address policy issues. Important aspects of GECAFS therefore include ascertaining the information needs of regional and national policymakers, resource managers and other stakeholders; developing with stakeholders relevant science questions; and delivering results throughout the research process so as to help policy formulation.

This GECAFS-Caribbean Science Plan and Implementation Strategy has been developed from the output of a series of coordinated planning workshops and associated activities involving regional researchers, policymakers, resource managers and donors (Annex 2). The regional planning process has also been influenced by developments in the GECAFS conceptual research agenda. This process has followed the general GECAFS method for developing GECAFS regional research to ensure the research questions are closely matched with key regional science interests, policy needs and donor priorities.

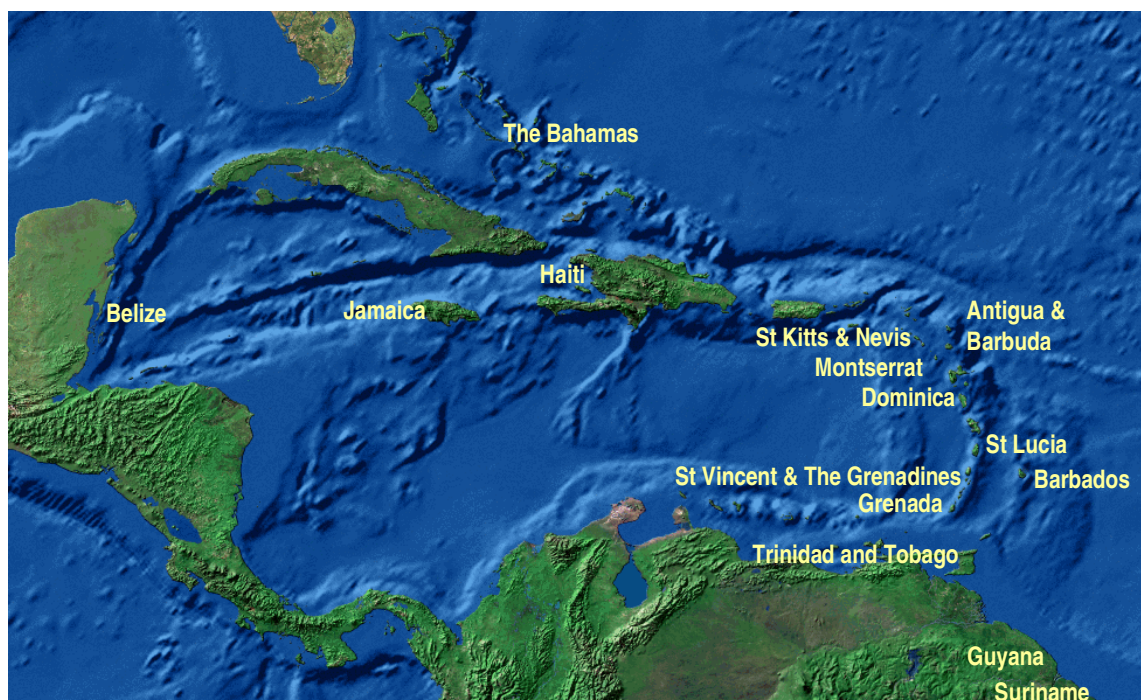


Figure 1: The Caribbean region highlighting CARICOM members

The GECAFS Caribbean Project (GECAFS-Caribbean) is designed to address the region as a whole, but with special reference to CARICOM (Figure 1). This is an important spatial scale for food security issues, food system research and GEC considerations for several reasons:

- climate and weather-related perturbations are often experienced at this scale in the region and adaptation strategies may be applicable across more than one locale or nation
- the adaptation strategies themselves may prove most effective if managed at the regional or sub-regional level with respect to institutional support arrangements or systems (CARDI, CDERA, CIMH, CEHI, CFRM, UWI)
- donors often plan at the national and regional scale and in many places regional governance structures have been established
- there is a mechanism for regional development planning and discussing related international agreements (CARICOM) which is a clear ‘client’ for a regional-level considerations
- while many natural science issues are already being addressed at the meso-scale, social science models and theories, methods and data are however often better developed at the micro- (household) and macro- (nation or larger) scales (Rayner and Malone, 1998). GECAFS-Caribbean is designed to bring these two areas of science together at the national and regional scales

2.3 GECAFS-Caribbean in relation to regional food security initiatives

A number of regional frameworks to reduce vulnerabilities reflect a consensus among regional governments for collective and regional initiatives including, *inter alia*:

- The Regional Food Plan
- Regional Transformation Programme in Agriculture
- Regional Negotiating Machinery
- Regional Training and Educational Standards
- Regional Special Program for Food Security (SPFS)
- Jagdeo Initiative
- Caribbean Cooperation in Health (CCH) Initiatives

These regional initiatives are being pursued in tandem with one another and with differing degrees of inter-dependence. Further, several of these programmes are agricultural-related and have been designed to strengthen agriculture’s own development and enhance the sector’s capacity to contribute to national and regional development. In particular these programmes seek to:

- (i) enhance the performance of the regional agricultural sector;
- (ii) increase food production of a diverse range of food and agricultural products;
- (iii) enhance food security;

- (iv) expand market share of traditional and new products in international markets to increase foreign exchange; and
- (v) increase employment and improve the quality of life, especially in rural areas.

Beyond these specific and focused programmes, these regional initiatives and approaches are designed to help regional countries improve their effectiveness in the areas of functional cooperation, trade and foreign policy and strengthen their intra-regional links thereby improving the capacity of individual Member States to address their vulnerabilities.

Given its regional mandate, groups central to such policy-related region-wide interests (notably CARICOM but also others e.g. IICA and FAO), have played a key role in defining the GECAFS-Caribbean agenda. This involvement has helped ensure that research planning directly addresses CARICOM goals and GECAFS-Caribbean brings to the front GEC issues relative to food security issues. As a result, GECAFS-Caribbean will contribute strategic scientific information that CARICOM and its implementation partners need to inform regional programmes and policies for developing national and regional integrated food security and poverty reduction policies and strategies.

Links to other regional food security research initiatives (see Annex 3) will also be developed as appropriate to ensure GECAFS-Caribbean outputs complement, build on, and contribute to ongoing efforts in the region. Some particularly-relevant regional efforts are:

- the FAO-RSPFS, which aims at addressing constraints related to increasing trade, increasing small farmer productivity, and improving food policy, food insecurity information and linkages between food product development and promotion and food health related issues. It involves Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago.
- the Partnership Initiative for Sustainable Land Management (under the UNEP Caribbean SIDS Programme), which seeks to prevent and reduce land degradation, and focuses on addressing the problems of drought and water shortage. The Caribbean Community Climate Change Centre (CCCCC) is the executing agency for this initiative. A sub-regional Task Force has been established to provide policy guidance on the further elaboration of this initiative and to identify opportunities for synergies between the UNCCD and other Multilateral Environmental Agreements (MEAs).
- the Mainstreaming Adaptation to Climate Change Project approved in 2003 by the GEF, which is a Stage II adaptation project aiming to facilitate adaptation to climate change. This project is also supported by CIDA and NOAA and is executed by the CCCCC.
- the Integrated Watershed and Coastal Area Management (IWCAM) Project in Caribbean SIDS, approved by the GEF in May 2004, which aims to provide a framework for countries to better address environmental management challenges. The overall objective of the IWCAM project is to strengthen the commitment and capacity of the participating countries to implement an integrated approach to the management of watersheds and coastal areas. The long term goal is to enhance the capacity of the countries to plan and manage their aquatic resources and ecosystems on a sustainable basis. This project is being executed by the Caribbean Environmental Health Institute (CEHI). CEHI also has a mandate for the provision of technical and advisory services to the Region in the areas of water resource management, agricultural production and pesticide control and natural resource conservation, among other areas.
- the Caribbean Water Initiative (CARIWIN) is a collaborative research and capacity building project designed jointly by the Brace Centre for Water Resources Management (BCWRM) of the University of McGill, the Caribbean Institute of Meteorology and Hydrology and partner Caribbean governments. It is funded by the Canadian International Development Agency (CIDA) and launched in February 2007. CARWIN aims to address some of the complex challenges of water resources management in the Caribbean region via an integrated approach through pilot projects in Grenada, Guyana and Jamaica. It is anticipated that models and best practices developed from these pilots can be embraced and utilised by the other territories of the region. Countries were selected based on poverty assessments, recent natural disasters, the diversity of land and water use, variation in water management issues (with agricultural water use being one of the prime areas of focus), the support and capacity of partner agencies, the presence of and support for equitable community-based participatory processes, and the relevance of gender and environmental issues to other CARICOM countries.
- the Caribbean Large Marine Ecosystem (CLME) Project which is currently under development.

3

GECAFS-Caribbean Goal & Research Agenda

GECAFS-Caribbean research will identify the social and geographical distributions of vulnerability of the region's food systems to GEC in the context of other stresses. Based on these new insights it will determine how, when and where adaptations to food systems to reduce their vulnerability to GEC can be instituted in line with long-term national and regional developmental goals. It will also assess the long-term social and environmental consequences of different adaptation measures adopted to enhance regional food security. In addition to addressing regional priorities, proposed research is also fully consistent with the international GECAFS conceptual and methodological research agenda and will be networked with other GECAFS research worldwide.

3.1 Goal

To determine strategies to cope with the impacts of global environmental change on Caribbean food systems and to assess the environmental and socioeconomic consequences of adaptive measures aimed at improving long-term food security.

This goal is derived from the regional planning process (Annex 2) and a number of research topics that have evolved from the process. Collectively, these constitute an innovative regional research approach which will:

- (i) build upon and integrate the natural and social sciences within a policy context;
- (ii) link researchers, the regional and sub-regional policy communities, and resource managers to deliver new insights into how GEC will interact with the region's food systems that underpin food security;
- (iii) be designed and implemented so as to help the region take advantage of opportunities that may arise, while contributing to the minimisation of further environmental degradation.

3.2 Overarching GECAFS-Caribbean research questions and conceptual framework

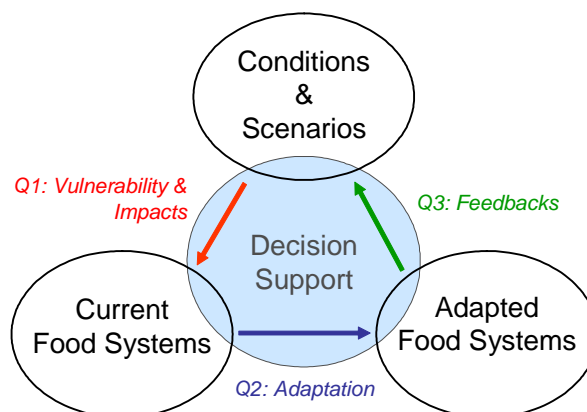
GECAFS-Caribbean research is based on three areas that are of interest to both regional science and development agendas.

- Q1 How will GEC affect the vulnerability of Caribbean food systems?
- Q2 How might Caribbean food systems be adapted to cope with GEC so as to enhance food security?
- Q3 How would various adaptation options for Caribbean food systems feedback on environmental and socioeconomic conditions?

These questions are based on the generic GECAFS conceptual framework (Box 3), and were refined during the GECAFS planning process in the region.

The GECAFS approach recognises that research questions for policy and science outputs, though not the same, are nevertheless complementary. Two types of research questions have therefore been developed for the GECAFS-Caribbean project: those of immediate relevance to food security and environmental management policy objectives as relating to Q1-3, above (Section 3.3); and others aimed at delivering a stronger scientific basis for addressing the policy-related questions (Section 3.4).

Box 3: GECAFS conceptual framework for research in the Caribbean Region



A relationship exists between current socioeconomic and environmental conditions and current food systems. The relationship highlights the vulnerability of the current food system to future scenarios of changed socioeconomic and environmental conditions. It also shows how policy and/or technical adaptation options to cope with the added stresses of GEC lead to adapted food systems; and that adaptation options will, in turn, feedback to socioeconomic and environmental conditions. Finally it highlights the importance of decision support in assisting with credible assessment of adaptation options, and especially in analysing their trade-offs between environmental goals (e.g. minimising damaging feedbacks to carbon budgets, the hydrological cycle and other components of the Earth system) and regional developmental goals (e.g. maximising positive feedbacks to food security, livelihoods and other socioeconomic conditions).

3.3 Research questions for food security and environmental management

Three sets of more detailed questions were developed from the overarching questions (Q1-3) and are summarised below. Given the varied policy interests of regional stakeholders, and recognising the complex spatial and temporal dynamics in the region to assess vulnerability, adaptation of food systems to GEC and the feedback of these on food systems and food security in the Caribbean:

- **Local questions**, researched at the sub-national and national level
- **Cross-scale questions**, which investigate the links between local-level and regional-level issues (bottom-up view of the region)
- **Regional questions**, to address issues relating to the region as a whole (top-down view of the region)

3.3.1 Vulnerability of food systems to GEC (re Q1)

Food systems vary considerably across the Caribbean region. Research is needed to establish how these food systems operate and how their vulnerability to GEC differs.

Key Q1 local-level questions

- How do socioeconomic and biophysical conditions determine how food systems operate at the local level? *e.g. resource tenure; climatic conditions; natural resource base; market structure; social safety nets; food preferences; ...*
- Which aspects of local food systems (activities and outcomes) are currently most vulnerable to environmental stress and which aspects of GEC are most threatening? *e.g. production; processing; distribution; consumption; availability, access, utilisation; ...*
- How do local-level policies and strategies (or lack thereof) within the individual countries affect the vulnerability of food systems to GEC at the local level and why? *e.g. land policies; marketing strategies; public awareness policies; production methods; ...*

Key Q1 regional-level questions

- How do regional-level policies and strategies (or lack thereof) affect the vulnerability of food systems to GEC across the region and why? *e.g. trade policies; transport systems and infrastructure to facilitate intra-regional trade; EEZs; regional marketing infrastructure and intelligence; ...*

- How will GEC destabilise food security in the region as a whole? e.g. wide-scale impacts; proportion of region's response capacity affected; key production areas affected; ...

Key Q1 cross-scale questions

- How does food system vulnerability to GEC vary across the region? e.g. production methods; locally-produced vs. imported food; variety and nutrition; cost over time/season; ...
- How is GEC affecting food security trends (availability, access and utilisation) across the region? e.g. production; economic; social; emergency relief; ...
- How well do local and regional level policies and strategies complement each other in reducing vulnerability to GEC? e.g. in terms of being mutually reinforcing; antagonistic; ...

3.3.2 Adaptation (re Q2)

The increasing vulnerability of Caribbean food systems to GEC, as demonstrated by escalating land and soil degradation and declines in food availability and access, are indications that technical, policy and institutional strategies are often weak and ineffective. Further, current strategies are mainly aimed at coping with the increasingly complex interaction of stresses in the short-term, and little attention is given to longer-term options for adapting food systems to the additional stresses GEC is bringing. Such options will vary across the region, depending on the nature and extent of the inherently-dynamic vulnerability of food systems to GEC.

Key Q2 local-level questions

- What local-level technical, policy and institutional adaptation strategies will reduce food system vulnerability to GEC? e.g. insurance; early-warning systems; diversification of cropping systems and fisheries (including aquaculture); physical infrastructure; landuse planning; enforced zoning; ...
- How does local governance affect the development and implementation of food system adaptation options and strategies? e.g. stability; corruption; vision; popular acceptance; capacity and capability; change of government; ...
- What are the current barriers to reducing potential local food insecurity in the face of GEC? e.g. political commitment; knowledge; local infrastructure; local perceptions and attitudes; history; community vs national levels; ...

Key Q2 cross-scale questions

- What regional-level policy instruments and strategies would enhance the effectiveness of technical and other support options at the local level aimed at reducing the vulnerability of food systems to GEC? e.g. insurance and re-insurance; market intelligence and marketing infrastructure; regional fisheries management mechanisms; ...
- How will interactions among regional-level and local-level food system adaptation strategies aimed at reducing the vulnerability of food systems to GEC affect decision-making at the local level? e.g. non-tariff barriers to trade; cross-border production integration arrangements; ...

3.3.3 Feedbacks (re Q3)

Technical, policy and institutional options for adapting Caribbean food systems to GEC will primarily be aimed at improving food security. There will however also be environmental, and other socioeconomic, consequences ('feedbacks'; see Box 3) of such options. New policies and technologies promoted at regional level will affect the capacity to adapt to change at the local level. Population change, disease spread, and movements of people between countries influence national food security, and some policy adaptation options might hinder positive demographic aspects or promote negative aspects. Adaptation options such as international trade policy, regional trade policy and intraregional transportation infrastructure will affect regional self-sufficiency as well as local livelihoods and the environment. Research needs to identify the potential feedbacks of possible adaptation options as identified in Section 3.3.2 and build such knowledge of critical feedbacks into policy formulation and resource planning.

Key Q3 local-level questions

- How would alternative local strategies and technical options affect local food security? e.g. availability, access, utilisation; stability; proportional reliance on local; intra-regional or extra-regional supply; ...
- How would alternative local strategies and technical options affect local environmental and socioeconomic conditions? e.g. rural development; urbanisation; biogeochemical cycling; national greenhouse gas budgets; coastal zone ecology; tourism; ...

Key Q3 regional-level questions

- How would improved regional cooperation aimed at reducing the GEC threat to regional food security affect international trade? e.g. niche produce; tourism; energy crops; increased processed agricultural outputs; ...

- To what degree would the implementation of regional policy instruments & strategies aimed at reducing the GEC threat to regional food security affect regional initiatives? *e.g. regional research agendas; delivery of other CARICOM programmes; investment patterns in the agri-food sector; ...*

Key Q3 cross-scale questions

- How would the implementation of the CSME affect food security, the environment and socioeconomic conditions at the local level? *e.g. nutrition; rural development; urbanisation; biogeochemical cycling; national greenhouse gas budgets; proportional reliance on local, intra-regional or extra-regional supply; compliance with international conventions; tourism; ...*
- How would different local adaptation strategies and technical options aimed at reducing the vulnerabilities of food systems to GEC and implemented across the region affect the region's economic development? *e.g. rural development; export commodities; reliance on extra-regional food supply; tourism; labour migration; ...*

These sets of Q1, Q2 and Q3 questions need to be considered for both current conditions and in the context of plausible scenarios of future conditions (see 3.4.2).

3.4 Caribbean science in the context of GECAFS conceptual research

While GECAFS research in the Caribbean is primarily aimed at the regional project goal, it will also contribute significantly to the four key topics comprising the overall GECAFS conceptual research agenda: (i) food systems concepts, (ii) vulnerability and adaptation of food systems to GEC, (iii) scenario construction, and (iv) decision support. Basic details of each of these research areas are given in the GECAFS Science Plan and Implementation Strategy (Ingram et al., 2005); and latest concepts are reported in the GECAFS Working Paper Series (available on www.gecafs.org).

3.4.1 Research on vulnerability and adaptation of food systems to GEC

GECAFS research has developed a framework to integrate the many research projects that address GEC impacts on food systems with concepts related to society's capacity to cope with, and/or recover from GEC (Bohle, 2001; Wisner et al., 2004); and with changes in societal aspects, such as policy options, institutions and resource accessibility (Adger, 1999). This integrated concept will allow GECAFS-Caribbean researchers to better understand the vulnerability of the food system (as a whole) to GEC, rather than just the impacts of GEC on production. Box 4 illustrates how this research can be further developed within GECAFS-Caribbean.

3.4.2 Regional scenarios for GECAFS studies

GECAFS-Caribbean research needs to be set within clearly defined, plausible alternative futures (or scenarios) of biogeophysical and socioeconomic conditions, because considerable uncertainty surrounds both policy development and implementation, and the nature and impact of GEC.

Proposed scenarios will:

- (i) research the interactions between regional food systems and GEC;
- (ii) assess which adaptation options are most appropriate for different future conditions;
- (iii) assess the resilience and adaptive capacity (Carpenter *et al.*, 2001; Walker *et al.* 2004) of food systems under different scenarios; and
- (iv) raise awareness amongst decision makers about the potential vulnerability of food security strategies under different, and largely uncertain, future conditions.

Fully-integrated regional scenarios that build on a set of already-completed prototype scenarios for the region's food systems³ will set the contexts for detailed discussions on adaptation and feedback issues.

3.4.3 Decision support research

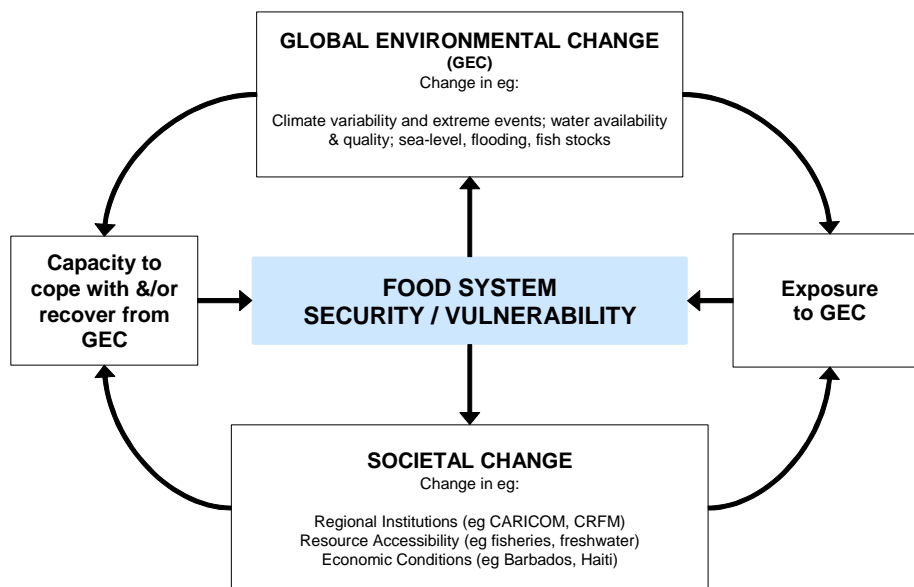
Work on assessing the possible strategies for adapting Caribbean food systems to GEC must include those involved in policy formulation and decision-making. Decision support (DS) platforms can help by providing a structured dialogue between scientists and policymakers. Innovative DS approaches and tools need to be developed, evaluated and refined to help assess potential regional- and national-level policy options. DS tools will be used to analyse tradeoffs between feedbacks to the Earth system (included, for instance, changes in greenhouse gas emissions, soil erosion, water resource degradation and biodiversity loss), and to socioeconomic conditions (such as food security, potential markets, livelihoods) arising from potential adaptation options (Q3, above). Advances in DS concepts from GECAFS-Caribbean research will contribute to international GECAFS agendas on DS development.

³ Initial work by a group of regional stakeholders and experts, and guided by GECAFS Science Officers, has developed a set of four Caribbean prototype scenarios focusing on regional food system development. These are based on the Millennium Ecosystems Assessment global scenarios and their underlying assumptions, and, while the four Caribbean prototype scenarios are largely coherent with their respective global "parents", they differ in aspects particularly relevant for Caribbean food systems. See GECAFS (2006) *A Set of Prototype Caribbean Scenarios for Research on Global Environmental Change and Regional Food Systems*. GECAFS Report No. 2; 62pp. Wallingford (available on www.gecafs.org)

Box 4: Integrated concepts of food system vulnerability with GEC science

GECAFS is interested in the vulnerability of food systems to global environmental change. Vulnerability is ‘the interface between exposure to the physical threats to human well-being and the capacity of people and communities to cope with those threats’ (The *Global Environment Outlook 3* Report, UNEP 2002). Therefore vulnerability has two sides: an external side composed of risks, shocks and stress, and an internal side which is the means for coping without damaging loss (Chambers, 1989).

The capacity to cope with, and adapt to stress is often being diminished in the face of multiple, interacting shocks (e.g. climatic catastrophes) and transformations (e.g. political and economic developments). Furthermore, negative outcomes for large numbers of people affect in turn, the context itself. A dynamic cycle results, where vulnerability is generated by both exposure to change, by responses to change, and by the outcomes of these processes (Gillespie & Kadiyala, 2005; Leichenko and O’Brien, 2002).



*Factors determining the vulnerability of Caribbean food Systems to GEC
(Adapted from Ingram and Brklacich, 2006)*

GECAFS is integrating social vulnerability concepts with those from natural science to provide a more holistic approach to vulnerability studies in the context of GEC in the Caribbean. Regional networks will bring together researchers to assess existing paradigms and approaches. For the conceptual research on food systems and vulnerability for instance, studies could include livelihood-based food security assessments and future vulnerabilities; multiple stresses (O’Brien, 2004; Quinlan *et al.*, 2005; Misselhorn, 2005) and climate vulnerability hotspots (Adger *et al.*, 2005); multi-level modelling (Downing *et al.*, 2004) linking vulnerability to food security. Merging vulnerability assessments with adaptation and resilience research provides an opportunity to provide explicit links between vulnerability assessments and the formulation of policies supporting future food security (Adger *et al.*, 2003).

4

GECAFS-Caribbean Implementation Strategy

GECAFS-Caribbean will be implemented over a five year period. It will include (i) designing and launching a small number of Focussed Studies, each addressing the food systems questions relating to GEC vulnerability and impacts, adaptation options and feedbacks; (ii) regional scientific networking linking GECAFS Focussed Studies with other relevant research in the region and internationally; (iii) regional synthesis and integration to add value to individual research endeavours; and (iv) building science-stakeholder interfaces linking national researchers with policymakers, the private sector, civil society and representatives of regional food security programmes. Research will be organised into defined phases with clear outputs at each stage. When integrated, outputs will provide policy-relevant information at both local and regional levels with the communications strategy underpinned by stakeholder engagement at all research stages. Research will thereby support both local interests and those of major regional activities (e.g. CARICOM Secretariat, IICA and FAO). Research capacity will be developed by collaborative research within the international GECAFS project.

GECAFS-Caribbean will comprise:

- **Focussed Studies**, designed to address the food systems questions relating to GEC vulnerability and impacts (Q1), adaptation options (Q2) and feedbacks (Q3) areas of this Plan (Section 4.1; cf. Section 3.3)
- **Regional Scientific Networking**, to build on and add value to other research in the region that relates directly to aspects of this Plan; and which can contribute to the underpinning science in the GECAFS conceptual research agenda (Section 4.2; cf. Section 3.4)
- **Regional Synthesis and Integration**, to add value to individual research packages and to address the cross-scale and regional research questions (Section 4.3; cf. Section 3.3)
- **Science-Stakeholder Interfaces**, linking research output with policy formulation (Section 4.4; cf. Section 1.3)

4.1 Focussed Studies

The Caribbean encompasses wide-ranging socioeconomic and environmental conditions. GECAFS-Caribbean planning identified the CARICOM Secretariat and national interests in describing how the food systems vary across the region as a result of this heterogeneity (cf. 3.3.1). Many of the food security issues are based on socio-ecological interactions that are complex and warrant dedicated research to assess how they will interact with GEC. The GECAFS-Caribbean project will therefore develop a set of Focussed Studies aimed at capturing main aspects of the regional diversity in the context of the science issues laid out in this Plan.

Each study will provide a focus for collaborative GECAFS-Caribbean Q1-3 research involving national researchers closely linked to policymakers, the private sector, civil society (NGOs) and representatives of regional programmes.

Research developed using standard GECAFS methods to facilitate syntheses and integration will give insights into how diversity affects food security across the region and also what possible adaptation strategies can be considered both locally and for the region as a whole. Regional researchers will work closely with GECAFS Science Officers to develop proposals for funding such studies.

4.2 *Regional scientific networking and integration*

There are many national research projects in social, agronomic, fisheries, policy, economics, ecological and climate sciences which could be very relevant to the GECAFS objectives (see Annex 3). Where appropriate these will be drawn upon to contribute to case studies, and as in general, GECAFS-Caribbean will aim to systematically engage in strategic alliances with existing initiatives. However, a key GECAFS principle is also to network and synthesise ongoing research in the region relevant to GEC and food systems which may not be directly involved in the case studies. This will (i) help address the stated research questions by including a wider range of researchers; (ii) add value to the individual case studies by integrating them with other work to address questions the case studies alone cannot address (e.g. of a regional nature); and (iii) link regional research to the international GECAFS conceptual research agenda. To this end, GECAFS will build on relevant, high quality research directly related to this Plan. The GECAFS-Caribbean Regional Coordinating Committee (see Section 5.2.1) will establish criteria for assessing the potential value of such work to the regional project, in consultation with the international GECAFS project. Funds for networking activities (e.g. at regional and/or national GECAFS-Caribbean synthesis workshops) will be the subject of specific proposals.

Researchers addressing issues that can contribute to GECAFS conceptual research (section 4.5, below) would be invited to join the relevant GECAFS international networks. This contributes to GECAFS' overall integration by placing the regional work in a broader international context, and helps regional capacity building. Such contributions would be welcomed as formal inputs to the respective international network.

4.3 *Regional Synthesis and Integration*

Regional synthesis and integration will be achieved by closely linking the Focussed Studies and other networked research in the context of key 'synthesis questions' as outlined in Section 3.3. The GECAFS-Caribbean Regional Coordinator (see Section 5.2.2), assisted by the GECAFS Science Officers, will liaise with researchers to ensure consistent approaches are followed across the region to facilitate this process.

GECAFS-Caribbean synthesis workshops will add value to individual research packages and address regional-level and cross-scale questions. These exercises will meet both the overall objective of the GECAFS-Caribbean Project and also identify where further Focussed Studies should be developed.

A number of recently-completed, ongoing and/or imminent region-wide studies could be very relevant to the GECAFS-Caribbean goal. Annex 3 lists some of these, and indicates which aspects of the GECAFS-Caribbean agenda collaboration might be of mutual benefit. The GECAFS-Caribbean workshops will also include output from such studies to ensure that there is no duplication of effort, and that GECAFS-Caribbean and other projects can mutually benefit from advances made outside the Focussed Studies.

A major GECAFS-Caribbean synthesis workshop and reporting exercise will be planned for the final months of the five-year project. Other relevant regional efforts will be invited to participate in this meeting.

4.4 *Building science-policy interfaces*

One of the fundamental aims of the GECAFS research agenda in the Caribbean is to assist regional policymakers and development planners to develop a Caribbean perspective on responses to GEC (cf. Section 1.3). To ensure strong linkage between scientific research and food systems development, GECAFS-Caribbean is based on the participation of stakeholders in all stages of research planning and will maintain this approach during research implementation. This has been a valuable awareness-raising exercise in its own right, and will also pave the way for fruitful collaboration during the implementation phase. GECAFS-Caribbean will ensure that the wide range of regional policy-making institutions, researchers and development agencies engaged in the planning stage will continue to be involved in the research implementation cycle.

The direct engagement of regional policy making institutions, development practitioners and the research community from the early stage of defining the research themes has ensured that the research agenda focuses on issues of practical interest to policymakers in the Caribbean. Major regional policy institutions (e.g. CARICOM Secretariat, IICA, FAO) and development partners like FAO and USAID have participated to varying degrees in the research planning process, and GECAFS-Caribbean directly relates to the specific objectives of these organisations.

GECAFS-Caribbean will continue to foster interactions between scientists and regional policy decision-makers by holding regular meetings and developing a project website. These activities will be used to discuss the research proposals and disseminate results.

The GECAFS-Caribbean Coordinating Committee will aim to meet key regional policymakers on an annual basis at scheduled events in the region, such as the Caribbean Regional Climate Outlook Forum, CARICOM-COTED, etc. Major organisations will be invited to nominate representatives to work closely with the Regional Coordinator.

The science/policy interaction is an ongoing dialogue based on several activities:

- (i) GECAFS-Caribbean approves and posts the research themes on the GECAFS website and also develops a publication (to be prepared by a specialist in science communication) on the research agenda for circulation to scientists and policymakers;
- (ii) Biennial GECAFS-Caribbean science fora discuss the technical content of the research proposals, in the light of the GECAFS planning exercises;
- (iii) The biennial science fora are followed immediately with a policy- and decision-makers meeting to discuss how well the research plans are contributing to information needs for development (as identified during the planning/earlier phases); and
- (iv) GECAFS-Caribbean adapts research proposals in the light of the policy dialogue.

A GECAFS-Caribbean website will have an area for scientific publications and another area for disseminating policy and development related products; and summary policy briefs will be circulated to principal agencies in the region.

4.5 Phased Approach

Planning for the GECAFS-Caribbean project has been conducted over several years and a wide range of regional scientists and policymakers have been involved (see Annex 4). This planning process, which was supported by a wide range of donors, culminated in the preparation of this Plan.

The implementation phase will cover a five-year period which will be divided into three Phases (see Figure 2). Three capacity building workshops for regional collaborators will be held, with input from GECAFS Science Officers. These workshops will update collaborators on the latest GECAFS methodology to establish a standardised approach across case studies and initiate/strengthen collaboration.

4.5.1 Phase I implementation (1.5 years)

Key activities:

- Establish GECAFS-Caribbean Regional Coordinating Committee (RCC) through links created from the GECAFS-Caribbean planning phase and appoint a GECAFS Regional Coordinator (see Section 5.2.2)
- Hold launch workshop involving a wide range of regional researchers, policy makers, resource managers and donors
- Prepare proposals for Focussed Studies
- Refine GECAFS/ICSU Caribbean prototype scenarios
- Review available data and identify supplementary data needs
- Develop plan to acquire supplementary data in conjunction with National Statistical Departments/research-based institutions (eg sustainable development indicators are now being developed) in cases where data are unavailable
- Establish science-policy dialogue

Key products:

- Regional GECAFS RCC and coordinator established in appropriate institution
- Standardised food system descriptions for each case study for use in immediate and longer-term planning; and as foundation for GECAFS regional research
- Potential intra-regional research network members identified
- Refined scenarios combining GEC and socioeconomic drivers suitable for policy debates

4.5.2 Phase II implementation (3 years)

Key activities:

- Convene methodology and interim synthesis workshops
- Undertake GECAFS research on vulnerability and impacts, adaptation and feedbacks
- Launch intra-regional research networks and link to GECAFS international networks

- Consolidate intra-regional networks and further involvement in GECAFS international networks to contribute to GECAFS conceptual research
- Convene regular science-policy meetings to review direction and relevance of research

Key products:

- Improved understanding of Caribbean food system vulnerability to GEC
- New insights of regional hotspots for food systems vulnerability to GEC based on analyses of changing food supply and trade, wealth, food preferences and interactions with GEC

- Decision Support approaches and tools to aid policymakers’ decisions in response to GEC
- An established mechanism for the regular science-policy dialogue, monitoring and policy review and updating
- Increased awareness of potential environmental feedbacks from adaptation options
- New insights in research design for ‘science to aid policy development’

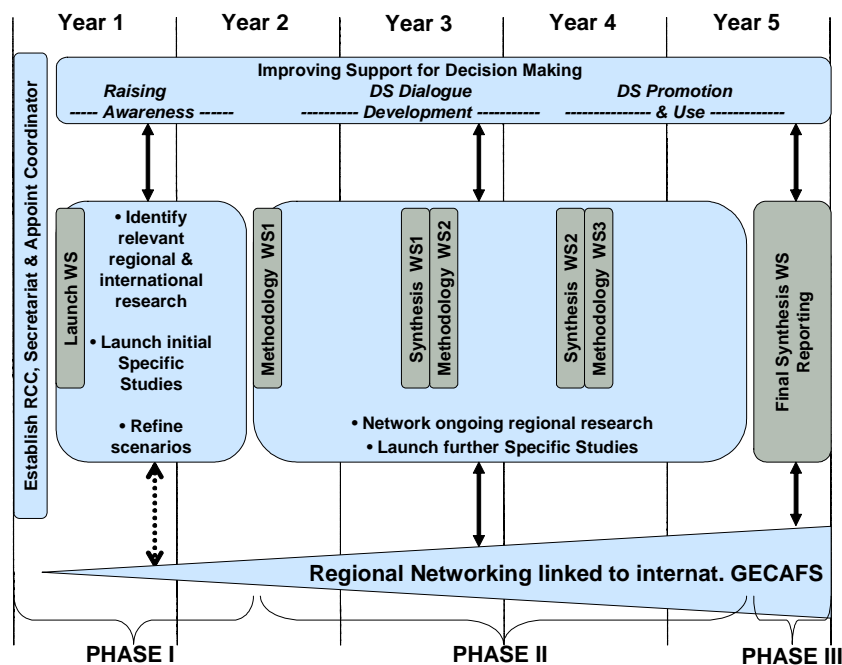


Figure 2: GECAFS-Caribbean timeline

4.5.3 Phase III implementation (0.5 years)

Key activities:

- Final synthesis workshop
- Plan follow-up activities
- Reporting

Key products:

- Improved understanding of Caribbean food system vulnerability to GEC, based on case studies

- New insights of regional hotspots for food systems vulnerability to GEC based on analyses of changing food supply and trade, wealth, food preferences and interactions with GEC
- Comprehensive, regional scenarios of future socioeconomic, environmental and ecological conditions involving the food system
- Increased awareness of potential environmental feedbacks from adaptation options
- New insights in research design for ‘science to aid policy development’

- Plans for an activity to determine how the new approaches and tools stemming from GECAFS-Caribbean will be put into effect across the diverse Caribbean situations

The sustainability of the GECAFS-Caribbean initiative will result from regional policy bodies such as the CARICOM Secretariat using GECAFS-Caribbean research products and from incorporating new insights into national development plans.

4.6 Communications strategy

Achieving the objectives of the proposed research relies on a mechanism or system to facilitate communication between researchers and policymakers at each step. The involvement of researchers and policymakers throughout the planning phase and the regional scenarios development raises awareness of GEC issues and what needs to be considered in decision-making (Zurek *et al.*, 2004), and is therefore a key part of the communications strategy. To expand the system, adaptive management approaches (Lee, 1999; Gunderson, 2002) will be built upon, with specific support for key decision makers at national and regional levels as outlined by Lal *et al.* (2001).

In addition to the active participation of stakeholder groups, the communications strategies will also employ presentations at regional and international workshops and conferences; submissions to the international, peer-reviewed literature; policy briefs, other publications; and the web. Close liaison with major regional programmes (e.g. CARICOM Secretariat, CARDI, CCCCC, IICA, UWI) will be maintained throughout.

Decision support (DS) development will play a major role in the communications strategy. It will be based on research into how best to determine stakeholder information needs, and on communicating and interpreting research findings (ODI/RAPID, 2004; see www.odi.org.uk for details about this approach). This will allow the DS process to be used to help retrieve information and evaluate scenarios in policy exercises that depend on multi-stakeholder negotiations. GECAFS conceptual research in DS will also contribute to regional communications by, for example, demonstrating the Questions and Decisions (QnD) system (Kiker *et al.*, 2005; Kiker and Linkov, 2005). QnD is a structured platform for modelling environmental processes and management decisions as a means to stimulate GECAFS discussions and analysis amongst stakeholders.

4.7 Capacity development

GECAFS-Caribbean will help build regional capacity in both science and policy-making in a number of ways.

Science capacity will be built by:

- networking scientists across the region and across disciplines to jointly address important research issues
- inception workshops run by GECAFS Science Officers to bring regional researchers up to date on latest GECAFS methods, and to feed-back regional insights into the GECAFS conceptual research agendas
- linking regional researchers with scientists world-wide through the GECAFS international research networks
- meetings with regional policymakers so that the science community are more aware of the key issues facing policymakers and the constraints under which they have to work

Policy capacity will be enhanced by:

- involving regional policymakers in scenarios exercises to raise their awareness of GEC issues and the consequences of various scenarios for development
- working with policymakers to interpret research findings in the context of policy formulation
- providing decision support tools to help with analysing tradeoffs between socioeconomic and environmental goals for given adaptation options
- identify and support broader policy processes to include GECAFS research findings

Institutional capacity will be improved in the following areas:

- Development of research capability within host institution
- Statistical and data collection within national statistical offices
- Further development and utilisation of indicators for sustainable development

4.8 Linking GECAFS-Caribbean research with GECAFS international networks

GECAFS-Caribbean will undertake research on impacts, adaptation and feedbacks (Q1-3) relating to the policy issues identified in the planning process. Such research is conducted in close association with GECAFS conceptual and methodological research worldwide on generic topics derived from science questions and policy issues. In addition to directly addressing Q1-3, GECAFS-Caribbean case study and other regional research will be networked with the worldwide GECAFS conceptual research agenda (Figure 3). This allows regional scientists to contribute to a global undertaking and build contacts with scientists working on similar issues in other parts of the world. This approach relates to all GECAFS conceptual research as follows:

Food systems concepts. Applying standard GECAFS methods in the Caribbean that capitalise on regional heterogeneity will provide valuable insights into the methods' robustness and will feedback into further conceptual development of the approach.

Food system vulnerability to GEC and adaptation. As noted in Section 3.4.2, considerable vulnerability research is underway in Caribbean (e.g. CPACC-MACC). This needs to be enhanced and focussed on food systems research relating to GEC aspects. Case study research on vulnerability, impacts and adaptation, when networked with other regional research will contribute to the overall development of this topic and enhance its applicability to policy and practice.

Regional scenarios for GECAFS studies. Methods for cross-scale linkages explored in the prototype scenarios exercise will be refined and regional scenario workshops will be used to construct up to four Caribbean scenarios combining socioeconomic and environmental conditions. The proposed GECAFS-Caribbean scenarios research will be networked with similar GECAFS efforts in other regions to help provide stronger conceptual frameworks for global-regional cross-scale linking.

Decision support research. This aims to refine a mechanism to integrate research activities to provide information to policy developers. It will encompass a range of approaches and tools, ranging from general discussions and mutual awareness-raising (including formal joint exercises such as scenarios construction and analyses) to simulation modelling, GIS and other tools for conducting quantitative analyses of trade-offs associated with policy options.

Regional researchers will be invited to join worldwide GECAFS research networks via the GECAFS Forum (see www.gecafs.org) and participate in international integration and synthesis activities.

4.9 Links to IGBP, IHDP & WCRP Core and ESSP Joint Projects

Research at a sub-continental scale is important. In addition, it also brings possibilities for collaboration with other GEC programmes working at similar spatial scales. These include research in other GECAFS regional projects and in other ESSP Joint Projects (see Table 1).

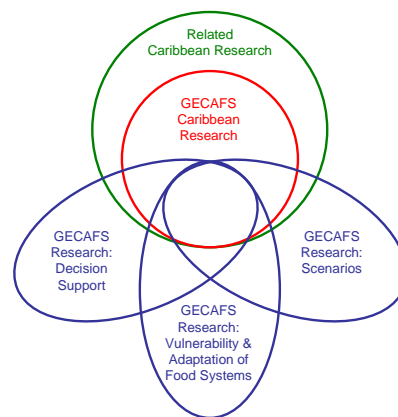


Figure 3. The relationship between GECAFS-Caribbean and conceptual research.

Table 1: Example potential collaborative activities with other International GEC Projects

International Project	Potential collaboration with GECAFS-Caribbean
IGBP-GLOBEC	Regional marine fisheries, e.g. CLIOTOP
IGBP/IHDP-GLP	FS policy/LUC links; vulnerability/resilience concepts
IGBP/IHDP-LOICZ	Vulnerability of coastal zone systems
IHDP-GECHS	Concepts of vulnerability
IHDP-IDGEC	Relationship between CARICOM and national policy
WCRP-CLIVAR	Extending and improving ENSO predictions
WCRP-GEWEX	Land surface changes in the hydrological cycle
ESSP-GECHH	GEC-induced changes in vector-borne disease
START-AIACC	Adaptations to climate change

5

GECAFS-Caribbean Funding Strategy and Governance

GECAFS-Caribbean research projects will use this Plan to apply for funding from regional and international organisations. Coordination funds will be raised to cover general regional networking activities, the science-policy interface and research management. A GECAFS-Caribbean Regional Coordinating Committee (RCC) will be established and a Regional Coordinator appointed. The RCC will provide scientific oversight of GECAFS-Caribbean, supported by the Regional Coordinator.

The GECAFS-Caribbean agenda primarily supports development issues related to the region as a whole. As a result, development agencies are expected to be the principal sources of funding for case study Q1-Q3 research. However, because the innovative research agenda also contributes to – and is strengthened by – GECAFS conceptual research (e.g. improved insights into food systems vulnerability and scenario construction), additional support will be sought from science agencies (the traditional investors in GEC research). This approach is welcomed across the donor community because it allows them to support common goals.

5.1 Funding strategy and indicative budget

The GECAFS-Caribbean funding strategy will be developed by the GECAFS-Caribbean RCC (see Section 5.2.1) and the GECAFS IPO. Donors will be approached to establish a GECAFS-Caribbean coordination fund. An indicative budget for the 5-year project is US\$100k per year which will cover:

- Regional Coordinating Committee travel (\$15k)
- Regional Coordinator post and operating costs (\$50k + \$15k)
- Seed funds for regional networking and synthesis exercises (\$20k)

Establishing this coordination fund will be critical to the successful implementation of GECAFS-Caribbean. It will allow for the integrated package of case studies, regional synthesis and communication with stakeholders to be

coordinated from within the region, overseen by leading regional scientists. This approach will encourage regional collaboration and help ensure wide scientific and policy contributions and capacity building.

The conceptual research aspects will be developed in close collaboration with the GECAFS international networks. Proposals prepared to science funding agencies for specific activities (e.g. regional scenario methodological development) will thereby complement the activities covered by the core fund.

5.2 Governance

5.2.1 Regional Coordinating Committee

The GECAFS Executive Committee, in consultation with the GECAFS SAC member responsible for the region, will establish a six-person GECAFS-Caribbean RCC comprising:

- Chair: GECAFS SAC member with responsibility for GECAFS-Caribbean region (*ex officio*)
- Four members representing regional and skills coverage and science/policy balance
- Host institution representative (*ex officio*)

The GECAFS-Caribbean Regional Coordinator will serve as Secretary. The GECAFS Executive Officer will attend key meetings to help ensure links with the overall GECAFS project.

The RCC (Figure 4) will:

- provide overall scientific guidance for GECAFS-Caribbean
- help prepare funding proposals for Specific Projects with the GECAFS IPO
- maintain financial oversight of the coordination fund and report to donors
- identify relevant regional research to network within the region and with GECAFS internationally
- maintain a quality control on endorsed network research
- organise regional synthesis workshops

- be transparent in operation and have an independent relationship with research teams
- be served by a Regional Coordinator based in an appropriate regional institution administered by a regional institute
- establish and maintain good links with CARICOM, IICA, IAI
- establish and maintain good links with regional, national and district policymakers
- report via the Chair/Regional Coordinator to the GECAFS SAC and to donors

Further details will be established with potential donors.

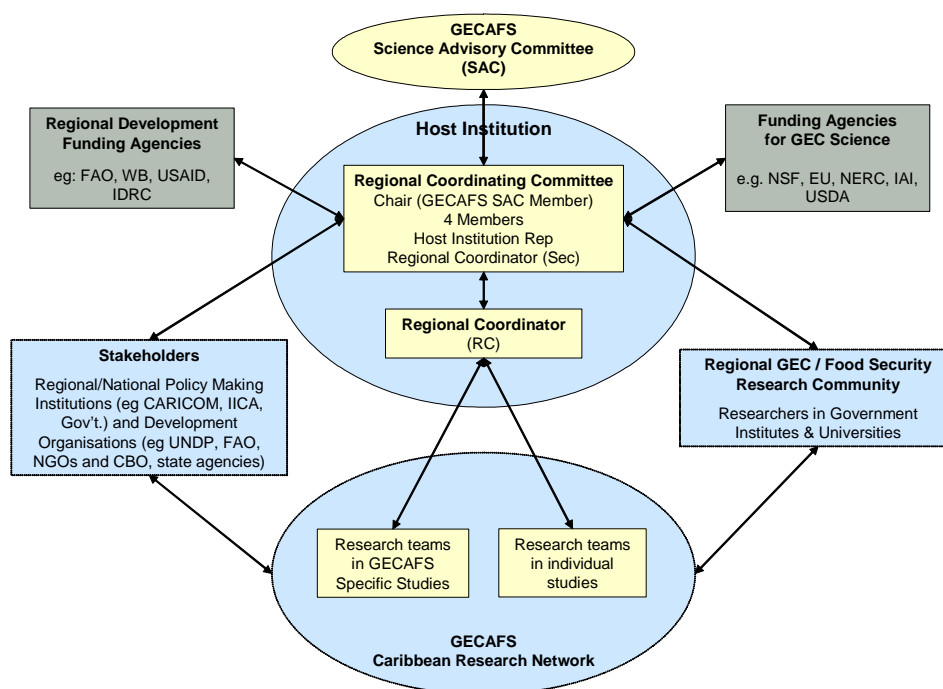


Figure 4: GECAFS-Caribbean Governance and Management Structure

5.2.2 GECAFS-Caribbean regional coordinator

A Regional Coordinator will be appointed and the position funded as a specific budget line in the core grant (cf. 5.1 above). The position will coordinate all aspects of the GECAFS Caribbean project, and in particular:

- help launch and facilitate all aspects of GECAFS-Caribbean research;
- plan and facilitate integration and synthesis exercises;
- maintain close working links with strategic partners and donors;
- develop an external communication (or outreach) programme;
- maintain project accounts and prepare financial statements;
- manage the project office on a day-to-day basis; and
- report to the RCC.

The GECAFS-Caribbean Regional Coordinator will be jointly appointed by CCCCC and UWI, and will be based in the Project’s host institution.

5.2.3 Host Institution

The project office will be based in an appropriate regional institution which

- will host the Regional Coordinator and RCC meetings;
- provide effective communication and administrative support, and credible finance management;
- already have a mandate to cover GEC and/or food issues for the region; and
- will be willing and able to promote GECAFS in the region.

6

Conclusions

The *GEC.AFS-Caribbean Science Plan and Implementation Strategy* offers an innovative and timely research framework on improving regional food security in the context of environmental stress. This is an issue of growing importance for the region.

This Plan:

- provides an integrated approach to food security and GEC research which will deliver a range of interim and longer-term policy-relevant products
- is based on a comprehensive set of research questions derived from wide regional consultation
- directly addresses the stated information needs of regional policy and development agencies
- builds on, and adds value to, existing research findings and infrastructure
- networks researchers both regionally and internationally
- contributes to an internationally endorsed research agenda

Principal outputs will include:

- improved understanding of how GEC will additionally affect food security across the region and among different socioeconomic groups
- assessments of how adaptation strategies designed to cope with GEC and changing demands for food will affect the environment, societies and economies
- enhanced regional capacity in food security and environmental research
- strengthened regional policy formulation capacity for food security and environmental governance
- policy recommendations for adaptation options

1 Annex

Global Environmental Change and Food Systems (GECAFS): A summary

Global Environmental Change and Food Systems (GECAFS) is an international, interdisciplinary research project focussed on understanding the links between food security and global environmental change. GECAFS was launched in 2001 as a Joint Project of the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP) and the World Climate Research Programme (WCRP), and has formal research partnerships with the Consultative Group on International Agricultural Research (CGIAR), the UN Food and Agriculture Organisation (FAO) and the UN World Meteorological Organisation (WMO).

The GECAFS goal is to determine strategies to cope with the impacts of global environmental change on food systems and to assess the environmental and socioeconomic consequences of adaptive responses aimed at improving food security. GECAFS undertakes research that not only studies food security in the context of GEC but also the feedbacks of adaptation strategies to the Earth system.

GECAFS addresses three major questions of interest to science, development and society:

- (i) How will global environmental change affect the vulnerability of food systems in different regions?
- (ii) How can we adapt food systems to cope with global environmental change and improve food security?
- (iii) How will various adaptation options feedback on environmental and socioeconomic conditions?

GECAFS is addressing these questions by bringing together and synthesising a worldwide portfolio of conceptual and methodological research and closely linking this to a set of regional projects.

Conceptual and methodological research topics include:

- *Food systems*, to improve understanding of the interactions between food systems and Global Environmental Change
- *Vulnerability and adaptation*, to (i) integrate social science and natural science concepts of what makes a food system vulnerable to GEC; and (ii) use this understanding to investigate adaptation options
- *Scenarios*, to construct plausible futures of socioeconomic and environmental conditions for food systems analysis
- *Decision support*, to improve dialogue between scientists and policymakers on the interactions between food security and environment

Regionally-based projects investigate GEC impacts on food security, food system adaptation options and possible feedbacks of different interventions, in the context of policy formulation. They are designed at the sub-continental scale, which is an important spatial scale for food security, food system research and GEC considerations. Initial GECAFS regional projects are underway for the *Indo-Gangetic Plain*, the *Caribbean*, and *Southern Africa*. Collectively they cover a range of major GEC issues and food systems.

More information on GECAFS is available from www.gecafs.org.

2 Annex

Developing a GECAFS research agenda for the Caribbean

An important aspect of the GECAFS regional approach is to ensure that the research agenda closely matches major regional GEC science interests, policy needs and donor priorities. The process to achieve this constituted the project planning phase and involved workshops⁴, informal conversations and discussions with a wide range of potential stakeholders in the region.

Caribbean scientists and policy makers have been in consultation with the GECAFS Executive Committee to develop a GECAFS food systems project for the Caribbean. Recognising the complexity of the research issues, the development of the GECAFS Caribbean project was seen to involve two major stages (cf. Section 4.5):

- Stage I Preparation and scoping – identifying the issues; defining research agenda, and publication of this Plan
- Stage II Project implementation – synthesis and assessment of existing information and current conditions; food systems case studies; development of GEC and food systems vulnerability assessment, scenarios and prototype decision support systems; assessing adaptation strategies; strengthening regional policy formulation capacity; reporting policy recommendations

Co-funded by USAID, NOAA-OGP, IAI and UK-NERC, Stage I consisted of a series of scoping meetings with regional scientists and policy makers. These both crystallized the nature of the regional policy issues relating to food security and helped raised awareness of GEC issues within the region generally. Specifically, Stage I (i) initiated dialogue within the GECAFS framework between national scientists & policy makers to determine overall GEC issues in the region (April 2002, Trinidad); (ii) reviewed key climate change impacts

research and identified critical research topics (September 2002, Trinidad); and (iii) identified GECAFS scientific objectives and potential collaborators (October 2002, St Lucia). Key overarching questions were also determined:

- How will GEC (especially land degradation, variability in rainfall distribution, sea surface temperature, tropical storms and sea-level rise) affect vulnerability of food systems in the Caribbean?
- What combinations of policy and technical diversification in food harvested and traded for local consumption, in export commodities and in tourism would best provide effective adaptation strategies?
- What would be the consequences of these combinations on national and regional food security, local livelihoods and natural resource degradation?

Follow-up discussions (Barbados, February & May 2003) refined these into a coherent set of researchable questions relating to the national issues and the regional as a whole. An Interim Steering Group oversaw the development of the Stage I and prepared this proposal. Membership comprised representatives from the Caribbean Agricultural Research and Development Institute (CARDI), CARICOM Fisheries, United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), Caribbean Institute of Meteorology and Hydrology (CIMH), Food and Agriculture Organisation (FAO), Mainstreaming Adaptation to Climate Change (CPACC-MACC), the University of the West Indies (UWI) and GECAFS Executive Committee.

An interim Stage I output was presented to the CARICOM Council for Trade and Economic Development (COTED, Guyana, 27 May 2003) and the GECAFS Caribbean project was there formally endorsed as an important regional activity. This is highly significant and is a direct consequence of the detailed workshops and discussions with regional policy-makers to establish their information needs relating to GEC and food systems. There is also formal collaboration with FAO and WMO, both of whom work closely with the policy

⁴ See www.gecafs.org

community; and with those components of the CGIAR which are more strongly policy-orientated. The overall planning was continued with aid of a USAID SANREM CRSP planning grant. Coupling these funds with those from the GECAFS IPO and USDA/ARS, three project planning workshops were conducted in 2005 (Washington D.C., May; Georgetown, Guyana, June; and Kingston, Jamaica, August).

The development of the GECAFS-Caribbean Science Plan and Implementation Strategy has followed the overall international project approach for developing GECAFS regional research. Figure A2.1 shows the main steps in this process, and the publication of this plan is the culmination of the planning stage (Steps 1-3). (Steps 4-6 constitute research implementation as described in Section 4.)

Step 1 Regional scientists interested in GECAFS interdisciplinary approach were identified from IGBP, IHDP and WCRP contacts and National Committees and a GECAFS initial regional planning group was established.

Step 2 Working with the initial regional planning group, regional science, policy and potential donor interests and information needs were identified in a series of workshops (see Figure A3.2, and Annex 3), consultancies and informal contacts.

Step 3 Working with the initial regional planning group, and with other stakeholders, GECAFS regional research questions were established and the GECAFS-Caribbean Science Plan and Implementation Strategy developed and published.

Step 4 Working with the initial regional planning group and joined by Core Project/ESSP representatives as appropriate, establish regional research/Core Project/ESSP collaboration and jointly design and implement GECAFS analyses.

Step 5 Working with regional scientists and policy community, and Core Project/ESSP representatives as appropriate, deliver and interpret GECAFS results in policy context.

Step 6 Integrate results across GECAFS studies in other regions to develop improved generic understanding of food systems and their vulnerability to GEC, scenarios and decision support.

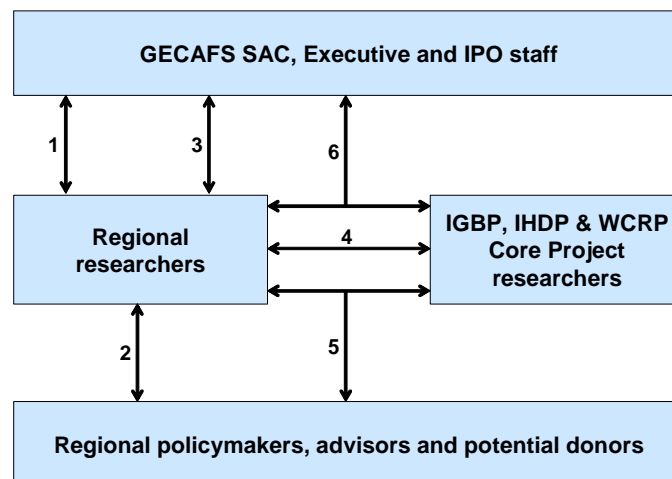


Figure A2.1 Key steps in design (Steps 1-3) and implementation (Steps 4-6) of GECAFS-Caribbean food systems research

3 Annex

Examples of regional research relevant to the GECAFS-Caribbean agenda

Regional research activity	GECAFS Regional Research			GECAFS Conceptual Research			
	Q1: Vulnerability & Impacts	Q2: Adaptations	Q3: Feedbacks	Food systems	Food system vulnerability	Scenario construction	Decision support
Caribbean Agricultural Research and Development Institute (CARDI)	<ul style="list-style-type: none"> Effects of climate change, effects of warmer temperatures, natural disasters, warmer seas rainfall patterns and coastal erosions on food security. Parham, 2005 	<ul style="list-style-type: none"> Adaptation to environmentally friendly agricultural practices The role of biotechnology in enhancing food security. <i>Paul, 2001</i> Identification of management systems to optimize the water and land resources. <i>Paul and Opadeyi, 2001</i> 	<ul style="list-style-type: none"> Effects on the environment of agricultural practices for hillside agricultural production. Simpson et al., 2002 Social, environmental and economic implications of increased soil erosion and agro-chemical use. Impact of continued heavy use of pesticide and chemicals on the environment. 	<ul style="list-style-type: none"> Key aspects of the food system. Simpson et al., 2002 Conceptual definition of some key aspects of the food system. CARDI, 2002 	<ul style="list-style-type: none"> Vulnerability of food systems to increasing incidents of pest and disease. Clark-Harris, 2002 Vulnerability of the food system through poor farming practices on hillsides. Simpson et al., 2002 		<ul style="list-style-type: none"> Surveys and decisions in the context of multidisciplinary programmes. Laloë et al., 2001 Recommendations on Good Agricultural Practices. Simpson et al., 2002; Simpson 2003 Proposals or decisions put forward based on the indicators/ problems identified in agriculture, ecosystem and environment
Caribbean Climate Change Center: Mainstreaming Adaptation to Climate Change	<ul style="list-style-type: none"> Key climate factors affecting the Caribbean 	<ul style="list-style-type: none"> Cultural, political and community adaptations to GEC 				<ul style="list-style-type: none"> Climate aspects of Regional scenario construction 	
Caribbean Disaster Management Project (CADM)		<ul style="list-style-type: none"> Mitigation of flooding hazard 					

Regional research activity	GECAFS Regional Research			GECAFS Conceptual Research			
	Q1: Vulnerability & Impacts	Q2: Adaptations	Q3: Feedbacks	Food systems	Food system vulnerability	Scenario construction	Decision support
CARICOM Fisheries Resource Assessment and Management Programme (CFRAMP)		<ul style="list-style-type: none"> Establishment of advisory mechanism and regional fisheries mechanism 					<ul style="list-style-type: none"> Preparation of fisheries management plan
Caribbean Food and Nutrition Institution (CFNI)	<ul style="list-style-type: none"> Food Security and health. Ballyram et al., 2003 			<ul style="list-style-type: none"> Food system paradigms 			
Caribbean Hazard Mitigation Capacity Building Programme (CHAMP)		<ul style="list-style-type: none"> Mitigation of flooding hazard 					
Caribbean Health and Environment Institute	<ul style="list-style-type: none"> GEC impact on food productivity 				<ul style="list-style-type: none"> Vulnerability of food system to GEC 	<ul style="list-style-type: none"> Climatic and land use change scenarios 	
Caribbean Institute for Meteorology and Hydrology (CIMH)	<ul style="list-style-type: none"> Aquifer vulnerability studies (salt water intrusion) 						
Caribbean Marine Research Center, "Perry Institute for Marine Sciences" (CMRC).	<ul style="list-style-type: none"> Impacts on coral reef species 	<ul style="list-style-type: none"> Increasing productivity of Caribbean spiny lobster 				<ul style="list-style-type: none"> Long-term oceanographic and climatic conditions data. Wellington et al., 2001; Powel et al., 2002 	<ul style="list-style-type: none"> Improving the design of marine reserves in the Caribbean
Caribbean Natural Resources Institute	<ul style="list-style-type: none"> An assessment of the likely impacts of Global Environmental Change on potential sustainable livelihoods strategies and options that would be considered for climate change adaptation 	<ul style="list-style-type: none"> Research and documentation of examples of community adaptation in post-disaster circumstances as a proxy to Global Environmental Change. 	<ul style="list-style-type: none"> Research on the process of building consensus to Global Environmental Change project outcomes/outputs and policy options among community stakeholders The development of the tools and methods that create opportunities for community and stakeholder participation and support for the building of consensus on Global Environmental Change specific adaptation strategies and policies 				

Regional research activity	GECAFS Regional Research			GECAFS Conceptual Research			
	Q1: Vulnerability & Impacts	Q2: Adaptations	Q3: Feedbacks	Food systems	Food system vulnerability	Scenario construction	Decision support
FAO Regional Project Management Unit		<ul style="list-style-type: none"> Role of irrigation technology, trade policy, household and community nutrition 		<ul style="list-style-type: none"> Conceptual definition of some key food system issues 			<ul style="list-style-type: none"> Food security assessment in CARICOM
GECAFS-Caribbean Project						<ul style="list-style-type: none"> Prototype Caribbean Scenarios for Research on GEC and Regional Food Systems. GECAFS, 2006 	
Inter-American Institute for Cooperation on Agriculture (IICA)		<ul style="list-style-type: none"> Improving the competitiveness of the food system 		<ul style="list-style-type: none"> Key aspects of food systems 			
Ministry of Agriculture - St. Lucia	<ul style="list-style-type: none"> Increasing demand for water supply and its impact on the food system. Issac, 2002 						
UNESCO	<ul style="list-style-type: none"> GEC impact on productivity of the food systems. PLEC, 2003 	<ul style="list-style-type: none"> Technological advances to deal with food security issues 					<ul style="list-style-type: none"> Policy proposal to combat the effects of climate change. PLEC, 2003
University of Guyana		<ul style="list-style-type: none"> Strategies to deal with food insecurity. Thomas, 2003 					
University of the West Indies St Augustin Campus	<ul style="list-style-type: none"> Climate Change Impact on Sugarcane performance. Gouvía et al., 2001a 	<ul style="list-style-type: none"> Factors affecting soil erosion in the Caribbean. Gumbs, 2001 Measures to mitigate soil erosion in agriculture. Gouvía, 2003 	<ul style="list-style-type: none"> The impact of management and land use practices on CO2 emissions from soil. Gouvía et al., 2001b 		<ul style="list-style-type: none"> Impacts of climate change on Caribbean Food Systems. Singh et al, 2003 The economics of adaptation to Climate change in Caribbean. Marlene, 2004 		<ul style="list-style-type: none"> The economics of adaptation to Climate change in Caribbean. Marlene, 2004
University of the West Indies Mona Campus	<ul style="list-style-type: none"> Coastal changes Robinson, 2001 Water quality and plankton of the Conch Fishery. Small et al., 2003 Sea water temperature variation. Quinn et al., 2001 Potential impact of climate change and severe weather events on urban water resources. Spence and Jones, 2003 	<ul style="list-style-type: none"> Environmental management and planning. Webber, ongoing 				<ul style="list-style-type: none"> Environment, resources, and development. McGregor et al, in press 	<ul style="list-style-type: none"> Analysis of long-term trends in coastal change Robinson, 2001 Coastal ecosystem monitoring under the CARICOM protocol, including deep reefs. Gayle, ongoing The role of environmental management in Caribbean economic development.. Hope, 2001

4 Annex

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5

Annex

Acronyms and abbreviations

AIDS	Acquired Immunodeficiency Syndrome
BPoA	Barbados Programme of Action
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community
CARICOM-COTED	Caribbean Community Council for Trade and Economic Development
CCCCC	Caribbean Community Climate Change Centre
CDERA	Caribbean Disaster Emergency Response Agency
CEHI	Caribbean Environmental Health Institute
CFNI	Caribbean Food and Nutrition Institute
CFRM	Caribbean Regional Fisheries Mechanism
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International Development Agency
CIMH	Caribbean Institute for Meteorology and Hydrology
CLIVAR	International Research Programme on Climate Variability and Predictability
CPACC-MACC	Caribbean Planning for Adaptation to Climate Change -Mainstreaming Adaptation to Climate Change
CSE	CARICOM Single Economy
CSM	CARICOM Single Market
CSME	CARICOM Single Market and Economy
DS	Decision Support
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
EEZ	Exclusive Economic Zones
ENSO	El Niño/Southern Oscillation
ESSP	Earth System Science Partnership
EU	European Union
FAO	United Nations Food and Agriculture Organisation
FAO-RSPFS	Regional Special Programme for Food Security

GDP	Gross Domestic Product
GEC	Global Environmental Change
GECAFS	Global Environmental Change and Food Systems
GECHH	Global Environmental Change and Human Health
GECHS	Global Environmental Change and Human Security
GEF	Global Environment Facility
GEWEX	Global Energy and Water Cycle Experiment
GIS	Geographic Information Systems
GLOBEC	Global Ocean Ecosystem Dynamics
GLP	Global Land Project
HIV	Human Immunodeficiency Virus
IAI	Inter-American Institute for Global Change Research
ICSU	International Council for Science
IDGEC	Institutional Dimensions of Global Environmental Change
IDRC	International Development Research Council
IGBP	International Geosphere - Biosphere Programme
IHDP	International Human Dimensions Programme on Global Environmental Change
IICA	Inter-American Institute for Cooperation on Agriculture
IPO	International Project Office
IWCAM	Integrating Watershed and Coastal Areas Management
LOICZ	Land-Ocean Interactions in the Coastal Zone
MA	Millennium Ecosystem Assessment
MEAs	Multilateral Environmental Agreements
NERC	Natural Environment Research Council of the UK
NGOs	Non-Governmental Organisations

NOAA	National Oceanic and Atmospheric Administration
NOAA-OGP	National Oceanic and Atmospheric Administration – Office of Global Programmes
NSF	National Science Foundation of the United States
ODI/RAPID	Overseas Development Institute / Research and Policy in Development
QnD	Questions and Decisions
RCC	Regional Coordinating Committee
SAC	Scientific Advisory Committee
SANREM-CRSP	Sustainable Agriculture & Natural Resources Management - Collaborative Research Support Program
SIDS	Small Island Developing States

START-AIACC	global change SysTem for Analysis, Research and Training - Assessments of Impacts and Adaptations to Climate Change
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
USDA/ARS	United States Department of Agriculture / Agricultural Research Service
UWI	University of the West Indies
WB	World Bank
WCRP	World Climate Research Programme
WMO	World Meteorological Organisation

6

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