

**“Strengthening the foundation for a climate  
responsive agricultural sector in the Caribbean”  
“AgREADY Project”**

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## **Acronyms and Abbreviations**

AAC	Agricultural Advisory Committee
ACCF	Africa Climate Change Fund
ADB	Agriculture Development Bank
ADB	Asian Development Bank
ADRM	Agriculture Disaster Risk Management
AE	Accredited Entity
AF	Adaptation Fund
AFD	French Development Agency
AFDB	African Development Bank
AFOLU	Agriculture, Forestry, and Other Land Use
ASAP	Adaptation for Smallholder Agriculture Programme
ATGS	Agriculture Transformation and Growth Strategy
BAEF	Barrier Analysis Enabling Framework
BANA	Barrier Analysis and Needs Assessment
BDB	Bahamas Development Bank
BMZ	Federal Ministry for Economic Cooperation and Development
CARDI	Caribbean Agriculture Research and Development Institute
CARICOM	Caribbean Community
CATIE	Tropical Agricultural Research and Higher Education Center
CAYF	Caribbean Agriculture Forum for Youth
CC	Climate Change
CCA	Climate Change Adaptation
CCAFS	Research Program on Climate Change, Agriculture, and Food Security
CCCCC	Caribbean Community Climate Change Center
CCORAL	Caribbean Climate Online Risk and Adaptation Tool
CDB	Caribbean Development Bank
CDM	Clean Development Mechanism
CDMA	Caribbean Disaster Emergency Management Agency
CDSS	Climate Decision Support System
CIDA	Canadian International Development Agency
CIF	Climate Investment Fund
CIMH	Caribbean Institute for Meteorology and Hydrology
COP	Conference of the Parties
CPI	Climate Policy Initiative
CR	Climate Resilient
CRA	Climate Resilient Agriculture
CRRP	Climate Resilience and Recovery Plan
CSA	Climate Smart Agriculture
CSGM	Climate Studies Group Mona
CTF	Clean Technology Fund
CVQ	Occupational Standards of Competence for Caribbean Vocational Qualifications
DEXIA	Dominica Export-Import Agency
DFI	Development Finance Institution
DFID	Department for International Development, U.K.
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction



DVRP	Disaster Vulnerability Reduction Project
EbA	Ecosystems-based Adaptation
EBRD	European Bank for Reconstruction and Development
ECLAC	Economic Commission for Latin America and the Caribbean
EU	European Union
EU ETS	European Union's Emissions Trading Scheme
EX-ACT	Ex-Ante Carbon-balance Tool (EX-ACT)
Ex-Im	Export-Import Bank of the United States
FAO	Food and Agriculture Organization
FCPF	Forest Carbon Partnership
FDI	Foreign Direct Investment
FFEM	French Global Environment Facility
FFS	Farmer Field School
FI	Financial Institution
FIP	Forest Investment Program
GAFS	Global Agriculture and Food Security Program
GCCA	Global Climate Change Alliance
GCCI	Global Climate Change Initiative (US)
GCF	Green Climate Fund
GCPF	Global Climate Partnership Fund (Germany, UK, and Denmark)
GDP	Gross Domestic Product
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIIF	Global Index Insurance Facility
GIZ	German Technical Cooperation
GSDS	Growth and Sustainable Development Strategy
ICF	International Climate Fund (UK)
ICFI	International Climate Forest Initiative (Norway)
ICI	International Climate Initiative (Germany)
ICT	Information and Communication Technology
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFI	International Financial Institutions
IICA	Inter-American Institute of Cooperation on Agriculture
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
JBIC	Japan Bank of International Cooperation
JICA	Japan International Cooperation Agency
KfW	German Development Bank
LDCF	Least Developed Countries Fund
MDB	Multilateral Development Bank
MOA	Ministry of Agriculture
MSME	Micro, Small and Medium Enterprises
NaGRiP	National Agricultural Policy
NAMA facility	Nationally Appropriate Mitigation Action Facility (UK and Germany)
NAMDEVCO	National Agricultural Marketing and Development Corporation

NAP	National Adaptation Plan
NASAP	National Adaptation Strategy and Action Plan
NC	National Communications
NCCSC	National Climate Change Sector Committee
NCCU	Nevis Cooperative Credit Union
NDA	Nationally Designated Authority
NDC	Nationally Determined Contribution
NDFD	National Development Foundation of Dominica
NFAP	National Food and Agricultural Policy
NFPAP	National Food Production Action Plan
NGO	Nongovernmental Organization
NLC	National Liaison Consultant
NORAD	Norwegian Agency for Development Cooperation
OECD	Organization for Economic Co-operation and Development
OPIC	Overseas Private Investment Corporation
PICSA	Participatory Integrated Climate Services for Agriculture
PPCR-CIF	Pilot Program for Climate Resilience, Climate Investment Fund
PPP	Public-Private Partnership
PWD	Persons With Disabilities
R&D	Research and Development
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SASAP	Sectoral Adaptation Strategy and Action
SBU	Small Business Unit
SCCF	Special Climate Change Fund
SDG	Sustainable Development Goal
SIDS	Small Islands Developing States
SLF	Sustainable Livelihoods Framework
SME	Small and Medium Enterprise
SOFA	FAO State of Food and Agriculture report
SREP	Scaling-Up Renewable Energy Program
TIMPs	Technology, Innovation and Management Practices
TNA	Technology Needs Assessment
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention for Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
UWI	University of the West Indies
VA	Vulnerability Assessment
WB	World Bank
WFP	World Food Programme
WMS	Weighted Mean Score
WTP	Willing to Pay
YAP	Youth Action Plan

## Executive Summary

# Chapter 1: Policy angle

## Introduction

**The Caribbean region comprises small and low-lying developing states that are resource-rich, and highly diverse but which face significant socio-economic challenges.** The Caribbean is endowed with abundant natural resources, rich biodiversity, and a warm, tropical climate upon which economic development and way of life have been premised. Over recent decades, socioeconomic development within Caribbean states has been hampered by a plethora of challenges that include low and variable economic growth; unsustainable debt and weak fiscal management; high unemployment; high prevalence of non-communicable diseases; vulnerability to the effects of climate change and natural hazards; environmental degradation; crime and increasing threats to citizen security; as well as persistent and extreme poverty and food insecurity (FAO and CDB 2019).

**The agriculture sector remains of vital socioeconomic importance in the Caribbean region despite being affected by a multiplicity of challenges, which have contributed to a steady decline in national and regional throughput over the past few decades.** The agriculture sector, which is highly dependent on natural resources, plays a multifunctional role in socioeconomic development as it remains a significant employer and contributor to the Gross Domestic Product (GDP) in several Caribbean states. For example, in Dominica, Haiti, Belize, Suriname and St. Vincent and The Grenadines, GDP contributions averaged between 7 and 20 percent over the last five years, with employment ranging from 8 to 30% of total employment in 2019 (World Bank 2022). The sector, however, has been marked by several challenges, including low competitiveness, low productivity (**Box 1**), slow growth, high trade costs, low capacity to comply with modern food safety and quality standards, as well as an inadequate response to the rapidly growing demands for high-standard, agri-food products from the tourism, processing and retailing sectors, which has led to increased imports (FAO and CDB 2019). Across the region, there are significant interlinkages between these challenges and other national, regional and international issues that have contributed to economic downturn within individual Caribbean states.

### Box 0: Factors Contributing to Low Productivity in the Agriculture Sector

“The productivity of agriculture is constrained by a broad set of factors, including inadequate access to improved varieties and other technologies, low access to credit, high labour costs, insufficient monitoring and response to pests and diseases, and inadequate skills and entrepreneurship among farmers.

The productivity of the livestock sector is constrained by several additional factors, including the low availability (and high prices) of quality feed – due to limitations in large-scale feed production and limited availability of grazing lands. Theft, low-quality feed concentrate, and low-quality breeding stock are other factors that specifically limit the productivity of the livestock sector.” – FAO and CDB 2019

**Threats such as climate change and the COVID-19 pandemic have exacerbated existing issues and resulted in reduced agricultural production and productivity in many instances, contributing to food insecurity within the region.** The agriculture sector has been identified as one of the most at-risk sectors to climate change in Caribbean countries, owing to its high dependency on natural resources and its multifunctional role in socioeconomic development. Across the region, changes in climate such as increasing temperatures, droughts, flooding, storms and rising sea levels, have resulted in significant losses in the sector (CSGM 2020). Temperature

increases have contributed to water loss, and more favourable conditions for certain pests and diseases, ultimately affecting crop production and yields. Droughts have also resulted in reduced crop yields, and extreme events such as flooding and hurricanes has cause significant crop losses. Sea level rise affects crop production and availability of arable lands. Within the livestock subsector, higher temperatures result in heat stress, which can lead to death in extreme cases, and negatively impact livestock and animal protein production (CSGM 2020). These conditions are generally expected to worsen given the projections for increasing temperatures, more variable rainfall, rising sea levels and more intense extreme events. In addition to climate change, the sector has also demonstrated vulnerability to the COVID-19 pandemic and externalities such as the Russia-Ukraine war, which have resulted in reduced availability and elevated prices of inputs and imported foods. These factors have contributed to the regional food and nutrition security situation being unstable and unpredictable, with elevated food prices and many persons in the region being severely food insecure.

**The complexity of the challenges facing the agriculture sector make a strong and urgent case for a cohesive and collaborative transition to climate-resilient agriculture within the region.** Climate-resilient agriculture (CRA) is an approach that involves sustainably using existing natural resources through crop and livestock production systems to achieve long-term higher productivity and farm incomes under climate variabilities (Srinivasarao 2021)<sup>1</sup>. While there have been several efforts geared towards implementing CRA technologies and practices, the region requires significant cohesiveness of policy, governance and operational elements as well as adequate human and financial resources in order to facilitate the transition of the sector to one that is climate-resilient.

## *1.1 About This Chapter*

**This chapter summarizes the key findings of a Barrier Analysis and Needs Assessment (BANA) of the enabling environment for** developing evidence-based climate-resilient responsive agriculture that is more attractive for private sector investments. The remaining sections of this chapter are organized as follows:

- *Section 2 (Approach and Methodology)* - Overview of the approach and methods used for the BANA, including record of key constraints and limitations.
- *Section 3 (Findings)* - Summary of the main BANA findings, including providing an overview of efforts towards CRA as well as critical barriers associated with the enabling environment, including the policy, legislative and regulatory framework, institutional arrangements/governance, financing, capacity building and knowledge management, social norms and behaviours, gender, youth and other vulnerable groups and adoption of technology.
- *Section 4 (Recommendations)*: Entry points for CRA in CARICOM AgREADY countries) Recommendations for strengthening the enabling environment for CRA in the Caribbean.

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<sup>1</sup> [https://www.downtoearth.org.in/blog/agriculture/climate-resilient-agriculture-systems-the-way-ahead-75385#:~:text=Climate%2Dresilient%20agriculture%20\(CRA\)%20is%20an%20approach%20that%20includes,farm%20incomes%20under%20climate%20variabilities.](https://www.downtoearth.org.in/blog/agriculture/climate-resilient-agriculture-systems-the-way-ahead-75385#:~:text=Climate%2Dresilient%20agriculture%20(CRA)%20is%20an%20approach%20that%20includes,farm%20incomes%20under%20climate%20variabilities.)

## 2. Approach and Methodology

### 2.1 Approach

Agriculture's high level of sensitivity to climate change, its characteristic as a significant global emitter of greenhouse gases (GHGs) as well as the mounting climate change related production and productivity decline in the sector emphasize the need for an increasingly robust and climate-resilient agriculture policy framework. The AgREADY Project BANA of the enabling environment takes an in-depth look at the agriculture sector in the countries within the CARICOM sub-region (**Figure 1**), with an aim to contribute to a better understanding of the critical bottlenecks, barriers and constraints to achieving climate-resilience in the sector, while providing pathways and entry points to overcome these, ultimately with the aim of developing evidence-based climate-resilient, responsive agriculture that is more attractive for private sector investments.

Figure 1: GCF CARICOM sub-regional AgREADY Project countries<sup>2</sup>



The assessment was conducted using a value chain approach, which focused the analysis of the enabling environment within the phases of the value chain (**Figure 2**). The literature posits that CRA requires coordinated actions among the range of stakeholders along the value chain, in so doing creating climate-resilient pathways by sustainably using existing natural resources through crop and livestock production systems to achieve long-term higher productivity and farm incomes under climate variabilities (Tankha *et al.*, 2019; Alvar-Beltrán *et al.* 2021,). Improved access and utilisation of technology, transparent trade

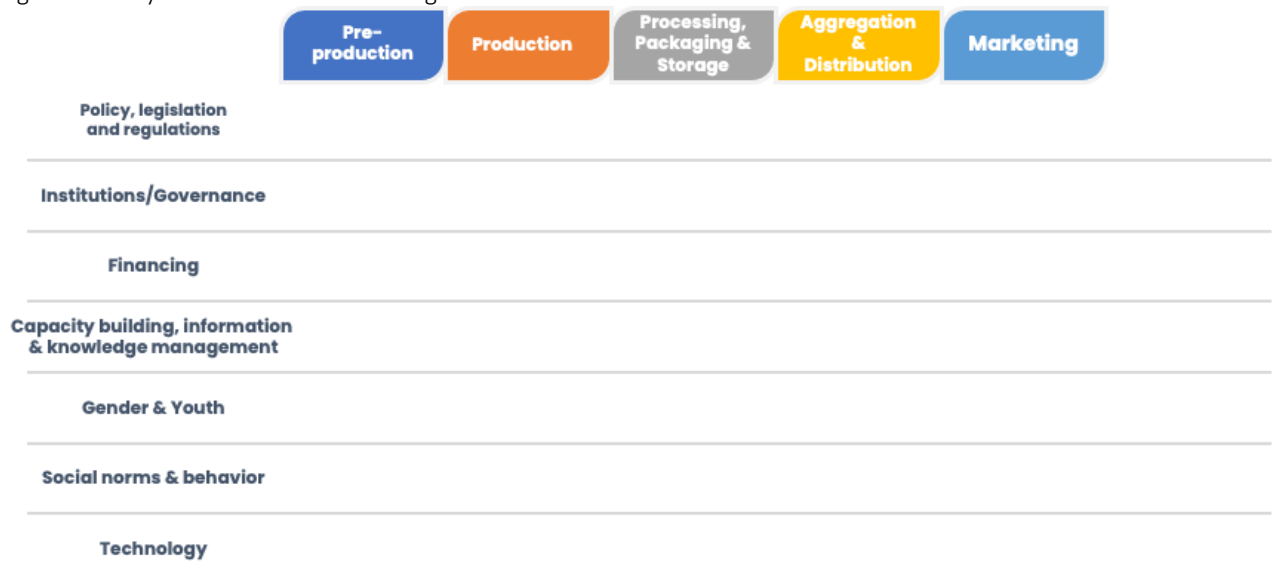
#### Box 0: Agri-food value chain

Agri-food value chains are designed to increase competitive advantage through collaboration in a venture that links primary producers, processors, marketers, food service companies, retailers and supporting groups such as shippers, research groups and suppliers. ([www.omafra.gov.ca](http://www.omafra.gov.ca))

<sup>2</sup> AgREADY Countries are represented with a black dot.

regimes, increased use of resources and conservation technologies, and increased adaptation of crops and livestock to climatic stress are the desired outcomes from implementing climate-resilient practices. The enabling environment for CRA encompasses factors that include: (1) innovation and transformational policies and corresponding governance structures to promote climate-resilient systems, (2) regulatory frameworks that stimulate innovation directly and indirectly, and (3) accompanying agricultural investments in rural credit, infrastructure and markets. These policies, investments, and regulatory reforms will trigger significant changes, such as improving the access of agricultural products to foreign markets, increasing private investment in agricultural R&D, and fostering the use of more sustainable agricultural practices and with the proper policy measures, people will make the transition to more promising economic activities.

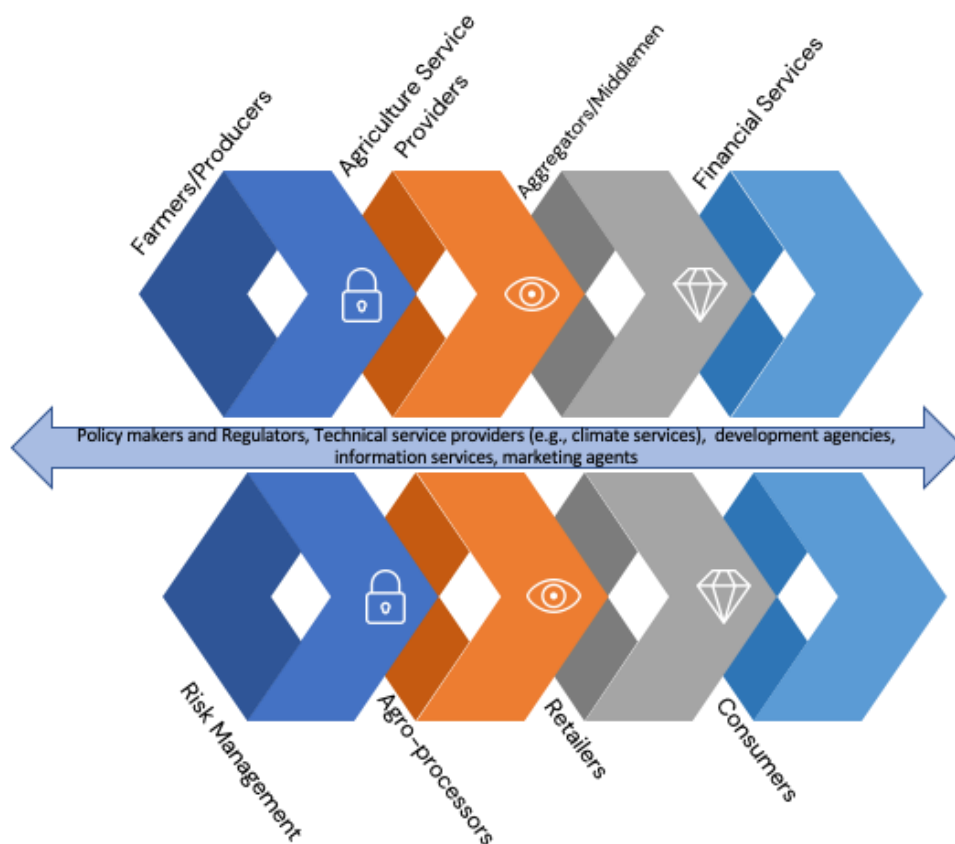
Figure 0: Analytical framework for the AgREADY BANA



## 2.2 Methodology

To meet the requirements of the CARICOM AgREADY Project, an exploratory mixed-methods approach was utilized for effective delivery of the policy-based BANA in a process of triangulation for verification and validation. This involved (i) a comprehensive review of pertinent documents, including those relating to the AgREADY project, regional and national agriculture sector policies, plans and projects, national development and sectoral plans, climate change policies, plans and programmes, and (ii) in-depth individual and group consultations with 101 value chain actors including online/remote focus group discussions with producers and producer groups and networks, GCF NDAs, and other stakeholders over a two-month duration (**Figure 3 and Annex 1**).

Figure 3: Primary (generalized) value chain actors for the AgREADY Project policy-based BANA



The BANA followed three key steps:

1. **Document review.** A preliminary review of documents sought to establish the contributory factors within the enabling environment that were responsible for, or linked to, the adoption of CRA. These were used to develop the consultation instrument for the range of value chain actors. **Annex 2** provides mapping of the key stakeholders and the focus areas for the consultations. Further document review sought to establish country and regional context for the BANA (including COVID-19 recovery plans) and was also used to refine the consultation instrument, contextualized to each country.
2. **Administer BANA data collection instrument.** The AgREADY Project NLCs supported this phase of data collection by carrying out logistics and facilitating the remote consultation meetings. The NLCs were also responsible for follow up with the key actors consulted for additional documents. Stakeholders (both public and private) within the agri-food value chain, identified in a stakeholder mapping process for each country, were consulted, with a snowball sampling method employed, allowing for the inclusion of others outside the initial sample. On average, consultations lasted 1-1.5 hrs. and included a set of open-ended questions, which offered flexibility and allowed for detailed discussion. The contents of the discussions were recorded in note form and digitally. These were finalized and key points matched with the different enabling factors.
3. **Collate and analyse the collected data and information.** All data and information collected, both via document review and direct stakeholder input, were collated and analysed. Gap filling exercises continued for a short time due to project time constraints.



4. **Conduct final analyses and develop BANA report.** Analyses of the data and information led to development of (i) key findings of progress, (ii) barriers to the enabling environment, and (iii) identification of entry points within the enabling environment for enhancing CRA ultimately with the aim of developing evidence-based climate-resilient, responsive agriculture that is more attractive for private sector investments.

The *Findings and Recommendations* sections of the report are built on the outputs of the above steps, supporting quantitative findings with qualitative narrative from the key informant interviews and documents reviewed. The report does not identify respondents in order to protect their anonymity but rather builds conclusions around the convergence of their opinions, triangulated with document review.

### *2.3 Methodological constraints*

The BANA primary data collection phase was conducted between May and June 30, 2022 but encountered country level limitations and constraints that must be acknowledged. These included:

1. Unavailability of stakeholders and unresponsiveness to the invitation to the discussions.
2. Unavailability of key stakeholders at the time of consultation meetings.
3. Stakeholder fatigue, due in large part, to multiple and similar activities ongoing simultaneously.
4. Slow pace with follow up to collect and collate documents, especially those noted during meetings.
5. Difficulty in locating pertinent documents.
6. Inability to access documents, including those in draft form but discussed in consultation meetings.
7. Incompleteness of data and information.
8. National Liaison Consultants (NLCs) fatigue due to multiple activities being implemented within a short timeframe, including administering multiple data collection instruments that proved to be time consuming. This resulted in few consultations for some countries and little support to the PA-designed farmer focus groups.
9. Challenges relating to completion of the planned consultations, with inadequacy of data at the local level.

Documents presented in French, and with few available for review made it difficult to grasp the situation in Haiti. Further to this, there was only one consultation for the country, and this did not adequately supplement the other sources. In other countries, changes in government made it difficult to conduct the assessment, especially where there was little to no buy-in for documents produced over five years ago. In instances, relevant stakeholders were either absent from work or had recently resigned from their posts. The assessment was however supplemented by regional studies completed in recent years that provided additional information, where appropriate. Similar to the challenges with data collection for Haiti, for Suriname, documents were sometimes provided in Dutch, which was a constraint to efficient review and analysis. Effort was however made by the AgREADY Project to translate these in as far as possible.

### 3. Findings

#### 3.1 Efforts Toward CRA

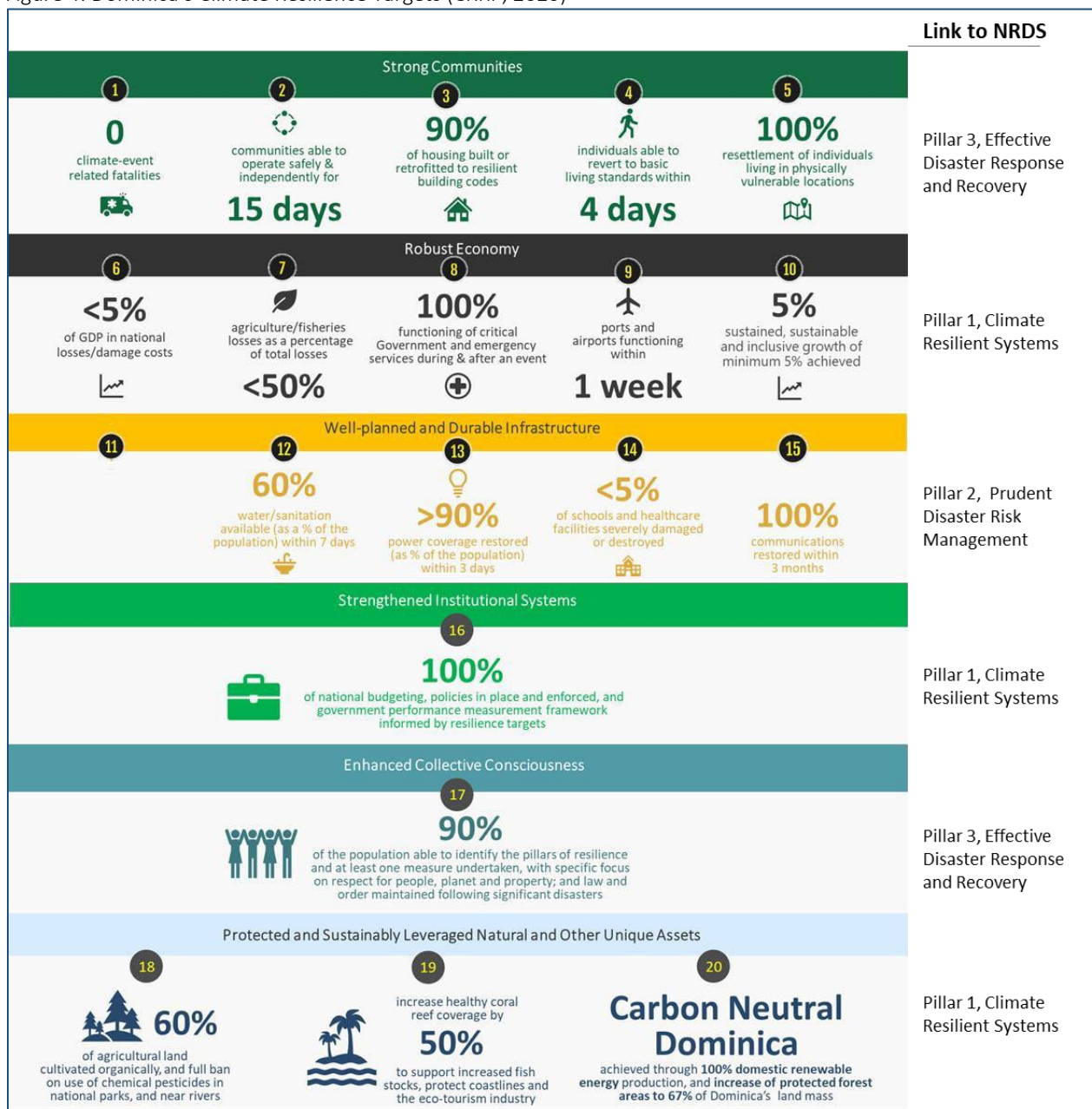
##### *3.1.1 Policy, Legislative and Regulatory Framework*

**AgREADY countries' agriculture-climate change policies have lagged behind the international agreements and although some countries had climate change entering the policy dialogue around 2015, the majority of countries responded in 2020 and beyond.** Belize (2015), Saint Lucia (2016) and The Bahamas (2019) had early responses in their agriculture policies with disaster risk reduction (DRR) and climate change (CC) being priority areas. Broadly, the domestic CC agenda for the AgREADY countries is generally aligned with, and respond to, the requirements of international climate change agreements. This includes strategy documents and plans, even where an updated overarching agriculture policy does not exist. Analysis of country NDCs revealed that the agriculture sector featured largely under adaptation, but since 2020 updated NDCs had increased agriculture contribution to mitigation targets. National Communications (NCs) and National Adaptation Plans (NAPs) largely included agriculture as a key sector for building resilience.

**AgREADY countries whose agriculture policy and sub-policy documents are outdated, and where the policy documents make mention of climate change and building climate-resilience, often do not have follow-on defined strategies and actions for implementation.** Dominica's Climate Resilient Act (2018) focused on building wider climate-resilience, including its governance arrangements, while the country's Climate Resilience and Recovery Plan (CRRP) (2020) established a set of twenty national resilience targets, including Targets #7 and #18 related to reduction of agriculture waste and promotion of organic agriculture (**Figure 4**). The CRRP (2020) includes visions for the transformation of Dominica into a 'Global Centre for Agriculture Resilience', through an appropriate policy and legislative framework reconfiguring the production chain from the farmers to end-users, and meant to become a model for best practice regionally and internationally. More specifically, this action is centred on the development of a scientific and practical approach to reducing the vulnerability of farmers [and fisherfolks] through the adoption of climate-resilient practices, as well as the introduction of climate-resilient crops and infrastructure (CRRP 2020).

The recently completed Dominica Medium Term National Agriculture Policy (NAGriP) 2021-2030 was developed with a set of goals and objectives and specific pre-requisites and a defined institutional framework for implementation. Absent, however, is a clearly defined action plan to drive implementation, and inter-sectoral coordination. The St. Kitts and Nevis' Agriculture Transformation and Growth Strategy (ATGS)(2022-2031) is also presented with a strategic framework, including institutional arrangements and a budget, but although there is an Action Plan appended to the document, it does not identify the key implementers for achievement of the outputs and outcomes. Saint Vincent and the Grenadine's Policy Framework & Strategic Plan for Agricultural Development (2010 - 2020) recognizes the issue of CC but does not place emphasis on the adaptation measures required to address the impacts in the agricultural sector. For Trinidad and Tobago, the National Food Production Action Plan's (NFPAP's) 2012-15 objective was to boost domestic food production for food security and import substitution and is currently outdated and does not make provisions for addressing climate change.

Figure 4: Dominica's Climate Resilience Targets (CRRP, 2020)



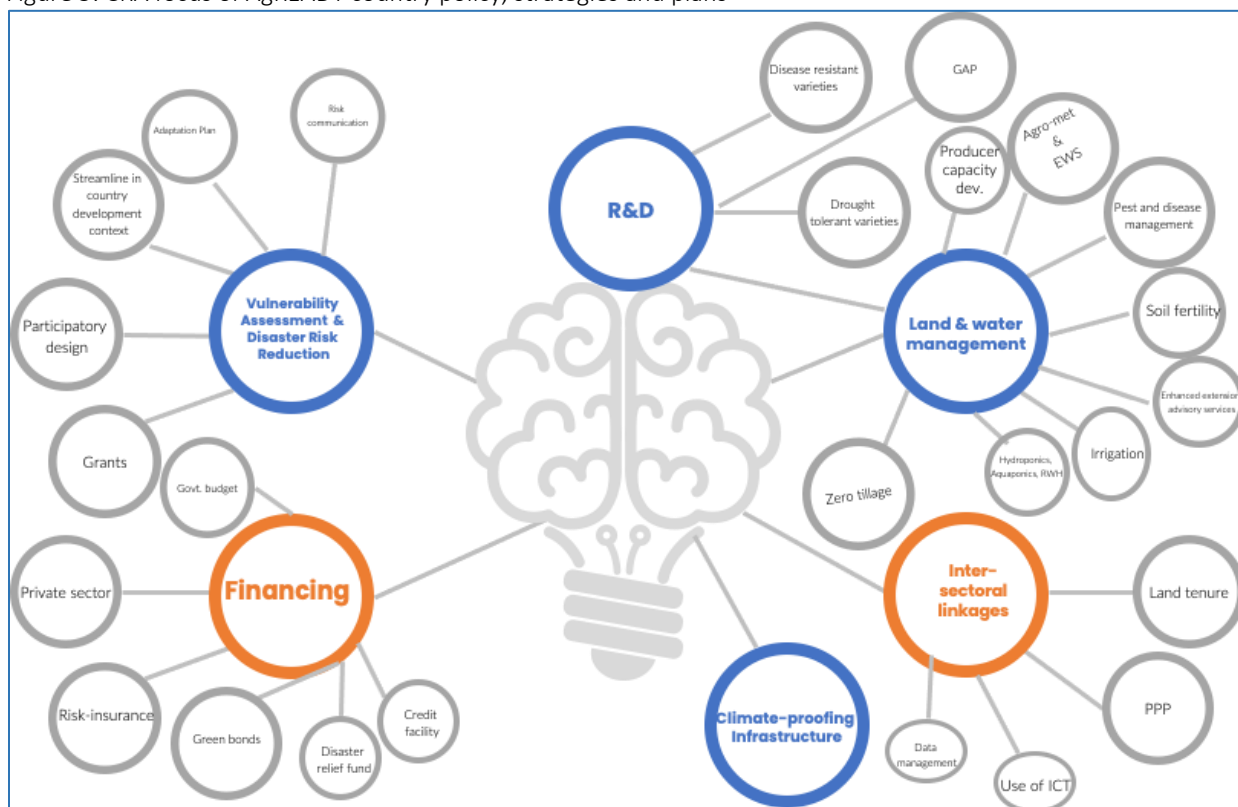
CRA policy directives were often found in National Adaptation Strategies and Plans, whether in an agriculture sector plan or more broadly in the NAP or other national documents with a focus on adaptation and mitigation. Examples include St. Vincent and the Grenadines NAP (2018), St. Kitts and Nevis' Second National Communications to the UNFCCC (2015); Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Agriculture Sector (Agriculture SASAP) 2018-2028 under the national adaptation planning process, and Suriname's National Adaptation Plan (NAP) 2019-2029. Further to this, policy directives were also given in ministerial budget presentations, an example of which is provided in **Box 3**.

**Box 0: Excerpts from Dominica's Prime Minister R. Skerrit's 2021-2022 Budget presentation**

- 31.9 million dollars was allocated to the Ministry of Blue and Green Economy, Agriculture and National Food Security in the 2021-2022 National Budget.
- Agriculture Resilience Programme will also continue with the distribution of seedlings, fertilizers and inputs to farmers.
- 250 livestock farmers will receive assistance in the form of materials valued at \$3.1 million, to facilitate construction of climate-resilient animal housing.
- Renovation of regional offices to enhance service delivery and rehabilitation of 3 propagation centers.
- Construction of a tissue culture facility and training center
- Establishment of the Agricultural Development Authority, to include Marketing and Market Access for specified crops, Production, Technology introduction and adaptation, and Financing to support the commercialization of agricultural production and agribusiness; Plant propagation and Research and development.

Where agriculture policies have been updated and plans developed, largely post-2015, their goals and objectives are often in keeping with the main elements of CRA. This mainstreaming of climate change into policy may have, however, outpaced the advances on climate change capacity with implications for implementation. The emergence of new climate-resilient agriculture policies from resolutions to pillars and strategies and specific action plans is evident and often include a proposed budget. **Figure 5** highlights the CRA actions found in the range of country documents reviewed.

Figure 5: CRA focus of AgREADY country policy, strategies and plans



A PLR framework for agri-food systems development exists and across the nine AgREADY countries, make provisions through a range of enabling factors associated with broader agricultural development. However, the specificity to CRA and the CRA transition has largely not been accounted for in legislative and regulatory frameworks. Enabling factors covered by

country-specific legislation and regulations as presented in **Table 1** include: governance and institutional arrangements, plant protection (against pests and diseases and phytosanitary measures, food safety and quality, animal health and disease prevention, marketing, packaging and storage, protection of agricultural land, soil conservation, use of quality seeds, among others.

Table 1: Examples of policy, legislation, regulations that create the enabling environment for agricultural development

Enabling factor for Agri-Food Systems	Examples of PLRs
<b>Governance and institutional arrangements</b>	The Bahamas Food and Nutrition Security Policy and Action Plan 2017-2022
<b>Plant protection (against pests and diseases and phytosanitary measures against pests and diseases and phytosanitary measures)</b>	The Bahamas Plant Protection Act, 2016 Saint Lucia Plant Protection Act, 1998 St. Vincent and the Grenadines Plant Protection Act, 2005 Suriname Plant Protection Act, 1965, 2020 Suriname Act on the Import and Export of Goods, 2003 Haiti Law on Plant Protection, 1936
<b>Food safety and quality</b>	The Bahamas Food Safety and Quality Act, 2016 St. Kitts and Nevis Agriculture Produce and Livestock Act, 2012
<b>Animal health and disease prevention</b>	The Bahamas Animal Health and Production Act, 2016 Belize Agriculture Health Authority Act 1999 (Poultry Health) Regulations 2022
<b>Marketing</b>	Belize Marketing and Development Corporation Act, 2003 Trinidad and Tobago NAMDEVCO Act, 2011
<b>Packaging and storage</b>	Belize Marketing and Development Corporation Act, 2003
<b>Protection of agricultural land</b>	Dominica National Land Use Policy, 2014 St. Vincent and the Grenadines Agriculture Amendment Ordinance, 1954
<b>Soil Conservation and erosion control</b>	St. Vincent and the Grenadines Agricultural Act, 1954
<b>Use of quality seeds</b>	Suriname Seed Act, 2005
<b>Research and Development</b>	Belize Institute of Agricultural Research and Development Act, 2003
<b>Financing</b>	Belize Marketing and Development Corporation Act, 2003 Trinidad and Tobago Agriculture Development Bank Act
<b>Irrigation</b>	Haiti Law on the creation of a special irrigation fund (1959) Haiti Law establishing the status of users of irrigation and drainage systems established or controlled by the State, 1952

### *3.1.2 Institutional Arrangements/Governance for CRA in AgREADY countries*

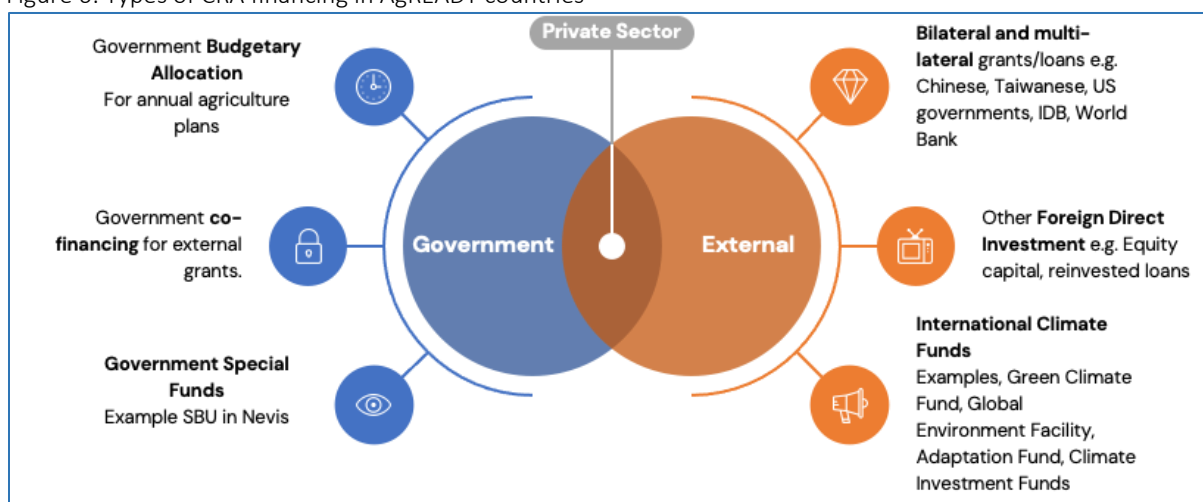
**Agriculture sector policy and planning documents that are aligned with CRA principles almost always outline the governance arrangements for policy or plan implementation.** The governance architecture for climate-resilience in agriculture policy and planning implementation is generally led by ministries with responsibility for agriculture. In The Bahamas, the oversight committee for the Climate Change Policy for Agriculture and Marine Resources is a National Climate Change Sector Committee that comprises multiple government and non-government entities. A Steering Committee is expected to provide oversight for implementation of St. Kitts and Nevis' ATGS (2022) and an Agricultural Advisory Committee will provide advice on the execution and implementation of recommended activities and oversee the monitoring, evaluation and learning functions. The arrangements as outlined in policy documents assume significant inter-agency coordination and collaboration, but weak coordination was identified as a critical barrier during the stakeholder consultations. While these governance arrangements are outlined in the documents, it was difficult to determine the effectiveness of these structures given the limitations of this BANA. Notwithstanding, the BANA was able to identify specific initiatives and programmes being implemented by partner entities. For example, in Dominica, the Meteorological Office has been actively involved in the Disaster Vulnerability Reduction Project (DVRP) whereby a new Meteorological Office building is being constructed and a geospatial information system (DOMI NODE) will be used to store and share data. The Dominica Meteorological Office is also collaborating with the Ministry of Agriculture and other external partners in the UNDP PICSA Project with new weather stations being installed in important agriculture areas and water level stations also being installed to provide alerts on water levels to farmers, especially in the event of flooding. Similarly, in Trinidad and Tobago the Meteorological Office provides 10-15 days agriculture forecasts and conducts drought monitoring and communicates these data and information to farmers and farming communities. These examples are indicative of ownership of these activities by CRA collaborators, having included them in their respective plans. Efforts to engage and involve Ministry of Agriculture stakeholders, including extension officers and working at the farm and farmer levels are also strengths of the arrangements. Initiatives were identified by other value chain actors, including marketing agencies (DEXIA in Dominica, NAMDEVCO in Trinidad, Small Business Unit in the Ministry of Finance in St. Kitts and Nevis), research and development organizations within and external to the countries (e.g., UWI, CIMH, CCCCC), and bilateral agencies providing financing and technical assistance support (e.g., the Taiwanese, Chinese governments, USAID, UKAID). Regional technical support organizations play important roles in policy development in the countries. IICA supported the development of the NaGRiP in Dominica and CARDI generally does work in validating applicable techniques and technologies and the potential for adoption in countries. Similarly, the FAO, working in Trinidad and Tobago for example, is helping with strengthening data and data management for decision making.

### *3.1.3 Financing for climate-resilient agriculture in AgREADY countries*

**There is a mix of financing mechanisms already being utilized for CRA practices in AgREADY countries.** Data analysis identified that financing for CRA included a mix of government budgetary allocation, bilateral and multi-lateral grant and loan financing, and other Foreign Direct Investment (**Figure 6**). Although only a small percent of national budgets are for agriculture (for example Haiti-5%, Dominica- 3.2% and Trinidad and Tobago -2%), key objectives for applying

financing for CRA in the countries have been to reduce the high food import bill and for food and nutrition security.

Figure 6: Types of CRA financing in AgREADY countries



Government financing support for CRA is evident in the inclusion of climate smart agriculture (CSA) and ecosystems-based adaptation (EbA) in its reporting under the Paris Agreement and collaborations with external financing entities. AgREADY countries' NDCs have increasingly included CSA and other resilience-building approaches (Table 2) along with NCs and NAPs, with a mix of both unconditional<sup>3</sup> and conditional<sup>4</sup> financing.

Table 1: CRA in AgREADY countries NDCs

CARICOM AgREADY Country	NDC	Agriculture-related adaptation goals
The Bahamas	Initial NDC (2015)	<ul style="list-style-type: none"> <li>Formulate and implement strategies and measures that will help to enhance food security and sustainable food production.</li> </ul>
Belize	Updated NDC (2021)	<ul style="list-style-type: none"> <li>Reduce post-harvest losses</li> <li>Develop and implement an enhanced early warning system for drought and extreme weather events</li> </ul>

<sup>3</sup> From government budgetary allocation

<sup>4</sup> Hinged on external sources of funding

CARICOM AgREADY Country	NDC	Agriculture-related adaptation goals
Dominica	Initial NDC (2015)	<ul style="list-style-type: none"> <li>Promote Food Security through Climate Resilient Agricultural/Fisheries Development to build climate resilient communities by strengthening capacity to address climate change risks to food security associated with changing precipitation patterns.</li> <li>Establish early warning systems, multi-use disaster shelters (powered by renewable energy and back up bio-diesel generators) and emergency preparedness training programs in vulnerable communities.</li> <li>Design and implement climate change adaptation and disaster risk management education and awareness program at all levels to be coordinated by the Department of Climate Change, Environment and Development.</li> </ul>
Haiti	Updated NDC (2021)	<ul style="list-style-type: none"> <li>Strengthen the population's adaptive capacities and resilience by: developing watersheds and soil conservation; enhancement and conservation of natural resources; preserving and strengthening food security; and the establishment of an information - education and awareness program.</li> </ul>
St. Kitts and Nevis	Updated NDC (2021)	<ul style="list-style-type: none"> <li>Expand SMART aquaponics and aquaculture systems.</li> <li>Develop alternative livelihoods and training and diversify away from at-risk crops</li> <li>Introduce drought resistance technologies and species in animal husbandry</li> </ul>
St. Lucia	Updated NDC (2021)	<ul style="list-style-type: none"> <li>Developing and implementing better practices in agricultural production</li> </ul>
St. Vincent and the Grenadines	Initial NDC (2015)	<ul style="list-style-type: none"> <li>Improve agricultural practices, pest and disease management.</li> <li>Improve agriculture policies/strategies.</li> </ul>
Suriname	New/Updated NDC (2020)	<ul style="list-style-type: none"> <li>Rehabilitation and enhancement of infrastructure such as dykes and river defences (precondition).</li> <li>Improvements in water resources management.</li> <li>Promotion of sustainable land management.</li> <li>Applying innovative technologies in the use of land.</li> <li>Introduction of a national land use planning system, to make the embedding of climate change in (agricultural) development plans possible.</li> <li>Strengthen capacity to implement a national research, development and innovation program, and strengthen agricultural research.</li> </ul>
Trinidad and Tobago	Initial NDC (2015)	Third National Communication includes CSA as an adaptation goal

Source: Country NDCs; GHGMI (2022)



Although CRA is not always the primary objective of government support for financing in AgREADY countries, there is evidence of a range of products and initiatives being utilised. In St. Vincent and the Grenadines, duty concessions are provided for CSA inputs, while in Trinidad and Tobago the removal of taxes and duties on all inputs and resources registered for agricultural purposes described during the 2021-2022 budget presentations would make agriculture an entirely tax-free industry. In St. Kitts and Nevis, there continues to be government subsidies on water although irrigation is not well developed, and the agriculture sector continues to utilize potable sources of water to supplement rainfed agriculture. In Nevis, once a farmer passes a product through the Department of Agriculture, 3-10% of proceeds are deducted for an insurance/savings scheme at the Marketing Division. In addition, the Department of Agriculture also provides seedlings to farmers. Development Banks in AgREADY countries have also been supporting climate-resilience building in agriculture (**Table 3**).

Table 0: Examples of support from financial and marketing institutions in AgREADY countries

AgREADY Country	Organization	Support
<b>The Bahamas</b>	The Bahamas Development Bank	Provides access to financing for agricultural development in crop production and animal husbandry as well as value added processing. The Bank is willing to work with farmers to tailor loans payments to harvest cycles and offer grace periods.
<b>Belize</b>	Development Finance Corporation	Provides agriculture loans for purposes such as land clearance and field preparation; seeds/plants; machinery, equipment, vehicles; operational expenses; non-traditional crops; livestock; water harvesting and renewable fuel production.
<b>Dominica</b>	National Development Foundation of Dominica	Provides micro-financing for hydroponics, waste reduction, renewable energy (use on poultry farms for example) and agro-processing. The NDFD intends to launch a pilot for fertigation, hydroponics and aquaponics  Also provides business training and support the clients with simple record keeping books to allow for development of manufacturing statement to determine cost of production and pricing their product.
<b>Haiti</b>		The agriculture sector has access to 2-3% of the bank's credit
<b>St. Kitts and Nevis</b>	Nevis Small Business Unit/Taiwanese Government	Supports women in agriculture (currently 5 women in agriculture have applied and received the loan- assistance with fencing and irrigation. Prerequisites for the loan are: business plan, licence, invoices, proof of address, IDs, completed application form. Following in-house analysis, and Board review, the Nevis Cooperative Credit Union facilitates the banking element. Funding is dispersed in stages and monitoring done.
<b>Saint Lucia</b>	St. Lucia Development Bank (SLDB)	Business Recovery Programme (BRP) is a facility under the SLDB's Climate Adaptation Financing Facility (CAFF) that will support Saint Lucia's COVID-19 Economic Recovery and Resilience Plan (ERRP) by providing financing and technical support to Micro, Small, and Medium Enterprises (MSMEs) affected by the COVID-19 pandemic. It provides a mixed loan/grant facility to potential borrowers with the grant being used to incentivize the adoption of climate smart technology and provide liquidity support to assist them to recover and becoming more resilient. The BRP is one of the policy interventions under ERRP Pillar 1 – Stimulating the Economy. It is designed to provide liquidity and affordable credit to MSMEs in sectors critical to Saint Lucia's economy such as agriculture, fisheries, tourism, manufacturing, and other services.

AgREADY Country	Organization	Support
		Provides agriculture loans for land for crop and livestock enterprises, rainwater harvesting, agricultural equipment, irrigation equipment, farm infrastructure, marketing of agricultural produce, refrigeration equipment, among others.
Suriname	VCB Bank	Provides business loans to entrepreneurs in the agricultural sector who depend on seasonal income for the repayment of their credit. These loans target entrepreneurs such as rice farmers, pig farmers, flower growers, etc. The seasonal credit can be used for the reclamation and sowing of agricultural areas.
Trinidad and Tobago	NAMDEVCO  Agriculture Development Bank	Grants accessible to youth, entrepreneurial agriculture graduates  Has 10 loan products on offer. Including for equipment, primary production, and agro-processing. ADB loans support technology driven production systems – hydroponics, controlled agriculture systems.

### *3.1.4 Knowledge Management, Capacity Building and Awareness for CRA in AgREADY countries*

**The AgREADY countries have recognized the importance of knowledge management systems that facilitate access to agriculture data and streamlining of agricultural activities to meet sector targets, and have taken several steps towards establishing such systems.** Efficient agriculture sector operations are heavily dependent on the flow of data and Information along the agri-food value chain. According to a CTA Report (McNaughton and Soutar 2015), studies have shown that Information and Communications Technology (ICT) infrastructure improvements (such as increased mobile coverage, information services, real-time pricing and weather data) directly result in improved income of farmers and lower market prices. Belize is one of the few AgREADY countries with an agriculture information management system that serves as a repository of data (such as number of farmers, location of farms, farm size, commodity being produced, amount of production, among other things) that guides sector operations. Both St. Lucia and Suriname also have agriculture information and management systems/applications, while the development of a similar system is underway in Dominica. It should be noted that even where such systems exist, improvements are necessary to ensure they can be effectively used to improve decision-making within the sector that is geared towards improved climate-resilience, reduced food waste, improved market access and supply, livelihood generation and overall sector performance.

**Across the nine AgREADY countries, CRA-related training has been evident at various levels, with the capacity of extension services and other relevant agriculture ministry stakeholders being built in order to facilitate knowledge transfer to farmers.** Enhancement of extension officer capacity is crucial to driving CRA implementation, and as can be inferred from **Table 4**, the capacity of extension officers in CRA is built to support delivery of CRA-related training to producers. In general, water management/irrigation, covered structures, crop nutrition, soil conservation, artificial insemination, improved plant varieties and animal species have been some of the key training areas of focus within the nine AgREADY countries. While capacity building and training efforts are often project-driven, the agriculture ministries have largely prioritised capacity

building as outlined in applicable policies, strategies and plans. As a result of these efforts, farmers are more aware of common CRA technologies, promoted by the agriculture ministry within each country. For example, in SVG, farmers now have a better understanding of CSA and are more receptive to implementing certain techniques and technologies (e.g., greenhouses), with improvements in the lives of farmers noted. Notwithstanding, across the AgREADY countries, there remain factors that constrain knowledge and awareness being translated to implementation as discussed in Section 3.2.

Table 2: Examples of CRA training delivered to extension officers and producers in AgREADY countries

Training Delivered	Extension Services	Farmers and Agro-processors
General CRA	x	
CSA	x	x
Crop Management	x	x
Protected Agriculture (e.g., greenhouses, shade houses, climate-resilient livestock housing)	x	x
Animal and Plant Health	x	x
Water Management/Soil Conservation	x	x
Participatory training and education (e.g., FFS)	x	x
Post-harvest technologies/ Reduction of food waste	x	x
Food Safety and Quality	x	x
Sustainable Agricultural Enterprises	x	x
Recordkeeping/ Business Planning		x
Organizational Development		
Proposal Writing/Project Development		
Climate Change Awareness		x
Climate services/ Agromet/ climate decision support	x	x

### 3.1.5 Social Norms and Behaviours

**Understanding of traditional ecological knowledge and agricultural practices is important and has been recognized as crucial for the CRA transition in AgREADY countries.** Traditional agricultural practices place a premium on localization, biodiversity and a cultural appreciation for a diverse range of crops. CRA requires cultural and biological diversity, especially for compensation where one method or crop fails especially as a result of weather patterns, and by extension, longer-term climate projections.

**Family, farm and community structures are important for CRA and relationships among smallholder farmers have proved to be advantageous, with multiple benefits.** CRA approaches such as FFS have been used in AgREADY countries and strong farmer relationships have been especially important for information sharing and knowledge management. In Dominica for example, through a local practice called *koudmain'*, and similarly in Trinidad and Tobago through *Gayap*, farmers support each other through rotating farmer field days where they share new and innovative practices they have learnt and help with on-farm activities. There was also evidence of sharing of tools and equipment among farmers in The Bahamas and St. Kitts and Nevis.

### *3.1.6 Considerations for Gender, Youth and other vulnerable groups in CRA in AgREADY countries*

**AgREADY countries have made strides in providing financing for CRA practices to women, youth and other vulnerable groups.** In Nevis, the NIA/SEDU Relending Fund is a special loan product for women, and male youth 35 years and under, of which 2% is for the agriculture sector, including crops, livestock and agro-processing and to date, there has been five agriculture women beneficiaries. Similar loan facilities were also noted for Belize and Dominica. Additionally, the UNDP/Government of Japan has a women-focused livelihood resilience project in Dominica [and Guyana] that focuses on value chain development, microfinancing and CSA and supports rural women and vulnerable groups. In Dominica, examples of grants were noted that were geared towards increasing the capacities of women in Climate Smart activities and due to its success, was expanded into different regions. The NDFD in Dominica launched a study in the Kalinago territory to determine interest in loan products for green financing and through the IDB, funded an activity with case studies of women-owned agri-businesses.

**Women's involvement in agriculture in the AgREADY countries has been reflected in their leadership roles, the number of women's farmer organizations that exist in some countries, and their general active participation across the value chain.** Dominican stakeholders reported that women, due to their receptiveness and organization capacity, are having increasing prominence as leaders of farmer organizations. Additionally, there are a number of women farmer groups that have been active and have participated in CRA activities. It was noted that across the AgREADY countries, women are actively involved in vegetable production, agro-processing, beekeeping, aquaponics, micro skills, table skills and handicrafts.

**In AgREADY countries there has been significant focus on building the capacity of women in CRA.** Agriculture policy in St. Kitts and Nevis is driving increased participation of women in agriculture and there have been efforts including training, provision of tools and equipment, inputs and special financing. In St. Lucia and St. Vincent and the Grenadines, involvement of women at the policy level was given special mention. In the Extension Division of the Nevis Department of Agriculture, most of the officers trained in CRA were women. In Haiti, the Ministry of Agriculture is training all farmers to become better decision makers with regard to climate change and agroforestry. The training sessions reflect a gender ratio of 6 males: 4 females. In Dominica, the UNDP and FAO are working with women farmers to build their resilience and in St. Kitts women are increasingly participating in the backyard garden program. Also in Dominica, IICA used its internal funds post Hurricane Maria to support beekeepers women's groups, among other farmer groups, for capacity building to identify adaptation options to reduce vulnerabilities, through land and water management, soil conservation and Infrastructure development. In St. Vincent and The Grenadines, it was noted that workshops and seminars on climate change had more women than men participating.

**Educational institutions in AgREADY countries have incorporated gender and youth considerations in agriculture course offerings that promote their involvement in CRA.** Curricula of agricultural colleges and research institutions have incorporated CRA theory and practice. There is generally a good understanding of sensitive groups and provisions are generally made for women and youth. COTED mandated that UWI partner with IICA and FAO to develop training in agriculture climate-smart technologies. Dominica was selected as the first country deliver the programme in a formalized way. UWI St Augustine partnered with the Dominica Open Campus to

deliver courses for extension services in climate-smart technologies and these have included a gender and youth focus. In St. Vincent and the Grenadines, the St. Vincent and the Grenadines Community College's representative noted that there was no bias to who can apply and that the college has always had more females registered than males, excepting for the current cohort. In alignment with the CARICOM's Youth Action Plan (CYAP), St. Vincent and the Grenadines has developed a youth in agriculture policy, while St. Kitts and Nevis has developed targeted programmes and projects and more broadly, regional civil society groups (e.g., Caribbean Agriculture Forum for Youth) have been established. These have been developed to address the chronic shortage of youth interest and participation in agriculture and the aging population of farmers. The IICA/CARICOM/GCF AgREADY Project includes an activity to design a strategy to strengthen the capacity of AgREADY Caribbean youths in climate responsive agricultural techniques, technologies, and approaches. The strategy will be complemented with a template for Occupational Standards of Competence for Caribbean Vocational Qualifications (CVQ) and associated Level 1 course outline.

### *3.1.7 Advances towards the CRA transition in AgREADY countries through technology*

**Several CRA technologies have been piloted and, in some cases, perfected across the AgREADY sub-region and the wider Caribbean region.** BANA data collection identified a slate of CRA applications and facilitatory strategies that have been applied across the nine AgREADY countries that are summarised under nine thematic areas in **Table 5**. The identified applications provide significant opportunities for upscaling.

**Table 5: Summary of CRA Applications or Facilitatory Strategies Across AgREADY Countries**

Themes	CRA Applications or Facilitatory Strategies Across AgREADY Countries
Water Management	<ul style="list-style-type: none"> <li>▪ Rainwater harvesting,</li> <li>▪ Solar or renewable energy technologies</li> <li>▪ Soil moisture conservation/mulching</li> <li>▪ Water use efficiency – drip and micro irrigation</li> <li>▪ Catchments</li> </ul>
Plant breeding / germplasm improvement	<ul style="list-style-type: none"> <li>▪ Drought tolerant varieties of key food crops</li> <li>▪ High-yielding varieties of cassava</li> </ul>
Animal breeding/productivity improvements to reduce carbon footprints	<p>Artificial insemination - upscale to breed for:</p> <ul style="list-style-type: none"> <li>▪ Heat tolerant expressions</li> <li>▪ Productivity improvements in animals</li> </ul> <p>Productivity improvements through feed and nutrition management</p> <ul style="list-style-type: none"> <li>▪ Alternative feeds through forage and pasture management</li> <li>▪ Manure management</li> <li>▪ Manage enteric emissions</li> </ul>
Modified environmental production systems	<ul style="list-style-type: none"> <li>▪ Exploring container gardening</li> <li>▪ Greenhouse or shade house production systems</li> <li>▪ Aquaponics and hydroponics</li> </ul>
Climate information decision support	<ul style="list-style-type: none"> <li>▪ Climate services or agromet services</li> </ul>
Ecosystem-based Adaptation	<ul style="list-style-type: none"> <li>▪ Agroforestry</li> <li>▪ Land management techniques to address landslide and erosion</li> <li>▪ Silvo pastoral systems</li> </ul>

Themes	CRA Applications or Facilitatory Strategies Across AgREADY Countries
Trade facilitation/value chain strengthening	<ul style="list-style-type: none"> <li>Food safety standards</li> <li>Traceability</li> <li>Agro-processing and post-harvesting technologies (food loss and waste reductions)</li> </ul>
Financing Strategies	<ul style="list-style-type: none"> <li>Line of credit to micro-organizations for green or energy efficiency technology retrofitting (lighting fixtures, equipment, etc).</li> <li>Risk insurance products</li> <li>Loan Guarantees</li> </ul>

**AgREADY country-specific Technology Needs Assessments and Barrier Analysis Enabling Frameworks (BAEFs) that have been completed as part of the requirements of parties to the Paris Agreement prioritized key technologies for adoption in the agriculture sector.** Six of the nine AgREADY countries completed TNAs that identified and prioritized technologies applicable to and considered important for increasing productivity in the agriculture sector. In keeping with the projections for climate change, technologies common across the countries included crop diversification, soil conservation, and irrigation. **Table 6** outlines the priority technologies defined for the six AgREADY countries.

Table 3: Priority CR Technologies identified through AgREADY countries' Technology Needs Assessment

AgREADY Country	Priority Technologies
Belize	Agroforestry; Crop diversification and new varieties; Drip irrigation; Rainwater harvesting; Soil conservation, Sprinkler irrigation
Dominica	Nutrient management; Soil conservation, Drip irrigation, Protected agriculture, Aquaponics; Hydroponics
Haiti	Agroforestry
St. Kitts and Nevis	Early warning systems for forecasting wet and dry periods; Adoption of drought-resistant cultivars; Geographical Information Systems (GIS); Change of sowing and harvesting periods; Pesticide application technologies and practices; Integrated Pest Management (IPM) systems and practices; Soil management technologies and practices; Aquaculture and mariculture technologies.
Suriname	Integrated farming systems; Improved irrigation efficiency; Climate-resilient crop varieties and livestock breeds
Trinidad and Tobago	Pressurized irrigation technologies; Protective Structure Cooling Systems - Caterpillar tunnel; Establishment of early warning systems; Crop breeding; E-livestock management; Virtual Soils Doctor

**Technical assistance is provided by five key regional and international institutions that support AgREADY countries to build the enabling environment for CRA.** The premier technical CRA support organizations in the region are CARICOM, CCCCC, CARDI, IICA and the FAO. The support institutions provide technical assistance, general coordination, climate-smart tools and services, financing and research and development to member states. **Table 7** provides examples of the support provided by the range of technical institutions within the region to AgREADY countries.

Table 4: Types of CRA technical assistance support provided to AgREADY countries

Institution	Examples of Technical Assistance Support Provided
CARDI	<ul style="list-style-type: none"> <li>Genetics improvements relating to the West Indian Red Habanero</li> <li>improvement of sweet potato cultivars</li> <li>Development of protected agriculture production systems</li> <li>Climate information decision support for the agriculture and fisheries sectors</li> </ul>

Institution	Examples of Technical Assistance Support Provided
	<ul style="list-style-type: none"> <li>Improving small ruminant production</li> </ul>
FAO	<ul style="list-style-type: none"> <li>Used GCF-accreditation status to support country projects</li> <li>GHG emissions technologies, EX-ACT<sup>5</sup> and GLEAM<sup>6</sup> for agri-food systems monitoring</li> <li>Baseline data collection</li> </ul>
IICA	<ul style="list-style-type: none"> <li>Partnership with CATIE to support the region</li> </ul>
ECLAC	<ul style="list-style-type: none"> <li>Research, sector assessments</li> </ul>
UWI	<ul style="list-style-type: none"> <li>Research</li> </ul>
CARICOM	<ul style="list-style-type: none"> <li>Facilitate advances in education and training related to CRA</li> <li>Promote youth engagement through the CARICOM Youth Development Action Plan<sup>7</sup></li> </ul>
CCCCC	<ul style="list-style-type: none"> <li>Climate-related policy advice</li> <li>Archive and clearinghouse for regional climate change data and documentation</li> <li>Dissemination of CCORAL to support climate risk planning and development</li> <li>GCF-accreditation</li> </ul>
CDB, USAID, World Bank, IDB, EU	<ul style="list-style-type: none"> <li>Financial support</li> <li>Sector assessments</li> </ul>
GCF NDA and AE	<ul style="list-style-type: none"> <li>In-country support for access to GCF financing</li> </ul>

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<sup>5</sup> The Ex-Ante Carbon-balance Tool (EX-ACT), an appraisal system developed by FAO, provides ex-ante estimates of the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance.

<sup>6</sup> GLEAM differentiates key stages along livestock supply chains such as feed production, processing and transport; herd dynamics, animal feeding and manure management; and animal products processing and transport. The model captures the specific impacts of each stage, offering a comprehensive and disaggregated picture of livestock production and its use of natural resources.

<sup>7</sup> The CARICOM Youth Development Action Plan emphasizes commitment to promoting and facilitating sustainable livelihoods and ensuring optimal food security within the region by creating meaningful opportunities for youth in agriculture through investment in modernised approaches that encourage youth to explore diverse career options and entrepreneurship in agriculture as a viable alternative for their development.

### 3.2 Critical Barriers to developing climate-resilient agriculture in AgREADY Countries

#### 3.2.1 Policy, Legislative and Regulatory Framework

**Despite successive efforts at the regional level, development and implementation of national PLR frameworks and plans associated with the CRA transition for enhanced food and nutrition security in CARICOM AgREADY countries remains challenging and incomplete.** The COVID-19 pandemic highlighted the fragility of food security in the region and specifically in households and dependency of the region on other territories, with over 38% of the population of the Caribbean affected. Although efforts at the national level have been launched to improve agricultural productivity, these have been stymied by limited physical capital, human capital and technology needed to drive CRA. In Dominica and St. Kitts and Nevis, a focus on building CRA is not well supported by irrigation policy and with the increased droughts, the largely rainfed agriculture has had to be supplemented by potable water supply, which is both inefficient and costly. Other infrastructural policy deficiencies include transportation, roads, and electricity. Although there is evidence of value chain development largely for export most of the AgREADY countries have been slow in developing priority value chains for food and nutrition security. Land tenure and land policy reforms have also been lagging and many small farmers are unable to respond to the requirements for financing due to the insecurity of tenure. In Haiti, for example, land tenure is characterised by fragmented and shared farming approaches. The land tenure insecurity generates a reticence or even the fear to invest and favours the emergence of violent conflicts disturbing social peace, which has resulted in loss of life and material damage and destruction.

*“If the Caribbean is to remain wedded to the SDGs, it would require greater attention be paid to its food systems, especially in terms of ensuring food security, combating the threats posed by climate change and being able to mobilize financing for climate resilient agriculture”* President Dr. Mohamed Irfaan Ali, President of the Cooperative Republic of Guyana (Food Systems Summit 2021)

**Other common policy, legislative and regulatory challenges include a lack of coherence between sectors due to a siloed approach to the CRA transition, poor coordination in policy implementation and a lack of political will, driven by five-year political cycles in the Caribbean.** Where policies have been developed by respective sectors and organizations, efforts to integrate them have been largely unsuccessful. Water policies have not kept up with the changing climate, specifically in relation to the need for irrigation as a result of reduction in rainfall and water availability for crop production in particular. Value chain development is often opportunistic and although the focus is on export potential and/or food and nutrition security it does not give adequate consideration to important climate hazards and their impacts. Gaps in land policy reform to protect agriculture lands from being converted to other land uses and for boosting domestic food production continue to exist. In the northern leeward islands, there are significant connectivity and transport challenges and road networks in agriculture areas are often difficult to traverse during and after heavy rainfall events. Although gender policies are increasingly being developed as a result of the needs for international climate reporting and implementation, the considerable opportunity to mainstream gender into CRA policies and programmes has not been sufficiently explored. In addition, there are data sharing problems and siloed planning. In a similar manner, efforts to strengthen associated legislative instruments and regulations such as those that govern rights to productive resources, including access to land titles and capital have been slow. There have also been inadequacies with regulatory agencies to support food safety and plant and animal health. In St. Kitts and Nevis for example, the prevalence of a mango seed weevil



prevents the country from exporting to US ports. Also in St. Kitts and Nevis, the required labelling and testing systems and associated facilities do not exist.

**At the sectoral level there is an inherent inadequacy in capacity and coordination for implementation of agriculture policies.** Even where cross-sectoral and multi-stakeholder governance arrangements have been defined in policy documents, these have not effectively operationalized. Further to this, development of supporting strategies and plans often do not involve the key partner organizations and the lack of ownership and buy-in is reflected in little to no effort to mainstream the actions in their own organisational plans. Notwithstanding the existence of policy, legislative and regulatory instruments described in Section 3.1, the efforts to update outdated instruments that can facilitate the CRA transition have been weak. Beyond the implementation of projects that promote CRA and support the enabling environment, there has been slow transition and mainstreaming into country PLR frameworks. Dominica's Sale of Produce Act (1941) requires producers to keep record of produce and sales, but enforcement has been weak. The issue of poor record keeping practices was corroborated during consultations with financial institutions across multiple countries. CSA as an approach to CRA has been a feature of many projects, and NCs, NAPs and country NDCs also include actions as part of adaptation plans. However, in Belize's NDC for example, the document falls short on including more specific CSA practices and relating to specific value chains in support of practical financing and implementation of the NDC. Currently in Belize, no major policies are being formulated relating to individual CSA pillars, but several policies have been formulated, whose objectives cut across the different CSA pillars, such as the Growth and Sustainable Development Strategy (2016), National Adaptation Strategy (2015), and the National Agriculture and Food Policy (2015 - 2030). The major barrier that seems to be affecting the implementation of those legally formalized policies is inadequate financing for the implementation of the laid-out policy actions, and coordination among relevant ministries. Still, attractive opportunities exist for coordination among all relevant stakeholders to assist in addressing and financing the implementation of those policies (CIAT 2018).

**The dependency on externally funded projects to drive CRA in AgREADY countries has its own set of impacts on CRA policy implementation. Projects are often opportunistic and efforts towards multi-stakeholder coordination and cooperation are weak.** Furthermore, these do not generally support policy coherence. Even with lessons learned and good practices emanating from projects, these generally do not drive policy reform, reflected in weak sustainability. The siloed approach to project implementation also impacts the ability to achieve policy coherence and a more coordinated approach to policy development.

**A primary hindrance to CRA policy development and coherence with other policies is competing development agendas.** Competing development priorities such as the recent COVID-19 pandemic and the specific country responses, improving road networks and others directly affects climate-resilience building in the agriculture sector. This is often intricately linked to inadequate financial capacity and the prioritisation of short-term development goals. Another barrier is poor planning and management, which affects policy effectiveness and associated outcomes. Even in countries like Saint Lucia, Dominica and St. Kitts and Nevis where policy documents have been recently revised or developed to integrate climate-resilience building, the CRA planning and responses typically remain project driven. As a result, a more coordinated response is stymied by application of a donor funding model.

### *3.2.2 Institutional Arrangements/Governance*

**The key institutions defined within the governance framework for CRA relate not only to the value chain but also to critical hazards such as floods and drought. Their inherent interconnectedness and relevance for the vulnerability of the farmer/producer and agro-processor communities assumes a level of coordination that has not materialized.** Coordination is a key function of CRA to ensure alignment between climate change adaptation and mitigation, agriculture sector, other sectoral and development priorities. The inter-relatedness of the value chain phases, climate hazards and their impacts and the response mechanisms associated with these were not well developed and synergistic development among the key value chain actors remain at best weak. As a result, actions are siloed and piecemeal. Further to this, there are perceived conflicts between the climate change and development agendas. At the same time, for small holder farmers who have limited land space, there is often a trade-off between maximizing planting area and investing in CR technologies. In addition, access to financing is a major impediment to the CRA transition.

**Coordination along the food value chain is often weak.** Although the assessment found that most AgREADY countries defined the governance arrangements and requirements for inter-agency coordination, the participatory mechanisms to establish linkages among the stakeholders, establish ownership and realize engagement of all stakeholders were not well developed. More often than not in defining the institutional arrangements for implementation of agriculture policies, the roles and responsibilities of the stakeholders were not defined. This was generally evident in supporting implementation plans, whereby implementing partners, required resources and timelines as well as provisions for monitoring and evaluation were often absent. This resulted in a siloed approach at the sectoral level with limited networking and inadequate information sharing, that resulted in slow policy reform, especially to support CRA. Similarly, although the climate change policies analysed have established various ministries to achieve the objectives, in practice, there is still no real coordination and in most instances the policies are largely implemented by the agriculture ministry. Countries have suffered from this reality, especially as climate change interventions (including those in the agriculture sector) are often projectized where different institutional mechanisms are involved depending on the requirements from the donor agencies, which at times can overlap or contradict each other. Furthermore, there is limited communication and dialogue across government, exacerbating policy incoherence.

**Institutional barriers that are constraining, or have the potential to constrain, the ability for organizations and farmers to better facilitate adaptation to climate change were evident across AgREADY countries.** In general, the institutions function relatively well, however there is a need to link the additional stresses on the social-ecological system that will be introduced by future climate change impacts, including: increase in temperature, drought and extreme rainfall during the wet periods, and decrease in annual rainfall and more severe storms and hurricanes. The unevenness in availability of technical skills and knowledge is also acknowledged. Often meteorological offices, academic institutions and regional technical support agencies are the main repository of climate change data and information and the availability of climate services and decision support systems although growing, is inadequate. Evidence shows that awareness and skills for CRA planning is not well disseminated across the value chain.

**The impacts from future climate projections are also likely to put extra stresses on institutions in the future in different ways, according to the roles and responsibilities of the institution.** The

discussion brings into focus the roles and responsibilities of the institutions according to the CRA components of increased productivity and higher incomes, adaptation and resilience building, and mitigation by reduction in GHG emissions. Associated institutional barriers that are impacting and will likely continue to impact institutions include: capacity to identify and adopt appropriate and cost-effective CRA technologies; human resource capacity to drive CRA policy, legislation and regulations and planning for provision of CRA extension services to farmers and other stakeholders; ability to work with farmers to improve security of land tenure, which will also be important for accessing well-needed financing for CRA; ability to provide adequate water especially in times of drought; efforts at advancing R&D; ability to develop credit financing products to support CRA adoption; enhancing the capacity to maintain existing markets and access new ones, especially where it concerns food safety standards and specific market requirements.

**The insufficiency of expertise related to climate change and adaptation and mitigation measures reported by some AgREADY countries suggests that there is a barrier occurring that constrains the development of human resources for implementing adaptation and mitigation policies.** This can have a direct effect on farmer communities who rely on the capacity of agriculture ministry personnel related to seed variety selection and shifting seasonal calendars. Low human resource capacity for CRA may also limit the scale of these initiatives, which in light of the adverse effects of climate change are likely to become more frequent, widespread and advanced.

**Actual effectiveness of risk governance structures (policy frameworks and institutional arrangements) in the implementation of aligned climate change adaptation-DRR objectives, is also weak.** Some countries refer to ineffective policy frameworks and plans as a baseline to develop more supportive and effective structures. While projects and even NDCs tend to highlight progress in the implementation of specific climate change adaptation-DRR projects or programmes, there is little evidence of comprehensive evaluations of progress, implementation, and effectiveness of risk governance arrangements.

**Public-private dialogue was found to be *ad hoc*, and this was not in keeping with good governance and effective value chain development strategies.** Input from private sector actors is important to identify the key binding constraints on the further development of value chains, and to prioritize public investments. Public-private dialogue was also not well developed as part of the policy development process. As a form of collaboration, there was no real policy direction towards facilitation and promotion of public-private partnerships (PPPs) for CRA.

**For most AgREADY countries adaptation was seen as a more pressing concern over mitigation for the agriculture sector.** NDC analysis was a good measure of the climate focus of the agriculture sector and the AgREADY project's review of country documents found more effort towards adaptation and less focus on mitigation and reducing GHG emissions in the respective NDCs, though even these were spottily addressed and often were reliant on conditional financing. As a result, donors, even when they have the funds to contribute to agriculture adaptation measures, lack the political will or the administrative capacity to support massive and sustained action in this arena, and when they do, it is often with attached conditionalities, which seek to impinge on basic governance processes in the receiving country. This blunts their focus and effectiveness. For these

reasons, even though it is becoming increasingly clear that avoiding climate action has serious cost implications, knowledge about climate change is not translating into sufficient action.

### *3.2.3 Financing constraints for CRA*

**The current levels of financing for climate change adaptation and mitigation in the agricultural sector are woefully inadequate. Climate-resilient interventions in agriculture require substantial investments and innovative types of financing to support the transformational changes that are needed to maintain or increase agricultural productivity while using less resources, and build the resilience of vulnerable farming communities to the impacts of climate change while also reducing or removing greenhouse gas emissions and this is often a challenge for AgREADY countries. Although there is evidence of a range of types of financing, these are often not wide-scale and not tailored to the specific circumstances of many small holder farmers, who make up the majority of producers.** Several<sup>8</sup> of the nine AgREADY countries have developed climate financing strategies, which identify the agriculture sector among the sectors prioritised for climate financing. These strategies indicate that a multiplicity of financing sources are required to support agriculture sector climate change adaptation and mitigation programmes and actions. In Belize, for example, the Climate Financing Strategy (2021-2026) outlines that to fulfil agriculture-related targets and actions linked to Belize's NDC will require US\$41 million for mitigation actions (with approximately US\$ 31 million already identified/mobilized) and US\$113 million USD for adaptation actions (with an estimated US\$41 million already identified/mobilised).

**Another key financing gap in the AgREADY countries, is the general absence of risk-reducing financing mechanisms to address production losses, linked to climate change, or otherwise.** Across the countries, there are several examples of sub-sector wide losses linked to factors such as climate change, loss of preferential agreements and other externalities that ultimately result in reduced sector earnings. These factors have contributed to a reluctance to develop and implement de-risking measures. In Belize, for example, "agricultural insurance, be it multi-peril or index-based insurance does not exist. Farmers can insure their life, health, houses, barns, tractors and transport vehicles, but they cannot insure against risks affecting their production outcome" (World Bank, 2018). While AgREADY country governments have implemented response measures, e.g., cash pay-outs or provisions of inputs post a climate-related disaster or in response to severe downturn linked to disasters such as the COVID-19 pandemic, these are often not sufficient to build the levels of resilience required by farmers and can contribute to farmers' misgivings as it relates to employing new technologies that are perceived to increase their risk profile. "Knowing they are exposed to risks, many farmers are very conservative, and they tend to have reservations regarding innovations that could bring additional risk exposure. On the other hand, when they are convinced that an innovation will reduce risk and generate reasonable returns, they are generally willing to invest, as indicated by the cases of fertilizer, pesticides, and tractors" World Bank (2018).

**The criteria and pre-requisites of various types of financing are sometimes restrictive and discourage many smallholder farmers from seeking additional financing.** Criteria for access to credit often include stringent requirements for collateral, one of which is production records that

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<sup>8</sup> Saint Lucia, Belize and Suriname

can prove onerous for farmers. Additionally, unattractive repayment terms (high interest rates and short duration for loan repayment) and in some instances, high requirement of working capital, also prove to be significant deterrents. While some countries have recognized these issues and have tried to develop and make available financing instruments geared towards the agricultural sector or to MSMEs generally, the requirements are sometimes still too restrictive, especially for smallholder farmers.

**Land tenure/ownership is a major issue for many small farmers who seek access to loan financing.** This corroborates with the insecurity of tenure issues faced by many smallholder farmers and the policy reform gaps identified. Almost all of the nine AgREADY countries are faced with this issue. Furthermore, where prime agriculture lands are owned by government, there is inconsistency in efforts to make these available to farmers. Trinidad and Tobago was one of few countries with such a programme, which targets the youth in particular.

#### *3.2.4 Knowledge Management, Capacity Building and Awareness*

**Although the importance of knowledge management and communication along the agricultural value chain and its potential to effect sector improvements has been recognised, these tend to be lacking or not functioning effectively where they exist within the AgREADY countries.** BANA consultations and literature review revealed that effective knowledge exchange and communication is often impeded by infrastructural (lack of, or inadequate ICT), financial, institutional (inadequate collaboration and corporation) barriers, which negatively impact timely and efficient collection, storage, retrieval, dissemination of, and access to, data and information among agriculture stakeholders.

**Deficiencies in institutional capacity is another key barrier that hampers widescale adoption of CRA.** While key agriculture sector stakeholders have been trained in CRA thematic areas, as previously highlighted in Section 3.1, there still remain knowledge, capacity, human resource and financial constraint gaps. According to the FAO (2019), “many Caribbean countries and regional institutions still require further assistance and support to (a) increase their knowledge and capacity to assess climate change risk and (b) to design and implement appropriate climate-resilient policies and programmes”. This was largely confirmed for the AgREADY countries during the BANA consultations. In Belize, for example, it was highlighted that capacity building and training is needed to understand the kinds of data needed and also how to use that data to support sustainable operations in the sector. Capacity building is also needed to adopt, or adapt where necessary, the technologies that have been identified as promising for the local agriculture sector.

While capacity limitations and low levels of awareness of smallholder farmers also impede wider CRA adoption in the AgREADY countries, resolution of these issues do not immediately translate to CRA advancement, where there is a general absence of policy, financing, social inclusion mechanisms, and other key enabling factors. Section 3.1.4 outlined some of the advances linked to capacity building, training and awareness within the AgREADY countries, however, there still remains significant capacity building needs as shown in **Table 8**. The need for field/practical demonstrations was also highlighted. In Dominica, for example, extension officers are sometimes only able to do short trainings (one day) with farmers, which is often indoors with no field demonstration.

**Box 4: Factors that affect access to information, knowledge and decision-making for women, youth and vulnerable groups**

“With limited access to and control of resources, women have more difficulties accessing training, improved technology, market information, and agricultural inputs, such as fertilizer and irrigation to improve production. For example, access to irrigation water often depends on tenure of property, which female farmers are less likely to have. Rural women, youth and vulnerable groups are also more likely to lack access to the knowledge and resources required to meet rapidly evolving phytosanitary and food safety standards – enforced by local, regional and international markets for processed products. Agriculture extension services in most BMCs are not sufficiently sensitized to the importance of gender-equitable service provision, which can lead to the exclusion of women in accessing benefits and participating in decisions.

– FAO and CDB 2019

**Table 5: Identified CRA training needs for value chain stakeholders**

Training Needs	Extension Services	Farmers and Agro-processors	Policymakers and Planners
General CRA	X	x	x
CSA	X	x	
Crop Management	X	x	x
Protected Agriculture (e.g., greenhouses, shade houses, climate-resilient livestock housing)	X	x	
Animal and Plant Health	X	x	
Water Management/Soil Conservation	X	x	
Participatory training and education (e.g., FFS)	X	x	
Post-harvest technologies/Reduction of food waste	X	x	x
Renewable technologies	x	x	x
Food Safety and Quality	x	x	x
Sustainable Agricultural Enterprises	x	x	
Recordkeeping/ Business Planning		x	
Organizational Development		x	
Proposal Writing/Project Development		x	x
Climate Change Awareness		x	
Climate services/ Agromet/ climate decision support	x	x	x
R &D/ Product Development		x	x
Marketing			x
Climate Financing, including risk transfer			x
Digital technologies/ICT	x	x	x

Training Needs	Extension Services	Farmers and Agro-processors	Policymakers and Planners
Monitoring, evaluation and learning			x

### *3.2.5 Social Norms and Behaviours*

**Land tenure and the fragmented and insecure nature of land ownership across the CARICOM AgREADY subregion is grounded in socially accepted norms.** For family inherited lands, there is a tendency to pass on land predominantly to males, resulting in chronic gender-biased land ownership in the region. In addition to this, the practice where family inherited lands have been passed down to multiple beneficiaries has resulted in fragmentation and inefficient-sized agriculture holdings, that often do not observe legal land transfer methods. A result of this is the inability to access credit from formal financial institutions.

**Smallholder farmers in AgREADY countries, especially aged farmers, have a tendency to adhere to traditional agricultural practices, which do not always align with the tenets of CRA.** The traditional agricultural practices involve the use of labour-intensive approaches, traditional knowledge, tools, natural resources, organic fertilizer, and old customs and cultural beliefs of the farmers. Some of these practices rely on outdated information and tools and prove to be inefficient and exacerbate environmental degradation, including loss of biodiversity and the farmers are not readily accepting of change. For example, in the Hinterlands in Suriname, some farmers continue to maintain their longstanding practices, which often do not result in increased productivity and do not build resilience. There are some who wait to see that the new practices/technologies work/make a profit before they embrace them. Another example is in the Bahamas with an aging farmer population, the adoption of new technology was considered to be low.

**The low level of uptake of credit financing for farmers is often a result of farmer preference and perceptions.** In Dominica for example, farmer perception of loans was negative and resulted in a preference for grants. This affected the uptake of available loan products and was found to be a constraint to the adoption of CRA technologies.

### *3.2.6 Gender, Youth and other vulnerable groups*

**Although women account for 22-30% of the registered farmers in the Caribbean region, in AgREADY countries there is a wide variation in opportunities due to limited access to finance, land, networks, and information.** While several AgREADY countries would have made significant strides in narrowing the gender divide, systemic discriminatory practices around land tenure, accessing credit and decision-making continue to constrain women's participation in CRA. In Dominica and St. Kitts and Nevis, stakeholders emphasized that women had significant constraints to meeting the criteria for loans, including the required collateral and this affected their ability to adopt CRA technologies and realize the gains from increased productivity and increased income. Other constraints for women farmers articulated by stakeholders included dual responsibilities as homemaker and farmer, labour-intensive farming practices that often require hiring of additional labour and high transportation costs.

**Poor land access has been recognized as a critical barrier to the inclusion of youth in CRA.** Although there was evidence of initiatives for youth access to agriculture lands such as in Trinidad and Tobago and St. Vincent and the Grenadines, where the youth faced immense challenges to access land, this effectively excluded them from participating in CRA practices and applying technologies even when they have had opportunities to participate in training and other capacity building exercises. The BANA did not identify any youth-responsive land policies to change the status quo.

### *3.2.7 Barriers to a CRA transitions related to technology adoption*

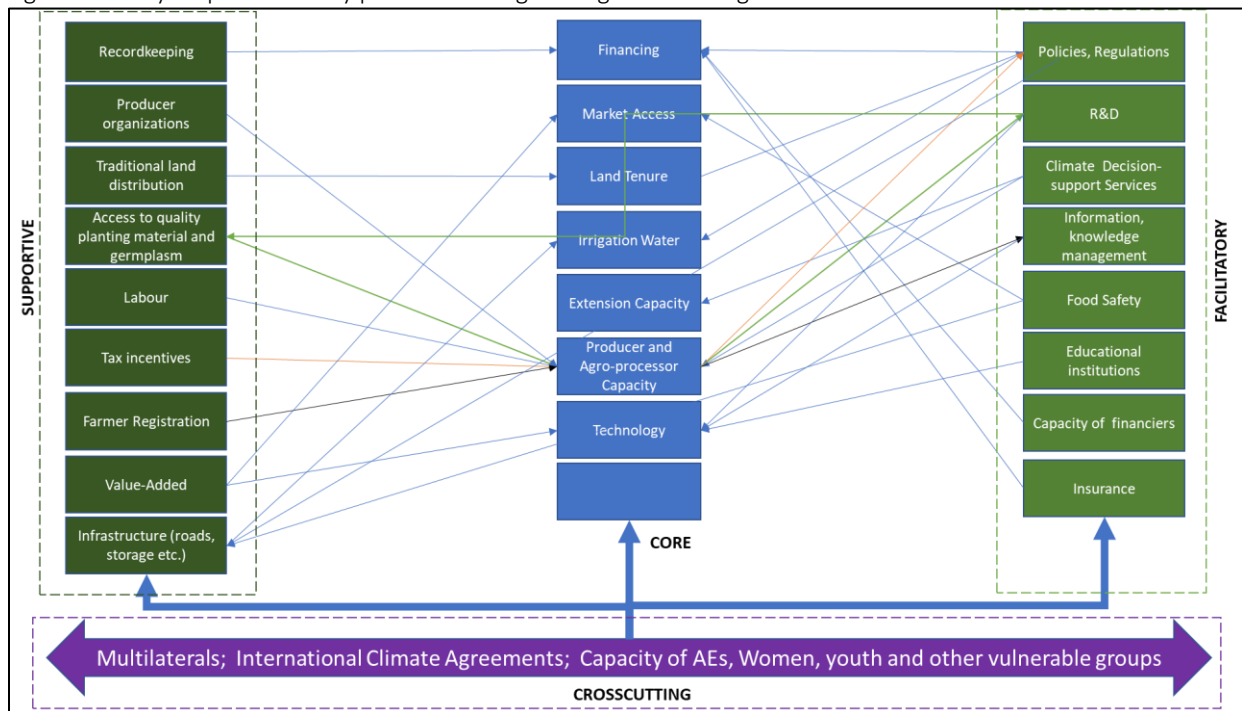
**AgREADY country-specific Technology Needs Assessments and Barrier Analysis Enabling Frameworks (BAEFs) that have been completed as part of the requirements of parties to the Paris Agreement identified key barriers to adoption of CRA technologies.** The BAEFs identified the main barriers and constraints to include high capital investment for CRA technologies, limited technical capacity in the agriculture sector, especially among small farmers, affordable credit, financing not easily accessible to small producers, land insecurity and limited processing and quality standards to support the CRA solutions. Further to this, in consultations, Haiti identified key constraints to adoption of agroforestry technology to include lack of technicians with specific knowledge of agroforestry technology, inadequate compensation to balance the price of products of agroforestry systems compared to products of short-cycle systems, poorly developed market for the sale of agroforestry products and limited processing capacity for agroforestry by-products. For Dominica's priority technologies that included integrated soil nutrition management and soil conservation, the major barriers identified were the high capital cost for the establishment of organic fertilizer producing facilities, limited localized information on available technology, absence of production standards/quality assurance systems for production, and insecure land tenure status, which impacts access to finance.

## **4. Recommendations: Entry points for CRA in CARICOM AgREADY countries**

The impacts of climate change, especially on subsistence agriculture in AgREADY countries, are likely to exacerbate food insecurity and generate cascading impacts in multiple fronts, including health and nutrition, well-being, and livelihoods. The BANA identifies the following key gaps to CRA in AgREADY countries: slow policy reform especially in areas of land tenure, irrigation, food safety and financing, limited access to climate information, extension services, and poor governance mechanisms. Further to these, relevant predictors of barriers, e.g. credit access, market access, land tenure, and inputs availability, are not well accounted for in more current agriculture policies. Sectoral policies, strategies and plans also aim to improve farmers' climate-resilience through initiatives including promotion of drought tolerant crop varieties, climate-resilient livestock housing, increasing farmers access to climate information and extension services, availability of financing. Scrutiny of these barriers will be important to the refinement of the NAP sector policies, agriculture policies and programs to eliminate such barriers. **Figure 7** presents a policy map of identified barriers to the enabling environment for CRA transition and the response entry points for realizing the transition (combinations of core, facilitatory, supporting and cross-cutting factors)



Figure 7: Policy map of the entry points to strengthening the enabling environment for CRA



#### A. Enhance financing for climate-resilient agriculture

Financing is a core barrier and constraint to achievement of CRA in the AgREADY countries. Governments, development organizations and the private sector make up the primary sources of finance for both infrastructural and non-structural CRA technologies and for response and recovery from disasters. Even where insurance is available, there may still be a requirement for government to fund the response, especially given the extent of a disaster and its impact on the food value chain.

Financial resources can be delivered from various sources through different mechanisms and instruments (**Figure 8**). Decisions on how, when, to whom and by whom finance will be allocated, provided or mobilised to build climate-resilience involves various factors. They include the acceptable level of residual risks for individual stakeholders despite efforts to adapt to climate change. They also involve the relative allocation of identified risks by reducing, transferring or retaining them. Other factors not directly related to finance may also influence decisions. These could include capacities of stakeholders, political power dynamics and the cultural acceptability of the proposed measures. The psychological and emotional distress expected to be triggered by the impacts of climate change is another consideration.

Figure 8: Examples of types of financial sources for CRA

	Public	Private
Domestic	<ul style="list-style-type: none"> <li>• National budgets</li> <li>• Sub-national budgets</li> <li>• National development financial institutions and funds</li> </ul>	<ul style="list-style-type: none"> <li>• Businesses and households</li> <li>• Commercial banks</li> <li>• Non-bank financial institutions (microfinance, credit unions)</li> <li>• Philanthropy</li> <li>• Insurance companies</li> </ul>
International	<ul style="list-style-type: none"> <li>• Governments of providers of ODA and other official flows</li> <li>• Multilateral and bilateral development financial institutions</li> <li>• International climate funds and facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Remittances</li> <li>• Multinational enterprises</li> <li>• Commercial banks and institutional investors (insurance companies, funds, etc.)</li> <li>• Philanthropy</li> </ul>

**1. Identification of priority actions for CRA and assessment of the associated financial needs:**

- Engage with value chain stakeholders to better understand the climate risks to agriculture and the food value chain and explore suitable measures to address these risks and determine their associated costs.
- Agree on and utilize methodological approaches to assess the costs of the actions to strengthen climate-resilience.
- Engage with development, commercial and micro-financial institutions to harness their financial expertise and private sector perspectives, as relevant, for articulating assessments of financial needs.

**2. Integration of CRA into public financial management**

- Strengthen the planning and budgeting process for mainstreaming CRA actions in sector planning, prioritization and budgeting, and where possible incorporate a gender budgeting approach. Ensure that actions that involve women, youth and other vulnerable groups are included and appropriately budgeted.
- Enhance collaboration between agriculture, planning and finance ministries and other government entities responsible for climate policy through the budgeting process.
- Tag budgets and public expenditure to better understand and monitor where, how and how much public finance is allocated for CRA and potential gaps.
- Develop and enhance social safety nets that are responsive to shocks, while encouraging public investments in DRR where possible.

**3. Selection and blending of financial instruments for CRA and managing climate risks in the food value chain.**

- Conduct stock takes of available and accessible financial instruments (grants, debt instruments, risk transfer/sharing instruments) and develop a comprehensive blending strategy to manage risks to CRA.
- Identify and apply tools to support selection of financial instruments based on the uncertainty and unpredictable nature of climate change, coupled with efficacy and broader socio-economic considerations such as gender and social inclusion.
- Explore and pilot emerging financial instruments and solutions such as parametric insurance, bonds, equity, low credit facilities, which are especially suitable for small holder farmers and agro-processors.

#### **4. Exploration and maximisation of the benefits of risk insurance solutions**

- a. Expand and develop the insurance sector through capacity building and awareness raising for policy makers, domestic insurers and potential beneficiaries, building on public-private partnerships and pilot activities. Create the appropriate linkages with other sectors to ensure the risk transfer products can meet the needs of small holder farmers and MSME agro-processors in particular.
- b. Build the capacity of insurers and potential beneficiaries to harness data for a long-term view of climate risks.
- c. Involve target beneficiaries, including women, youth and other marginalized groups, in early stages of development of products and solidify functioning partnerships to achieve scale.
- d. Manage the expectations of beneficiaries/policy holders regarding the benefits of insurance products through financial literacy programmes.

#### **5. Enhancement of private sector engagement for CRA**

- a. Establish clear and bold policy targets on CRA to build private sector confidence and boost the attractiveness through well-defined co-benefits and risk-return profiles of potential CR investments in agriculture. Establish linkages with and engage private sector in the conduct of Technology Needs Assessment (TNA) for international climate change reporting to increase their understanding of sector needs.
- b. Develop and enforce legal and regulatory frameworks that lower investment barriers and enhance economic incentives for private sector investment in CRA.
- c. Utilise blended financial instruments for projects with the potential to deliver impacts on CRA but cannot reach scale due to the significant risks or costs to the private investor.
- d. Harmonise domestic legal frameworks and standards for PPP, with policies on climate-resilience and in particular CRA.

#### **6. Facilitation of access to domestic and international climate finance**

- a. Support and facilitate preparation of project proposals by domestic actors, linked with the production, collection and analysis of the data needed for climate risk assessment for proposals especially geared towards the international financial community (e.g., GCF, AF, GEF, multi-lateral institutions and other IFIs).
- b. Engage target stakeholders, especially the most vulnerable to climate change and its impacts, including women, youth and indigenous groups, early in project conceptualization and development. Build their collateral capacity (e.g., land title) and business acumen (record keeping and business planning) to access financing for CRA.
- c. Identify the most relevant international financing sources based on the eligibility criteria, access modalities, programming priorities and logical frameworks of the financial sources in light of country and sector priorities and capacities.
- d. Support capacity development at the organizational and operational levels in accessing climate finance, especially focal points, national implementing entities and direct access entities, where relevant.

## **B. Enhance the policy, legislative and regulatory environment to support CRA**

While the AgREADY countries have made several strides towards mainstreaming climate change in agriculture sector policies and plans, there are deficiencies and gaps within the policy, legal and regulatory framework, which pose a significant barrier to the CRA transition. In order to establish a more cohesive and integrated policy, legal and regulatory framework that will translate to effective implementation on the ground, it will become necessary to identify and address gaps that contravene the sustainable management and use of natural resources within the sector and to overcome barriers and constraints to PLR framework implementation. Key actions in this regard include:

- 1. Engagement of public, private sector and civil society and technical service providers in policy development and implementation activities.**
  - a. Work collaboratively with other sectoral and national level stakeholders towards increasing the use of green and renewable technologies.
    - i. Supporting actions could include reduction of import duties on green technologies such as greenhouses and solar-powered pumps.
  - b. Hold dialogue with producers, agro-processors and other local level stakeholders early in the policy development stages. Prioritise involvement of women, youth and other vulnerable groups in policy dialogue.
  - c. Engage private sector in the policy development and implementation process, especially in relation to financing of policy actions.
- 2. Development and enhancement of agriculture and other policies relevant to the CRA transition.**
  - a. Assess agriculture and other relevant policies for gaps in the CRA transition.
  - b. Utilise climate data and information to inform new policy actions.
    - i. Identify sources of climate data and information and establish a plan for collection, analysis and utilisation in policy development.
    - ii. Conduct vulnerability analyses, crop suitability assessments and other relevant climate-based analyses to inform policy, legislative and regulatory reform.
    - iii. Incorporate climate data and information into agriculture policy monitoring.
  - c. Develop and update policies and their associated implementation plans that fill identified gaps and reflect critical elements necessary to drive CRA, including, but not limited to policies that:
    - i. Are geared towards (i) preserving agricultural lands for productive use within the sector and (ii) regularizing tenure and land access for farmers as this will positively impact investment in sustainable and climate-resilient land management technologies and practices.
    - ii. Prioritise the promotion of best-practice CRA technologies and practices.
    - iii. Improve R&D outputs as responses to the impacts of climate change.
    - iv. Drive adoption of green technologies (infrastructural and inputs) in the production systems.
    - v. Support trading of fresh produce and processed goods that undergo climate-resilient processes, including meeting food safety and quality standards.

- vi. Ensure alignment of agriculture policies with climate policies and national development policies and plans and other relevant sector policies.
- vii. Promote livestock diversification and “climate-ready” species and breeds.
- viii. Encourage high-quality diets for livestock that increase conversion efficiency and reduce emissions.
- ix. Provide incentives for small holder farmers for (i) increased access to quality planting material and germplasm while (ii) enhancing the infrastructure to support reduced GHG emissions, reduction of waste and increased productivity.
- x. Drive use of digital technology systems for commodity pricing and marketing.

**3. Implementation of policy actions that drive CRA adoption.**

- a. Explore sources of financing for implementation of policy actions that include government budgetary allocation, local and international private institutions, bilateral and multilateral organizations, among others.
- b. Encourage ownership of policy actions by relevant stakeholders by tracking efforts to mainstream the actions in their organizational plans, including budgeting.
- c. Establish and utilise a policy monitoring committee that monitors implementation of policy actions against relevant production and climate-resilience targets and facilitates adaptive management.

**C. Enhance capacity to facilitate farmer adoption of CRA technologies**

Capacity building has reverberated throughout the BANA as a limiting factor to the enabling framework to support accessibility, affordability, and application of CRA technologies across AgREADY countries. Through regional and international collaborations, there are several structures that AgREADY countries may leverage to enhance capacity for CRA technologies. In addition, options to strengthen inter-regional pathways for capacity building in CRA technologies for youths and other vulnerable groups present opportunities to increase the pipeline of regional skillsets.

- 1. Establishment of partnerships with regional and international training institutions to build a cadre of persons to support adoption of CRA technologies inclusive of youths.**
  - a. Build a pipeline of technically competent talent in CRA solutions through the use of scholarships and fellowships. Provide scholarships to students interested in areas where skillsets are short to meet industry needs through private partners.
  - b. Leverage development partnerships to provide fellowships to private and public sector professionals to strengthen their capacity in key CRA talent areas.
- 2. Strengthening of extension services to support farmer adoption of CRA technologies.**
  - a. Utilise tried and proven farmer training techniques to build extension officer capacity, for example, through the widely accepted <sup>9</sup>farmer field school (FFS).

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<sup>9</sup>Farmer Field School (FFS) is an approach based on people-centered learning. Participatory methods to create an environment conducive to learning: the participants can exchange knowledge and experience in a risk-free setting. Practical field exercises using direct observation, discussion and decision-making encourage learning-by-doing. The field is the space where local knowledge and

<sup>10</sup>The FFS extension delivery methodology is flexible and has been applied in addressing a growing range of technical topics such as: soil, crop and water management, seeds multiplication and varietal testing, IPM, agropastoralism, aquaculture, agroforestry, nutrition, value chain, and link to markets, etc.

**3. Building flexible youth certification programmes to support adoption and utilisation of CRA technologies.**

- a. Provide training options, in addition to the existing TVET and CVQ training, that are more flexible and adaptable to the qualifications, or lack thereof, of several at-risk youth who are currently in agriculture or may benefit from going into agriculture. These options may include enhancing and improving accredited agriculture courses through the inclusion of CRA, strengthening access to accreditation for farmers (possibly a hybrid FFS approach) and expanding 4H movement to serve as a feeder approach for youth in agriculture.

**D. Develop and expand on water-focussed CRA technologies to address the impacts of drought on food production and productivity**

Agriculture is an important sector in AgREADY countries, and while the sector is not a large contributor to GDP, it provides employment opportunities to rural populations, and supports achievement of national food and nutritional security goals. In AgREADY countries, water management in rain-fed agriculture is becoming more and more complex to overcome the expected water scarcity stress. In addition to this, climate change projections suggests that water requirements for agriculture will have to be met through the judicious application of climate-smart water technologies. An entry point to maintaining and improving food production and productivity levels and by extension increasing incomes and supporting livelihoods is through safeguarding critical water resources for sustainable use through adaptive measures for effective water management, particularly in drought-prone areas. An integrated approach needs to be implemented in agricultural water management through adoption of innovations such as water harvesting, micro-irrigation and resource conservation farming to increase water-use efficiency in agriculture and other critical services to human and animals.

**1. Prioritisation of key actors affected by or who impact water availability, distribution and access for their incorporation into water-investment and development plans.**

- a. Engage sectoral government entities, primary producers and agro-processors, and special groups including women, youth and other vulnerable groups in determining policy objectives and priority actions for water-related CRA.
- b. Assign the responsibilities for overseeing and implementing the actions.
- c. Devise and utilize mechanisms to ensure equity in availability and access of the water resource.
- d. Build capacity of key government and local actors for monitoring and maintenance of new and upgraded irrigation systems.

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outside scientific insights are tested, validated and integrated, in the context of local ecosystem and socio-economic settings.

<sup>10</sup> [www.fao.org/farmer-field-schools/overview/en/](http://www.fao.org/farmer-field-schools/overview/en/)

**2. Assessment of drought risks to the agriculture sector and reflect them in the development plans for the sector**

- a. Use vulnerability assessments (VAs) and climate information such as Standard Precipitation Index to determine the main impacts of drought and reduced rainfall and future projections on the agriculture sector.
- b. Identify and prioritise climate-resilient measures and integrate them into, or link them to, sectoral development plans.
- c. Communicate the level of climate risk that needs to be borne by the private sector actors and the level at which the government is required to provide public support or investment.
- d. Develop and strengthen irrigation policies, as relevant, to support water availability in response to the impacts of drought.
- e. Utilize PPPs to support new and expanded irrigation infrastructural development within defined geographic areas.
- f. Use Climate Decision Support Systems (CDSS) for ongoing monitoring of water - use efficiency of irrigation systems and balance with use of rain-fed agriculture.
- g. Establish agriculture drought management governance structure, with participation of public, private, producers and agro-processors, R&D institutions and other key stakeholders and utilise this structure for policy development and implementation, decision making and monitoring, evaluation and learning (MEL) relating in particular to harnessing of water, storage, distribution and cost as well as other measures such as water conservation (e.g., drip-irrigation technology, water harvesting and storage).

**3. Integration of climate-resilience considerations into sector investment plans**

- a. Develop inventories of key infrastructure and assets within the agriculture sector and consider short, medium and long term climate risks in sector and investment plans. Give consideration to use of renewable energy sources for operations of irrigation systems.
- b. Assess the costs associated with capital investments, operational expenditure and other expenses for implementing water-related CRA technologies in agriculture sector (and in some cases water sector) development plans.
  - i. Utilise existing technology needs assessment (TNAs) and other sector assessments to determine the water-related needs, suitability of the technology and cost-effectiveness to the priority actors.

**4. Incorporation of grey infrastructure to manage excess flooding for future use.**

- a. Establish appropriate grey infrastructure to facilitate the capture and storage of floodwater for future irrigation purposes. This could include excavated catchments or micro dams.
- b. Manage groundwater sources for agriculture purposes (including monitoring of salinity)

**E. Support access to land for wider CRA application:**

Land, and secure access to same, is fundamental to agriculture sector growth and development, particularly within the context of competing demands on the finite resource and the challenges posed by climate change. Within the Caribbean, there are several land-related issues that negatively impact agriculture sector performance. These include:

- Insecure tenure – Many farmers are land tenants not landowners. Insecurity of tenure is recognized as the main factor limiting the ability of land tenants to invest in improvements to their farms.” (FAO 2013). Additionally, the matter of “family lands” can affect investment in agriculture as while persons enjoy the right to live upon and cultivate the land, it cannot be used as collateral for a loan (FAO 2013).
- Poor land management - Poor land management has been recognized as a major constraint to sustainable agricultural production (FAO 2013).
- Absence of effective land zoning/land use policies - In some instances, this had led to agricultural lands being converted to other uses.

These factors speak to the need for land-use policies, supported by implementation mechanisms as well as capacity building and training that is geared towards fostering agricultural productions systems that are sustainable, efficient and climate-resilient. Resolving land issues for agricultural development requires an integrated approach that considers other key related sector needs such as water availability. In instances where the responsibility for land matters does not reside with the same ministry responsible for agriculture, then the agriculture ministry and other stakeholders may be required to play a strong advocacy role in ensuring land issues relevant to the agriculture sector are appropriately addressed.

- 1. Engagement of key government, private and civil society stakeholders as well as customary landowners in land policy reform and implementation**
  - a. Involve key stakeholders early in the dialogue on land policy reforms. Consider exploration of the influence of social norms and behaviours, conflicting legislative instruments and land use practices on land tenure.
- 2. Development and implementation of integrated land reform policies, legislation and institutional framework that supports the sustainable and equitable use of land for agriculture.**
  - a. Establish an intersectoral land policy advisory body to provide guidance and support monitoring of implementation of the integrated land reform programme.
  - b. Develop and implement a land regularization programme, ensuring that women, youth and other vulnerable groups are not disenfranchised. This may include:
    - i. Land survey and registration of titles
    - ii. Security of tenure for CRA adoption (e.g., through formal long-term land lease arrangements)
  - c. Establish land zoning policies and structures that are evidence-based (i.e., built on climate projection data, water availability considerations, crop suitability studies) to ensure effective pairing of agricultural lands and activities for enhanced production.
  - d. Develop and implement associated plans and financing strategies for rollout of the land reform programme.
  - e. Utilise incentives to promote restoration of marginal and degraded lands.
  - f. Discourage the conversion of prime agriculture lands to other uses.
  - g. Secure farmer access to irrigable and arable agricultural lands that has supporting infrastructure such as developed road networks and adequate drainage systems.



### **3. Building capacity and awareness of sustainable land management technologies and practices**

- a. Encourage the development of farm plans that support:
  - i. Soil conservation to improve agricultural productivity.
  - ii. Sustainable cropping systems (e.g., crop rotation, multi cropping).
  - iii. The use of CRA technologies for greater land-use efficiency and productivity, especially for smallholder farmers, while minimizing the impact on biodiversity through land expansion.
- b. Support farmers to restore marginal and degraded lands and watershed areas.
- c. Promote diversity of land uses for agriculture.
- d. Encourage increased cover of trees and perennials.
- e. Protect against large-scale erosion.

### **F. Market access to support trade in agri-food products**

Market access and, more so, trade facilitation can be valuable tools to support multiple objectives. Market access is facilitated by both domestic and international trade policy dynamics, food safety rules, coupled with economic theories such as demand and supply and marketing tools such as consumer preferences, branding, and others. All these dynamics, have to be balanced with national priorities such as the economic development agenda and food and nutrition security. Entry points to facilitate market access include:

1. **Strengthening trade facilitation and food and nutrition security policies and enabling framework for key crops, livestock, and processed food simultaneously.**
  - a. Secure alignment between market access and import substitution objectives in conjunction with trade reciprocity and the safeguarding of national food and nutrition security.
  - b. Enhance capacity for food safety and traceability issues to allow for ease of manoeuvring food safety and quality standards of international markets.
  - c. Strengthen capacity of marketing organizations to work with farmers, agro-processors, and other stakeholders across the supply chain. Areas for strengthening include market potential assessments and supply chain management to further improve market access.
  - d. Develop a food safety and traceability framework in order to safeguard local food and nutrition security.
2. **Increasing focus on food quality and safety requirements.**
  - a. Support farmer/agro-processor behavioural change towards recordkeeping through awareness-raising on food quality, safety and traceability requirements.
  - b. Build capacity of primary producers and agro-processors to record all stages of production, processing, distribution and sales and make these available for inspection and certification.
  - c. Develop and implement a “traceability/good agriculture product” system to support market access for agri-food products from AgREADY countries.
  - d. Enhance packaging and labelling that build consumer confidence in the quality of products.

## **G. Build multi-level governance and enhance coordination across the food value chain**

Weak coordination is a critical barrier to achieving CRA. An effective CRA governance arrangement provides an important basis for agriculture ministries to coordinate CRA actions by different ministries and agencies, local governments, producers, agro-processors, the range of other value chain stakeholders and development co-operation providers.

A governance arrangement for action on climate-resilience must therefore be inclusive to ensure its approaches are informed by the needs of the most vulnerable people. Women and people in marginalised and Indigenous groups often face barriers to participating in decision making, from farm level to national agriculture and other relevant policy-making processes. Developing inclusive governance must therefore pay attention to equitable engagement of vulnerable stakeholders in decision making for CRA. This includes, for instance, improving their access to information and considering the domestic responsibilities of women, the involvement of youth and other vulnerable groups.

Inclusive governance arrangements also facilitate the generation of context-specific information about climate risks and possible solutions to address them. Governance arrangements that foster coherence between development policies and priorities, agriculture policies and strategies, climate policies and other policy agendas can help governments achieve CRA and broader sustainable development goals. Such policy coherence may contribute to improving efficiency in the use of financial and human resources, and minimising misalignment between different policy objectives (e.g. climate mitigation, health and well-being, agriculture sector development, disaster risk reduction, water resource management and conservation of biodiversity).

The following are key entry points for enhancing coordination and strengthening CRA governance arrangements:

### **1. Building inclusive governance arrangements for CRA**

- a. Map the agri-food value chain, including women, youth, and other vulnerable groups (e.g., persons with disabilities and indigenous peoples)
- b. Build mechanisms for stakeholder participation in CRA policy, planning, implementation, and monitoring and evaluation, including in formally developed policy consultation processes, multi-stakeholder decision making bodies, farmer organizations. Utilise other arrangements including climate change engagement mechanisms such as those for the GCF.
- c. Facilitate understanding of stakeholders' respective roles and responsibilities and mainstream relevant CRA actions in their organizational plans.
- d. Engage with civil society organizations and the private sector, for assessing climate risks to the agri-food value chain and discussing associated policy options to address them.

### **2. Development of governance mechanisms for adaptive decision making**

- a. Establish and enhance governance arrangements that support adaptive decision making for CRA, especially as it relates to the uncertainty presented by the identified climate hazards and their impacts.
- b. Explore and apply tools and approaches to support adaptive decision making with both vertical and horizontal exchange of information, robust decision making and dynamic adaptive policy development pathways.

- c. Support continuous learning about climate risks and regularly adjust CRA actions and measures as needed.

### **3. Enhancement of governance for greater coherence across different development agendas**

- a. Equip agriculture ministries and agencies with information and incentives to integrate CRA measures and that they are aligned and consistent with the national development agenda, and other policies and plans for building climate-resilience (e.g., NDCs, NAPs, ADRM and other DRR policies and plans).
- b. Strengthen inter-sectoral and inter-agency linkages for key facilitatory and support enabling factors including policy coherence (e.g., developing irrigation policy to address drought and water scarcity issues; land policy reforms to address land insecurity issues).
- c. Integrate CRA into a policy cycle with policy implementation at strategic, operational and technical levels.
  - i. Strategic- alignment with international climate and agriculture agreements.
  - ii. Operational- strengthened agriculture policy frameworks and institutional arrangements that support farm level and MSME implementation. Also ensuring alignment with national climate and DRR policies and plans.
  - iii. Technical- strengthened technical capacity to assess climate and disaster risks and opportunities and prioritise CRA and DRR measures. Capacity and readiness of producers and agro-processors through harnessing skills and availability and access to financing are key.

### **4. Promoting PPPs for increased private sector investment in CRA.**

- a. Establish interlinkages and ensure alignment between CRA policies and broader country PPP policies.
- b. Utilise relevant PPP models that support the CRA transition, operating at different levels of the agri-food value chain.
  - i. Incorporate accurate, sustainable and efficient distribution of risks and benefits between public and private counterparts of the transaction risk distribution.
- c. Build awareness on mechanisms for development of innovative partnerships, which can accelerate the scaling of CSA and climate information services.

## **H. Promote agriculture as a viable option for national economic development and livelihood enhancement**

Despite declines in GDP contribution over recent decades, agriculture remains a significant contributor to socioeconomic development. Challenges such as climate change, aging farming population, inability to access credit, market access limitations, high cost of inputs, low productivity, praedial larceny, among others, have impacted the perception of agriculture as a viable livelihood generation option. Another critical issue facing the sector is the disparity in access to resources, goods and services experienced by women, youth and other vulnerable groups, and as such, these groups require special focus to ensure they are not marginalized as the sector seeks to transition to CRA. While governments across the region have tried, through policies, plans, programmes and projects, to address some of these issues (e.g., in St. Lucia, the government has implemented programmes to encourage youth participation in the sector), a

more streamlined and integrated approach is required. Equitable and sustainable agriculture sector development that results in livelihood enhancement for farmers will require:

**1. Enhancement of productivity**

- a. Enable access to CRA productivity improvement technologies.
- b. Facilitate availability of technical services for CRA technology adoption.

**2. Strengthened entrepreneurial and business outlook for CRA**

- a. Facilitate investment in agriculture through access to capital, land, labour, inputs.
- b. Engender market access through value chain diversification and expansion.
- c. Enhance capacity for adoption of best practices in agribusiness management at the producer level.

**3. Establishment of mechanisms to create equity in access to resources, goods and services and decision making among women, youth and other vulnerable groups.**

- a. Develop financial products and services to support CRA adoption by women, youth and other vulnerable groups that are:
  - i. Gender-sensitive
  - ii. Age-appropriate
  - iii. Geared towards incentivising PWDs, indigenous and other vulnerable groups.
- b. Engage women, youth and other vulnerable groups in agriculture advisory and decision-making bodies.

# *Chapter 2: Economic and market barriers angle*

Vincent Little, PhD

## **Introduction**

### *1.1 The Study*

This chapter presents the findings of an analysis undertaken to determine the economic and market barriers that limit the transformation of Caribbean agricultural production systems from an “as-is or business-as-usual” state to climate-resilient production systems that provide strong arguments/rationale for private and public sector investments. The analysis forms an integral part of the GCF-Readiness Project titled “Strengthening the Foundation for a Climate Responsive Agricultural Sector in the Caribbean” (GCF CARICOM AgREADY, in short), which is funded through a Grant Agreement with the Green Climate Fund (GCF). The Ministry of Environment and Housing of the Bahamas is the lead National Designated Authority (NDA), and the Inter-American Institute of Cooperation on Agriculture (IICA) is the delivery partner. The IICA-GCF Readiness Project targets nine countries (The Bahamas, Belize, Dominica, Haiti, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago) in the CARICOM sub-region.

The AgREADY project seeks to raise the profile of the agricultural sector in GCF’s climate financing prioritization processes by implementing an evidence-based and inter-sectoral strategy for developing and rebranding Caribbean agriculture as “low-emissions,” to enhance market opportunities and attract private sector investments. In this broad context, the project-specific objectives and activities aim to:

- Improve the enabling conditions to design, implement and evaluate options for enhanced climate action in the agricultural sector by strengthening policies, capacities, frameworks, methods and institutional arrangements for the collection, monitoring, measuring, reporting, verifying (MRV) and analyzing agricultural and associated activity data from the sector.
- Increase the number of projects identified for development and investment in a pipeline of evidenced-based and bankable projects aligned with regional and national priorities as informed by climate risk assessments of the agriculture sector.
- Disseminate best practices for institutional capacity building, coordination, and pipeline development of more robust proposals for building climate resilience along prioritized agricultural value chains, with a focus on cultivating the innovative capacity of the region’s youth.

In a much more narrowly defined, but integrated context, the analysis of the economic and market barriers focused on the following areas:

- Development of a baseline of the key economic and market barriers that affect the effectiveness and efficiency of current agricultural production systems.

- Execution of a comprehensive analysis of the economic issues and challenges that affect climate resilient systems including output growth, use of capital, income and expenditure, competition, and volatility.
- Identification and determination of opportunities and proposed approaches and strategies for addressing economic-market gaps and barriers to enhance enabling environment for supporting and scaling-up climate resilient production systems.

The analysis conducted covered the areas of a) existing and potential markets, b) investments, and c) the economic impact of Covid. It is the expectation that the results and findings of the analysis will feed into an overarching barrier analysis and needs assessments of the enabling environment for developing evidence-based climate resilient responsive agriculture that is more attractive for private sector investments.

## *1.2 Background to the Study*

The Caribbean Region is comprised of Small Island and Low-Lying Coastal developing states (SIDS) that are highly vulnerable to the effects of climate change and variability (Nurse et al. 2014). Three of the top ten (10) countries in the world facing the highest level of climate risk globally are located in the Caribbean Region. *A growing body of research suggests that for the region, climate changes are already evident and manifested in more intense rain events, longer dry spells, higher and more frequent extreme temperatures and rising sea levels (see e.g., Nurse et al. 2014; Peterson et al. 2002; and Stephenson et al. 2014). Other studies suggest a general intensification of these changes in the future under increased global warming projections (see for e.g., Campbell et al. 2010; Taylor et al. 2012; McSweeney et al. 2010a; and McSweeney et al. 2010b).* Vulnerability is, however, not uniformly distributed among the countries of the Caribbean, (Rhiney et al. 2015) due to variations in different factors governing exposure and resilience e.g., geography, demographics, economic ability to withstand and cope with disasters, and exposure to extreme climatic events.

In the context of their vulnerabilities, countries in the Caribbean region have incurred and will continue to incur considerable costs to cope with and adapt to climate impacts, which often exceed their financial capacity. Estimates of the economic impact of climate change for Caribbean SIDS are generally higher than the world average (>5% of GDP/year), with costs projected to surpass US\$ 22 billion per year by 2050. This will account for approximately 10% of the current size of the Caribbean economy if adaptation measures are not successfully implemented (Atteridge et al. 2017). On average, the economic impact of hurricanes (1950-2014, 200 hurricanes) accounts for an estimated 2.5% of GDP each year (Acevedo 2016). However, in some cases, damages and losses from a single climate-related extreme event, such as Hurricane Maria in Dominica in 2017, can amount to greater than 100% of the GDP of the country (Government of the Commonwealth of Dominica 2017).<sup>11</sup> For these reasons, many Caribbean SIDS depend on external financial support to supplement the expenditures of national governments, which often have weak or volatile finances due mainly to low or negative economic growth rates and high levels of public debt. This international support is likely to remain critical in efforts to build resilience to climate change and invest in low-carbon development in the Caribbean.

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<sup>11</sup> GCF CARICOM AgREADY Project Document, 2020.

Climate change has been the focus of action for over two decades by governments, since the signing of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, and increasingly since the late 1990s by businesses (Kolk et al., 2008). Agriculture, including forestry, is and will continue to be profoundly affected by climate change. **Agriculture has been identified as one of the most vulnerable sectors to climate change in Caribbean SIDS, due to its high dependency on natural system resources and multifunctional role in socioeconomic development.** In the region, the impact of climate change on agriculture is expected to be manifested in the following ways:

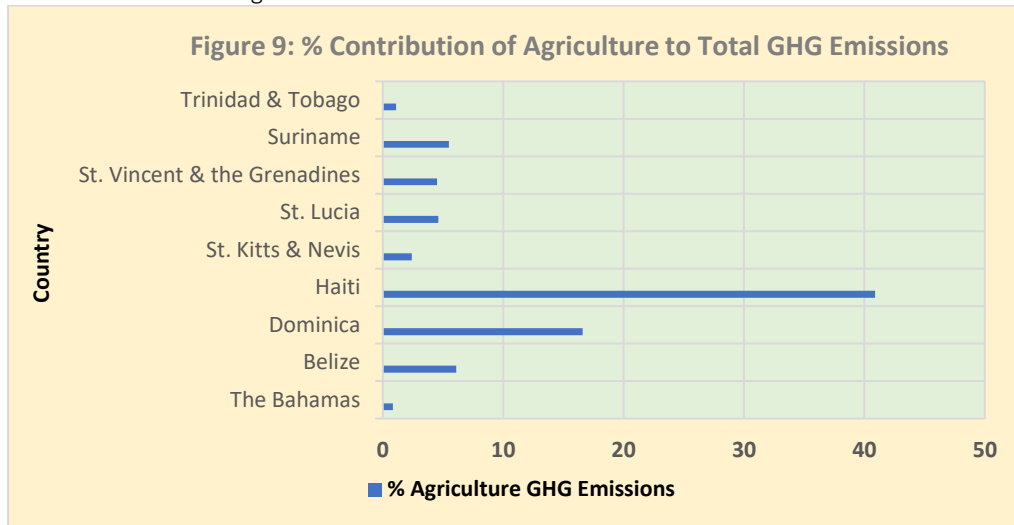
- **Scarcity of water for irrigation.** Drought decreases the environmental carrying capacity and productivity of the soil. Sea level rise can cause the salinization of aquifers and loss of agricultural lands on the coast.
- **Increased incidence of pests.** Changes in temperature and humidity increase the vulnerability of agro-systems to pests and introduced species.
- **Food insecurity.** Changes in rainfall patterns and temperatures affect the timing of agricultural production and crop yields, affecting food prices and availability.
- **Low livestock productivity.** Drought, heat stress, and dry pastures reduce the availability of feed, which increases animal mortality and increases the cost of production by increasing the use of concentrate feed.
- **Social vulnerability.** Populations and prime agricultural lands are located in coastal areas, vulnerable to sea level rise. Insurance coverage of farms is low; only 16% of farms have crop insurance coverage and the average net household income is low, making the vulnerability to climate change among Caribbean farmers very high.

However, agriculture, **particularly small-scale farming**, is not only a victim of the effects of climate change but also a contributor to greenhouse gas (GHG) emissions. It is recognized that agriculture is a significant sector in terms of GHG emissions, and so will face pressure to mitigate climate change through GHG emission reductions. In 2019, the agriculture sector contributed 5.79 GtCO<sub>2</sub>e GHG emissions worldwide, which represented 12.04% of its total emissions excluding land-use change and forestry (48.1 GtCO<sub>2</sub>e), and 11.65% including LUCF (49.8 GtCO<sub>2</sub>e).<sup>12</sup> Data compiled on the contribution of the agricultural sector contribution to total GHG emissions for the nine (9) countries selected for this study is presented in **Figure 9** below. Agricultural activities such as bush burning, and deforestation are part of the human activities contributing to GHG emissions (IPCC. Climate Change, 2014; Amboll et al., 2017). The potential for GHG emission reductions from agriculture up to 2030, through reductions in GHG emissions and increases in soil sequestration, is estimated to be between 4500 and 6000 Mt CO<sub>2</sub>e/year (Branca et al., 2013; Smith et al., 2008). This mitigation will present multiple constraints for agriculture, as methane, N<sub>2</sub>O and CO<sub>2</sub> are linked to fuel and electricity use, but are also produced through fertilizer production, ruminants and land-use changes.

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<sup>12</sup> CAIT Climate Explorer/ World Resource Institute

Figure 9: % Contribution of Agriculture to Total GHG Emissions



Source: CAIT Climate Explorer

Further, under current projections, in order to feed the global population in 2050, food production must increase by 70%. Previous yield increases have often been gained through the use of fossil fuels, creating further urgency with regard to GHG emission levels due to agriculture. This implies that future increases must find climate-smart methods and inputs (Bogdanski, 2012). Whilst facing these challenges, agriculture must also deal with increasing weather variability and unpredictability, affecting the resilience of our food production systems (Bogdanski, 2012; Nelson et al., 2009). **Climate change is expected to lead to greater variability in weather patterns, with increases in the occurrence and severity of extreme weather such as floods, storms, droughts or heat waves, which can all negatively impact agriculture** (Coumou et al., 2014; Trinka et al., 2014); whilst many impacts are expected to be negative, some areas will experience positive side-effects from climate change (European Commission, 2015). National, regional and international production patterns and methods are, therefore, likely to change due to such impacts.

Developing countries, **including those within the Caribbean region in particular**, are vulnerable to climate change impacts. These impacts on agriculture threaten the economic development of such countries, and the welfare of their populations (FAO and EU, 2014). **Climate change poses new challenges to the fight against poverty and sustainability of livelihoods through declining crop yields and livestock productivity caused by increased hurricane intensity with larger peak wind speeds and heavier precipitation, rainfall variability, rising air and sea temperatures, increased ocean acidity, and increased pest/disease incidence** (Grossi et al., 2019; Jordaan et al., 2014; Taylor, 2017; Torquebau et al., 2018; UN, 2018; and UN ECLAC, 2011). Increasing climate variability and extremes, affecting both crop and livestock systems, are indicated as one of the causes leading to the continued rise in global hunger, malnutrition, and severe food crises (Atela et al., 2018). Due to these reasons, much research is evident on agriculture and climate change within developing nation contexts, and specially in terms of Climate Resilient Agriculture (CRA) technologies and practices (Abergunde, et al., 2019; Anuga et al., 2019; Arslan et al., 2013; Bogdanski, 2012; Branca et al., 2011; Eidt et al., 2012; Gledhill et al., 2012; Greatrex et al., 202015; Long et al., 2015; Long et al., 2019; Maharjan, 2019; Senyolo et al., 2021; Thongoh et al., 2021; and Yameodo et al., 2017).



Despite this, the agriculture sector has not been meaningfully prioritized in climate finance programming and processes related to Nationally Determined Contributions (NDCs). In light of projections of increasing frequency of extreme climatic events and pandemic threats such as COVID-19, opportunities for climate-resilient agriculture to enhance food security and rural livelihoods while reducing GHG emissions, as part of the Agriculture Forestry and other Land Use (AFOLU) category, are increasing in importance. Though useful, past regional multi-sectoral initiatives have not resulted in the development of a more programmatic and iterative approach to raise the profile of agriculture for accessing GCF resources and other international sources of climate finance. Moreover, current GCF-funded activities on agriculture are national in scope and limited to a few activity areas that may not holistically address common sectoral challenges in the region or capitalize on opportunities to accelerate action through South-South exchange. The specific challenges and existing gaps relate to the limited capacity of the agricultural sector to identify, compile and manage data and information on needs, practices and technologies to catalyze low-emission and climate resilient agriculture investments. This, combined with weak linkages to other sectors, limits the agricultural sector's access to international climate finance necessary for building resilience and promoting low-carbon development.

It is therefore against this background that this analysis is undertaken to determine the economic and market barriers that limit the transformation of existing Caribbean agricultural production to a state of climate resilient production systems. It is anticipated the results of this analysis will raise the profile of the agricultural sector in GCF's climate financing prioritization processes by increasing awareness of the sector's potential contribution to climate solutions, identifying promising practices and technologies to enhance resilience, and quantifying its contribution to GHG reductions. This is viewed as a foundational part of an evidence-based and inter-sectoral strategy for developing and rebranding Caribbean agriculture as "low-emissions", to enhance market opportunities and attract private sector investments.

## **2. Conceptual and methodological frameworks of analysis**

### ***2.1 Conceptual Framework***

Climate resilient agriculture (CRA) focuses on coordinated actions among different actors in the value chain towards climate-resilient pathways. This is accomplished through building evidence-based research information platforms, increasing local and institutional effectiveness, fostering coherence between climate and agricultural policies, and linking climate and agricultural financing. Even though CRA can provide adaptation and mitigation benefits, it's still not clear what type of transformation in policy frameworks, institutions and funding is necessary to aid adoption (Tankha et al., 2020). An appreciation of the variables and dynamics which affect the transition to CRA production systems through the diffusion of Climate Smart Agriculture Technology, Innovation and Management Practices (CSA TIMPs), is an important factor in determining which CSA initiatives can successfully be integrated into CRA production systems. A clear understanding of and applying system and value chain thinking to food and nutrition security is important to get to the root cause of the systems' failure regarding climate change variability, impacts and resilience on food security (Birch, 2018). There is no doubt that CSA TIMPs that sustainably increase productivity, support farmers' adaptation to climate change, and reduce levels of greenhouse gases, in general, do exist. However, their diffusion is slow and limited (Descheemaeker et al., 2016; Tankha et al., 2020). In addition, where they exist, the focus is on

crop farming, mainly addressing the producer level and not permeating the entire value chain (Pantano and Di Pietro, 2012). Agriculture value chains consist of input suppliers, producers, traders, middlemen, transporters, processors, distributors, retailers and consumers.

Based on the literature, several types of barriers are mentioned to be relevant in the adoption and diffusion of technological innovations and management practices within agriculture. A key barrier well represented within the literature is the role of financial or cost factors. Simply, the cost of many technological innovations is prohibitive, especially early in the diffusion process due to difficulties in initial commercialization efforts. The expense of establishing production facilities, as technology developers transform themselves into technology producers, often means that profits are hard to obtain and increases the costs of innovative product or service (Cullen et al., 2013; Faber and Hoppe, 2013; Luthra et al., 2014). These can be expressed as 'early adopter costs' (del Río Gonzalez, 2005), and impact both technology users as well as technology producers. Relevant factors that impact the actual and relative costs of innovations include changes to input prices (Kemp and Volpi, 2008) if perverse subsidies exist for current technologies (Weiss and Bonvillian, 2013) or the willingness of customers to pay price premiums for products or processes with a lower environmental impact (Reinstaller, 2008). The relative cost of innovations is also dependent on whether the adopter or wider industry has the necessary skills and capabilities to integrate and use the innovation or where the current technological stock has a long capital life (del Río Gonzalez, 2005; Montalvo, 2008).

Even where economic and technological barriers are low or have been overcome, the literature highlights a range of socio-economic, institutional and behavioural/psychological barriers at play (Hoffman and Henn, 2008). Innovation must be accepted to be adopted (Wheeler, 2008), which is affected by factors such as the age or educational level of the adopter (Tey and Brindal, 2012). However, there is conflicting research on the specific impacts of age and experience on willingness to adopt innovations. Drawing on psychological and sociological perspectives in their study of the adoption of green building practices, Hoffman and Henn (2008) found that individuals seemingly acted irrationally - over discounting the future, suffering from overly positive illusions (seeing the future as better than it is likely to be) (Vishwanath, 2009) and enacting presumed associations (such as green practices associated with 'hippy culture') (Ratten and Ratten, 2007) to the detriment of sustainable outcomes. Organizational impacts are also noted, operating through the control of language and terminology, perverse rewards (often short-term), habitual routines and organizational inertia (Faber and Hoppe, 2013), leadership (Blok et al., 2014) and the CSR identity of the firm (Roelofsen et al., 2015).

Other key factors advanced in the literature include the impact of uncertainty and risk perceptions (del Río Gonzalez, 2005; Johnson, 2010), market failures (such as information asymmetries) (Weber and Rohrer, 2012), and internal and external stakeholder pressures (Montalvo, 2008). Principle-agent issues such as landowners refusing efficient technologies for tenant farmers can also be identified, (Guerin, 2001) as well as cultural barriers (linked to consumer habits and expectations) (Ceschin, 2013) and the credibility and authority of advisers or consultants (Guerin, 2001; Johnson, 2010).

Many of the barriers noted above are specific to the adopters of technological innovations. However, it can be conceived that the sources of the barriers noted above lie with producers also. This is one reason for splitting barriers into supply (technology provider) and demand (technology user) categories, as technological innovation producers suffer specific barriers as well. These can

include financial barriers, such as inadequate funding, as well as the impact of risk avoidance behaviors (Andrews, 2006). Innovating for sustainability, an area with clear links to the development of CSA technological innovation is also highlighted as involving several barriers. These can include the impact of secondary stakeholders, where the innovations have wider societal impacts, such as the use of genetic modification in the development of new crop strains (Hall and Vredenburg, 2003).

Market forces can also be identified as a key barrier for technological innovation providers, for example, where technological innovation is having to compete against established products (Costa-Campi et al., 2014). In addition, current policy or administrative systems may not be supportive of technological innovations, especially where they represent a radical innovation (Weiss and Bonvillian, 2013).

Long et al. 2015, categorized the main barriers to the adoption of CRA Technological Innovations and Management Practices. These key barriers to the adoption of CSA technological innovations, both general and specific to agriculture, are provided in **Table 9** below.

Table 9: Barriers to the Adoption of CRA Technological Innovations and Practices

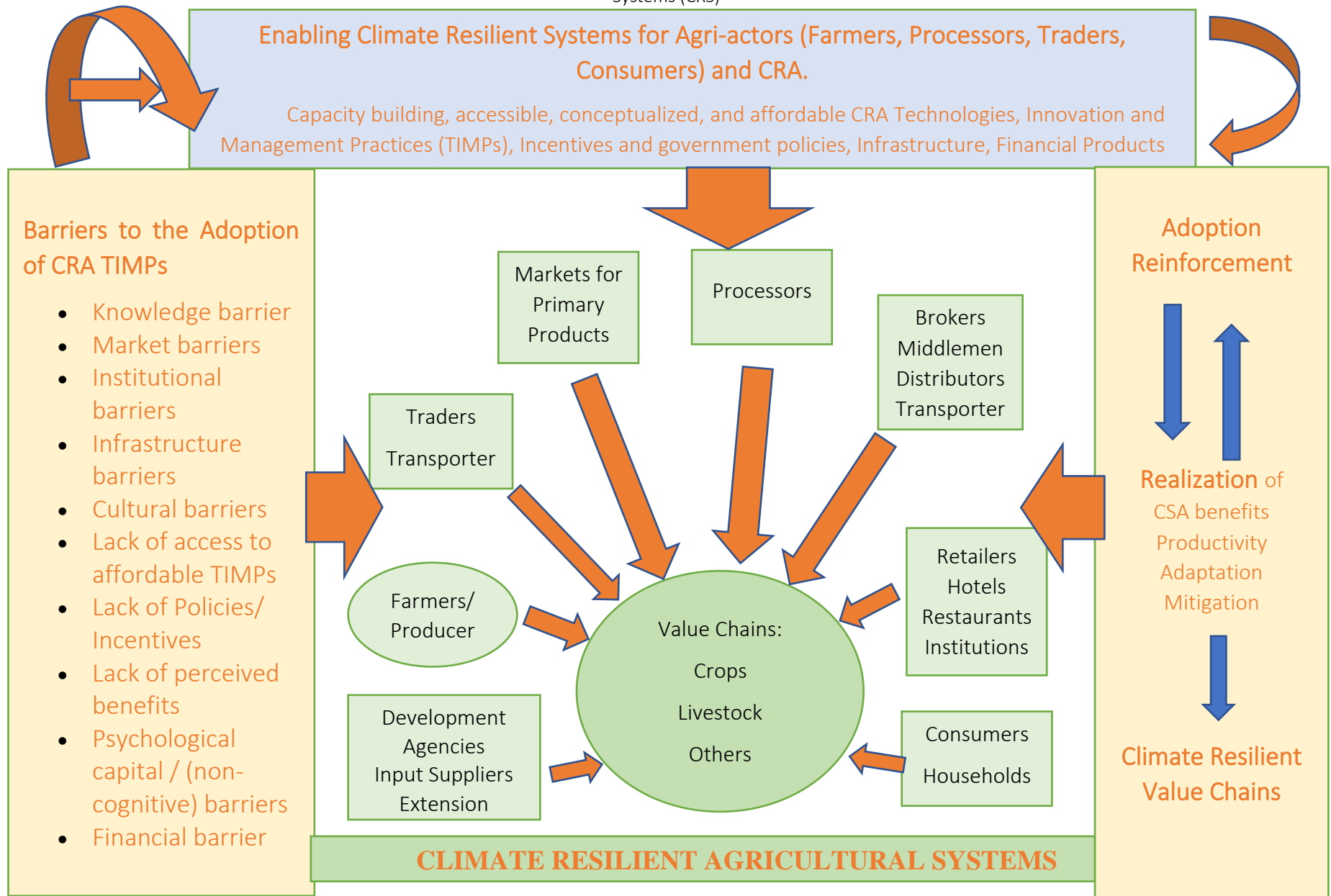
Barrier	Specific Description
<b>Economic</b>	High initial investments
	Poor access to capital
	Uncertain returns and results
	Uncertain returns and results
	Hidden costs
	Competing financial priorities
	Long pay-back periods (ROI)
	Switching costs/existence of the installed base
	High implementation costs (actual and perceived)
	Temporal asymmetry between costs and benefits
<b>Institutional/regulatory</b>	Over discounting the future
	Low institutional support
	Use of overly scientific language (Jargon)
	Farmer's knowledge not considered in Rand D
	Lack of regulatory framework
<b>Behavioural/Psychological</b>	Prohibitively prescriptive standards
	Lack of management support/awareness
	Conflict with traditional methods
	Overly complex technologies
	Results/effects of technology difficult to observe
	Farmer's beliefs and opinions
	Low trust of advisers or consultants/lack of acceptance
	Irrational behaviour
<b>Organizational</b>	Negative presumed assumptions
	Lack required competencies/skills
	Poor readiness
	Poor information
	Inability to assess technologies
	Overly short-term/perverse rewards
	Organizational inertia/habitual routines
<b>Consumers/Market</b>	Poor information

	Lack market attractiveness/do not align to preferences
	Uncertainty
	Consumers/farmers level of motivation
	Market uncertainty
<b>Social</b>	Social/peer pressures

*Source: Long et al., 2015*

The conceptual framework for such an analysis of these barriers that limit the effectiveness of climate adaptation strategies such as CSA, along the agriculture value chains is presented in **Figure 10**. These perceived critical barriers were identified through the literature review process and grouped under ten (10) main categories. Notwithstanding, the study will focus its analysis on only those socio-economic and market barriers that limit the transformation of Caribbean Agriculture from the existing Conventional State to Climate Resilient Systems.

Figure 10: Conceptual Framework for the Analysis of Economic and Market Barriers to the Transformation of Caribbean Agriculture to Climate Resilient Systems (CRS)



## *2.2 Methodological Approach*

### *2.2.1 Overall Objective of the Study*

As indicated earlier, the overall objective of the study was to conduct an analysis of the economic and market barriers that limit the transformation of Caribbean agricultural production systems from an “as-is or business-as-usual” (conventional) state to climate-resilient production systems that provide strong arguments/rationale for private and public sector investments.

### *2.2.2 Scope of the Study*

In terms of geographic scope, nine countries were targeted ((The Bahamas, Belize, Dominica, Haiti, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago) in the CARICOM sub-region.

The functional scope of work focused on the following thematic areas:

- Development of a baseline of the key economic and market barriers that affect the effectiveness and efficiency of current agricultural production systems.
- Execution of a comprehensive analysis of the economic issues and challenges that affect climate resilient systems including output growth, use of capital, income and expenditure, competition, and volatility.
- identification and determination of opportunities and proposed approaches and strategies for addressing economic-market gaps and barriers to enhance enabling environment for supporting and scaling-up climate-resilient production systems.

### *2.2.3 Methodology*

The Consultant utilized a diversity of methods to undertake this study inclusive of a) literature review, b) cross-sectional surveys of agriculture value chain actors, and c) questionnaire for in depth interviews of actors from development and banking institutions. An Input-Process-Output (IPO) framework was utilized to provide a logical pathway for the analysis of the socio-economic and market barriers. This logical Framework is presented in the **Annex 3**.

The literature review and analysis of relevant documents were used to further strengthen the contextual and methodological frameworks for the consultancy and informed the identification and determination of:

- The key economic and market barriers that affect the effectiveness and efficiency of current agricultural production systems for baselining.
- The economic issues and challenges that affect climate resilient systems including output growth, use of capital, income and expenditure, competition, and volatility of underlying factors.
- The opportunities and proposed approaches and strategies for addressing socioeconomic and market gaps and barriers to enhance enabling environment for supporting and scaling-up climate resilient production systems.

The desk study included the reviews of international, Caribbean regional and national literature on strategies and outcomes related to the three areas of focus, CRA (including relevant selected

case studies) and climate change, DRM/CCA integration into agriculture sector development planning, and financing of climate change initiatives. The relevant initiatives/documentation included sources from the GCF, UNFCCC, World Bank, IFAD, WFP, FAO, IICA, UN, UNDP, UNISDR, CDEMA, CARICOM Secretariat, CCCCC, UWI, the relevant Ministries of the Caribbean countries, as well as from other regions of the world.

In parallel to the desk study, stakeholder consultations were undertaken to triangulate information gathered during the literature review process. These consultations were conducted using a Survey Instrument and were aimed at obtaining the views, opinions, and aspirations of key stakeholders (public and private sectors) on barriers, economic issues and challenges, and opportunities and proposed approaches and strategies to the development and implementation of climate resilient systems within the agriculture sector. A copy of the Survey Instrument is presented in the **Annex 4. In-depth interviews with selected key informants, where appropriate, were also conducted with national policy analysts, agricultural planners, and technical specialists, using a semi-structured interview schedule.**

Finally, budget analyses were conducted for six (6) of the nine (9) countries included in the study, specifically to:

- Quantify climate-related expenditures through the budgetary system and extra-budgetary channels.
- Track climate finance through national delivery channels.
- Identify opportunities and constraints for integrating climate change within the national and sub-national budget allocation and expenditure process.
- Inform decision-makers and development partners in assessing how best to upscale access and delivery of climate finance for the country.

The analysis and report focused on but were not limited to climate finance issues related to:

- Finance gap.
- Barriers to scaling-up finance.
- Barriers to scaling up public (donor) finance.
- Barriers to scaling up private finance.
- Barriers to the introduction and/or scaling up carbon market finance.
- Policy frameworks influencing climate finance in the Caribbean.

#### *1.2.4 Limitations of the Study*

The main limitation of the study is related to the paucity of data in general and disaggregated data in particular in the Caribbean region, which impact the quality of the analyses. Another limitation relates to the inadequacies of Caribbean region studies for comparative analysis on economic and market barriers to the transformation of agriculture to climate-resilient production systems. Finally, the size of the data set for analysis was limited, which to some extent could impact confidence in the findings of the study.

### **3. Results and analysis of socio-economic and market barriers**

#### **3.1 Overview**

Climate change represents a serious threat to the agricultural sector in the Caribbean, requiring the building of resilience to climate impacts and reductions in greenhouse gas (GHG) emissions. While concerns regarding mitigation and adaption to climate change are renewing the momentum for investments in agricultural research and are emerging as added innovation priorities, it is expected that the development and effective diffusion of new agricultural technologies and practices will influence how well farmers mitigate and adapt to climate change (Lybbert and Sumner, 2010).

The main challenge facing agriculture concerning adaptation and mitigation is that there is a need for more food which is produced efficiently under highly unpredictable conditions with net reductions in GHG emissions from production and marketing. Hence, input use efficiency is necessary to keep up with these productivity demands and to compensate for the effects of climate change. Innovative approaches, which can be institutional or technological, will be an important response (Asayehegn et al., 2017; Msangi et al., 2012). A prominent approach is the building of Climate Resilient Agriculture (CRA) production systems through the implementation/application of climate-smart agriculture (CSA).<sup>13</sup> This process attempts to sustainably increase agricultural productivity, food security and incomes through adaptation and enhancing resilience to climate change as well as by reducing GHG emissions (Arslan et al., 2015; FAO, 2010, 2013). CSA can also help to achieve the development goals of vulnerable populations who depend on agriculture (Partey et al., 2018), but this will involve effective management of synergies and trade-offs between mitigation, adaptation and productivity goals.

Considering that technology uptake is a multifaceted process, shaped by many factors, the exploration to understand the diffusion and utilization of agricultural technologies and management practices cannot be limited to just understanding the characteristics of adopters, their biophysical contextual factors or information sources. The adopter's perceptions of climate change and/or technologies or management practices to address them are also needed to provide a comprehensive picture for analysing decision-making (Jiri et al., 2015; Meijer et al., 2015; Mushunje et al., 2011; Pannell et al., 2006; Rankoana, 2016; Ubisi et al., 2017). For instance, a comprehensive framework comprising the extrinsic (e.g., characteristics of adopters and innovations) and intrinsic (knowledge, perceptions, and attitudes) variables may increase the understanding of the complex process of adoption (Meijer et al., 2015). Accordingly, exploring the contribution of socio-psychological factors such as perceptions of farmers regarding the specific attributes of CRA technologies in addition to the highlighted socioeconomic factors could contribute to the understanding and ongoing discussion about CSA adoption. In the following subsections, these specific sets of factors will be explained in greater detail. In the conceptual framework presented in Figure 2.1 above, there is the implicit assumption that adoption decisions are conditioned by the socio-economic realities of the farmer, the characteristics of the external environment (or contextual factors), as well as the perceived characteristics of CRA technologies and management practices.

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<sup>13</sup> In this chapter, CRA and CSA will be used interchangeably.



Previous research has explored farmers' perceptions of climate change, evaluated CRA technologies and management practices, explored demographic use patterns, and agronomic, economic and environmental benefits of the technologies (Baiyegunhi, 2015; Fischer et al., 2015; Gandure et al., 2013; Mulaudzi and Oyekale, 2015; Mutamba and Mugoya, 2014; Rankoana, 2016). Considering that farmers' socio-economic conditions and perceptions of technology affect adoption decisions (Bryan et al., 2009; Deressa et al., 2009; Drechsel et al., 2005; Tessema et al., 2013; Ubisi et al., 2017), this subsection of the report seeks to present an analysis of the role of these factors within the context of CSA technologies in agriculture settings. For instance, factors such as poverty, income, education, or investment costs, may limit the widespread implementation of CSA (Harvey et al., 2014).

### 3.2 Socioeconomic Characteristics of Farm Household and Farm Enterprise

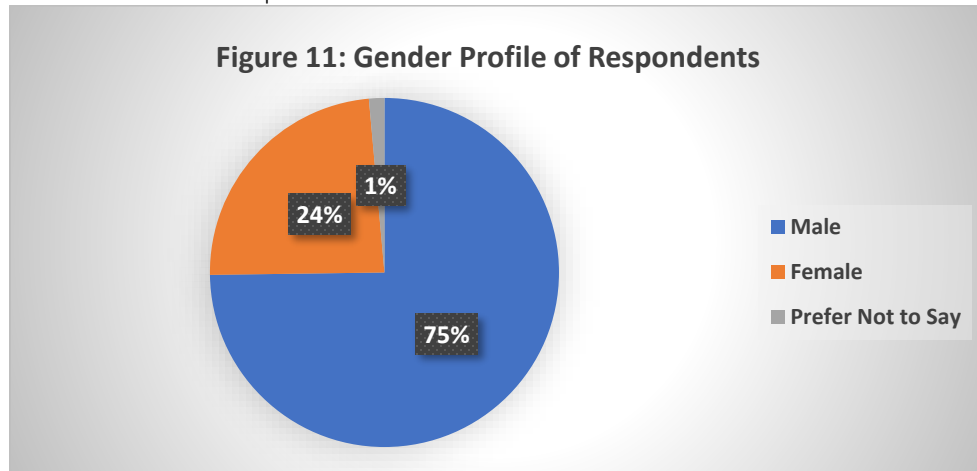
Information was collected on the demographic characteristics of 30 farmers spread over five (5) of the nine (9) countries involved in the study (**Table 10**). These characteristics were gender, age, educational level, farm size, head of households, size of farm households, years of experience in farming, annual farm income, the distance of the farm from the homestead, and land tenure arrangements.

Table 10: Profile of Farmers Involved in the Study

Parish	No. of Respondents	Percentage (%)
Haiti	10	33.33
St. Kitts and Nevis	4	13.33
St. Lucia	10	33.33
Suriname	5	16.67
Trinidad and Tobago	1	3.33
<b>Total</b>	<b>30</b>	<b>100.0</b>

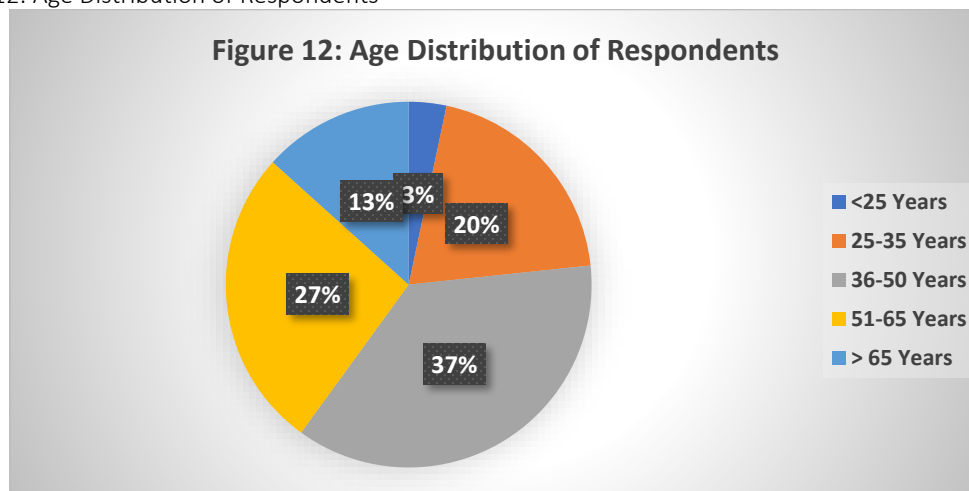
**Figure 11** presents the gender profile of the thirty (30) farmers. The male farmers were represented by 75% of the respondents, while the female farmers were 24% and others 1%. Assasie (2008) observed that women may go into farming to meet demands at the home. He further explained that gender has proven to be an essential variable for analysing roles, responsibilities, constraints, opportunities, incentives, costs, and benefits in agriculture.

Figure 11: Gender Profile of Respondents



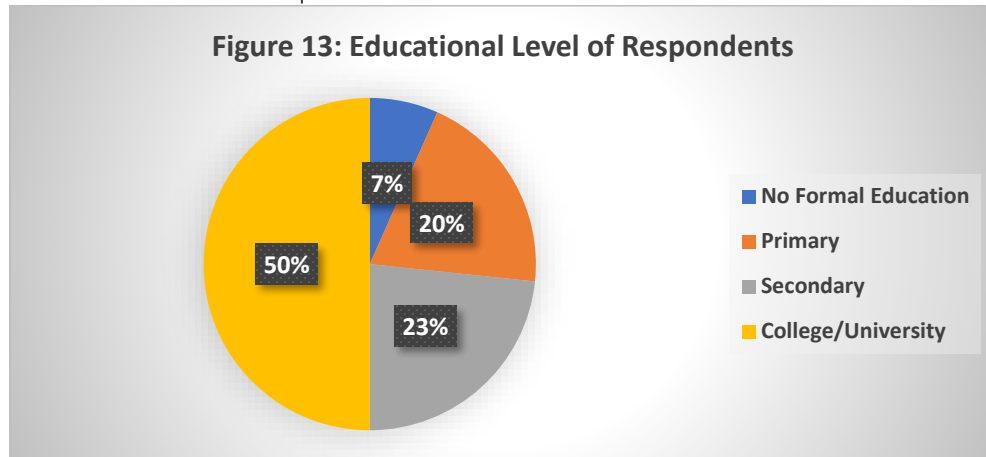
**Figure 12** presents the age distribution among the 30 farmers in the survey. The results showed that 64% of farmers surveyed fall within the 36-65 years age group. Of these farmers, 37% are within the age group 36-50 years, and 27% are within the age group of 51-65 years. Notwithstanding, the results generated showed that a significant number of farmers are in their active years of production, as approximately 60% of farmers are below the age of 50. There were no farmers over 75 years old. This report to a large extent supports the findings of Tham-Agyekum et.al, 2010, and is contrary to that of the Government of Barbados 1998 Sondeo conducted by the Ministry of Agriculture and Rural Development, which stated that “the rapid ageing of that country’s farm workforce is a reflection of disdain among youths for agricultural work.”

Figure 12: Age Distribution of Respondents



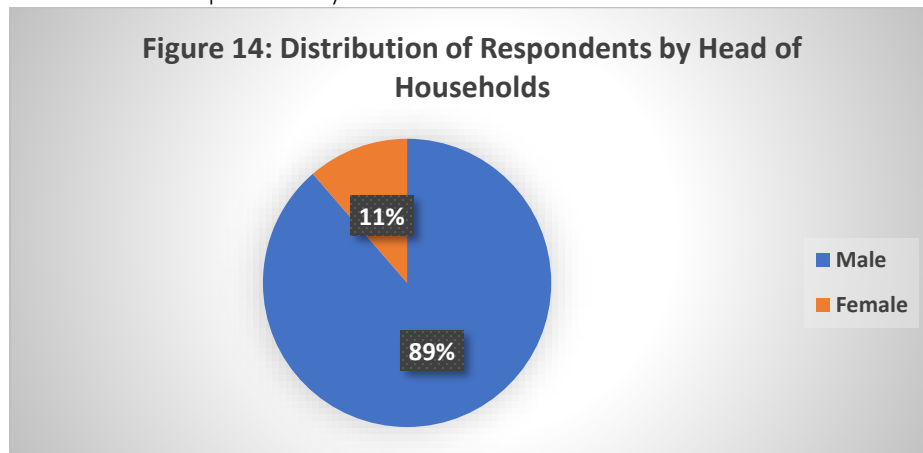
The findings on educational status suggest that farmers in the region have a fairly high literacy rate since over 73% of the farmers had reached the secondary level and beyond (**Figure 13**). This is likely to be reflected in the technical capacity of the sector to transform from a business-as-usual agricultural state to climate-resilient production systems.

Figure 13: Educational Level of Respondents



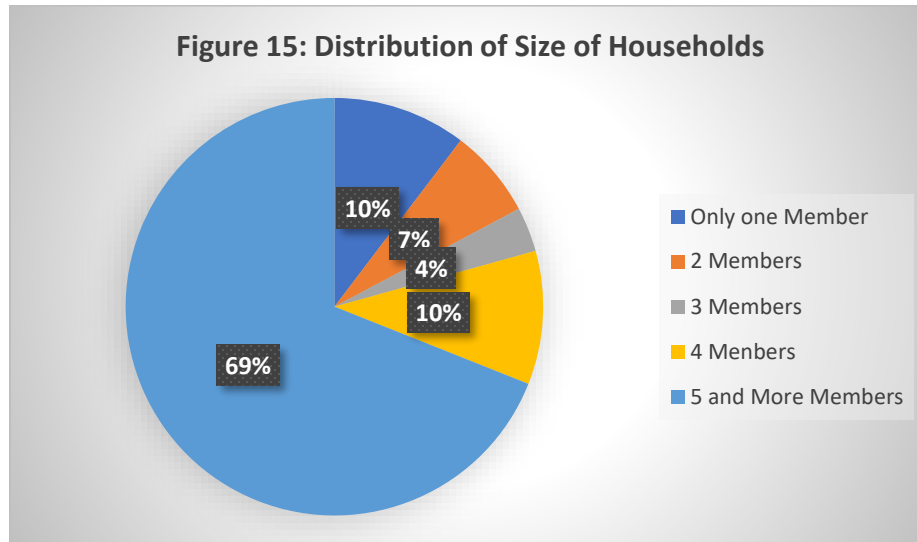
**Figure 14** presents the distribution of producers by the head of households, which shows that 89% of the farm households are headed by men. Studies on agricultural production and gender are full of contradictions as to whether female farmers are less productive than male farmers even under similar production systems and environments.

Figure 14: Distribution of Respondents by Head of Households



The distribution of the size of the households is presented in **Figure 15**, from which it can be observed that 69% of the households have 5 and more members.

Figure 15: Distribution of Size Households

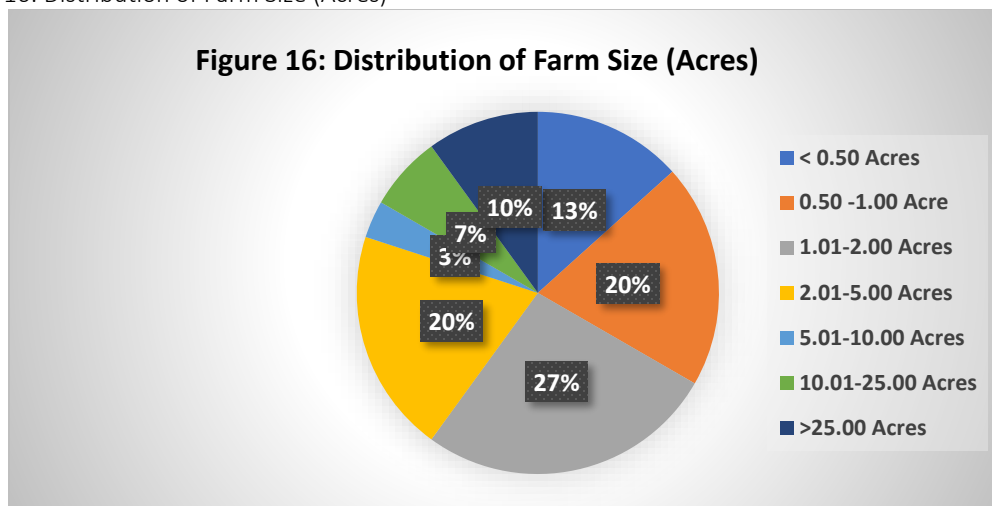


Further analysis of the size of household's data revealed that:

- Average size of Farm Households was 5.17 persons
- Average size of Male-headed Farm Households was 5.21 persons
- Average size of Female-headed Households was 5.00 persons
- Size range of Farm Households was 1 to 13 persons
- Mode of Farm Households was 5 persons.

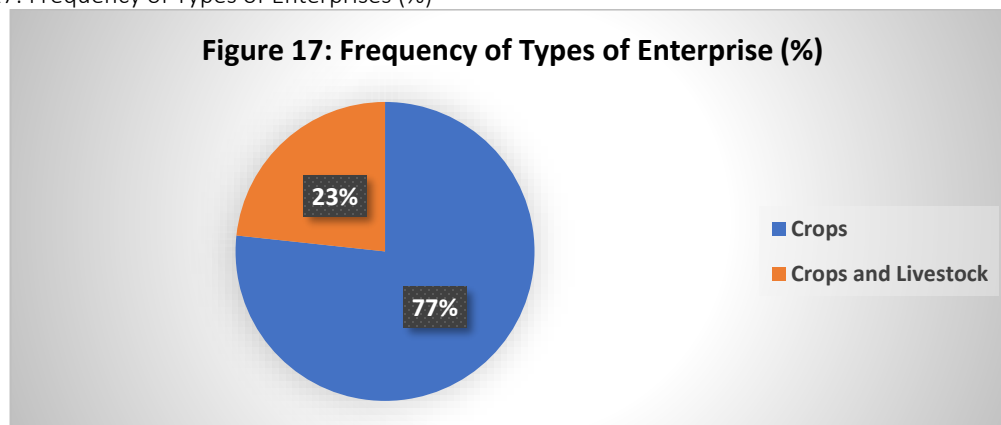
The distribution of lands among seven (7) land groupings can be observed in **Figure 16**, which shows that approximately 80 % of the farmers surveyed were operating on lands of five (5) acres and less, with 33% farming on less than one (1) acre. Only 13% of the farmers were operating on lands of over twenty-five (25) acres. This finding to a large extent reflects the skewed nature of land distribution in the Caribbean and suggests the urgent need for land reform in the region.

Figure 16: Distribution of Farm Size (Acres)



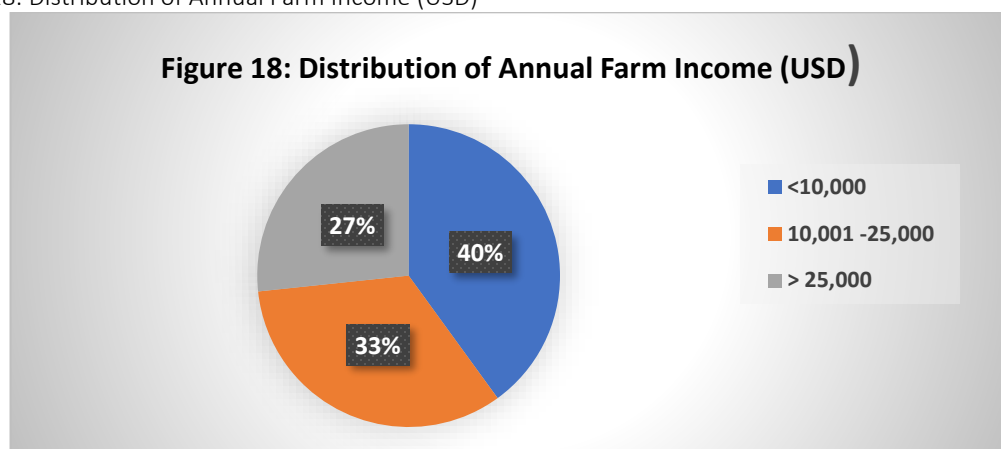
As can be gleaned from **Figure 17** that 77% of all respondents were engaged in crop production only, with mixed farm operations represented by 23% of the farmers.

Figure 17: Frequency of Types of Enterprises (%)



Approximately 40% of all farmers earned less than US\$10,000 annually from their farming operations, while 33% of all producers earned between US\$10,000 and US\$25,000 (**Figure 18**).

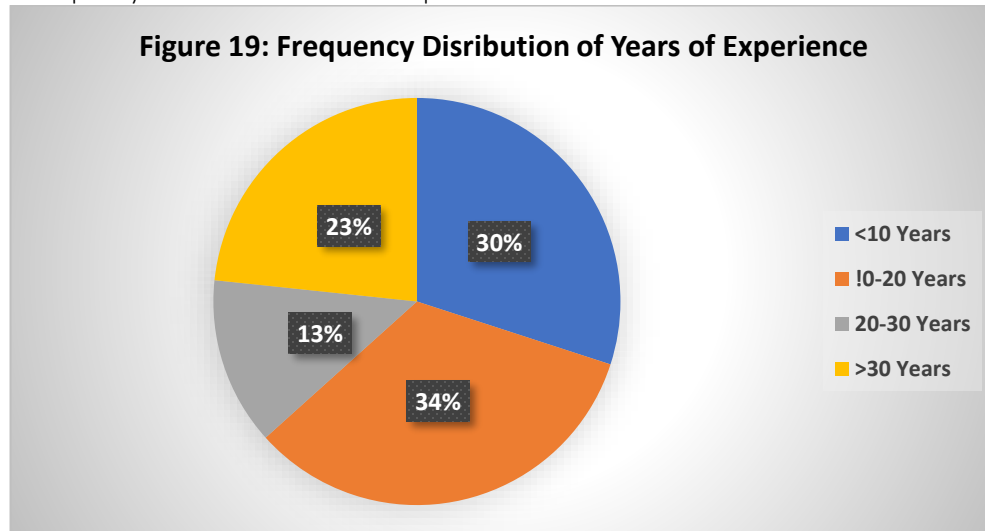
Figure 18: Distribution of Annual Farm Income (USD)



Only 23% of producers earned more than US\$25,000 annually. The situation of the level and distribution of farm income among respondents could be partially explained by the nature of farmer household status with respect to sources of income. There is the general consensus in the Caribbean region that a significant number of farmers are part-time producers and thus derive their household incomes from 'agriculture and services', and 'agriculture and business'. This may be due to the farmer's limited assets, including the fact that many of the farmer's holdings are very small, and therefore unable to generate sufficient income to support the household spending requirements. In addition, agriculture is a very risky business and, therefore, many farmers try to diversify their sources of household income as a risk management strategy.

The findings from the survey show that the farmer's experience in agriculture in the region may be characterized as relatively low to medium, with 64% of all respondents reporting having less than twenty (20) years in agriculture and related activities (**Figure 19**).

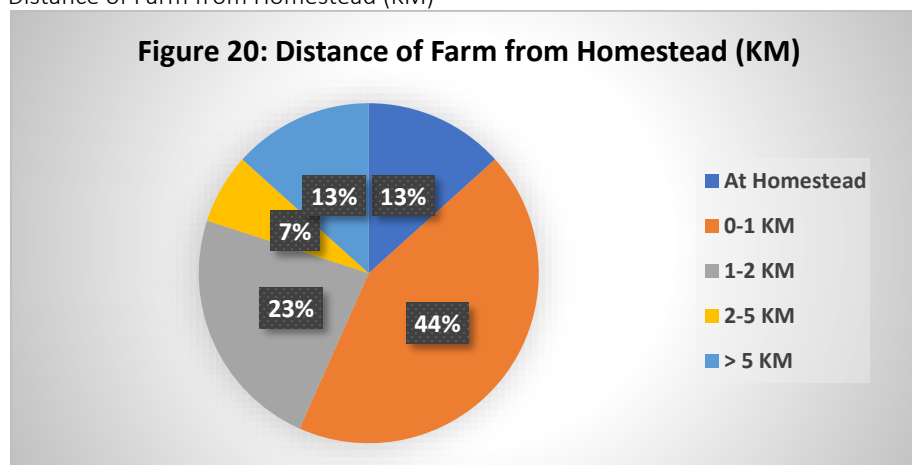
Figure 19: Frequency Distribution of Years of Experience



In addition, approximately 30% of all respondents have less than ten (10) years of farming experience. It must be appreciated that there was increased concern shown by the governments of the Caribbean region over the last two decades on the status of the nation's agriculture, **which resulted in concerted efforts made to address critical issues such as national food and nutrition security and reducing the country's large and increasing food import bill**. Thus, the sector has attracted new entrants over the period, especially young farmers into farm business enterprises, hence the findings of low to medium experiences of farmers, which is also reflected in the age distribution of farmers. **Experience is the basis of progress and success in business (Johl and Kapur, 2001)**. It should be noted that limited experience in agriculture is likely to result in low production and income for farmers (Adekoya, 2005).

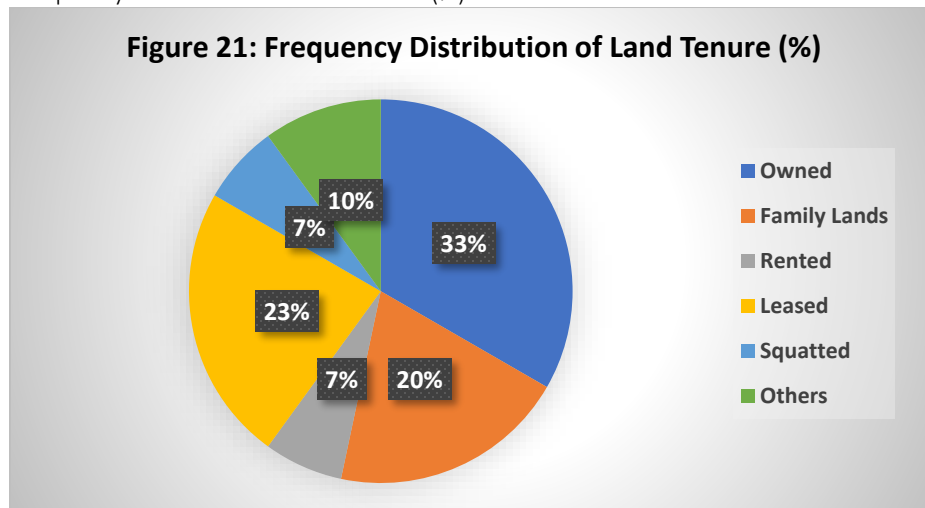
**Figure 20** presents the survey findings on distance from the farm homestead. The results showed that approximately 57% of all farmers/producers lived within less than 1kilomete (1KM) of the farms. This is important in the context of securing farm outputs in the Caribbean region, as the issue of praedial larceny is impacting the production decisions of farmers.

Figure 20: Distance of Farm from Homestead (KM)



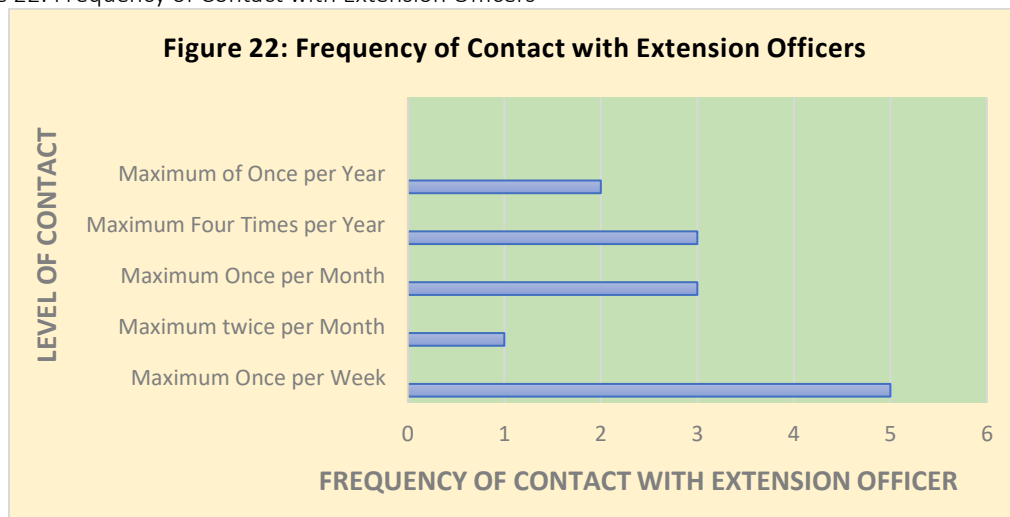
The frequency distribution of land tenure arrangements obtained from the survey is presented in **Figure 21**. The data revealed that 33% of farms are owned by the holder, another 20% are family-owned, 30% are rented or leased and the remainder is operated under various kinds of common law or illegal actions, including squatting on private or government land. The results can be compared with that of Graham, 2012<sup>14</sup>, who found that 56% of farms are owned by the holder, another 26% are family-owned, 10% are rented or leased and the remainder is operated under various kinds of common law or illegal action, including squatting on private or government land.

Figure 21: Frequency Distribution of Land Tenure (%)



The findings from the survey revealed that producers had fairly good access to extension officers, where the level of contact recorded a mean score of 3.2 out of a maximum of 5. Notwithstanding, of the mean score obtained for access to extension officers, only approximately 47% (14) had contact with the extension officers. The frequency of such contact is presented in **Figure 22** below. The figure shows a highly infrequent level of contact of producers with extension officers.

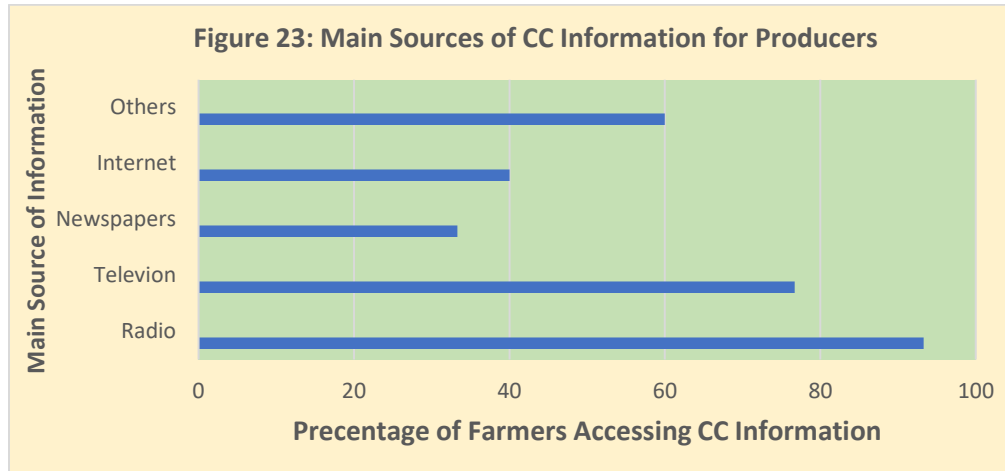
Figure 22: Frequency of Contact with Extension Officers



<sup>14</sup> Profile of the Small-Scale Farming in the Caribbean

The findings from the survey also revealed that producers had fairly good access to climate change information from a variety of sources, where the level of access recorded a mean score of 3.17 out of a maximum of 5. **Figure 23** presents the main sources of climate change information for producers.<sup>15</sup>

Figure 23: Main Sources of CC Information for Producers



The traditional media sources of radio and television are still the major ones for farmers' climate change information. However, the study revealed that the internet is a significant climate change information platform for farmers (40%).

Finally, the study revealed that the level of producer's membership in organizations is not very high, with approximately 47% of respondents reported as belonging to any organization, as reflected in **Annex 5**.

### 3.3 Relationship between Farm Household and Farm Enterprise Characteristics and Adoption of CRA Technologies and Practices

Acevedo et al., 2020, within the context of a scoping review, utilizing PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols), examined the conditions that have led to the adoption of climate-resilient crops over the past 30 years in lower-and middle-income countries. The descriptive analysis performed on 202 papers shows that small-scale producers adopted climate-resilient crops and varieties to cope with abiotic stresses such as drought, heat, flooding and salinity. The primary goal of the scoping review was to identify factors in the adoption of climate-resilient crops in climate-vulnerable countries. Insights into these factors may inform the design of interventions aimed at equipping farmers to adopt climate-resilient technologies before experiencing devastating impacts of climate change and encourage the adoption best practices (Roge et al., 2014; and Kihupi et al., 2015).

The principal factors determining the adoption of climate-resilient crops or crop varieties were largely consistent across the three regions with robust numbers of publications: sub-Saharan Africa, South Asia and East Asia. The most important determinants across these regions were, in order of importance: (1) access to extension services or information about options, (2) education

<sup>15</sup> Overall total is more than 100% as farmers access CC information from multiple sources



level of head of household, (3) access to needed farm inputs, (4) experience and skills of the farmer, (5) social status, and (6) access to climate information. Access to extension services and information about options, and the education level of the head of household were among the top five determinants for adoption for all three regions. Access to farm inputs was the first and second most important determinant for adoption in South Asia and sub-Saharan Africa, respectively, but was only the sixth most important for East Asia. **Experience and skills of farmers were the first and third most important determinants for adoption in East Asia and sub-Saharan Africa, respectively, and the sixth most important in South Asia. Social status was highly important in South Asia and sub-Saharan Africa, but only moderately important for determining the adoption of technologies in East Asia.** Although there were few papers and thus limited information for Latin America and the Middle East and North Africa regions, the education level of the head of the household was cited as the most important determinant for adoption in both regions.

In the Acevedo et al., analysis, approximately 53% of studies reported that social differences (such as sex, education and age of head of household) influence the adoption of varieties or crops as mitigation strategies against the effects of climate change, whereas 30% of studies did not report any effect of social difference. **Fifteen percent of studies did not include data on social differences.** Of the studies that identified social differences as influencing the adoption of climate-resilient crops and crop varieties, education (22%), sex (28 %), age (24%) and family size (14%) emerged as the most important factors. **Income (6%), access to information (5%), marital status (2%) and experience (2%) were also mentioned, but much less frequently.** The papers were examined for sex disaggregation of data, in which the sex of household heads was considered. Forty-five per cent of studies reported on the sex of respondents, with 39% reporting on both male and female household heads, 5% including men only, and only 1% of studies including only female respondents. **Most of the studies explored social differences only superficially, by including variables in surveys, but few substantiated these findings with follow-up qualitative research to understand the social dynamics driving the observed adoption decisions.**

The studies largely concur that the socio-economic status of farmers plays a large part in their adoption of climate-resilient technologies. **Thirty-one percent of the studies highlighted the socio-economic status of farmers.** Various studies indicated that a nuanced understanding of the socio-economic status of farmers is vital for the targeting of climate-resilient crop technology interventions and their adoption and sustainability in practice. Thirteen studies reported a positive effect of farmer income on adoption. Farmers with access to finance, such as risk transfers (for example, insurance or remittances) and credit (for example, bank loans or community loans), were more likely to adopt climate-resilient crop technologies. Farmers who reported constrained credit were less likely to grow modern crops and more likely to cultivate local varieties (Fisher and Carr, 2015). This is partly because the lack of cash or credit may prevent farmers from using purchased inputs (Kabote, 2014).

Abegunde et al., 2020 assessed the factors affecting the level of adoption of CSA practices by small-scale farming households in two selected local municipalities of South Africa. With the aid of a close-ended questionnaire, structured interviews were conducted and formed the basis on which data were generated from 327 small-scale farmers selected through random sampling. They reported that the majority (56.6%) of the sampled farmers fell in the medium category of users of CSA practices, while the lowest proportion (17.7%) of the sampled farmers fell in the high category. The use of organic manure, crop rotation and crop diversification were the most popular CSA practices among the sampled farmers. Educational status, farm income, farming experience,

size of farmland, contact with agricultural extension, exposure to media, agricultural production activity, membership of an agricultural association or group and the perception of the impact of climate change were found to be statistically significant and positively correlated with the level of CSA adoption. Furthermore, off-farm income and distance from farm to homestead were statistically significant but negatively correlated with the CSA level of adoption. The paper argued that climate change-related education through improved extension contact and exposure to mass media can strengthen integrated farm activities that bolster farm income. Additionally, farmer associations or groups should be given adequate attention to facilitate CSA adoption as a means of climate change mitigation and resilience.

With respect to the pattern in **age distribution** in the sampled small-scale farmers, Abegunde et al., 2020 reported that there were more aged people involved in farming than youths in both municipalities of South Africa. The low level of involvement of youths in agriculture, they opined, could be because they find agriculture unattractive and prefer to search for jobs in other sectors. The dominance of older farmers in the farming system could be an advantage in terms of wealth experience and social capital in the system. However, the farming system could also be laden with a state of fatigue. However, conversely, a study conducted by Ogunleye, 2015 in the Osun State of Nigeria, revealed that the mean age of the respondents was 47.4 years with many (44.3%) within the age range of 41 to 59 years and the last age group (8.3%) was 71 years and above. This implies that the majority of the respondents were still in their active years and might be in need of training to increase their knowledge since at this age farmers will be very willing to learn how to bring about improvements in their farm work. About 70% of the respondents were male, 68.3% were married, and more than half (51.7%) had a family size of less than 5 people.

It has been widely acknowledged that the **education levels of farmers** have a positive correlation with technology adoption, and the synthesis report of Acevedo et al., 2020 demonstrates that this is also relevant for the adoption of climate-resilient crops (Mujeyi et al., 2019; Asfaw et al., 2013; Onu, 2006; and Tenge et al., 2004). Highly educated heads of households are more likely to readily accept and access information about new technologies in a shorter period of time than less educated heads of households; education was measured as educational attainment and reported in 49% of the studies.

The findings of Abegunde et al., 2020 on the **educational status** of the sampled farmers revealed that they were exposed, on average, to a primary level of education. **The reports from the census conducted in 2001 and 2011, although low, reveal improved access to education in both municipalities over the years (King Cetshwayo District Municipality. Integrated Development Plan, 2017).** Educational status was found to have a statistically significant and positive influence on the level of adoption of CSA practices in one municipality but did not influence CSA adoption level in the other. Onyeneke et al. 2018; and Onyeneke and Nwajiuba, 2010, in their studies, found that education positively affects climate change adaptation. Their findings agree with the findings of Abegunde et al., 2020 on the effect of educational status on CSA adoption level. A better level of literacy could be an added advantage in mainstreaming innovations and practices, particularly CSA among the farmers in the area. Farmers' literacy is expected to enhance their capacity to obtain, process and utilize information relevant to the adoption and management of agricultural practices (Onyeneke et al. 2018). Additionally, farmers' education could enhance the productivity of agricultural extension services, as educated farmers could be more receptive to **and productive with** new agricultural innovations or practices. However, the result obtained is in contrast with the finding of Wekesa et al. 2018, who reported a negative influence of years of schooling on the

choice of CSA package. Wekesa et al. 2018 argued that educated farmers would opt out of a CSA package if it does not offer risk reduction measures that could protect their investment against the risks of climate change.

The results obtained by Abegunde et al., 2020 on **household size** revealed a considerable average household size for the sampled small-scale farmers in both municipalities. **A large household is a potential contributor to the labour force for agricultural activities, which the farming households in both municipalities could be enjoying (Ojoko et al., 2017).** Nonetheless, household size was found to have no statistical significance on the level of adoption of CSA practices. Ogunleye, 2013 findings showed a positive and significant relationship with constraints faced in managing the effects of climate change.

The results of Abegunde et al., 2020 showed that **average monthly farm income** has a statistically significant positive effect on the level of adoption of CSA practices in one municipality. Income from farming activities tends to increase the level of adoption of CSA practices by the farmers. This finding may be because farmers with higher farm incomes are less risk-averse and have better exposure to information (Onyeneke et al., 2018; Knowler and Bradshaw, 2007). **The result is in line with the conclusion of Onyeneke et al. 2018 who established that there is an increased likelihood of the adjustment of the agricultural production systems with an increase in farm income.** Vera et al. 2017, and Katengeza et al. 2012 also confirm a statistically significant positive influence of farm income on the intensity of adoption of technologies and climate change adaptation. With an increase in income from farming activities, farmers would be able to acquire resources needed for the adoption of recommended practices or newly obtained information either from extension services, colleagues, social platforms or the media. Farmers need to be financially capable to adopt some agricultural practices or innovations successfully. Hence, financial empowerment is crucial to mainstream CSA adoption into the small-scale farming system successfully.

Abegunde et al., 2020 findings on **income from other sources than farming (off-farm income)** show that the sampled farmers from the uMhlathuze Municipality had a higher average income from alternative sources than in the Mthonjaneni Municipality. **This finding could be attributed to the fact that there were more economic activities in uMhlathuze Municipality, than in Mthonjaneni which could serve as sources of income (Municipal Directory).** Such activities identified among the respondents include trading, handwork, cleaning and other sources of income such as child support and the old age grant. Average monthly off-farm income was found to have a statistically significant and negative influence on the level of adoption of CSA practices in the report for both Mthonjaneni and uMhlathuze Municipalities. The finding on off-farm income suggests that rather than using off-farm activities as mere alternative sources of income to augment income from farming activities, the off-farm activities were major sources of income for farming households. A flourishing alternative source of income could result in a weak commitment to agricultural production. This result is in line with the findings of Vera et al. 2017, who confirmed that income generation from other sources than farming reduces the likelihood of the adoption of more CSA practices. Farmers who can diversify their sources of income, generally can deal with agricultural production shocks and may see no need to improve the resilience of their agricultural production through the adoption of more CSA practices (Vera et al. 2017).

Farmers generally tend to be risk averse, which leads to limited investment and adoption of improved agricultural production technology (Hansen et al, 2019). Experienced farmers use precautionary strategies to protect against the possibility of catastrophic loss in the event of a climatic shock and thus optimize management for average or likely conditions, but not for unfavourable conditions. These ex-antes, precautionary strategies include the selection of crops and cultivars and improved production technology (Hansen et al, 2019). In general, there is widespread agreement that aside from the useful experience that farmers gain from the time they have spent in farming, their experience with climatic shocks is key to their adoption of climate-resilient technologies. **Many studies showed that farming experience is influential in adoption and utilization, and previous experiences with environmental shocks such as drought can influence the adoption of climate-resilient crops and crop varieties.** The more experience farmers have with climatic shocks, the more likely they are to be receptive to the adoption of related climate-resilient technologies. **For example, experience with drought shock in the agro-ecological zone of Brong Ahafo, Ghana, increased the probability of adoption of drought-tolerant varieties by 15%, and farmers reported that drought shock was the primary reason for the adoption of drought-tolerant varieties (Abdoulaye et al., 2017).**

Generally, the results obtained by Abegunde et al., 2020 show a **high farming experience** for the sampled farmers, which is in line with the descriptive evidence of the dominance of older farmers in the study area/s. **However, there is a higher proportion of the sampled farmers with more years of farming experience in Mthonjaneni Municipality as compared to uMhlathuze Municipality. This could be one of the reasons for the higher agricultural potential reported for Mthonjaneni Municipality (Taruvinga et al. 2016).** The farming experience was found to have a statistically significant and positive influence on the level of adoption of CSA practices in Abegunde et al., 2020 report for uMhlathuze Municipality. **This finding is also true for the combined analysis of both Municipalities.** This result implies that an increase in the years of farming experience would increase the level of CSA adoption. Farmers with more years of farming experience could have a higher level of CSA adoption through more efficient rapport with extension services and a stronger social network. According to Onyeneke et al. 2018, farming experience significantly increases the likelihood of adjusting agricultural production and management systems. The stated result suggests that involving experienced farmers in promoting CSA among small-scale farmers can substantially impact the uptake of various CSA practices and enhance the implementation of CSA-related programs and projects among small-scale farmers.

It is important to note that in a 2013 study (Onyeneke, 2013), the analysis revealed that **farming experience** and farm size had a positive and significant relationship with constraints faced in managing the effect of climate change. This implies that as the farmers increase their farming experience, they faced more constraints in managing the effect of climate change. This implies that the farmer's experience has not helped them in managing their farms against climate change effects. This corroborates the findings that without additional mitigations efforts beyond those in place today, and even with adaptation, warming by the end of the 21<sup>st</sup> century will lead to high then very high risk of severe, widespread and irreversible impacts globally (IPCC, Climate Change Synthesis Report, 2014).

The results on the **distance of farm to homestead** (Abegunde et al., 2020) of the sampled small-scale farmers in uMhlathuze Municipality found a statistically significant and negative effect on the level of CSA adoption. This finding is also true of the analysis for the combined municipalities. The result implies that farmers whose farms are far from their homesteads would likely adopt

fewer CSA practices. This could be attributed to the challenges they would be facing in exercising proper and effective management as a result of stress posed by distance when compared with their counterparts who live closer to their farms. According to Teklewold et al. 2013, besides influencing market accessibility, distance can also affect important factors critical to agricultural production such as access to technologies, information and credit institutions.

**The size of farmland** was reported as having a statistically positive effect on the level of CSA adoption in both municipalities **in the King Cetshwayo District** of South Africa (Abegunde et al., 2020). The finding indicates that farmers with larger farmlands adopted more CSA practices, thereby implying that land fragmentation could be a constraint to CSA adoption. The land is a crucial resource in agricultural production and farmers will be able to accommodate innovations or practices necessary for a successful agricultural venture with access to land and other needed resources. However, this is not supported by the study of Onyeneke (2013), which reported that farm size had a positive and significant relationship with constraints faced in managing the effect of climate change. This implies that as the farmer's land size increases more the constraints are faced in managing the effect of climate change.

About 50% of the studies included in this scoping review of Acevedo et al., 2020 identified **agricultural extension and awareness outreach** as the most relevant factor for the adoption of climate-resilient technologies in low and middle-income countries. Agricultural extension links farmers with the latest research and engages in a translational practice to make complex information more accessible to farmers. It has been shown that farmers who have access to early-warning systems such as weather forecast systems can better cope and adapt to a changing climate (Mujeyi et al., 2019). Farmers plan better for farming activities, including choice of crop varieties to plant, after having had access to weather forecast information (for example, from a community-managed weather station). Emerging digital technologies provide an opportunity to use information and communications technology-enhanced extension and climate services that can provide timely information that farmers can use for decision-making and adapt their farming practices. These could also improve the efficiencies of extension services while also reducing their cost. Poor funding for extension services in the developing world has limited farmers' access to training and expert guidance on emerging technologies (Meena and Rout, 2016). Partnerships with other emerging players in information exchange, such as telecommunications companies and non-governmental organizations, will be key.

Access to extension services and advisory roles plays an essential role in the enhancement of adoption and innovation (Kassem et al., 2019). With increased and quality exposure to extension services in the farming system, farmers will likely have a higher chance of better exposure to new or more productive innovations or practices, particularly as it relates to CSA. Contact with agricultural extension agents has a statistically significant and positive effect on the level of adoption of CSA practices **of the sampled small-scale farmers in both Municipalities of South Africa** (Abegunde et al., 2020). Agricultural extension services serve as a crucial source of information on climate change, climate change adaptation and resilience, as well as agricultural management practices (Onyeneke et al. 2018). **This result obtained is consistent with the finding of Onyeneke et al. 2018, who confirmed that contact with extension agents increases the likelihood of the adoption of CSA practices.** It is expected that frequent contact with extension agents would increase the chances of awareness of climate change and CSA practices that can be adopted to address the issues of climate variability and shocks. Besides, farmers, through extension services, can learn climate change mitigation measures and strategies that can enhance

resilience. However, agricultural extension services, in influencing CSA adoption, can also be influenced by factors such as farmers' literacy, years of experience and financial capacity. Literacy and farming experience could enhance farmers' appreciation and processing of what extension service offers, while financial capacity could influence the implementation. The complementarity of these factors forms a package that should be considered in mainstreaming CSA in the small-scale farming system.

Exposure to media was statistically significant and positively affected the level of CSA adoption of the sampled small-scale farmers in both Municipalities of South Africa (Abegunde et al., 2020). Onyeneke et al. 2018, in their study, also established that exposure to mass media increases the probability of the uptake of CSA practices. BIRTHAL et al. (2015), in their study, found that farmers making use of relevant information in agricultural production realized a 12 per cent higher net return per hectare compared with their counterparts. Farmers could learn about different innovations or practices through modern information and make use of this information (Sapkota, 2008). However, farmers' literacy could play a significant role in influencing farmers' exposure to information through the media. Exposure to media denotes that those farmers who have considerable access to information through media have a better chance of awareness of the impacts of climate change and how to swiftly respond.

Results **on gender** show that **a higher proportion of the sampled farmers in both municipalities of South Africa were female (Abegunde et al., 2020).** These results are consistent with the findings of Simelane (2017), Kutya (2017) and Masuku (2013) who also observed that small-scale farming in South Africa is practised primarily at a local level by older females. Nieuwoudt and Groenewald (2003) also described small-scale farmers as usually consisting of elderly women. Both age and gender, however, were found to have no statistical significance on the level of adoption of CSA practices in the study by Abegunde et al., 2020.

Changing crop varieties is one of the most frequently cited climate-resiliency strategies for both **men and women farmers**, but interventions are most successful when they are tailored to their environment and the cropping system (Acevedo et al., 2020). Seemingly contradictory or opposing (positive and negative) effects of each determinant of adoption were commonly reported among, and sometimes within, studies. Sex, age, education, years of farming experience and indicators of socio-economic status or wealth (assets) all affected decisions to adopt climate-resilient technologies in context-specific and sometimes opposite ways, depending on interacting environmental, policy and household factors. For example, equal and sizable numbers of studies (13 each) identify positive and negative effects of age on adoption (Acevedo et al., 2020). Whereas some studies identified older farmers to be more reluctant to adopt new technologies, other studies found that the earned experience, broad social networks and accumulation of wealth associated with older farmers may explain a positive effect on adoption. Extension and access to information about climate-resilient technologies and weather might be exceptions to this trend, as these determinants seem to transcend context-specific implementation. The resulting conclusion is that there is no 'one size fits all' recommendation to ensure the adoption of climate-resilient crops and crop varieties, and interventions are unlikely to uniformly benefit all climate-vulnerable farmers (Table 3). This is consistent with the large number of papers in the study that reported farmers adopting climate-resilient crops as part of broader climate-resilient strategies (Acevedo et al., 2020).



Results obtained by Abegunde et al., (2020) on the influence of production activity reveal that the sampled farmers who practice mixed farming would adopt more CSA practices than their counterparts who are engaged with only one enterprise activity. This finding suggests that small-scale farmers, who are more open to the integration of different farming techniques, would adopt more CSA practices compared to their counterparts who rely solely on one farming enterprise. **Being open to the combination of varying farming techniques creates a promising and conducive platform for mainstreaming CSA (Wekesa et al., 2018).**

Membership in an agricultural-related association or group was found to have a statistically significant and positive influence on the level of adoption of CSA practices (Abegunde et al., 2020) for one municipality in the King Cetshwayo District of South Africa. The result implies that the sampled farmers in both the lower and medium user categories who belong to an agricultural-related association or group would adopt more CSA practices than their counterparts who do not. Membership in a group is part of the build-up of the social capital of farmers, since it influences access to public spheres, particularly in rural areas (Aryal and Holden 2013). **Membership of agricultural groups plays crucial role in the enlightenment of their members (Ojoko et al., 2016).** Agricultural associations or groups present a platform for farmers to discuss their challenges with their colleagues, thereby benefitting from counsel on how to cope with problems. Farmers with membership in an agricultural-related group could enjoy better access to information and resources (Ojoko et al., 2016). A strong social network among farmers could enhance CSA adoption in the farming system.

### 3.4 Farmers' Perception of the Impact of Climate Change

In the determination of farmers' perception of the impact of climate change on their operations, weighted mean scores (WMS) were calculated and ranked in descending order of impact as show in **Table 11**.

Table 11: Distribution of Producers' Perceived Effect of Climate Change on Production

Statements	Weighted Mean Score (WMS)	Rank
Climate Change has resulted in changes in the weather pattern, thereby making agricultural production more unpredictable and unreliable	4.23	1
Increased drought associated with climate change will lead to a decrease in crop yields	4.03	2
Climate Change has resulted in increased agricultural production cost	4.00	3
Changes in climate factors affect planting time and make production planning more difficult	3.93	4
Unpredictable weather changes favor disease prevalence which affects crop sustainability.	3.90	5
An increase in temperature associated with climate change does not make the plant grow well because of heat stress	3.87	6
Increased flooding causes erosion and reduced crop growth	3.73	7
The late commencement of rainfall has caused an adverse effect on crops in terms of germination and growth	3.70	8
Increased landslides associated with flooding have reduced the amount of land available and suitable for crop cultivation	3.60	9

Climate Change resulted in practices that maintain soil moisture such as mulching to effectively reduce evaporation from the soil and make crop yield good	3.47	10
Climate Change has resulted in the need for the use of more fertilizer in improving and conserving soil structure better.	3.03	11

The table showed that the respondents were highly aware of the effect of climate change on production. The results obtained must be situated and discussed in the context of not only farmers' perception of the effect of climate change, but also the wider framework of farmers' perception of agricultural risks and risk management strategies employed. This broader treatment of the subject is addressed in **Section 3.5** of this Chapter.

Onyeneke, 2013, in his study on **farmers' perception of the effect of climate change** in Nigeria showed that the respondents were highly aware of the effect of climate change on crop production, except that the farmers did not agree that land portions have been less suitable for crop cultivation (2.73). This might be because the small holdings of the farmers, where the mean farm size is 0.82ha, constrained them from regarding any land portion as not suitable for cultivation. This also emphasizes the reason farmers do not practice shifting cultivation in managing the effect of climate change on crops. This practice, therefore, contradicts the opinion that many adaptations and mitigation options can be combined to address climate change, because no single option is sufficient by itself (IPCC, Climate Change Synthesis Report, 2014).

Results obtained by Abegunde et al., 2020 on the **perception of the sampled farmers of the effect of climate change** show that there were more sampled farmers who perceived climate change to have an adverse effect on agricultural production in Mthonjaneni than in uMhlathuze. The analysis of the combined Municipalities indicates that there were more farmers who perceived climate change to have an adverse effect than those who did not. Perception of the effect of climate change was found to have a statistically significant and positive influence on the level of adoption of CSA practices in the report for Mthonjaneni and uMhlathuze Municipalities. **This finding is also true for the combined analysis. The results show that the sampled farmers who perceive that climate change has a significant adverse effect on agricultural production and food systems would adopt more CSA practices.** This correlates with the finding of Vera et al. [1], who reported that farmers who observed an increase in floods and changes in moisture levels in their area had a higher probability of adopting more CSA practices. **This finding is expected, considering that farmers who appreciate the risk attached to extreme weather conditions and varying weather patterns see the essence of adopting CSA practices to enhance their resilience to climatic shocks. However, based on the results, there is a difference in the matter of degree of the adoption practices. In the Mthonjaneni Municipality, adopters are less likely to be in the low user category.** The finding on the perception of the farmers of the effect of climate change suggests that an adequate level of awareness of the adverse impact of climate change on agricultural production among the farmers will likely enhance CSA adoption in the farming system of the area/s.



### ***3.5 Farmers' Perception of Agricultural Risks and Risk Management Strategies Employed***

#### ***3.5.1 Overview***

Agricultural enterprise has always been at risk from factors such as pest and disease attacks, uncontrollable weather events and market variability (Martin, 1996; Legesse et al., 2005; and Ullah et al., 2016). Many risks are now being exacerbated by global environmental, social, and economic change, including continued human population growth, limited arable land, land degradation, and climate change (Carvalho, 2006; Sulewske et al., 2014; and Poulsen et al. 2015). Agricultural risks come from different sources and are experienced to differing degrees across different geographic and political scales. Sources of agricultural risks have previously been classified into price or market risk (output and input price fluctuation, market shocks), financial risk (loans and credits), production risk (weather-related risk, pests and diseases (biosecurity threats), technology change, yields), institutional risk (regulations, legal, environment and tax policy), and human resource risk (physical and mental health) (Harewood et al., 1999; and Hardaker et al., 2015).

Farmers' management response to risks is influenced by their perceptions of the risk concerned (Mankad, 2016). Based on how they perceive risks, farmers implement a wide range of strategies to limit the impacts of agricultural risks (Martin, 1996; Meuwissen et al., 2001; Flaten et al., 2005; and Bergfjord, 2009). Farmers employ strategies including informal mechanisms at the farm level (crop and animal diversification and advanced technology applications) to formal mechanisms such as insurance and contracting (World Bank, 2005).

With different socio-economic backgrounds (age, education, culture, religion, farming practice, income, peer pressure, and community values) farmers have different risk perceptions, resulting in different economic behaviours and decision-making (Ashan, 2011; and Bergfjord, 2013), including response to risks. Farmer-level choices to adopt management strategies and successfully manage risks have been shown to be limited by many factors, including the absence of transparent information, limited institutional support, and lack of capital (Knutson et al., 2011; Woods et al., 2017). To enable improved institutional support relating to risk management, it is, therefore, essential to understand farmers' risk perceptions, the socio-economic factors that influence risk perceptions and likely response to risks, and the barriers to implementing management strategies (Sulewski et al., 2014; Botterill et al., 2004; OECD, 2011; Menapace et al., 2013; Lewerin et al., 2015). For example, in recent years, research has investigated how farmers perceive agricultural risks, and how farmers respond to particular perceived risks (Legesse et al., 2005; and Tzouramani et al., 2013), factors affecting farmers' perception and strategies (Winsen et al., 2014; Saqib et al., 2016; and Oo et al., 2017), and barriers to risk management (Ochieng et al., 2017). Those studies primarily focus on individual cases of crops and animals, ranging from developing countries (Lu et al., 2017) to developed countries (Sulewski et al., 2014) spanning Asia (Bastakoti et al., 2013), Africa (Harvey et al., 2014), and Europe (Visschers et al., 2015).

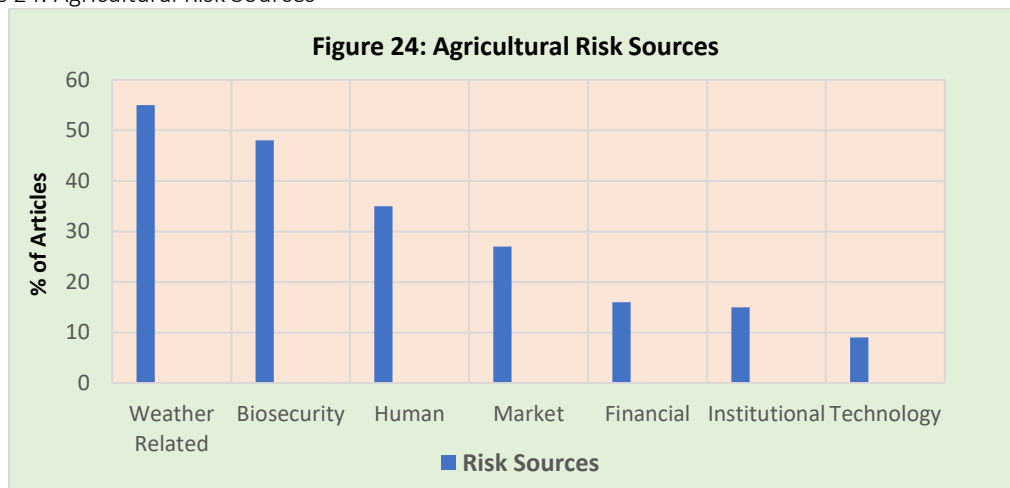
While the existing literature has begun to tie these various concepts together in case studies, there has not, to date, been a systematic review of how these concepts are related, in the context of agricultural risks. This section of the literature review aims to identify (1) the major sources of agricultural risks perceived by farmers, (2) common risk management strategies employed by

farmers, (3) linkages between risk sources and risk management strategies, (4) socio-economic factors that affect farmers' perceptions and management strategies, (5) the barriers to the management of agricultural risks, and (6) to explore the implications for Caribbean agriculture in the context of climate change and variability. It draws heavily on the work of Birthal et al., 2021 and Duong et al., 2019.

### 3.5.2 Agricultural Risks Perceived by Farmers

Duong et al., 2019 conducted a global review of farmers' perceptions of agricultural risks and risk management strategies. They found that in general, more than half (55%) of the studies reported that farmers perceived weather and climate change as the main risk to their farm enterprises, followed by biosecurity threats (48%), human risk (35%), and market risk (27%), while technology was least frequently mentioned (**Figure 24**).

Figure 24: Agricultural Risk Sources

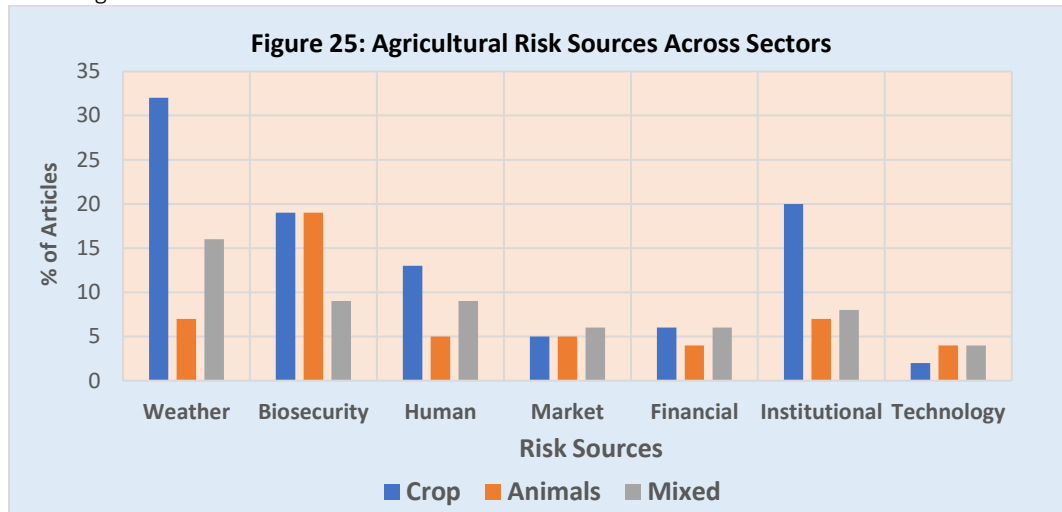


Source: Duong et al., 2019

As can be observed from **Figure 25**, weather risk, human risk, and biosecurity threats were the most frequently cited risks by the farmers in the crop sector. In the animal sector, biosecurity threats, weather risks, and human risks are the most frequently cited. In the mixed production sector (crop and animal), the most cited risks in studies were weather risk, biosecurity threats, and market risk.

**Figure 25** below presents the agricultural risk sources across sectors (Duong et al., 2019).

Figure 25: Agricultural Sources Across Sectors



Source: Duong et al., 2019

Duong et al., 2019 also found notable differences in farmers' perceptions of risk sources between studies in developing countries and developed countries. Weather-related risk, biosecurity threats, and human risk were mostly cited in developing countries while in developed countries biosecurity threats were the most cited, followed by weather-related risk and human risk (**Table 12**).

Table 12: Number of Studies Citing Risk Sources Perceived by Farmers in Developed and Developing Countries

Risk	Developed Countries (N= 112)		Developing Countries (N = 85)	
	Number	%	Number	%
Weather Related	75	67	33	39
Biosecurity	48	43	46	54
Human	41	37	27	32
Market	30	27	23	27
Financial	16	14	15	18
Institutional	10	9	20	24
Technology	8	7	10	12

Source: Duong et al., 2019

### 3.5.3 Risk Management Strategies Adopted by Farmers

Duong et al., 2019 constructed and analyzed a typology of twelve risk management strategies based on the most relevant strategies discussed in the reviewed studies. They reported that more than a quarter of the studies (28%) found that farmers considered "crop and animal diversification" to be an effective risk management strategy (**Table 13**). "Pests and diseases monitoring and prevention" was adopted by farmers in 40 studies. "Off-farm work" (14%) and obtaining "farm insurance" (13%) were the third and fourth most frequently stated management strategies. "Cooperation with other farmers", "extension services" and "training and education" were less frequently stated (**Table 13**).

Table 13: Frequencies of Risk Management Strategies Taken by Farmers Across Reviewed Literature<sup>16</sup>

<b>Risk Management Strategies</b>	<b>Number</b>	<b>%</b>
<b>Crop and animal diversification</b>	56	28
<b>Pests and Diseases monitoring and prevention</b>	40	20
<b>Off-farm work</b>	27	14
<b>Farm insurance</b>	25	13
<b>Off-farm investment</b>	20	10
<b>Debt reduction</b>	19	10
<b>New technology adoption</b>	13	7
<b>Produce at the lowest costs</b>	11	6
<b>Extension services</b>	9	5
<b>Cooperation with other farmers</b>	8	4
<b>Update with government</b>	8	4
<b>Training and education</b>	2	1

Source: Duong et al., 2019

Birthal et al., 2021 employed a multinomial endogenous switching regression technique to farm-level data in India to identify the determinants of farmers' own risk management measures and then evaluate their impacts on farm income and downside risk exposure. There were three key highlights of their analysis and results:

- Farmers, based on their past exposures to climate risks, endowments of resources, and access to credit and information, often used more than one measure or strategy to mitigate, transfer, and cope with the climate risks.
- All the risk management strategies were found to be effective in improving farm income and reducing risk exposure, but it was the joint implementation that yields larger payoffs.
- The joint adoption of different adaptation strategies was positively associated with farm size, but with liquidity and information constraints relaxed, the probability of their joint adoption was expected to increase further. These findings impinged on the concept of climate-smart agriculture and suggested the need to identify and integrate traditional farm management practices with science-based innovations to provide an effective solution to climate risks

#### *3.5.4 The Link Between Perceived Risk Sources and Management*

Duong et al conducted a factor analysis on 93 studies (47%) review that explored both risk sources and risk management strategies, resulting in six components explaining 71.32% of the total variance. Notwithstanding, ten (10) out of the 93 studies (11%) concluded that there was a mismatch between farmers' perceptions of risks sources and their risk management strategies addressing the risks accordingly. The reality is some of the risk sources were not correlated with risk management strategies, and varying association between risk sources and risk management strategies were found.

<sup>16</sup> Note that many articles described more than one risk strategy

### *3.5.5 Socioeconomic factors Affecting Farmers Perceptions and Management of Agricultural Risks*

In the literature review of Duong et al., thirty-five studies (18%) mentioned potential socio-economic factors determining farmers' perceptions of agricultural risks. Factors included educational levels, farmers' age, gender, farm size, experience in farming, farm income, and farm location.

Only 21 studies (11%) investigated factors affecting farmers' adoption of risk management strategies (Duong et al., 2019). These studies, collectively, mentioned some factors including educational levels, farm size, experience in farming, farm location, farm ownership, gender, and annual farm income.

### *3.5.6 Barriers to the Management of Agricultural Risks*

Twenty-two out of 197 studies (11%) explored barriers to the management of agricultural risks (Duong et al., 2019). Lack of information helping farmers control agricultural risks was mentioned in 15 studies, mostly in developing countries. Poor access to formal, low-risk and regulated financing was found to hinder farmers' ability to manage their farming enterprises, as discussed in ten (10) studies. Limited institutional support and lack of market mechanisms (access and input supplies) were additional barriers encountered by farmers.

## *3.6 Psychological Capital and Farmer's Climate Adaptation Decisions*

### *3.6.1 Overview*

For a long time, the sustainable livelihoods framework (SLF) has provided a holistic approach to assessing household livelihoods. The traditional five livelihood assets (human, physical, financial, natural, and social capitals) formed the basis for characterizing farming systems in previous typology studies (e.g., Bigodeza et al. 2009; Goswami et al., 2014; Pienaar and Traub 2015). Although the effects of psychological, social, cognitive, and emotional factors on the economic decisions of individuals and institutions, and the consequences for market prices, returns, and resource allocation are the subjects of behavioural economics (Baddeley 2017), psychological capital as a livelihood asset has not yet been fully integrated into the SLF.

Psychological capital, a relatively new concept in agricultural economics, is the state of mind of an individual at a given time (Seligman 2002). Psychological capital is concerned with the individual mindset that enhances or hinders willingness and ability to take advantage of opportunities (such as irrigation schemes) despite prevailing constraints. If individuals are endowed with positive psychological capital, their entrepreneurial drive is enhanced, and they will most likely develop the tenacity necessary to undertake the entrepreneurial process (Hmieleski and Carr 2008). To date, this concept seems to be hardly applied in agricultural economics. Based on field observations and literature showing its role (Luthans 2004), it was argued by Chipfupa and Wale, 2018 that psychological capital should be integrated into the SLF to define farmer typologies. In this context, studying on-farm entrepreneurship without accounting for psychological capital is missing the key factor critical to the transformation of Caribbean Agriculture from a business-as-usual situation to CRA production systems.

The general conceptual framework in the literature for such studies is based on modified SLFs which integrate psychological capital as the sixth livelihood capital. This is meant to explain the diversity among farmers brought about by differences in individual mindsets. In the past, heterogeneity among small farmers has been attributed to differences in indigenous knowledge, farm management practices, and other resource endowments (Muthamia et al., 2011; Wale and Yalew 2007). However, very few literature reviews explain the differences normally observed among small farmers working in the same village, having a similar resource endowment, and faced with similar institutional and infrastructural constraints. However, the studies of Chipfupa and Wale, 2018; and Chipfupa et al., 2021 argue that these differences can be explained by variations in psychological capital endowment. Liu and Liu (2016) posit that farmers' different perceptions and attitudes towards their lives affect their livelihood strategies and outcomes.

Psychological capital emanates from the literature on positive organizational behaviour, with firm foundations from the social cognitive theory (Luthans, Youssef-Morgan, and Avolio 2007). Psychological capital can help to explain differences in farmers' ability to take advantage of opportunities when they arise; the dependency tendencies observed among some small farmers; different levels of confidence in agriculture as a sustainable livelihood strategy; and farmers' varying abilities to cope with different challenges. Psychological capital is mainly associated with four constructs: confidence, hope, optimism, and resilience (Luthans et al., 2015). Individuals who have self-confidence persevere even when faced with difficulties and those who are optimistic take these obstacles as opportunities to think differently (Simons and Buitendach 2013). They always bounce back, and through hope, they generate different pathways to accomplish goals (Simons and Buitendach 2013). When resources are limited and, individuals are faced with risky decisions, those with positive psychological capital are in a better position to make effective decisions and employ more resilient adaptation strategies. Positive psychological capital is, therefore, an important means to manage and utilize all the other forms of resources effectively.

### *3.6.2 Psychological Capital and Farmer's Climate Adaptive Behaviour*

Climate change adaptation in the agricultural sector has widely been studied (Burnham and Ma 2016; Islam and Nursey-Bray 2017; Khanal et al. 2018; Trinh et al. 2018; Truelove et al., Carrico and Thabrew 2015; Wuepper et al. 2019). However, there has been an unbalanced focus on the thematic areas known to influence human adaptive behaviour to climate change. Most studies have focused on tangible factors (e.g., demographic factors, assets, institutions and social networks), neglecting the intangible non-cognitive behavioural factors (e.g., personality traits, attitudes and motivation) (Dang et al. 2019; Grothmann et al. 2013; Truelove et al. 2015). Dang et al. (2019) posited that researchers shy away from such factors because they tend to be contextual, complex and challenging to measure. However, there are studies that have demonstrated the importance of non-cognitive factors to climate change adaptation (Swim et al. 2009; Truelove et al. 2015; Wuepper et al. 2019), economic decisions (Lybbert and Wydick 2018), irrigation farming (Chipfupa and Wale 2018; Phakathi and Wale 2018), disaster resilience and hazard risk perception (Armaş et al., 2017; Béné et al. 2019; Mertens et al. 2018). The conclusions of these studies show that non-cognitive (psychological) factors influence the decisions of individuals or households and hence their adaptive capacity to stressors in life. Thus, the failure to comprehensively account for these factors will likely result in the design of inappropriate climate change adaptation policies and strategies (Feola et al. 2015).

Adaptation to climate change in smallholder agriculture refers to the farm household's ability to develop practical ways of reducing the impacts of climate change events, such as drought, floods, hurricanes/storms, and heat waves, among others (Grothmann and Patt 2005). It requires both the ability and willingness to adapt. While ability is a question of endowment with livelihood assets, willingness is by and large a behavioural construct. Climate change adaptation is a behavioural aspect that is influenced by one's decision-making (Feola et al. 2015; Grothmann and Patt 2005). Decision-making itself is a psychological construct because it involves a non-cognitive process of applying scientific knowledge to the selection of a course of action amongst many alternatives (Todt and Luján 2014).

Chipfuga et al., 2021 provide the first attempt to empirically examine the role of psychological capital in climate change adaptation. Their study was based on the posit that psychological capital is a form of non-cognitive skill which defines an individual's mindset that determines his or her propensity to make the right decisions and choices in life (Luthans et al., 2004). It is the primary asset that can explain why individuals endowed with the same resources and working environment can perform differently, a feature common amongst smallholder farmers in the Caribbean. It is also the ultimate asset that determines the effective and efficient use of all the other resources that an individual or household possesses (Chipfuga and Wale 2018). The literature has distinguished four dimensions that constitute psychological capital, that is, self-confidence (internal locus of control), optimism, hope and resilience (Luthans et al. 2004; Luthans et al., 2015). According to Luthans et al. (2015), self-confident individuals have a belief in their ability to accomplish something, even in the presence of challenges. Optimism allows such individuals to take challenges as opportunities and look forward to a better future, while hope affords them the willpower to explore different routes of addressing such challenges. Resilience gives them the ability to cope with adversities. Given those constructs, the article by Chipfuga et al., 2021 argues and postulates that psychological capital affects not only smallholder farmers' response to climate change but also their demand for adaptive strategies.

Developments in the field of positive psychology have demonstrated that it is possible to provide a standardized measure of the psychological capital endowment of an individual. Studies that have attempted to integrate the effect of non-cognitive factors in climate change adaptation research (Dang et al. 2014; Grothmann and Patt 2005; Mertens et al. 2018; Truelove et al. 2015; Wuepper et al. 2019) fail to provide such a comprehensive measure that captures all the facets of psychological capital. There are also no generic indicators for measuring the non-cognitive abilities of smallholder farmers, with each study developing its own construct. Like many other psychosocial studies, the ones mentioned above are mostly influenced by Bandura's self-efficacy theory (Bandura 1977) and the locus of control theory (Rotter 1966). **The challenge, however, is that the two theories have a weakness because of their inability to address the other non-cognitive aspects related to hope (willpower to accomplish) and resilience (perceptions on the ability to adjust and adapt). Chipfuga et al., 2021 applied a more comprehensive and robust theory, the 'psychological capital theory' (Youssef-Morgan and Luthans 2013).**

Adaptation behaviour has been conceived in the climate change literature using the protection motivation theory (PMT) (Grothmann and Patt 2005; Mertens et al. 2018; Swim et al. 2009; Truelove et al. 2015). The theory states that people facing a threat will adopt behaviours that protect themselves if they deem the risk of the threat to be high (Rippetoe and Rogers 1987; Rogers 1983). If the loss as a result of the risk is deemed to be lower than the cost of adapting, they are expected to maintain the status quo. Otherwise, they will adapt. Some similarity exists

between the PMT and the random utility theory (RUT). According to the RUT, farmers generally choose what they prefer, and that preference considers the utilities of the different options. Where they do not do so, their choice can be explained by random factors (Cascetta 2009). Chipfuga et al., 2021 study draws from the same literature, extending the work of Grothmann and Patt (2005) and Truelove et al. (2015).

Chipfuga et al., 2021, with the use of data collected from 328 smallholder farmers in KwaZulu-Natal province, South Africa analysed and obtained results that showed an association between some psychological capital indicators and smallholder adaptation decisions. They found that social networks, having multiple farming objectives, access to credit and the type of farmer (irrigators vs. non-irrigators) were also significant in determining smallholders' adaptation decisions. In conclusion, the study recommends the need for practical ways for enhancing smallholders' endowment with key non-cognitive abilities. **They also suggest the need for researchers to develop a comprehensive framework for assessing non-cognitive factors critical for climate change adaptation. This they said will improve the use of positive psychology theories to advance the literature on climate change adaptation. They recommend that support should also be provided to communities facing higher risks of climate change adaptation and that more focus should also be given to improving smallholder farmers' ability to adapt, including access to affordable credit. They concluded that the role of social networks in information sharing remains critical, and hence their promotion should be prioritized.**

Grothmann and Patt (2005) and Truelove et al. (2015) proposed models for assessing the effect of psychological factors on adaptive behaviour. Their models discuss a non-cognitive process of risk and adaptation appraisal that results in climate change risk perceptions and perceptions of adaptive capacity. However, they do not explicitly present what constitutes a non-cognitive process. The study of Chipfuga et al., 2021 posits that people's risk and coping appraisals are themselves a result of an underlying psychological construct, here referred to as psychological capital. Béné et al. (2019) also proposed a similar psychosocial conceptual framework for assessing resilience capacities of households in disaster crises. However, their focus was on how psychosocial factors affect people's 'subjective resilience'<sup>17</sup> and hence their responses to disasters. Again, this is only one dimension of psychological capital.

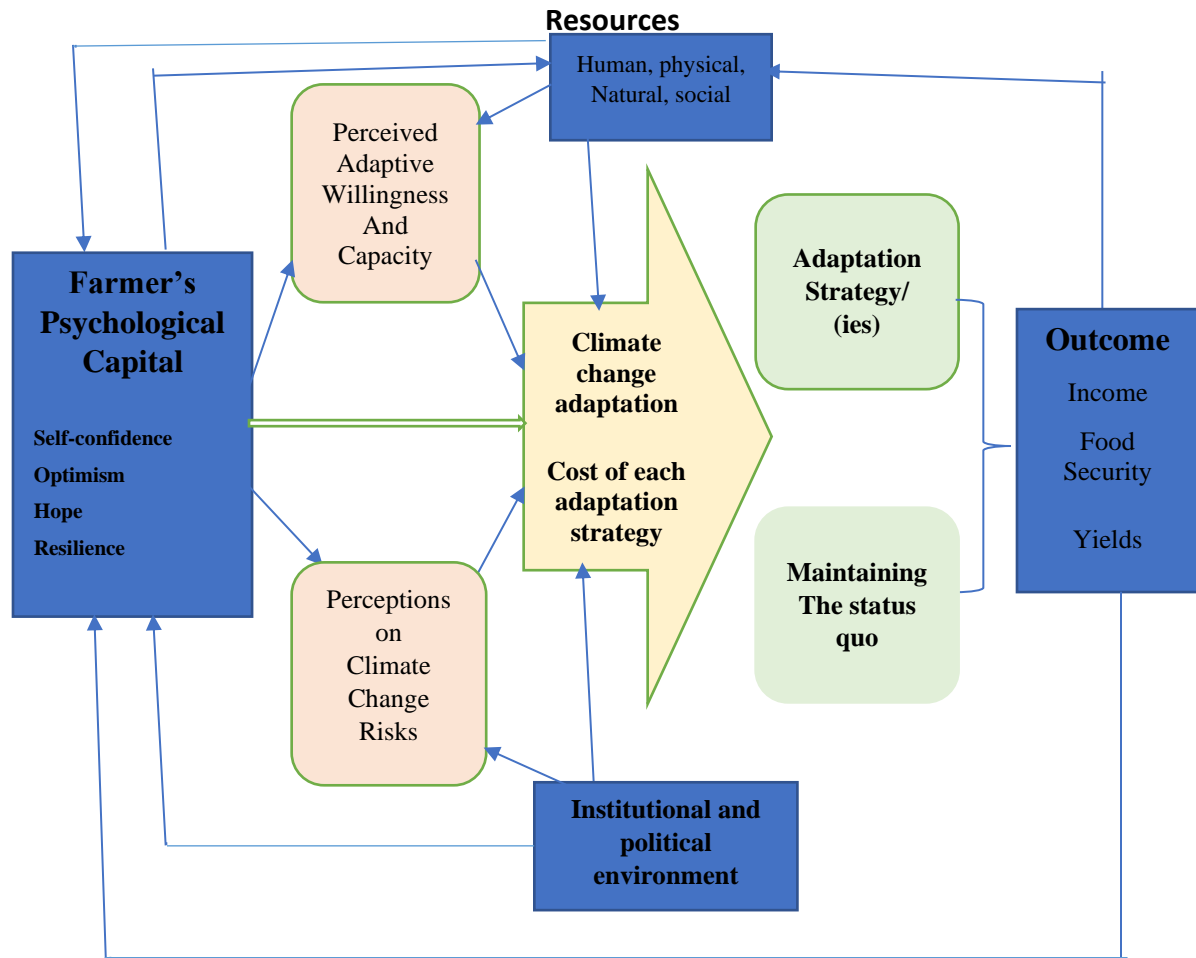
**Figure 26** depicts a comprehensive psychological capital model of adaptive behaviour to climate change. It starts by highlighting the four constructs of psychological capital which potentially affect the perceptions of smallholder farmers about any shock they face (e.g., climate change; perceived climate change risks) and their adaptive capacity (perceived adaptive willingness and capacity) (Béné et al. 2019; Grothmann et al. 2013; Wuepper et al. 2019). The constructs affect smallholder farmers' adaptation motivation, that is, the realization of the climate change risk and the need for action (Grothmann et al. 2013). A farmer endowed with positive psychological capital is better placed to make a value judgement about the perceived probability and severity of a climate change threat. Likewise, if they do not perceive to have the ability to be resilient, they would not make adaptation decisions.

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<sup>17</sup> Own perceptions about one's ability to cope with shocks.



Figure 26: Psychological Model of Adaptive Behaviour to Climate Change



Source: Adapted from Grothman, et al., 2013

Once an individual has formulated an intention to adapt, their ability and extent of response (adaptation strategies) will depend on four key factors, that is, their resource endowment, cost of each adaptation strategy, perceived risk of maintaining the status quo and the institutional and political environment. Regarding resource endowment, including psychological capital, it is envisaged that the propensity of smallholder farmers to act will be a function of their willingness (psychological readiness to face the opportunity cost of adaptation) and their ability (asset endowment). Each adaptation strategy has a cost implication to be borne by the farmer. The challenge is that smallholder farmers often find themselves constrained by resources and the operating environment that affects their ability to adapt (Veider and Matzler, 2016). However, the final decision will depend on the perceived risk of not taking any action. The higher that risk, the higher their motivation to adapt and vice versa. The institutional environment defines the rules, value systems and regulations existing in society (Swaminathan and Wade 2016). The key functions of institutions in smallholder farming include information provision, capacity building and facilitating access to finance and markets. Several studies have shown that institutions influence the adaptive capacity to climate change (Berman, Quinn and Paavola, 2012; Mubaya and Mafongoya. 2017).

In practice, differences will be observed among farmers in terms of psychological capital endowment and their perceived adaptation efficacy (the belief in one's ability to respond to the climate change threat). Irrespective of the perceived cost of adaptation and existing institutions, smallholders with similar resources might respond differently to a climate change threat. Their willingness to adapt, which constitutes their objective orientation and motivations (Veider and Matzler 2016), will differ by the level of their psychological capital endowment. Those with a higher level of internal locus of control are inclined to organize their endowments to protect themselves from climate change threats, while others (with an external locus of control) wait for external support (from government or other entities) to bail them out.

The approach used in the study to measure psychological capital is based on the work of Luthans et al., 2007. In this context, a psychological capital questionnaire (PCQ) was constructed where farmers were asked 13 five-point Likert-scale questions (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The questions were meant to solicit farmers' views regarding themselves i.e., how they rate themselves in relation to each question. **Table 14** presents the questions asked under each construct and the weighted mean scores (WMS) obtained.

**Table 14: Psychological Capital Construct Measurements**

Psychological Capital Constructs	Weighted Mean Score (WMS)
<b>Self-confidence</b>	
How confident are you about farming as a way of life in your country?	4.13
How confident are you about farming as a business in your country?	4.00
How confident are you in yourself as a farmer?	4.40
Do you agree that you have the power to affect the outcome of your farming?	4.20
<b>Optimism</b>	
Are you optimistic about the future of agriculture in your area/country?	3.67
Would you give up on agriculture easily?	4.03
Are you willing to take more risk in agriculture?	3.73
<b>Hope</b>	
Do you frequently hope that agriculture will get better?	3.97
Are you willing to forego a profit opportunity in the short run, to benefit from potential profit in the long run?	3.50
Are you willing to try new ideas even without full knowledge about the possible outcomes?	3.30
<b>Resilience</b>	
How are you coping with shocks such as drought, flood, hurricanes, and other natural disasters?	3.17
Would you be in farming if there was a better alternative source of income?	3.33
Do you think the is government responsible for the well-being of rural households?	3.40

An integrated analysis of the weighted mean scores obtained in this study supports the arguments for a considerable association between psychological capital and smallholder farmers' decision-making process, including adaptation to climate change. Therefore, in addition to already known factors such as self-confidence and locus of control, having hope or aspirations for oneself in farming is also important in decisions meant to address the impact of climate change on

agriculture production systems. Chipfupa et al., 2021 suggest that there is a need for practical ways of changing smallholder farmers' mindsets and enhancing their endowment with such non-cognitive abilities. At the farmer's level, this can be done through integrating the ideals of psychological capital in available platforms such as farmer field days, farmer training workshops and mentorship programmes. The learning and sharing of experiences with colleagues and experts will bolster smallholder farmers' willpower and belief in themselves and enhance their willingness and ability to choose contextually relevant adaptation strategies.<sup>18</sup>

### 3.7 Technology-based Barriers

#### 3.7.1 Introduction

Despite the benefits of CSA technologies (Elum et al., 2017; Khatri-Chhetri et al., 2017, 2016), adoption by farmers can be fairly low as numerous factors influence ~~it the extent to which farmers adopt them~~ (Khatri-Chhetri et al., 2017; Palanisami et al., 2015). While technological adaptations may benefit from the literature on agricultural technology adoption (Tessema, 2018), understanding the adoption process of specific CSA technology is necessary to ascertain if the determinants of adoption are similar or unique in the face of changing climate. In agriculture, adoption processes take place amid specific policy, social and cultural, climate, geographical, technological, and economic contexts (Botha and Atkins, 2005; Falaki et al., 2013; Mackrell et al., 2009).

Considering that technology uptake is a multifaceted process, shaped by many factors, the exploration to understand the diffusion and utilization of agricultural technologies cannot be limited to just understanding the characteristics of adopters, their biophysical contextual factors or information sources. The adopter's perceptions of climate change and/or technologies or practices to address them are also needed to provide a comprehensive picture for analysing decision-making (Jiri et al., 2015; Meijer et al., 2015; Mushunje et al., 2011; Pannell et al., 2006; Rankoana, 2016; Ubisi et al., 2017). For instance, a comprehensive framework comprising the extrinsic (e.g., characteristics of a adopters and innovations) and intrinsic (knowledge, perceptions, and attitudes) variables may increase our understanding of the complex process of adoption (Meijer et al., 2015). Accordingly, exploring the contribution of socio-psychological factors such as perceptions of farmers regarding the specific attributes of CSA technologies in addition to the highlighted socioeconomic factors could contribute to our understanding and ongoing discussion about CSA adoption. In the following subsections, the specific sets of factors are explained in greater details. The conceptual framework assumes that adoption decisions are conditioned by the socio-economic realities of the farmer, the characteristics of the external environment (or contextual factors), as well as the perceived characteristics of CSA technologies.

Various technology adoption studies conducted in developing countries (Adesina and Chianu, 2002; Akinola et al., 2010; Doss, 2006; Feder and Umali, 1993), indicate that the importance of factors affecting technology adoption varies across countries and regions owing to differences in natural resources, political and cultural ideologies, and socio-economic realities. Moreover, determinants of the adoption of agricultural technologies can be grouped in several ways

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<sup>18</sup> Chipfupa et al., 2021.

(Mwangi and Kariuki, 2015). Categories include technology and location, among others (Bonabana-Wabbi, 2002).

### 3.7.2 *The Conceptual Framework*

CSA can involve the implementation of a wide array of technologies, practices or actions, including for example water management, intercropping, agroforestry, integrated crop-livestock management approaches or the integration of renewable energy systems (Taneja et al., 2014). Although CSA includes a multiplicity of technological, policy and institutional approaches, the focus of this research concerns CSA technological innovations. In this paper we define these as hardware, software and org-ware that help solve climate-induced problems in agriculture, including increased agricultural productivity, reduced vulnerability of agro-food systems to climate impacts and the reduction of GHG emissions (or enhanced GHG emission storage) (McCarthy, 2001).

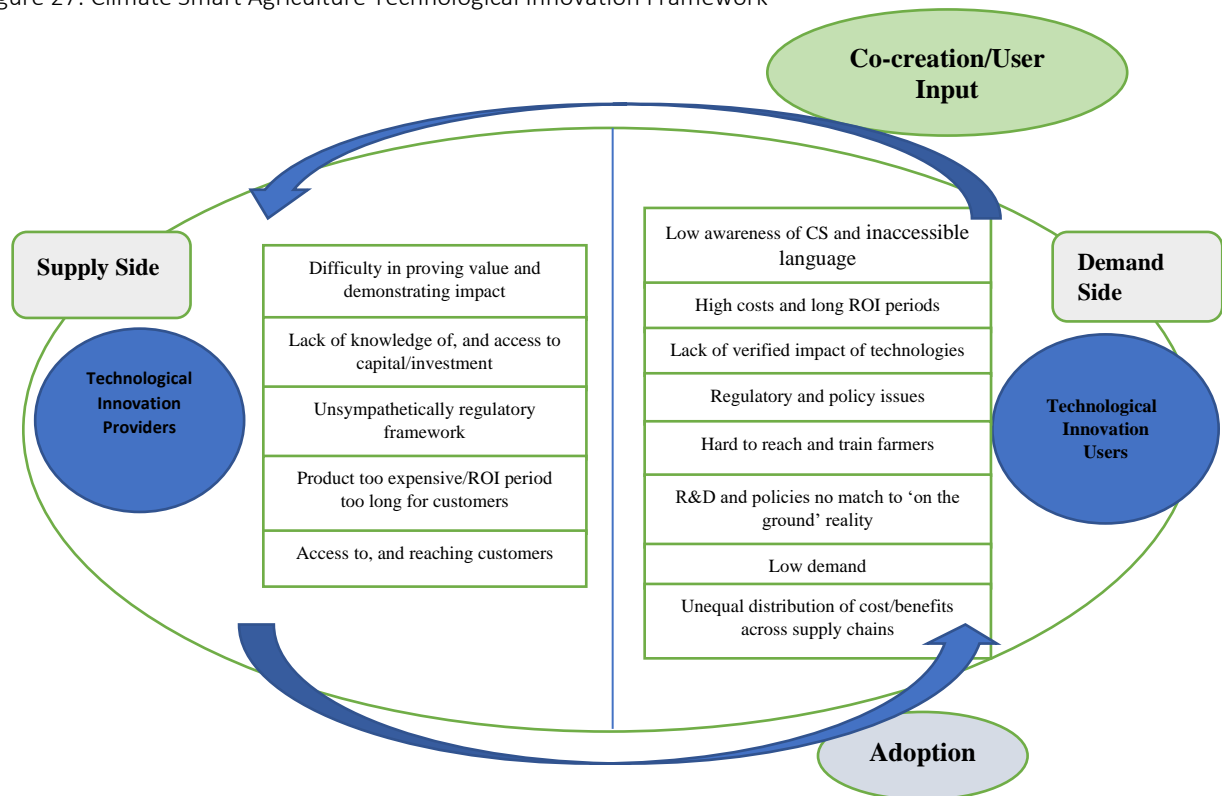
CSA technological innovations at the field and farm level are those that have the potential to achieve the potential 'triple-win' associated with CSA, i.e., enhance the productivity of agricultural land, whilst simultaneously reducing climate change risks through mitigating GHG emissions or adapting the agricultural system (FAO, 2010; Scherr et al., 2012). The concept of eco-innovation offers some value to the analysis of CSA technological innovations, as it is concerned with the process of developing new products, processes or services that provide added economic value, whilst also substantially reducing environmental impacts (Horbach et al., 2012). This relates well to CSA, which similarly seeks to increase productivity or incomes/economic outcomes, as well as mitigation or adaptation benefits. It is recognized that the adoption of innovation alone may not achieve optimal outcomes, due to mismatches between the technological innovation design and the context within which it is ultimately used; as such, adoption of technology can be seen as a process of adaptation and appropriation. Suboptimal outcomes can occur due to a lack of user participation in the design process (Wever et al., 2008), and due to top-down, rather than bottom-up design methods. To ensure the appropriate use of technologies, the concepts of 'user-centered innovation' or 'co-creation' are proposed, as these forms of design can increase the positive impact of pro-environmental innovations (Wever et al., 2008). So, whilst eco-innovation is comparable to CSA, eco-innovation opens a specific perspective on CSA innovations that enables the consideration of the innovation process as a process of adaptation and appropriation.

Additional important considerations for understanding the characteristics of barriers to technological innovation adoption include their internal (i.e., behaviour or senior management) versus external (i.e., government policy) operation (Boons et al., 2013; Brunke et al., 2014). These approaches to categorizing and understanding barriers are able to include all decision-making actors within our analysis of the barriers and can also illustrate the interlinkages. However, to further strengthen this approach to categorizing and understanding how barriers operate, the method employed by Wheeler (2008) can be included, which categorizes barriers according to their location on the supply or demand side of the adoption and diffusion process. Through the literature review, different levels at which barriers can operate are identified, via a demand or supply side, and in terms of their internal or external operation.

Long et al., 2015 conducted a study to identify key socio-economic barriers, in terms of supply and demand, that inhibit the adoption and diffusion of CSA technological innovations in Europe. The results obtained demonstrate that barriers exist on both the demand (user) and supply

(technology provider) sides. The CSA technology barrier framework is presented in **Figure 27** below.

Figure 27: Climate Smart Agriculture Technological Innovation Framework



Source: Adapted from Long et al., 2015

The report of the study provides recommendations for increasing the adoption and diffusion of CSA technological innovations. The relevance and implications for Caribbean CSA and innovation are noted.

### 3.7.3 Economic Related Technology Barriers

In this chapter, an analysis of the economic-related technology factors was conducted from two perspectives: the farmers and the research, development and technology transfer institutions. The results are presented in **Tables 15 and 16** below. The results are discussed within the context of other findings.

The findings of this study on farmers' access to productive resources, as indicated by the outcomes in weighted mean scores are very significant (**Table 15**). The farmers have indicated that they have moderate to good access to productive assets/inputs such as farm inputs, markets for outputs, transport for farm inputs and produce, land for agricultural purposes, and agricultural information. However, they are limited to significant degrees in their access to climate information relevant to agriculture, agricultural labour, agricultural credit, access to adequate government incentives from qualitative and quantitative perspectives, and access to effective and efficient insurance schemes to cover farm risks.

Table 15: Farmers' Access to Productive Assets and Inputs

<b>Farmers' Assessed Technology-based Barriers to the adoption of Climate Resilient Agriculture (CRA) Systems</b>	<b>Mean Score 5 = Max</b>	<b>Rank</b>
Do you readily have access to farm inputs?	3.50	1
Do you readily have access to land for agriculture?	3.30	4
Do you readily have access to agricultural credit?	2.07	8
Do you readily have access to agricultural labour?	2.57	7
Do you readily have access to transport for farm inputs and produce?	3.33	2
Do you readily have access to markets for outputs?	3.33	2
Do you readily have access to agricultural information?	3.20	5
Do you readily have access to climate information relevant to agriculture?	2.90	6
Do you readily have access to agricultural incentives (Subsidies, rebates, tax emptions, etc.)?	2.03	9
Do you have access to insurance schemes for agriculture?	Yes =3 No =27	
Do you use insurance schemes in your farm business to manage climate related risks?	1.13	10

The **research and development institutions** have identified several barriers to the uptake of CSA technologies most of which are in support of those identified by farmers.

Table 16: Service Provider Identification of Technology Barriers to CRA Production Technologies

<b>Research and Development Institution's Technology-based Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems</b>	<b>Mean Score 5 = Max</b>	<b>Rank</b>
Do you agree that the upfront investment costs that a farmer must make are too high?	4.00	2
Do you agree that the input/operating costs (labor, fertilizers, chemicals, etc.,) are too high?	3.75	5
Do you think that the riskiness of some Climate Resilient Agriculture (CRA) technologies and practices constrain their adoption?	3.5	7
Do you agree that the government is not investing sufficient resources in the development of CRA technologies and practices	4.00	2
Do you agree that the current level of incentives provided by the government is insufficient to drive the research and development agenda for CRA technologies and practices	4.25	1
Do you agree that the private sector is not investing sufficient resources in the development of CRA technologies and practices	3.75	5
Do you agree that the Research and Development Agencies are not investing sufficient resources in the development of CRA technologies and practices	4.00	2
Do think the government is willing to make temporary short-term trade-offs within the sector to realize medium- or longer-term benefits?	3.00	8
How would you characterize the level of preparedness of the sector to make trade-offs that may involve CRA pillars, for example between productivity-enhancing technologies and increased GHG emissions?	2.25	9

The most important of these factors are:

- The current level of incentives provided by the government is insufficient to drive the research and development agenda for CRA technologies and practices

- The upfront investment costs that a farmer must make to adopt CSA technologies are too high
- The input/operating costs (labour, fertilizers, chemicals, etc.,) related to the application of some CSA technologies and practices are too high
- The government, private sector, and research and development institutions are not investing sufficient resources in the development of CRA technologies and practices
- The riskiness of some Climate Resilient Agriculture (CRA) technologies and practices constraining their adoption.

The institutions also characterized the level of preparedness of the sector to make trade-offs that may involve CRA pillars (for example between productivity-enhancing technologies and increased GHG emissions) as very low.

#### *3.7.4 Analysis of Finding and Results of Barriers Hampering Technology Providers*

In Long et al., 2015, technology providers reported a range of barriers that inhibited their ability to sell and distribute their technological innovations, which result in reduced levels of adoption and diffusion. These are summarized below.

**Proving the value of the product/demonstrating impact:** Technology providers reported that they are hindered in the selling of their technological innovations due to difficulties in proving the value of their technological innovations. It was also reported that it is difficult to establish that the innovations work as claimed. Scientific or impact studies are often required to prove impact and highlight value, however, these were highlighted as often being complex and expensive. The main problem was convincing potential customers that it works since it is a new technology.

**Lack of knowledge of, and access to capital/investment:** Technology providers noted a lack of knowledge of, and access to capital and investment, meaning that expansion and other business objectives requiring financing were unable to be pursued. For instance, linked to the above-noted barriers, without access to this finance, impact studies could not be conducted to prove the claimed impact of technologies. In some instances, technology providers pursued novel finance raising strategies, yet these were also hindered by a lack of guarantees and other factors associated with start-up companies.

**Unsympathetic regulatory landscape:** Several technology providers highlighted issues with the policy and regulatory landscape, which acted as barriers to their ability to successfully diffuse their technological innovations. Included within this theme were factors such as inconsistent policies between different countries or regions, the lack of consistent carbon pricing (preventing the costing of GHG emission reductions) or having to compete against other products that qualified for or had obtained subsidies.

**Products too expensive/ROI periods overly long:** Technology providers highlighted that often they found that potential customers felt that their technologies were too expensive and/or had ROI periods that were too long.

**Access to and reaching customers:** Many of the technology provider's interviews highlighted difficulties in identifying and reaching potential customers. This included identifying specific

customer segments or where identified, finding successful avenues to contact and sell through. Clearly, reaching the customer is currently a major issue.

### *3.7.5 Analysis of Findings of Barriers Hampering Technology Users*

Demand side barriers were those that were identified through the responses of potential users of CSA technological innovations. These barriers impacted potential users and prevented or inhibited them from adopting CSA technological innovations. An evaluation of such barriers is presented below.

**Low awareness of CSA/inaccessible language:** CSA was reported to be a little-known phrase among potential users of CSA technological innovations. More widely, climate change and sustainability initiatives (including CSA) were associated with 'jargon', which non-experts found hard to understand and off-putting. Potential users highlighted difficulties in accepting the need for CSA technological innovations due to the lack of a focus on 'business impacts'; for example, how technological innovations would impact 'efficiency', or if they were 'cost-effective'. In addition, it was noted that many potential users at the farm level only spoke their mother tongue, which meant that technology providers from different countries may find it difficult to access and communicate with farm-level users outside their native countries.

**High costs and long Return on Investment (ROI) periods:** Simply, many potential users of CSA technological innovations noted that they were too expensive; this manifested itself in terms of high upfront costs and/or overly long ROI periods.

**Lack of verified impact of technologies:** In order to invest in technologies, potential users noted that they needed assurances over the impacts of technologies. These are often lacking with CSA technologies, which as new products, do not have a track record, and regularly lack supporting impact studies. Technologies should have a proven impact, so farmers are convinced to use it.

**Regulatory and policy issues:** Policy and regulatory barriers related to issues such as some countries placing greater emphasis on climate mitigation over adaption, or for example the lack of a clear carbon pricing and eligibility of CSA activities in compliance. Inconsistencies between national and agriculture sector level policies were also highlighted. Also, the implementation of unequal rules among the countries (policies and regulations), and more strict rules related to environmental protection make farmers less competitive, as consumers are not well informed on efforts made by companies who want to take care of the environment and climate adaptation.

**Hard to reach and train farmers:** Some potential users of the CSA technological innovations (and technology providers) are based several supply chains stages away from the farm, meaning that no direct commercial relationship exists. This makes it hard to reach and impact farmers upstream in the supply chain. This barrier reflected difficulties experienced by food industry actors, rather than farmers; this was often the case where actors downstream in agro-food chains were engaging with suppliers and encouraging uptake of technological innovations. In addition, some farmers were reluctant to change tried and tested traditional farming methods.

**Research and Development and policies do not match to 'on-the-ground' reality:** It was highlighted that policy and research is often made and conducted away from the farm, meaning



that it neglects many 'day-to-day' realities faced by farmers. In turn, this means that technologies that are developed or subsidies do not match the demands or needs of farmers.

**Low consumer demand:** Linked to the reported relatively high costs of CSA technological innovations, potential users noted that if they adopted the technological innovations, this would lead to price increases for the end products bought by consumers. The central hindrance noted by potential users was that consumers were unwilling to pay a price premium for CSA products. This lack of demand for products produced in line with CSA principles meant investment in, and the adoption of CSA technological innovations made little 'business' sense.

**Unequal distribution of costs/benefits across supply chains:** The unequal distribution of costs and benefits across agro-food supply chains was noted as reducing the motivation of farmers to adopt CSA technologies. Specifically, this is due to a mismatch where many of the economic benefits are located downstream, with consumer products companies or retailers, whilst many of the environmental/climate benefits are located on the farm.

In terms of identified barriers to technological innovation adoption and diffusion in the literature, costs and other financial factors were well represented in the results (Cullen et al., 2013; Faber and Hoppe, 2013; Luthra et al., 2014). In Long et al., 2015, cost barriers were noted and recognized by both technology providers and potential users. *As many of the technology providers included in the survey of Long et al., 2015 were attempting to sell young technologies still in development, these can be seen to be consistent with del Río Gonzalez (2005) and their assertion regarding 'early adopter costs' for potential users of the technological innovations.* Further, the lack of consumer demand identified by potential users is also highlighted in the wider literature, by Reinstaller (2008), and their assertion that consumers will not pay a premium for products with lower environmental impacts. Other barriers present within the wider technological innovation adoption literature that are confirmed through the study include the impacts of language and terminology (Faber and Hoppe, 2013) and policy and regulatory issues, such as problems with accessing subsidies that are available for competing technologies (Weiss and Bonvillian, 2013). *This highlights that some general barriers are also relevant to the specific case of CSA in the countries.*

The empirical literature on barriers to farmers' adaptation documented by Yameogo et al., 2017 indicated that the lack of credit facilities (Acquah, 2011; Maddison, 2007; Nhemachena and Hassan, 2007), lack of information on adaptation options (Acquah, 2011; Deressa, Hassan et al., 2008; Maddison, 2007; Nzeadibe et al., 2011), lack of access to water (Acquah, 2011; Maddison, 2007), labour shortages (Deressa et al., 2008; and Sofoluwe et al., 2011) and irregularities of extension services (Gbetibouo, 2009) constitute the major factors that challenge the adoption of practices. McCarthy et al. (2011) showed that up-front investment costs, opportunity and transaction costs across a wide range of investments and practices can be significant barriers to the adoption of CSA practices. Moreover, according to the authors, potential synergies between the three main pillars of CSA (food security, adaptation and mitigation opportunities), as well as costs, can differ substantially across different agro-ecological zones, climate regimes, and historical land use patterns. Neufeldt et al. (2011) proposed seven key points to overcome hindrances that impede the successful adoption of CSA practices by the poor; these are: provide an enabling legal and political environment; better access to the market; improve access to the decision-making process; improve access to knowledge and training; improve tenure rights; overcome the barriers of high opportunity costs to land; and improve access to capital. For

Barnard et al. (2015), factors that prevent the adoption of CSA practices can be classified under two broad categories: hardware barriers (including physical inputs such as land; human resources; equipment; infrastructure and finances) and non-physical or software barriers (institutional, cultural, policy and regulatory environment; information, knowledge and skills; technologies and innovations; and governance among others). According to Peterson (2014), the main barriers to CSA practices adoption were lack of sufficient financial capital, difficult access to or low availability of the necessary agricultural inputs (tools, seeds and fertilizers), and in some cases insufficient labour to carry out the practice. In his study, water scarcity was also identified as a major hurdle for practices such as micro-irrigation, dry season gardening and agroforestry (farmers reported that tree seedlings often died due to lack of water). Descheemaeker et al. (2016) argue that major institutional barriers (such as access to markets and relevant knowledge, land tenure, insecurity and the common property status) limit the adoption potential.

Thongoh et al., 2021, in an assessment of climate change impacts on livestock systems and corresponding value chains, revealed that the majority of actors lacked access to inputs and technologies on CSA (17%) and financial support services that would enhance adoption (16%). In addition, 15% of the actors expressed that return on investments informed decisions to adopt the CSA, while 14% felt that CSA technologies were costly.

Other barriers identified in Yameogo et al., 2017 study, included the high costs of inputs, lack of financial resources (capital, credit...), market problem, lack of government support, water scarcity, lack of knowledge about CSA practices, the risks associated with climate change/climate variability, and shortage of labour. It was found that the main constraints to the adoption of CSA practices were the high costs of inputs (improved seeds, fertilizers, pesticides), and limited access to physical and financial resources.

With regards to the high costs of inputs (improved seeds, fertilizers, pesticides) for farmers, it was pointed out that the main issues were the delays in the supply of subsidized/improved seeds, and their unavailability at the local level.

Other Authors argued that limited access to equipment and other inputs (inorganic fertilizers, pesticides, and herbicides) represent a significant constraint to the adoption of CSA practices such as Conservation Agriculture in a maximally productive manner (Barnard et al., 2015; Milder et al., 2011). Food insecure farmers, in the instinct for survival, would first seek to increase their food production by using affordable technology even if this latter is environmentally unfriendly. For example, a study conducted among food insecure and food secure farmers in Kenya (Thorlakson and Neufeldt, 2012) showed that poorer farmers were not investing in improved farm management practices because they were entirely focused on activities that contribute to their sources of household food supply. In this case, reducing the cost of improved seeds, fertilizers, and pesticides may create incentives to expand food production, and help to achieve food security.

To successfully adopt CSA practices, smallholder farmers often need financial resources and/or credit for acquiring agricultural inputs (land, equipment, labour, seeds and other farm inputs), and farmers may fail in their activities when any or all of these inputs are absent or available in limited quantities or volumes. Most farmers, in Yameogo et al., 2017 study, raised the problem of access to physical and financial resources (weak financing mechanisms, lack of access to credit or long and complex procedures link to credit access). Vulnerable farmers are especially risk-averse

due to household food security concerns (Milder et al., 2011), and some CSA technologies and practices are generally more profitable in the long-term compared to conventional farming (Barnard et al., 2015); therefore, assistance for the establishment of certain measures may be needed for small-scale subsistence farmers if costs are beyond their means and if quick benefits are not guaranteed (Liniger et al., 2011). Actions aiming at relaxing credit or other financial constraints (easing farmers' access to credit by reducing the conditions, local insurance-warrant systems, safety net programs...) would potentially hearten risk-averse farmers to try other suitable options. **Limited access to markets and capital are among the main constraints for smallholder farmers and limit their ability to innovate and raise their income (Neufeldt et al., 2011).**

The poor understanding of CSA concepts and the lack of information/knowledge on existing practices were identified by farmers as the main obstacles that impede the adoption of CSA practices Yameogo et al., 2017). **Access to information/knowledge plays a major role in CSA adoption.** As stated by AGRA (2014), "CSA is clearly knowledge-intensive and for it to be effectively implemented, well designed, inclusive, and innovative knowledge management systems are essential". As cited by farmers in the Yameogo et al., 2017 study inadequate knowledge of CSA concepts, lack of contact with extension services, limited technical assistance constitute limiting factors to the adoption of CSA practices. In a case study done in Western Kenya, Neufeldt et al. (2011), revealed that improved access to knowledge and training significantly improved farmers' willingness to plant more trees. For Thorlakson (2012), educational farm visits to successful management practices can increase adoption rates.

Previous literature also points towards the credibility and authority of advisors and consultants as impacting adoption and diffusion levels (Guerin, 2001; Johnson, 2010). This could be seen to be consistent with issues related to overly complex language and 'jargon'. It was noted these were often used by experts in relation to CSA and more widely sustainability (Long et al., 2015). **Indeed, this has previously been noted specifically within agricultural contexts (Eidt et al., 2012), and relates to the lack of appreciation, in policy and research, of day-to-day farm realities, identified in the literature (Eidt et al., 2012; Long et al., 2015).**

A lack of skills highlighted by del Río Gonzalez (2005) and Montalvo (2008) was not identified explicitly by Long et al., 2015. However, as a lack of awareness of CSA and associated technological innovations was identified (Long et al., 2015), a lack of skills may not yet have been recognized, due to the immature nature of the CSA technological innovation market. However, potential users' further downstream agro-food supply chains, such as retailers, have noted that it was difficult to reach and train farmers (Long et al., 2015). The impact of mismatched costs and benefits across supply chains, resulting in farmers receiving few economic benefits, can be related to Cullen et al. (2013). They found that adoption decisions by farmers are shaped by narrow economic benefits, excluding possible social or environmental benefits.

### **3.8 Market Barriers**

Markets and marketing in the Caribbean are constrained by several factors including:

- Low marketable surplus of Agricultural goods
- Producer does not determine the price and is basically a price taker

- Limited storage for agricultural products which are mainly seasonal in production and perishable
- Problems in Transportation
- Long chain of middlemen
- Malpractices in the marketplace to include activities such as:
  - Use of false weights and measurements
  - Adulteration
  - Black-marketing and hoarding and so on.
- Lack of Market Information
- Inelastic demand
- Limited grades, quality standards, product traceability
- The bulky nature of agricultural goods necessitates packing.

The study sought to verify the existence of some of the constraints using a survey questionnaire the results of which are presented in **Table 17**.

Table 17: Weighted Mean Scores of Researched Market Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems

Market Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems	Mean Score 5 = Max	Rank
How would you rate farmers' access to the markets for CRA technologies?	2.50	5
How would you rate farmers' access to the markets for inputs for the adoption of CRA technologies and practices?	2.25	7
How would you characterize the adequacy of financial support services available for the adoption of CRA technologies and practices?	3.00	3
How would you rate farmers' access to markets for their products?	2.75	4
Are marketing channels readily available?	3.25	1
Are marketing channels dominated by middlemen and traders?	2.50	5
Are farmgate prices much lower than market prices?	3.25	1
Are farmers utilizing risk transfer financial products/practices such as insurance/emergency funds?	1.50	9
Are there adequate storage facilities beyond the farm gate for produce?	2.25	7

The findings obtained from the study suggested that there are critical market barriers to the adoption of CRA technologies and practices. The weighted mean scores for the availability of marketing channels for farmers, farmgate prices obtained by producers are much lower than market prices, and the adequacy of financial support services available for the adoption of CRA technologies and practices may be classified as fair to moderate. However, the scores were low for other factors. These factors include:

- Farmers access to markets for their product
- Farmers access to the markets for CRA technologies
- Domination of the marketing channels by middlemen and traders
- Farmers access to the markets for inputs for the adoption of CRA technologies and practices
- Adequacy of storage facilities beyond the farm gate for produce
- Farmers not utilizing risk transfer financial products/practices such as insurance/emergency funds

It should be noted that while the adequacy of financial support services available for the adoption of CRA technologies and practices achieved a very high weighted mean score, the real issue for producers is not adequacy but access to financial resources.

In Yameogo et al., 2017 study, approximately 39% of surveyed farmers indicated local market failure (inconsistent distribution system, corruption in the distribution chain, presence of many intermediaries in the market, prices fixed by buyers...) as one of the main barriers preventing them for adopting CSA practices. To this, add a disorganized marketing system (farmers are not well organized in the market), poor roads and infrastructures, shortages of outlets for crop/ livestock production, and an absence of post-harvest treatment and storage infrastructure for off-season products conservation.

In Thongoh et al., 2021 study, the main marketing channel indicated by producers is the live animal markets (primary and secondary markets which are dominated by middlemen and traders). Nearly three-quarters of pastoralists did not have prior access to market information (Otieno et al., 2012). Consumers believed that information asymmetry allows middlemen to take advantage of farmers, giving them lower prices for their animals, yet meat in Kenya is a high-price food which economic benefit does not trickle back to farmers, hence affecting their incomes and ability to invest in modern technologies and sustainable practices that would need financial resources. **For abattoirs/slaughterhouses, they indicated that the key inputs into their processes are water, labour and electricity, these three form the highest overheads, eroding their already thin margins and hindering their ability to invest in sustainable practices or modernize the slaughterhouses.**

### 3.9 Physical Infrastructure Barriers

Agriculture depends heavily on infrastructure and physical capital such as roads, equipment, and buildings; all of which can be impacted by extreme events. The potential economic loss triggered by such climate events may represent a serious threat to the agricultural sector. This is especially so given the high value of fixed assets compared to the average annual output and farm income. Therefore, it is necessary to develop preventative actions and instruments to cope with potential damage to agricultural infrastructure. Importantly, these actions must be tailored to regional characteristics if they are to be successful (EU Commission, 2009). An effective way to increase the resilience of agricultural infrastructure is to mainstream climate change adaptation techniques into policy, planning and budgeting.

In this chapter, two main but related issues were analysed: the cost of the infrastructure as a barrier and producers' access to those physical infrastructures. The results from the analyses are presented in **Table 18** below.

Table 18: Weighted Mean Scores of Physical Infrastructure

Physical Infrastructure Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems	Mean Score 5 = Max	Rank
Do you have adequate access to the required physical infrastructure (transport, roads, facilities, and some form of assets) to adopt CRA TIMPs?	2.24	3
Do you think the cost is a major issue in having access to adequate levels of physical infrastructure (transport, roads, facilities, and some form of assets) for the adoption of CRA TIMPs?	4.25	1

Do you have adequate access to power/source of energy for the adoption of CRA TIMPs?	2.00	4
Do you think energy costs are too high for the adoption of CRA TIMPs?	4.25	1

The results obtained from the analysis suggested that the cost of the physical infrastructure was a major factor limiting the farmer's availability as well as farmer's access. A similar situation existed with energy where its high cost was a barrier to the use of energy in the agriculture sector.

Farmers have identified the lack of government support as a factor that impedes or slows down the adoption of CSA practices (Yameogo et al., 2017). As noted by Barnard et al. (2015), physical (water management structures, transport, markets...) and social infrastructures (farmers' organizations and cooperative societies) play central roles in any economic activity. Poor and inadequate infrastructure limits the adoption of technologies, particularly for smallholder farmers. Investments in physical infrastructures (roads, water retention, irrigation ...) are often beyond the capacity of local communities and small-scale farmers and require heavy investments; these investments may only be undertaken by the government, NGOs and donors.

The physical infrastructure for red meat value chains mainly consists of roads, availability of power, and connection to power lines, water and sewer lines, especially for abattoirs, built areas/physical market for live animals, processing structures and equipment, i.e., slaughterhouses and abattoirs, trucks and infrastructure for transportation of the animals to the live animal markets and slaughterhouses, transportation of slaughtered carcasses and meat by distributors and retailers. In the assessment of the barriers associated with physical infrastructure, Thongoh et al., 2021, reported that 50% of the actors expressed a lack of physical infrastructures e.g., good roads, those do not flood or get washed away during the rainy season, as a hindrance towards adoption of sustainable practices such as CSA while the other 50% cited lack of power or energy sources or where present, the power was too costly.

### 3.10 Policy Incentives, Cultural Perspectives and Social Barriers

**Table 19** presents the results of the barriers analyses conducted on policy incentives, cultural perspectives and social barriers. The research and development institutions concurred that government support in terms of incentives and subsidies in place for CRA adoption was grossly inadequate, especially in the areas of incentives, subsidies, governance systems and programmes.

Table 19: Weighted Mean Scores of Physical Infrastructure Incentives, Cultural Perspectives and Social Barriers

Policy Incentives, Cultural Perspectives and Social Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems	Mean Score 5 = Max	Rank
<b>Policy Incentives</b>		
How would you rate the adequacy of government support in terms of incentives and subsidies in place for CRA adoption	2.25	
<b>Cultural Perspectives and Social Barriers</b>		
Do you think CRA technological innovation and management practices (TIMPs) are the preserve of the commercial, large farms and businesses?	2.25	3

Do you think cultural tradition customs, norms and religious beliefs discouraged the adoption of CRA TIMPs?	2.50	2
Do you think CRA technologies and practices are good for agriculture?	4.75	1

With regards to cultural perceptions and social barriers, the results of the study indicated that:

- CRA technological innovation and management practices (TIMPs) are not the preserve of commercial, large farms and businesses, with a low WMS of 2.25 out of a maximum of 5
- Cultural tradition customs, norms and religious beliefs to some extent discouraged the adoption of CRA TIMPs, with a WMS of 2.5 out of a maximum of 5
- CRA technologies and practices are good for agriculture, with a very high WMS of 4.75 out of a maximum of 5.

The results may be indicating that traditional customs, norms and lack of trust with respect to new technologies and practices are barriers to the adoption of CSA, as adoption can only result from social norms and behaviour that promotes environmental sustainability (UNEP, 2010).

## 4. Climate Finance in The Caribbean

### 4.1 Overview

Caribbean countries face considerable threats from climate change-related extreme events, and considerable costs to cope with and adapt to climate impacts. At the same time, governments need to continue making crucial investments in development, which also help build resilience to climate change and disaster risks – and they need to shift their economies onto low-carbon pathways.<sup>19</sup> There is a general consensus that the combined costs of climate change mitigation and adaptation endeavours far exceed the countries' own capacity; thus, international financial support plays – and will continue to play – a critical role in supplementing governments' and citizens' own expenditures.

It is, therefore, important that Caribbean countries and support organizations working on climate change-related issues in the countries have a fair understanding of:

- The climate finance landscape in general and for CRA in particular
- The flows of international financial resources for climate change mitigation and adaptation measures in the countries and for agriculture in particular
- The allocation of budgetary resources by Caribbean countries for climate change measures in general and for the agricultural sector in particular
- The climate finance barriers faced by Caribbean countries and options for scaling up climate finance

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<sup>19</sup>Atteridge, A. et al. 2017. Climate finance in the Caribbean region's Small Island Developing States.

For Caribbean countries, such an understanding could provide the foundation upon which to make strategic decisions about how to mobilize climate finance for the countries of the region, how such finance should be allocated, and how its impacts should be evaluated. It could also provide the basis for dialogue with bilateral development partners and multilateral climate funds.

## **4.2    *The Climate Finance Landscape***

### *4.2.1 Overview*

The climate finance landscape is quite diverse. While private investments provide the main source of climate finance, public resources remain the key drivers of the climate finance system and domestic investments.<sup>20</sup> This section of the report provides an identification of agriculture and climate finance resources that may be used for new, innovative or mainstreamed CRA investment.

### *4.2.2 Global Climate Finance Architecture*

An architecture of the global financing for climate change activities is provided by Nakhooda et al., 2015, which is presented in the **Figure 28** below. As can be gleaned from the figure below the main categories of financing sources with relevance to CRA are:

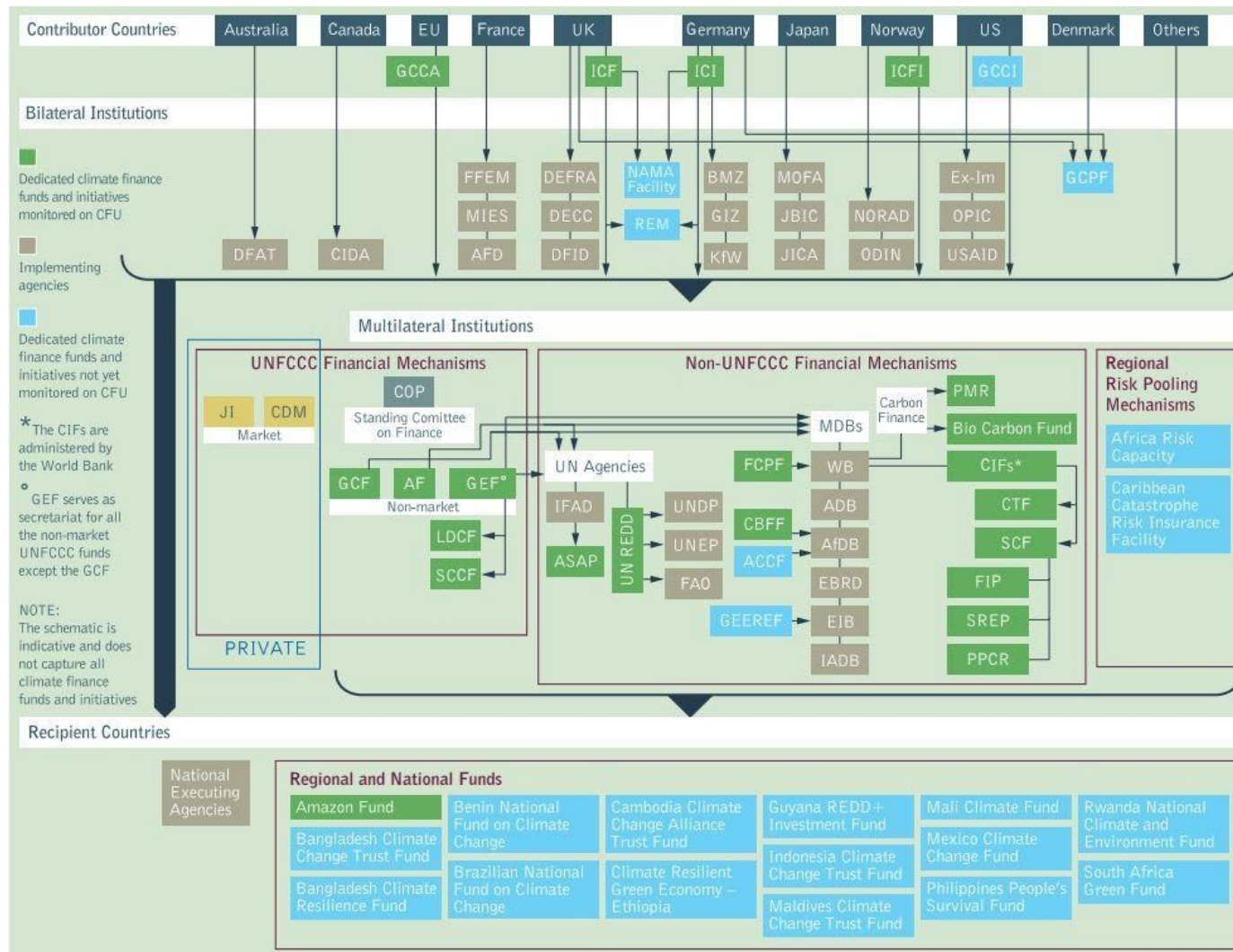
- Financial mechanism of the UNFCCC
- Multilateral funding
- Bilateral funding
- Market based funding
- National and regional climate funds

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<sup>20</sup> <http://csa.guide/csa/systems-approaches>



Figure 28: Architecture of the global financing for climate change activities



#### 4.2.3 *Financial Mechanism of the UNFCCC*

The UNFCCC's mechanism provides funding to developing country parties in order to implement the Convention. It is comprised of different operating entities and funds, which provide such funding to include:

- The Global Environment Facility (GEF)
- Green Climate Fund (GCF)
- Least Developed Countries Fund (LDCF)
- Special Climate Change Fund (SCCF)
- Adaptation Fund

**GEF** is partly entrusted with the operation of the financial mechanism. For its sixth programming period from 2014 to 2018, the GEF-6 promoted approaches that reduce nitrous oxide (NO<sub>2</sub>) and methane (CH<sub>4</sub>) emissions from crop and livestock production. In addition, it promoted measures to increase carbon storage in farmlands, and thus supported activities of the Land Degradation Focal Area. The GEF Climate Mitigation Focal Area supports the development and implementation of models that increase food productivity without undermining the mitigation efforts. Such models ensured the triple win of food security, climate change mitigation, and resilience of agricultural systems.<sup>21</sup>

The GEF also administers the LDCF and the SCCF under the guidance of the UNFCCC Conference of Parties (COP). The GEF is also part of the Adaptation Fund.

The **Green Climate Fund** is an operating entity of the UNFCCC's financial mechanism that dispersed funds to cover adaptation and mitigation in all sectors, using both public and private resources (FAO, 2013). GCF is expected to be a major source of financing for CSA going forward.

The **Least Developed Countries Fund (LDCF)** and the **Special Climate Change Fund (SCCF)** are special funds managed by the GEF, to support climate change adaptation initiatives. The LDCF mandate is to finance the formulation and implementation of least developed countries' National Adaptation Programmes for Action (NAPA). Countries in other stages of development have to rely on SCCF to fund climate change adaptation activities. In both cases, agriculture is one of the main recipients of funding from the sources for the adaptation aspects of CSA activities (FAO, 2013).

The **Adaptation Fund (AP)** was established in 2001 to finance concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change. The AF receives most of its funding from the CDM and is built on a principle of direct access, to resources for national Implementation entities.<sup>22</sup>

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<sup>21</sup> <https://www.thegef.org/topics/climate-change-mitigation>.

<sup>22</sup> <http://unfccc.int/cooperation-and-support/financial-mechanism/adaptation-fund/item>

#### *4.2.4 Multi-lateral Funding*

Multilateral funding for CRA outside of the UNFCCC financial mechanism includes the International Fund for Agricultural Development (IFAD), Adaptation for small Holder Agriculture Programme (ASAP) as well as UN-REDD which brings together UNDP, UNEP and FAO to support REDD+ activities. Other important multilateral institutions and funds include the development banks such as the African, Asian and Inter-American Development Banks. The World Bank also administers a range of funds such as the Forest Carbon Partnership Facility, the Partnership for Market Readiness and the Bio Carbon Fund (Nakhooda et al., 2015).

#### *4.2.5 Bilateral Funding*

Bilateral funding is another important financing source for CRA and provides funding on a country-by-country basis based on bilateral agreements, either directly or through institutions. For example, the German Development bank -International Climate Initiative (KfW) provides support in areas related to CRA such as agriculture, climate resilience, natural resource management, sustainable land management and water efficiency (FAO, 2013).

#### *4.2.6 Market-Based Funding*

Market-based funding is available through a range of voluntary and compliance schemes. The Clean Development Mechanism (CDM) allows emission reduction projects in developing countries to earn certified emission reduction (CER) credits (each equivalent to one ton of CO<sub>2</sub>). These CERs can be traded and sold and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. Besides the payments, the recipient countries benefit from advanced technology transfer.<sup>23</sup>

The voluntary carbon market is attractive to smaller projects that find the UN or EU certification process too complicated and expensive. While interest in agricultural GHG emission reductions has been increasing in voluntary carbon markets, their share of actual activities in any carbon market remains small. There are some promising niche markets for agricultural carbon credits, such as methane avoidance from manure management, fertilizer use efficiency and agro-forestry.<sup>24</sup>

#### *4.2.7 National and Regional Climate Funds*

National Climate Funds (NCFs) and Regional Climate Funds are mechanisms that support countries to manage their engagement with climate finance by facilitating the collection, blending, coordination of, and accounting for climate finance. There are numerous NCFs and RCFs support activities that directly contribute to agriculture and have become an important source of financing for CRA (UNDP, 2011).

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<sup>23</sup> <http://cdm.unfccc.int/about/index.html>

<sup>24</sup> <http://climatecorp.eu-co2-market/facts-figures/>

## 4.2 Flows of International Financial Resources for Climate Change Measures

### 4.3.1 Overview

This section of the Report relied heavily on the work of Atteridge, A. et al. (2017)<sup>25</sup>, who analysed climate finance flows to Caribbean SIDS, using data from the Organization for Economic Co-operation and Development (OECD) Development Assistance Committee's Creditor Reporting System (CRS). Their findings showed that a total of US\$ 1477 million in climate finance – flows labelled as principally targeting climate change – was committed to Caribbean SIDS in 2010–2015, out of about 6% of total reported aid flows to the region. Only 15 of the 29 Caribbean countries covered by the analysis directly received climate finance, although others may have received funds as part of a regional allocation. In summary the report revealed that about 62% of the finance was provided as grants, with the other 38% being loans. Around 48% of the climate finance was for mitigation activities, 32% for adaptation, and 20% for both together.

It also revealed that most of the finance, 85%, came from bilateral sources, and about 77% was delivered as project-based support. The sector that received the largest share of climate finance was “general environment protection”. Finally, the analysis of Atteridge, A. et al. (2017) showed that disbursements of climate finance in 2010–2015 represent only 39% of total commitments in the same period. Overall, the data revealed some important patterns in the way climate finance is being allocated and used in the Caribbean and provided a basis for a deeper assessment of how climate finance is working for the region's small island states. These finds are presented in more details below.

### 4.3.2 Climate Finance to the Caribbean, 2010 – 2015

According to Atteridge, A. et al. (2017), for the 15 countries that received development finance flows in the period 2010–2015, the total volume of financial commitments is about US\$ 24.8 billion: US\$ 17.4 billion in ODA and US\$ 7.4 billion in other flows. Of this, US\$ 1.48 billion (around 6% of the total, all ODA) was reported as principally targeting climate change. This amount is what was referred to in their report as “climate finance”. The Distribution of climate finance by Caribbean country is presented in **Table 20 below**, with a distinction made between CARICOM and Non-CARICOM Countries.

Another US\$ 699 million of finance was reported as “significantly” related to climate change, which means the activities do not mainly target climate change, but they were likely to have climate-related co-benefits

Table 20: Distribution of Climate Finance Committed to Caribbean Countries – US\$ Million (2010-2015)

Country	Climate Finance Commitments (US Million)- 2010-2015			
	CARICOM	Non-CARICOM	West Indies, Regional	Total
Antigua and Barbuda	15.77			15.77
Barbados	0.02			0.02
Belize	19.47			19.47

<sup>25</sup>Climate finance in the Caribbean region's Small Island Developing States, 2017.

Cuba		65.15		65.15
Dominica	31.87			31.87
Dominican Republic		498.69		498.69
Grenada	1.57			1.57
Guyana	391.03			391.03
Haiti	162.44			162.44
Jamaica	62.50			62.50
Saint Kitts & Nevis	0.10			0.10
Saint Lucia	36.71			36.71
Saint Vincent & the Grenadines	15.20			15.20
Suriname	28.66			28.66
Trinidad and Tobago	0.10			0.10
West Indies, Regional			148.17	148.17
Total	765.44	563.84	148.17	1,477.45

**Source:** Atteridge, A. et al. 2017. *Climate finance in the Caribbean region's Small Island Developing States*

Just under two-thirds of these flows (62%) were grants, with the remaining 38% being loans, primarily from France to the Dominican Republic along with Dominica and Suriname, and from the World Bank's Climate Investment Funds to Dominica, Haiti, Jamaica and Saint Lucia.

Atteridge, A. et al. (2017) estimated that around 48% of the climate finance was for mitigation activities, 32% for adaptation, and 20% was targeted for both objectives simultaneously. Although the proportion varied between countries, most countries were allocated more for adaptation than mitigation. Only Cuba, the Dominican Republic, Grenada and Guyana had a greater share of funding for mitigation.

The climate finance picture for Caribbean SIDS during the 2010-2015 period was heavily distorted by two funding relationships in particular. Norway had allocated US\$ 351 million in grants to Guyana, almost all of which was for forest protection (though it has been classified in the CRS as "general environment protection"), and France provided several loans to the Dominican Republic totalling US\$ 420 million. These two relationships alone make up 52% of the total climate finance committed to the region's SIDS.<sup>26</sup>

Of the total amount of US\$ 1477 million, 85% came from bilateral sources. After the French and Norwegian contributions noted above, the next largest sources were the World Bank's Climate Investment Funds (CIFs), the European Union, Canada, the Global Environment Facility, and Japan. The CIFs' allocations were mainly through the Pilot Program for Climate Resilience (PPCR, US\$ 112 million) for projects in Dominica, Haiti, Jamaica, St. Lucia, St. Vincent and Grenadines, and regional activities, and also included funding to Haiti by the Clean Technology Fund (US\$ 16 million, including US\$ 14.5 million in official development assistance loans).<sup>27</sup>

According to Atteridge, A. et al. (2017), three-quarters of the total funding (77%) were delivered as project-based support. Most of the rest (20%) consisted of allocations to special-purpose

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<sup>26</sup>Atteridge, A. et al. (2017).

<sup>27</sup> Ibid

programs and funds. Only a tiny fraction, around 1%, was provided via sector budget support. Finance sourced from the multilateral climate funds were all delivered through projects.

The sector that has received the largest share of climate finance was “general environment protection”, which included primarily activities targeting “environmental policy and administrative management”.<sup>28</sup> The second-largest sector allocation was to transport. However, this consisted mainly of allocations to just two countries, the Dominican Republic and Haiti.

Support for both the disaster and energy sectors was spread across different countries, suggesting both were a common target across the region. Energy activities targeted a mix of renewable technologies, including solar, hydroelectric, geothermal, biofuels and wind. The level of finance for the energy sector appeared relatively small when one considers that many small islands depend on imported fossil fuels and the priority many countries have given to the energy sector in their climate plans and NDCs.<sup>29</sup>

Some sectors critically important long-term resilience-building sectors, such as health and education, did not during the 2010-2015 evaluation period receive any funding for climate finance.<sup>30</sup> This did not mean there was no other financial support for these sectors since only finance that had climate change as its principal objective was examined.<sup>31</sup> The agriculture sector received very little climate finance. Climate-proofing of agriculture is also likely to be a critical priority in the future. The narrow range of sectors represented in the climate finance data in the countries suggested that the countries may be finding it difficult to align the available climate funding with a wide range of other complementary development priorities. If so, this could be a missed opportunity and also leave some gaps in implementing country adaptation strategies.

The linking of the available climate funding to priority resilient-building sectors is likely to require a rethinking of what “adaptation” means. At a country level, more sectors should be targeted to increase communities’ capacities to cope with and adapt to climate change. However, limiting them to international climate funding will probably require some fundamental changes in the approach of major international climate funds; some funds have adopted a relatively narrow interpretation of how climate finance might be spent, which limits the choices and priorities that countries can bring forward.<sup>32</sup>

**Annex 6** presents some details of the climate finance committed to the Caribbean countries selected for this project based on information contained in Atteridge, A. et al. (2017) report.

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<sup>28</sup> This was mainly support from Norway to Guyana for forest protection activities

<sup>29</sup> Atteridge, A. et al. (2017).

<sup>30</sup> Ibid

<sup>31</sup> Ibid

<sup>32</sup> Ibid

## 4.4 Findings on Public Sector Capital Budget Analysis, 2017 -2021

### 4.4.1 Overview

This section of the report provides an analysis of public sector support for climate funding for agriculture in the selected countries, including support from national budgets, and multilateral and bilateral institutions/agencies. More specifically, this section presents the findings with respect to:

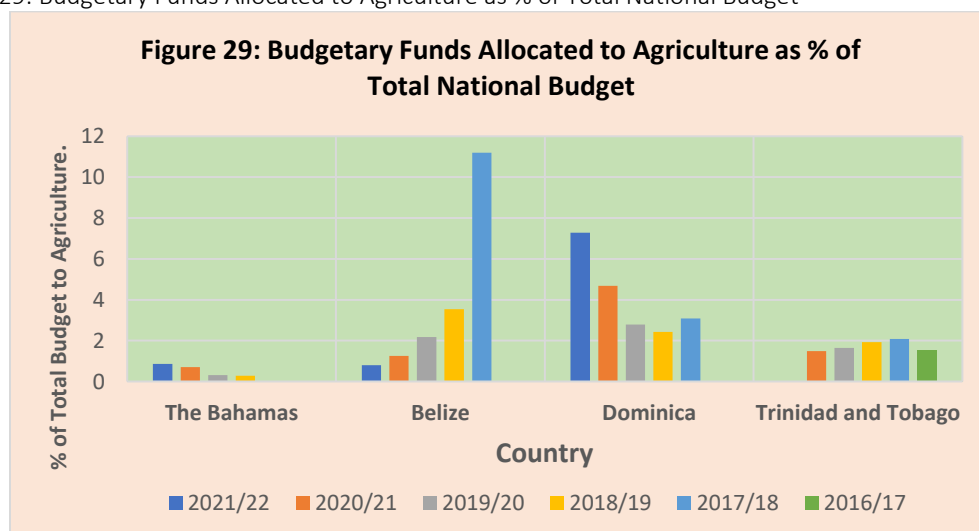
- Agriculture finance in the national budgets
- Climate finance in national budgets
- CSA finance in national budgets

The details of these findings are presented in the **Annex 6**.

### 4.4.2 Agriculture Finance in the National Budgets

**Figure 29** below presents the findings of the analysis of the level of capital funding for the agricultural sector in the overall national budgets based on the countries' annual allocations by financial year. The figure clearly demonstrates low levels of financing for the agricultural sector in the four countries evaluated, when funds allocated to the sector are expressed as a percent of total annual budgets. The low budgetary allocation to agriculture may be a reflection of the priority accorded the sector, especially in the context of the limited fiscal space of each country. Notwithstanding there is a need for the countries to match their political commitments to the sector with a commensurate level of support needed for its development. It should be noted that the level of expenditures for agriculture increased significantly in Dominica over the last four years; presumably in response to Hurricane Maria which impacted the country in 2017.

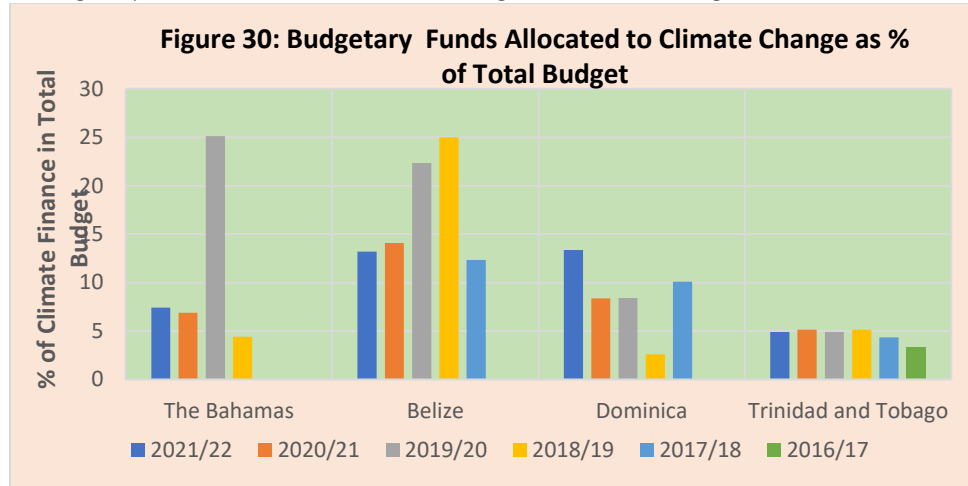
Figure 29: Budgetary Funds Allocated to Agriculture as % of Total National Budget



#### 4.4.3 Climate Finance in the National Budgets

**Figure 30** provides an indication of the level of climate financing in national budgets. It is obvious from the figure that the budgetary allocations to climate change are much higher than those budgeted for agriculture. In addition, the budgetary allocations seem haphazard, which might be suggesting that the allocations are programmed to address damages caused by climate change-related events to economic assets and infrastructure. This might be obvious with respect to the Bahamas (Hurricane Dorian) and Dominica (Hurricane Maria).

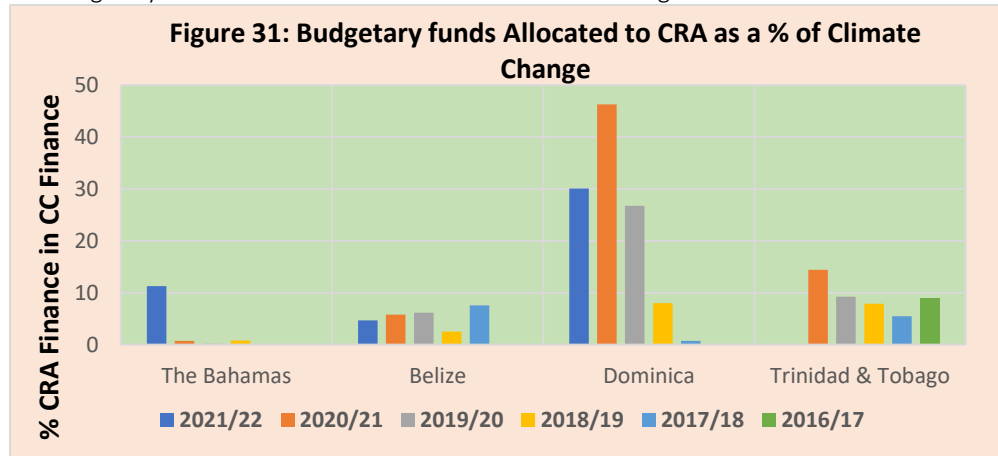
Figure 30: Budgetary Funds Allocated to Climate Change as % of Total Budget



#### 4.4.4 Climate Resilient Agriculture Finance in the Climate Change Budgets

The study also examined the quantity of CRA financing in the Climate Change budgets (**Figure 31**). The results show that it varies significantly across countries, and to a large extent may be reflecting the vulnerabilities of the sectors in those countries. There are also within-country variations, which may be reflecting the importance of the sector to national economic development and/or the need for the prioritization of climate change resources across sectors as a result of the limited fiscal space of the governments.

Figure 31: Budgetary funds Allocated to CRA as a % of Climate Change

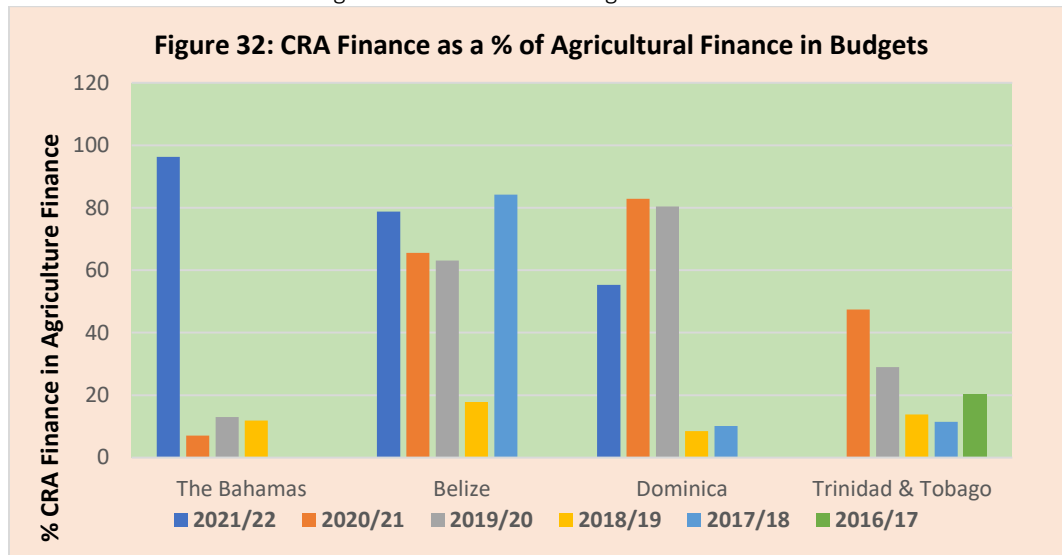




#### 4.4.5 Climate Resilient Agriculture Finance in the Agriculture Finance

**Figure 32** presents CRA funding as a percentage of total agriculture allocations in the budgets. The results clearly show that CRA finance is a major component of agriculture budgets in most countries. Notwithstanding, the level of inconsistency of the CRA funding may be reflecting the response of the sector to the rehabilitation/reconstruction of destroyed/damaged assets and not to a structured programme of building resilience in agriculture.

Figure 32: CRA Finance as a % of Agricultural Finance in Budgets



### 4.5 Climate Finance Barriers Analysis

#### 4.5.1 Overview

This section of the study is **based heavily on the report of Gledhill et al., 2012**, which explored the opportunities and challenges of scaling up investment in CSA with specific reference to Sub-Saharan Africa. It examined the barriers to scaling up climate finance for CSA, the sources and availability of finance across public and private sectors, and relevant case studies that demonstrate how public and private finance can be used effectively to overcome these barriers and deliver finance to CSA at scale. The different sources of public and private finance considered in this report include:

- bilateral and multilateral official development assistance (ODA) for agriculture and wider donor 'climate finance' for climate change and agriculture (public sector)
- debt and equity instruments, insurance and certification in the private sector
- compliance and voluntary carbon markets.

There are also opportunities to combine these sources of finance in order to overcome some of the barriers to scaling up finance for CSA (Eco-agriculture Policy Focus 2011). However, a number of barriers as outlined in this section will need to be addressed.

The key messages from the report are:

- The **finance gap** between what is needed for food security and what is available is already significant. If climate change is also factored in, the gap is even larger.
- The **amount of finance currently channelled to CSA is highly uncertain**. There is limited data on the amount of funding available and disbursed or invested in climate change projects in agriculture globally, in both the public and private sectors.
- **Dedicated CSA funds are a fraction of overall funding** for climate action and agriculture. The majority of specific CSA funding is designated as climate finance, but these funds are relatively small compared with total climate finance and very small compared with total ODA for agriculture and rural development.
- **Private finance for agriculture generally does not consider climate change**. Large amounts of capital for agriculture can be generated in domestic and international markets. This finance is not typically 'climate-smart'; however, some are focused on adaptation as this can be critical to productivity.
- **Private finance** for agriculture, particularly at the smallholder or primary production level, is constrained by the high risk-return profile associated with it. Unlocking the scale of finance inherent in the private sector for CSA requires the presence or development of an appropriate investment and business case for financiers and lenders. Often, this may mean collaboration with the public sector players that can absorb or 'buy out' some of the risks, to make the risk-return profile more attractive for financiers and investors.
- **Finance for CSA could best be scaled up** by:
  - **Mainstreaming climate change into all public and private finance for agriculture**. The greatest impact from climate finance could be generated by using it to cover the additional cost of 'climate-smarting' agricultural activities which are already supported by ODA or private finance (e.g., technical assistance on specific CSA practices for smallholders).
  - **Ensuring that CSA is eligible for climate finance** for mitigation, adaptation and REDD+. Climate finance is a fast-growing source of finance that could be used to support CSA. Ensuring that CSA activities are eligible to receive some of this funding will be an important part of scaling up finance in this area.
  - **Considering a specific funding window for CSA under the Green Climate Fund (GCF)** that recognizes the cross-cutting benefits of CSA activities. In addition to ensuring that CSA activities are eligible to receive funding under both the adaptation and mitigation (including REDD+) funding windows of the GCF, there is also scope for the GCF Board to consider the need for additional funding windows. As CSA activities are cross-cutting in their contribution to adaptation and mitigation a specific window for CSA should be considered. It will be important that CSA is also eligible for funding under the GCF private sector facility.
  - **Integrating public and private finance** to deliver successful CSA activities and scale up delivery of finance. Integrating public and private finance will be key to delivering and further scaling up the total volume of finance. While the private sector has the ability to generate the scale of finance required for CSA, its risk appetite for investing in agriculture is low. To overcome these constraints and effectively create an environment for the adoption of CSA practices, innovative partnership models that combine public and private sources of finance could be effective in delivering results and scaling up finance for CSA.

#### 4.5.2 Barriers to Scaling up Public (Donor) Finance

This section of the study examined the main factors limiting the scaling up of public finance for agricultural development in the Caribbean region. The results of this analysis are presented in **Table 21**, with nine key barrier factors (9) factors weighted and ranked.

Table 21: Analysis of Public Financial Barriers

Public Financial Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems	Weighted Mean Score (WMS)	Rank
How would you rate the level of integration between climate finance and agriculture finance?	2.25	9
Is there a separation of adaptation and mitigation funding reducing the ability to maximize co-benefits?	3.25	3
Is there competing budgets and priorities within both Climate Change and development budgets?	4.00	1
How would you rate the level of mainstreaming of Climate Change Projects/Activities into National budgets	2.75	5
How would you rate the level of mainstreaming of Climate Change Projects/Activities into Agriculture Sector budgets	2.75	5
How would you rate the political profile of CRA's elevation at the national level?	2.75	5
How would you rate the political profile of CRA's elevation at the international level?	2.75	5
Is there adequate clarity as to the meaning of CSA to generate traction and donor support?	3.25	3
Do you think there are 'investment ready' projects that are scalable and can demonstrate results in multiple areas?	3.75	2

The results obtained from the analysis of the key issues of public financial barriers (**Table 21**) revealed serious challenges to the financing of CRA/CSA technologies and practices through donor support and from the public budgets. This is reflected in the unfavourable outcomes for most issues addressed in this area of the study as reflected by the weighted mean scores. These variables include:

- The high level of competing budgets and priorities within both Climate Change and development budgets
- The low rating of the political profile of CRA's elevation at the national and international levels
- The low levels of mainstreaming of Climate Change Projects/Activities in the agriculture sector and national budgets
- The low rating for the level of integration between climate finance and agriculture finance.

Gledhill et al., 2012 identified several reasons for the outcomes obtained in this study which are presented below.

**Lack of integration between climate finance and agriculture finance.** One of the biggest challenges to scaling up finance for CSA is that current funding systems and policies for agriculture development, food security, and climate change mitigation and adaptation are insufficiently integrated (Schmidhuber et al 2009). While some donors are improving the coordination between

these different areas, this is an area for improvement and greater internal capacity building. Developing appropriate frameworks that better combine the two at the appropriate institutional levels (e.g., country level if this is where programming occurs with support from headquarters) can maximize the leverage potential of climate finance **by better integrating it with larger agriculture and rural development programmes.**

**Separation of adaptation and mitigation funding.** CSA practices can provide both adaptation and mitigation benefits. However, climate finance for adaptation and mitigation has so far been treated separately within the United Nations Framework Convention on Climate Change (UNFCCC) framework. A similar pattern applies at the donor level and multi-lateral climate fund level, where programming efforts for adaptation and mitigation are often separated in organizations and/or specific funds, reducing the ability to maximize co-benefits (Schmidhuber et al 2009). This reduces the scope for CSA projects to receive climate finance when their objectives and benefits are holistic and span both adaptation and mitigation.

**Competing budgets and priorities within both climate change and development budgets.** The inclusion of agriculture in international climate change negotiations is a new development<sup>33</sup> and it has received a relatively small amount of climate finance to date. It competes with a range of other sectors for climate finance and ODA (including in the land-use area, REDD+) and because many of the benefits of CSA are related to adaptation, they are inherently difficult to measure. For CSA to increase its access to both these sources of finance, results from CSA activities need to be measured and communicated in a way that demonstrates the effectiveness of public finance to achieve a range of objectives. An elevated political profile of CSA at the international level would help to increase the political imperative to fund CSA. Recent steps forward in this direction were the high-level 'Climate Smart Agriculture – Africa: A Call to Action' event at COP17 in Durban, and the formation of the CSA Partnership.<sup>34</sup>

**The emergence of the issue and a lack of clarity on what it means on the ground.** CSA is a recent term, which seeks to combine agriculture and climate change issues in a variety of ways. The combination of a range of disciplines and the lack of clarity of what 'climate-smart agriculture' means for programming, national policy and multilateral agency portfolios, has meant that generating traction and donor support for this issue has been difficult. In donor agencies where climate change is being mainstreamed, there are significant challenges in reconciling the short timeframe of programmes (3-5 years) and the need to demonstrate results within that timeframe, with the longer timescale over which climate change impacts will be felt.

**Lack of 'investment ready' projects that are scalable and can demonstrate results in multiple areas:** Many donors have demonstrated their interest in scaling up funding in this area and are talking about 'climate-smarting' their entire ODA for agriculture, however one issue has been that there is a lack of 'investment-ready' projects that can achieve results against multiple objectives and at scale. It seems that in the absence of projects that can measure and demonstrate results in the areas of development and climate change, donor finance is likely to go to other sectors or projects that are able to do this more easily.

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<sup>33</sup> Agriculture was included as an agenda item for SBSTA discussions at COP17 in Durban, 2011.

<sup>34</sup> A partnership between FAO, WB, IFAD, WFP, UNEP, GM, CCAFS.  
<http://www.climatesmartagriculture.org/en/>

### 4.5.3 Barriers to Scaling up Private Finance

**Table 22** presents the outcome of this study on the analysis of the barriers to the scaling up of private finance.

Table 22: Analysis of Private Financial Barriers

Private Financial Barriers to the Adoption of Climate Resilient Agriculture (CRA) Systems	Weighted Mean Score (WMS)	Rank
Are there a range of risks that are preventing capital providers from investing in CRA?	4.50	1
If so, what are the main risks? Rank the top five (5) in descending order of importance.		
Is agriculture perceived to be a low-margin business?	2.50	6
What are the main issues that can directly affect returns to investors? Rank the top five (5) in descending order of importance.		
Do you consider the high transaction costs related to the insufficient aggregation at the smallholder's level a major issue?	4.50	1
Do you think that the pre-requisite for smallholders to attract private funding is greater than those for public funding sources?	3.50	2
If so, what are the main barriers for smallholders in obtaining the necessary financing to apply CRA practices? Rank the top five (5) in descending order of importance.		
Do you think the return on investments informed the decisions to adopt CRA technologies and practices?	3.50	2
Do you consider CRA technologies very costly?	3.50	2

The findings obtained from the analysis of the key issues related to private financial barriers (**Table 4.3**) revealed serious challenges to the financing of CRA technologies and practices through private support. This is reflected in the unfavourable outcomes for most issues addressed in this area of the study as reflected by the weighted mean scores. These unfavourable outcomes include:

- The wide range of risks that are preventing capital providers from investing in CRA
- The high transaction costs related to the insufficient aggregation at the small holder's level a major issue
- The reality is that the pre-requisite for smallholders to attract private funding is greater than those for public funding sources
- The return on investments informed the decisions to adopt CRA technologies and practices, which are considered low
- The fact that the costs associated with CRA technologies are very high.

Several risks have been identified that are preventing capital providers from investing in Climate Resilient Agriculture. These risk-related factors include:

- Applicant's credit-worthiness
- Vulnerability of the sector to natural disasters
- Limited risk-sharing opportunities in the sector, including those related to agricultural insurance
- Low level of perception of agriculture as a business
- Low levels of labor productivity in the sector
- Praedial larceny
- Limited trust in CRA technologies and practices

Three main factors have been identified as directly affecting the return to investors to include:

- Vulnerability of the sector to external shocks
- Producers' poor access to markets
- Low return from agriculture that impacts the producer's ability to pay

The main barriers that have been identified as limiting producers from obtaining the necessary financing to apply CRA technologies and practices are:

- Lack of farm production and financial records
- Lack of collateral to secure the loans
- Lack of sufficient financial history
- High levels of risks associated with production and marketing within the sector
- Lack of insurance

In the report of Gledhill et al., 2012, additional reasons were identified for the outcomes obtained in this study, which are presented below.

**Risks associated with agriculture projects in developing countries.** Whether real or perceived, there is a range of risks that may prevent capital providers, particularly those in the private sector, from investing in CSA in developing countries. These include the risks associated with agriculture, investing in undeveloped rural markets in developing countries, and potential political and regulatory constraints in doing business in these regions, including land tenure issues.

**Agriculture is perceived to be a low-margin business (Oxfam Research Report 2009).** Despite growing recognition of the need for land-use methodologies and eligibility under climate finance schemes, CSA practices still have difficulty in attracting private sector funding. A range of issues such as lack of access to technology, inadequate infrastructure, and unstructured markets can have a negative impact on basic productivity at the small-holder level, which can directly affect returns to investors. In addition, CSA practices include transitions to more sustainable land use, which can delay returns to investors (FAO 2011).

**Insufficient aggregation at the smallholder level (CGIAR 2011).** Smallholder farmers account for a significant percentage of all farming. Financing individual smallholders for any activities (climate change mitigation, adaptation or general agriculture activities) has high transaction costs, and aggregation may be required to create more efficient lending channels (i.e., bank financing of producer groups instead of individual farmers).

**Pre-requisites for smallholders to attract private funding.** The requirements for smallholder farmers to attract funding from the private sector are greater than those for public funding sources. Lack of land tenure, collateral, financial literacy, track records, basic financial services, aggregation, infrastructure, and market and product information are barriers for smallholders in obtaining the necessary financing to apply CSA practices (CGIAR 2011). These constraints influence the level of funding the private sector is willing to provide.

#### 4.5.4 Barriers to Scaling up Carbon Market Finance

The outcome analysis of the barriers to the scaling up of carbon market finance is presented in **Table 23**.

Table 23: Weighted Mean Scores of Carbon Market Finance Barriers

Analysis of Barriers to Scaling up Carbon Market Finance	Mean Score 5 = Max	Rank
Do you think there is a weak demand overall in voluntary and compliance carbon markets?	4.00	1
Do you think the limited eligibility of CRA activities in compliance and voluntary carbon markets is a major issue?	3.50	2
Are the technical burdens of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA?	3.25	4
Are the high transaction costs of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA?	3.50	2

The results obtained from this study strongly suggested that:

- There is a weak demand overall in voluntary and compliance carbon markets
- The limited eligibility of CRA activities in compliance and voluntary carbon markets is a major issue
- The high transaction costs of developing 'market ready' CRA projects are limiting the ability to scale up carbon markets finance for CRA
- There are the technical burdens of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA.

The findings obtained in this study are consistent with those of the report of Gledhill et al., 2012, and are discussed below.

**Weak demand overall in voluntary and compliance carbon markets.** Carbon markets generally have experienced fluctuations in demand and cover prices as a result of instability in the economic conditions in many developed countries, and the lack of certainty of the market in the future. Weakness and uncertainty in all carbon markets limit the ability to source finance for CSA activities from carbon markets, increasing transaction costs and risks for developers and reducing potential returns from agricultural carbon projects.

**Limited eligibility of CSA activities in compliance and voluntary carbon markets.** There are a limited number of methodologies that can be used to quantify emission reductions from CSA practices. Under compliance markets, agricultural soil carbon management in croplands and grassland avoided deforestation and degradation are ineligible to generate emissions reductions under the Clean Development Mechanism (CDM), and afforestation and reforestation are ineligible under the European Union's Emissions Trading Scheme (EU ETS), which is the largest market for certified emissions reductions (CER). There is a wider range of methodologies appropriate for CSA in the voluntary carbon markets, but this is very small compared with compliance carbon markets (less than 1% of total global carbon markets) and the volume of emissions reductions generated to date is small.

**Technical burden and high transaction costs are borne by project developers.** Methodologies that do exist to generate emissions reductions from CSA activities are technically demanding, creating a need for project developers to rely on external consultants. This, as well as the high non-permanence risk buffers and the need for aggregation of emissions reductions above the farmer level, means that transaction costs for these types of projects are high. This high cost of developing ‘market ready’ CSA projects limits the ability to scale up carbon market finance for CSA.

#### 4.5.5 *Mainstreaming of Climate Resilient Agriculture Funds*

The study evaluated the extent to which climate change funds were mainstreamed at the sectoral, national, and international development support levels. The results, which are presented in **Table 24** show moderate outcomes.

Table 24: Weighted Mean Scores for the Level of Mainstreaming of Climate Resilient Funds into Development Objectives

Level of Mainstreaming of Climate Resilient Funds into Development Objectives	Mean Score 5 = Max	Rank
How would you rate the level of mainstreaming of Climate Change into agriculture sectoral and national budgetary processes?	3.00	1
How would you rate the level of mainstreaming of Climate Change into agriculture ODA by many donors?	3.00	1

## 5. Discussions of Results and Conclusions

### 5.1 *Overview*

As mentioned earlier, climate resilient agriculture (CRA) focuses on coordinated actions among different actors in the value chain towards climate-resilient pathways. This is accomplished through building evidence-based research information platforms, increasing local and institutional effectiveness, fostering coherence between climate and agricultural policies, and linking climate and agricultural financing. Even though CRA can provide adaptation and mitigation benefits, it is important to identify the barriers that are limiting the transformation of Caribbean Agriculture into a Climate Resilient regime. The benchmarking of the present status quo with respect to CRA will help to provide some clarity as to what type of transformation in policy frameworks, institutions and funding are necessary to aid in the adoption of CRA technologies and management practices.

The study made in this chapter was able to identify some of the key economic and market barriers which limited the transition of current agriculture in the Caribbean to CRA production systems. The study was also able to determine the extent of the gaps in economic and market barriers, through a weighted mean score application of questions poised to shareholders in the sector. The study found that both socio-economic and market factors are limiting the adoption of CSA technologies and management practices in the countries reviewed. The results of the study are summarized under the various relevant sections that followed immediately below.



## 5.2 Demographic Characteristics of Farmers and Farm Enterprises

Information was collected on the demographic characteristics of 30 farmers spread over five (5) of the nine (9) countries involved in the study. The findings are summarized as follows:

- Male farmers dominate the farm population, where males were represented by 75% of the respondents, while the female farmers were 24% and others 1%.
- Sixty-four per cent (64%) of farmers surveyed fall within the 36-65 years age group. Of these farmers, 37% were within the age group 36-50 years, and 27% were within the age group of 51-65 years. The results generated showed that a significant number of farmers were in their active years of productive as approximately 60% of farmers are below the age of 50. There were no farmers over 75 years old.
- The findings on educational status suggest that farmers in the Caribbean region have a fairly high literacy rate, with over 73% of the farmers have reached the secondary education level and beyond.
- The distribution of farmers by the head of households, showed that 89% of the farm households are headed by men.
- Further analysis of the size of household's data revealed that the:
  - Average size of Farm Households was 5.17 persons
  - Average size of Male-headed Farm Households was 5.21 persons
  - Average size of Female-headed Households was 5.00 persons
  - Size range of Farm Households was 1 to 13 persons
  - Mode of Farm Households was 5 persons.
- The land distribution pattern showed that approximately 80% of the farmers surveyed were operating on lands of five (5) acres and less, with 33% farming on less than one (1) acre. Only 13% of the farmers were operating on lands of over twenty-five (25) acres.
- Thirty-three per cent (33%) of farms are owned by the holder, another 20% are family-owned, 30% are rented or leased and the remainder is operated under various kinds of common law or illegal actions, including squatting on private or government land.
- Seventy-seven per cent (77%) of all respondents were engaged in crop production only, with mixed farm operations represented by 23% of the farmers.
- Only 23% of producers earned more than US\$25,000 annually. **The situation of the level and distribution of farm income among respondents could be partially explained by the nature of farmer household status with respect to sources of income.** There is the general consensus in the Caribbean region that a significant number of farmers are part-time producers and thus derive their household incomes from 'agriculture and services', and 'agriculture and business'.
- Farmer's experience in agriculture in the region may be characterized as relatively low to medium, with 64% of all respondents reporting having less than twenty (20) years in agriculture and related activities. In addition, approximately 30% of all respondents have less than ten (10) years of farming experience.
- Approximately 57% of all farmers/producers lived within less than 1kilometre (1KM) of the farms.
- Farmers/producers had fairly good access to extension officers; however, the level of actual visitation of contact of extension officers to farms may be characterized as highly infrequent.
- Farmers/producers had fairly good access to climate change information from a variety of sources, with the traditional media sources of radio and television the major ones for

farmers' climate change information. However, the study revealed that the internet is a significant climate change information platform for farmers.

In a study conducted by Lowitt, K et al., 2015 in four Caribbean countries<sup>35</sup>, an association was established between a number of demographic characteristics surveyed and the low levels of innovation potential, including relatively low levels of formal education and land ownership across the region. Overall, the findings from the study revealed that just less than half (48 %) of all surveyed farmers had completed secondary school (average values ranged from 19 % in Saint Lucia to 68 % in St. Kitts-Nevis). Previous research suggests that low levels of formal household education constrain farmers' capacity to adopt new practices and technologies and acquire more specialized skills and training (Dahkil, M., and Clercq, D. 2004; Huffman, W. 1999).

Lowitt, K et al., 2015 also revealed variable patterns in land and farm ownership among farmers. The study established the governments as the largest landowners in CARICOM and recognized that many countries have introduced various land reform programs and policies to address historically uneven land ownership patterns (IICA 2013; Williams 2003). However, across the region, uncertain title to land for agricultural and residential use persists (IICA 2013; Williams 2003). Land tenure is an important factor shaping household vulnerability to environmental and socio-economic shocks (Reale, A., and Handmer, J. 2011; Williams, A. 2003) with households living on land with insecure tenure often particularly vulnerable to displacement following natural disasters and low levels of access to credit (Reale, A., and Handmer, J. 2011).

The survey results of Lowitt, K et al., 2015 also showed relatively low levels of farm ownership among the farmers sampled (65%). However, they found considerable variations between countries, with only 8% of surveyed farmers in St. Kitts-Nevis owning their farm, compared to 89% in Guyana. There is little doubt that more secure farmland tenure is generally associated with more profitable and sustainable agricultural production, with positive implications for household income and food security (Maxwell and Wiebe 1999; Reale and Handmer 2011). Insecurity in land tenure may deter investment in agricultural infrastructure, and, if a tenure system allows the sale of land, could result in the loss of livelihood in the event of a severe shock (Maxwell and Wiebe 1999; Reale and Handmer 2011). **The study of Lowitt, K et al., 2015 also indicated that land tenure interacts with environmental change in complex ways. For example, in St. Kitts, 73 % of surveyed farmers identified wildlife pests, and in particular monkeys, as a constraint to successful crop production. Wildlife pests in the country have become worse in recent years as the measures used to previously control them in the export-oriented agricultural system are no longer in place. The environmental problem is compounded by farmers not owning farmland, making them unable to live on the farm and thereby potentially scare away wildlife pests.**

Lowitt, K et al., 2015 showed that 16 % of the farming households surveyed were headed by women. Research in many developing area contexts has shown that women face a unique set of livelihood vulnerabilities related to constrained access to agricultural resources, including land, credit, and inputs (FAO 2011). In addition, women often provide labour for other farms because they cannot access the resources needed to farm on their own.

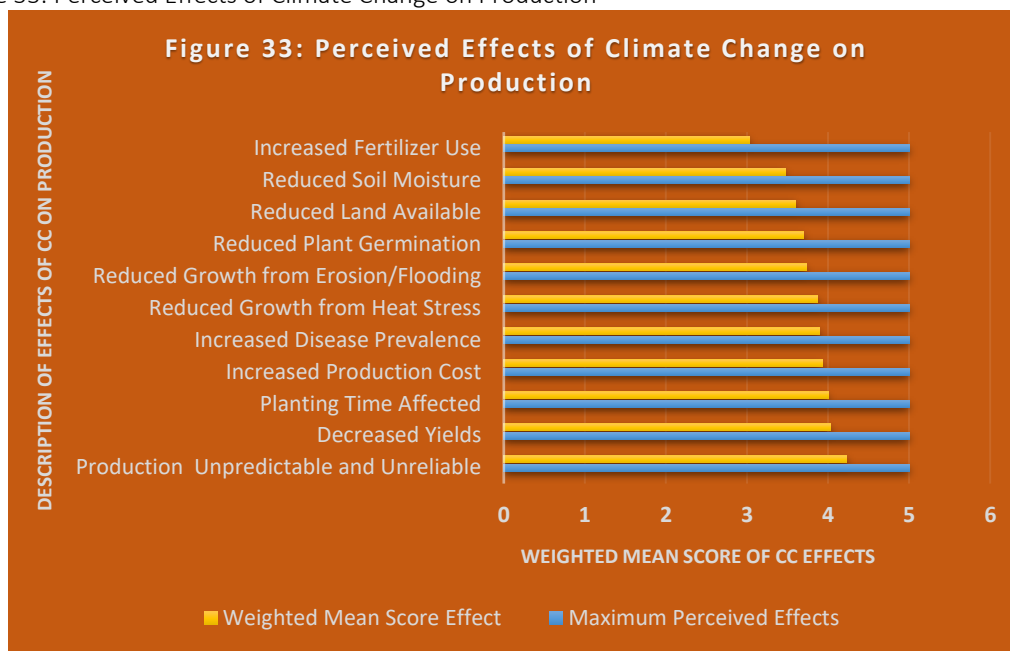
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<sup>35</sup> St. Lucia, St. Kitts and Nevis, Trinidad and Tobago and Guyana.

### 5.3 Farmers' Perception of the Impact of Climate Change

The perceived effects of climate change on agricultural production are summarized in **Figure 33** below. The figure shows that the farmers were highly aware of the effect of climate change on production.

Figure 33: Perceived Effects of Climate Change on Production



However, the results obtained must be situated and discussed in the context of not only farmers' perception of the effect of climate change, but also the wider framework of farmers' perception of agricultural risks and risk management strategies employed.

### 5.4 Farmers' Perception of Agricultural Risks and Risk Management Strategies Employed

#### 5.4.1. Perceptions of Risk Sources

As mentioned earlier, the benchmarking of the present status quo with respect to CRA will no doubt help to provide some clarity as to what type of transformation in policy frameworks, institutions and funding are necessary to aid in the adoption of CRA technologies and management practices. However, the benchmarking of the present status quo of CRA should be conducted within the broad context of agricultural risks and their management strategies to provide evidence-based information for determining the types of policy frameworks, technologies, markets, institutions and financial reforms that are necessary to aid in the transformation of Caribbean Agriculture to climate-resilient production systems. The discussion on this broader concept of agricultural risks borrowed heavily from the study of Duong, T., Brewer, T., Luck, J., Zander, K. (2019): **A global review of farmers' perceptions of agricultural risks and risk management strategies.**

The factor analysis conducted by Duong, T.T et al., 2019 identified three main clusters of risks: direct risks to production, weather risk and biosecurity threats. The classification demonstrates that farmers conceptualize risks associated with biosecurity and weather-related risks, such as climatic change, separately from other identified risk types. **One reason why weather risk and biosecurity threats seem to be considered separately might be because they are treated by farmers as intrinsic features of farming production cycles rather than direct risks such as market risk and financial risk (Duong et al., 2019).** Based on the intrinsic features of the two risks, if weather risk were grouped with biosecurity threats, it could improve future risk management because farmers with inadequate adaptive capacity are likely to be highly vulnerable to climate risks, especially smallholders or farmers in developing countries such as in the Caribbean (Morton, J.F. 2007; Muller, C et al. 2011). **For instance, coupling pest and disease distribution predictions with climate predictions could reduce risks more efficiently than if both risks were managed separately.**

Duong, T.T et al 2019 considered the risk group of “human”, “market”, “institutional”, “technology”, and “financial” to be direct risks to production as they mostly occur as a consequence of farm-level decision-making and actions. Farmers need to gather information and make decisions themselves to manage those risks at the farm level, **with decisions varying among farmers.** Among the five risks in the group, market risk and institutional risk may be correlated because they are viewed as both expected and, as such, beyond the direct control of farmers. For example, any policy relating to agriculture such as environmental regulations, food safety, or business regulations will affect production (Girdziute, L. 2012), but the avenues by which farmers can influence such policy are at the best convoluted and insurmountable at worst.

#### *5.4.2. Risk Management Strategies*

Based on the review of the literature, the risk management strategies employed by farmers varied across the studies. The most commonly selected strategies were to diversify production sectors to minimize risk (Lin, B.B. 2011; Jin, J., et al 2015), pursue off-farm work, or purchase insurance (Gillespie, J., et al (2011; Ruiz, J. et al. 2015). Duong, T.T et al 2019 reported that in most studies reviewed farmers were not likely to adopt new technologies although adopting innovative practices is pivotal to fostering agricultural production sustainably (Aldy, J.E. et al 1998) and efficiently (Atreya, K. 2007).

The factor analysis conducted by Duong, T.T et al 2019 identified that “training and education” and “extension services” correlated with “update with the government”, which may indicate that training and extension services from relevant government bodies are generally well received by farmers. Farmers’ participation in training has been shown to increase net income and higher yield (Gautam, S., et al 2017). Some training programmes which were initiated by the government delivered a positive outcome for farmers (Siroco, M. et al 2006). The other clusters of risk management strategies are “productivity strategies” and “financial strategies”.

#### *5.4.3. The Linkage between Risk Sources and Risk Management Strategies*

Risk perception can affect economic behaviour, and thus the decision to adopt a specific risk management strategy (Alamerrie, K. et al. 2014). In the global review of the literature by Duong,

T.T et al 2019 a mismatch between perceived risks and risk management strategies was identified in 10 of 197 studies reviewed. There is a need to understand why there is a mismatch between the farmers' perceived agricultural risk sources and risk management strategies. A better understanding of why management strategies that appear to be a suitable response to particular risks are not employed might highlight further barriers to agricultural risk management, which, if overcome, could enhance the productivity of agricultural systems.

The factor analysis of Duong, T.T et al 2019 also found some correlations and patterns between risk sources and risk management strategies. Firstly, the "direct risks and financial incentives" group includes the risks (market, financial, human, institutional, and technology), and those risks are mainly matched with financial strategies (farm insurance, debt reduction, produce at the lowest cost). On the one hand, those strategies were seen as effective in tackling the volatility of output and input prices, and unfavourable changes in the financial market, but were not relevant in tackling "human risk." Secondly, facing weather risks, farmers have a range of strategies to diversify their income (off-farm investment, off-farm work, crop and animal diversification), while when facing biosecurity threats, they tend to rely on only "pests and diseases monitoring and prevention". Maybe the weather has always been an issue, and farmers learned constantly to adapt to changes in weather and climate, but biosecurity might be too new, a potential knowledge gap. Thirdly, another cluster of risk management was identified as "knowledge support" which included training, education, extension services, and updates from the government. This suggests the primary role of government in supporting farmers with more training and extension services, as highlighted by Fielke, S.J., and Bardsley, D.K. 2014.

"Technology risk" and "new technology adoption" did not load highly on the same factor. According to Duong, T.T et al 2019 farmers that claimed to experience changes in technology did not consider new technology instalments as a strategy to address any particular risk. Besides, they found that farmers did not appear to adopt new technology as a response to risk. In their study "Technology risk" was clustered with "crop and animal diversification", possibly signifying those farmers used technology to boost productivity (Chang, S.C et al., 2015) rather than to address inherent risk. This could indicate that technology adaptation could be related to long-term planning rather than being reactive to a specific risk. "Cooperation with other farmers" was not associated with any specific agricultural risks, which may indicate farmers' interaction with other farmers for purposes such as networking and social events, rather than to tackle specific risks.

#### *5.4.4. Socio-Economic Factors Affecting Farmers' Risk Perceptions and Management of Risks*

Several studies have investigated the socioeconomic factors influencing farmers' risk perceptions. Perceptions of risk can differ between male and female farmers (Kisaka-Lwayo, M., and Obi, A. 2012; Lasco, R.D., et al. 2015; Kiama, T. N., et al. 2016), as female farmers were more concerned about the critical roles of education and extension service in farming (Ullah, R. et al. 2015). Education has been positively related to personal risk, farm business risk, and off-farm income (Kisaka-Lwayo, M., and Obi, A. 2012; Stockil, R.C. et al. 1997; Elkin. P.D. 2007; and Borges, J.A.R. and Machado, J.A.D. 2012). Results show mixed findings between the age of farmers and risk perceptions. In South Africa, older farmers were more worried about the possible shortage of

farm labour than younger farmers (Kisaka-Lwayo, M., and Obi, A. 2012. According to Borges, J.A.R. and Machado, J.A.D. 2012, however, age did not significantly affect farmers' risk perceptions in Brazil.

Some studies reported that farmers who managed larger farms were primarily concerned with production risks (Ullah, R. et al. 2015; Boggess, W.G et al. 1985; and Nmadu, J.N. et al. 2012).

Despite the weather-related risk and biosecurity threats being frequently mentioned in Duong, T.T et al 2019, factors affecting farmers' perceptions of weather-related risks have been extensively investigated, but factors influencing farmers' biosecurity risk perception have been sparsely studied. *Driven and motivated by the trend and impact of climate change on agriculture, weather-related risk has received enormous interest from researchers and farmers alike (Wheeler, T et al. 2013).* Education levels, farm size, and farmers' experience in farming were found to have a significant impact on how farmers perceive and adopt risk management strategies (Lu, W.; et al. 2017; Borges, J.A.R. and Machado, J.A.D. 2012; and Hall, D.C, et al. 2000).

#### *5.4.5. Barriers to the Management of Agricultural Risks*

The results of this literature review have revealed a range of barriers to managing agricultural risks. *However, most research on barriers to managing agricultural risks has presented results from case studies in large agricultural enterprises in developed economies (Toma, L., et al. 2013; Ilbery, B. et al. 2013) and in small-scale agriculture in developing countries (Legesse, B. et al. 2005).*

A lack of institutional support from the government was identified as a significant barrier to managing agricultural risks in both developing and developed countries. *For example, in Nigeria, a lack of marketing training and support from the government for plantain farmers was identified (Baruwa, O.J. et al. 2015). Similarly, Indian farmers aiming to adopt organic farming practices encountered institutional problems and a lack of support from the government in acquiring new methods to control pests and diseases and accessing new markets (Panneerselvam, P. et al. 2011). The need for better institutional support from developed countries has been confirmed (Woods, B.A. et al. 2017).*

Poor and smallholder farmers are particularly vulnerable to agricultural risks (Legesse, B. et al. 2005; and Mannon, S.E. 2005) and have difficulty adopting new technologies and crop types due to inadequate technical knowledge, lack of funds, and limitations to their production technology (Awan, M.I. et al. 2015). Financial and technical support from reliable sources is often inadequate (Harvey, C.A. et al. 2014; and Baruwa, O.J. et al. 2015). *For instance, smallholder farmers in Ethiopia, Madagascar, and Pakistan have reported failure in accessing formal financial services [(Harvey, C.A. et al. 2014; Gebreegziabher, K.; Tadesse, T. 2014; and Elkin. P.D. 2007).*

#### *5.4.6. The Way Forward*

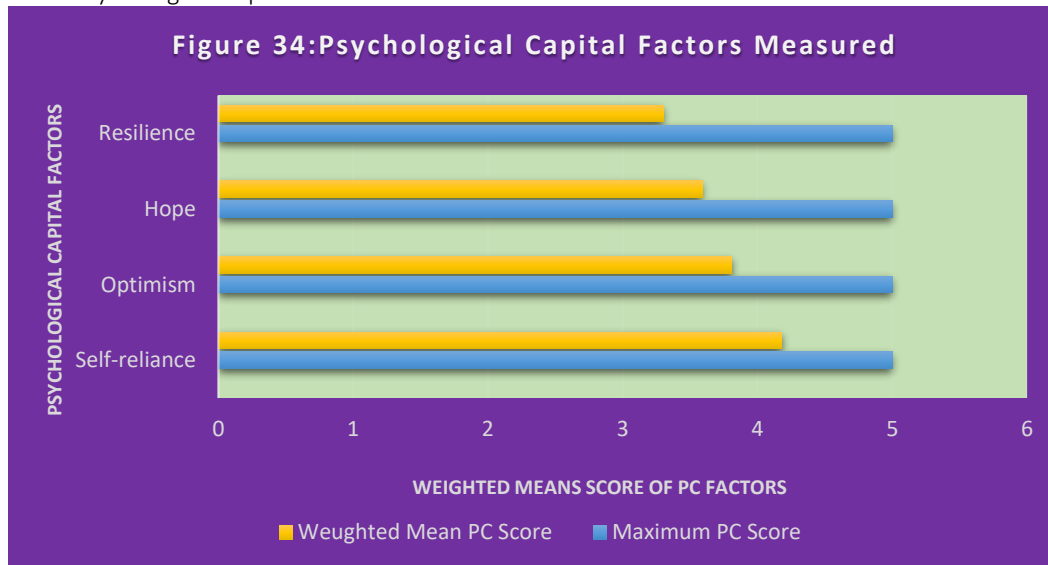
Risks associated with agriculture are increasingly diverse, complex, and interconnected. Consequently, there is a pressing need to gain a greater understanding of the nexus of agricultural risks, how farmers respond to risk, factors affecting their perceptions and management of risk, and barriers hindering the way they manage risks to ensure stable livelihoods and national food

security. The aspect of the study was based mainly on the review of the literature on farmers' risk perception and their management strategies employed. Such a review revealed some interesting anomalies and points of interest including the absence of studies across large developmental gradients, the small disproportionality volume of research on biosecurity risk management strategies and socioeconomic factors associated with biosecurity threats, the apparent mismatch between perceived risks and management responses, and the clustering of risks and risk management strategies. A better understanding of farmers' risk perceptions and risk management strategies, factors affecting their perceptions and management, and the barriers to their risk management could enable more collaborative solutions to managing future risks.

### 5.5 Psychological Capital and Farmer's Climate Adaptation Decisions

A psychological capital questionnaire (PCQ) was constructed to solicit farmers' views regarding themselves i.e., how they rate themselves in relation to self-confidence, optimism, hope, and resilience. The findings from the study are summarized in **Figure 34** below.

Figure 34: Psychological Capital Factors Measured



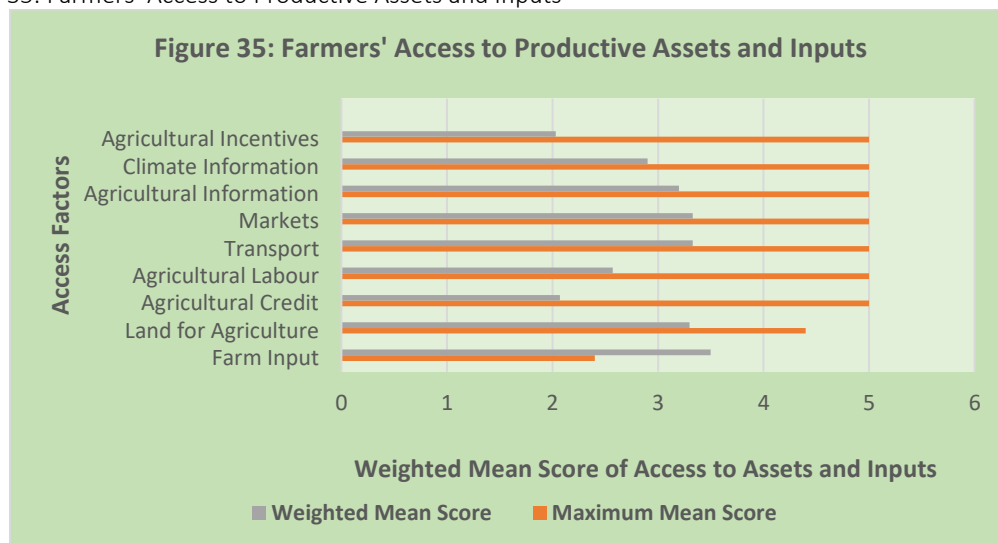
An integrated analysis of the weighted mean scores obtained in this study supports the arguments of a considerable association between psychological capital and smallholder farmers' decision-making process, including adaptation to climate change. Therefore, in addition to already known factors such as self-confidence and locus of control, having hope or aspirations for oneself in farming is also important in decisions meant to address the impact of climate change on agriculture production systems.

### 5.6 Technology-based Barriers

The summary results of the analysis of the economic-related technology factors, which was conducted from two perspectives: the farmers and the research, development and technology transfer institutions are presented in **Figures 35 and 36**.



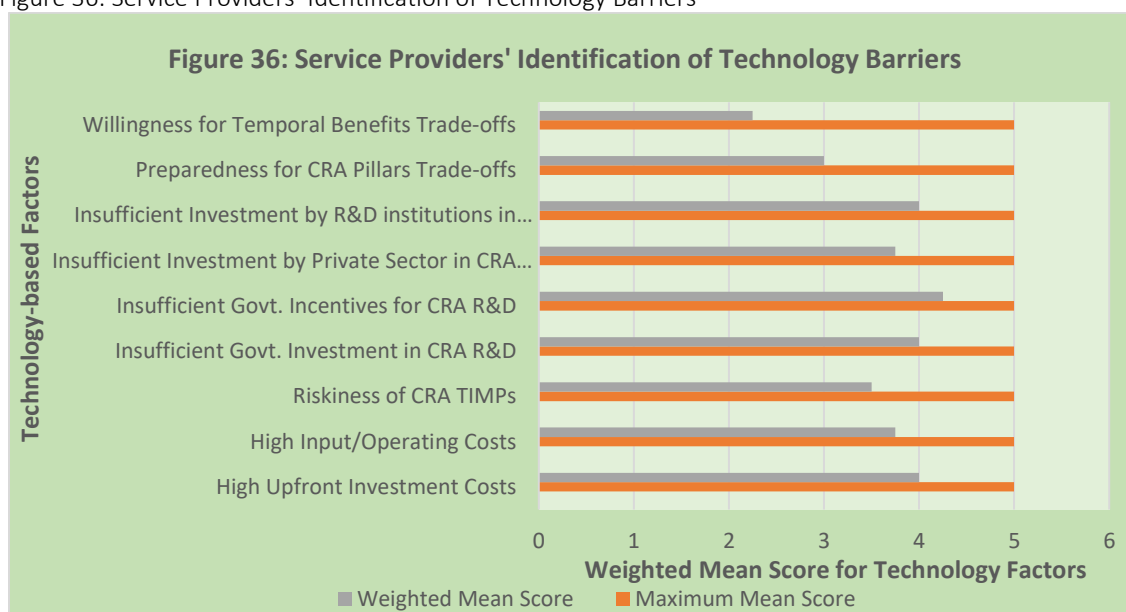
Figure 35: Farmers' Access to Productive Assets and Inputs



As can be observed from **Figure 35**, the farmers have indicated that they have moderate to good access to productive assets/inputs such as farm inputs, markets for outputs, transport for farm inputs and produce, land for agricultural purposes, and agricultural information. However, they are limited to significant degrees in their access to climate information relevant to agriculture, agricultural labour, agricultural credit, access to adequate government incentives from qualitative and quantitative perspectives, and access to effective and efficient insurance schemes to cover farm risks.

The **research and development institutions** have identified several barriers to the uptake of CSA technologies most of which are in support of those identified by farmers (**Figure 36**).

Figure 36: Service Providers' Identification of Technology Barriers



The most important of these factors are:



- The current level of incentives provided by the government is insufficient to drive the research and development agenda for CRA technologies and practices
- The upfront investment costs that a farmer must make to adopt CSA technologies are too high
- The input/operating costs (labour, fertilizers, chemicals, etc.,) related to the application of some CSA technologies and practices are too high
- The government, private sector, and research and development institutions are not investing sufficient resources in the development of CRA technologies and practices
- The riskiness of some Climate Resilient Agriculture (CRA) technologies and practices constraining their adoption.

Only 30% of farmers surveyed indicated having access to insurance schemes, while very few farmers are utilizing insurance as a risk transfer mechanism.

The effectiveness of production inputs in increasing agricultural productivity is influenced by the type (quality) of inputs and their level (quantity) of application. Poor application of production inputs leads to low yields. The study found that most farmers have limited access to modern production inputs because they do not have access to credit. However, some farmers are reluctant to seek funds on credit to procure farm inputs due to fear of production failure due to weather-related events or not knowing where to sell their products after harvest. It is the case that farmers rely heavily on government financial assistance and subsidies to purchase production inputs. The situation differs in the case of more prosperous individual producers who supply the formal markets. Such farmers are more willing to apply for production loans from financial institutions.

Land is regarded as one of the most important agricultural resources, playing a crucial role in agricultural productivity. It is widely acknowledged that access to land, complemented by other resources, is the most fundamental determinant of the income-earning potential of small farmers in rural communities. Although most farmers in the study had access to land for agricultural production, the size of the land was identified as a major constraint. Approximately 80 % of the farmers surveyed were operating on lands of five (5) acres and less, with 33% farming on less than one (1) acre. Only 13% of the farmers were operating on lands of over twenty-five (25) acres. The situation is exacerbated by the land ownership situation in the region. In the study thirty-three per cent (33%) of farms were owned by the holder, another 20% were family-owned, 30% were rented or leased and the remainder was operated under various kinds of common law or illegal actions, including squatting on private or government land.

In the study, the lack of access to financing was a key constraint to the farmer production in our sample of farmers and can serve as a barrier to agricultural innovation. The issue of financing is raised often as limiting farmers' ability to diversify into livestock production due to the need to invest in fencing and shelter for animals. This could be a major reason why most farm enterprises in the study were crop only. Lack of finance is also a barrier to improving water infrastructure for irrigation which would allow farmers to diversify and increase crop production. Many farms are rain-fed, and long dry seasons strain production and contribute to crop losses. Compounding this

challenge was that many farmers did not own farmland to use as collateral in securing a loan for irrigation and other infrastructure.

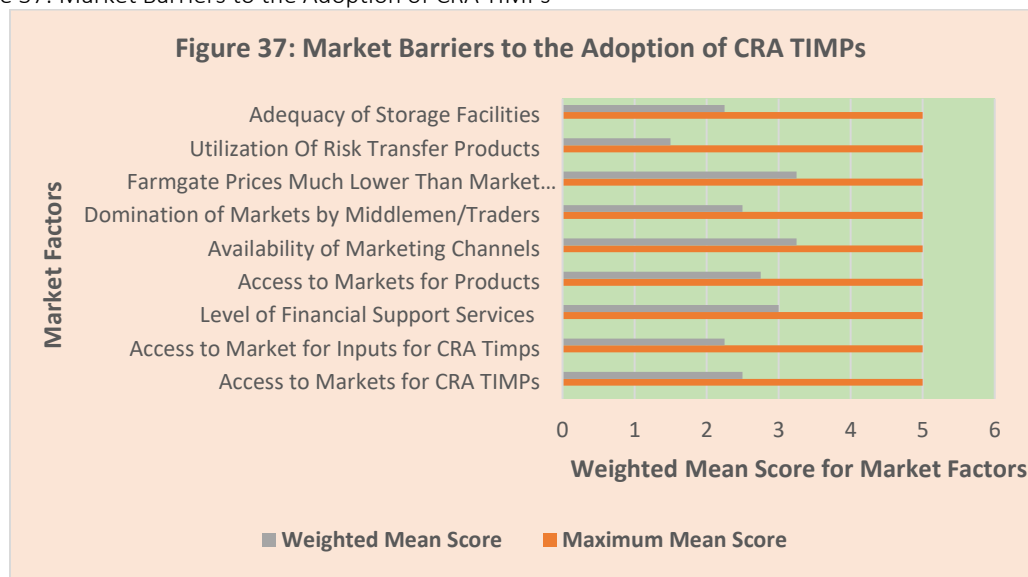
Access to information and technical assistance is another challenge to farmers' production in the region. The survey results related to seeking technical assistance and adopting new technologies provide further insights into the fractured nature of agricultural knowledge networks for smallholder farmers in the region. While farmers reported moderate access to agricultural information, their access to climate change information was quite limited. In this study, a lack of knowledge emerged as a barrier to improved TIMPs; with many farmers alluded to operating in an agricultural knowledge and information vacuum, significantly undermining their adaptive capacity in the event of Climate change or market-related shocks.

These findings point to the need for new approaches to agricultural research and extension in the region that more explicitly embrace knowledge networks better capable of accounting for the complexity of the farming systems (Foran et al. 2014; Isaac et al. 2007). As indicated by Lowitt, K. et al., 2015, internationally, the concept of "innovation platforms" has emerged as a potentially powerful approach to supporting actor-driven innovation in different institutional contexts (Foran et al. 2014). Kilelu et al. (2013) defined an innovation platform as a "multi-actor configuration deliberately set up to facilitate and undertake various activities around identified agricultural innovation challenges and opportunities" (p. 66). Innovation platforms work to build capacity among actors, including communication, participatory planning, and network facilitation and have the potential to act as models for broader agricultural research and development planning (Adekunle and Fatunbi 2012; Foran et al. 2014).

### **5.7    *Market Barriers***

The study sought to verify the existence of some of the main market constraints identified in the Caribbean region using a survey questionnaire, the results of which are presented in **Figure 37**. The weighted mean scores for the availability of marketing channels for farmers, farmgate prices obtained by producers are much lower than market prices, and the adequacy of financial support services available for the adoption of CRA technologies and practices may be classified as fair to moderate. However, the scores were low for other factors.

Figure 37: Market Barriers to the Adoption of CRA TIMPs



The low score factors include:

- Farmers access to markets for their product
- Farmers access to the markets for CRA technologies
- Domination of the marketing channels by middlemen and traders
- Farmers access to the markets for inputs for the adoption of CRA technologies and practices
- Adequacy of storage facilities beyond the farm gate for produce
- Farmers not utilizing risk transfer financial products/practices such as insurance/emergency funds

Market access emerged as a significant constraint facing smallholder farmers in the study by Lowitt, K. et al., 2015. Across the four countries studied (St. Lucia, St. Kitts and Nevis, Trinidad and Tobago and Guyana), smallholder farmers were selling their products primarily to local domestic markets, including supermarkets and public markets. However, as highlighted by their survey results, only 20 % of farmers surveyed had formal contracts for accessing these markets, with nearly all farmers relying on informal arrangements or no contracts at all. The finding of Lowitt, K. et al., 2015 points to a key vulnerability in the domestic food production systems of CARICOM, with a lack of established formal market connections restricting access to the information that smallholders need to participate effectively in markets, such as current prices and product demand (Robbins et al. 2005; Markelova et al. 2009). A recurring challenge associated with markets was the need to compete with imported foods, particularly fresh fruits and vegetables. Key issues included the contractual agreements between supermarkets and food importers that were seen as limiting the willingness of supermarkets to sign contracts or purchase more produce from local farmers.<sup>36</sup>

Economic and trade liberalization reforms beginning in the 1980s have had the effect of reducing domestic controls on trade and import tariffs which are needed to protect smallholder farmers in

<sup>36</sup>Lowitt, K. et al., 2015

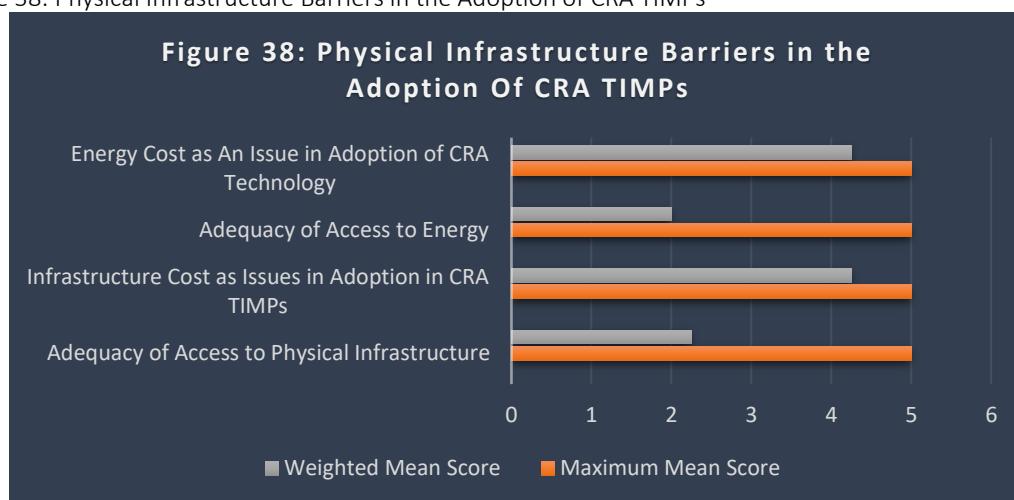
SIDS (Ford et al. 2007). During these reforms, many government-owned agricultural enterprises were sold to the private sector (FAO 1995). The closure of the government-supported Agricultural Marketing Agencies in the Caribbean that were established in the early 1980s to buy food crops from farmers, due to structural adjustment programmes, resulted in the removal of a key marketing support institution for domestic smallholder farmers. Drawing on a range of international agricultural case studies, Markelova et al. (2009) found that smallholder farmers acting collectively may be able to reduce transaction costs of accessing inputs and outputs, obtain market information, tap into high-value markets, and potentially improve their bargaining power with buyers.

While most farmers in the study of Lowitt, K et al., described selling their products independently to supermarkets and public markets, there is evidence of successful group marketing efforts on the part of small commodity groups or farmers' cooperatives in the region. For example, the Black Bay region of St. Lucia has an active Farmer's Cooperative originally launched as a pilot project in 1974 to boost economic activity in the region and increase farm production through collective farming and product marketing (IICA 1989). Nonetheless, qualitative results in all four countries of Lowitt, K et al., 2015 indicated that getting smallholder farmers to work together, including responding to market demand, was extremely challenging. However, as the capacity to innovate becomes increasingly linked to an ability to act collectively (Adger 2010; Subramaniam and Youndt 2005), there is a crucial need to build social capital among farmers to overcome mistrust and social fragmentation (Agrawal 2001; Lowitt et al. 2015; Nahapiet and Ghoshal 1998). Enhanced social capital among farmers may not only improve the capacity for collective action in marketing, but also support the social cohesion necessary for addressing other production constraints identified by farmers in this study.

## 5.8 Physical Infrastructure Barriers

**Figure 38** presents a summary of the main issues analysed with respect to physical infrastructure: the cost of the infrastructure as a barrier and producers' access to those physical infrastructures.

Figure 38: Physical Infrastructure Barriers in the Adoption of CRA TIMPs



The results obtained from the analysis suggested that the cost of the physical infrastructure was a major factor limiting the farmer's availability as well as the farmer's access. A similar situation

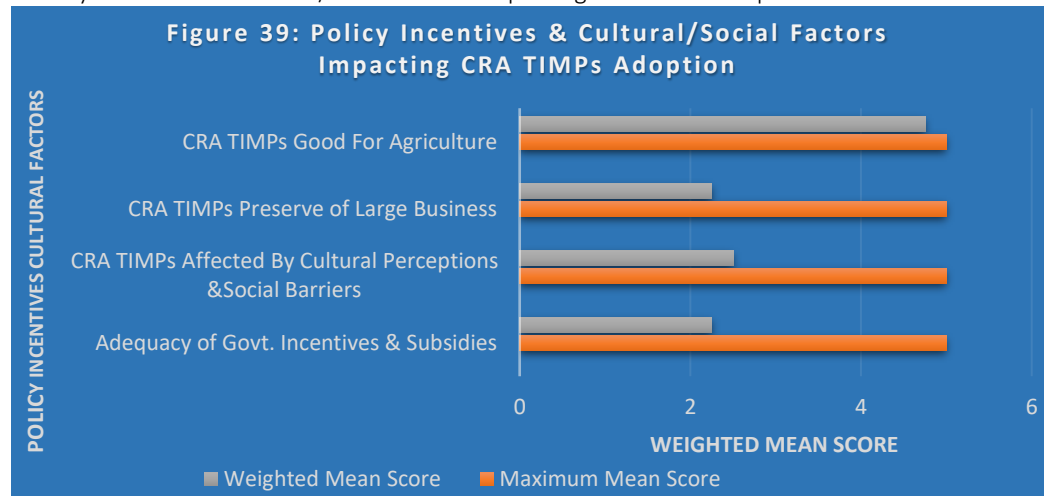
existed with energy where its high cost was a barrier to the use of energy in the agriculture sector. Most small-scale farmers have no or limited means of transport to carry their produce to markets. Transportation problems can result in loss of quality and late delivery of produce, which in turn can lead to lower prices. This is regarded as one of the greatest problems faced by emerging farmers, poor and inadequate infrastructure limits the adoption of technologies, particularly for smallholder farmers. Investments in physical infrastructures (roads, water retention, irrigation ...) are often beyond the capacity of local communities and small-scale farmers and require heavy investments; these investments may only be undertaken by the government, NGOs and donors.

## 5.9 Policy Incentives, Cultural Perspectives and Social Barriers

**Figure 39** presents the results of the barriers analyses conducted on policy incentives, cultural perspectives and social barriers. The findings from the study may be summarized as follows:

- CRA technologies and practices are good for agriculture
- Government support in terms of incentives and subsidies in place for CRA adoption was grossly inadequate, especially in the areas of incentives, subsidies, governance systems and programmes
- CRA technological innovation and management practices (TIMPs) are not the preserve of commercial, large farms and businesses
- Cultural tradition customs, norms and religious beliefs to some extent discouraged the adoption of CRA TIMPs

Figure 39: Policy Incentives & Cultural/Social Factors Impacting CRA TIMPs Adoption



## 5.10 Climate Finance

### 5.10.1 The Climate Finance Landscape

Caribbean countries face considerable costs to cope with and adapt to climate impacts. At the same time, there is a general consensus that the combined costs of climate change mitigation and adaptation endeavours far exceed the countries' own capacity; thus, international financial

support plays – and will continue to play – a critical role in supplementing governments’ and citizens’ own expenditures.

The climate finance landscape is quite diverse. While private investments provide the main source of climate finance, public resources remain the key drivers of the climate finance system and domestic investments. The architecture of the global financing for climate change activities is comprised of five (5) main categories of financing sources with relevance to CRA are:

- Financial mechanism of the UNFCCC
- Multilateral funding
- Bilateral funding
- Market-based funding
- National and regional climate funds

The UNFCCC’s mechanism provides funding to developing country parties in order to implement the Convention. It is comprised of different operating entities and funds, which provide such funding include:

- The Global Environment Facility (GEF)
- Green Climate Fund (GCF)
- Least Developed Countries Fund (LDCF)
- Special Climate Change Fund (SCCF)
- Adaptation Fund

Multilateral funding for CRA outside of the UNFCCC financial mechanism includes the IFAD, ASAP, UN-REDD which brings together UNDP, UNEP and FAO to support REDD+ activities, Inter-American Development Bank, and the World Bank also administers a range of funds such as the Forest Carbon Partnership Facility, the Partnership for Market Readiness and the BioCarbon Fund. Bilateral funding is another important financing source for CRA and provides funding on a country-by-country basis based on bilateral agreements, either directly or through institutions.

Market-based funding is available through a range of voluntary and compliance schemes. The Clean Development Mechanism (CDM) allows emission reduction projects in developing countries to earn certified emission reduction (CER) credits (each equivalent to one ton of CO<sub>2</sub>). These CERs can be traded and sold and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. The voluntary carbon market is attractive to smaller projects that find the UN or EU certification process too complicated and expensive. While interest in agricultural GHG emission reductions has been increasing in voluntary carbon markets, their share of actual activities in any carbon market remains small. There are some promising niche markets for agricultural carbon credits, such as methane avoidance from manure management, fertilizer use efficiency and agro-forestry.

National Climate Funds (NCFs) and Regional Climate Funds are mechanisms that support countries to manage their engagement with climate finance by facilitating the collection, blending, coordination of, and accounting for climate for climate finance. There are numerous NCFs and RCFs support activities that directly contribute to agriculture and have become an important source of financing for CRA.

### *5.10.2 Flows of International Financial Resources for Climate Change Measures*

From 2010 to 2015, a total of US\$ 1477 million in climate finance – flows labelled as principally targeting climate change – was committed to Caribbean SIDS, out of, about 6% of total reported aid flows to the region during that period. Only 15 of the 29 Caribbean countries covered by the analysis directly received climate finance, although others may have received funds as part of a regional allocation. About 62% of the finance was provided as grants, with the other 38% being loans. Around 48% of the climate finance was for mitigation activities, 32% for adaptation, and 20% for both together.

The vast majority of finance, 85%, came from bilateral sources, and about 77% was delivered as project-based support. The sector that received the largest share of climate finance was “general environment protection”. Finally, the disbursements of climate finance in 2010–2015 represent only 39% of total commitments in the same period.

The US\$ 1477 million in climate finance allocated to Caribbean SIDS in 2010–15, particularly when analysed as per capita allocations to each country, is generally lower than what was allocated to small island states in the Pacific region. Perhaps this is to be expected since the Caribbean SIDS are generally wealthier; all but Haiti and (until 2016) Guyana were classified as upper-middle-income countries.<sup>37</sup> Caribbean islands also tend to be less geographically dispersed than their Pacific counterparts.

The sectoral distribution of finance is a theme that deserves closer examination. It appears that some sectors that are likely to be critical for building long-term resilience and are also core components of countries’ national development agendas have not been targeted as recipients of climate finance.<sup>38</sup> This is confirmed through the examination of the countries’ climate investment priorities being articulated by Caribbean SIDS in national climate plans (NDCs) and international communications, which suggests that climate finance may not be aligning well with domestic priorities.

In Saint Lucia, for example, virtually all climate finance has targeted the disaster sector, either prevention (75% of the total) or post-disaster reconstruction (19% of the total). Yet the range of priorities expressed in the country’s 2003 National Climate Change Policy and Climate Action Plan (Government of Saint Lucia 2003), and NDC of 2021 is much broader; in addition to protection of human settlements from storms, it includes coastal and marine resources (including fisheries and coral reef protection), agriculture, terrestrial biodiversity, water resource planning and water source protection, climate-planning in the tourism sector, climate-sensitive building codes, addressing climate risks in the financial sector, and health. Virtually no climate finance has gone to these sectors. However, it is possible that these sectors are receiving financial support via ODA that is not tagged as principally addressing climate change.<sup>39</sup>

Fisheries is an interesting example because the sector plays an important role in many of the Caribbean SIDS. Countries such as Guyana, Suriname and Trinidad and Tobago all host a

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<sup>37</sup>World Bank Database

<sup>38</sup> Atteridge, A. et al. (2017).

<sup>39</sup> Ibid

substantial amount of the region's fish production (UN-OHRLS 2015), but there has been virtually no climate finance directed to the fisheries sector in any of these countries, or across the region more broadly.<sup>40</sup>

The importance of aligning climate finance with the development agenda has been emphasized often in both international agendas (e.g., Shine and Campillo, 2016; Haites, 2014). Still, there may be different reasons why climate finance is not linked to a broader range of sectors. Atteridge, A. et al. (2017) provided three possible reasons as follows:

- In some cases, national climate plans, which would guide requests for climate finance, may be disconnected from domestic development priorities (which can happen if they are prepared by line ministries without cross-government collaboration).
- Another possible explanation may be that, because finance is delivered through intermediaries, it is skewed towards sectors in which these intermediaries have the expertise or convening power.
- Another factor is that some of the climate funds are not operating flexibly enough to enable countries to finance their highest priorities where these occur in sectors that are not typically understood as “climate sectors”. In doing so, the funds are creating an artificial separation between “climate investments” and “development investments” that does not match thinking on the ground.

The latter is a problem that must be urgently addressed, for a number of reasons. First, bringing forward development investments is one legitimate strategy that countries may choose to build coping and adaptive capacity against climate change; this is already widely recognized in adaptation research and guidance, but not necessarily by the boards of key climate funds, including the GCF (Atteridge, A. et al., 2017). *Dominica, for instance, emphasizes in its NDC (2015) as well as in its National Resilience Development Strategy 2030, that a key strategy for building resilience to climate change is to create a supportive enabling framework whereby communities and vulnerable segments of society (women, youth, elderly, people with disabilities) can manage their own climate change risks. The establishment of such an enabling environment might legitimately involve investments in areas such as education, health, mobility or women's empowerment.*

Second, the nature of some NDCs is that climate action is contingent on other forms of development support. The Government of Guyana, for instance, clearly explains that the country offers to protect its forests, and preserve the carbon stocks they contain, on the condition that the international community helps to fund other elements of its sustainable development agenda (Government of Guyana 2015). Thus, focusing climate finance primarily on the forest sector – as has happened so far – seems at odds with the intention of the NDC, unless substantial new funding for Guyana has been mobilized through other aid flows in parallel (which is not the case for the 2010–15 period). In Guyana's case, therefore, climate finance could legitimately be directed to helping the country with other sustainable development priorities, at the same time as

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<sup>40</sup> Ibid



investments in forest protection, since the government has expressly linked these two outcomes in its NDC.<sup>41</sup>

Not all the climate finance was actually used to invest in distinct sectors or directly into communities where support was needed, or even for domestic policy support. For instance, some grants were provided to help countries to prepare and apply for climate finance, which means perversely that climate finance was spent on helping recipient countries to overcome the complexity of the climate finance system itself (for GCF “readiness” programmes). Some countries have suggested that readiness programmes have strengthened domestic financial management systems, which is itself a useful outcome.<sup>42</sup>

Another clear problem in the region relates to the actual disbursement of funds. Disbursements of climate finance were typically low across the region, in some countries less than 10% for the 2010–15 period. It is also noteworthy that climate finance appeared much more difficult to disburse than other aid flows.<sup>43</sup>

When bilateral and multilateral sources of finance were compared, bilateral funders programmed funding into a wider range of sectors. In addition, bilateral sources channelled their climate finance through a wider range of first recipients than multilateral funds.<sup>44</sup>

Atteridge, A. et al., 2017 observed that up to the end of 2015, multilateral sources made up only 15% of total climate finance to the Caribbean SIDS. They suggested that it could be at least partly a reflection of the higher transaction costs associated with accessing finance via the various climate funds compared to through bilateral relationships, though it may also be because some funds, such as the GCF, were relatively new and only began project approvals at the end of 2015. As the GCF ramps up, it is likely that the relative share of multilateral finance will increase, and already in 2016–17, there have been several large allocations to the region.

### *5.10.3 Public Sector Capital Budget Analysis for Climate Change Allocations*

There are four main conclusions based on the findings obtained from the evaluation of four of the nine (9) countries selected for this study. Firstly, the results demonstrate low levels of financing for the agricultural sector when funds allocated to the sector are expressed as a percent of total annual budgets. The low budgetary allocation to agriculture may be a reflection of the priority accorded the sector, especially in the context of the limited fiscal space of each country. Notwithstanding there is a need for the countries to match their political commitments to the sector with a commensurate level of support needed for its development.

Secondly, the budgetary allocations to climate change are much higher than those budgeted for agriculture. In addition, the budgetary allocations seem haphazard, which might be suggesting that the allocations are programmed to address damages caused by climate change-related events to economic assets and infrastructure. This may be the situation with respect to the Bahamas (Hurricane Dorian) and Dominica (Hurricane Maria).

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<sup>41</sup> Atteridge, A. et al., 2017.

<sup>42</sup> Ibid

<sup>43</sup> Ibid

<sup>44</sup> Ibid

Thirdly, there are significant variations across countries in the quantity of CRA financing in the Climate Change budgets, which to a large extent may be reflecting the vulnerabilities of the sectors in those countries. There are also within-country temporal variations, which may be reflecting the importance of the sector to national economic development and/or the need for the prioritization of climate change resources across sectors as a result of the limited fiscal space of the governments.

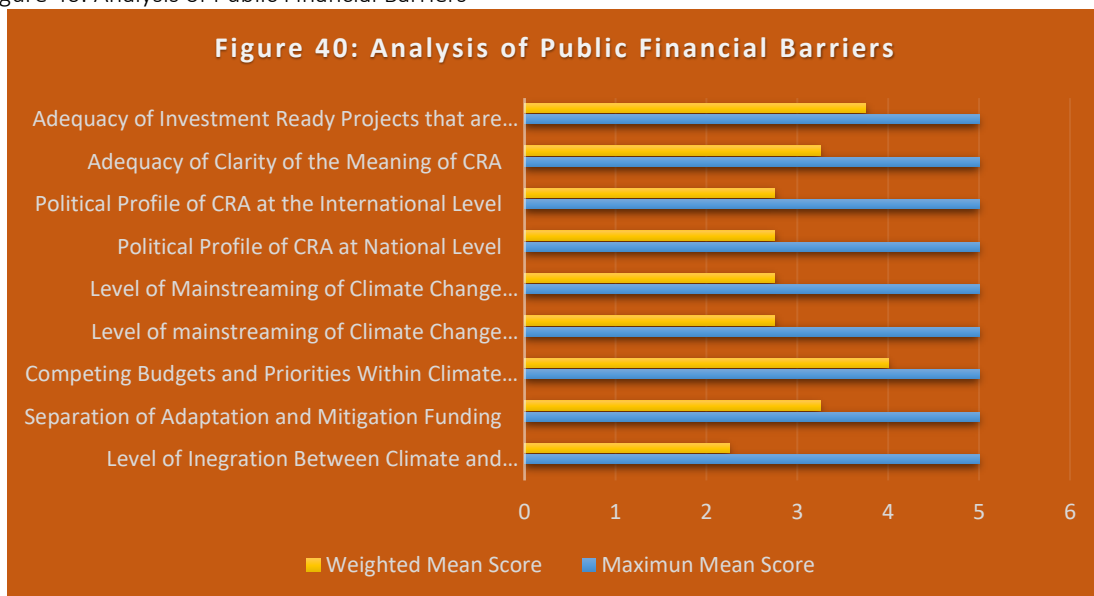
Finally, the results show that CRA budgetary allocation within agriculture is a major component of total agriculture budgets in most countries. Notwithstanding, the level of inconsistency of the CRA funding may be reflecting the response of the sector to the rehabilitation/reconstruction of destroyed/damaged assets and not to a structured programme of building resilience in agriculture.

#### 5.10.4 Climate Finance Barriers

The results obtained from the analysis of the key issues of public financial barriers (**Figure 40**) revealed serious challenges to the financing of CRA/CSA technologies and practices through donor support and from the public budgets. This is reflected in the unfavourable outcomes for most issues addressed in this area of the study as reflected by the weighted mean scores. These adverse findings include:

- The high level of competing budgets and priorities within both Climate Change and development budgets
- The low rating of the political profile of CRA's elevation at the national and international levels
- The low levels of mainstreaming of Climate Change Projects/Activities in the agriculture sector and national budgets
- The low rating for the level of integration between climate finance and agriculture finance.

Figure 40: Analysis of Public Financial Barriers



The results obtained in this study are consistent with that of Gledhill et al., 2012, who identified several reasons for the outcomes which were presented earlier, but merit repeating here

**Lack of integration between climate finance and agriculture finance.** One of the biggest challenges to scaling up finance for CSA is that current funding systems and policies for agriculture development, food security, and climate change mitigation and adaptation are insufficiently integrated. *While some donors are improving the coordination between these different areas, this is an area for improvement and greater internal capacity building.* Developing appropriate frameworks that better combine the two at the appropriate institutional levels (e.g., country level if this is where programming occurs with support from headquarters) can maximize the leverage potential of climate finance by better integrating it with larger agriculture and rural development programmes.

**Separation of adaptation and mitigation funding.** CSR practices can provide both adaptation and mitigation benefits. However, climate finance for adaptation and mitigation has so far been treated separately within the United Nations Framework Convention on Climate Change (UNFCCC) framework. A similar pattern applies at the donor level and multi-lateral climate fund level, where programming efforts for adaptation and mitigation are often separated in organizations and/or specific funds, reducing the ability to maximize co-benefits. This reduces the scope for CSA projects to receive climate finance when their objectives and benefits are holistic and span both adaptation and mitigation.

**Competing budgets and priorities within both climate change and development budgets.** The inclusion of agriculture in international climate change negotiations is a fairly new development<sup>45</sup> and it has received a relatively small amount of climate finance to date. It competes with a range of other sectors for climate finance and ODA and because many of the benefits of CRA are related to adaptation, they are inherently difficult to measure. For CSA to increase its access to both these sources of finance, results from CSA activities need to be measured and communicated in a way that demonstrates the effectiveness of public finance to achieve a range of objectives.

**The emergence of the issue and a lack of clarity on what it means on the ground.** CRA is a recent term, which seeks to combine agriculture and climate change issues in a variety of ways. The combination of a range of disciplines and the lack of clarity of what 'climate-smart agriculture' means for programming, national policy and multilateral agency portfolios, has meant that generating traction and donor support for this issue has been difficult. In donor agencies where climate change is being mainstreamed, there are significant challenges in reconciling the short timeframe of programmes (3-5 years) and the need to demonstrate results within that timeframe, with the longer timescale over which climate change impacts will be felt.

**Lack of 'investment ready' projects that are scalable and can demonstrate results in multiple areas:** Many donors have demonstrated their interest in scaling up funding in this area and are talking about 'climate-smarting' their entire ODA for agriculture. However, one issue has been that there is a lack of 'investment-ready' projects that can achieve results against multiple objectives and at scale. It seems that in the absence of projects that are able to measure and

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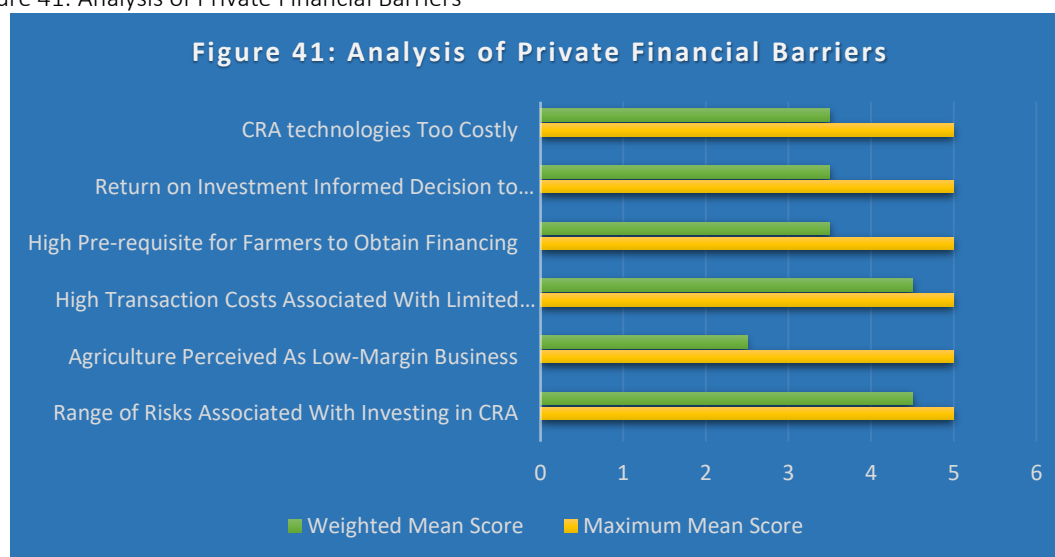
<sup>45</sup> Agriculture was included as an agenda item for SBSTA discussions at COP17 in Durban, 2011.

demonstrate results in the areas of development and climate change, donor finance is likely to go to other sectors or projects that are able to do this more easily.

The findings obtained from the analysis of the key issues related to private financial barriers (**Figure 41**) revealed serious challenges to the financing of CRA technologies and practices through private support. This is reflected in the unfavourable outcomes for most issues addressed in this area of the study as reflected by the weighted mean scores. These unfavourable outcomes include:

- The wide range of risks that are preventing capital providers from investing in CRA
- The high transaction costs related to the insufficient aggregation at the small holder's level are major issues
- The reality is that the pre-requisite for smallholders to attract private funding is greater than those for public funding sources
- The return on investments informed the decisions to adopt CRA technologies and practices, which are considered low
- The fact that the costs associated with CRA technologies are very high.

Figure 41: Analysis of Private Financial Barriers



In the report of Gledhill et al., 2012 several private financial barriers were identified to the adoption of CRA TIMs which are consistent with the outcomes obtained in this study. These are worth repeating here and are thus presented below.

**Risks associated with agriculture projects in developing countries.** Whether real or perceived, there is a range of risks that may prevent capital providers, particularly those in the private sector, from investing in CSA in developing countries. These include the risks associated with agriculture, investing in undeveloped rural markets in developing countries, and potential political and regulatory constraints in doing business in these regions, including land tenure issues.

**Agriculture is perceived to be a low-margin business (Oxfam Research Report 2009).** Despite growing recognition of the need for land-use reforms and eligibility under climate finance

schemes, CSA practices still have difficulty in attracting private sector funding. A range of issues such as lack of access to technology, inadequate infrastructure, and unstructured markets can have a negative impact on basic productivity at the small-holder level, which can directly affect returns to investors.

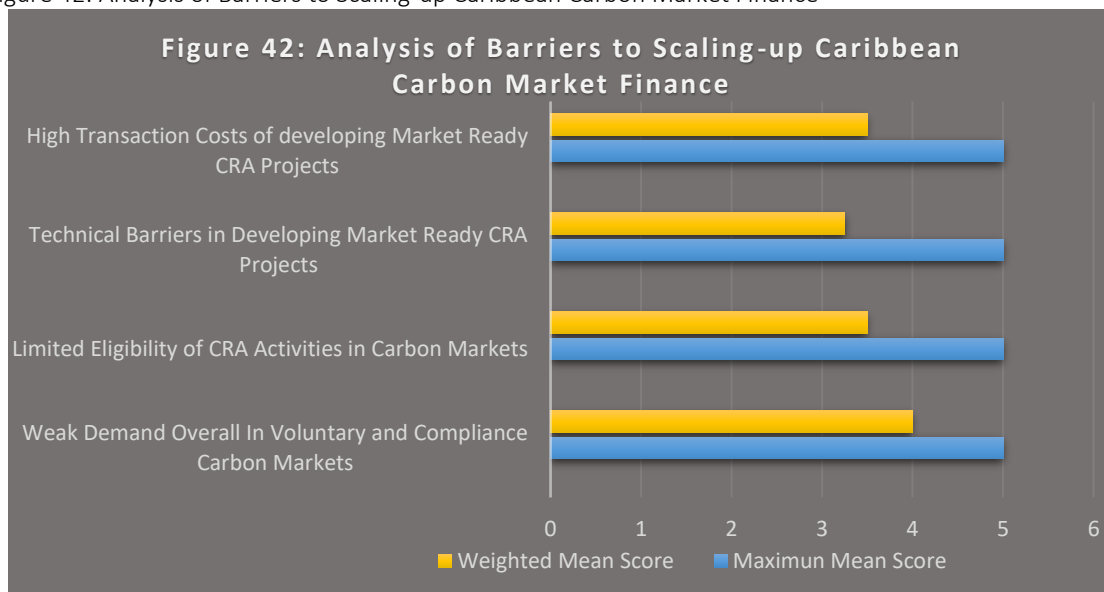
**Insufficient aggregation at the smallholder level (CGIAR 2011).** Smallholder farmers account for a significant percentage of all farming. Financing individual smallholders for any activities (climate change mitigation, adaptation or general agriculture activities) has high transaction costs, and aggregation may be required to create more efficient lending channels (i.e., bank financing of producer groups instead of individual farmers).

**Pre-requisites for smallholders to attract private funding.** The requirements for smallholder farmers to attract funding from the private sector are greater than those for public funding sources. Lack of land tenure, collateral, financial literacy, track records, basic financial services, aggregation, infrastructure, and market and product information are barriers for smallholders in obtaining the necessary financing to apply CSA practices (CGIAR 2011) These constraints influence the level of funding the private sector is willing to provide.

The outcome analysis of the barriers to the scaling up of carbon market finance is summarized and presented in **Figure 42**. The results obtained from this study strongly suggested that:

- There is a weak demand overall in voluntary and compliance carbon markets
- The limited eligibility of CRA activities in compliance and voluntary carbon markets is a major issue
- The high transaction costs of developing 'market ready' CRA projects are limiting the ability to scale up carbon markets finance for CRA
- There are the technical burdens of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA.

Figure 42: Analysis of Barriers to Scaling-up Caribbean Carbon Market Finance



The findings obtained in this study are consistent with those of the report of Gledhill et al., 2012, and are discussed below.

**Weak demand overall in voluntary and compliance carbon markets.** Carbon markets generally have experienced fluctuations in demand and cover prices as a result of instability in the economic conditions in many developed countries, and the lack of certainty of the market in the future. *Weakness and uncertainty in all carbon markets limit the ability to source finance for CSA activities from carbon markets*, increasing transaction costs and risks for developers and reducing potential returns from agricultural carbon projects.

**Limited eligibility of CSA activities in compliance and voluntary carbon markets.** There are a limited number of methodologies that can be used to quantify emission reductions from CSA practices. Under compliance markets, agricultural soil carbon management in croplands and grassland avoided deforestation and degradation are ineligible to generate emissions reductions under the Clean Development Mechanism (CDM), and afforestation and reforestation are ineligible under the European Union's Emissions Trading Scheme (EU ETS), which is the largest market for certified emissions reductions (CER). There is a wider range of methodologies appropriate for CSA in the voluntary carbon markets, but this is very small compared with compliance carbon markets (less than 1% of total global carbon markets) and the volume of emissions reductions generated to date is small.

**Technical burden and high transaction costs are borne by project developers.** Methodologies that do exist to generate emissions reductions from CSA activities are technically demanding, creating a need for project developers to rely on external consultants. This, as well as the high non-permanence risk buffers and the need for aggregation of emissions reductions above the farmer level, means that transaction costs for these types of projects are high. This high cost of developing 'market ready' CSA projects limits the ability to scale up carbon market finance for CSA.

The evaluation of the extent to which climate change funds were mainstreamed at the national and international development support levels revealed moderate outcomes.

## **5.11 Conclusion and Recommendations**

### **5.11.1 Overview**

Several socio-economic and market barriers that limit the transformation of Caribbean agricultural production systems from an "as-is or business-as-usual" state to climate-resilient production systems were analysed in detail under the various sections above. These barriers may be summarized as:

- Farm household characteristics such as gender, age, education, household structure (head of household, size of household)
- Farm enterprise characteristics such as type of commodity produced, farm size, farm income, the main source of income, farming experience, distance from the farm, land tenancy, extension services support, exposure to media, membership in agriculture-related association or group, and access to productive resources and markets (land, credit, labour, transport, market, information, incentives, insurance schemes)

- The farmers' perception of the effects of climate change on agricultural production
- Psychological capital (a form of non-cognitive skill), including indicators related to self-confidence, optimism, hope and resilience, in the adoption of CRA technologies and practices
- Overall different types of agricultural risks experienced by farmers and value chain actors across different socioeconomic backgrounds and geographic scales
- Riskiness and high cost of CSA technologies, including the related input
- Limited contributions of government and the private sector to the promoting of CRA technologies and practices
- Limited resource endowments of farmers (land, labor and capital) to invest in business opportunities associated with CRA TIMPs
- Limited access to credit, which has become more expensive, to invest and/or purchase required more expensive inputs - with the cost of these inputs rising and governments' removing of subsidies
- Producers competing with imported foods
- Lack of access to organized markets for produce, which is now monopolized by larger producers
- Inadequate risk sharing facilities, with the existing ones very costly
- Inadequate financial protection strategy of the countries
- Inadequate mainstreaming of CRA funds related to TIMPs at the sectoral, national and international levels.

This suggests the need for a wide range of interventions to promote CRA and to ensure that there is an environment conducive for farmers to adopt the technologies and practices. These interventions must focus on addressing the issues highlighted in the summary table below (**Table 25**). The alleviation of the issues may be considered the critical success factor in the transformation of Caribbean agricultural production systems from an "as-is or business-as-usual" state to climate-resilient production systems. The results of the analysis suggest the need to develop risk assessment procedures for access to funding based on project review, experience and motivation of applicants, rather than solely on ownership of land and other forms of collateral. There is also the need to provide technical assistance, mentoring, training, small grants and micro-finance for people, especially women and young people, starting on the entrepreneurship path and to 'top up' resources sourced from within family and friend networks.

Table 25: Key Socio-economic and Market Barrier Intervention Areas

Barrier	Specific Description
Economic	High initial investments
	Poor access to capital
	Uncertain returns and results
	Uncertain returns and results
	Hidden costs
	Competing financial priorities
	Long pay-back periods (ROI)
	Switching costs/existence of the installed base
	High implementation costs (actual and perceived)
	Temporal asymmetry between costs and benefits
	Over discounting the future
Market	Lack of market information

	Poorly developed marketing channels
	Long marketing chain dominated by middlemen
	Limited grades, quality standards, product traceability
	Limited storage for agricultural products which are mainly seasonal in production and perishable
	Poor transportation facility
	Limited aggregation of production for markets/marketing
<b>Consumers</b>	Poor information
	Lack of market attractiveness/do not align to preferences
	Uncertainty
	Consumers'/farmers' level of motivation
	Market uncertainty
<b>Behavioral/Psychological</b>	Lack of management support/awareness
	Conflict with traditional methods
	Overly complex technologies
	Results/effects of technology difficult to observe
	Farmer's beliefs and opinions
	The low trust of advisers or consultants/lack of acceptance
	Irrational behavior
	Negative presumed assumptions
<b>Social</b>	Social/peer pressures

In addition, this chapter would like to highlight three critical issues that should be addressed urgently:

- Land distribution and tenure systems
- Climate mainstreaming and climate proofing
- Development of a Financial protection strategy for each country.

### *5.11.2 Land Reform Policies*

Land in the Caribbean is heavily concentrated in the hands of a few holders. This unequal distribution of land ownership is an obstacle to economic, social and political development, as well as providing a constant reminder of historical injustice. It may also impede productivity and spur rural migration of landless farmers into environmentally vulnerable areas. In the case of highly polarized rights, and unequal access, to land, where land is underused by large owners, or when historical injustices need to be addressed, land redistribution emerges as a pivotal issue.

It is therefore recommended that the countries review existing land policies, the goal of which is to promote sustainable and equitable economic growth by enabling the land to play its role optimally as a factor in the production of goods and services. The land-related outcomes that are associated with the goal are:

- Efficiency, via increased tenure security, investment and dynamic land markets
- Equity, via access to resources by disadvantaged groups; and
- Sustainability, via efforts at land protection.

The recommendation, therefore, recognizes that the dialogue on land policies in most countries is driven by three overlapping and sometimes conflicting objectives:



- The development of a vibrant land market, with the aim of increasing productivity and investment, through secure, documented and transparent title to land.
- The elimination of poverty, through equitable access to land and other natural resources and the provision of security of tenure to poor households, allowing them to transform their land assets into sustainable livelihoods.
- The conservation of the natural environment and improvement of the built environment, through land use planning and environmental regulations.

The challenge here is to find the legal, institutional and policy measures to balance these three overlapping objectives.

The recommendation also recognizes that access to land, security of tenure and land management all have significant implications for livelihood, development, land degradation reduction, and investments in Sustainable Land Management (SLM); land tenure security is, moreover, central to agricultural production and sustainable use of natural resources. These are all crucial elements to consider in view of the challenges faced by humanity today, which include climate change, the provision of adequate and equitable housing, food security, disaster risk reduction, and peace and security.

### *5.11.3 Mainstreaming and Proofing of DRR and CCA Measures*

The need to embrace a methodological framework to enhance the **mainstreaming and proofing of disaster risk reduction (DRR) and climate change adaptation (CCA) measures** in public investments in the Caribbean region is very compelling. In this context, the Disaster Risk Reduction/Climate Change Financing Framework (DRR/CCFF) is being proposed as a robust methodology for the mainstreaming and proofing of DRR and CCA into public investments. The DRR/CCFF focused primarily on Public Finance Management (PFM) systems<sup>46</sup> and covers the entire PFM cycle. The approach taken allowed for the embedding of the DRR/CCFF within existing institutional arrangements.

The DRR/CCFF represents an integrated, structured set of policy and institutional instruments, primarily focused on budget systems and processes, that are expected to serve as the platform to increase the government's capacity to mobilize, manage, and target DRR and CCA finance at different levels. The methodology blends top-down guidelines under a whole-of-government approach, attached to a high-level strategic resource envelope, with bottom-up approaches for prioritizing allocations through the budget cycles at various levels of government, starting with the national to the sectoral/departments of government. It links policy decisions to budget allocations and expenditure tracking in a very structured way. It outlines specific steps to be undertaken to integrate DRR and CCA measures in public investments through the Public Financial Management (PFM) systems to ensure and enhance effective financing.

The six entry points for DRR/CCA mainstreaming and proofing in public investments are:

- The DRM and National Climate Change Coordination Mechanisms

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<sup>46</sup> Aspects of the PFM system include budget management cycle: financial planning, project preparation, project selection, budget and expenditure tracking, reporting and financial accountability.

- Sector Policies and Planning
- Medium Term Expenditure Framework.
- DRR/CCA Screening and Investment Appraisal
- Monitoring and Reporting System
- Accountability and Oversight.

#### *5.11.4 Promotion of an Enhanced Financial Protection Strategy*

It is recommended that each country in the Caribbean develop and implement a comprehensive **Financial Protection Strategy (FPS)**, which is intended to provide the mechanism for improving the country's financial resilience against natural disasters. Such a financial protection strategy should be aimed at ensuring that the public and private sectors, including micro, small and medium-sized enterprises, large enterprises along the entire food value chain, and more so the most vulnerable population can meet post-disaster financial requirements resulting from the impacts of climate change and variability induced natural hazards.

The FPS should be viewed as an integral part of the disaster and climate risk management agenda. In this context, the FPS provides the strategic direction for the development and implementation of sustainable and cost-effective financial policies and operational plans. To a large extent, it provides a clear roadmap of what is to be accomplished in supporting the government, businesses, households, farmers and fisherfolks, and the poor and most vulnerable in the society to manage the financial impacts of disaster and climate risks without compromising sustainable development, fiscal stability and wellbeing.

It is in this context that the proposed FPS should be aimed at strengthening disaster risk financial management over the long term, including:

- Developing a cost-effective FPS that builds on an optimal combination of financial instruments, including contingency budgets, national and local disaster (multi-year) reserves, contingent credit, and risk transfer instruments (including insurance). This is to ensure that cheaper sources of money are used first, with the most expensive instruments used only in exceptional circumstances. The intention of this approach is to channel funding in an efficient and timely manner to disaster-affected groups.
- Making disaster risk finance an integral part of a broader disaster risk management and climate change plan, complementing investments in prevention and risk mitigation.
- Reviewing the policy, legal, institutional and operational frameworks of available funds for natural disaster prevention and management aimed at strengthening the financial resilience of the country.
- Recognizing that the private sector is an essential partner as they can bring capital, technical expertise, and innovative financial solutions to better protect the government and society against natural disasters.

The development of a Financial Protection Strategy for the countries of the Caribbean is expected to provide benefits in the following ways:

- It helps to improve the country's financial resilience against natural disasters by providing a portfolio of implementable sustainable and cost-effective financial protection policies and operations.

- It helps minimize the cost and optimize the timing of meeting post-disaster funding needs without compromising development goals, fiscal stability, or the well-being of the population.
- It promotes comprehensive financial protection strategies to ensure that governments, small and medium-sized enterprises, large enterprises along the food value chain, and the most vulnerable populations can meet post-disaster financial needs resulting from the impacts of natural hazards and climate change and variability.
- It is an integral part of disaster and climate risk management.
- It supports governments, businesses, and households in managing the financial impacts of disaster and climate risks without compromising sustainable development, fiscal stability, or wellbeing.

The financial protection strategy should be located at the nexus of four major policy practices:

- Disaster risk management - how it contributes to building resilience.
- Public financial management- how it addresses the impact of shocks on public finances.
- Financial sector development- how it builds a strong financial sector for risk transfer.
- Social protection- how it supports contingent financing to reach the poorest.

In the context of the above, the Caribbean countries should increase their efforts along the following lines:

- Strengthen the catastrophic insurance market coverage.
- Evaluate the existing farm household insurance instruments, including those for low-income populations, with a view to creating financial instruments to help provide affordable hurricane insurance for low-income farm households.
- Develop the catastrophic insurance market for MSMEs, by fostering the development of new products and expanding penetration in MSMEs, especially in areas where some insurers have already initiated steps in this direction.
- Develop the microinsurance market, with a focus on the low-income population. The countries should therefore review options for expanding the list of microinsurance products and adapting current legislation with a view to promoting a responsible microinsurance market.
- Strengthen agricultural insurance, including for the fisheries sub-sector.

In terms of the **overarching goal of the FPS**: The Governments of Caribbean countries should seek to (i) sustain economic growth and protect development gains from disaster shocks, within the context of achieving the goals established under their **Vision Platforms**; and (ii) reduce the impact on the poorest and most vulnerable and prevent them from falling into a cycle of poverty.

# Chapitre 3: Market and Value chain angle

By Govin Seepersad

## Introduction

The AgREADY project logic is premised on a vision of developing “**A Climate Responsive Agricultural Sector in the Caribbean that supports food security, livelihoods and uses natural resources sustainably**” by addressing barriers of ineffective mechanisms and engagement with agricultural experts and stakeholders in GCF climate programming processes. The main objective is to conduct an analysis of the market and value chain barriers that limit the transformation of Caribbean agricultural production systems from an “*as-is or business-as-usual*” (conventional) state to climate-resilient production systems that provide strong arguments/rationale for private and public sector investments.

The Market and Value Chain analysis focuses on the following areas:

1. Conducting a comprehensive analysis on barriers that affect demand and supply in the Caribbean agricultural sector.
2. Analysing and proposing market development strategies for adoption or adaptation within the Caribbean region.
3. Reporting on key value chain barriers that affect the agricultural sector which will form a baseline for further research.
4. Proposing means and methodologies transcend the gap from the existing situation to the ideal agricultural environment within the Caribbean region.

This chapter covers the areas of existing and potential markets and will feed into the overarching barrier analysis and needs assessments of the enabling environment for the development of evidence-based climate-resilient responsive agriculture that is more attractive for private sector investments.

## 2. Conceptual model

In order to adapt to climate change risks in agriculture, farmers can use several adaptation strategies. These include use of short-duration crop varieties, adjustment in sowing time, use of stress-tolerant crop varieties and shifting to new crops (e.g. more stress tolerant, or with shorter or longer crop cycles). Adaptation practices include changes in planting dates, methods of application of fertilizer and water, and other aspects of crop management and cultivation practices. Adaptation practices are meant to reduce risk as low as reasonably practicable and may minimize the negative consequences of climate change.

In keeping with the Terms of Reference, this component of the study utilizes the barrier analysis methodology to assist with the collection and verification of agricultural and associated activity data from the sector. The data generated from the survey will be the basis for evidenced-based identification of projects for development and investment, which are bankable and aligned to regional and national priorities. The results will also inform best practices for institutional capacity building, coordination, and pipeline development through more robust proposals for building

climate-resilience along prioritized agricultural value chains, with a focus on cultivating the innovative capacity of the region's youth.

This Market and Value Chain component undertakes a comprehensive analysis of barriers that affect demand and supply in the Caribbean agricultural sector. It disaggregates the Supply Side of the Value Chain into its detailed components, from field production and support services up to post-harvest and marketing, and seeks to determine the mitigation or lack thereof at the respective nodes.

The Demand side looks at the buyers of the output be it intermediary or final products, more specifically the agro-processors and well as consumers. The output from the supply and demand side analyses will help to inform market development strategies for adoption or adaptation.

This study was carried out in nine Caribbean countries: **The Bahamas, Belize, Dominica, Haiti, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago.** While the Caribbean may be considered as a common climatic and geographical zone, most countries are largely different agroecological zones. While there may be some commonalities, many countries focus to some extent on different crops and livestock (**Annex 10, 11 and 12**). Nonetheless, the data collection strategy focused on “**Climate Responsiveness in Agriculture**” spread across food and agriculture priorities and across countries.

### 3. Data collection

#### *3.1 Identification of Levers towards Climate Change Mitigation*

Theory of Change (ToC) has become common in climate adaptation circles. The planning process articulates how change can be achieved by mapping the relationship between a long-term goal of a project and the intermediate and early changes that are required to bring it about. **Annex 8** provides a conceptual framework of the ToC. The concept works backward starting from the Desired Output (#1). The Problem is related to the issue at hand (#2). In order to get change, Pathways of Change or Levers will be required to assist with mitigation of the problem (#3) and the Intervention and Activities or change that are required to give you the desired outcome (#4). This will require an understanding of the Assumptions and Barriers that exists (#5). In this chapter, a Barrier Analysis was undertaken to determine the factors that have been preventing climate change adaptation from happening. It also assisted in the identification of indicators using a “Doer” or achievable benchmark and a “Non-Doer” approach.

#### *3.2 Approach to Data Collection*

In order to conduct the study, the agricultural system was disaggregated into (i) **The production stage** (ii) **The collection and processing stage** and (iii) **The trading stage** (*Annex 9*).

In order to collect the data, a structured questionnaire was developed. The questions were designed to acquire data on climate resilient practices used (or not being used) in the vegetable and livestock value chain. The supply side was disaggregated into nodes of the vegetable/fruit and livestock value chains. It focussed on those activities required to bring a product through various phases of farmers' production to its market destination. It also looks at farmers' climate resilient

agriculture knowledge, along with the market side in the crop and livestock value chain (processors and consumers).

Given the limited resources and time available for data collection, a total of 20 value chain actors were targeted to be surveyed in each of the nine countries. Both supply side and demand side were enumerated and analysed. The supply side includes vegetable/fruit and livestock farmers, and input suppliers (**Table 26**).

The collected data was coded and entered into Google Forms which facilitated the real-time generation of descriptive statistics.

The results were used to determine what climate-resilient practices are being used in the livestock and crop value chains. Alternatively, where climate-resilient practices were not being used, the results determined why this is the case. The results will help to inform policy formulation and interventions necessary to help farmers adapt to climate change and mitigate against emissions of greenhouse gases (GHGs).

Table 26: Nodes in the Agribusiness Value Chain - Examples of Climate Change Risks and Opportunities

CRITERIA	RISKS	Process	OUTPUT / OPPORTUNITY
<b>Climate Change Information</b>	✓ Identification of the major types of risks that impact on Caribbean Agriculture.	✓ Verification of published works and experiences with respect to climate change through literature review and market information	✓ Knowledge of methodology to be used for climate change related study, experiences in other jurisdictions, correlation of producer / consumer prices and climate related factors. Quantitative analysis of data to support recommendations and levers.
<b>SUPPLY SIDE</b>			
<b>Raw Materials Sourcing</b>	✓ Availability of agricultural commodities and raw materials for production (eg. Disrupted supply, factory down time)	✓ Verification whether other forms of mitigation equipment, more selective pesticides, additional amounts of livestock feeds, etc are easily available and ease of sourcing; finance available for sourcing; training to use new equipment to facilitate training	✓ Information of whether higher precision irrigation equipment, improved pesticides, knowledge on its use to facilitate demonstration, additional volumes, and sources of feeds, etc are required. Policy re-formulation. Quantitative and qualitative analysis of data to support recommendations and levers.
<b>Production</b>	<ul style="list-style-type: none"> <li>✓ Increasing drought</li> <li>✓ Increasing floods</li> <li>✓ Unpredictable rainfall</li> <li>✓ Temperature increases</li> <li>✓ More intense or frequent storms</li> </ul>	✓ Verification whether producers mitigate or not against climate change risks; what made it possible to mitigate, what agronomic, livestock production and technical factors prevent producers from mitigating; whether its their level of knowledge of interventions that can be used to mitigate, shortage of finance, availability, expected marginal returns do not warrant the intervention, inability to cope or indifference	✓ Information of the barriers preventing intervention or adoption of mitigation strategies; enabling environment required – whether it requires provision of public or private goods, technical training, market information and intelligence, risk information or finance; forage banks, renewed focus on well adapted breeds, better housing designs, etc. Quantitative and qualitative analysis of data to support recommendations and levers.
<b>DEMAND SIDE</b>			
<b>Processors</b>	<ul style="list-style-type: none"> <li>✓ Commodity price volatility (eg. Prices during shortages)</li> <li>✓ Shortages and oversupply situations</li> </ul>	✓ Verification of type of climate change event affecting processors, type of impact and knowledge and adoption of coping / mitigation strategies	✓ Information of whether there is the need for new sources of supply, contract farming, production expansion, guaranteed prices, diversification of supply base to less risky areas, assistance with expansion of storage, knowledge sharing with respect to demand, etc. Quantitative and qualitative analysis of data to support recommendations and levers.
<b>Sales / Consumers</b>	✓ Changes in consumer preferences, consuming patterns, (eg. Shortages / higher prices)	✓ Verification of consumers knowledge about climate change and its impact on suppliers of food; willingness to pay for climate change mitigation services	<ul style="list-style-type: none"> <li>✓ Demand for climate-resilient products and services (eg. willingness to pay for climate smart produce, innovative labelling)</li> <li>✓ Demand for new products, services and labelling</li> </ul>

	discourage consumption)		✓ Consumers reaction to seasonality through quantitative and qualitative analysis of data to support recommendations and levers.
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Thus, the results from the VC analysis can be used to inform the facilitators in the Enabling Environment (Input Services Providers & Government) involved in Supply of Technology, Policy Formulation, Utilization and Consumption, the Development of Levers and Implementation of Strategies for Action). The results will feed into the policy and socioeconomic aspects of the study and inform the development of coping strategies such as formulation of water policies for agriculture, buildings, road, and drainage infrastructure, and changes in societal behaviours and norms.

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## ***Part B: Adaptation: Determination of the Changes in the Suite of Levers Used in Production and Marketing***

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### **4.Results of the study**

Climate change has been manifesting itself in different ways and showing increasing intensity in the Caribbean Region, through the higher frequency of storms, droughts and less-marked differences between wet and dry seasons for example. The variety of effects has been impacting the food value chains and some of the reactions to it are being determined in this study, the output of it will inform recommendations on the way forward.

A review of various studies found different types of interventions which include increasing resilience to climate change along the various value chain segments (i.e., pre-production, production, processing, storage, transport, retail, and consumption), including building the level of market access which focuses on helping smallholders to organize themselves and overcome the barriers of entry to higher-earning markets.

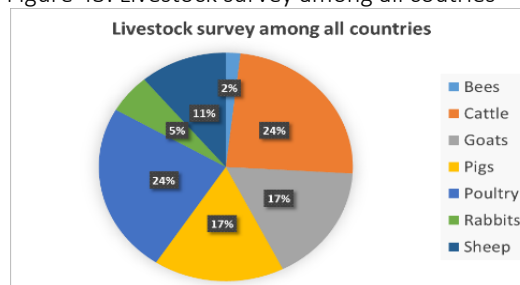
Given that it is not possible to include all interventions in a single project, prioritization of a top set of climate risks is critical. Climate risks that affect small producers have focused on agricultural production, from pre-production to post-production phases of the chain. Focus has been placed on the following three elements:

- I. **Diversification:** Inclusion of a wider set of options to increase farmers' livelihood, farming and environmental management portfolios as a risk management strategy.
- II. **Climate-proofing:** Specific interventions to make key stages of the value chain more climate resilient in ways that bring livelihood and resilience benefits to farmers.
- III. **Supply chain efficiencies:** Measures such as inventory management that increase efficiency, deliver higher profitability (and hence higher adaptive capacity in a general sense) to farmers and small businesses in the value chain, and generate mitigation co-benefits.

## 5. Analysis of the impact of climate change on the CARICOM livestock value chain

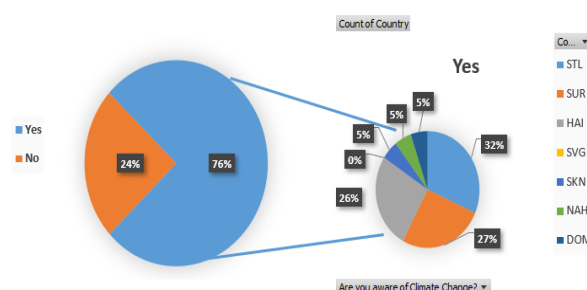
1. The survey comprised of 54 responses and 7 livestock species. A total of 28% was done in St. Lucia, 24% Suriname, 20% Haiti, 16% SVG, and 4% each for SKN, Bah and Dom.

Figure 43: Livestock survey among all countries



2. The study found a high level of **awareness about climate change** amongst livestock farmers in the CARICOM Region. A total of 76% said they were aware while only 24% was unaware. The highest level of awareness was in St. Lucia (32%) followed by Suriname (27%) Haiti (26%).

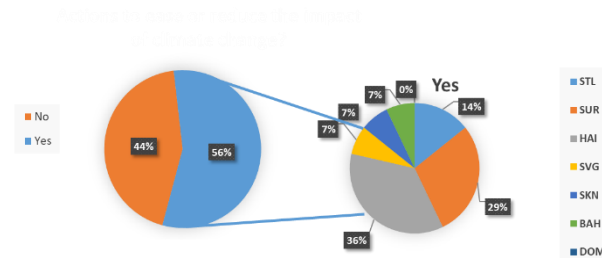
Figure 44: Awareness about climate change



3. The study sought to enquire whether livestock farmers were aware of **weather change over the last year**. A total of 84% said yes, 8% did not recall and another 8% said no.
4. An estimated 52% said that they **could manage your farm business well under more intense impacts of climate change**; 28% said no and 20% did not know.

Figure 45: Farmers that took action to reduce the impact of climate change

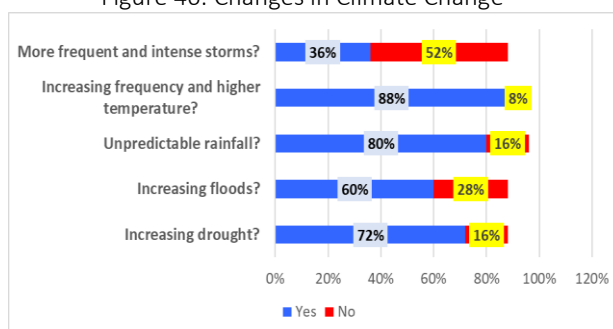
5. A total of 56% **took action to ease or reduce the impact of climate change**. The highest “doers” were from Haiti (36%) followed by Suriname (29%).





6. The highest **response to changes in Climate Change** was with respect to higher temperature (88%) and unpredictable rainfall (80%).

Figure 46: Changes in Climate Change

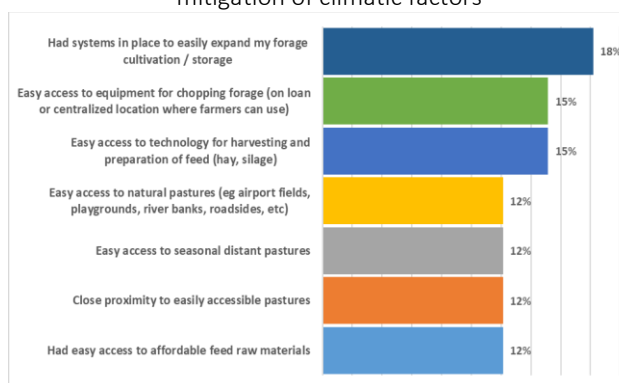


### 5.1 Doers in the livestock production system

In anticipation of climatic factors that impacted the livestock production operation, the levers that made it easy to continue include:

- having systems in place to easily expand forage cultivation/storage (18%),
- easy access to chopping equipment (15%) and,
- easy access to technology for harvesting and feed preparation (15%).

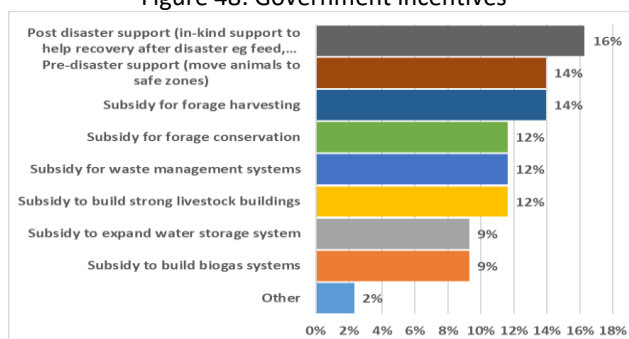
Figure 47: Levers that facilitate the mitigation of climatic factors



Government incentives that made it easy to continue your livestock operation include:

- Post-disaster support such as in-kind support to help recovery after disaster e.g. feed, breeding stock, etc. (16%)
- Pre-disaster support such as moving animals to safe zones (14%)
- Subsidy for forage harvesting (14%)

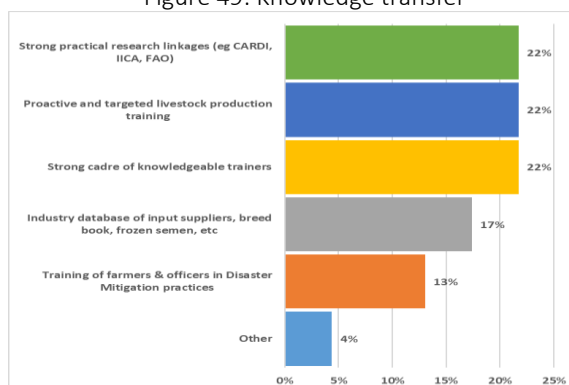
Figure 48: Government incentives



Features of the knowledge transfer system that made it easy to continue the livestock operation include:

- Strong practical research linkages (e.g. CARDI, IICA, FAO) (22%)
- Proactive and targeted livestock production training (22%)
- Strong cadre of knowledgeable trainers (22%)

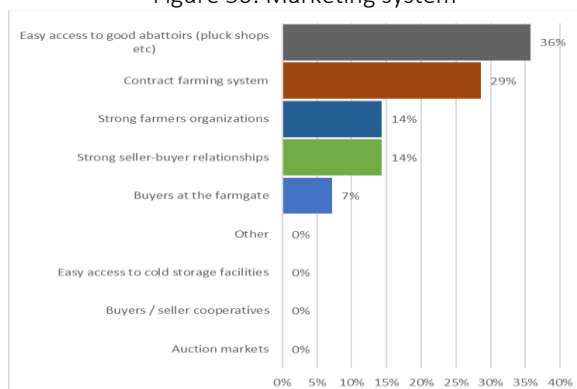
Figure 49: Knowledge transfer



Features of the marketing system that made it easy to continue the livestock operation include:

- Easy access to good abattoirs (pluck shops, etc.) (36%)
- Contract farming system (29%)
- Strong farmers organizations (14%)
- Strong seller-buyer relationships (14%)

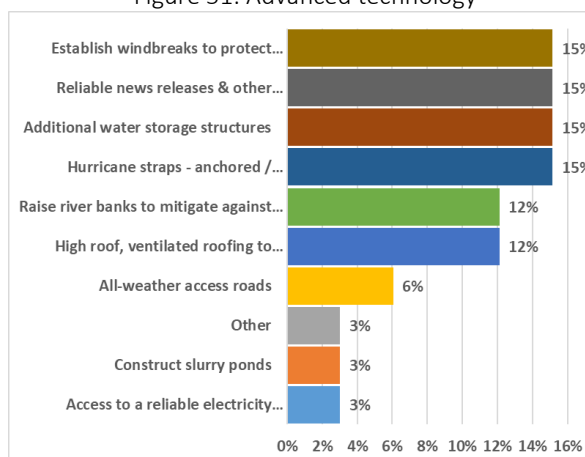
Figure 50: Marketing system



Extra-ordinary or advanced technology used in the production system that made it easy to continue the livestock operation include:

- Establishment of windbreaks to protect buildings (15%)
- Reliable news releases & other means of communication (15%)
- Additional water storage structures (15%)
- Hurricane straps – anchored/ reinforced roofing (15%)

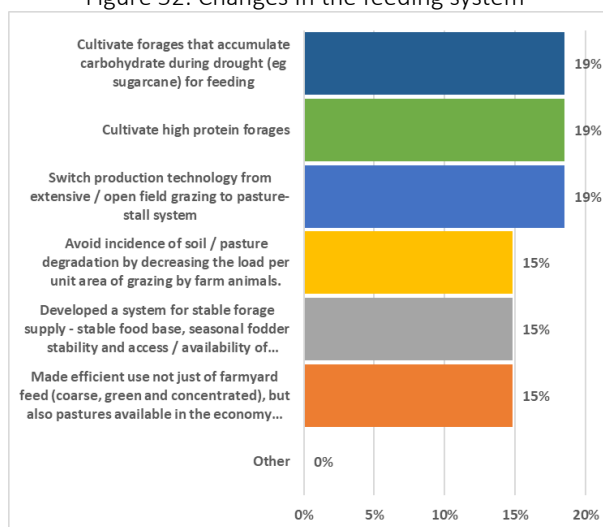
Figure 51: Advanced technology



Changes in the feeding system that made it easy to continue the livestock operation include:

- Cultivation of forages that accumulate carbohydrates during drought (e.g. sugarcane) for feeding (19%)
- Cultivation of high protein forages (19%)
- Switch production technology from extensive/open field grazing to pasture-stall system (19%)
- Avoid incidence of soil / pasture degradation by decreasing the load per unit area of grazing by farm animals. (15%)
- Developed a system for stable forage supply - stable food base, seasonal fodder stability and access / availability of... (15%)
- Made efficient use not just of farmyard feed (coarse, green and concentrated), but also pastures available in the economy... (15%)

Figure 52: Changes In the feeding system

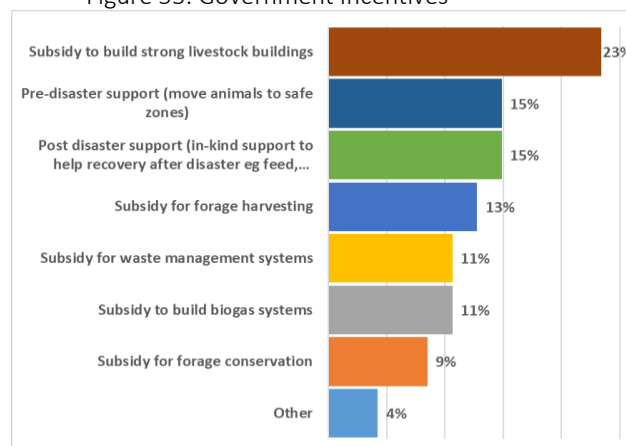


## 5.2 Non-Doers in the livestock production system

**NON-DOER: Government Incentives** - In anticipation of drought, flood, or any of the climatic factors, the levers that will make it easier to continue the livestock operation include:

- Subsidy to build strong livestock buildings (23%)
- Pre-disaster support (15%)
- Post-disaster support (15%)
- Subsidy for forage harvesting (13%)
- Subsidy for waste management systems (11%)
- Subsidy to build biogas systems (11%)
- Subsidy for forage conservation (9%)
- Other (4%)

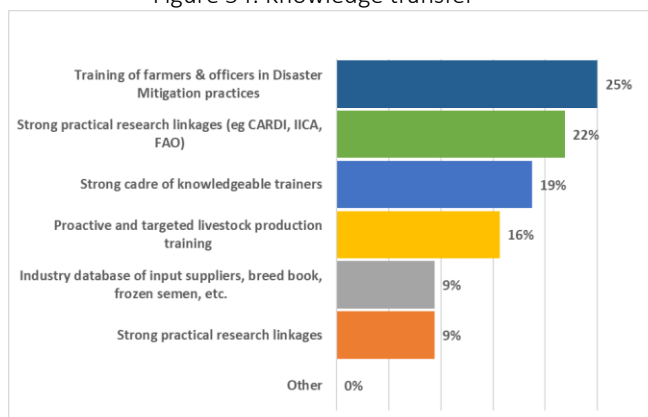
Figure 53: Government Incentives



The features of the knowledge transfer system that would make it easy to continue the livestock operation include:

- Training of farmers & officers in Disaster Mitigation practices (25%)
- Strong practical research linkages (e.g. CARDI, IICA, FAO) (22%)
- Strong cadre of knowledgeable trainers (19%)
- Proactive and targeted livestock production training (16%)
- Industry database of input suppliers, breed book, frozen semen, etc. (9%)
- Strong practical research linkages (9%)
- Other (0%)

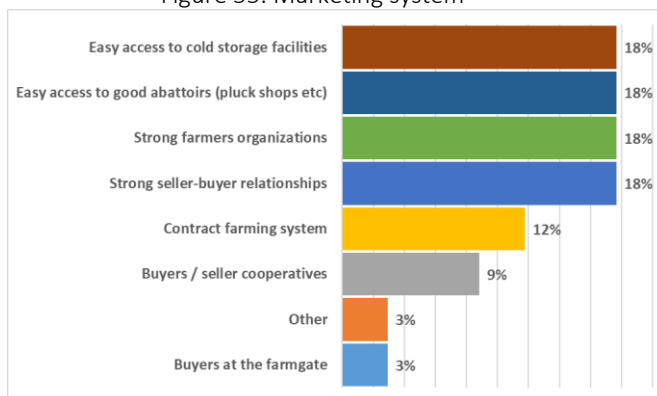
Figure 54: Knowledge transfer



The features of the marketing system would make it easy to continue the livestock operation include:

- Easy access to cold storage facilities (18%)
- Easy access to good abattoirs (pluck shops etc) (18%)
- Strong farmers organizations (18%)
- Strong seller-buyer relationships (18%)

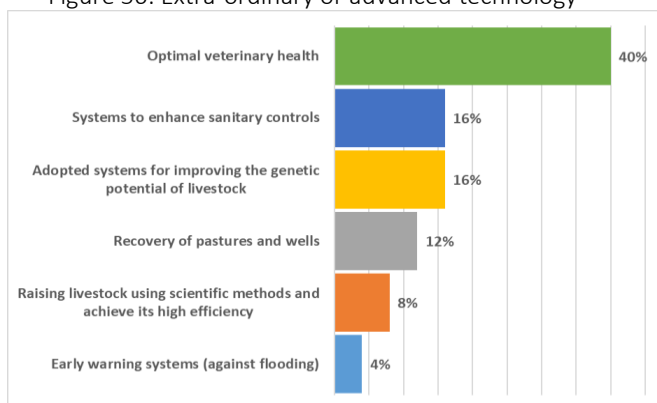
Figure 55: Marketing system



The extra-ordinary or advance technology used in the production system that would make it easy to continue the livestock operation include:

- Optimal veterinary health (40%)
- Systems to enhance sanitary controls (16%)
- Adopted systems for improving the genetic potential of livestock (16%)

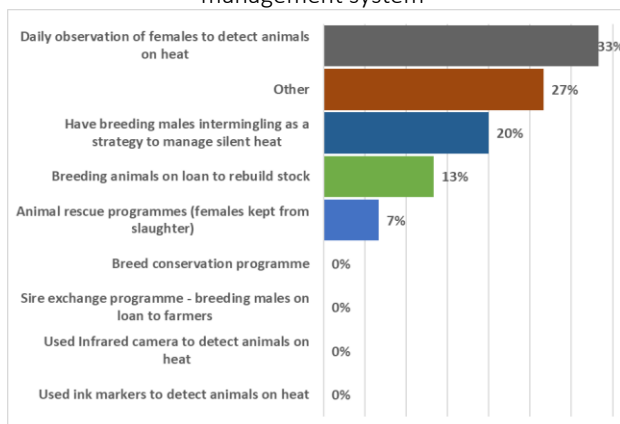
Figure 56: Extra-ordinary or advanced technology



The features of the breeding/reproduction management system that would make it easy to continue the livestock operation include:

- Daily observation of females to detect animals on heat (33%)
- Other (27%)
- Have breeding males intermingling as a strategy to manage silent heat (20%)

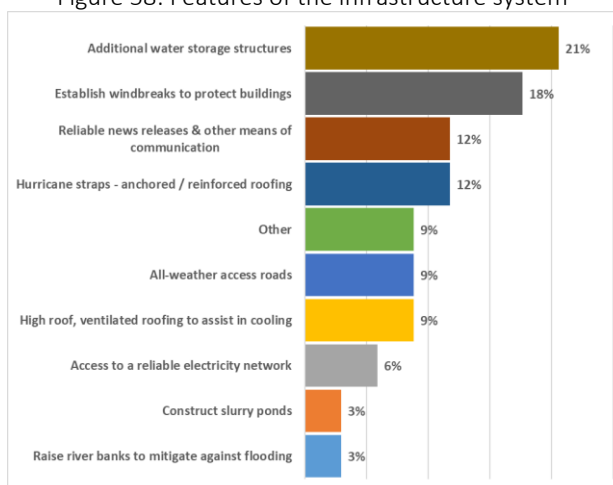
Figure 57: Features of the breeding/reproduction management system



The features of the infrastructure system that would make it easy to continue the livestock operation include:

- Additional water storage structures (21%)
- Windbreaks to protect buildings (18%)
- Reliable news releases & other means of communication (12%)
- Hurricane straps - anchored / reinforced roofing (12%)

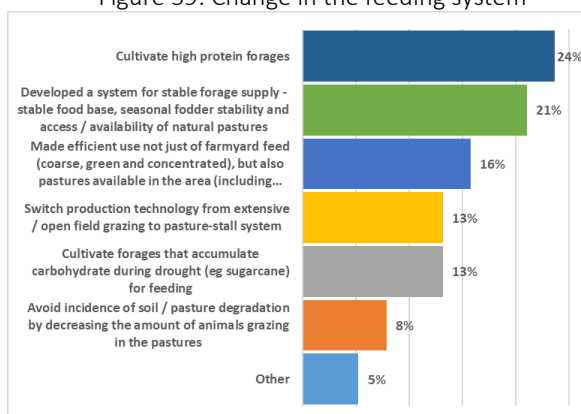
Figure 58: Features of the infrastructure system



The change in the feeding system that would make it easy to continue the livestock operation include:

- Cultivate high protein forages (24%)
- Developed a system for stable forage supply (21%)
- Efficient use of farmyard feed, pastures available in the area including roadside / "long acres" (16%)

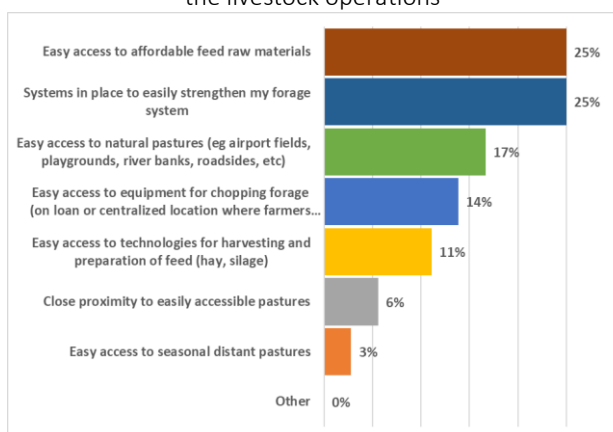
Figure 59: Change in the feeding system



The following will also make it easy to continue the livestock operation:

- Easy access to affordable feed raw materials (25%)
- Systems in place to easily strengthen my forage system (25%)
- Easy access to natural pastures (17%)

Figure 60: Other things to facilitate the continuation of the livestock operations



## 6. Analysis of the Impact of Climate Change on the CARICOM Crop Value Chain

### 6.1 Introduction

The crop production survey included 29 respondents from the countries of Haiti which accounted for 50% of respondents, Suriname 25%, St. Kitts & Nevis 15%, Trinidad and Tobago 5% and The Bahamas 25%. The average farm size was 21.5 acres in Haiti, 3.7 acres in Trinidad and Tobago, 1.4 in St. Kitts & Nevis and 1.3 in Suriname.

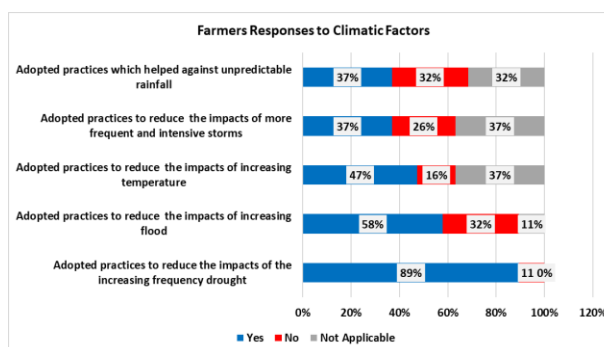
The impacts of climate change are known to aggravate deficiencies in the knowledge base of technical personnel and manifest itself in various forms. This study used a “Doer” vs “Non-doer” approach. In general, an estimated 75% of the farmers acted to ease or reduce the impact of climate change. Of this, 89% acted to reduce the impact of drought, 58% adopted practices to reduce the impact of increasing floods, 47% increasing temperature and 37% to increasing frequency of storms, 37% acted to address unpredictable rainfall. An estimated 80% said the weather pattern is different this year when compared to last year. To triangulate further, 60% said that rain came unexpectedly soon after the farmers applied a weedicide or insecticide, all showing a high level of awareness to climate change.

Respondents (65%) said their present knowledge, money, and skills would allow them to manage their farm business

### 6.2 Drought

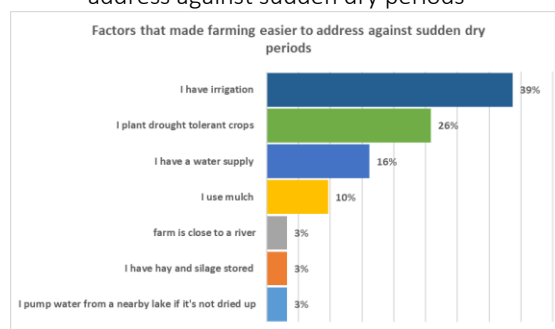
When farmers are impacted by drought, adequate water for crop (and livestock) production becomes the major challenge. Climatic changes may also create favourable conditions for certain pests, moving them beyond the economic threshold. Sourcing and setting up irrigation equipment may also be a challenge. This section looks at how farmers responded to periods of drought and their coping strategies. The responses are based on Doers’ that participated in the survey.

Figure 61: Farmers Responses to Climatic Factors



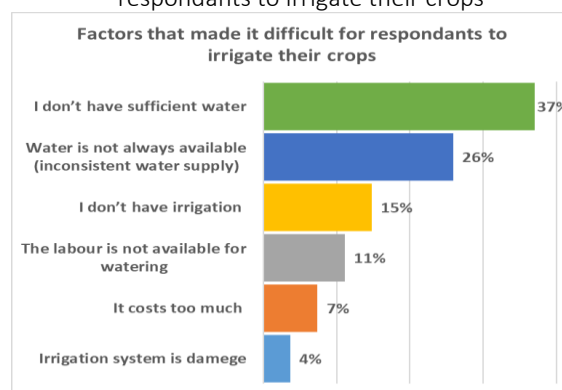
The top two factors that made farming easier to address during sudden dry periods were having irrigation (39%) and planting drought tolerant varieties (26%).

Figure 62: Factors that made easier to address against sudden dry periods



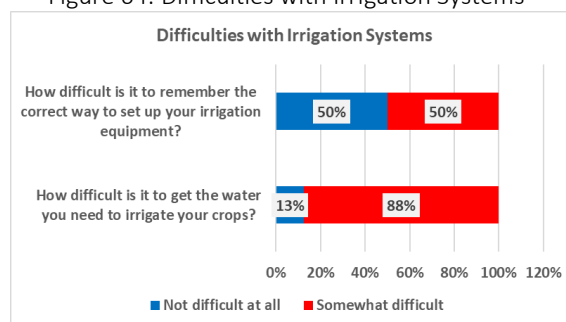
The factors that made it difficult for respondents to irrigate their crops were insufficient water (37%) and its inconsistent availability (26%).

Figure 63: Factors that made it difficult for respondents to irrigate their crops



**Difficulties with Irrigation Systems:** Producers who have an irrigation system also have challenges. The study found that 50% found it somewhat difficult to remember the correct way to set up their irrigation system, highlighting the need for irrigation technology education.

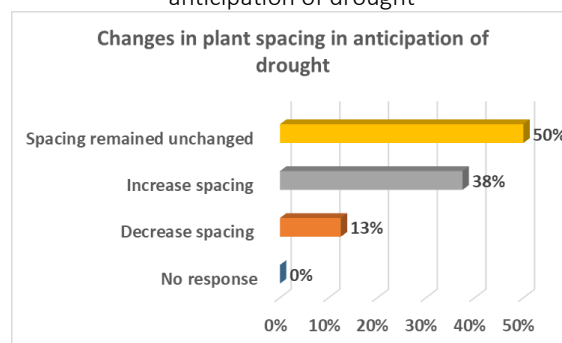
Figure 64: Difficulties with Irrigation Systems



Further, 88% said they experienced difficulty getting water to irrigate the crop.

**Plant Spacing practices:** During periods of drought, vegetable farmers are expected to use closer spacing during crop establishment. However, the study found that 50% kept the spacing the same, and 38% used wider spacing while only 13% reduced spacing. This highlights the need for crop production R&D as well as technology transfer.

Figure 65: Changes in plant spacing in anticipation of drought



**Plant propagation:** In response to drought, 47% of producers used older seedlings for transplanting, as well as shifted to container-grown seedlings (26%).

Figure 66: Change of method of plants propagation in response to drought

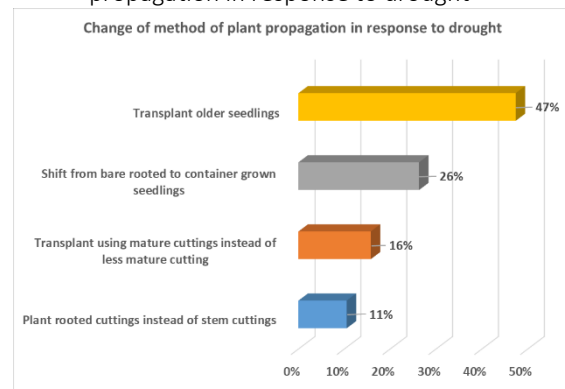


Figure 67: Change your method of transplanting in anticipation of drought

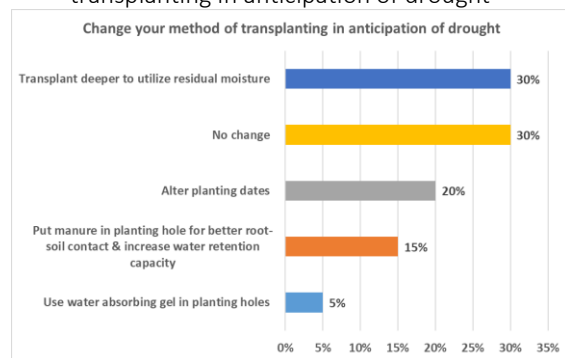
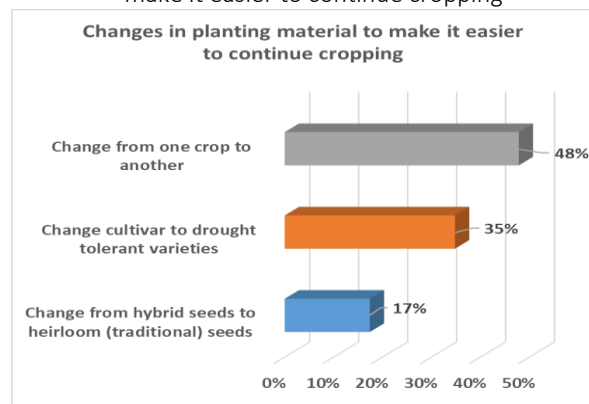


Figure 68: Changes in planting material to make it easier to continue cropping



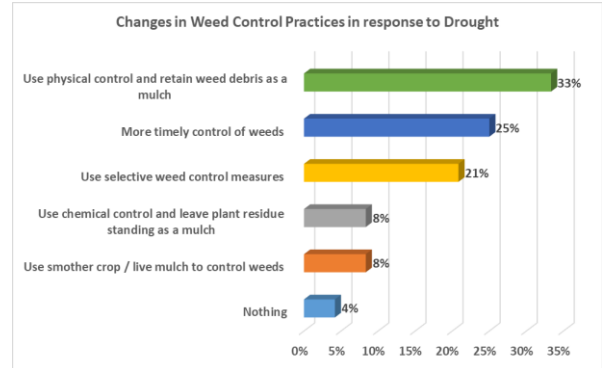
**Method of transplanting:** In anticipation of drought, 30% of growers planted deeper and 20% altered planting dates which is the expected response. However, 30% did not plant at greater depth, again highlighting the need for drought mitigation practices.

**Changes in planting material:** In order to cope with drought, it is expected that growers will switch to drought-tolerant crops as a strategy to continue cropping. From the survey data, 48% changed from one crop to another while 35% changed cultivars towards more drought tolerant varieties. There was also a change from hybrid seeds to heirloom seeds (17%).



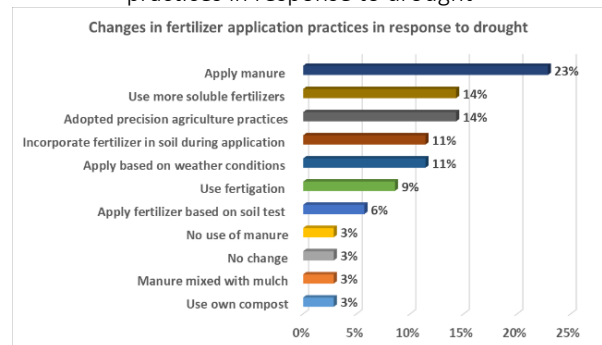
**Weed Control:** During periods of drought, weed growth is reduced and the cut weeds can be used for mulch. In response to drought, 33% of growers used physical weed control practices and retained weed control debris to use as mulch, 25% did more timely weed control; a practice that will reduce competition for water and 21% used selective weed control measures.

Figure 69: Changes in Weed Control Practices in responses to Drought



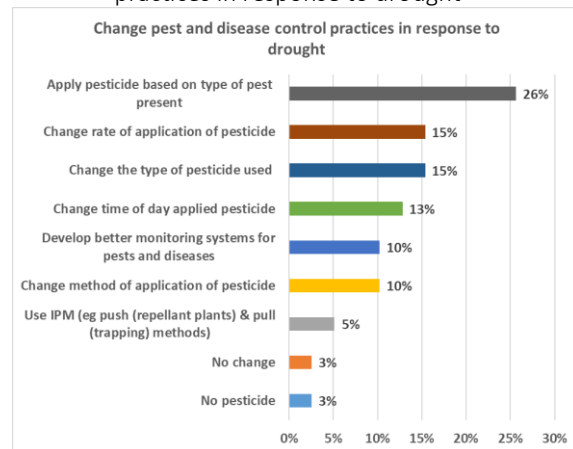
**Fertilizer application:** During periods of drought, precision agricultural practices such as fertigation are expected. The study found that 23% of respondents applied manure, 14% used more soluble fertilizers, and another 14% used precision agriculture practices. Other practices included the incorporation of fertilizer during land preparation; apply based on weather conditions amongst others; all rational decisions.

Figure 70: Changes in fertilizer application practices in response to drought



**Pest and Disease Control:** The weather, when favourable to certain pests can lead to crop damage beyond the economic threshold. Growers reported that they changed their pest control practices: 26% selectively applied pesticides based on the pest that is present, 15% changed the rate of application and 15% changed the type of pesticide used.

Figure 71: Change pest and disease control practices in response to drought



**Systems that made it easy to cope with drought:** A total of 14% reported installation of irrigation, 12% had a supply of irrigation water, 12% knew how to set up an irrigation system and 10% had money to purchase an irrigation system. What is notable is the low number of operators with irrigation.

Figure 72: System that made it easy to irrigate crops

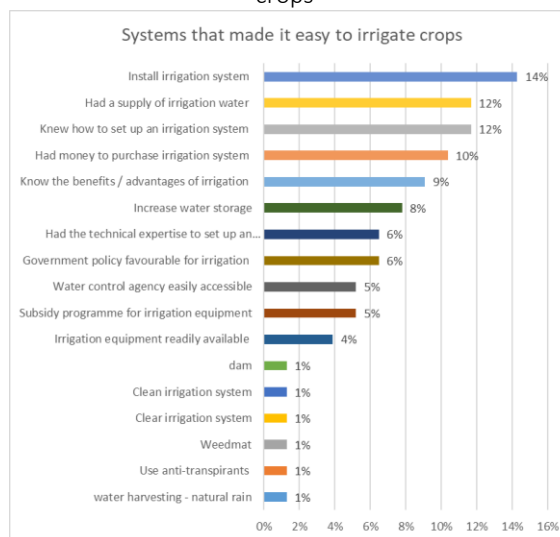


Figure 73: Changes in crop harvesting practices in anticipation of drought

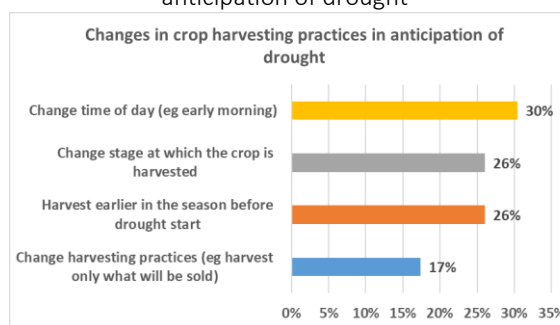
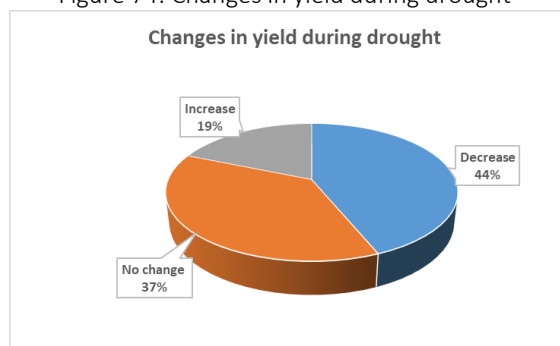


Figure 74: Changes in yield during drought



**Crop Harvesting Practices:** Dry weather may be associated with high temperatures, full sunlight and water loss in some cases. Changes in crop harvesting practices include harvesting during the cooler time of day (30%), changing the stage at which the crop is harvested (26%) and harvesting previous crops earlier in the season before the drought started (26%).

**Changes in yield:** During periods of drought, yields may vary depending on whether water is available, pest populations, management systems amongst others. The study found that 44% experienced a decrease, 19% an increase while 37% had no change.

This response should be triangulated where 88% said they experienced difficulty to get water to irrigate the crop as well as 14% reported they installed irrigation, and 12% had a supply of irrigation water. Thus, the availability of water as well as irrigation would need attention as the region plan its regional climate change mitigation strategy.

**Postharvest Practices:** In anticipation of drought, respondents said they would keep their harvested crop in a damp environment (45%). Depending on the vegetable/fruit, this practice may be intended to reduce water loss from the harvests.

Figure 75: Changes in postharvest practices in anticipation of drought

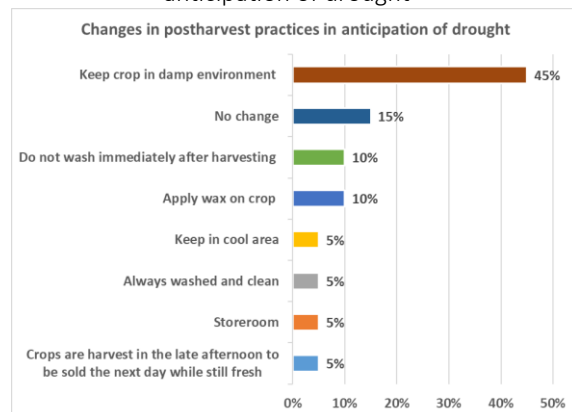


Figure 76: Changes in aggregation (collection) and transport practices in anticipation of drought

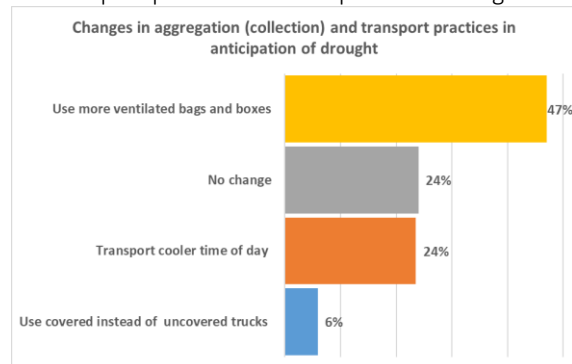
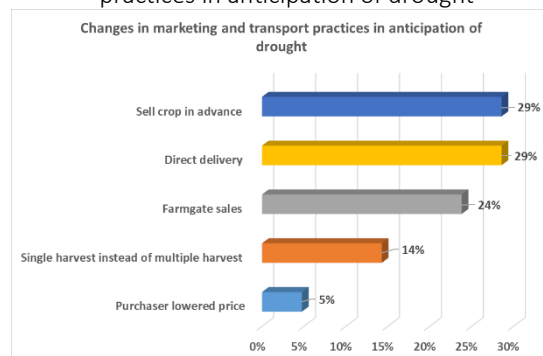


Figure 77: Changes in marketing and transport practices in anticipation of drought

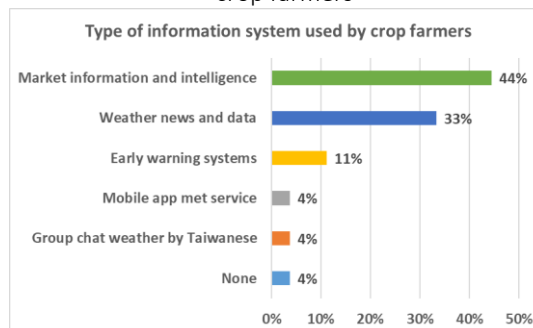


**Aggregation (Collection) and Transport Practices:** Changes in aggregation (collection) and transport practices include use of more ventilated bags and boxes as a heat management strategy by 47% of respondents.

**Marketing and Transport Practices:** In anticipation of drought, changes in marketing and transport practices include selling crop in advance (29%), direct delivery (29%) and farmgate sales (24%). Clearly these strategies are directed at transferring the products in the shortest possible time as well as hedging to reduce losses.

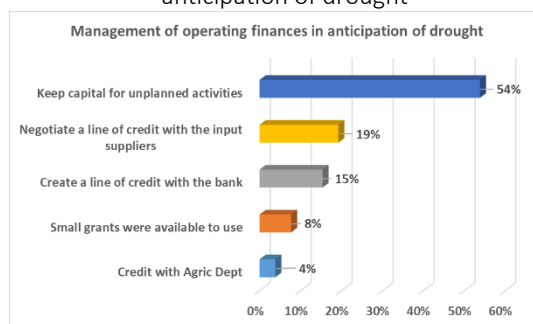
**Information Systems:** In response to climate change, the type of information system used by crop farmers include market information and intelligence (44%) as well as weather news (33%). Early warning systems, mobile app from the met services and group chat were not very common.

Figure 78: Type of Information system used by crop farmers



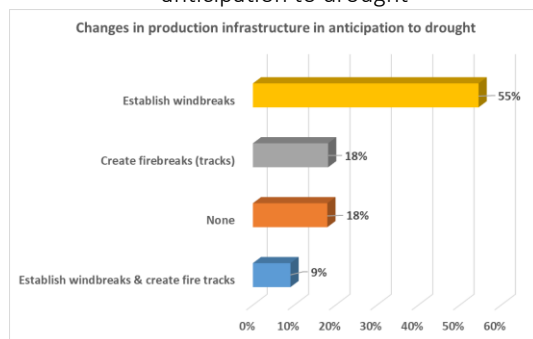
**Operating Finances:** A strategy of keeping capital for unplanned activities was reported by 54% of farmers. Credit facilities and access to small grants were not very common.

Figure 79: Management of operating finances in anticipation of drought



**Risk Infrastructure:** Changes in production infrastructure in anticipation included the establishment of windbreaks (55%) as well as firebreaks (18%).

Figure 80: Changes in production infrastructure in anticipation to drought



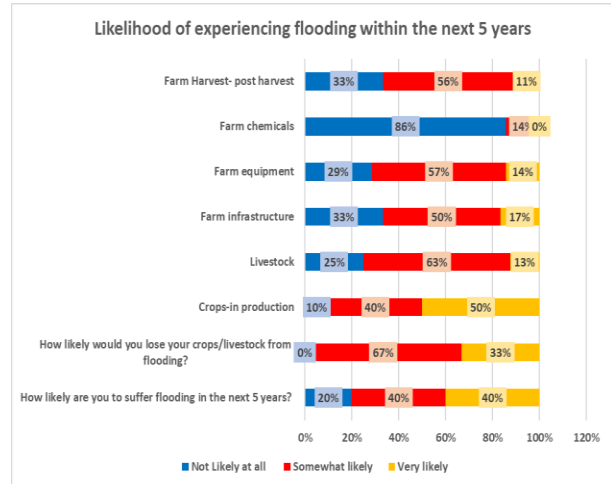
## 6.3 Flooding

### Likelihood of experiencing flooding within the next 5 years

The likelihood of experiencing flooding is very high amongst certain categories and is a **cause for alarm**. For example, data shows that:

- 50% of respondents are “*very likely*” and 40% “*somewhat likely*” to lose their crop under production.
- 33% are “*very likely*” and 67% “*somewhat likely*” to lose their crop/livestock from flooding, and
- 40% are “*very likely*” and 40% “*somewhat likely*” to suffer flooding in the next 5 years.
- Persons are also somewhat likely to lose farm equipment, farm infrastructure, and livestock.

Figure 81: Likelihood of experiencing flooding within the next 5 years

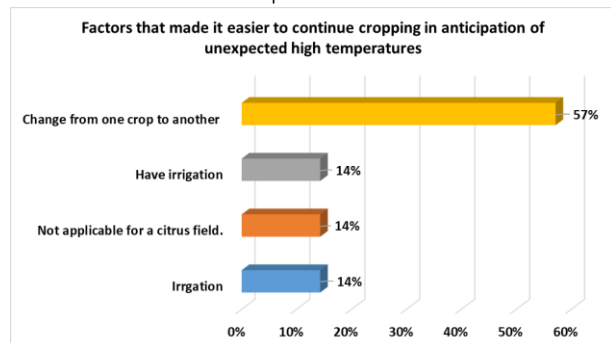


**As climate change is likely to intensify and flooding becomes more likely, greater attention will be required with respect to flood mitigation.**

## 6.4 High Temperatures

**HIGH TEMPERATURES:** An estimated 57% changed from one crop to another as a strategy to continue cropping in anticipation of unexpected high temperatures. This strategy will also be dependent on the crop being affected.

Figure 82: Factors that made it easier to continue cropping in anticipation of unexpected high temperature



**METHOD OF TRANSPLANTING.** Transplanting method varies by type of crop. Nonetheless, 43% didn't change their method, however, 28% said they wet soil and transplant deeper to utilize soil moisture and others (29% alter the planting time during the day).

Figure 83: Change in method of transplanting in anticipation of unexpected high temperature

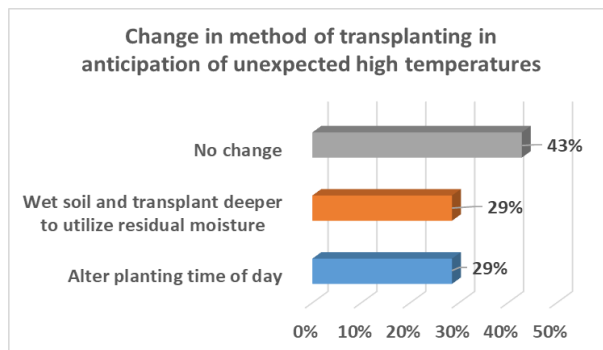


Figure 84: Factors that made it easier to irrigate crops in anticipation of unexpected high temperatures

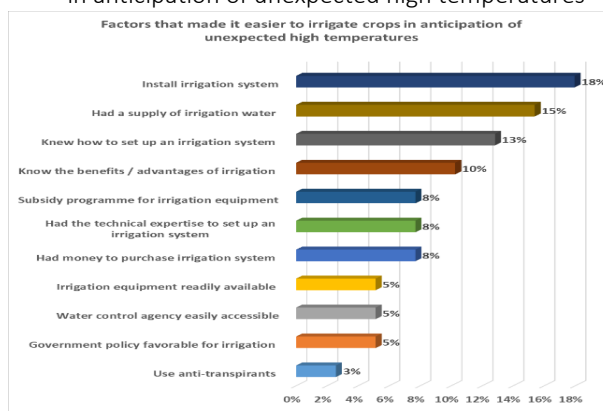
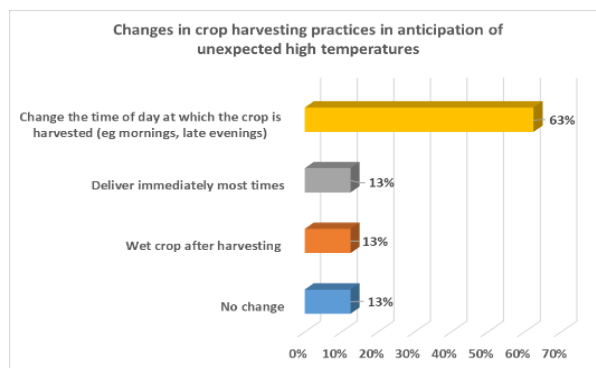


Figure 85: Changes in crops harvesting practices in anticipation of unexpected high temperatures

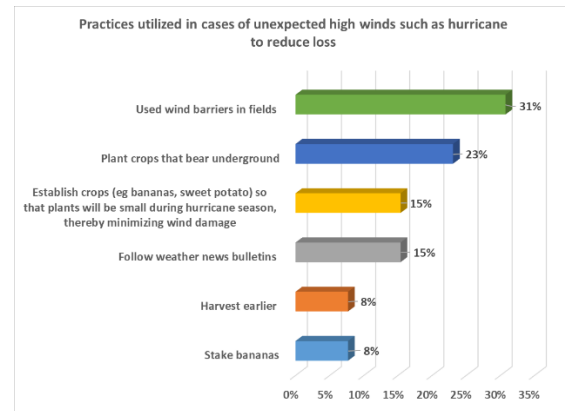


**CROP HARVESTING:** Producers indicated they changed the time of harvest to the cooler time of day in anticipation of unexpected high temperatures.

## 6.5 High Winds

**HIGH WINDS:** In anticipation of unexpected high winds such as hurricanes, producers used wind barriers (31%), planted crops that bear underground (23%), and in a few cases establish crops such as banana at a time when the plants will be small in the hurricane season (15%) in order to reduce losses. The mitigation strategy will change according to the type of crop however, this should be an area for greater focus where production corridors are given special attention such as windbreak establishment, advising on the choice of crops, etc.

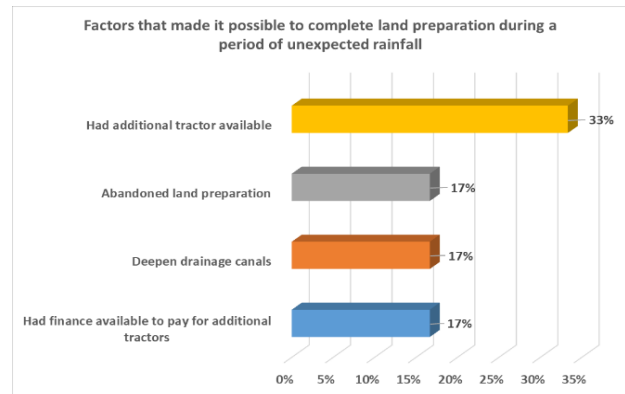
Figure 86: Practices utilized in cases of unexpected high winds such as hurricane to reduce loss



## 6.6 Unexpected rainfall

**LAND PREPARATION:** Unexpected rainfall during land preparation affects the efficiency of land preparation (e.g. effort per unit area) and also its adequacy (tillage/refinement required). In order to address the loss of efficiency and effectiveness, tractors operators may need additional tractors and or tractor power to complete the task on time. If the rainfall is too heavy, it may mean a loss of opportunity to prepare the land and establish the crop. These features can be measured in terms of costs to the farm operation.

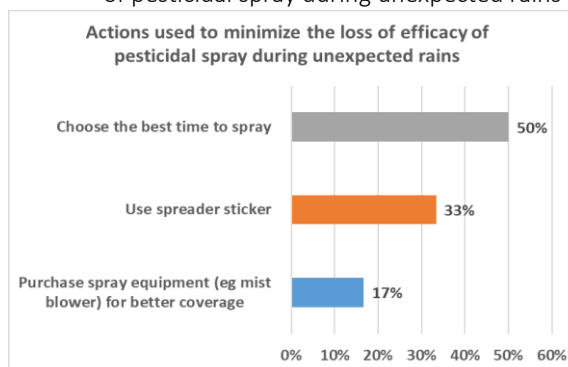
Figure 87: Factors that made it possible to complete land preparation during a period of unexpected rainfall



The data showed that 33% of farmers had additional tractors available which made it possible to complete the land preparation during a period of unexpected rainfall. However, 17% abandoned land preparation, another 17% deepened drainage canals and others indicated they had finance available to pay for additional tractors.

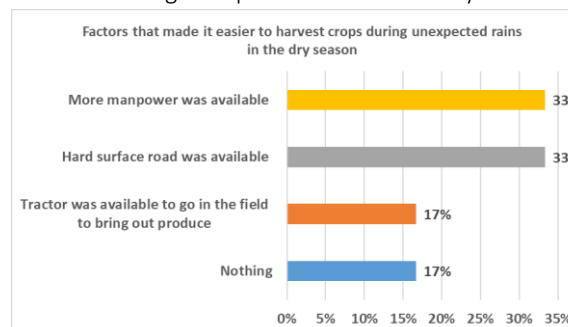
**EFFICACY OF PESTICIDAL SPRAY:** Unexpected rainfall during or soon after application of pesticides translate into reduced efficiency and efficacy and also loss of capital used for purchase and labour costs. When it becomes difficult to predict whether rain will fall or not, farmers resorted to choosing the best time of day to spray (50%), use of spreader sticker (33%) and purchasing higher capacity spraying equipment such as mist blowers for better coverage (17%). These actions highlight additional costs that can be attributed to climate change.

Figure 88: Actions used to minimize the loss of efficacy of pesticidal spray during unexpected rains



**HARVEST CROPS.** During unexpected rains, farmers reported that having additional manpower (33%), and hard surface roads (33%) made it easier to harvest crops during unexpected rains in the dry season.

Figure 89: Factors that made it easier to harvest crops during unexpected rains in the dry season



## 7. Input suppliers

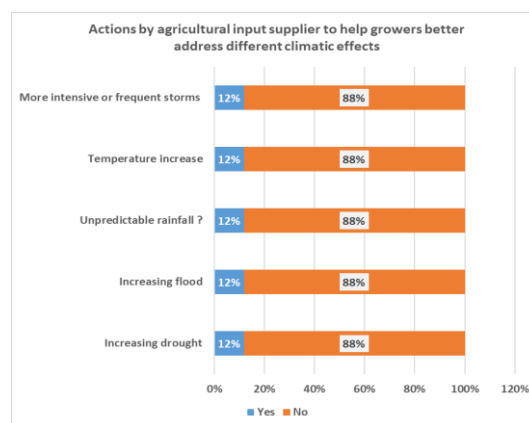
Only 24% of the 17 agricultural input suppliers surveyed were aware of climate change.

Input suppliers indicated that having finance made it easier to purchase more effective pesticides (50%), while 25% said they knew where to source the required stocks and another 25% reported that affordable high-quality pesticide was available.

In the case of livestock, the local feed mill increased production during the period of drought (50%). Knowing where to source irrigation equipment made it easy to source and supply irrigation equipment.

Only 12% of input suppliers took action to help growers better address different climatic effects.

Figure 90: Actions by agricultural input supplier to help growers better address different climatic effects





## 8. Analysis of the impact of climate change on the CARICOM food market

### 8.1 Interaction of Changes in Prices vs Climatic Factors

This section provides a demonstration of the interaction between climatic factors and market prices. Data for Trinidad and Tobago wholesale market prices were used in the case analysis. Note (i) vegetable prices decreased in the dry season when rainfall is lower, (ii) imports decrease when local supply volumes increase and (iii) prices decrease when supply volumes increase (and vice versa). There will be interaction between pest population, available soil moisture, irrigation availability, market information and intelligence, agroecological zones and farmers knowledge and expertise.

**Case 1: Cabbage**, a leafy vegetable and tomato, a vegetable fruit, are used to illustrate the influence of climatic factors on the markets for the commodities.

Data obtained from the NAMIS website shows average monthly volumes of green cabbage produced in Trinidad and Tobago as well as the average monthly prices in \$TT/kg. From the illustration, it can be clearly seen that volumes are higher during the drier months due to early planting using available soil moisture. During these months the volumes are higher, mirroring lower prices from the higher supply volumes. During the rainy season, the pest and disease populations are higher, thereby lowering volumes delivered to the market and mirroring higher average monthly prices.

As volumes decrease cabbage is imported to meet the supply shortfalls.

Figure 91: Cabbage Monthly Production and Prices 2017-2019 av produced in Trinidad and Tobago

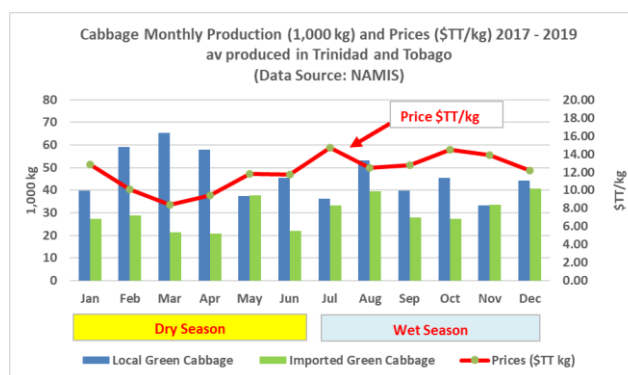
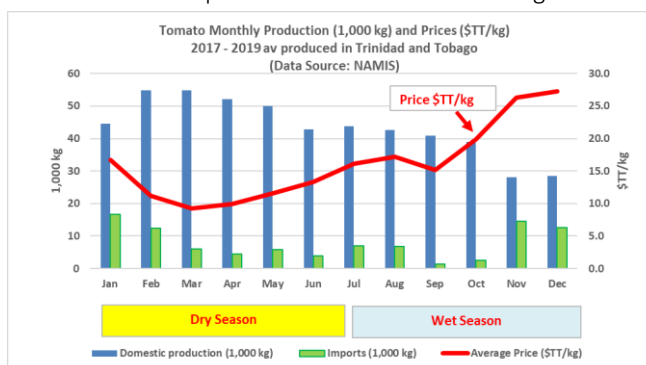


Figure 92: Tomato Monthly Production and Prices 2017-2019 av produced in Trinidad and Tobago

**Case 2: Tomato:** During the dry season the volumes are higher, mirroring lower prices from the higher supply volumes. Similarly, during the rainy season, the pest and disease populations are higher, thereby lowering volumes delivered to the market by domestic producers and mirroring higher average monthly prices.

Simultaneously, as volumes decrease as a result of the impact of higher rainfall on the crop, tomato is imported to meet the supply shortfalls.



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## Part C: Demand Side Analysis

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This section of the chapter presents the Demand Side of the CARICOM Agricultural Value Chain study. Research was undertaken amongst the buyers of the output, be it intermediary or final products. The focus has been placed on agro-processors and well as consumers.

### 9. Analysis of the Impact of Climate Change on the CARICOM food processors

#### 9.1 Introduction

The level of understanding of climate change may not be fully understood amongst processors, however, there is a high level of awareness, but the responses were not standardized. In this regard, a triangulation approach was used to better find out the level of understanding and how the processors responded and adapted to the phenomenon. The first responses are highlighted below, and the probed responses are presented in subsections that follow.

- A total of 73% of processors said they can recall at least one climate related event, impacts or occurrences in the last 5 years while 27% said no.
- An estimated 62% of processors said they didn't do anything to reduce the impact of climate change, while 38% said they acted.
- 54% of processors said there was an instance when unexpected weather events (e.g. unexpected heavy rain) prevented your daily operations, while 46% said no.
- Nonetheless, 92% said that they did consider implementing measures.

#### 9.2 Climate Change factors that impacted food processors

Food processors were asked to indicate which of the following climate change related event they had to address (or the suppliers to your processing plant) over the last 5 years?

The most important factors were the increasing frequency of drought (62%) followed by higher temperature (38%), unpredictable rainfall (38%) and increasing floods (31%).

Figure 93: Climate Change factors to which processors adapted during the last 5 years

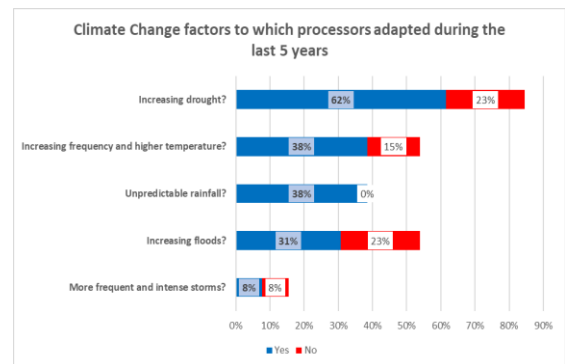


Figure 94: Doers: How processors changed their procurement practices in anticipation of Climate Change

**Doers:** In the case of processors who adopt new climate change practices, when asked what made it easier, 30% said that they contracted growers to supply them with the key inputs into their processing operations, and also (30%) contacted importers as a strategy to diversify their supply base.

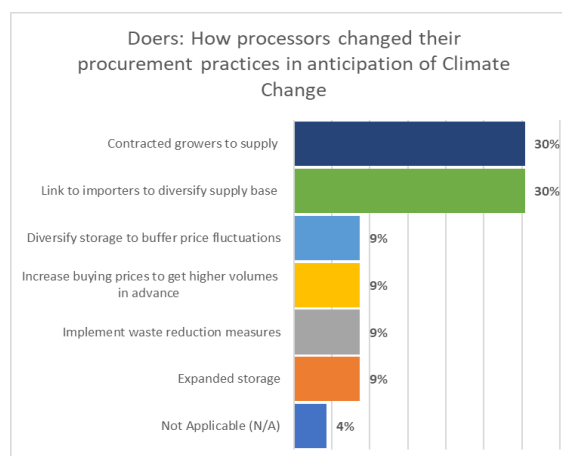
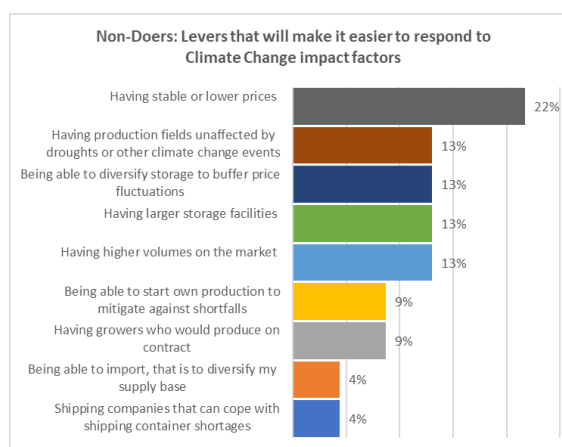


Figure 95: Non-Doers: Levers that will make it easier to respond to Climate Change Impact Factors

**Non-Doer:** In the case of processors in the target countries who didn't adapt to new climate change practices, when asked what will make it easier for them to procure commodities in anticipation of factors such as drought, flood, or any of the factors, a total of 22% said that having stable or lower prices was most important.

Other important levers included having production fields that are unaffected by climate change, diversification of storage to buffer price fluctuations, expanding storage facilities and having higher volumes on the market (13%).



### 9.3 Indirect Valuation of Climate Change Adaptation practices

Processors were asked to indicate how much money (i) they would need to expand their storage facilities and (ii) to purchase raw material in advance of a drought. They were also asked to indicate how much they would be willing to increase purchase prices in order to secure raw material. Responses are shown in **Table 27** below.

Table 27: Money required to expand storages facilities and to purchase raw material

Additional money required to expand their storage facilities (XCD)	Additional sums of money required to purchase raw material in advance of a drought (XCD)	Increase in purchase price to secure supplies
1,000	1,000	10%
60,000	72,000	\$0.40
135,000	189,000	35%
20,000	10,000	5-10%
15,000	10,000	70%

### Demographic information of producers

- Respondents were located in the following countries: St. Lucia (38%), Haiti (15%), Trinidad and Tobago (15%), St. Vincent (15%), Dominica (8%) and Suriname (8%).
- **Age:** An estimated 46% of respondents were 49-58 years old, 31% were 29-38 years, 15% were 39-48 years and 8% were 59-68 years old.
- **Education:** From the survey population, 38% had certificates, 30% had tertiary education, 23% had attained secondary education and 8% primary education only.
- **Gender:** 69% female and 31% male.

## 10. Consumers responses to Climate Change

A total of 166 consumers were enumerated. From this population, 60% were females and 39% males. The age of consumers surveyed ranged from 18 to more than 68 years. Amongst the two highest age groups, a total of 25% were in the 29-38 years age group and 25% were 39 – 48 years.

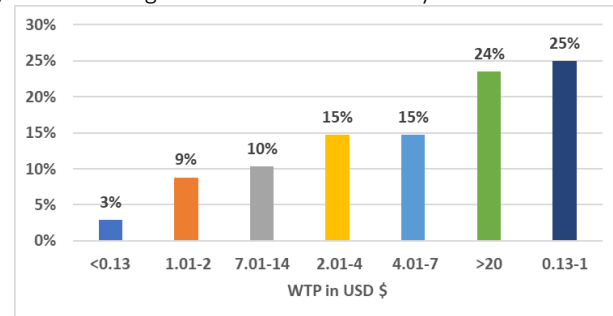
The highest group of consumers ranged from tertiary (55%), certificates 29%, secondary 12% and primary 3%.

From the 166 consumers enumerated, 83% of consumers observed a change in the weather “this year when compared to last year”. An estimated 84% took action to ease or reduce the impact of climate change.

A total of 62% of consumers indicated a willingness to contribute money to restore the farm if a grower lost his/her crop in a hurricane or natural disaster while 38% said no.

For those who have indicated a willingness to contribute, their one-time payment ranged from less than USD 0.13 to a high of USD 20.00.

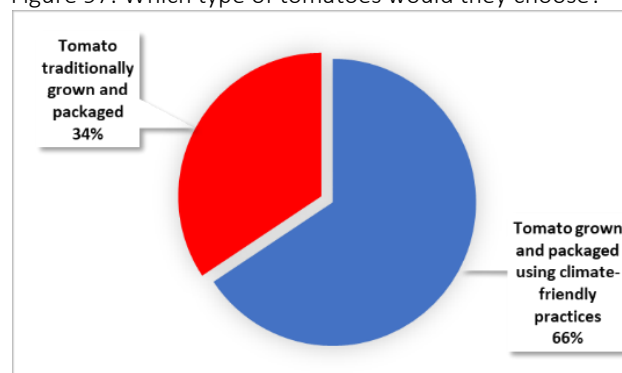
Figure 96: Willingness to contribute money to restore the farm



Further, an estimated 61% of consumers indicated that if “produced using climate friendly practices”, it will be healthier to consume.

The study used tomato for this case study analysis given that the vegetable is quite popular. Thus, consumers were asked “beside the price, which type of tomato they would choose?”. An estimated 66% indicated that they would choose tomatoes grown and packaged using climate-friendly practices while 34% would choose traditionally grown and packaged tomatoes.

Figure 97: Which type of tomatoes would they choose?



The consumers were probed further; they were asked if growers printed: **"tomato produced using climate-friendly practices"** on the label, 64% said that they would be willing to pay more for it.

An estimated 34% indicated that they are willing to pay US\$0.13 - \$0.30 more on a per pound basis for tomatoes labelled **"produced using climate-friendly practices"**. An additional 16% were willing to pay \$0.51 - \$1.00/lb and another 16% were willing to pay \$0.13/lb. Other willingness to pay are presented in the graphic.

An estimated 68% of consumers indicated that if tomatoes were grown on a farm that **installed irrigation systems to reduce the effects of unexpected drought**, they were willing to pay more for it.

An estimated 35% were willing to pay \$0.13 - \$0.30/lb for tomato grown using irrigation; 19% were willing to pay \$1.01 - \$ 2.00/lb and another 18% were willing to pay \$0.51 - \$ 1.00/lb. Other willingness to pay are presented in Figure 2.

Consumers were asked if they were willing to pay growers more for fresh produce when the **climate negatively affects their farms**. A total of 67% said yes and 33% no.

Based on this scenario, they were also asked **"how much more they would be willing to pay for per pound of tomatoes"**? From this survey population, 36% said \$0.13 - \$0.30/lb and 29% said \$1.01 – 2.00 / lb.

Figure 98: Willingness to pay more for climate-friendly tomato

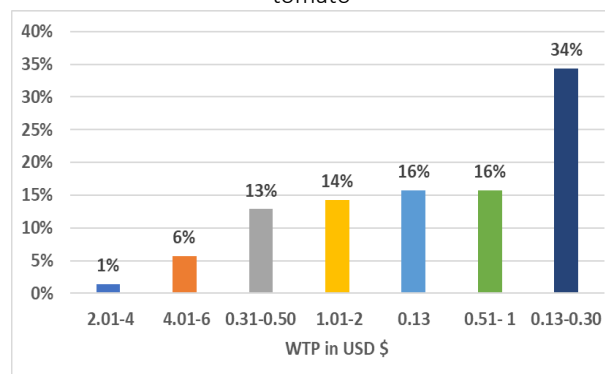


Figure 99: Willingness to pay more for tomatoes from a farm with irrigation system to reduce effect of drought

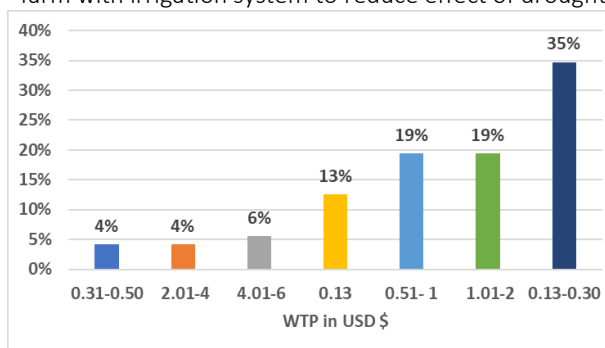
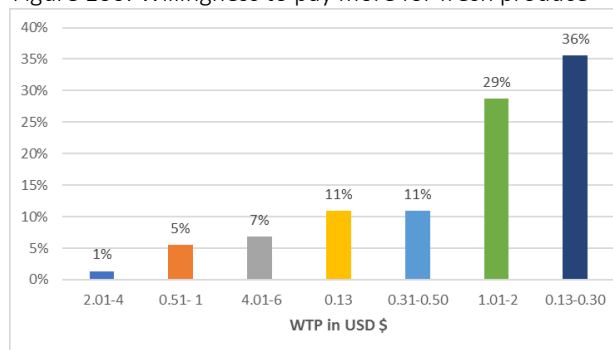


Figure 100: Willingness to pay more for fresh produce



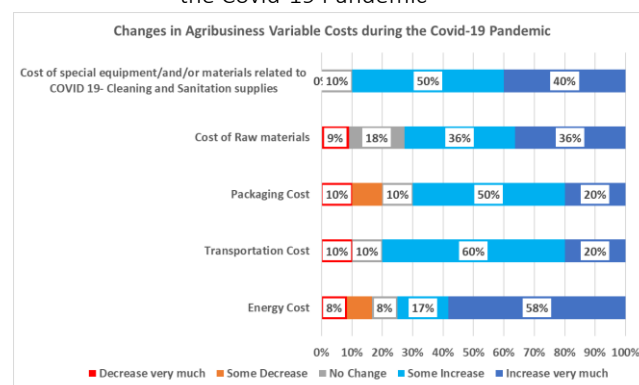
## 11. Experiences of Producers and Consumers During the Covid- 19 Pandemic

### 11.1 Producers

During the Covid-19 pandemic, 30% of reporters indicated that they had to cease operations, while 70% were not affected.

Variable cost increases included raw materials (72%), packaging cost (70%), transportation (80%) and energy (75%) when “some increases”, and “increased very much” were summed.

Figure 101: Change in Agribusiness Variable Costs during the Covid-19 Pandemic



### 11.2 Input Suppliers

Table 28: Accesibility of stocks

	Rate the accessibility of stocks from 1-5					
	1	2	3	4	5	
Less Access	6%	35%	29%	18%	12%	High Access

Accessibility of stocks were impacted by the Covid-19 pandemic. From 17 respondents, 35% reported a weight of experiencing “less access”.

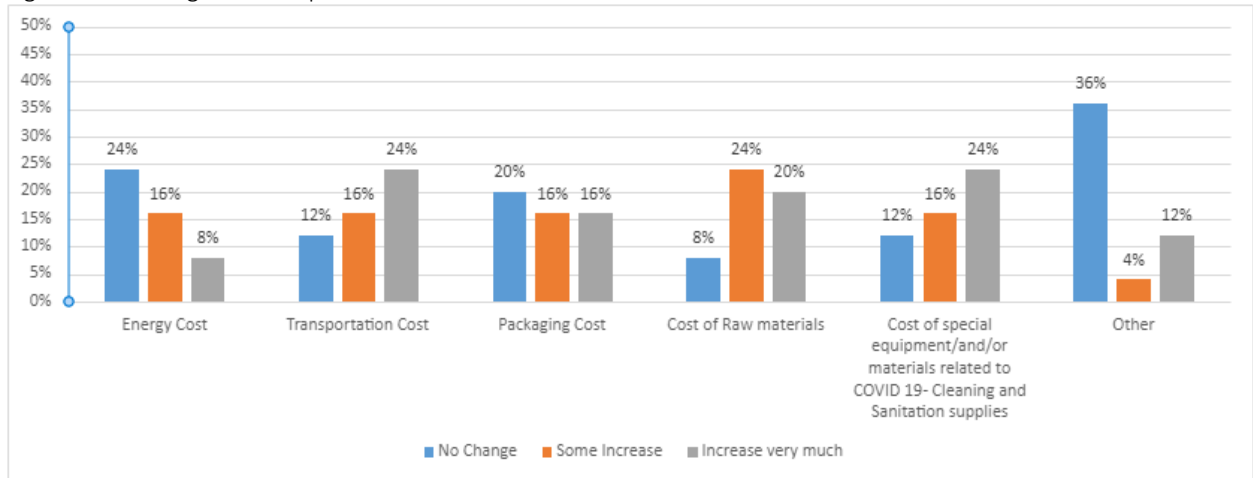
### 11.3 Processors

#### Evaluation of the Covid-19 Pandemic on Processors

Various health protocol regulations have been affected as strategies to manage the spread of the Covid-19 pandemic in 2021-2023 period. An estimated 62% said that it didn’t affect their operations while 38% said processing operations were affected; that is, they had to stop processing.

Those that were affected indicated that energy, transportation, packaging, raw materials and special equipment and cleaning chemicals were the major cost centres impacted. Cost centres that experienced “some increases”, this ranged from 4% to 16%, while those that “increased very much” ranged from 8% to 24%.

Figure 101: Change in cost operations



## 11.4 Consumers

### 11.4.1 Covid 19 Pandemic

From the 166 consumers enumerated, 55% observed an increase in market prices while 43% saw no change.

**Food availability:** Further, 55% observed a decrease in the availability of food and 32% saw no change.

**Food prices:** 94% saw an increase in food prices.

Figure 102: Changes observed during the Covid-19 Pandemic

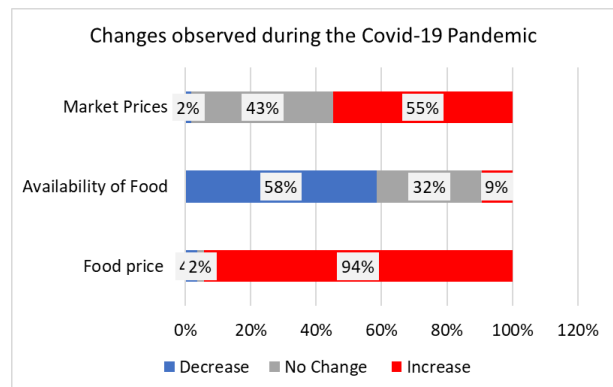
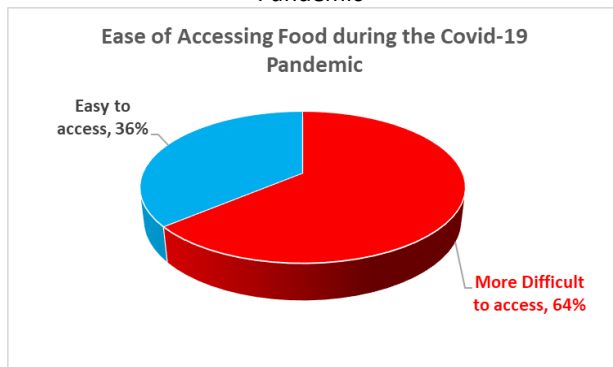


Figure 103: Ease of Accessing Food during the Covid-19 Pandemic



**Food access:** 64% said it was more difficult to access food while 36% said it was easy to access during the Covid 19 Pandemic.

An estimated 68% said they haven't changed where they commonly purchased food during the Covid 19 Pandemic while 32% said yes. From the study, countries from which the source from which consumers purchased food, least change was in The Bahamas, Haiti, Dominica, followed by St. Vincent and St. Lucia. Suriname had a major change where consumers purchased food.

Figure 104: Have you changed where you commonly purchase food during the Covid-19 Pandemics?

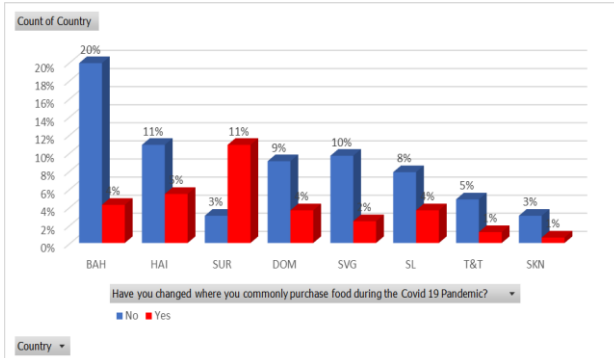


Figure 105: Change of physical market toward online market during the Pandemic

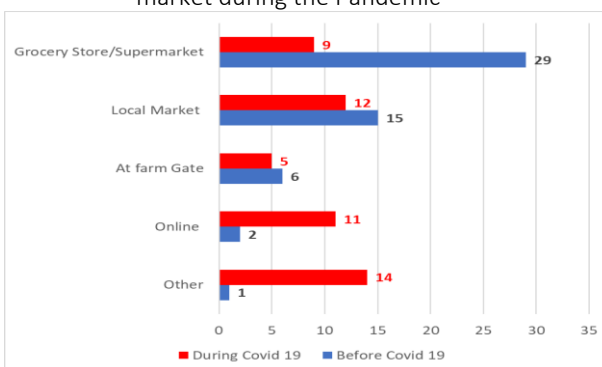


Figure 106: Percentage of Consumers switching to more packaged foods during the Covid-19 Pandemic

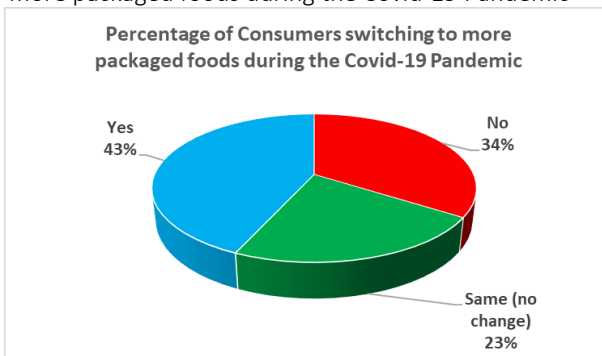
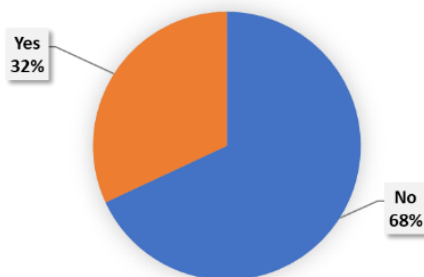


Figure 107: Confidence in the food bought after Covid-19



Consumers switched from Groceries/supermarkets and local markets to online and other sources Before vs during the COVID 19 pandemic.

An estimated 43% purchased more packaged foods during the Covid-19 Pandemic.

Consumers were not more confident (68%) about the safety of the food bought after Covid-19 Pandemic started.



## 12. Summary & Recommendations

### 12.1 Summary

The main objective of this chapter was to conduct an analysis of the market and value chain barriers that limit the transformation of Caribbean agricultural production systems from an “*as-is or business-as-usual*” (conventional) state to one that has climate resilient production systems which can provide strong arguments/rationale for private and public sector investments.

The Market and Value Chain analysis focused on the following areas:

1. Conducting a comprehensive analysis on barriers which affect demand and supply in the Caribbean agricultural sector.
2. Analysing and proposing market development strategies for adoption or adaptation within the Caribbean region.
3. Reporting on key value chain barriers that affect the agricultural sector which will form a baseline for further research.
4. Proposing means and methodologies transcend the gap from the existing situation to the ideal agricultural environment within the Caribbean region.

**The Problem:** Increasing weather variability and climate change have been threatening Caribbean agriculture. If continued unabated, this can circumvent the achievement of economic growth, exacerbate food insecurity and aggravate poverty.

In order to adapt to climate change risks in agriculture, the study found that some farmers and other operatives in the value chain used several adaptation strategies. These included change in crop varieties, adjustment in planting methods, change in crop varieties, different methods of application of fertilizer and water, and other aspects of land preparation and crop management practices. The adaptation practices are meant to reduce risk and minimize the negative consequences of climate change.

In keeping with the Terms of Reference, this component of the study utilized the barrier analysis methodology to assist with the collection and verification of agricultural and associated activity. The data generated from the survey provides first-hand evidence that can form the basis for development initiatives and investments; aligned to regional and national priorities.

#### *12.1.1 Summary - Supply-Side Production*

The impacts of climate change are known to aggravate deficiencies in the knowledge base of technical personnel and manifest itself in various forms. This study used a “Doer” vs “Non-Doer” approach. The results are as follow:

##### **1. Input suppliers**

A total of 24% of the 17 agricultural input suppliers surveyed were aware of climate change. Having finance made it easier to purchase more effective pesticides, knowing where to source the required stocks and the availability of affordable high-quality pesticides made it easier to cope

with climate change. Knowing where to source irrigation equipment made it easy to source and supply irrigation equipment.

## 2. Livestock Producers

In the case of livestock, the local feed mill increased production during period of drought, mitigating against shortage of forage. A summary of the initiatives undertaken by livestock producers is presented below in the **Table 28**.

Table 28: Livestock Production System

<b>Table 28: LIVESTOCK PRODUCTION SYSTEM</b>	
<b>Primary Production</b>	<ul style="list-style-type: none"> <li>i. Expand forage cultivation / storage</li> <li>ii. Easy access to chopping equipment</li> <li>iii. Cultivation of forages that accumulate carbohydrate during drought</li> <li>iv. Cultivation of high protein forages</li> <li>v. Switch to pasture-stall system</li> </ul>
<b>Government incentives</b>	<ul style="list-style-type: none"> <li>i. Post disaster help to recover after disaster</li> <li>ii. Pre-disaster support such as moving animals to safe zones</li> </ul>
<b>Knowledge transfer</b>	<ul style="list-style-type: none"> <li>i. Strong practical research linkages (e.g. CARDI, IICA, FAO),</li> <li>ii. Proactive and targeted livestock production training</li> </ul>
<b>Extra-ordinary or advance technology</b>	<ul style="list-style-type: none"> <li>i. Establishment of windbreaks to protect buildings</li> <li>ii. Reliable news releases</li> <li>iii. Additional water storage structures</li> <li>iv. Hurricane straps</li> </ul>
<b>Marketing system</b>	<ul style="list-style-type: none"> <li>i. Easy access to good abattoirs</li> <li>ii. Contract farming system</li> <li>iii. Strong farmers organizations</li> <li>iv. Strong seller-buyer relationships</li> </ul>

## 3. Crop Producers

The range of adjustments undertaken by crop producers was much broader. The adjustments varied based on the type of climatic influence. A summary of the initiatives undertaken by livestock producers is presented below in the **Table 29**.

Table 29: Crop Production System – Initiatives that Made it Easy to Continue Production

Table 29: CROP PRODUCTION SYSTEM - INITIATIVES THAT MADE IT EASY TO CONTINUE PRODUCTION				
	DROUGHT	HIGH TEMPERATURES	HIGH WINDS	UNEXPECTED RAINFALL
Primary Production	<ul style="list-style-type: none"> <li>i. Planting drought tolerant varieties</li> <li>ii. Used wider spacing</li> <li>iii. Used older seedlings for transplanting</li> <li>iv. Shifted to container grown seedlings</li> <li>v. Planted deeper</li> <li>vi. Alter planting dates</li> <li>vii. Changed from one crop to another</li> <li>viii. Changed cultivar towards more drought tolerant varieties</li> <li>ix. Physical weed control practices and retained weed control debris to use as mulch,</li> <li>x. More timely weed control</li> <li>xi. Selective weed control measures</li> <li>xii. Apply manure</li> <li>xiii. Change the rate of application</li> <li>xiv. Changed the type of pesticide used</li> <li>xv. Having irrigation equipment</li> <li>xvi. Supply of irrigation water</li> <li>xvii. Having money to purchase an irrigation system</li> <li>xviii. Harvesting during the cooler time of day</li> <li>xix. Changing the stage at which the crop is harvested</li> <li>xx. Harvesting previous crops earlier in the season before the drought started</li> <li>xxi. Keep their harvested crop in a damp environment</li> <li>xxii. Use of more ventilated bags and boxes as a heat management strategy</li> </ul>	<ul style="list-style-type: none"> <li>i. Changed from one crop to another as a strategy to continue cropping.</li> <li>ii. Wet soil before planting</li> <li>iii. Transplant deeper to utilize soil moisture</li> <li>iv. Alter the planting time during the day.</li> <li>v. Having an irrigation system</li> <li>vi. Having a supply of irrigation water</li> <li>vii. Knowing how to set up the irrigation system</li> <li>viii. Changed the time of harvest to the cooler time of day</li> </ul>	<ul style="list-style-type: none"> <li>i. Wind barriers</li> <li>ii. Plant crops that bear underground</li> <li>iii. Establish crops such as banana at a time when the plants will be small in the hurricane season in order to reduce losses</li> </ul>	<ul style="list-style-type: none"> <li>i. Farmers had additional tractors available to complete the land preparation</li> <li>ii. Abandoned land preparation</li> <li>iii. Deepened drainage canals</li> <li>iv. Had finance available to pay for additional tractors</li> <li>v. Resorted to choosing the best time of day to spray</li> <li>vi. Use of spreader sticker</li> <li>vii. Purchasing higher capacity spraying equipment such as mist blowers for better coverage</li> <li>viii. Farmers reported that having additional manpower</li> <li>ix. Hard surface roads</li> </ul>
Government incentives	<ul style="list-style-type: none"> <li>i. Market information and intelligence</li> <li>ii. Weather news</li> <li>iii. Keeping capital for unplanned activities</li> </ul>			
Knowledge transfer	<ul style="list-style-type: none"> <li>i. Knew how to set up an irrigation system</li> </ul>			
Extra-ordinary or advance technology	<ul style="list-style-type: none"> <li>i. Change from hybrid seeds to heirloom seeds</li> <li>ii. Selectively apply pesticides based on pest present</li> <li>iii. Use more soluble fertilizers</li> <li>iv. Use precision agriculture practices</li> <li>v. Establishment of windbreaks</li> <li>vi. Establishment of firebreaks</li> </ul>			
Marketing	<ul style="list-style-type: none"> <li>i. Selling crop in advance</li> <li>ii. Direct delivery</li> <li>iii. Farmgate sales</li> </ul>			

### *12.1.2 Summary – Demand Side*

#### **1. Processors**

The level of understanding of Climate Change may not be fully understood amongst processors however, there is a high level of awareness however the responses were not standardized. They adapted through contracting growers to supply them with the key inputs into their processing operations and also contacted importers as a strategy to diversify their supply base.

In the case of non-doer processors, those who didn't adapt new climate change practices, they indicated having stable or lower prices was most important. Other important levers included having production fields that are unaffected by climate change, diversification of storage to buffer price fluctuations, expanding storage facility and having higher volumes on the market.

#### **2. Consumers**

From a total of 166 consumers enumerated, 83% of consumers indicated an awareness to climate change and a willingness to pay more for produce using climate friendly practices and assist the grower if he/she lost his/her crop in a climatic related event. They also indicated that they would choose vegetables grown and packaged using climate-friendly practices when indicated on the label and would be willing to pay more for it. Consumers were also willing to pay growers more for fresh produce when the climate negatively affects their farms.

### *12.2 Summary – Responses to the Covid-19 Pandemic*

1. **Producers:** An estimated 30% of producers had to cease operations; variable costs increased (raw material, packaging, transportation and energy).
2. **Input Suppliers:** Many input suppliers had difficulty accessing stocks for relate.
3. **Processors:** Many (38%) said processing operations were affected; having to cease operations. Cost centers affected included energy, transportation, packaging, raw materials, special equipment and cleaning chemicals.
4. **Consumers:** 55% observed a decrease in food availability; 94% saw an increase in food prices **and** 64% said it was more difficult to access food. In addition, an estimated 68% said they haven't changed where they commonly purchased food while 32% switched from groceries/supermarkets and local markets to online and other sources. An estimated 43% purchased more packaged food and they were not more confident (68%) about the safety of the food bought after Covid-19 Pandemic started.

### *12.3 Recommendations: Pathways of Change*

**Development of Levers to assist with Climate Change Mitigation:** The study found that less than 50% of the respondents adopted some type of practice to assist them to cope with climate change. In this regard, any programme to mitigate against climate change should include reinforcement of those that have been adopted by the doers.

A programme should be developed to facilitate adoption by non-doers. Features identified by non-doers that will assist them in mitigating include having access to water and an irrigation system and agronomic features such as the best plant spacing, planting depth to optimize soil moisture, early warning systems, mobile app from the met services, group chat, credit facilities and access to small grants.

**RECOMMENDATIONS:** The following activities or interventions are recommended to achieve each desired outcome:

1. **Awareness:** Development of a special climate change education system that will introduce all actors to the concept of climate change, its manifestation, and strategies to adopt to minimize its effects. The current approach to education and communication needs to be revisited to one that meets the clientele.
2. **Adoption of Best practices:** Develop a programme to convert Non-Doers to Doers, guided by strategies adopted by Doers in the development of teaching and intervention modules.
3. **Attitude:** Swings in weather patterns calls for a dynamic and agile mindset. While the major issue highlighted was drought, intervention programmes should be designed accordingly, both by policymakers and other actors along the value chain.
4. **Technology:** A lot of climate resilience technology already exists however its utilization need to be addressed. Thus, programmes for utilization of drought tolerant seeds, anti-transpirants, variable release fertilizers, soil moisture meters, etc., needs to be popularized.
5. **Infrastructure:** Many of the buildings and field infrastructure used for agriculture uses a technology invented more than a century ago. With the advent of climate change this may no longer be relevant. Thus, designs for high winds, heat reflection, cooling, water conservation and utilization, irrigation technology and plant bed structures for example should be revisited.
6. **Situational considerations:** Consider “*mix-and-match*” interventions/flexibility. Adopt a modular approach to technological and attitudinal changes that cater for early and late adopters, resource poor and varied sociological levels.
7. **Feedback Loop** – Obtain funding to set up climate mitigation demonstration units across countries to facilitate experiential learning. Users should see the technology working.
8. **Markets:** Develop strong governance organizations linking producers to actors in the markets (processors, marketing intermediaries, food services, etc.,) to facilitate easy off-take and feedback. Utilize the value system of consumers to get better prices for producers (not the willingness to pay results).
9. **Funding:** Droughts were highlighted as the most critical climate related event. In-depth analysis should be undertaken on the actual water requirements needed to mitigate against this factor in all countries. An Agricultural Water Policy should be developed for all countries of the study and funding developed for mitigation strategies identified.

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## Annex 1: Stakeholders Consulted

AgREADY Country	Stakeholder
Bahamas (8 stakeholders)	Ministry of Agriculture Policy Planning & Research Unit
	CARDI- Bahamas Rep.
	Bahamas Agricultural Industrial Cooperation – General Manager
	Leader of the Free National Movement and former Minister of Agriculture
	BRON Intl.- Leading Climate voices in the country
	Bahamas Department of Meteorology – Head of the Climate Section
	University of The Bahamas- Climate Change Adaptation and Research Resilience Center- Current lead but the not the Executive Director
	BRON Intl.- Senior Environmental Scientist
Belize (8 stakeholders)	Ministry of Agriculture, Food Security and Enterprise (3)
	American Sugar Refining, Inc.
	Belize Agricultural Health Authority (2)
	Development Finance Corporation
	National Climate Change Office, Ministry of Sustainable Development, Climate Change and Disaster Risk Management
Dominica (16 stakeholders)	Ministry of Agriculture-Policy Formulation and Administration Unit
	The MET Office
	CARDI
	Division of Agriculture
	UWI, St. Augustine
	Benjo Seamoss (Private Sector)
	Dominica Export Import Agency (DEXIA)
	Central Universal Farmers Group
	Lands and Surveys Division
	FAO Correspondent
	IICA Specialist-Dominica
	Extension Unit
	GCF NDA (2)
	Ministry of Planning
	National Development Foundation of Dominica-Finance related
Haiti (1 stakeholder)	Ministry of Agriculture, Natural Resources and Rural Development - Forestry Unit
Saint Kitts and Nevis (23 stakeholders)	Department of Agriculture, Saint Kitts
	Department of Agriculture, Nevis
	Extension, Dept. of Agriculture, Nevis
	Water Resources
	Nevis Island Administration
	Small Business Development UNIT
	Nevis Island Administration
	Economic Affairs and Public Sector Investment Programme and GCF NDA Ministry of Sustainable Development St. Kitts
	Economic Affairs and Public Sector Investment Programme

	Ministry of Sustainable Development St. Kitts
	Project Analyst / (NDC Partnerships Co-Focal Point) Department of Economic Affairs and Public Sector Investment Planning Ministry of Sustainable Development St. Kitts
	Nevis Disaster Management Department
	Department of Planning and Environment Nevis Island Administration
	Farmers (9)
	Input Suppliers (2)
	Agro-processors (2)
Saint Lucia (14 stakeholders)	Water Resources Management Agency (3)
	Meteorological Service (2)
	Ministry of Agriculture, Fisheries, Food Security and Rural Development (2)
	Farmer Groups (3)
	Independent Farmers (4)
Saint Vincent and the Grenadines (13 stakeholders)	Ministry of Agriculture, Forestry, Fisheries, Rural Transformation, Industry and Labor
	Ministry of Agriculture, Forestry, Fisheries, Rural Transformation, Industry and labor
	IICA
	CWSA
	Department of Forestry
	MET office
	SVG Technical College
	Farmers (6)
Suriname (12 stakeholders)	Ministry of Regional Development (2)
	FAO
	University of Suriname
	Retired Met Office Personnel
	Retired Agriculture Researcher
	Farmer Groups/Collectives (6)
Trinidad and Tobago (6 stakeholders)	NAMDEVCO
	Meteorological Office of Trinidad and Tobago
	Agricultural Development Bank of Trinidad and Tobago
	Network of Rural Women Producers in Trinidad and Tobago (NRWPTT) (2)
	IICA Trinidad and Tobago

## Annex 2: Stakeholder/Consultation Mapping

**GCF- AgREADY Project “Strengthening the foundation for a climate responsive agricultural sector in the Caribbean”**

**Policy Analysis: Stakeholders for Barrier Analysis**

This document is a guide for National Liaison Consultants and IICA Country Teams for preparation for and conduct of stakeholder consultations for the PA Barrier Analysis



STAKEHOLDER/ENTITY	FOCUS FOR CONSULTATIONS
UNFCCC Focal Point or their designate <i>(written questions to be sent as follow-up to previous NDC discussions)</i>	<ul style="list-style-type: none"> <li>Understanding of: <ul style="list-style-type: none"> <li>how the government intends to roll-out the work programme or the CC response programme</li> <li>the position of agriculture in the CC response programme</li> <li>the adequacy of agriculture in climate response plans and strategies</li> </ul> </li> </ul>
Ministry of Agriculture: <ul style="list-style-type: none"> <li>Policy and Planning Unit</li> <li>Finance</li> </ul>	<ul style="list-style-type: none"> <li>Mapping of the policy-making process or governance framework</li> <li>Framework involved in agricultural planning to determine gaps and opportunities for strengthening.</li> <li>Climate resilience in the ag sector <ul style="list-style-type: none"> <li>Key climate and non-climate factors that threaten the food system</li> <li>Policy direction that gives consideration to climate change and esp. climate projections</li> <li>Mainstreaming (climate resilience roadmap) climate change in agricultural policies, strategies, planning processes and budgeting</li> <li>Current and planned climate smart investments</li> <li>Assessment of GHG emissions from the agriculture sector with supporting mitigation actions (and any adaptation co-benefits)</li> </ul> </li> <li>Roles of key institutions involved in policy, programming, coordination and resource allocation in the ag sector</li> <li>Impact of COVID-19 and any economic stimuli</li> <li>Impact of imports on food systems and food security</li> <li>Policies that support access to inputs</li> <li>Legislation for seeds and genetic material</li> <li>Regulations for timely access for inputs access</li> <li>Availability of skilled workers along the value chain and strategies for youth engagement</li> <li>Barriers to, and challenges with, participation of women, youth, poor and PWDs</li> <li>Diversification and value addition, provision of climate-resilient production technologies, dissemination of climate information services, and availability of financial and insurance services</li> <li>Food safety concerns and efforts to minimize loss and waste</li> <li>Facilitation of PPPs</li> <li>Impact of trade policies on food systems</li> <li>Impact of policies on price and market conditions</li> <li>Project portfolio, particularly climate-changed based projects</li> </ul>
Ministry of Agriculture – <ul style="list-style-type: none"> <li>Marketing and distribution</li> <li>Data Management and Information</li> <li>R&amp;D</li> </ul>	<ul style="list-style-type: none"> <li>Climate resilience in the ag sector <ul style="list-style-type: none"> <li>Key climate and non-climate factors that threaten the food system</li> <li>Current and planned climate smart investments</li> <li>Mainstreaming (climate resilience roadmap) climate change in agricultural policies and strategies</li> </ul> </li> </ul>

STAKEHOLDER/ENTITY	FOCUS FOR CONSULTATIONS
	<ul style="list-style-type: none"> <li>○ Assessment of GHG emissions from the agriculture sector with supporting mitigation actions (and any adaptation co-benefits)</li> <li>● Quality of technical information and communication with extension service and farmers</li> <li>● Types of agricultural data usually captured and utilised</li> <li>● Main challenges to information dissemination</li> <li>● Impact of policies on price and market conditions</li> <li>● Linkages and coordination across value chain phases</li> </ul>
Ministry of Agriculture <ul style="list-style-type: none"> <li>● Extension Services</li> </ul>	<ul style="list-style-type: none"> <li>● Climate resilience in the ag sector <ul style="list-style-type: none"> <li>○ Key climate and non-climate factors that threaten the food system</li> <li>○ Current and planned climate smart investments e.g., water adaptation measures</li> </ul> </li> <li>● Quality of technical information and communication with extension service and farmers</li> <li>● Barriers to, and challenges with, participation of women, youth, poor and PWDs</li> <li>● Linkages and coordination across value chain phases</li> <li>● Role of traditional practices and impact on application of CSA</li> <li>● Current agriculture climate resilience projects</li> </ul>
Ministry of Agriculture (or other Ministry(ies)) <ul style="list-style-type: none"> <li>● Land management</li> <li>● Water management</li> </ul>	<ul style="list-style-type: none"> <li>● Policies that support access to inputs</li> <li>● How is land categorized and what priority is given to agriculture land and its distribution?</li> <li>● Programmes that support land tenure and agriculture land management</li> <li>● Land distribution, including programmes that make provision for farmer groups and their associated costs and benefits</li> <li>● Distribution of irrigation water</li> <li>● Availability of irrigation versus rainfed water for farmers, including cost of water</li> <li>● Impact of drought and extreme rain conditions on water availability</li> <li>● Planning for irrigation water in light of future climate projections</li> <li>● Current and planned water adaptation measures</li> <li>● Current programmes that support water demand</li> </ul>
Farmers' Groups (including youth)	<ul style="list-style-type: none"> <li>● <i>Focus group questions to be provided separately</i></li> </ul>
Academia and Non-Government Technical Service Providers	<ul style="list-style-type: none"> <li>● Role of R&amp;D in food systems</li> <li>● Main institutions driving research and summary of work being undertaken, including gaps, challenges and successes</li> <li>● Main challenges disseminating information</li> <li>● Key supporting organizations that facilitate access to key agricultural inputs. <ul style="list-style-type: none"> <li>○ Roles of these organizations.</li> <li>○ Perceived barriers to participation</li> </ul> </li> <li>● Availability of skilled workers to support utilization of climate responsive technologies</li> </ul>

STAKEHOLDER/ENTITY	FOCUS FOR CONSULTATIONS
	<ul style="list-style-type: none"> <li>• Ongoing programs targeting youth to build capacities in climate resilient best management practices along the ag value chain</li> <li>• Capacity in support organizations to manage the transitions to green technologies and sustainable development practices <ul style="list-style-type: none"> <li>○ Adequacy of these institutions to manage the transition and associated standards</li> </ul> </li> <li>• Capacity in support organizations to provide market facilitation</li> </ul>
Disaster Risk Planning and Management	<p><i>To be led by Dr. Vincent Little</i></p> <ul style="list-style-type: none"> <li>• How agriculture and food security are featured in emergency scenarios</li> </ul>
Ministry of Finance/National Development Planning Entity	<ul style="list-style-type: none"> <li>• Importance of agriculture to national development (food security, exports, economic development)</li> <li>• Impact of imports on food security and economic development</li> <li>• Agriculture intersectoral linkages (e.g., agriculture-tourism, agriculture-health)</li> <li>• Understanding of how the government prioritize industries including agriculture</li> <li>• Financing framework, strategy for financing climate actions or low emission development.</li> </ul>
Private Sector Stakeholders	<ul style="list-style-type: none"> <li>• Access to finance, risks transfer products or insurance, R&amp;D, market access, access to inputs</li> </ul>
Meteorological Office	<ul style="list-style-type: none"> <li>• Information sharing with the agriculture sector, climate services such as drought monitoring</li> <li>• Access to weather data and data collection infrastructure such as automatic weather stations</li> <li>• Capacity to transform information into decision support for the agriculture sector</li> <li>• Current and future climate services for the agriculture sector</li> </ul>
Development entities (FAO, IICA, CARDI, etc.)	<ul style="list-style-type: none"> <li>• Roles and responsibilities</li> <li>• Climate resilience building support provided</li> <li>• Current projects underway</li> <li>• Capacity building support for climate resilience in agriculture</li> <li>• Key value chains supported (if any)</li> </ul>
Government marketing agency	<ul style="list-style-type: none"> <li>• Certification programmes to meet international standards</li> <li>• Selection of international markets</li> <li>• Priority markets for crops (what are the key exports)</li> <li>• Promoting value addition</li> </ul>

### Annex 3: Input – Process-Output Logical Framework for the Analysis of Economic and Market Barriers

CODE	INPUT	PROCESS	OUTPUT
1	I1 Literature Review	P1 Review of the international, regional and national literature on economic and market barriers to the transformation of Caribbean Agriculture to Climate Resilient Systems	<p><b>O1.1</b> Background information on the adoption of CRA technologies and management practices in the Caribbean and elsewhere generated, including a typology of main technologies and practices</p> <p><b>O1.2</b> Preliminary list of Economic and Market barriers to the adoption of CRA technologies and practices and applicability to the Caribbean identified and categorized</p> <p><b>O1.3</b> Preliminary list of opportunities, approaches, and strategies for addressing economic and market gaps and barriers to the transformation of Caribbean Agriculture to Climate Resilient Systems at the micro, meso and macro levels generated</p> <p><b>O1.4</b> Methodological framework for the assessment of economic and market barriers issues and challenges to the transformation of Caribbean Agriculture to Climate Resilient Systems determined</p>
2	I2 Execution of Survey Instrument		
	I2.1 Profile of Respondent	P2.1 Develop a Profile of each respondent in the Survey to include name, location/ country, gender, age, education, household structure (head of household, size of household) as a critical component of the socio-economic characteristics of the farm household.	O2.1 Farm household characteristics that present themselves as barriers to the adoption of CRA technologies and practices are identified as explanatory variables for analysis to include age, gender, education, head of household, size of household
	I2.2 The Farm Enterprise	P2.2 Develop a Profile of the Farm Enterprise as a critical component of the socio-economic characteristics of the farm household	O2.2 Farm enterprise characteristics that are barriers to the adoption of CRA technologies and practices are identified as explanatory variables for analysis to include: type of commodity produced, farm size, farm income, main source of income, farming experience, distance from the farm, land tenancy, extension services support, exposure to media, membership in agriculture related association or group, access to productive

			resources and markets (land, credit, labor, transport, market, information, incentives, insurance schemes).
	<b>I2.3 Farmers' Perception of Climate Change</b>	<b>P2.3</b> Investigate the farmers' perception of the effects of climate change on agricultural production	<p><b>O2.3.1</b> Farmers' perception of the effect of climate change on agriculture determined and ranked utilizing weighted mean perception scores.</p> <p><b>O2.3.2</b> The main constraint/barriers faced by farmers in managing the effect of climate change are identified</p> <p><b>O2.3.3</b> The relationship between constraints/barriers faced in managing the effect of climate change and key characteristics of farmers are analyzed</p>
	<b>I2.4 Psychological Capital and Climate Change Adaptation</b>	<b>P2.4</b> Examine the role of psychological capital (a form of non-cognitive skill) in the adoption of CRA technologies and practices	<b>O2.4</b> Results generated on the association between key psychological capital indicators, including indicators related to self-confidence, optimism, hope and resilience, and farmers climate adaptation decisions
	<b>I2.5 Agricultural Risks and Risks Management Strategies</b>	<b>P2.5.1</b> Conduct an analysis of the different sources of agricultural risks	<b>O2.5.1</b> Sources of agricultural risks experienced by farmers and value chain actors across different socioeconomic backgrounds and geographic scales are identified and classified to include price or market risk (output and input price fluctuations, market shocks), financial risk (loans and credits), production risk {(weather-related, pests and diseases ( biosecurity), technology, yields}, institutional risk (regulations, legal, environmental, subsidies, incentives, tax policy), and human resource risk (physical and mental)
		<b>P2.5.2</b> Conduct an analysis of the risk management strategies employed by smallholders to climate related risks	<b>O2.5.2.1</b> The main climate-related risks and associated management measures adopted by farmers identified to include no risk management, risk mitigation measures (cultivation of horticultural crops, ownership of livestock, ownership of non-farm business), risk transfer (diversification of farm enterprise, agricultural insurance, renting out of land), and risk coping (employment, outmigration, remittances, and sales of livestock)
			<b>O2.5.2.2</b> The linkage between perceived risk sources and risk management strategies explored
			<b>O2.5.2.3</b> The socioeconomic factors influencing farmers' risk perceptions and the management of risks investigated and reported upon

			<b>O2.5.2.4</b> The determinants of climate risk management measures and their impact on farm income are evaluated
			<b>O2.5.2.5</b> Barriers to the management of agricultural risks investigated and presented
	<b>I2.6 Technology-based barriers</b>	<b>P2.6</b> Conduct a detailed examination of the technological related barriers to the adoption of CRA technologies and practices	<b>O2.6</b> Results generated on the technology-based barriers to the adoption of CRA technologies and practices to include: cost (investment and operating), riskiness, physical access, technical knowledge of actors on how to implement and manage the CRA options, capability of actors to make trade-offs decisions on temporal benefits or on CRA pillars (e.g. productivity enhancing technologies and increase GHG emissions), capability of information platform to cater to recurring needs of actors, acceptability of the CRA technologies and practices with respect to socio-cultural norms of the community, sufficiency of evidence for robust statements on efficacy of different CRA technologies and practices in different conditions.
	<b>I2.7 Market Barriers</b>	<b>P2.7</b> Assess markets and markets related barriers to the adoption of CRA technologies and practices	<b>O2.7.1</b> The extent of differences between farmgate prices and market prices are evaluated and presented
			<b>O2.7.2</b> The adequacy of market information is evaluated
			<b>O2.7.3</b> The availability of marketing channels and the extent to which they are dominated by middlemen and traders evaluated
			<b>O2.7.4</b> The adequacy of storage facilities for produce along the entire value chain is analyzed
			<b>O2.7.5</b> The extent to which producers have access to the markets for inputs, technologies, and financial support services are evaluated
			<b>O2.7.6</b> The extent to which producers have access to the markets for and utilize risk transfer financial products/ practices such as insurance is assessed
			<b>O2.7.7</b> The extent to which producers have access to emergency funds and social protection facilities are evaluated

<b>I2.8 Physical Infrastructure Barriers</b>	<b>P2.8</b> Assess the adequacy and cost of the physical infrastructure as barriers to the adoption of CRA technologies and practices	<b>O2.8 Cost</b> of physical infrastructure as barriers to the adoption of CRA technologies and practices, including those related to the availability and adequacy of transport, farm roads, water/irrigation and drainage facilities, energy and community assets evaluated
<b>I2.9 Cultural perception and Social Barriers</b>	<b>P2.9</b> Examine the extent to which soft institutional-social cultural dimensions, customs, values, attitudes, and gender are barriers in the adoption of CRA technologies and practices	<b>O2.9.1</b> The extent to which farmers and other value chain actors think that CRA technologies and practices are the preserve of the commercial, large farms and agri-businesses is assessed
		<b>O2.9.2</b> The extent to which cultural traditions (norms/customs), or religious beliefs discouraged the adoption of CRA technologies and practices by farmers and other value chain actors is determined
		<b>O2.9.3</b> The extent to which farmers and other value chain actors trust and believe that CRA technologies and practices are beneficial is assessed
<b>I2.10 Policy Support (Subsidies and Incentives)</b>	<b>P2.10</b> Examine the policy related barriers	<b>O2.10.1</b> The adequacy of existing government support, incentives, and subsidies to enhance the adoption of the adoption of CRA technologies and practices is evaluated
		<b>O2.10.2</b> The adequacy of existing government laws, rules and policies that support the adoption of CRA technologies and practices is assessed
		<b>O2.10.3</b> The adequacy of existing standards for the adoption of CRA technologies and practices is evaluated
		<b>O2.10.4</b> The influence of land related issues, including land ownership/land tenure and property rights in determining the adoption of CRA technologies and practices is assessed
<b>I2.11 Public Financial Barriers</b>	<b>P2.11</b> Assess the main barriers to increasing public funding for the adoption of CRA technologies and practices	<b>O2.11.1</b> The level of integration between climate finance and agriculture finance is determined through an assessment of existing framework (systems and policies) for agriculture development, food security, and climate change mitigation and adaptation
		<b>O2.11.2</b> The level of separation of adaptation and mitigation funding from donor and multi-lateral levels for CRA technologies and practices are evaluated to

			<p>determine the scope for CRA projects to maximize co-benefits</p> <p><b>O2.11.3</b> Quantitative and qualitative results from CRA activities are documented and communicated in a way that demonstrates the effectiveness and benefits of public finance and is aimed at increasing access to both climate change and development budgets</p> <p><b>O2.11.4</b> The level of clarity as to what CRA means for programming, national policy and donor and multi-lateral portfolios is assessed within the context of generating traction and support for funding CRA technologies and practices</p> <p><b>O2.11.5</b> The extent to which ‘investment ready’ CRA projects that can achieve results against multiple objectives and scale in the areas of development and climate change is assessed</p>
	<b>I2.12 Private Financial Barriers</b>	<b>P2.12</b> Assess the main barriers to increasing private funding for the adoption of CRA technologies and practices	<p><b>O2.12.1</b> The range of and extent to which risks may prevent capital providers, particularly those in the private sector, from investing in CRA technologies and practices is evaluated, including those risks associated with agriculture, undeveloped rural markets, political and regulatory constraints in doing business, including land distribution and tenure issues (See also <b>O2.10.4</b>)</p> <p><b>O2.12.2</b> The range of and extent to which issues such as access to technology, inadequate infrastructure, unstructured markets, and limited transition to more sustainable land-use which can have negative impacts on basic productivity at the farm level and hence directly affects return to investors is assessed (See also <b>O2.6</b>)</p> <p><b>O2.12.3</b> The extent to which insufficient aggregation at the smallholder level, with the high transaction cost associated with financing individual small holders for any CRA activities (mitigation, adaptation, and general agriculture) is examined</p> <p><b>O2.12.4</b> The extent to which the pre-requisite for smallholders to attract private funding for CRA technologies and practices is assessed to include those</p>



			related to land tenure, collateral, financial literacy, track records, basic financial services, aggregation, infrastructure, and market and product information
<b>3</b>	<b>I3 Public Sector Budget Analysis</b>	<b>P3.1</b> Conduct an analysis of agriculture finance in national budgets	<b>O3.1</b> National agriculture finance budgets in terms of how much by source (domestic and international), what it is used for, and how much is 'climate smart' is determined and presented (See also <b>O2.13.1</b> and <b>O2.13.2</b> )
		<b>P3.2</b> Conduct an analysis of climate finance in national budgets	<b>O3.2</b> National climate finance budgets in terms of how much by source (domestic and international), what it is used for, and how much climate finance is for agricultural activities is determined and presented
		<b>P3.3</b> Conduct an analysis of sources of international climate finance for agricultural activities	<b>O3.3</b> Climate funding for agricultural activities from the various international sources identified and documented (See also <b>O3.2</b> )

## Annex 4: Survey Instrument

### ECONOMIC AND MARKET BARRIERS THAT AFFECT CLIMATE RESILIENT SYSTEMS

#### A. Farm Level Endogenous Factors

No.	QUESTION	RESPONSE OPTIONS			
<b>Section 1: Personal Information</b>					
1	Name of Farmer				
2	Location	District:			
		Parish:			
		Country			
3	Telephone #	Home:			
		Mobile			
4	Gender	Male:			
		Female:			
5	Age	< 25 Years:			
		25 – 35 Years:			
		36 – 50 Years:			
		51 – 65 Years:			
		65 – 75 Years:			
6	Education	No Formal:			
		Primary:			
		Secondary:			
		College/University:			
		Postgraduate:			
7	Farm Household Structure				
7a	Who is the head of your household?	Male			
		Female			
7b	What is the size of your household?	Only one Member			
		2			
		3			
		4			
		≥ 5			
<b>Section 2: The Farm Enterprise</b>					
8	Farm Size				
8a	What is the size of your farm?	< 0.50 Acre:			
		0.50 – 1.00 Acre:			
		1.01 – 2.00 Acres:			
		2.01 – 5.00 Acres:			
		5.01 – 10.00 Acres			
		!0.01 – 25.00 Acres			
		> 25 Acres:			
8b	How many livestock do you have?	Beef Cattle #:			
		Dairy Cattle #:			

		Pigs (#):				
		Sheep (#):				
		Goats (#):				
		Broiler (#):				
		Layers (#):				
9	What is your annual household income (USD)?	< \$5,000:				
		\$5,000 - \$10,000:				
		\$10,001 - \$25,000:				
		\$25,001 - \$50,000:				
		\$50,000 - \$100,000:				
		> \$100,000:				
10	What is the main Source of Income?	Agriculture alone				
		Agriculture and Other Business				
		Agriculture and Employment				
11	How many years of farming experience do you have?	< 5 Year:				
		5 Year – 10 Year:				
		10 Year – 20 Year:				
		20 Year – 30 Year				
		30 year – 40 Year				
		> 40 Year				
11	What is the distance of your farm from your home?	At Homestead (0 KM)				
		0 – 1 KM				
		1 - 2 KM				
		2 – 5 KM				
		➤ 5 KM				
12	What land Tenure arrangement do you have?	Owned				
		Family Lands				
		Rented				
		Leased				
		Squatted				
		Community				
		Others				
13a	Do you have readily access to your Extension Officers?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
13b	Do you Readily contact Extension Officers?	Yes				
		No				
	If Yes How Often?	≥ Once per Week				
		≥ Twice per Month				
		≥ Once per Month				
		≥ Four times per Year				
		Once per Year				
		≥ Once per Year				
		1	2	3	4	5

14	Are you able to obtain information on climate change from the media?	Never	Occasionally	Sometimes	Often	Always
	If Yes Which one?	Radio				
		Television				
		Newspaper				
		Internet				
		Others: Specify				
Section 3: Access to Productive Assets and Inputs						
15	Are you a member of any agricultural-related Association or Group?	Yes				
		No				
16	Do you readily have access to farm inputs?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
17	Do you readily have access to land for agriculture?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
18	Do you readily have access to agricultural credit?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
19	Do you readily have access to agricultural labour?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
20	Do you readily have access to transport for farm inputs and produce?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
21	Do you readily have access to markets for outputs?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
	Do you readily have access to agricultural information?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
22	Do you readily have access to climate information relevant to agriculture?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
23	Do you readily have access to agricultural incentives (Subsidies, rebates, tax emptions, etc.)?	1	2	3	4	5
		No	Occasionally	Sometimes	Often	Always
24	Do you have access to insurance schemes for agriculture?	Yes				
		No				
		1	2	3	4	5

	Do you use insurance schemes in your farm business to manage climate related risks?	No	Occasionally	Sometimes	Often	Always
<b>25</b>	<b>Section 4: Farmers' Perception of the Impact of Climate Change</b>					
		1	2	3	4	5
<b>25a</b>	Climate Change has made agricultural production more unpredictable and unreliable.	Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25b</b>	Climate Change has resulted in increased agricultural production cost.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25c</b>	Climate Change resulted in practices that maintain soil moisture such as mulching to effectively reduced evaporation from the soil and make crop yield good.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25d</b>	The late commencement of rainfall has caused adverse effect on crops in terms of germination and growth.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25e</b>	Climate change has affected planting time and make crop production planning more difficult.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25f</b>	Increased drought associated with climate change will lead to decrease in crop yields	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25g</b>	Increase in temperature associated with climate change will not make the plant grow well because of heat stress.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
<b>25h</b>		1	2	3	4	5

	Climate Change has resulted in the need for the use of more fertilizer in improving and conserving soil structure better.	Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
25i	Unpredictable weather changes favor disease prevalence which affects crop sustainability.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
25j	Increased flooding causes erosion and reduced crop growth.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
25k	Increased landslides associated with flooding has reduced the amount of land available and suitable for crop cultivation.	1	2	3	4	5
		Strongly Disagree	Disagree	Never Agree nor Disagree	Agree	Strongly Agree
Section 5: Psychological Capital and Climate Change Adaptation						
26	Self-confidence					
26a	How confident are you about farming as a way of life in your country?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
26b	How confident are you about farming as a business in your country?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
26c	How confident are you in yourself as a farmer?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
26d	Do you agree that you have the power to affect the outcome of your farming?	1	2	3	4	5
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
27	Optimism					
27a	Are you optimistic about the future of agriculture in your area/country?	1	2	3	4	5
27b	Would you give up on agriculture easily?	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
		1	2	3	4	5

27c	Are you willing to take more risk in agriculture?	Definitely not	Probably not	Possibly	Probably	Definitely
28	Hope					
28a	Do you frequently hope that agriculture will get better?	1 Never	2 Occasionally	3 Sometimes	4 Often	5 Always
28b	Are you willing to forego a profit opportunity in the short run, to benefit from potential profit in the long run?	1 Definitely not	2 Probably not	3 Possibly	4 Probably	5 Definitely
28c	Are you willing to try new ideas even without full knowledge about the possible outcomes?	1 Definitely not	2 Probably not	3 Possibly	4 Probably	5 Definitely
29	Resilience					
29a	How are you coping with shocks such as drought, flood, hurricane, and other natural disaster?	1 Very poor	2 Poor	3 Fair	4 Good	5 Excellent
29b	Would you be in farming if there was a better alternative source of income?	1 Definitely	2 Probably	3 Possibly	4 Probably not	5 Definitely not
29c	Do you think the is government responsible for the wellbeing of rural households?	1 Definitely	2 Probably	3 Possibly	4 Probably not	5 Definitely not
30	Technology-based Barriers					
30a	Do you agree the upfront investment costs that a farmer must make too high?	1 Strongly agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree
30b	Do you agree that the input/operating costs (labor, fertilizers, chemicals, etc.,) are too high?	1 Strongly agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree
30c		1	2	3	4	5

	<b>Do you think that the riskiness of some Climate Resilient Agriculture (CRA) technologies and practices constraining their adoption?</b>	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
<b>30d</b>	<b>Do you agree that the government is not investing sufficient resources in the development of CRA technologies and practices</b>	1	2	3	4	5
		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
<b>30e</b>	<b>Do you agree that the current level of incentives provided by the government is insufficient to drive the research and development agenda for CRA technologies and practices</b>	1	2	3	4	5
		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
<b>30f</b>	<b>Do you agree that the private sector is not investing sufficient resources in the development of CRA technologies and practices</b>	1	2	3	4	5
		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
<b>30h</b>	<b>Do you agree that the Research and Development Agencies are not investing sufficient resources in the development of CRA technologies and practices</b>	1	2	3	4	5
		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
<b>25i</b>	<b>Do think the government is willing to make temporary short-term trade-offs within the sector to realize medium- or longer-term benefits?</b>	1	2	3	4	5
		Definitely not	Probably not	Possibly	Probably	Definitely
<b>25j</b>		1	2	3	4	5



	How would you characterize the level of preparedness of the sector to make trade-offs that may involve CRA pillars, example between productivity enhancing technologies and increase GHG emissions?	Very poor	Poor	Fair	Good	Excellent
<b>31</b>	<b>Public Financial Barriers</b>					
<b>31a</b>	How would you rate the level of integration between climate finance and agriculture finance?	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
<b>31b</b>	Is there a separation of adaptation and mitigation funding reducing the ability to maximize co-benefits?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
<b>31c</b>	Is there competing budgets and priorities within both Climate Change and development budgets?	1	2	3	4	5
		Always	Often	Sometimes	Occasionally	Never
<b>31d</b>	How would you rate the political profile of CRA's elevation at the national level?	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
<b>31e</b>	How would you rate the political profile of CRA's elevation at the international level?	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
<b>31f</b>	Is there adequate clarity as to the meaning of CSA to generate traction and donor support?	1	2	3	4	5
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Do you think there are 'investment ready' projects that are scalable and can demonstrate results in multiple areas?	1	2	3	4	5
		Definitely not	Probably not	Possibly	Probably	Definitely
<b>32</b>	<b>Private Financial barriers</b>					

32a	Are there a range of risks that are preventing capital providers from investing in CRA?	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
32b	If so, what are the main risks? Rank the top five (5) in descending order of importance?	1	2	3	4	5
32c	Is agriculture perceived to be a low -margin business?	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
327d	What are the main issues that can directly affect returns to investors? Rank the top five (5) in descending order of importance?	1	2	3	4	5
32e	Do you consider the high transaction costs related to the insufficient aggregation at the small holder's level a major issue?	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
32f	Do you think that the pre-requisite for small holders to attract private funding is greater than those for public funding sources?	1	2	3	4	5
		Almost always true	Usually, true	Occasionally true	Usually not true	Almost never true
32g	If so, what are the main barriers for small holders in obtaining necessary financing to apply CRA practices? Rank the top five (5) in descending order of importance?	1	2	3	4	5
32h	Do you think the return on investments informed the decisions to adopt CRA technologies and practices?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
32i		1	2	3	4	5

	<b>Do you consider CRA technologies very costly?</b>	Definitely	Probably	Possibly	Probably not	Definitely not
<b>33</b>	<b>Barriers to Scaling up carbon market finance</b>					
<b>33a</b>	<b>Do you think there is a weak demand overall in voluntary and compliance carbon markets?</b>	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
<b>33b</b>	<b>Do you think the limited eligibility of CRA activities in compliance and voluntary carbon markets a major issue?</b>	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
<b>33c</b>	<b>Are the technical burdens of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA?</b>	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
<b>33d</b>	<b>Are the high transaction costs of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA?</b>	1	2	3	4	5
		Definitely	Probably	Possibly	Probably not	Definitely not
<b>34</b>	<b>Mainstreaming of CRA Funds</b>					
<b>34a</b>	<b>How would you rate the level of mainstreaming of Climate Change into agriculture sectoral and national budgetary processes?</b>	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
<b>34b</b>	<b>How would you rate the level of mainstreaming of Climate Change into agriculture ODA by many donors?</b>	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
<b>35</b>	<b>Markets</b>					
<b>35a</b>	<b>How would you rate farmers access to the markets for CRA technologies?</b>	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent

50b	How would you rate farmers access to the markets for inputs for the adoption of CRA technologies and practices?	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
35c	How would you characterize the adequacy of financial support services available for the adoption of CRA technologies and practices?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
35d	How would you rate farmers access to markets for their product?	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
35e	Are marketing channels readily available?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
35f	Are marketing channels dominated by middlemen and traders?	1	2	3	4	5
		Always	Often	Sometimes	Occasionally	Never
35g	Are farmgate prices much lower than market prices?	1	2	3	4	5
		Always	Often	Sometimes	Occasionally	Never
35h	Are farmers utilizing risk transfer financial products/practices such as insurance/emergency funds?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
35i	Are there adequate storage facilities beyond the farm gate for produce?	1	2	3	4	5
		Never	Occasionally	Sometimes	Often	Always
36	Policy and Regulatory Barriers					
36a	How would you rate the adequacy of government support in terms of incentives and subsidies in place for CRA adoption	1	2	3	4	5
		Very poor	Poor	Fair	Good	Excellent
37	Cultural Perception and Social Barriers					
		1	2	3	4	5

<b>37a</b>	<b>Do you think CRA technological innovation and management practices (TIMPs) are the preserve of the commercial, large farms and businesses?</b>	Definitely	Probably	Possibly	Probably not	Definitely not
<b>37b</b>	<b>Do you think cultural tradition customs, norms and religious beliefs discouraged the adoption of CRA TIMPs?</b>	1 Definitely	2 Probably	3 Possibly	4 Probably not	5 Definitely not
<b>37c</b>	<b>Do you think CRA technologies and practices are good for agriculture?</b>	1 Definitely not	2 Probably not	3 Possibly	4 Probably	5 Definitely
<b>38</b>	<b>Physical Infrastructure Barriers</b>					
<b>38a</b>	<b>Do you have adequate access to the required physical infrastructure (transport, roads, facilities, and some form of assets) to adopt CRA TIMPs?</b>	1 Definitely	2 Probably	3 Possibly	4 Probably not	5 Definitely not
<b>38b</b>	<b>Do you think cost is a major issue to having access to adequate levels of physical infrastructure (transport, roads, facilities, and some form of assets) for the adoption of CRA TIMPs?</b>	1 Definitely	2 Probably	3 Possibly	4 Probably not	5 Definitely not
<b>38c</b>	<b>Do you have adequate access to power/source of energy for the adoption of CRA TIMPs?</b>	1 Definitely not	2 Probably not	3 Possibly	4 Probably	5 Definitely
<b>38d</b>	<b>Do you think energy costs are too high for the adoption of CRA TIMPs?</b>	1 Definitely	2 Probably	3 Possibly	4 Probably not	5 Definitely not

## Annex 5: Economic and Market Barrier Analysis

	Economic and Market Barrier Analysis		
1	Technology-based Barriers to the adoption of Climate Resilient Agriculture (CRA) Systems	Mean Score 5 = Max	Rank
1a	Do you agree the upfront investment costs that a farmer must make too high?	4.00	2
1b	Do you agree that the input/operating costs (labor, fertilizers, chemicals, etc.,) are too high?	3.75	5
1c	Do you think that the riskiness of some Climate Resilient Agriculture (CRA) technologies and practices constraining their adoption?	3.5	7
1d	Do you agree that the government is not investing sufficient resources in the development of CRA technologies and practices	4.00	2
1e	Do you agree that the current level of incentives provided by the government is insufficient to drive the research and development agenda for CRA technologies and practices	4.25	1
1f	Do you agree that the private sector is not investing sufficient resources in the development of CRA technologies and practices	3.75	5
1h	Do you agree that the Research and Development Agencies are not investing sufficient resources in the development of CRA technologies and practices	4.00	2
1i	Do think the government is willing to make temporary short-term trade-offs within the sector to realize medium- or longer-term benefits?	3.00	8
1j	How would you characterize the level of preparedness of the sector to make trade-offs that may involve CRA pillars, example between productivity enhancing technologies and increase GHG emissions?	2.25	9
2	Public Financial Barriers		
2a	How would you rate the level of integration between climate finance and agriculture finance?	2.25	9
2b	Is there a separation of adaptation and mitigation funding reducing the ability to maximize co-benefits?	3.25	3
2c	Is there competing budgets and priorities within both Climate Change and development budgets?	4.00	1
2d	How would you rate the level of mainstreaming of Climate Change Projects/Activities into National budgets	2.75	5
2e	How would you rate the level of mainstreaming of Climate Change Projects/Activities into Agriculture Sector budgets	2.75	5
2f	How would you rate the political profile of CRA's elevation at the national level?	2.75	5
2g	How would you rate the political profile of CRA's elevation at the international level?	2.75	5
2h	Is there adequate clarity as to the meaning of CRA to generate traction and donor support?	3.25	3
2i	Do you think there are 'investment ready' projects that are scalable and can demonstrate results in multiple areas?	3.75	2
3	Private Financial barriers		
3a	Are there a range of risks that are preventing capital providers from investing in CRA?	4.50	1
3b	If so, what are the main risks? Rank the top five (5) in descending order of importance?		
3c	Is agriculture perceived to be a low -margin business?	2.50	6

3d	What are the main issues that can directly affect returns to investors? Rank the top five (5) in descending order of importance?		
3e	Do you consider the high transaction costs related to the insufficient aggregation at the small holder's level a major issue?	4.50	1
3f	Do you think that the pre-requisite for small holders to attract private funding is greater than those for public funding sources?	3.50	2
3g	If so, what are the main barriers for small holders in obtaining necessary financing to apply CRA practices? Rank the top five (5) in descending order of importance?		
3h	Do you think the return on investments informed the decisions to adopt CRA technologies and practices?	3.50	2
3i	Do you consider CRA technologies very costly?	3.50	2
4	<b>Barriers to Scaling up carbon market finance</b>		
4a	Do you think there is a weak demand overall in voluntary and compliance carbon markets?	4.00	
4b	Do you think the limited eligibility of CRA activities in compliance and voluntary carbon markets a major issue?	3.5	
4c	Are the technical burdens of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA?	3.25	
4d	Are the high transaction costs of developing 'market ready' CRA projects limiting the ability to scale up carbon markets finance for CRA?	3.50	
5	<b>Mainstreaming of CRA Funds</b>		
5a	How would you rate the level of mainstreaming of Climate Change into agriculture sectoral and national budgetary processes?	3.00	1
5b	How would you rate the level of mainstreaming of Climate Change into agriculture ODA by many donors?	3.00	1
6	<b>Markets</b>		
6a	How would you rate farmers access to the markets for CRA technologies?	2.50	5
6b	How would you rate farmers access to the markets for inputs for the adoption of CRA technologies and practices?	2.25	7
6c	How would you characterize the adequacy of financial support services available for the adoption of CRA technologies and practices?	3.00	3
6d	How would you rate farmers access to markets for their product?	2.75	4
6e	Are marketing channels readily available?	3.25	1
6f	Are marketing channels dominated by middlemen and traders?	2.50	5
6g	Are farmgate prices much lower than market prices?	3.25	1
6h	Are farmers utilizing risk transfer financial products/practices such as insurance/emergency funds?	1.50	9
6i	Are there adequate storage facilities beyond the farm gate for produce?	2.25	7
7	<b>Policy and Regulatory Barriers</b>		
7a	How would you rate the adequacy of government support in terms of incentives and subsidies in place for CRA adoption	2.25	
8	<b>Cultural Perception and Social Barriers</b>		
8a	Do you think CRA technological innovation and management practices (TIMPs) are the preserve of the commercial, large farms and businesses?	2.25	3
8b	Do you think cultural tradition customs, norms and religious beliefs discouraged the adoption of CRA TIMPs?	2.50	2
8c	Do you think CRA technologies and practices are good for agriculture?	4.75	1
9	<b>Physical Infrastructure Barriers</b>		
9a	Do farmers have adequate access to the required physical infrastructure (transport, roads, facilities, and some form of assets) to adopt CRA TIMPs?	2.24	3

<b>9b</b>	<b>Do you think cost is a major issue to having access to adequate levels of physical infrastructure (transport, roads, facilities, and some form of assets) for the adoption of CRA TIMPs?</b>	4.25	1
<b>9c</b>	<b>Do farmers have adequate access to power/source of energy for the adoption of CRA TIMPs?</b>	2.00	4
<b>9d</b>	<b>Do you think energy costs are too high for the adoption of CRA TIMPs?</b>	4.25	1



## **Annex 6: Analysis of Caribbean Countries Committed Climate Finance**

### **A6.1 Analysis of Belize Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 19.5 million in finance was allocated to Belize for activities that principally targeted climate change objectives. This was all delivered in the form of grants.

Of the total, 92% (US\$ 17.93 million) was for adaptation, 4.5% (US\$ 0.87 million) supported mitigation activities, and 3.5% (US\$ 0.67 million) targeted both objectives simultaneously.

The largest single sources of climate finance for Belize were the Global Environment Facility (GEF), Adaptation Fund and EU. The sectors that have received the largest commitments overall are water supply and sanitation, and energy policy.

For the 2010–2015 period, the disbursement ratio (disbursed amounts compared with committed amounts in the same period) for Belize was 60 % (US\$ 11.67 million).

### **A6.2 Analysis of Dominica Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 31.9 million in finance was allocated to Dominica for activities that principally targeted climate change objectives. Of this, US\$ 23.27 million was in the form of grants, with the remaining US\$ 8.63 million delivered as ODA loans for renewable energy.

Of the total, 33% (US\$ 10.66 million) supported mitigation activities, 66% (US\$ 21.16 million) was for adaptation, and a minor amount (US\$ 0.05 million) targeted both objectives simultaneously.

The Climate Investment Funds have provided the largest share of Dominica's climate finance, and this has been for disaster prevention and preparedness (US\$ 21 million). France has contributed ODA loans for renewable energy, and the Global Environment Facility (GEF) has also committed funding for renewables.

For the 2010–2015 period, the disbursement ratio (disbursed amounts compared with committed amounts in the same period) was low for Dominica, at 10% (US\$ 3.19 million).

### **A6.3 Analysis of Haiti Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 162.4 million in finance was allocated to Haiti for activities that principally targeted climate change objectives. Of this, US\$ 147.9 million was in the form of grants, with the remaining US\$ 14.5 million delivered as ODA loans from the Climate Investment Funds for renewable energy.

Of the total, 33% (US\$ 54.39 million) supported mitigation activities, 59% (US\$ 95.09 million) was for adaptation, and 8% (US\$ 12.96 million) targeted both objectives simultaneously.

Haiti has been allocated climate finance from a diversity of different sources. The largest contributions have come from Germany, Japan, the Climate Investment Funds, and the Global Environment Facility (GEF). There has also been a considerable spread across different sectors receiving the funding, among which the largest recipients have been renewable energy, transport, and disaster prevention and preparedness. The general environment protection category includes activities targeting energy and

agriculture, as well as the Ridge to Reef program of the GEF and the EU's Global Climate Change Alliance program.

For the 2010–2015 period, the disbursement ratio (disbursed amounts compared with committed amounts in the same period) for Haiti was 31% (US\$ 50.13).

#### **A6.4 Analysis of Saint Kitts & Nevis Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 0.1 million in finance was allocated to Saint Kitts and Nevis for activities that principally targeted climate change objectives. This comes from a combination of four different sources each making very small allocations (Australia, the United Kingdom, Japan, and the Global Environment Facility).

#### **A6.5 Analysis of Saint Lucia Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 36.7 million in finance was allocated to Saint Lucia for activities that principally targeted climate change objectives. Of this, US\$ 21.7 million was in the form of grants, with the remaining US\$ 15 million delivered as ODA loans from the Climate Investment Funds.

Of the total, over 94% (US\$ 34.65 million) was for adaptation, while around 5% (US\$ 2.05 million) supported mitigation activities, and a minor amount (US\$ 0.01 million) targeted both objectives simultaneously.

The largest single source of climate finance for Saint Lucia was the Climate Investment Funds, which targeted activities in disaster prevention and preparedness. The other main contributors have been the EU, also in the disaster sector, and the Global Environment Facility (GEF).

For the 2010–2015 period, the disbursement ratio (disbursed amounts compared with committed amounts in the same period) for Saint Lucia was very low, around 2% (US\$ 0.82 million).

#### **A6.6 Analysis of Saint Vincent & the Grenadines Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 15.2 million in finance was allocated to Saint Vincent and the Grenadines for activities that principally targeted climate change objectives. This was all in the form of grants.

Of the total, around 19% (US\$ 2.92 million) supported mitigation activities, 81% (US\$ 12.24 million) was for adaptation, and a minor amount (US\$ 0.04 million) targeted both objectives simultaneously.

The largest single source of climate finance for Saint Vincent and the Grenadines was the EU, followed by the Climate Investment Funds and Global Environment Facility (GEF). The bulk of the funding has targeted the disaster sector, but also includes GEF commitments for the energy sector.

For the 2010–2015 period, the disbursement ratio (disbursed amounts compared with committed amounts in the same period) for Saint Vincent and the Grenadines was very low, less than 4% (US\$ 0.56 million).

#### **A6.7 Analysis of Suriname Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 28.7 million in finance was allocated to Suriname for activities that principally targeted climate change objectives. Of this, US\$ 14.9 million was in the form of grants, with the remaining US\$ 13.87 million delivered as ODA loans from France.

Of the total, 23% (US\$ 6.51 million) supported mitigation activities, 60% (US\$ 17.22 million) was for adaptation, and 17% (US\$ 4.93 million) targeted both objectives simultaneously.

France was the largest single source of climate finance for Suriname, providing ODA loans for the water supply and sanitation sector. The other main contributors were the Global Environment Facility (GEF), which funded renewable energy, the Netherlands and the EU. The EU commitments categorized under “general environment protection” is the Global Climate Change Alliance program, and the Dutch contributions under this category were to WWF Guianas.

For the 2010–2015 period, the disbursement ratio (disbursed amounts compared with committed amounts in the same period) for Suriname was very low, at just under 10% (US\$ 2.79 million).

#### **A6.8 Analysis of Trinidad and Tobago Committed Climate Finance, 2010-2015**

During 2010–2015, a total of US\$ 0.1 million in finance was allocated to Trinidad and Tobago for activities that principally targeted climate change objectives. This was primarily a commitment from Finland to disaster prevention and preparedness.

## Annex 7: Findings on Public Sector Budgets: Capital Expenditures (US\$)

### Capital Budget Analysis: The Bahamas

No.	Description of Capital Budget Line	Budget Commitments/Expenditures (US\$)					
		2021/22	2020/21	2019/20	2018/19	2017/18	2016/17
1	Total Capital Budget	372,423	515,525	387,197	299,319	268,707	
2	Agriculture Capital	3,220	3,589	1,193	840		
3	Agriculture Capital/ Total Capital (%)	0.86	0.70	0.31	0.28		
5	Climate Change Capital	27,475	35,666	97,207	13,063		
5	Climate Change Capital/Total Capital (%)	7.4	6.9	25.1	4.4		
6	Climate Resilient Agriculture (CRA) Capital	3,100	243	155	100		
7	CRA Capital/ Climate Change Capital (%)	11.3	0.70	0.20	0.77		
8	CRA Capital/ Agriculture Capital	96.3	7.0	13.0	11.9		

### Capital Budget Analysis: Belize

No.	Description of Capital Budget Line	Budget Commitments/Expenditures (US\$)					
		2021/22	2020/21	2019/20	2018/19	2017/18	2016/17
1	Total Capital Budget	55,027	88,541	46,519	33,493	29,588	56,839
2	Agriculture Capital	433	1,103	1,009	1,185	3,301	3,186
3	Agriculture Capital/ Total Capital (%)	0.79	1.25	2.17	3.54	11.2	5.6
5	Climate Change Capital	7,256	12,480	10,395	8,375	3,655	
5	Climate Change Capital/Total Capital (%)	13.19	14.10	22.35	25.00	12.35	
6	Climate Resilient Agriculture (CRA) Capital	341	723	637	211	278	
7	CRA Capital/ Climate Change Capital (%)	4.70	5.79	6.13	2.52	7.60	
8	CRA Capital/ Agriculture Capital	78.8	65.5	63.1	17.8	84.2	

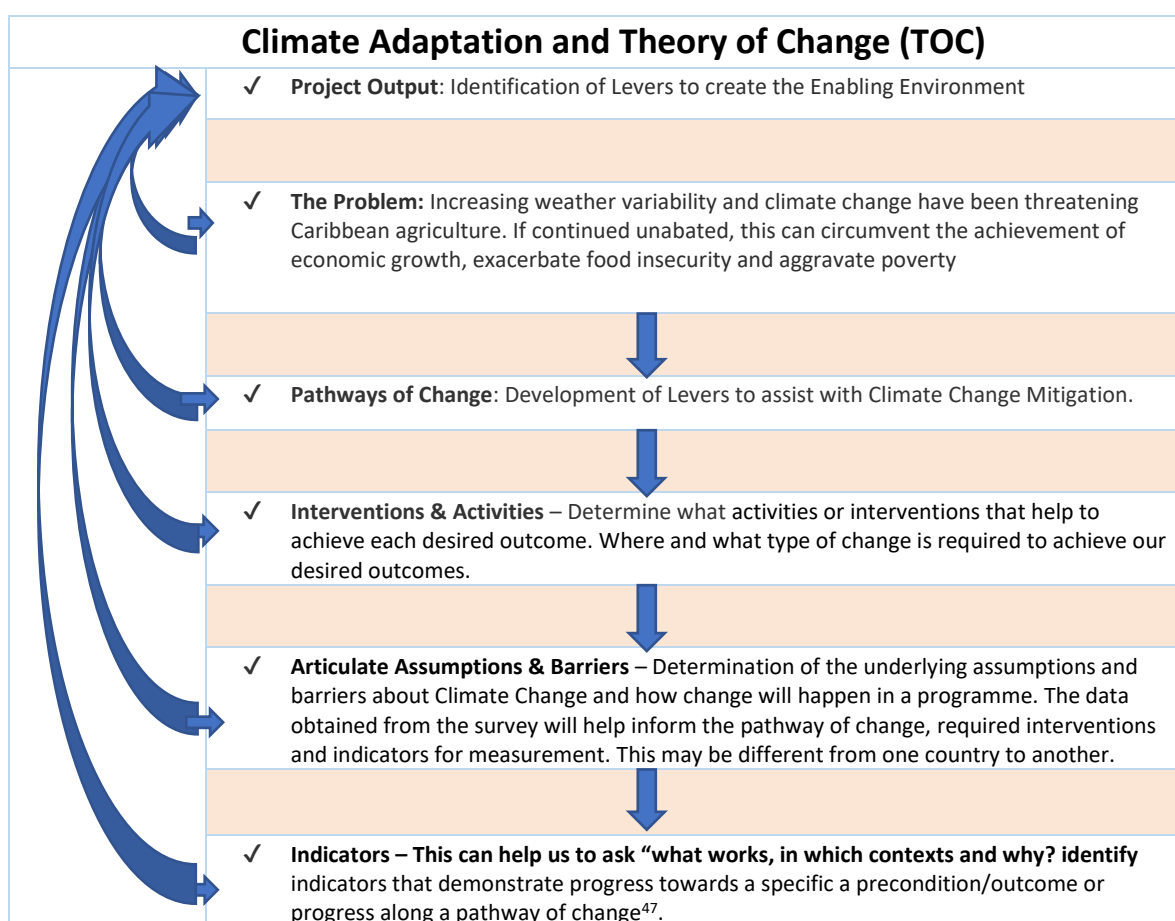
### Capital Budget Analysis: Dominica

No.	Description of Capital Budget Line	Budget Commitments/Expenditures (US\$)					
		2021/22	2020/21	2019/20	2018/19	2017/18	2016/17
1	Total Capital Budget	162,540	166,043	178,439	160,164	83,633	
2	Agriculture Capital	11,827	7,772	4,980	3,881	2,572	
3	Agriculture Capital/ Total Capital (%)	7.28	4.68	2.79	2.42	3.08	
5	Climate Change Capital	21,714	13,897	14,973	4,132	8,446	
5	Climate Change Capital/Total Capital (%)	13.36	8.37	8.39	2.58	10.1	
6	Climate Resilient Agriculture (CRA) Capital	6,537	6,437	4,006	330	59	
7	CRA Capital/ Climate Change Capital (%)	30.11	46.32	26.75	7.99	0.70	
8	CRA Capital/ Agriculture Capital	55.27	82.82	80.44	8.50	2.29	

### Capital Budget Analysis: Trinidad and Tobago

No.	Description of Capital Budget Line	Budget Commitments/Expenditures (US\$'000')					
		2021/22	2020/21	2019/20	2018/19	2017/18	2016/17
1	Total Capital Budget		685,000	679,586	866,667	588,398	574,742
2	Agriculture Capital		10,192	11,129	16,770	12,243	8,877
3	Agriculture Capital/ Total Capital (%)		1.49	1.64	1.93	2.08	1.54
5	Climate Change Capital		33,575	34,809	29,334	25,538	19,987
5	Climate Change Capital/Total Capital (%)		4.90	5.12	3.38	4.34	3.48
6	Climate Resilient Agriculture (CRA) Capital		4,833	3,221	2,309	1,401	1,815
7	CRA Capital/ Climate Change Capital (%)		14.39	9.25	7.87	5.49	9.08
8	CRA Capital/ Agriculture Capital		47.42	28.94	13.77	11.44	20.44

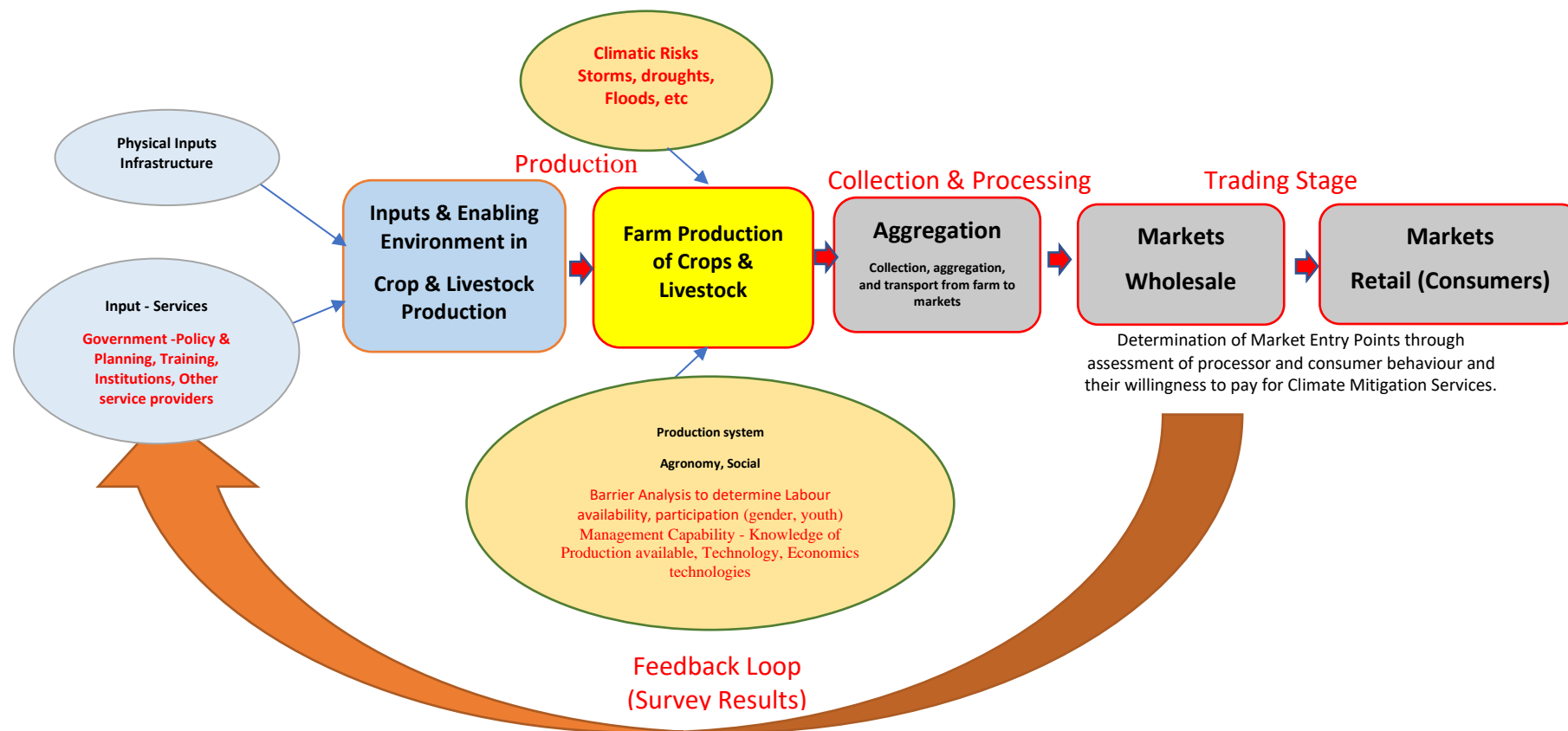
## Annex 8: Climate Adaptation and Theory of Change (TOC)



<sup>47</sup> **Indicators & Thresholds are for example**, “reduce losses from flooding and coastal inundation” can include measures such as: a) no losses at all, b) a percentage reduction in losses, if so, by how much and for which farmers? May also include non-economic losses such as loss of knowledge or cultural value of land.

## Annex 9: Conceptual Model - Major Nodes, Actors & Interactions in the Crop

Determination of market and value chain barriers that limit the transformation of Caribbean agricultural production systems



Identification of Levers, Policy and Interventions for Strengthening the Enabling Environment for Development of Climate Resilient Production Systems using an Evidence-based Climate Resilient Responsive Agriculture Systems Approach

## Annex 10: Identification and prioritization of climate risks and responses

Node in Value Chain / Food System	Identification and Prioritization of Climate Risks							Opportunities for increasing resilience to climate change along the value chain segments identified
	Examples of Adaptation Strategy	Doer	Non-Doer	Interventions Diversification	Interventions Climate-proofing	Interventions Supply chain efficiencies	Evidence-based climate narrative obtained	
<b>Pre-production</b>								
<i>Nursery</i>	Additional seedlings required			√		√		
<i>Selection of crop</i>	Drought / flood / hurricane tolerant crop			√				
<i>Selection of planting material</i>	Change from one crop to another Change cultivar to drought tolerant varieties Change from hybrid seeds to heirloom (traditional) seeds Change from heirloom (traditional) seeds to hybrid seeds			√				
<i>Method of land preparation</i>	Had additional tractor power available Clear only planting site vs whole field Keep previous crop to act as a surface mulch Incorporate plant debris into the soil Utilize minimum tillage strategies vs conventional (plough & refine whole field) tillage Form flat beds Form cambered beds Form concave beds Form ridge and furrow No change				√			
<b>Input Suppliers</b>								
<i>Supplier of pesticides (insecticides, fungicides, weedicides)</i>	Additional volumes of pesticides required Additional type of pesticides required Additional capital needed to purchase pesticides			√		√		
<i>Source and supply additional amounts of livestock / ruminant feed</i>	Additional volume of feed required for droughts Need to source new suppliers Additional capital needed to purchase feed			√		√		
<b>Production</b>								
	Landscape measure management (land clearing)			√	√			
<i>Method of soil conservation</i>	Contour drains, barriers, etc				√			
<i>Method of plant propagation</i>	Shift from bare rooted to container grown seedlings Plant rooted cuttings instead of stem cuttings Transplant older seedlings Transplant using mature cuttings vs less mature cutting			√				
<i>Method of transplanting</i>	Transplant deeper to utilize residual moisture Put manure in planting hole for better root-soil contact & increase water retention capacity Use water absorbing gel in planting holes Alter planting dates No change				√			
<i>Spacing / Plant density</i>	Increase spacing Decrease spacing Spacing remained unchanged				√			



Node in Value Chain / Food System	Identification and Prioritization of Climate Risks							Opportunities for increasing resilience to climate change along the value chain segments identified
	Examples of Adaptation Strategy	Doer	Non-Doer	Interventions Diversification	Interventions Climate-proofing	Interventions Supply chain efficiencies	Evidence-based climate narrative obtained	
<i>Irrigation</i>	Install irrigation system Had a supply of irrigation water Knew how to set up an irrigation system Had the technical expertise to set up an irrigation system Know the benefits / advantages of irrigation Subsidy programme for irrigation equipment Irrigation equipment readily available Had money to purchase irrigation system Water control agency easily accessible Government policy favourable for irrigation Use anti-transpirants				✓			
<i>Weed control</i>	More timely control of weeds Use physical control and retain weed debris as a mulch Use chemical control and leave plant residue standing as a mulch Use selective weed control measures Use smother crop / live mulch to control weeds				✓			
<i>Fertilizer application</i>	Apply manure Use fertigation Use more soluble fertilizers Apply fertilizer based on soil test Incorporate fertilizer in soil during application Apply based on weather conditions Adopted precision agriculture practices				✓			
<i>Pest &amp; Disease Control</i>	Use spreader sticker Choose the best time to spray Purchase spray equipment (eg mist blower) for better coverage Apply pesticide based on type of pest present Change the type of pesticide used Change time of day applied Change rate of application Change method of application Use IPM (eg push (repellant plants) & pull (trapping) methods) Develop better monitoring systems for pests and diseases				✓			
<i>Systems for strengthening animal forage, as well as raw materials</i>	<input type="checkbox"/> Systems in place to easily strengthen my forage system <input type="checkbox"/> Access to affordable feed raw materials <input type="checkbox"/> Proximity to easily accessible pastures <input type="checkbox"/> Access to seasonal distant pastures <input type="checkbox"/> Access to natural pastures (eg airport fields, playgrounds, river banks, roadsides, etc) <input type="checkbox"/> Access to technologies for harvesting and preparation of feed (hay, silage) <input type="checkbox"/> Access to equipment for chopping forage (on loan or centralized location where farmers can use)			✓				

Node in Value Chain / Food System	Identification and Prioritization of Climate Risks							Opportunities for increasing resilience to climate change along the value chain segments identified
	Examples of Adaptation Strategy	Doer	Non-Doer	Interventions Diversification	Interventions Climate-proofing	Interventions Supply chain efficiencies	Evidence-based climate narrative obtained	
Feeding practices	<ul style="list-style-type: none"> <li>[ ] Switch production technology from extensive / open field grazing to pasture-stall system</li> <li>[ ] Made efficient use not just of farmyard feed (coarse, green and concentrated), but also pastures available in the economy (including roadside / "long acres").</li> <li>[ ] Developed a system for stable forage supply - stable food base, seasonal fodder stability and access / availability of natural pastures</li> <li>[ ] Avoid incidence of soil / pasture degradation by decreasing the load per unit area of grazing by farm animals.</li> <li>[ ] Cultivate high protein forages               <ul style="list-style-type: none"> <li>[ ] Cultivate forages that accumulate carbohydrate during drought (eg sugarcane) for feeding</li> </ul> </li> </ul>			√	√			
Harvesting	<ul style="list-style-type: none"> <li>More manpower</li> <li>Tractor available to go in the field to bring out produce</li> <li>Hard surface road</li> <li>Cool immediately after harvesting</li> <li>Wet crops after harvesting</li> <li>Change stage at which the crop is harvested</li> <li>Change harvesting practices (eg harvest what will be sold)</li> <li>Change time of day (eg early morning)</li> <li>Harvest earlier in the season before drought start</li> </ul>			√	√			
Postharvest Handling	<ul style="list-style-type: none"> <li>Apply wax on crops</li> <li>Keep crop in damp environment</li> <li>Do not wash immediately after harvesting</li> </ul>					√		
Aggregation and Transport	<ul style="list-style-type: none"> <li>Use ventilated bags &amp; boxes</li> <li>Transport in cooler time of day</li> <li>Use covered/uncovered trucks</li> <li>Use refrigerated trucks</li> </ul>					√		
Processing	<ul style="list-style-type: none"> <li>Transportation cost (Vincent)</li> <li>Contracted growers to supply</li> <li>Bought out fields before drought / flood occurred</li> <li>Expanded storage</li> <li>Increase buying prices to get higher volumes in advance</li> <li>Implement waste reduction measures</li> <li>Diversify storage to buffer price fluctuations</li> <li>Link to importers to diversify supply base</li> <li>Commenced own production to mitigate against shortfalls</li> </ul>					√		
Storage								
Marketing	<ul style="list-style-type: none"> <li>Sell crop in advance</li> <li>Harvest earlier</li> <li>Earlier delivery</li> <li>Lower price to sell quicker</li> <li>Direct delivery</li> <li>Farmgate sales</li> <li>Single harvest vs multiple harvests</li> <li>Use ripener to bring crop in earlier</li> </ul>					√		

Node in Value Chain / Food System	Identification and Prioritization of Climate Risks							Opportunities for increasing resilience to climate change along the value chain segments identified
	Examples of Adaptation Strategy	Doer	Non-Doer	Interventions Diversification	Interventions Climate-proofing	Interventions Supply chain efficiencies	Evidence-based climate narrative obtained	
<i>Retail Consumption</i>	Willingness to pay for climate friendly ... Willingness to pay for low carbon.. Willingness to participate in climate proofing activities					√		
<b>Information system</b>	Weather news and data (GS) Early warning systems (GS) Market Information & Intelligence (GS) <b>Information Platform (Vincent)</b>				√	√		
<b>Governance</b>	Policy consultant							
<b>Technology</b>	Cost of technology and access (Vincent)							
<b>Financial Services</b>	Keep capital for unplanned activities Create a line of credit with the bank (GS & VL) Negotiate line of credit with input suppliers Small grants (Vincent)			√				
<b>Cultural and Social Barriers</b>								
<b>Production Infrastructure (Crops)</b>	Create fire breaks Construct greenhouses Establish windbreaks Drainage Water harvesting Water storage systems				√			
<b>Production Infrastructure (Livestock)</b>	[ ] High roof, ventilated roofing to assist in cooling [ ] Hurricane straps - anchored / reinforced roofing [ ] Additional water storage structures [ ] Access to a reliable electricity network [ ] All-weather access roads [ ] Reliable news releases & other means of communication [ ] Raise river banks to mitigate against flooding [ ] Establish windbreaks to protect buildings [ ] Construct slurry ponds				√			
<b>Agricultural production – Livestock breeding / reproduction systems</b>	[ ] Have breeding males intermingling as a strategy to manage silent heat [ ] Used ink markers to detect animals on heat [ ] Used infrared camera to detect animals on heat [ ] Daily observation of females to detect animals on heat [ ] Breeding animals on loan to rebuild stock [ ] Sire exchange programme - breeding males on loan to farmers [ ] Breed conservation programme [ ] Animal rescue programmes (females kept from slaughter)			√				
<b>Agricultural production -</b>	[ ] Recovery of pastures and wells			√	√			

Node in Value Chain / Food System	Identification and Prioritization of Climate Risks							Opportunities for increasing resilience to climate change along the value chain segments identified
	Examples of Adaptation Strategy	Doer	Non-Doer	Interventions Diversification	Interventions Climate-proofing	Interventions Supply chain efficiencies	Evidence-based climate narrative obtained	
advanced technologies	<ul style="list-style-type: none"> <li>[ ] Raising livestock using scientific methods and achieve its high efficiency</li> <li>[ ] Adopted systems for improving the genetic potential of livestock</li> <li>[ ] Optimal veterinary health</li> <li>[ ] Systems to enhance sanitary controls</li> <li>[ ] Systems for reducing GH gas emissions</li> <li>[ ] Early warning systems (against flooding)</li> </ul>							
Integration of research into practice	<ul style="list-style-type: none"> <li>[ ] Strong cadre of knowledgeable trainers</li> <li>[ ] Proactive and targeted livestock production training</li> <li>[ ] Training of farmers &amp; Officers in Disaster Mitigation practices</li> <li>[ ] Strong practical research linkages (eg CARDI, IICA, FAO)</li> <li>[ ] Industry database of input suppliers, breed book, frozen semen,</li> </ul>				√			
Incentives to facilitate climate technologies	<ul style="list-style-type: none"> <li>[ ] Subsidy to build strong livestock buildings</li> <li>[ ] Subsidy to build biogas systems</li> <li>[ ] Subsidy for waste management systems</li> <li>[ ] Subsidy for forage harvesting</li> <li>[ ] Subsidy for forage conservation</li> <li>[ ] Post disaster support (in-kind support to help recovery after disaster eg feed, breeding stock, etc)</li> <li>[ ] Pre-disaster support (move animals to safe zones)</li> <li>Incentives (VL)</li> </ul>			√	√			

## Annex 11: Priority Agriculture Value Chains of Selected Countries

Priority Value Chain	BAH	BEL	DOM	HAI	STKN	STL	STV	SUR	TT
<b>Crops</b>									
<b>1.1. Musa Group</b>									
▪ Banana / Plantain		√	√			√	√	√	
<b>1.2. Root Crops</b>									
▪ Dasheen						√	√		
▪ Cassava	√						√	√	
▪ Sweet Potatoes	√		√		√	√	√		
▪ Irish Potatoes		√			√				
<b>1.3. Fruiting Vegetables</b>		√			√		√	√	
▪ Tomatoes		√				√			√
▪ Sweet Pepper		√				√			√
▪ Hot Pepper	√		√		√				√
<b>1.4 Leafy Vegetables</b>									
▪ Cucumber						√			√
▪ Cabbage		√				√			√
▪ Lettuce						√			√
<b>1.5. Pulses</b>									
▪ Peas / Beans	√	√						√	
<b>1.6 Livestock</b>									
▪ Cattle	√	√			√			√	√
▪ Broilers	√	√			√	√		√	
▪ Sheep	√	√	√		√	√	√		√
▪ Goats	√		√		√	√	√		√
▪ Pigs	√	√			√	√	√	√	√

## Annex 13: CARICOM Priority Sectors and Related Variables

CARICOM Priority Sectors and Related Variables																		
Priority Industry/Commodity/Products	Investment Areas	Antigua	Bahamas	Barbados	Belize	Dominica	Grenada	Guyana	Haiti	Jamaica	Montserrat	St Kitts	St Lucia	St Vincent	Trinidad	Suriname	Rationale for selection of production base/ product	
Poultry meat	Poultry Meat																Productive capacity	
Poultry Hatching Eggs	Intermediate supply (production and distribution)																Domestic demand	
Corn/ Soya bean	Feed Production																Current production	
Rice	Feed Production																Productive capacity	
Meat	Beef, Pork, Mutton																Demand as an intermediate input	
Roots and Tubers	Yams																Productive Capacity	
	Sweet Potato																Demand for the produce	
	Irish/Table Potato																	
	Cassava																	
Vegetables	Niche Vegetables																Strong import demand	
Coconut	Production																Domestic demand	
Fruits	Production																Domestic demand	
	Juices and purees																Regional industrial demand by beverages producers	
	Mangoes																	
	Avocado																	
	Soursop																	
	Guava																	
	Pineapple																	
Non-Traditional Crops	Moringa																International Demand for natural remedy solutions	
	Other medicinal plants																	
Herbs and spices	Ginger																Domestic demand (intermediate and final)	
	Turmeric																Policies in place	
	(fresh and ground, value-added activities such as teas)																Regional industrial demand by beverages producers	
Source: IMPLEMENTATION PLAN "STRATEGY FOR ADVANCING THE CARICOM AGRI-FOOD SYSTEMS AGENDA; PRIORITISING REGIONAL FOOD AND NUTRITION SECURITY"																		
CAPHFS: Bananas and Plantain, Cruciferous vegetables and lettuce, Cucurbits, Solanaceous plants, Alliums																		
Targeted countries																		