Alliance

POLICY BRIEF No. 50

Climate-Smart Agriculture Investment Portfolios in Guyana: A Way Forward

Guyana has densely populated coastal regions and relatively inaccessible Hinterland and is highly vulnerable to climate change and climate variability. The agriculture sector requires a transformation towards climate-resilient agriculture systems. In order to respond to this priority, the Alliance of Bioversity International and CIAT, the Ministry of Agriculture of the Government of Guyana and local partners[1], joined efforts to develop and implement a Caribbean Development Bank (CDB) financed project, 'Development of a Framework for Prioritizing Climate-Smart Agriculture (CSA)'. Interventions were focused on two regions in Guyana - Region 3 (Essequibo Islands-West Demerara) and Region 9 (Upper Takutu-Upper Essequibo).

CLIMATE RATIONALE

- Guyana is highly exposed to climate extremes with population, economic activities, and critical infrastructure located in coastal regions and in areas with significant flooding risk, and subsistence agricultural activities in the hinterland region facing impacts from droughts.
- Future climate scenarios show increase of climate extremes in both regions leading to reduction of suitable areas for agriculture and negative effects on productivity of some crops if no adaptation measures are taken.
- Farm specific characteristics and farmers capacities matter to overcome barriers for adaptation and successful uptake of climate-smart technologies at scale.
- Gender and social inclusion are of great significance for the successful transformation to climate-resilient farming in Guyana.
- Improved water management for drainage and irrigation, improved and innovative market mechanisms that generate added value, and creating decentralized infrastructure and services are critical for transforming agriculture in Guyana.

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Policy Shifts Required to Enhance Climate-Smart Agriculture Investments

- Prioritize investments to create new CSA portfolios focusing on culturally appropriate bundles of technologies that attain multiple benefits such as agro-biodiversity, nutritional security, sustainable productivity, adaptation and mitigation while reducing the barriers to adoption.
- A transformative approach to establish sustainable implementation of Climate-Smart Agriculture in Guyana will require policy frameworks, institutional innovations and investments that prioritize financial mechanisms, value chain development, rural public goods, water technologies, and ecological pest and disease management aligned with CSA principles.
- Digital innovations offer significant potential as cornerstone in reimagining decentralized extension services in Guyana, promoting the inclusion of youth and women and giving the opportunity for agriculture to provide prosperity to farmers while reducing vulnerability.
- Balance between positive and negative environmental externalities of agricultural investments and conserve ecological functions of ecosystems.

Guyana Urgently Needs a Transformation toward Climate-Resilient Agriculture

Background

Guyana's agricultural sector is one of the largest employers in the country and is responsible for 12.1% of the share of the total working population. After stagnating since the second half of the 1990s, agricultural production and exports have been increasing since 2011, primarily as a result of the growth of rice production. According to FAOSTAT, in 2019, some of the main crops in Guyana were rice (206,428 ha), coconut (19,595 ha), sugarcane (17,896 ha), plantain (6,594 ha), maize, pineapple, cassava, and fruits. Meanwhile, the export value of some key agricultural exports was as follows: rice, USD 333 million; distilled alcoholic beverages, USD 43 million; raw sugar, USD 13 million; and coconut, USD 6,6 million. The agricultural products with the highest gross product value were chilies and other peppers, milk, tomatoes, eggplant, coconut, pumpkin, pineapple, and cabbage.

Competitiveness and constraints in Guyana's business environment, including the agriculture sector, remain a concern. The country ranks 121st out of 140 countries in the Global Competitiveness Report of the World Economic Forum. Though Guyana does not have recent data on poverty, the last

published report on poverty from 2015 shows that the poverty rates in hinterland communities, where most of the indigenous population inhabit, are two to three times higher than the national average. Of a total population of 751,223 (from the last census 2012, Bureau of Statistics – Guyana), 88.1% live in the coastal regions and the rest in the relatively inaccessible hinterland region, which provides most of the natural resources. Though most its population, economic activities, and critical infrastructure are concentrated in the climate-vulnerable coastal areas, in fact, 39% of Guyana's population and 43% of its GDP are in the coastal zone in regions that are exposed to significant flooding risk, while the hinterland is characterized by subsistence agricultural activities facing impacts from droughts.

Within the Latin American and Caribbean region, Guyana is ranked as the fourth most exposed country to natural disasters (IDB Disaster Exposure Index 0.6 on a scale of 0 to 1), mainly because of its high exposure to and experience with flooding as well as drought. Other threatening impacts from climate change on agricultural production come from sea-level rise and the resulting risk of salt-water intrusion into crop fields. Recurrent and devastating flooding events in recent years deeply harmed the Guyanese economy (2005, 2006, 2008, 2010, 2011, 2013, 2014, 2015, and 2017). In 2005, flooding seriously affected Guyana's economy, impacting 60% of its GDP, representing about USD 465 million. In 2016, Region 9 experienced one of the worst droughts in years, calling attention to the increasing occurrence and intensity of droughts in the whole country. Mayor droughts occurred from 1997–1998 to 2009–2010, and more recently in 2015–2016. In 1998, the Government of Guyana declared a state of emergency as a result of severe water shortage affecting 80% of the Guyanese population. Regions 1 and 9 were severely affected by decreased food supplies due to crop failures.

Small-scale farmers, subsistence farmers, and indigenous communities in remote rural areas are the most vulnerable populations threatened by climate change and climate variability. Farmers in the remote areas of Guyana face many challenges and limitations for adapting their farming systems to a changing climate. Fragmentation of traditional knowledge, lack of access to new technologies, and knowledge on how to become more resilient to climate shocks, structural difficulties in accessing modern farm infrastructure, under- or undeveloped transport networks and value-added markets are examples of such constraints. Although agricultural services have been in place for many years, they are centralized and do not reach the remote communities properly.

Future climate projections from global and regional models show an increased probability of climate extremes for Guyana. Projected is an increase in temperature (between 0.9 to 3.3°C in the period of 2040s to 2070s) across all seasons and regions combined with an overall decrease of annual rainfall. As well, an increase in heavy precipitation events over the next decades is projected to lead to more concentration of droughts and flood events. Guyana's sea level is also projected to rise over time (up to 43 cm by the 2050s) and increased storm surge heights will lead to more damage like that observed since 2005 as flooding.

A way forward

A global review shows that, to prepare for rapidly advancing climate changes in agriculture and food production requires transformational adaptation (Vermeulen et al., 2018), but national strategies for adaptation of the agricultural sector to climate change often focus on incremental adaptation. **Incremental Adaptation** is characterized by the extension of actions and behaviors that have already been trialed, at least somewhere in the country, to deal with natural variation in climate and extreme events. Incremental adaptation, however, may be insufficient to address rapid shifts and tipping points expected from climate change. The rapidly advancing effects of climate change require transformative processes in agriculture and food production, usually implemented over longer time frames. This long-term vision and corresponding implementation require effective leadership from policy and institutional levels. **Transformational Adaptation** can be defined as a response to climate risks in combination with other drivers with comprehensive and long-term approaches to adaptation and mitigation planning alongside financial and technical assistance, within a framework that rewards farms as multi-functional systems. Transformative processes in agriculture iterate over a cycle of four stages: i) understanding goals and objectives, ii) developing a vision and pathway, iii) implementing adaptation actions, and iv) monitoring, evaluating and learning.

In this context, climate-smart agriculture (CSA) is useful to underpin both incremental and transformational adaptation. The principles of CSA are to "incorporate adaptation/ resilience and mitigation measures while ensuring sustainable production, have the potential to build synergies and limit tradeoffs in agriculture under present climate uncertainties, and reduce existing knowledge gaps and facilitate alignment between sectors and policies" (FAO, 2020). Furthermore, CSA is a context-specific approach that aligns with at least seven Sustainable Development Goals (Figure 1).

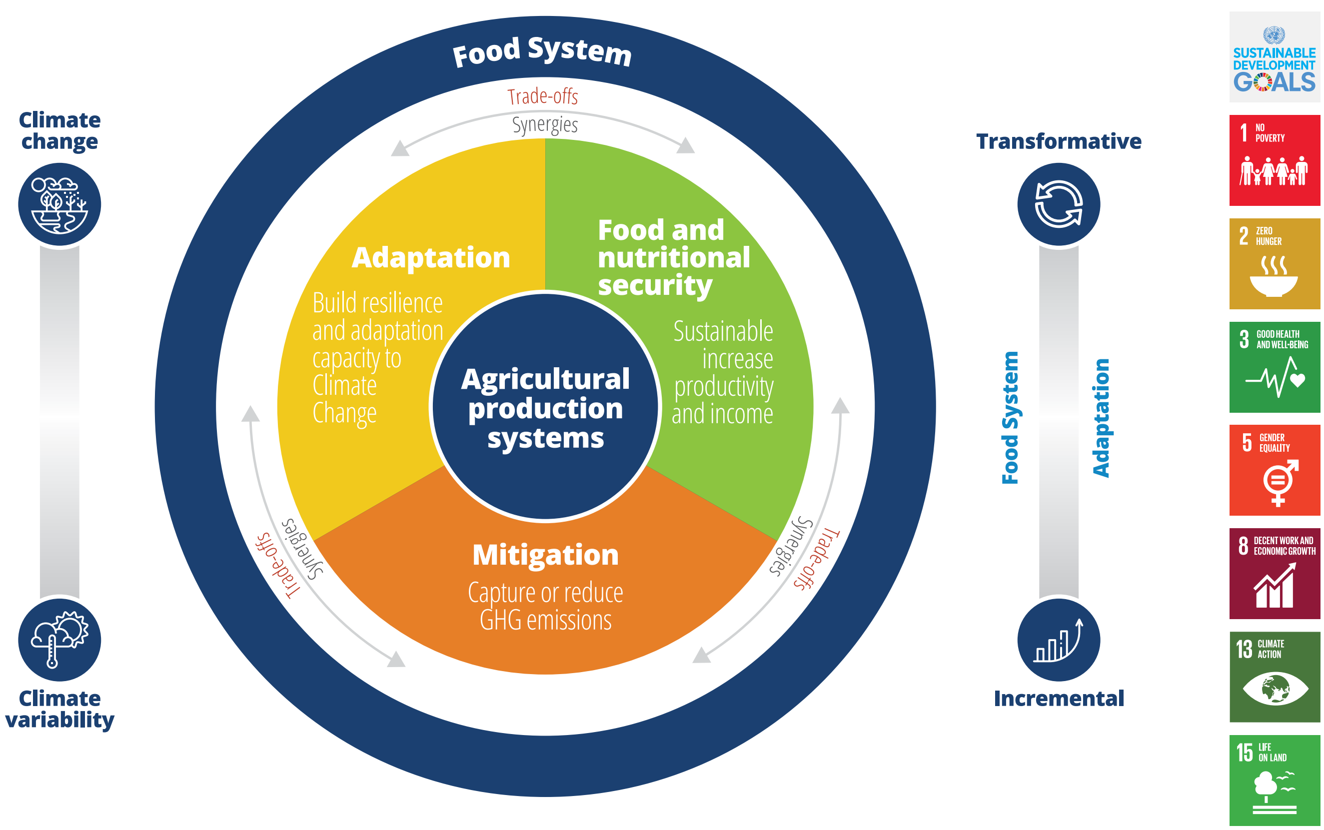

Figure 1. The concept of climate-smart agriculture was introduced by the Food and Agriculture Organization of the United Nations (FAO) in 2010. It was further adapted by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and others.

Conceptualizing an Evidence-based, Gender-Equitable Framework for Climate-Smart Agriculture Investment

Approach

- An assessment of farmers' risks;
- The definition of underlying factors that define vulnerability;
- The identification of local barriers to and the enabling factors that support adaptation;
- Modelling crop-suitability and productivity under current and future climate scenarios; and
- Development of CSA investment portfolios through round table dialogues with key informants, considering economic cost-benefit outcomes, climate-smartness, and opportunities and barriers to adoption of CSA actions.

Methods and tools for prioritizing CSA interventions

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has developed research methods and tools to overcome the challenge of identifying context-specific technologies and understanding better the tradeoffs and co-benefits that different combinations of portfolios could deliver for different stakeholders. The *Evidence-Based, Gender Equitable Framework for Prioritizing Climate-Smart Agriculture Interventions* (Figure 2) has been adapted from different tools and implemented for the first time in Guyana. The framework integrates the Climate-Smart Agriculture Rapid Appraisal (CSA-RA) tool with the CSA Prioritization Framework (CSA-PF), and modeled Crop Climate-Risk Assessment (CRA).

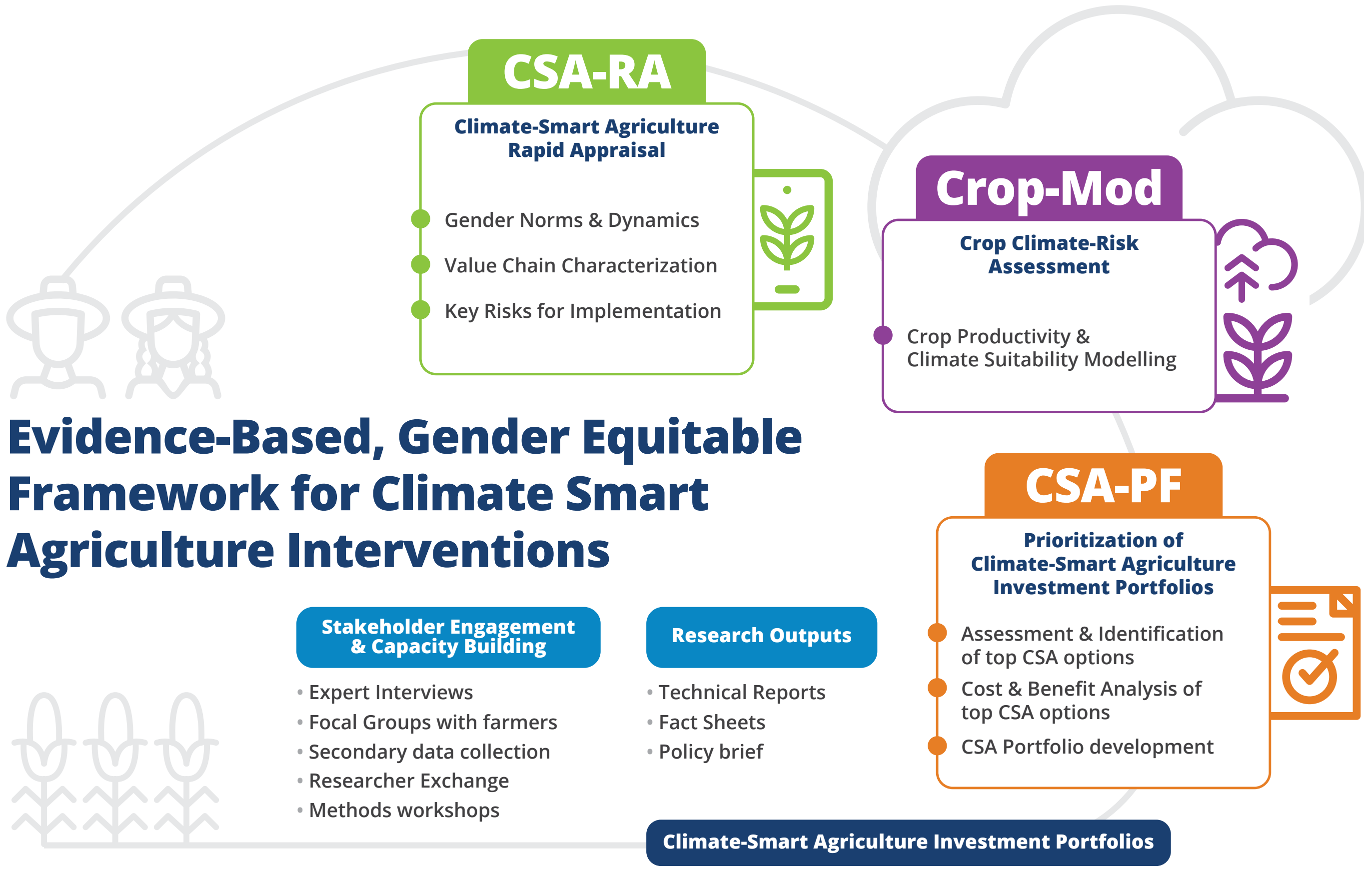

Figure 2. Overall framework for developing evidence-based, gender-equitable climate-smart agriculture investment portfolios.

All three framework components involved a strong participatory process based on national stakeholder engagement as well as consultations with local communities. The consultations with farming communities, household visits, and transect walks took place in the Island of Leguan, Parika Backdam, Santa Aratak, and for canal farmers in Aracari in Region 3, and in Bina Hill Annai, Nappi, and Sand Creek in Region 9. Capacity building was a core activity to the project as it aimed to enhance institutional capacity to apply the framework. Some of the capacity-building activities included workshops, researcher exchange, and the establishment of agreements with local universities, for example, methodological training and fieldwork support for related thesis studies in Rupununi in Region 9.

BOX 1

The Climate-Smart Agriculture Rapid Appraisal

The CSA-RA approach is a mixed method approach that draws on participatory focal groups, transect walks, and interviews to assess the heterogeneity of local contexts, to understand the underlying factors that cause some farmers be more affected than others by climate change and climate variability, and to identify barriers to adaptation and enabling factors that would support adaptation. The CSA-RA tool is described in a scientific publication and step-by-step guidelines can be found here.

BOX 2

Crop-Climate Risk Assessment

Crop productivity is heavily influenced by geographical and agro-ecological characteristics such as climate, topography, soil type and land cover. Geospatial techniques were applied to identify suitable areas for the selected crops using the following indicator variables: temperature, precipitation, and soil pH. To model the impact of climate change on crops, we used a reference climate dataset (1998 to 2018) and an ensemble of future climate scenarios and two Representative Concentrative Pathways (RCPs) from the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), RCP 4.5 and RCP 8.5 for the decade of 2050s (average of 2040 to 2070). For locations where historical weather station data were available, we used a crop simulation model, described in the scientific journal Agricultural Water Management, to quantify crop yield response to water availability. Crops were selected for the risk assessment according to their nutritional, economic and productive relevance for both regions.

BOX 3

Prioritization of Climate-Smart Agriculture Portfolios

The CSA Prioritization Framework (CSA-PF) is a participatory and multi-criteria decision-making process, co-designed as a holistic tool to support information-based CSA investments (Figure 3). CSA-PF has the objective to help decision-makers identify best-bet CSA investment portfolios that achieve sustainable gains in productivity, national food and nutrition security, and farmers' resilience and capacity to adapt to climate change and climate variability, and, when possible, decrease greenhouse gas (GHG) emissions in the food system. Together with national actors, the CSA-PF was carried out in Guyana as a stakeholder engagement process, in which participants set the scope and context of the analysis in order to filter a long list of potential CSA practices based on their climate smartness, economic costs and benefits, and opportunities for and barriers to adoption. This information was analyzed and refined during a series of regional workshops and focus group discussions identifying context-specific CSA investment portfolios. The type of actors connected to the process comprised farmers, academia and research organizations, the private sector, government institutions, international cooperation, and NGOs, among others.

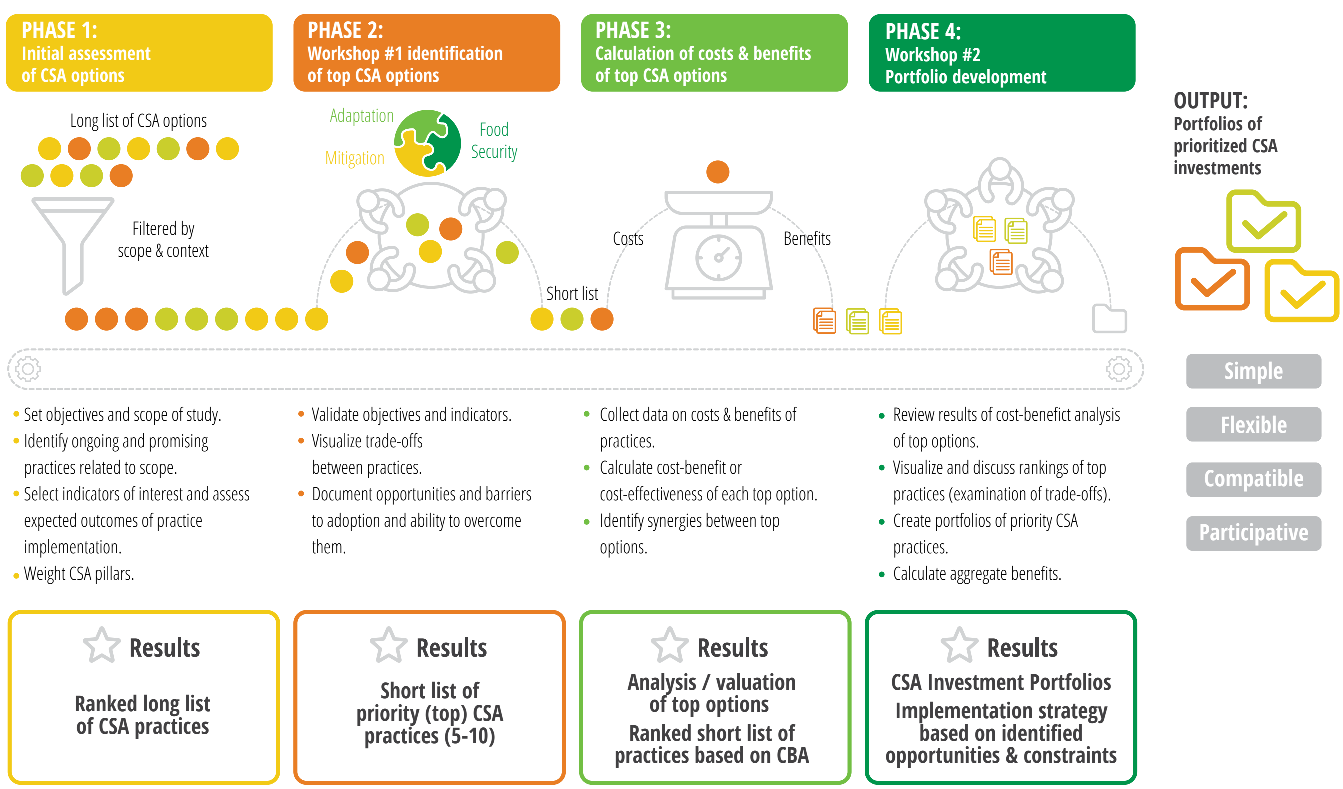

Figure 3. The CSA-PF follows a participatory process of assessment, identification of best-bet practices, and portfolio development for CSA interventions.

Opportunities for Enhancing Climate-Smart Agriculture Investments in Agriculture

Barriers to adaptation

Focus group sessions with farming communities in Regions 3 and 9 revealed that the main barriers to adaptation were a lack of drainage and irrigation infrastructure, weak access to value-added markets, shortage of farm equipment and improved seeds, and lack of adequate infrastructure for transportation and postharvest processing. Additionally, agricultural services are centralized and targeted agroclimatic information does not reach the farmers. In general, lack of employment opportunities is a major problem for both female and male villagers.

Gender dynamics

The analysis of gender dynamics showed that few women see themselves as farmers, but rather as women who farm because of the need to “assist” their husbands or male partners. In Guyana, as in many other countries, strong cultural views exist regarding what is acceptable and respectable female and male behavior. Guyana’s Gender Report 2018 shows inequitable traditional gender roles based on patriarchal family hierarchies (83% responded that it is natural that men should be the head of the home and 78% responded that a woman’s most important role is to take care of her home) and therefore women in general have less access to and control over economic and productive resources. During the focal group sessions, however, we learned that women farm on small- (kitchen garden) and large-scale levels and their success, or lack thereof, is not only determined by cultural or social gender dynamics, but income/class, access to decision-makers, the availability of support and protection from physical attacks on their way to and from farmlands that are not close to or part of their homes. Many do not have access to resources (e.g., bank loans) to purchase heavy equipment and are forced to engage in a system of “Mashramani” or an exchange of meals for hard labor to work tractors, fell trees and more. For women who farm or are farmers, addressing societal gender disparities are as essential as targeting climate-resilient interventions for adaptation.

Crop suitability future scenarios

Simulations of future climate characteristics show that some crops such as rice, sweet potato and cassava are more suitable for expected future climate conditions, while others such as pineapple and plantain will depend more on irrigation, especially in Region 9. Future scenarios show that plantain will face threats from climate change in both regions. Although some crops will retain or lose climate suitability, others are expected to increase their suitability in the future such as rice and cassava (Table 1).

Table 1. Summary of future productivity and land suitability conditions per region.

Crop	Essequibo Islands-West Demerara region (3)		Upper Takutu-Upper Essequibo region (9)	
	Productivity under future climate RCP4.5/RCP8.5 (2050s)*	Land suitability under future climate RCP4.5/RCP8.5 (2050s)	Productivity under future climate RCP4.5/RCP8.5 (2050s)	Land suitability under future climate RCP4.5/RCP8.5 (2050s)
Rice	Favorable	Increase	Favorable	Decrease
Plantain	Favorable	Decrease	Unfavorable in rainfed conditions, highly variable yield estimates under irrigated conditions	Decrease
Pineapple	Favorable	Decrease	Favorable under irrigated conditions	No major change
Cassava	Favorable	Increase	Favorable under irrigated conditions	Increase
Sweet potato	Favorable	Decrease	Favorable	Decrease
Peanut	-	No major change	-	Increase
Coconut	-	Decrease	-	Decrease

* Representative Concentration Pathways (RCPs) were used to model climate futures; in the RCP4.5 scenario, emissions are predicted to decline following a peak around 2040, and the RCP8.5 is considered a worst-case climate scenario for the planet.

The regional outlook shows an increase in climate extremes in both regions. In Region 3, climate is mainly influenced by the intertropical convergence zone (ITCZ) weather system. Many areas are below sea level, increasing hazard exposure to floods because of sea-level rise, saltwater intrusion from overtopping at conservancies, and sea defense breaches from tidal events. The findings point to increasing evapotranspiration rates, pest and disease outbreaks due to higher temperatures, and more severe and frequent dry spells. In Region 9, the climate is classified as "Tropical Wet and Dry," allowing for only one wet season (April to August) and one dry season (September to March). Region 9 is mainly exposed to flood and drought hazards associated with the annual wet and dry seasons. Temperatures are expected to increase by about 1 °C in the future while rainfall is projected to decrease. Therefore, prolonged dry spells and water stress are probable by the 2050s. Both regions will require measures to adapt to future drought and flood conditions.

CSA prioritized portfolios

Through a multicriteria analysis, the CSA-PF first identified four priority CSA practices for each key production system (crop) in both regions, followed by a cost-benefit analysis that revealed the financial profitability of the practices for farmers by evaluating indicators such as net present value (NPV), payback period (PP), internal rate of return (IRR), cost-benefit ratio (C/B), among other criteria. In a final workshop with stakeholders, the participants selected CSA indicators (food and nutritional security, adaptation, and mitigation) along with identified economic benefits, and conducted a multi-dimensional analysis of opportunities for and barriers to the adoption of CSA practices. This analysis considered socio-cultural, economic, environmental, political-institutional, and educational factors that were ranked, weighted and evaluated altogether to identify the priority CSA investment portfolios as listed in Table 2 for Region 3, and in Table 3 for Region 9.

Table 2. Climate-smart agriculture investment portfolio for the Essequibo-Islands-West Demerara region.

CSA practice	Net present value (GYD)*	Payback period (years)	Weighted prioritization criteria score			Final ranking
			CSA indicators	Costs & benefits	Barriers & opportunities	
Improved drainage system for sweet potato	9,835,121	1.6	3.0	1.2	0.5	1
Use of climate-resilient sweet potato varieties	8,353,464	1.8	2.6	1.0	0.6	2
Water reservoirs and pump irrigation for pineapple	12,561,015	2.6	2.9	0.4	0.2	3
Improved irrigation system for plantain	7,792,987	1.6	2.4	0.2	0.3	4
Improved land drainage system for coconut	1,252,838	4.3	2.7	-1.1	1.0	5
Improved land drainage for plantain	7,056,193	1.8	2.4	-0.3	0.6	6
Improved drainage system for cassava	3,320,237	1.4	2.1	-0.2	0.5	7
Use of climate-resilient pineapple varieties	12,309,942	2.6	2.4	-0.2	0.0	8
Water-efficient irrigation for cassava	3,678,872	1.3	2.0	-0.3	-0.7	9
Diversification of coconut varieties	1,201,158	4.1	2.2	-2.2	-0.4	10
Production and use of clean rice seeds	540,051	2.9	1.6	-2.3	0.1	11
Integrated pest management monitoring for rice	662,817	2.7	1.3	-2.0	-1.0	12

*GYD: Guyanese dollar; 1 USD ≈ 204 GYD as of December 2019.

Table 3. Climate-smart agriculture investment portfolio for the Upper Takutu-Upper Essequibo region.

CSA practice	Net present value (GYD)*	Payback period (years)	Weighted prioritization criteria score			Final ranking
			CSA indicators	Costs & benefits	Barriers & opportunities	
Crop rotation of peanuts with red bean	1,589,515	1.2	8.2	1.4	0.5	1
Intercropping of plantain with other crops (cassava, pumpkin, or watermelon)	1,260,256	1.5	8.0	1.0	0.0	2
IPM: keep areas of natural-habitat peanuts	1,011,670	2.8	7.6	-0.4	0.3	3
Improved drainage system for plantain	966,834	3.8	7.3	-0.5	0.3	4
Adjusted time of planting for rice	(177,266)	-	8.0	-1.4	0.2	5
Improved drainage system for rice	(203,745)	-	7.3	-1.4	0.1	6
Improved drainage system for cassava	432,048	3.4	5.1	-0.8	-0.2	7
Crop rotation of cassava	(214,228)	-	5.9	-2.7	-0.1	8
Water harvesting for cashew nut	-	-	8.1	-	0.6	9
Cashew nut tree management (pruning)	-	-	8.2	-	0.3	10

*GYD: Guyanese dollar; 1 USD ≈ 204 GYD as of December 2019.

Summary of Key Findings from Farmer Focus Groups and Transect Walks

- **Farm-specific biophysical characteristics and farmers' capacities matter** in the adoption of climate-smart technologies. Farmers can improve their productive and adaptation capacity only when extension services are tailored/aligned with their specific conditions through agro-advisory and climate information services.
- In the past, most indigenous communities, in both Region 3 and Region 9, used their **traditional knowledge** to adapt to environmental changes, using techniques such as slash and burn for traditional crops in areas that are not affected by floods or fire. Although the more remote communities continue following these practices, the application of indigenous knowledge has eroded with time. This is especially true in relation to the youth of indigenous communities, as they are not aware of the value of their traditional practices and that farmers (especially those growing subsistence crops) are now highly affected by extreme droughts and fires as well as by floods. The abilities of communities to cope with the barriers and opportunities that come along with climate change and climate variability, are still not well understood in Guyana and therefore require higher priority in order to achieve CSA goals. For example, farmers are aware of climate change, but have limited information about the actual effects of the phenomenon or what it means to be resilient to the anticipated impacts.
- **Gender and social dynamics are of great significance for the successful transformation to climate-resilient farming** and are an important consideration for the successful adoption of CSA options, for example, in promoting the acceptance of improved varieties by local communities. The importance of gender and social inclusiveness in climate change interventions to achieve equitable outcomes is still underestimated, yet it is key to climate change adaptation.
- **Water management is critical** for agriculture in Guyana. While Region 3 requires renewal and maintenance of the existing drainage infrastructure, Region 9 needs new drainage and water catchment programs, mainly because of the predicted future increase of dry spells in the region.
- **Infrastructure and agricultural services are centralized** and do not address what is needed in remote communities. For example, farmers consider that they lack access to extension services, proper seed programs, and on-farm and transport infrastructure.
- **Market mechanisms are the main driving force of income** for remote farming communities. If there is no access to markets (including for value-added products), farmers often are not even able to make enough money to access the inputs required to plant in the next season, not to mention the adoption of new technologies or management practices to cope with climate change and climate variability.

Summary of Key Findings from Workshops with Public Institutions on the Participatory CSA Prioritization Process

- The **climate-smart agriculture investment portfolios identified** 22 CSA practices suitable for priority crops in both regions focused on water management, farming system diversification, and crop management practices to underpin food/nutritional security, adaptation and mitigation (see Tables 2 and 3).
- The results underscored that the **average potential benefits of CSA practices** for Region 9 were higher for food/nutritional security, followed by adaptation and then mitigation. For Region 3, the average potential benefits were higher for adaptation, followed by food/nutritional security and then mitigation.
- The adoption of **CSA portfolios in an attractive option for the incremental adaptation of small-scale farmers** because they have greater economic and environmental value vis-a-vis conventional production systems. Even though most of them are profitable options, they imply relatively high startup costs, which lengthen the payback period of the investments. Other factors influencing the practices profitability are access to value-added markets and to financing instruments, maximization of selling price for farmers, regulation of agricultural imports (particularly products that local farmers cannot compete with), and dependency on external input products.
- There is room for improvement of regional innovation programs and initiatives to strengthen opportunities around **research and knowledge generation to underpin a sustainable livelihood diversification** to decrease farmers' high dependency on a single livelihood source and few crops.
- **The positive environmental externalities generated by CSA practices** such as biodiversity, carbon sequestration, and a decrease in GHG emissions related to on-farm diversification, conservation of natural ecosystems, and climate change mitigation have the potential to improve the economic conditions of farmers and can be further developed as part of medium- to long-term transformative adaptation of livelihood strategies that requires effective support from the policy and institutional level.
- **Because of the negative environmental externalities of large infrastructure investments,** for example, due to extensive agriculture in the Rupununi Region, the conversion of wetlands should be managed and mitigated. These externalities threaten the conservation of the Rupununi wetlands, identified as one of the most important wetlands of Guyana.

Policy Recommendations

Co-benefits and triple wins through adaptation, mitigation, and food security

CSA practices can be tailored to deliver multiple benefits and policies can prioritize co-benefits and triple wins in their adaptation strategies for the agricultural sector. The Government of Guyana and local stakeholders can identify other potential benefits of interest such as biodiversity, productivity, and carbon sequestration, and tailor them into the implementation of CSA practices. This entails identifying and fostering technology bundles and services according to the local conditions that have demonstrated synergies between adaptation, mitigation, and productivity. The co-benefits and "triple-wins" are key to decreasing vulnerability but also to complying with national and international commitments such as the Nationally Determined Contributions (NDCs) and Low Carbon Development Strategy. These technologies include tree management, improved pastures, silvopastoral systems, conservation agriculture, and water management. Some existing triple wins for Region 3 are water technologies while for Region 9 they are intercropping and crop rotation (Figure 5, in Lizarazo et al., 2021).

Decreasing the barriers to the adoption of CSA practices and technology bundles

This project identified and analyzed some of the best-bet CSA investment portfolios (Table 10, in Lizarazo et al., 2021). Yet, it also found that, despite their potential, the adoption of CSA practices remains quite low (Mwongera et al., 2020). If the Government aims to strengthen adaptation in the agricultural sector, a policy priority should be to address the key barriers to adoption. Any strategy towards this goal should rely on differential approaches to address these barriers, responding to specific contexts closely considering the local biophysical and social conditions.

Investment in CSA practices, the technification of cropping systems, and CSA training of local experts based on a sound rural extension program (and linked to farmer field schools and existing social networks, including learning from indigenous practices and digital innovations) could contribute to lowering the costs of production for farmers and increasing productivity. This would incentivize the adoption of various portfolios to promote adaptation and mitigation. Other key aspects to consider include security of land tenure for both women and men, short-term livelihood options (such as high-value cash crops), and a broad base of plant genetic resources (adapted to local conditions), including and preserving existing local gene banks, along with seed systems, diversification with plant or animal species, value chain development, and financial mechanisms such as credits and low interest rates, among other alternatives (Ng'ang'a et al., 2017). This in turn can help establish an enabling environment and solid ground for farmers to gradually transition to a more competitive, equitable and resilient agriculture.

3

Financial mechanisms

Several experiences globally could inform the Government of Guyana's approach to deliver sound financial mechanisms for smallholder agriculture. These efforts should consider the need to address multiple levels of inequality at the family and community levels, which limit access to investment. **Microfinance and financial inclusion** studies in Peru have looked at the gaps and opportunities to support and scale up green agriculture, smallholder agriculture, and financial inclusion, while experiences in Central America involve using microfinance to fight climate change. **For access to financial mechanisms and blended finance**, there is progress in building more resilient agricultural supply chains with blended finance focusing on the Latin American coffee sector and facilitating access to financial services through technology and microloans. **For impact investing and risk financing**, experiences involve risk financing instruments such as insurance and forecast-based financing and lessons learned to scale up more sustainable agricultural practices through impact investing.

4

Value chain development

The project results showed that cassava is an important crop cultivated in both regions (3 and 9). Yet, value chain development is quite limited, without mechanisms for value addition *in situ*. The case of cassava applies to other priority crops in Guyana. This limits the opportunity for agriculture to provide prosperity to farmers, for them to have access to more and better paid jobs, and for them to overcome long-lived poverty traps. Therefore, investment in the value chain development of some priority crops providing a balance between cash and subsistence crops, as well as crops of relevance for women and men, should be a priority. This should also consider the future productivity and land suitability as well as inherent cultural practices to device appropriate transition and crop diversification plans per region. Besides cassava, other crops noted by local stakeholders as the most important in the regions were pineapple, rice, plantain for Region 3, and horticulture, maize, banana, plantain, citrus and peanut for Region 9. Policy priorities for future investment in value chain development could consider new competitive options and target crops of relevance for the Caribbean Region, such as sugarcane and coconut (raw and refined sugar as well as oil rank in the top ten agricultural import items in the region) to contribute to import substitution.

5

Other investment priorities

The implementation of CSA portfolios can be costly. Therefore, public investment is required in areas such as road infrastructure, community seed banks, small-scale equipment (water pumps, solar panels, motorized equipment for processing of materials), and water efficient technologies. Priority should also be given to technologies that are gender sensitive, for example, that decrease the workload of women. Road infrastructure is important not only for facilitating access to markets and diminishing food waste and loss but also for facilitating extension services, as found in this project. Ideally, these investments should take place in tandem with the implementation of CSA practices by farmer communities to create an enabling environment for technology clusters.

6

Water-use efficiency

The establishment of water harvesting and water management technologies is a government priority now. In Guyana's Regions 3 and 9, several water management practices and technologies could be integrated into one single adaptation and mitigation strategy. These include improved land drainage and efficient irrigation systems (i.e., sprinkler, dripping) and water harvesting. This project underscored that water management approaches should consider the production system's needs in each region. This is the case of Region 3, where vegetables could be a promising productive option, yet, in order to thrive, a comprehensive approach to water management is required in which rice producers should bear in mind the water needs of other systems that could be affected by flooding (such as vegetables and fruits). This is also important if Guyana is to comply with the priorities set in its National Adaptation Strategy.

Rainfed agriculture is the most common practice of small-scale farms for subsistence crops in Region 9. Based on the experience of the Alliance in promoting water technologies for several decades, options such as AGRI (Water for Irrigation, by its Spanish acronym) exist to support the verification of superficial water sources for agriculture and potential sites for water harvesting. AGRI is now being implemented in Grenada funded by the Caribbean Development Bank (CDB). Another relevant experience of water management and water harvesting for irrigation that could provide valuable lessons for Guyana is the Water System of Honduras.

7

Decentralizing extension services through digital innovations for agriculture

A key step for strengthening adaptation and mitigation through information and extension services is to promote digital innovations giving smallholders access to inputs, finance, and extension advice. This can also be a means for education and training to strengthen the capacity of farmer communities and associations at the local level, especially in areas such as crop management and best practices. Digital innovations can also underpin the decentralization process of extension services facilitating access and information sharing.

Some examples of these innovations are analytics applications, data-driven agricultural programs, data-driven agronomy, and climate services. Within climate services for agriculture, Local Technical Agroclimatic Committees (LTACs) have contributed to community and institutional transformations, combat drought, analyze the impacts of the Covid-19 pandemic in agriculture to support farmers' decision making, combat hunger and improve food security, and promote technology bundles and water-use management, among other aspects. The LTACs are particularly relevant for facilitating access to information, strengthening institutional presence (for example in the case of Guyana, this could apply to the agricultural, hydrometeorological, and water authorities, including the NAREI Institute), and strengthening local capacity and progressive adaptation, especially toward climate variability. Relevant and cost-effective strategies such as best planting dates can be tested, tailored to the specific needs of each region, and agreed within the LTACs, which could considerably reduce the exposure of farmers to the annual flooding dynamics and saline intrusion affecting their crops.

The LTACs could build on the experience of the Farmer's Monthly Weather Bulletin circulated by the Hydrometeorological Service of Guyana and ingrain this innovation locally and regionally, promoting a bottom-up approach guided by expert advice, through validations and cross-learning on the ground. An opportunity exists for cross-learning between priority production systems as some of them have identified and used CSA practices that could be applied to other crops, for example, soil recovery and plan nutrient practices such as the *mulching/cover crops*. Further, practices of crop rotation for diversification (in Region 9) could be bolstered, especially to decrease vulnerability due to dependence on a few crops with low yields. As the information and extension services are strengthened and become more decentralized, other cost-effective practices could be used across production systems as well.

Within extension services and digital innovations, it is critical to provide an equal access to information as well as equal participation in decision making processes to both men and women. These digital innovations can be used as an engagement strategy for youth to guarantee next generations for agriculture.

8

Digital innovations at hand

The Government of Guyana and rural communities could rely on several open digital innovations. The Tumaini app is an artificial intelligence-based solution that helps to classify major banana diseases and provides recommendations and management options for the disease detected. PestDisplace is a complementary app as it works on monitoring the emergence, occurrence, and global distribution of pests and diseases. So far it has worked mainly with beans, cassava, citrus, musa, rice, potato, and sweet potato, and can be adapted and applied to other crops. Both Tumaini and PestDisplace can support in the detection and monitoring of *Fusarium oxysporum* f. sp. *cubense* Tropical Race 4 (FOC TR4) disease in musa, but foremost it is urgent to apply the necessary contingency measures to prevent its entrance into the country and the Caribbean. The Alliance of Bioversity International and CIAT is leading a regional platform to promote the innovation, competitiveness, and sustainability of muse and the Musa Research and Development Network for Latin America and the Caribbean (MUSALAC). There is also a Global Network on TR4 and a Research Agenda for the prevention and control of Fusarium.

The Latin American Fund for Irrigated Rice (FLAR) also has digital innovations such as FLAR Collect which supports data collection. The GeoFarmer App allows community workers and smallholders to easily collect and share information on climate-related agricultural interventions. Participatory Integrated Climate Services for Agriculture (PICSA) involves agriculture extension staff working with groups of farmers ahead of the agricultural season to develop and choose crop, livestock, and livelihood options best suited to individual farmers' circumstances. The application of PICSA is complementary to the LTACs.

9

Environmental considerations

CSA practices such as crop diversification have the potential for biodiversity conservation and for generating ecosystem services such as carbon sequestration, which is important for Guyana's Low Carbon Development Strategy. The sustainable management and conservation of biodiversity can be further incentivized by the establishment of Payment for Ecosystem Services (PES) schemes and regulations that could provide an additional stream of resources to farmers supporting the diversification of livelihood strategies. These approaches can help Guyana gradually transition to having biodiversity as a cornerstone for the transformation of its food systems.

Great potential exists for promoting community forest management (CFM) with an agroecological productive approach from and for indigenous and farmer communities, also to incentivize forest protection (land sharing) within farmers' fields. Especially Region 3 offers great potential for agroforestry systems (i.e., for adaptation, for increased productivity, etc.) and for the use of non-timber forest products (NTFPs) such as cashew nut as a means for diversifying livelihoods.

Further Readings: Studies and Technical Reports

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