Alliance

POLICY BRIEF No. 68

Climate-Smart Agriculture Investment Portfolios for the Southern Plains in Jamaica

Jamaica is highly vulnerable to climate change with a projected increase in the intensity and frequency of climate extremes, such as prolonged droughts and flooding from escalating rainfall variability. Future climate models show that Jamaica's seasonal maximum temperature is expected to increase by 2–4 °C and minimum temperatures by 1–3 °C. Temperature increases are likely to be accompanied by increased solar radiation. Changes in rainfall patterns will lead to drier conditions for the first agricultural season but wetter conditions for the second season.

A declining agricultural sector, shaped by trade liberalization since the 1980s, has positioned Jamaica as one of the five largest food importers within the Caribbean community. Longstanding local stresses continue to alter the adaptive capacity of farmers. Access to water is a crucial concern in the Southern Plains. Further, farmers lack access to financial instruments such as microcredit and insurance to compensate for harvest loss from climate impacts. Furthermore, training on how to use new technologies and management practices to improve resilience to the effects of climate change is limited.

The agricultural sector requires a climate-resilient transformation, focused on gender and social inclusion (women and youth). Bolstering the resilience of Jamaica's agricultural sector through climate-smart investment portfolios can be a win-win for both farmers and the environment alike and could increase the share of domestic production in the food basket. A way forward to resilience is to co-design Climate-Smart Agriculture (CSA) Investment Portfolios. CSA incorporates resilience through adaptation and mitigation measures while ensuring sustainable production and increased farm income. It is a context-specific approach, which aligns to at least seven United Nations Sustainable Development Goals (Figure 1).

The Evidence-Based, Gender-Equitable Framework for Prioritizing Climate-Smart Agriculture Interventions has been adapted from different tools and research methods developed by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) to overcome the challenge of identifying context-specific technologies and to better understand the trade-offs and co-benefits those different combinations of portfolios could deliver for different stakeholders. 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). In collaboration with the Department of Geography and Geology at the University of the West Indies, a Training Programs component (CSA-TP) was included for Jamaica (Figure 2).

POLICY RECOMMENDATIONS

- Design a policy framework that considers the creation of incentives for climate-smart farming.
- Develop capacity building through farmer field schools.
- Build up platforms for peer-to-peer knowledge exchange among farmers.
- Improve water efficiency through smart innovations.
- Strengthen land-use planning to promote an organized and more sustainable use of land for agricultural purposes.
- Create and promote access to financial mechanisms for implementing climate-smart investment portfolios.
- Develop regional hubs for food systems that provide farmers with options of product processing for added value.

February 2022

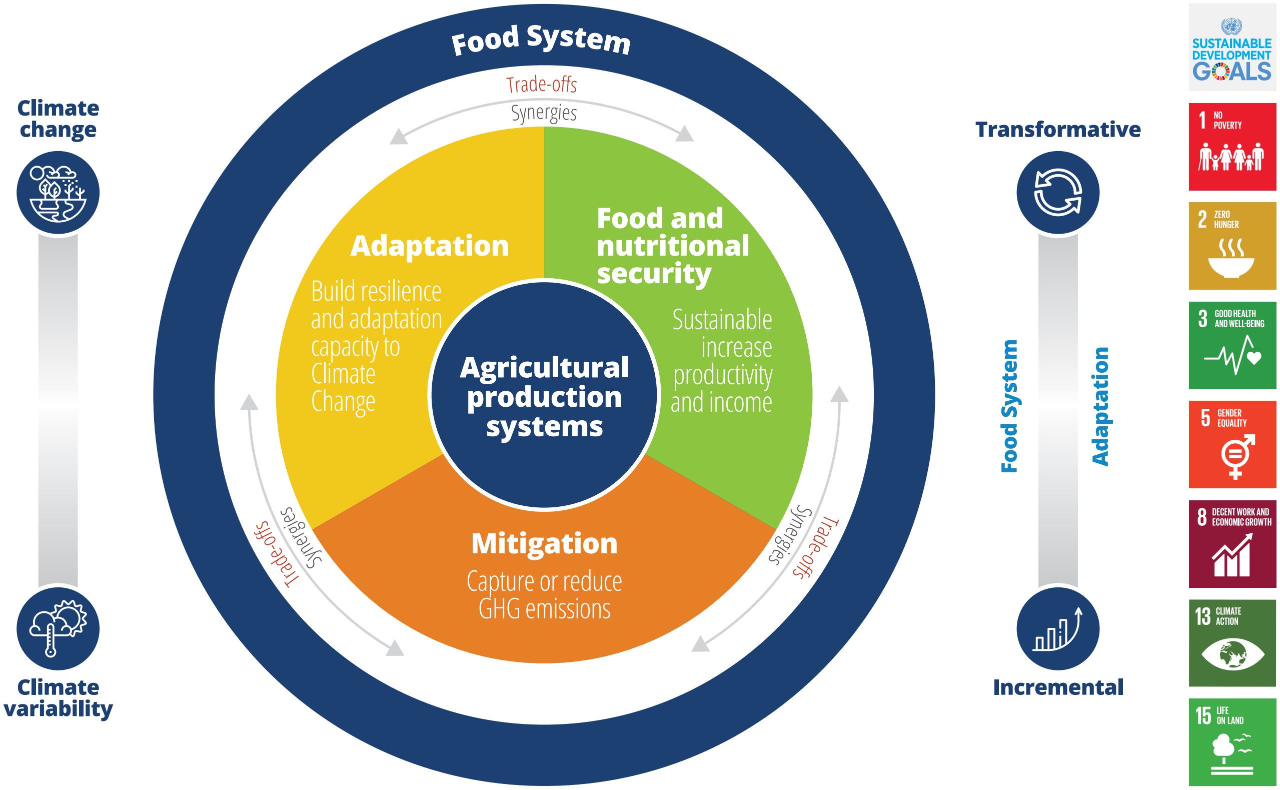


Figure 1. The concept of climate-smart agriculture was introduced by the Food and Agriculture Organization of the United Nations (FAO) in 2010. It was further adapted by CCAFS and others.

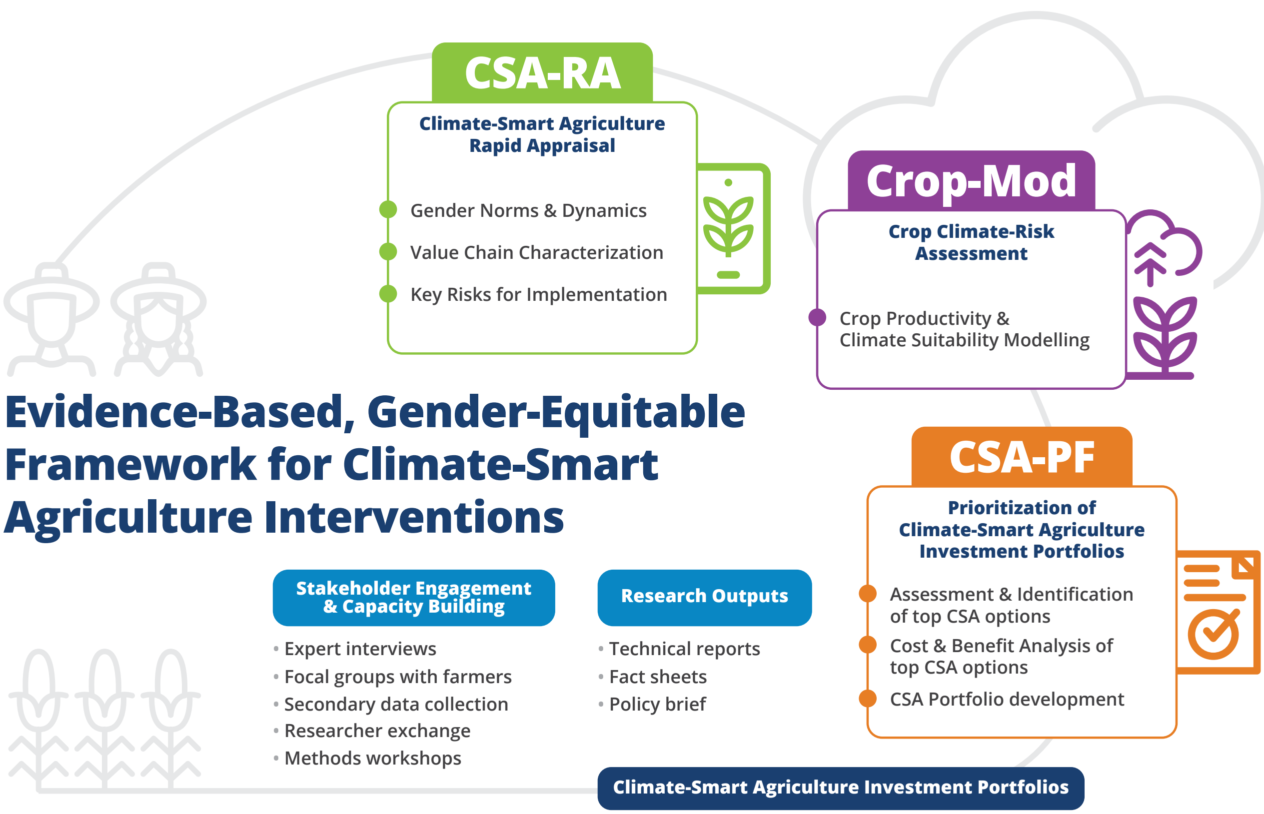


Figure 2. Overall framework for developing evidence-based, gender-equitable climate-smart agriculture investment portfolios and turning the blueprint int action.

Climate rationale

- The Southern Plains are Jamaica's breadbasket, but they are highly exposed to drought and heat, irregular rainfalls, and hurricanes.
- Future scenarios from the **Intergovernmental Panel on Climate Change** regional synthesis of observed trends and projected changes in climatic impact show an increase in temperature and relative evaporation, and the projections show high confidence of a decrease in mean precipitation and medium confidence of an increase in agricultural drought.
- The lack of access to water for farming is one of the region's main constraints. Improved water management for irrigation could boost farm productivity significantly.
- Farmers in the region have adapted to the dry conditions in the past by implementing practices for more effective water management and soil moisture conservation. However, these practices are labor-intensive and insufficient to balance crop water requirements.
- Climate-smart agriculture would be a way forward to increase co-benefits for productivity and climate resilience through adaptation and improve the footprint in water management for mitigation. However, climate-smart agriculture is a relatively new concept for farmers. It requires a policy framework for implementation and capacity building for farmers.

Climate-risk assessment

A spatial water-balance model was applied to four parishes to simulate the principal hydrological cycle components, including monthly runoff, effective precipitation, soil moisture, percolation, and potential and actual evapotranspiration. Overall, there is a risk for decreased water availability through increased evapotranspiration (Figure 3).

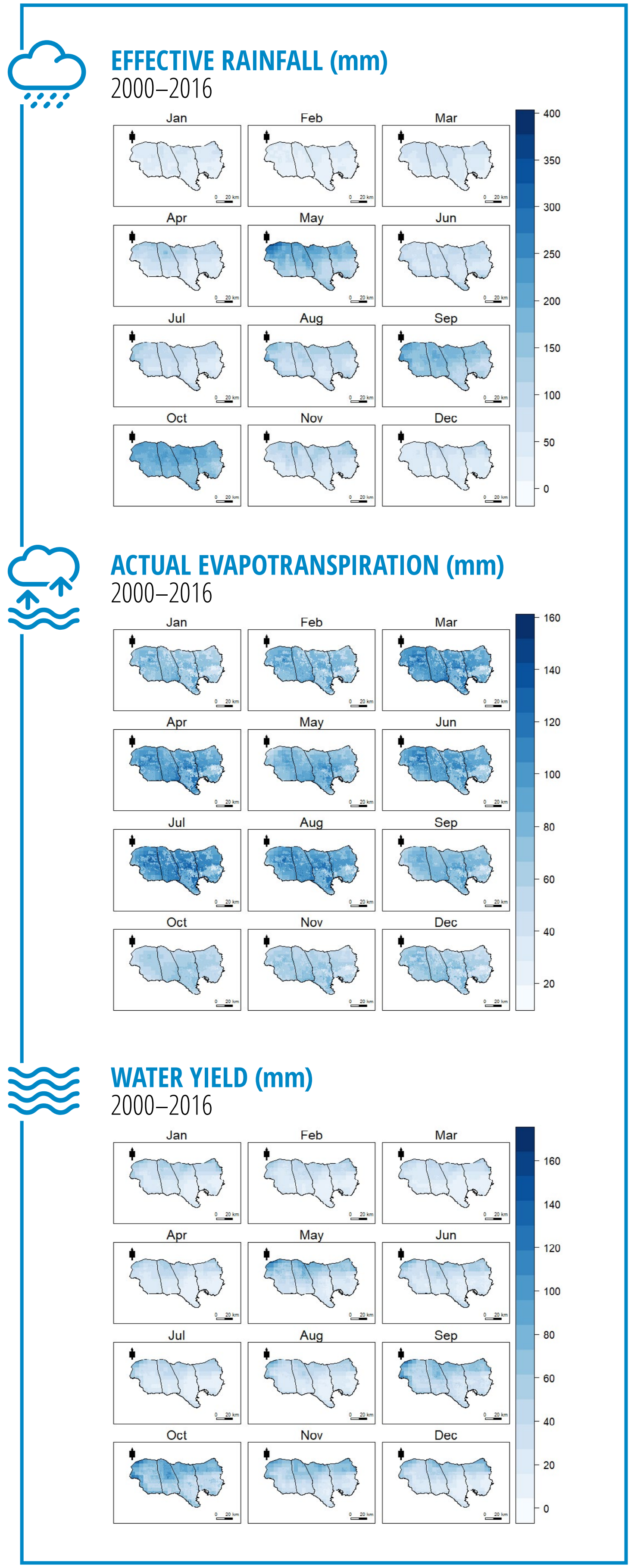


Figure 3. Outputs from the water-balance model show reduced water availability.

Simulations of future climate characteristics using the crop model AquaCrop show that some crops such as sweet potato and groundnut are more suitable for expected future climate conditions. In contrast, other crops, such as onion, will depend more on irrigation. Overall, irrigated systems to balance crop water demand are crucial to achieving higher yield.

Turning the climate-smart agriculture blueprint into action

> *"A dynamic transformation of the Jamaican agricultural sector through a sustained, research-oriented, technological, market-driven, and private sector-led revolution, which revitalizes rural communities, creates strong linkages with other sectors, and emphatically repositions the sector in the national economy to focus on the production of high-value commodities and contribute to national food security."*
>
> Source: Vision 2030 Jamaica – National Development Plan.

The government of Jamaica is currently implementing two irrigation development projects in the Southern Agricultural Plains, seeking to address the challenge of water supply for farmers. The application of the Evidence-Based, Gender-Equitable Framework for Prioritizing Climate-Smart Agriculture Interventions aims to climate-proof these projects and carry out a thorough climate-risk assessment, prioritize CSA options that are targeted to locally specific needs and vulnerabilities of farmers, and provide practical training programs to be used for extension services. The framework components were undertaken with farming communities in the following areas: Parnassus in May Pen Clarendon, Amity Hall in St. Catherine, and communities in the Essex Valley in Manchester/St. Elizabeth parishes (Figure 4).

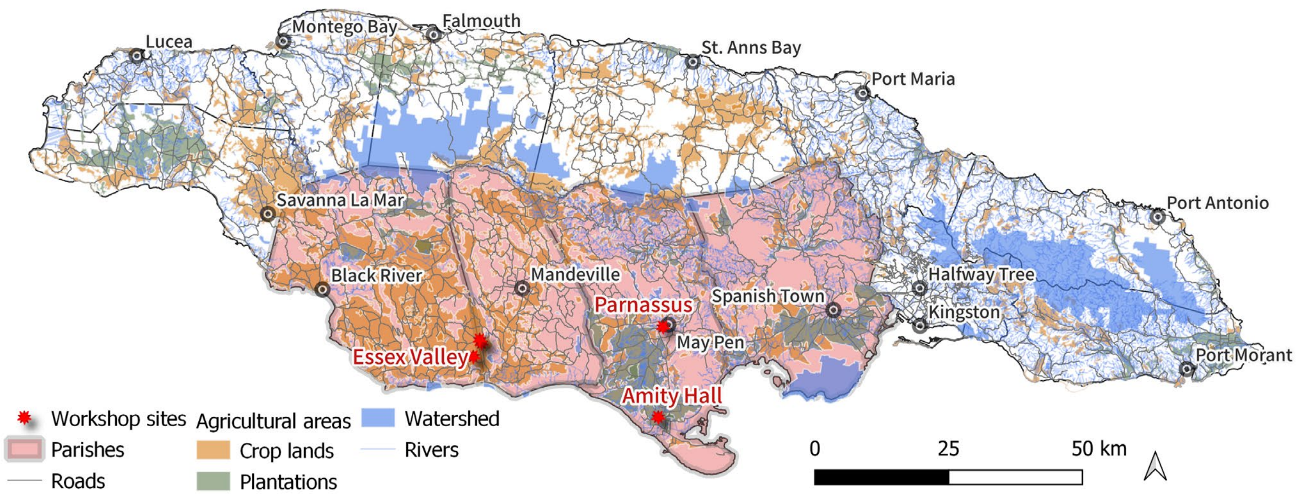
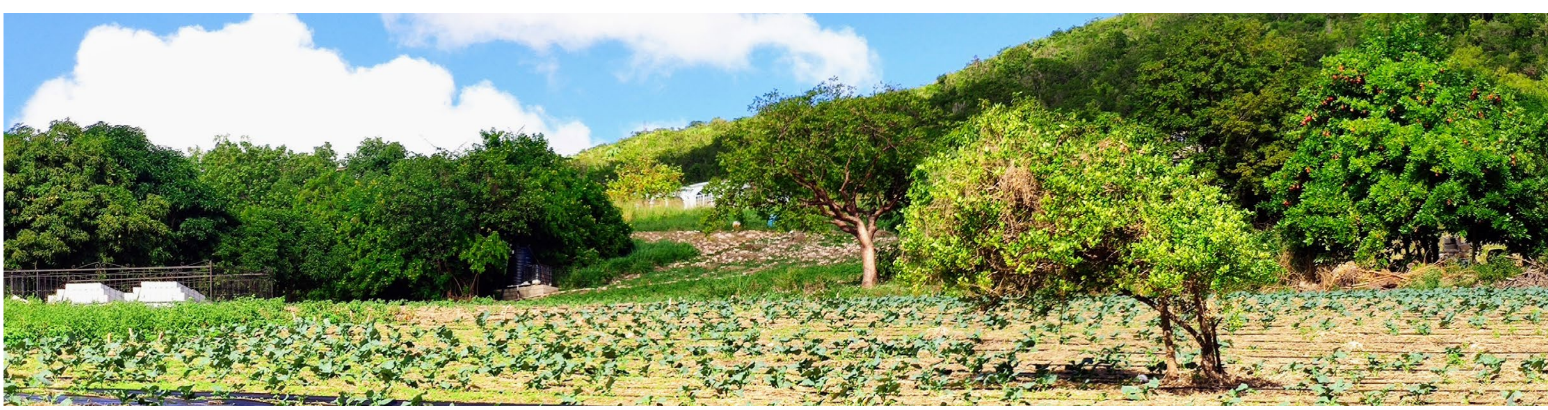


Figure 4. Project area map with communities in four parishes.



Value chain characterization with farmers

Essex Valley: Most farmers in the area cultivate scallion (95%) and watermelon (80%). Men and women work together on key activities along the value chain. Women dominate the marketing segment of the value chain for most crops in the region, while male farmers dominate the production segment of the watermelon value chain. Hazards affecting the value chain are severe droughts and pest and disease impacts. Farmers identified the lack of access to water and financial instruments (e.g. micro finance) as systemic challenges to production systems in the region. Barriers to adaptation are often related to a lack of infrastructure, such as shared facilities for agroprocessing, contract opportunities, and access to export markets.

Parnassus: Most farmers in the area cultivate pumpkin (65%) and a few farmers grow sweet potato (less than 5%). The other two key crops proposed by the Ministry of Agriculture and Fisheries (MoAF) for the area, Irish potato and hot pepper, are not currently grown by the farmers. Underlying factors that lead to barriers for adaptation are a lack of financial resources to offset costs of inputs and labor and an overall lack of access to infrastructure, such as tractors, processing facilities, and export markets. Hazards affecting the value chain are pest and disease impacts, mainly from a fungus that affects pumpkin and pests that affect sweet potato production.

Amity Hall: Most farmers in the area cultivate pumpkin (80%). Watermelon and hot pepper are also grown less by farmers. Flooding severely impacts the pumpkin value chain and moderately affects sweet potato production. Impacts from pests and plant diseases are predominantly observed in sweet potato production. Across the region, the impact of drought on pumpkin is considered moderate to severe. The underlying factors that hinder the adoption of new practices are a lack of access to funding or subsidies for tools and inputs, which farmers currently find it difficult to obtain because of their high costs. Further, the lack of farm infrastructure and facilities is another challenge for farmers.

Prioritized CSA investment portfolios

Through a multi-criteria analysis with stakeholders, priority CSA practices for each key value chain (crop) per site were identified, 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), and cost-benefit ratio (C/B), among others. In a final workshop with stakeholders, CSA practice indicators (food and nutritional security, adaptation, and mitigation), identified economic benefits, and a multi-dimensional analysis of opportunities for and barriers to adopting CSA practices were used to rank CSA practices across the three sites (Table 1).

Table 1. Climate-smart agriculture investment portfolios ranked for three sites in the Southern Agricultural Plains of Jamaica.

CSA PRACTICES	Net present value (JMD/acre)	Payback period (years)	Weighted prioritization criteria score			Final ranking
			CSA indicators	Costs & benefits	Barriers & opportunities	
PARNASSUS						
Sweet potato - crop rotation (cover crops with string bean)	$5,591,059	1.4	2.8	1.69	0.6	1
Irish potato - integrated soil management (raised beds)	$2,909,505	0.7	2.4	0.29	1.7	2
Scotch bonnet pepper - integrated soil management (raised beds)	$3,032,047	0.6	2.4	-0.39	1.7	3
Sweet potato - integrated pest management (traps and clean planting material)	$3,756,551	0.8	2.7	1.11	-0.6	4
Pumpkin - pack houses (shared facilities: cutting, washing, storage)	$4,552,765	0.7	2.2	1.50	-0.8	6
Irish potato - water-efficient irrigation (drip irrigation)	$2,041,620	0.4	2.4	-0.34	0.5	5
Pumpkin - integrated pest management (intercropping with marigold, traps, and scouting)	$3,226,238	0.1	2.6	0.43	-0.8	8
Scotch bonnet pepper - water-efficient irrigation (drip irrigation)	$1,032,822	1.8	2.4	-1.16	0.5	7
AMITY HALL						
Pumpkin - water-efficient irrigation (drip irrigation)	$6,146,200	1.0	2.7	1.11	1.0	1
Watermelon - water-efficient irrigation (drip irrigation)	$16,005,444	0.6	2.7	0.92	1.0	2
Scotch bonnet pepper - water-efficient irrigation (drip irrigation)	$3,553,350	0.3	2.7	0.24	1.0	3
Watermelon - crop rotation (with hot pepper)	$6,294,659	0.3	2.7	0.58	0.1	4
Sweet potato - crop rotation (with pumpkin)	$3,002,276	0.7	2.7	0.14	0.3	5
Scotch bonnet pepper - crop rotation (with maize)	$4,148,653	0.3	2.7	0.1	0.3	6
Sweet potato - water-efficient irrigation (drip irrigation)	$4,358,375	1.7	2.7	-0.92	1.0	7
Pumpkin - crop rotation (with maize)	$2,362,946	0.8	2.7	-0.34	0.3	8
ESSEX VALLEY						
Cauliflower - rainwater harvesting systems	$7,792,253	0.5	2.7	1.25	1.3	1
Peanut - use of drought-tolerant varieties (drip irrigation)	$2,324,086	1.1	2.7	0.38	0.3	2
Peanut - crop rotation (with sweet potato)	$4,892,265	1.3	1.7	1.07	0	3
Watermelon - use of drought-tolerant crops	$947,625	0.5	2.7	-0.67	0.3	4
Scallion - mulching	$1,858,575	3.7	2.7	-2.12	0.7	5
Watermelon - crop rotation (with tomato)	$3,054,630	0.9	2.6	-1.65	0	6
Cauliflower - minimum tillage	$2,564,007	3.4	2.3	-1.94	-0.3	7
Scallion - minimum tillage	$2,205,509	3.7	2.4	-2.46	0	8

Co-creation of training programs

The final step of the Evidence-Based, Gender-Equitable Framework for Prioritizing Climate-Smart Agriculture Interventions was co-creating with farmers the outlines for locally specific CSA training programs. Manuals were introduced to extension workers in a train-the-trainers workshop as part of the **GeoFarmer platform**. GeoFarmer helps democratize extension services and can facilitate two-way interaction and knowledge sharing between extension workers and farmers and among farmers (Figure 5).

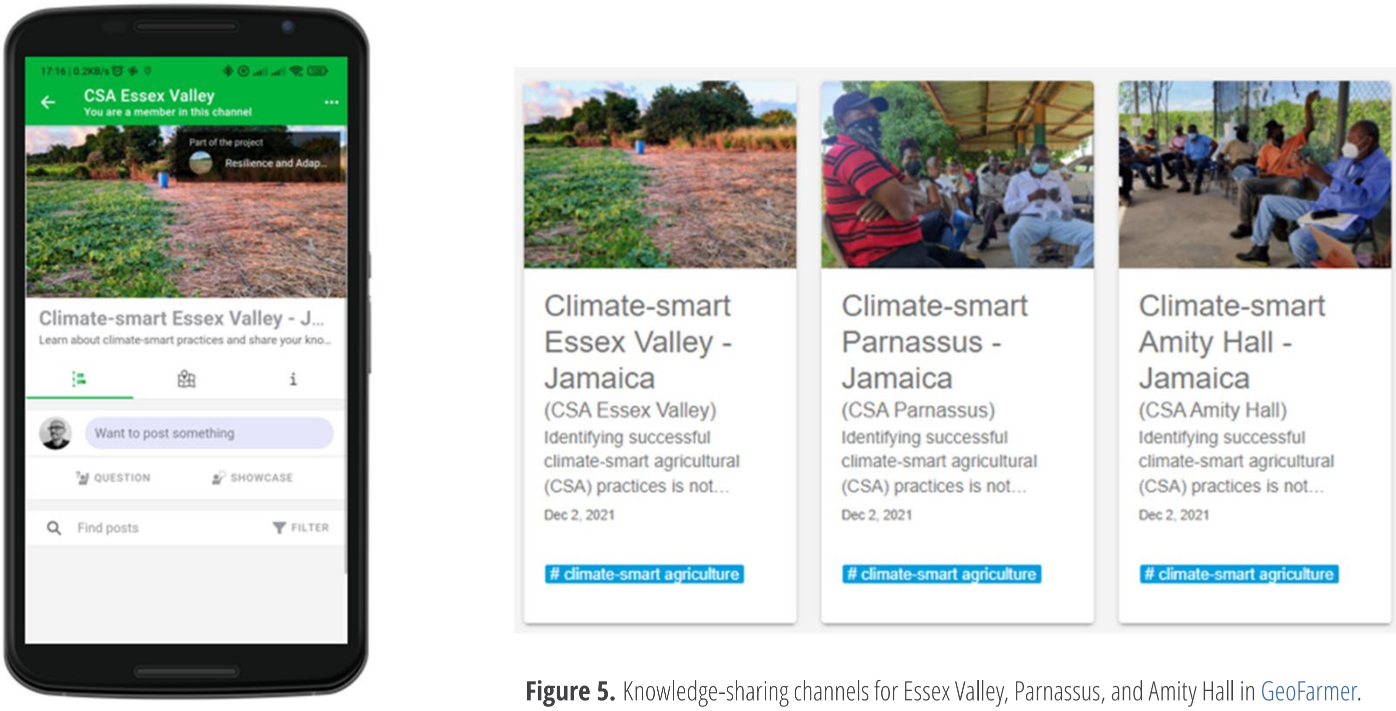


Figure 5. Knowledge-sharing channels for Essex Valley, Parnassus, and Amity Hall in GeoFarmer.

Policy recommendations

Farmers' incentives for climate-smart farming

The economic analysis of prioritized CSA practices reveals some profitable options of investment portfolios. However, the number of identified portfolio barriers was slightly higher than the opportunities. Decreasing the adoption barriers of CSA practices and technology bundles for farmers is crucial to reaching scale in farmer adoption of CSA practices. Although the return to investment is promising and payback periods are relatively short, farmers need incentives to adopt these practices.

Capacity building for extension services

Extension service staff need to be trained to promote climate-smart agriculture practices and technologies among farmers. An essential step for strengthening extension services is to promote digital innovations through the private sector to give smallholders access to information about inputs, finance, and extension advice. Some examples of these innovations are **analytics applications**, **data-driven agricultural programs**, **data-driven agronomy**, and **climate services**. Within extension services and digital innovations, it is crucial to provide equal access to information and tools to both men and women. **Local digital innovations** can be the key to engaging more youth in agricultural value chains and to guaranteeing generational change.

Capacity building for farmers

It is essential to promote the implementation of capacity building and farmer field schools at the community level. Education and training to strengthen the capacity of farmer communities and associations locally are critical for successful CSA implementation. In this context, **farmer field schools (FFS)**, first **introduced in Kenya**, and recently introduced by the **government of Jamaica**, are a promising way to promote climate-smart agricultural practices among farmers. Using traditional approaches such as **farmer-managed demonstration plots** combined with **digital innovations**

for knowledge sharing could be another strategy to spread knowledge and skills about CSA best practices. The **GeoFarmer app** allows community workers and extensionists to easily communicate with smallholders to collect and share information on climate-smart agriculture. Like the **Tumaini app** and **PestDisplace**, several other digital apps complement extension services, for example, for plant disease prevention and management. Short-term weather and seasonal climate forecast digital services bundled with agricultural advisory and extension services could further support farmers' decision-making.

Water efficiency through innovations

Rainfed agriculture is the most common practice of small-scale farms in the Southern Agricultural Plains. The irrigation development projects will bring a piped water supply to **improve water access for farmers** but cannot meet the overall demand for water for agriculture in the region. Several other water management practices and technologies could be integrated to build one single **Adaptation and Mitigation Strategy for Water-Use Efficiency**. One promising technology that has been implemented in other countries is **water harvesting**. The Alliance of Bioversity International and CIAT has experience in promoting water technologies with innovations such as **AGRI** (Water for Irrigation, by its Spanish acronym). AGRI supports the verification of external water sources for agriculture and potential sites for water harvesting. AGRI is an automated online tool to support greater precision and efficiency in identifying water sources and increase the cost-effectiveness of irrigation for smallholder farmers while ensuring drinking water supplies for rural communities. AGRI can improve both food security and income generation. Within the Caribbean community, AGRI has been implemented in Grenada funded by the Caribbean Development Bank (CDB). A project to implement AGRI in collaboration with the Food and Agriculture Organization of the United Nations (FAO) has recently started in Jamaica. Moreover, other valuable **experiences of water management in agriculture** that could be adapted to the Jamaican context.

Agricultural land-use planning

Strategic planning considering geographical and agro-ecological characteristics, such as climate, topography, soil type, environmental assets, and land cover, could help identify the best use of available land resources and achieve sustainable production resilient to climate change and climate variability. Primary considerations such as crop-water demand can be simulated in models and help to establish preferred areas for specific crops as well as irrigation recommendations for optimization according to the crop cycle. Comparing a baseline of the current climate and future climate change projections is crucial for planning strategic investments. In collaboration with research and academia, the Ministry of Agriculture and Fisheries could formulate research projects focusing on spatial modeling for agricultural zoning with a landscape approach that considers the sustainable use of the natural capital in the Southern Plains.

Financing mechanisms for implementing climate-smart investment portfolios

The government of Jamaica could explore global experiences to deliver sound financial mechanisms for smallholders to provide financial instruments that focus on addressing inequality at the community level. **Using microfinance and financial inclusion** to fight climate change or building more resilient agricultural supply chains with **blended finance** has been successfully used in other countries to overcome smallholders' limited access to resources for investing in CSA portfolio implementation. **Risk financing** instruments such as insurance and forecast-based financing in other countries can be explored as lessons learned to scale to more sustainable agricultural practices through **impact investing**.

Innovative market mechanisms

The lack of rural agro-processing of small-scale enterprises for some value chains limits the linkages of smallholder producers to high-value markets. Instead, they depend on local buyers that transport the produce to markets in urban areas. Small-scale processing centers should be established close to the productive areas, thus providing easy access for farmers to markets and adding value to their products. These processing centers can become an essential source of off-farm employment for rural communities. The government and private-sector value chain actors should develop new and **innovative market models** to underpin these rural centers and that generate added value for processing. These new market mechanisms could also be a measure to balance potential production surplus that could affect prices, thus creating a more stable income and sustainable value chain with farmers. Shared facilities have already been introduced at the community level as a new model in some communities by the Ministry of Agriculture and Fisheries. The **City Region Food System (CRFS)** can be complementary to ongoing initiatives for enabling small-scale farmers to produce for and access value-added markets, thus transforming the food system into regional CRFS hubs for food security of major urban areas, which could be another way forward for rural employment.

Drought-risk reduction

The aim is to build on the existing capacity in the Caribbean region for climate-risk management, such as the **Climate Studies Group Mona** and the **Caribbean Community**

Climate Change Centre, and liaise with other efforts in the region, such as **SERVIR Amazonia** which is now in the process of expansion in the Caribbean region. SERVIR, through advanced geospatial data, modeling, and capacity building, offers decision support services related to drought-risk management. Furthermore, drought-tolerant varieties are available for crops such as **sweet potato** and **peanut**. The use of these technologies can help diminish farmers' vulnerability to decreased rainfall and high temperatures in the short term. For the long term, it will be important to start a **diversification strategy** and introduce more drought-tolerant fruits and cereal crops in the region. To guarantee success, the Ministry of Agriculture and Fisheries needs to provide access to local and export markets for these value chains, and farmers need to be trained and incentivized for growing the new crops.

Further reading

Eitzinger A; Campbell D; Lizarazo M, Tomlinson J, Valencia J, Rodriguez J, Ramirez-Villegas J, Prager S, Rhiney K. 2022. Capacity Building Program to Improve Stakeholder Resilience and Adaptation to Climate Change in Jamaica (CBCA). CIAT Publication No. 525. International Center for Tropical Agriculture (CIAT). Cali, Colombia. https://hdl.handle.net/10568/117966

GOJ (Government of Jamaica). 2010. Vision 2030 Jamaica - National Development Plan. Accessed: 10 January 2021 https://www.vision2030.gov.jm/resources/vision-2030-jamaica-popular-version/

Rhiney K; Eitzinger A; Farrell AD; Prager SD. (2018). Assessing the implications of a 1.5 °C temperature limit for the Jamaican agriculture sector, *Regional Environmental Change*. 18(8): 2313-2327. https://doi.org/10.1007/s10113-018-1409-4

Tomlinson J; Rhiney K. 2017. Assessing the role of farmer field schools in promoting pro-adaptive behaviour towards climate change among Jamaican farmers. *Journal of Environmental Studies and Sciences*. https://doi.org/10.1007/s13412-017-0461-6

Eitzinger A; Bartling M; Feil C; Bonilla-Findji O; Andrieu N; Jarvis A. 2020. GeoFarmer app: A tool to complement extension services and foster active farmers participation and knowledge exchange. Infonote. Cali (Colombia): International Center for Tropical Agriculture (CIAT); Salzburg (Austria): University of Salzburg Interfaculty Department of Geoinformatics (Z_GIS) 10 p. https://hdl.handle.net/10568/107365

Acknowledgements

The project Capacity Building Program to Improve Stakeholder Resilience and Adaptation to Climate Change in Jamaica (CBCA) was conducted in a contract between the Ministry of Agriculture and Fisheries (MoAF) and the Alliance of Bioversity International and CIAT, with funding from the Caribbean Development Bank. We thank researchers from the Department of Geography and Geology at the University of West Indies (UWI) and relevant national stakeholders, for example, from the Rural Agricultural Development Authority (RADA), and and all focal group and workshop participants and farmers from communities in Sea Air, Comma Pen, Lititz, Parnassus, and Amity Hall.

This work was implemented as part of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which is carried out with support from CGIAR fund donors and through bilateral funding agreements. For details, please visit https://ccafs.cgiar.org/donors. The views expressed in this document cannot be taken to reflect the official opinions of these organizations..

Correct citation

Eitzinger A; Campbell D; Lizarazo M; Tomlinson J; Navarrete C. 2022. Climate-Smart Agriculture Investment Portfolios for the Southern Plains in Jamaica. Policy Brief No. 68. International Center for Tropical Agriculture (CIAT), Cali, Colombia. 12 p.

About the authors

Anton Eitzinger is a research fellow in Climate Action & Digital Inclusion at the Alliance of Bioversity International and CIAT based in Cali, Colombia. a.eitzinger@cgiar.org

Donovan Campbell is head of the Department of Geography and Geology at the University of West Indies (UWI). donovan.campbell@uwimona.edu.jm

Miguel Lizarazo is a senior research associate in Climate Action at the Alliance of Bioversity International and CIAT based in Cali, Colombia. m.lizarazo@cgiar.org

Jhannel Tomlinson is a doctoral candidate at the Department of Geography and Geology at the University of West Indies (UWI). jhannel_tomlinson@yahoo.com

Carolina Navarrete-Frías is a senior advisor on Environmental Policy and Biodiversity at the Alliance of Bioversity International and CIAT based in Cali, Colombia. c.navarrete@cgiar.org

CONTACT
Anton Eitzinger
Alliance of Bioversity International and CIAT
a.eitzinger@cgiar.org

The Alliance of Bioversity International and CIAT is part of CGIAR, a global research partnership for a food-secure future dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources.

https://alliancebioversityciat.org **www.cgiar.org**

Photo credit: A. Eitzinger