CSA-Prioritization Framework

Climate-Smart Agriculture in Belize: Identifying Investment Priorities

This document is part of a set of three complementary documents that focus on the prospects for climate smart agriculture (CSA) in Belize: Belize Climate-Smart Agriculture Country Profile [1], Belize Climate Smart Agriculture Prioritization Framework [2], and Financing Strategies for Climate Smart Agriculture in Belize [3]. The three documents describe the opportunities and challenges associated with CSA in Belize, identify a set of "best bet" practices that based on preliminary analysis appear to have great promise, and discuss opportunities for mobilizing the resources that will be needed to finance CSA investments.

Photo: MoA, Research Unit

Key Messages

- Similar to many low-lying coastal nations, Belize is vulnerable to the effects of climate change. Over time, these effects are likely to include increased variability in the amount and seasonal distribution of rainfall, increased frequency and intensity of tropical storms, rising sea levels, and increased temperature and droughts. All of these will directly affect agricultural production systems, fisheries ecosystems, and other economic sectors.

- The vulnerability of Belize's agricultural sector to climate change highlights the importance of promoting the adoption of climate-smart agriculture (CSA) practices. CSA practices enable farmers to increase productivity and production sustainably. At the same time, CSA practices increase farmers' capacity to contribute to climate change adaptation and mitigation.

- This document presents a multi-criteria framework for identifying and prioritizing CSA practices for Belize. The prioritization framework can help policymakers target scarce CSA investment resources more effectively.

- A multi-phase participatory exercise carried out using the prioritization framework led to the identification of a set of promising CSA practices and technologies. These include cover structures, drip irrigation systems, water harvesting, adjustment of planting dates, crop rotation, intercropping, conservation tillage, use of improved planting material, and improved livestock breeds, pasture improvement, production of hay and silage, and introduction of agroforestry systems.

- Adoption of CSA practices has been slowed in Belize by multiple barriers, including lack of information about promising CSA practices, lack of technical knowledge on the part of farmers, lack of resources to finance initial investment costs, and lack of affordable credit and crop insurance, among others.

- The government can strengthen incentives to adopt CSA practices. The Maximizing Finance for Development approach provides a useful framework for identifying measures needed to leverage private financing, as well as areas in which public investment will be needed.

Climatic hazards in Belize

Belize has a population of approximately 387,800, about 55% of whom reside in rural areas [4]. The relatively stable year-round subtropical climate with adequate rainfall has contributed to a thriving agricultural and agribusiness sector, which contributes 15% of GDP [5].

Belize's agricultural policy has used market-led strategies in pursuing as its main goals product diversification and food self-sufficiency. Notable achievements include the improvement of production systems for traditional export crops such as sugar and citrus, development of new export crops such as Habanero peppers, and expansion of the food crop and livestock subsectors. Production of vegetables for the domestic market has increased, reducing the need for imports [6]. Meanwhile, agricultural exports increased to US$ 229 million [4].

Belize's ecosystems featuring highly biodiverse tropical rainforests and coral reefs are very susceptible to natural disasters. As the country has 386 km of coastline, large areas are located very close to sea level. Coastal areas and small islands are vulnerable to natural disasters such as tropical storms, hurricanes, and floods. Furthermore, farmland in the coastal plains is vulnerable to salinity as a result of sea-level rise and floods [7].

Climate change and climate variability could result in a decrease in precipitation throughout the country, ranging from 6.9% in the northern zone to 10% in the southern zone. The most detrimental effect is likely to come from increased variability in the seasonal distribution of rainfall, resulting in greater frequency of droughts, floods, and landslides triggered by extreme precipitation. Temperatures are projected to change as well; annual mean temperature is likely to rise 1.3 °C by the 2030s and 1.7–1.8 °C by the 2050s in all districts [8].

Over the past few years, extreme weather events have intensified worldwide, causing repercussions in the form of economic losses. Central American countries have been among the most affected by climatic events [7]. These events can severely impact the agricultural sector and cause losses all along the value chain-in the provision of inputs, at the farm level, and in postharvest stages [8]. In Belize, during the first quarter of 2018, excessive rain and subsequent flooding affected more than 2,510 acres of vegetables, corn, beans, and plantain, resulting in losses to the agricultural sector amounting to US$ 1.9 million [9].

The value of agricultural production exposed to climate risks in Belize is significant. At any given time, up to US$ 1.25 million of agricultural production is exposed to risk of floods, and up to US$ 520,000 is exposed to risk of drought (Figure 1).

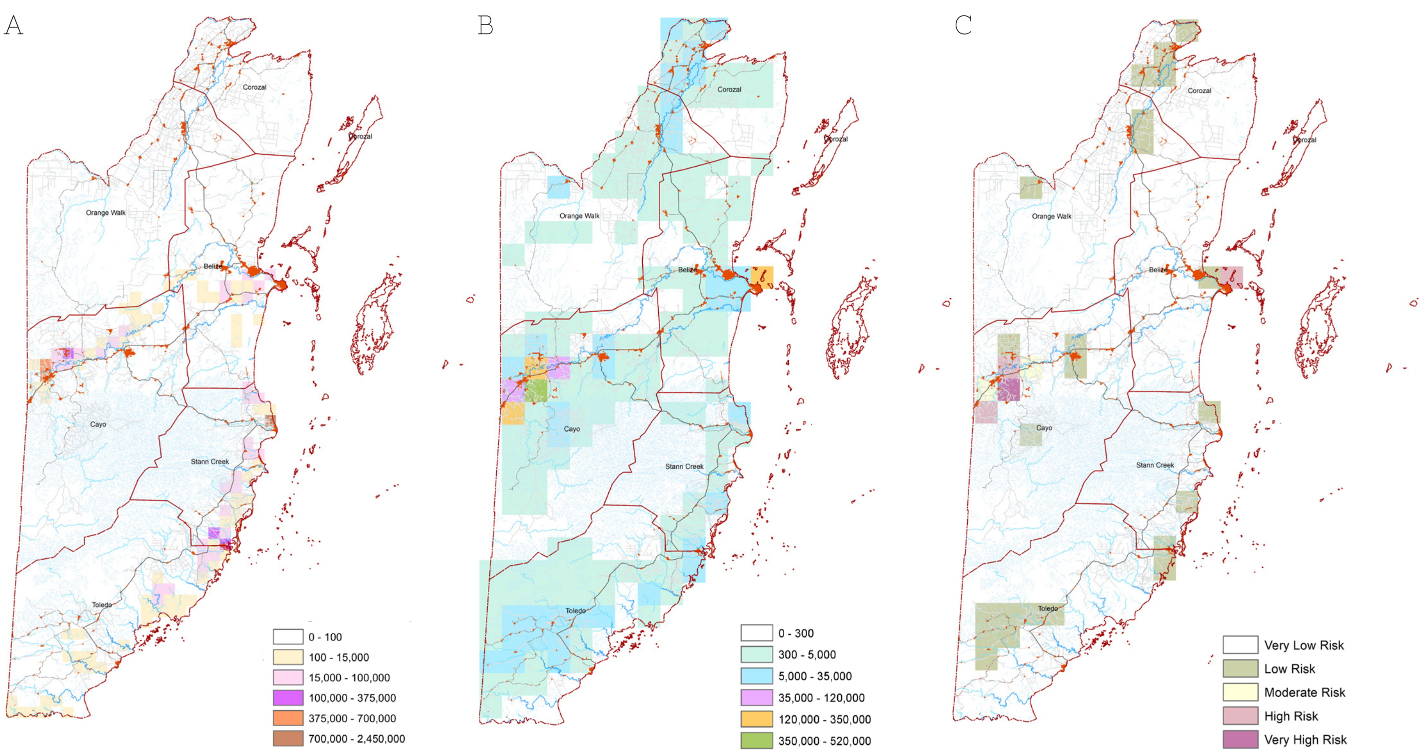

Figure 1. (A) economic exposure to floods (US$); (B) economic exposure to droughts (US$); (C) risk for multiple hazards (tropical cyclones, floods, and landslides).

Why and how can we prioritize actions?

Climate-smart agriculture (CSA) has the potential to deliver "triple wins" by contributing to multiple objectives: (1) sustainably increasing productivity and food security, (2) enhancing farmers' resilience capacity (adaptation), and (3) reducing or removing greenhouse gas emissions (mitigation). The context-specific nature of CSA points to the need to ground efforts to promote CSA in holistic food system analysis, integrating landscape, ecosystem, and value chain approaches. Incentives to adopt CSA practices usually are influenced by a combination of economic, sociocultural, environmental, and political considerations, meaning that governance arrangements, institutional structures, and financing mechanisms must be well aligned to ensure that desired outcomes can be achieved efficiently, taking into account the goals of multiple stakeholders [10, 11].

The Government of Belize (GOB), through the Ministry of Agriculture, Fisheries, Forestry, the Environment, Sustainable Development and Immigration (MAFFESDI) with funding from the World Bank, in partnership with the International Center for Tropical Agriculture (CIAT) and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), has taken on the challenge of developing the Belize Climate-Smart Agriculture Prioritization Framework (CSA-PF). This multi-criteria decision-support framework provides a process that can be used to direct investments toward promising CSA options by identifying and prioritizing existing and potential CSA practices and technologies, assessing trade-offs and synergies among them, calculating costs and benefits associated with their uptake, and identifying barriers to and opportunities for adoption [12]. It is hoped that the CSA-PF will help to improve national CSA planning and allow more effective targeting of climate change and agricultural investments by facilitating the design of context-specific portfolios of CSA practices [13].

The Belize CSA Prioritization Framework was tested using a participatory process that elicited experiences from national actors through workshops, interviews, surveys, and focus group discussions (FGDs). In addition, a comprehensive literature review was carried out to ensure alignment with countrywide sectoral initiatives, stakeholders' criteria, and Belizean realities. Using this diverse set of inputs, a long list of CSA agricultural practices was identified as having potential for Belize. With the help of the CSA Prioritization Framework, the long list was then filtered down to a short list of promising CSA practices and technologies.

CSA-PF in Belize

The objective of this document is to contribute to CSA planning in Belize by describing the CSA Prioritization Framework methodology and presenting the results of an initial effort to implement the CSA Prioritization Framework.

Promising CSA practices relevant to the production systems considered critical for national food security were classified and evaluated. The practices were classified into three categories based on their implementation cost and the level of effort required from private and public perspectives for their adoption (low cost, medium cost, high cost).

As part of the prioritization exercise, economic criteria were identified that policymakers will often want to consider in deciding which CSA practices to promote. These economic criteria include capital investment cost, operation and maintenance cost, net present value (NPV), internal rate of return (IRR), payback period (PBP), and positive externalities (carbon capture and biodiversity).

In addition to the economic criteria, mechanisms were explored that could be used to facilitate large-scale uptake of CSA practices, integrating technical, sociocultural, environmental, and political perspectives to identify barriers and opportunities, taking into account potential impacts of the practices on productivity, adaptation, and mitigation.

The results of this initial effort to apply the CSA Prioritization Framework must be considered indicative, since they reflect in part the subjective judgments made by a particular group of stakeholders, but they illustrate the type of information needed and the nature of the criteria that must be taken into account to identify promising CSA practices and prioritize among them.

It is hoped that the Belize CSA Prioritization Framework will serve as an example that will be useful for policymakers, program administrators, development agencies, and private firms, including finance organizations, as they think about building CSA programs and identify instances where conditions are favorable for promoting large-scale adoption of CSA practices, as well as instances where conditions are not as favorable and where attention is needed to adjust government policies and/or institutional arrangements [14].

Application of the CSA-PF in Belize

P0 Project scoping and stakeholder engagement

Who?

Representatives from **Government institutions**, **farmers**, **community organizations**, **academe, research, NGOs, development partners,** and others

Objective

Introduce the **CSA approach**, project objectives, scope of implementation (timeline, data sources, and indicators) and methods of the **CSA-PF** as well as **CSA Country Profile**

P1 Identification of current and potential CSA options

Objective

To build and validate

- Crops
- Livestock species
- CSA practices

Aligned with **national policies** and partners' objectives

Inputs and sources

The National Adaptation Strategy to Address Climate Change in the Agriculture Sector in Belize (NAS), National Agriculture and Food Policy of Belize 2015-2030, Effects of Climate Change in Agriculture in Belize, MAFFEDI Program, Commodity Matrix, FAOSTAT, USDA, World Development Indicators (WB).

Maps: projected changes in temperature and precipitation by 2050, economic exposition to floods and droughts, Risk index for multiple hazards.

Criteria for commodities selection

- Economic relevance
- Productivity
- Nutritional quality[1]

Criteria for practices identification

Previous inputs + Focus on primary agriculture (i.e., farm-level production) + Potential benefits for CSA pillars, **major agricultural challenges**

i.e. current and projected climatic hazards, pests and diseases, soil and water management, and biodiversity loss

Outputs

- Top 10 Commodities (Banana, bean, cattle, cacao, citrus, coconut, corn, rice, sugarcane and vegetables)
- Long list of CSA practices (5-13 practices per commodity)

P2 Prioritization and assessment of CSA practices

Objective

To refine the list of CSA practices and **select Top 3 practices per commodity**

Criteria used for CSA practices prioritization

P1 Inputs from P1 + Relevance of the practice in key dimensions (Technical, environmental, socio-cultural, economic and political)

CSA investment portfolios are context-specific selections of priority agricultural practices and technologies that seek to maximize investment yield, exploit synergies and avoid trade-offs, minimize income risk, and address priorities of diverse agricultural stakeholders in multiple dimensions.

P4 Construction of CSA investment portfolios

Objective

To **co-design CSA investment portfolios** using inputs from previous phases and identify **barriers to and opportunities for adoption**

Criteria for portfolio selection

Climate smartness + Cost-benefit analysis (CBA) + Qualitative evaluation of relevant **barriers to and opportunities for adoption** (technical, environmental, socio-cultural, economic and political)

How?

Workshop, plenary discussion, and round tables per commodity with multisectoral experts, use of **CSA-Prioritization tool**

Outputs

CSA portfolios based on different approaches
Climate hazards (floods, drought, etc.), geographic scale, CSA pillars (A, P, M), farmer scale (small, medium, large), market orientation (local, export), commodity specific, level of investment required (low, medium, and high cost) among others.

P3 Assessment of costs and benefits of promising CSA practices

Objective

To calculate the **costs and benefits of priority CSA practices** compared to a baseline (conventional agriculture)

Criteria for practices assessment

IC – OM – NPV – IRR – PP + +E

- IC: Investment cost
- OM: Operation and maintenance cost
- NPV: Net present value
- IRR: Internal rate of return
- PP: Payback period
- +E: Positive externalities (biodiversity and carbon capture)

How?

Interviews and FGDs with farmers, technicians, and professionals in each commodity. Accompanied by specialized literature review

Outputs

Costs and benefits analyzed for priority CSA practices per commodity

Criteria for practices assessment

Climate smartness
15 climate-smart indicators are evaluated in order to define the potential impact of practices on CSA pillars (productivity, adaptation, mitigation) under context-specific scenarios for each commodity

How?

Workshop, plenary discussion, and round tables per commodity
with multisectoral experts

Outputs

Short list of 3 priority CSA practices per commodity
based on multiple criteria and climate smartness

Toward adoption and scaling up of CSA practices and portfolios

A farmer's decision whether or not to adopt a particular CSA practice is influenced by many factors. These factors include but are not limited to the farmer's awareness of the practice, the amount and quality of information about the practice at the farmer's disposal, the financial incentives to adopt, the farmer's time preference and appetite for risk, and the farmer's environmental consciousness, among others. An understanding of these elements plays a vital role in the process of CSA portfolio adoption and dissemination [15, 16].

Looking beyond the farm, an important matter that policymakers will want to consider is the amount of cooperation required among stakeholders at the local and national level to ensure successful adoption. In many cases, the success of CSA initiatives depends on the commitment of collaborating organizations to contribute their competences and experiences [17]. Building and successfully promoting adoption of CSA practices and portfolios often requires close coordination between public policies and CSA interventions at different geographic scales, since public policies influence the technical, economic, and social mechanisms needed to ensure that CSA portfolios of practices, technologies, and financial and credit services can be introduced and scaled up in a sustainable way [18].

To see the importance of close coordination between public policies and CSA initiatives, it is worthwhile to consider an example. In conventional food systems, almost all stages in the value chain are highly dependent on oil and other fossil fuels. At the farm level, fossil fuels not only power many operations including land preparation, irrigation, weeding, and harvesting, but they also figure prominently in the production of chemical fertilizers and pesticides, irrigation equipment, and packaging materials.

In Belize, from 2011 to 2015, the use of chemical fertilizers and pesticides averaged 231 kg/ha and 8.2 kg/ha, respectively, much higher than the Latin American and Caribbean averages of 101 kg/ha and 0.7 kg/ha [5]. This suggests that public policies in Belize promoting the use of fertilizer and pesticides may have been encouraging very high GHG emissions from agriculture, contributing to climate change and possibly threatening the sustainability of the food system.

Many crop and livestock farmers in Belize are already implementing CSA practices to some extent (Figure 2) [8]. Still, more widespread adoption of CSA practices has been hindered by a number of factors, including lack of information and technical knowledge, land tenure insecurity, deficiencies in physical infrastructure, and economic constraints, especially the lack of financial resources to pay initial investment costs.

Policymakers and program administrators in Belize have begun to pay more attention to promoting information flows, raising environmental consciousness, and helping farmers manage risk. There is still room, however, to better understand farmers' perceptions and attitudes as these relate to CSA practices.

The promising CSA practices that were identified for Belize have the potential to deliver various types of benefits, such as reduced management costs, reduced use of purchased inputs, increased productivity, and in some instances production of additional products through diversification (e.g., through intercropping

Banana	Timely bagging (using biodegradable bags)	Ba_PB
	Water-efficient mgmt (drainage-canals/irrigation-drip)	Ba_WEM
	Biofertilization (ground cover with N-fixing legumes)	Ba_BIOF
Bean	Crop rotation (e.g. corn, soybean)	Be_CR
	Planting high-yielding varieties	Be_HYV
	Adjusted planting date to match rainfall pattern	Be_APD
Cattle	Crop rotation (e.g. corn, soybean)	Ca_UH&S
	Use of improved pastures (e.g. Mombasa)	Ca_UIP
	Use of improved breeds (e.g. Brangus)	Ca_UIB
Cacao	Grafting techniques	Cac_GRA
	Management of cacao trees (pruning)	Cac_PRU
	Agroforestry (e.g. mahogany, salmwood, plantain)	Cac_AFS
Citrus	Intercropping (e.g. coconut, pineapple, soursop)	Ci_INTC
	Improved drainage (e.g. raised beds)	Ci_ID
	Use of certified planting material	Ci_UCPM
Coconut	Integrated pest management (biological control)	Co_IPM
	Use of high-quality certified planting material	Co_UCPM
	Intercropping (e.g. soursop, lime, pineapple)	Co_INTC
Corn	Plant density management	Cor_PDM
	Crop rotation with beans	Cor_CR
	Water-efficient irrigation (e.g. sprinkler)	Cor_WEM
Rice	Planting high-yielding varieties	Ri_HYV
	Water harvesting (e.g. ponds)	Ri_WH
	Water-efficient mgmt (alternate wetting & drying)	Ri_AWD
Sugarcane	Planting of high-sugar-content varieties	Sc_HSCV
	Water-efficient mgmt (e.g. vinasse for irrigation)	Sc_WEM
	Soil and land management (minimum tillage)	Sc_S&LM
Vegetables	Use of disease-tolerant varieties	Ve_UDTV
	Cover structures (e.g. bubble house)	Ve_CS
	Drip Irrigation (fertigation)	Ve_DI

Figure 2. Production systems + CSA practices + acronyms.

or agroforestry systems) [19]. At the same time, implementing CSA practices frequently entails additional costs for farmers compared to business-as-usual (BAU) practices. As discussed below, these costs range from low to high.

Low-cost practices

Many farmers in Belize have taken up low-cost CSA practices that generate incremental benefits compared with the BAU scenario. Low-cost CSA practices that have been used for quite some time in Belize include crop rotation of corn and beans (Be-CR) and plant density management to achieve higher yields (Be-APD). For these two CSA practices, investment costs and operation and maintenance costs come to about US$ 225 and US$ 259 per acre per year, respectively. Many farmers have been taking on these relatively low costs themselves, which is made easier by the short payback period of 1 year on average. The investments are attractive, generating a positive net present value (NPV) of US$ 618. When farmers implement these particular CSA practices in isolation, the benefits accrue mainly to the farmers themselves, as few externalities are generated (e.g., increased biodiversity or enhanced carbon sequestration). But when many farmers implement these practices, the externalities can be significant, increasing the payoffs to society of the farmers' investments (Figure 3).

Investments for low-cost CSA practices are similar to investments made for conventional practices. Therefore, many CSA practices can be adopted easily, resulting in significant benefits. Practices such as crop rotation and plant density management lead to short- to long-term gains in productivity (increasing yield as a result of enhanced soil health and fertility), and allow farmers to reduce their use of purchased inputs, thus lowering production costs and increasing net income.

With respect to climate change adaptation, these practices promote efficient use of water and nutrient cycling, potentially increasing soil fertility and reducing soil erosion. With respect to climate change mitigation, these practices reduce the use of nitrogen-based fertilizer when leguminous crops such as beans are introduced, thus reducing related GHG emissions per unit of output. They also help maintain or improve soil carbon stocks and soil organic matter (Figure 4).

Despite the known benefits, in many cases adoption of low-cost CSA practices is hampered by factors not directly related to the profitability of those practices, for example, farmers' lack of technical knowledge, their inability to mobilize the additional labor required to carry out timely rotations, and the challenges associated with marketing surplus production. This points to the need to strengthen extension and education programs, support

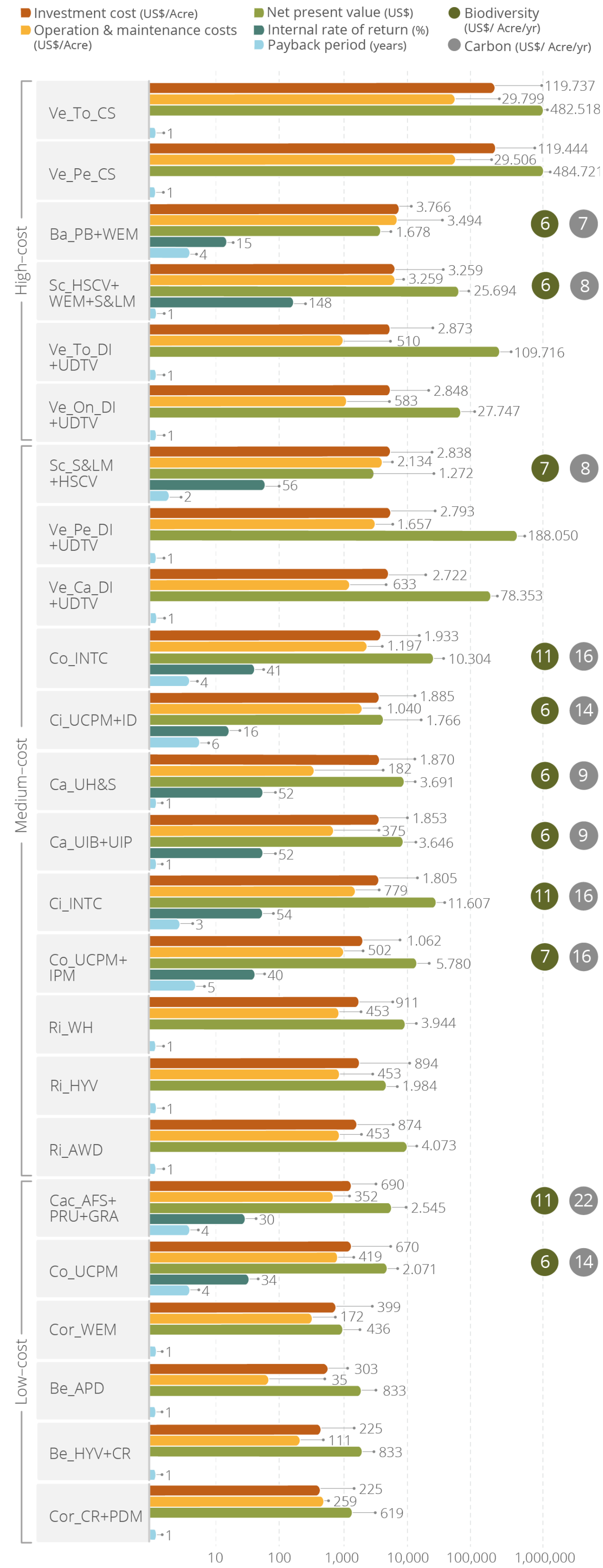

Figure 3. Cost-benefit analysis (CBA) of CSA practices. The graph is shown in logarithmic scale.

labor markets, and launch initiatives to better link farmers to markets.

Technology that allows farmers to more easily access market information (e.g., mobile phones, internet terminals) can enhance the value of CSA practices. To the extent that farmers' use of such technology can be increased through collaboration among public agencies, private firms, NGOs, and farmers themselves, the uptake of CSA practices can often be accelerated.

Medium-cost practices

Some farmers in Belize have adopted medium-cost CSA practices. For example, rearing of Brangus cattle (a hybrid breed well suited for meat production) on improved pastures (Ca-UIB) requires an initial investment of US$ 1,852.50 and operating and maintenance costs of US$ 375 per year. The investment, while quite substantial, generates attractive returns: the NPV is estimated at US$ 3,646, with an expected IRR of 52%. Despite the expected profitability of this practice, as well as others in this cost range, the significant investment cost and relatively long payback period of 3–6 years pose formidable barriers for many livestock producers. Many livestock producers in Belize face cash constraints and have no means of accessing credit. In addition, investment in livestock is considered risky.

The barriers that have discouraged adoption of medium-cost CSA practices in Belize often can be overcome by increasing the availability and affordability of credit and by improving access to purchased inputs. The specific challenges and risks faced by farmers need to be systematically analyzed, however, and interventions designed that fit local circumstances. With respect to credit, financial instruments may need to be made more flexible in timing, amounts disbursed, and repayment schedules. For purchased inputs, the government may be able to reduce the cost to the farmer by facilitating imports, improving infrastructure (ports, handling facilities, roads), and reducing the regulatory burden on distributors.

Another set of medium-cost CSA practices identified during the recent prioritization exercise consists of forestry and agroforestry practices. Planting of semi-permanent and woody species presents opportunities for carbon capture and biodiversity conservation (Figure 4). Under a scenario in which the country has the financial resources and institutional systems needed to provide compensation for these benefits, so-called payment for ecosystem services (PES) schemes would be an interesting alternative to explore for generating additional income for farmers.

Adoption of CSA practices depends on farmers being aware that the practices exist and well informed about how to implement them. This suggests that adoption of CSA practices depends on farmers having timely access to tailored and credible technical information on CSA practices and portfolios. MoA, working in collaboration with NGOs and international development agencies, has made positive strides in this direction by building the capacity of its extension officers in the use of different extension methodologies [20].

High-cost practices

A third set of promising CSA practices identified through the recent prioritization exercise can be characterized as high-cost. High-cost CSA practices present special challenges due to the high initial investment costs and the long payback period. Despite the high cost, a few farmers in Belize have adopted these practices. For example, the use of a cover structure (bubble house of 560 ft^2) in vegetable production (Ve-CS) requires an initial investment of US$ 1,555 and results in operating and maintenance costs of US$ 387 per year. Nevertheless, if farmers can mobilize the resources needed to implement the practice, the investment will generate an attractive return, as reflected in an estimated NPV of US$ 6,266.50, indicating that the investment is very attractive.

Successful adoption of high-cost CSA practices is much more likely when key enabling factors are present. Awareness programs can ensure that farmers know about the practices and recognize their potential benefits. Materials and equipment needed to implement the CSA practices must be available in local markets, along with advisory services that can deliver technical guidance regarding their proper use. Since few farmers will be able to afford the high initial investment costs from their own resources, access to financing will usually be critical, and even then farmers' own resources may have to be supplemented with public investments. Finally, the policy and regulatory environments must be such that farmers have incentives to invest in high-cost CSA practices [21].

Promising high-cost CSA practices identified through the recent prioritization exercise include construction of cover structures, planting native tree species for shade and timber, and integrating fruit trees into conventional production systems. These practices have the potential to generate attractive returns for farmers, but they will not necessarily generate large externalities in the form of adaptation and mitigation benefits unless adoption takes place at sufficiently large scale. If large numbers of farmers were to adopt, however, landscape-level impacts would include significant climate change adaptation and mitigation benefits. For example, planting native tree species and integrating fruit trees into conventional production systems, if done on a sufficiently large scale, would not only increase and stabilize farmers' incomes by enabling them to diversify their mix of products, but it would also generate significant ecosystem services in terms of biodiversity enhancement, soil and water conservation, and reduced GHG emissions.

Most farmers will need help to finance the high initial investment costs and long payback period associated with high-cost CSA practices. In the case of CSA practices that generate significant environmental externalities, those resources could come at least partly through payment-for-environmental-services (PES) programs. The policy and regulatory environment would also have to favor investments in high-cost CSA practices. For example, given the long payback period associated with investments in trees, land tenure security will be vital [16].

As pointed out earlier, adoption of CSA practices is influenced by a wide range of factors. Some of these are directly linked to government policies, whereas others relate to farmers' own decisions but can potentially be influenced by policy. The degree to which policymakers consider the various factors and are able to address them when formulating policies and programs will critically influence the uptake of CSA practices [22].

The National Adaptation Strategy identifies five areas in which public investment has the potential to generate an enabling environment suitable for effectively implementing and scaling up CSA practices:

1. Infrastructure and equipment,

2. Research and training,

3. Education and early warning,

4. Commodity insurance, and

5. Monitoring and documentation [23].

Following from the above, many actions can be taken at national level targeting priority productions systems that would likely accelerate the uptake of the promising CSA practices identified through the prioritization exercise.

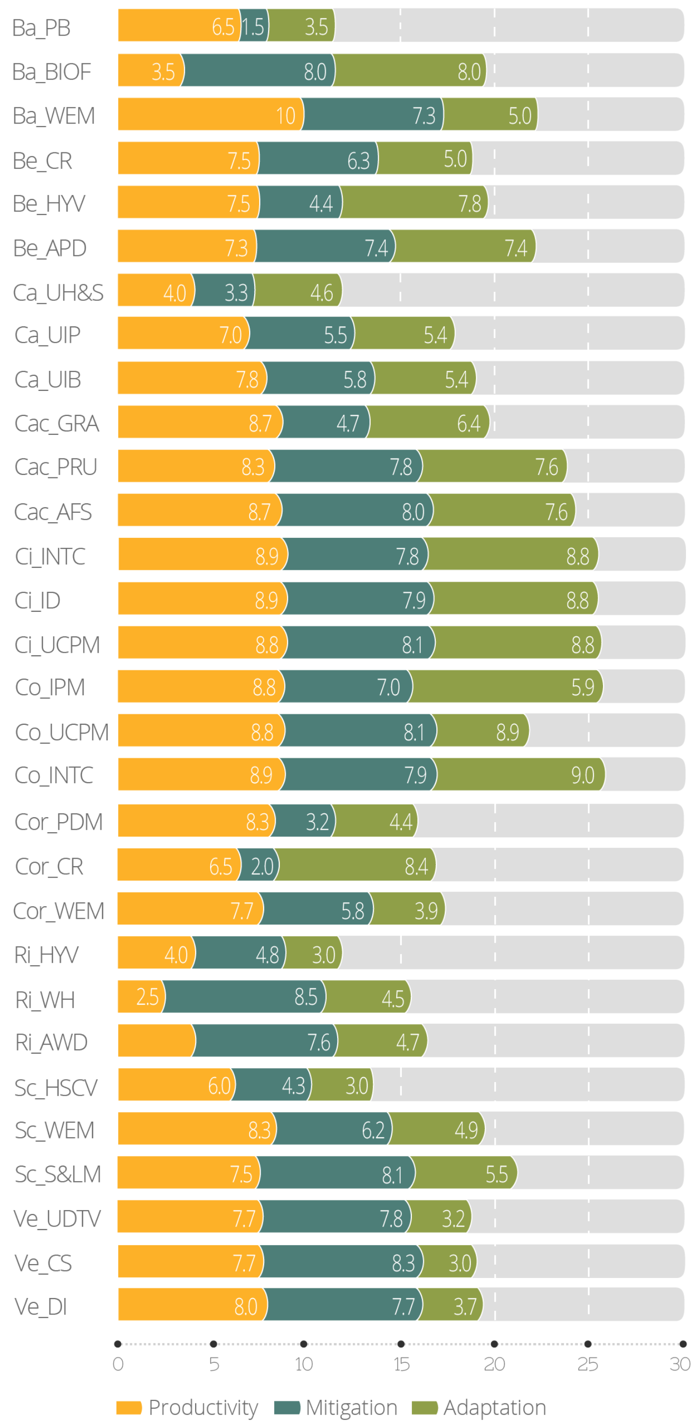

Figure 4. Benefits on CSA pillars of CSA practices.

Entry points for promoting CSA

It is important that policymakers make informed decisions when considering whether or not to promote CSA. Recent research has revealed the critical role played by diverse factors in influencing farmers' decisions whether or not to adopt CSA practices [16]. By taking into account a wide range of technical, economic, and sociocultural factors, the CSA-PF can help identify areas in which coordinated action is needed among the many domestic and international actors working on agriculture, environment, and climate change initiatives.

Results of the recent prioritization exercise carried out to test the CSA-PF were used to identify entry points for potential future actions by the government and selected partners and stakeholders who are active in promoting agricultural development in Belize:

- As a member of the Caribbean Community (CARICOM), Belize can participate in regional initiatives to gain insights into what other countries in the region are doing related to climate change.
- As a member of the Central American Integration System (SICA in Spanish), Belize can seek funding through the Central American Agricultural Council (CAC) for promoting sustainable agriculture adapted to the effects of climate change and climate variability.
- As a member of the Caribbean Agriculture Research and Development Institute (CARDI), Belize can access exchange programs for capacity building.
- Belize can establish new partnerships with international agricultural research organizations and programs such as the International Center for Tropical Agriculture (CIAT in Spanish) and the CGIAR Program for Climate Change, Agriculture, and Food Security (CCAFS) and jointly identify climate change impacts and adaptation options for rural small-scale farmers.
- Belize can strengthen existing relationships with regional organization such as IICA, OIRSA, and CARDI, which offer technical advice and capacity building in various areas of climate change adaptation.
- Belize can strengthen the existing relationship with UNDP, which has supported rural agricultural projects (Japan Caribbean Climate Change Partnership) to guide small farmers in climate change adaptation.
- Belize can strengthen existing relationships with IFAD and GCF, which are funding a CSA project, Rural Resilient Belize (RRB), which aims to minimize the impacts of climatic and economic events on smallholder farmers while supporting sustainable market access for their produce.
- MoA can continue to pursue relationships with local NGOs that are working to promote CSA at the local level, such as Ya'axché.
- MoA can continue to pursue relationships with private firms that are investing in CSA practices for commercial reasons, such as American Sugar Refinery/Belize Sugar Industries Limited (ASR/BSI).

Momentum of national efforts to tackle climate change

What is the government of Belize doing to promote CSA? Addressing the threats to agriculture posed by climate change requires a multifaceted approach in which national policies and strategies are coordinated with and linked to international initiatives. A number of ongoing policies, programs, and initiatives are contributing to this effort:

- The National Climate Change Policy, Strategy and Action Plan to Address Climate Change in Belize provides policy guidance for the development of an administrative and legislative framework for building resilience to climate change. A key recommendation is the adoption of standards and best practices for the extraction, production, and distribution of water to strengthen the resilience of freshwater resources. It also highlights, for the agricultural sector, the importance of diversifying livestock systems, improving access to drought-resistant crops including those used to feed livestock, promoting adoption of improved soil management practices, and providing early warning/meteorological forecasts and related information.
- The National Adaptation Strategy to Address Climate Change in the Agricultural Sector (NAS) addresses the current and projected impacts of climate change on the agricultural sector in Belize. It further highlights that the implementation of the strategy will require investments in infrastructure and equipment, research and training, education and early warning systems, and matching funds for a public/private sector partnership commodity insurance scheme.
- The National Agriculture and Food Policy (NAFP) of Belize 2015–2030 outlines several initiatives that can help to overcome the challenges of climate

change, including (i) adopting innovative approaches to develop efficient small-farm production systems, which can contribute significantly to rural poverty alleviation and food security; (ii) developing new approaches to financing agriculture; (iii) improving the incentive system to attract both local and foreign investment; (iv) simplifying regulations and bureaucratic procedures to reduce the costs of doing business; and (v) investing in support services and basic infrastructure [24].

- The National Development Framework for Belize: Horizon 2030 prioritizes integrating environmental sustainability into development planning, including planning for climate change impacts.

- The Nationally Determined Contribution (NDC) focuses on agriculture, forestry, fisheries and aquaculture, coastal and marine resources, and water resources as key areas for adaptation. Some strategies mentioned for supporting adaptation in the agricultural sector involve promoting improved crop production technologies, promoting improved soil management practices, diversification into drought-resistant crops and livestock, and scaling up the use of efficient low-water irrigation systems.

- The Growth and Sustainable Development Strategy (GSDS) guides overall development for 2015–2018 and contributes to longer-term development objectives. The GSDS calls for the continued mainstreaming of climate change considerations into national development planning and the integration of climate change resilience into sector development plans.

The National Climate Change Adaptation Strategy makes clear that scope exists to promote CSA practices in a number of policy areas, including:

- Land use
- Water use
- Agriculture policy and strategy
- Disaster risk reduction
- Energy
- Biosafety
- Aquaculture [23]

The NAS goes on to identify specific actions that are needed to enhance the resilience of Belize's agricultural sector in the face of climate change. These actions are classified into four main categories: (1) infrastructure and equipment, (2) research and training, (3) education, and (4) early warning. Table 1 presents the actions identified in the NAS and indicates for each action the time required to produce impacts, the estimated costs, possible financing sources, and suitable implementing entities [23].

Significant financing will be needed to implement all the actions that have been identified. Of the estimated total cost of approximately BZ$ 27 million, the vast majority (97%) is needed for infrastructure and equipment.

Financing CSA investments: the Maximizing Finance for Development approach

In Belize as elsewhere, current levels of investment in the agricultural sector are insufficient to achieve national development goals. This is true for agriculture in general and for CSA in particular. Many of the investments described in the NAS and summarized in Table 1 will require significant amounts of financing. This begs the question: What strategies can be followed to mobilize the financing needed to ensure adoption of CSA practices on a large scale?

From farm to fork, developing agricultural value chains is predominantly a private sector affair, meaning agribusiness can and must play a central role in advancing the larger agricultural development agenda. It is therefore both possible and essential to leverage private sector resources in pursuing the transformational opportunities offered by agriculture and food systems. But where are the opportunities to leverage private sector resources?

The Maximizing Finance for Development (MFD) approach being promoted by the World Bank provides a framework that can be used to address this question in a systematic way. The MFD approach seeks to crowd in private resources to help achieve development goals by optimizing the use of scarce public resources to enable private sector investment and build inclusive linkages, promote good governance, and ensure environmental and social sustainability, among others. The central idea underlying the MFD approach is systematically to discern whether sustainable private sector solutions can substitute for public expenditure and to determine where the key enabling roles for the public sector are to be found. To guide this process, a structured sequence of questions can be used to systematically assess entry points for public-sector interventions (Figure 5) [25].

The questions posed at each stage of the MFD cascade are intended to clarify the respective roles of the public and private sectors in carrying out a given activity. In

Table 1. Actions addressed in NAS, their timeline, cost, financing sources, and implementing institutions as enabling actions for CSA portfolio implementation. Adapted from NAS. Short term (S): 1–3 years; medium term (M): 4–6 years; long term (L): >6 years.

Actions	Timeline	Cost annually (US$)	Financing sources	Implementing
Infrastructure and equipment				
1. Design and construct drains in sugar belt	S	2,000,000	AMS, farmers	AMS, farmer
In banana belt	S	800,000	BAMs, farmers	AMS, farmer
In citrus belt	M	1,000,000	GOB , partners	AMS, farmer
In Sarawee	S	50,000	GOB	AMS, farmer
2. Construct and equip laboratory for biological control	S	75,000	GOB, association	SIRDI, BAHA
3. Construct and equip laboratory for soils and tissue analysis	M	125,000	GOB, association	CREI
4. Construction of protective cropping structures	S	200,000	GOB , farmers	Agriculture Department.
5. Road infrastructure: feeder roads	M-L	5,000,000	EU and partners	Ministry of Works
6. Electrification in banana region for irrigation improvements	M	750,000	BAMS	BEL, farmers
7. Electrification in sugar region for irrigation improvements	M	1,250,000	AMS	BEL, farmers
8. Solar-powered irrigation pumps	M	1,000,000	AMS, farmers/GOB	Farmers
9. Composting plant for banana industry	M	125,000	BAMS	BGA
10. Composting plant for sugarcane industry	L	125,000	AMS	Association
11. Composting facilities for 10 small farmer groups	S	150,000	FAO and partners	Farmer groups
12. Germplasm bank: expansion and upgrade	L	75,000	GOB, FAO	MoA/CARDI
13. Water harvesting catchment demonstrations	L	30,000	Partners	Agriculture Department
14. Research equipment for national facility	M	100,000	MoA, EU, and UNDP	Agriculture Department
15. Agro-met forecasting equipment	S	200,000	GOB	Meteorology Department
16. Monitoring and documentation system - software and training	M_L	20,000	Partners	Agriculture Department
	Subtotal	**13,075,000**		
Research and Training (R&T)				
1. T MSc. soil agronomist	S	30,000	Partners	CREI and MoA
2. T MSc. agric. engineering	S	30,000	Partners	MoA
3. T MSc. entomology	S	30,000	Partners	MoA
4. T MSc. pathology	S	30,000	Partners	MoA
5. T MSc. hydrology	S	30,000	Partners	Hydrology Dept.
6. T MSc. food processing	S	30,000	Partners	MoA
7. T in geographic information systems	S	15,000	Partners	LIC, GOB
8. T in information technology applications	S	15,000	Partners	MoA, producer groups, associations
9. T Research and statistics (local or agency professionals)	M	10,000	Partners	CARDI, MoA
10. R&T Climate modelling	M	15,000	Partners	Meteorology
11. R&T Pest modelling	L	15,000	Partners	MoA, BAHA
12. T monitoring and documentation	M	20,000	GOB	MoA/producer groups
13. T composting	S	10,000	GOB	Producer groups
14. Research in biological control	M On-going	20,000	GOB and farmer associations	GOB , SIRDI, CREI,UB
15. R&T in Protective cropping structures	S	60,000	GOB and farmer associations	GOB , farmers
	Subtotal	**360**,000		
Education and early warning				
1. Weather forecasting transmission: texts, e-mail to focal points	S	5,000	GOB	Meteorology Department
2. Awareness programmes: TV, radio programs -vegetation, watershed, wetlands management	S	5,000	GOB	Dept. of Environment
3. TV, radio programs - importance of diversity (refuges)	S	5,000	GOB	BAHA
4. Radio, texts, e-mail pest forecasting	L	2,500	GOB	MoA, BAHA
5. TV, radio programmes - climate change awareness	S	5,000	GOB	Climate Change office
6. TV, radio programmes - GMO, LMO	S	2,500	GOB	MoA, BAHA
	Subtotal	25,000		

Belize, the answers to the questions can help to delineate the scope for policy reforms to shape incentives and crowd in private sector financing to support needed CSA investments, as well as to identify areas in which public financing is likely to be needed to produce public goods and services necessary to promote large-scale adoption of CSA practices. Use of the MFD cascade can help identify the actions and activities in which the government and other development partners can have the largest impact.

To apply the MFD approach to CSA, the first step is to define precisely each CSA practice that is considered a priority. Once a priority CSA practice has been defined, the starting question can be posed: "Is the private sector doing it?" The answers to this starting question and to the subsequent questions in the MFD cascade help to identify areas in which the public and private sectors can contribute to investment in the practices, playing different roles. It is important to understand that the answers to the questions are often non-binary; a "yes" answer may identify only part of the potential contribution of the private sector at that level, and movement to subsequent levels may be needed to ensure a complete assessment of all questions around MFD and identification of all the potential roles of the public and private sectors in promoting those CSA practices. Once these roles are understood, actual implementation of policy and regulatory changes and public investments need not be sequential. In many cases it will make sense to implement them simultaneously, but that does not detract from the value of asking the questions sequentially.

Outlook

CSA practices have potential to deliver "triple wins" for the agricultural sector of Belize by sustainably increasing productivity, enhancing resilience, and reducing or removing GHGs. Although the concept of CSA is new and still evolving, many of the practices and technologies that make up CSA already exist worldwide and are currently being used to cope with a range of climate-related production risks. Many farmers in Belize are already using CSA measures to some degree. However, more widespread adoption of many CSA technologies has been hindered largely by a lack of information and technical knowledge, and lack of resources to pay for initial investment costs. In addition, careful planning is needed to capture synergies and address trade-offs among the three CSA pillars: productivity, adaptation, and mitigation.

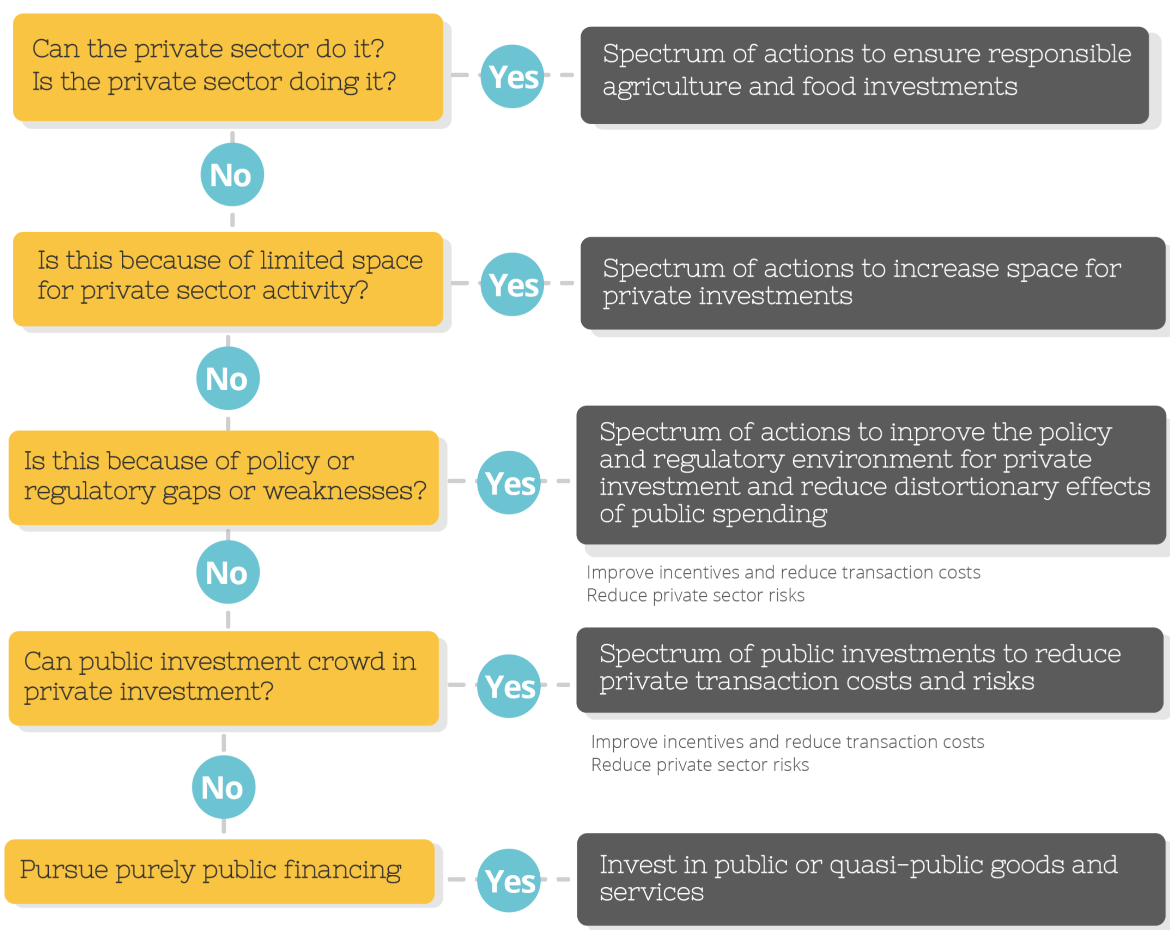

Figure 5. The Maximizing Finance for Development (MFD) approach.

Mainstreaming CSA into national policies and programs requires a critical mapping of technically effective, financially profitable, and environmentally sustainable CSA practices, diagnosis of barriers to adoption and strategies for overcoming those barriers, and the identification of institutional and financial enablers. The Belize CSA-PF is a multi-criteria decision-support framework that provides a process that can be used to direct investments toward promising CSA options by identifying and prioritizing existing and potential CSA practices and technologies, assessing trade-offs and synergies among them, calculating costs and benefits associated with their uptake, and identifying barriers to and opportunities for adoption.

The Belize CSA-PF was used to identify a set of promising CSA practices and technologies using a participatory process that elicited experiences from national actors through workshops, interviews, surveys, and focus group discussions. In addition, a comprehensive literature review was carried out to ensure alignment with countrywide sectoral initiatives, stakeholders' criteria, and Belizean realities. In a two-step process, a long list of CSA agricultural practices of potential relevance to Belize was identified and then filtered down to a short list of promising CSA practices and technologies.

In Belize as elsewhere, current levels of investment in the agricultural sector are insufficient to achieve national development goals. Many of the promising CSA investments identified and prioritized with the help of the CSA-PF—especially those with medium and high costs—will require significant amounts of financing. What strategies can be followed to mobilize the financing needed to ensure adoption of CSA practices on a large scale? Agriculture is predominantly a private sector affair, meaning agribusiness can and must play a central role in advancing the larger agricultural development agenda. It is therefore both possible and essential to leverage private sector resources in pursuing the transformational opportunities offered by agriculture and food systems.

The Maximizing Finance for Development (MFD) approach provides a framework that can be used to address this question in a systematic way. The MFD approach provides a structured sequence of questions that can be used to systematically assess entry points for public-sector interventions. The questions posed at each stage of the MFD cascade are intended to clarify the respective roles of the public and private sectors in carrying out a given activity.

Increased engagement of the private sector in promoting CSA is highly important for in-field adoption of practices, especially where CSA practices and technologies are too capital-intensive for farmers to afford implementation. This requires institutional dialogue, joint planning of interventions, as well as availability of and access to accurate farm data to allow for analysis and further prioritization of interventions and pathways for scale-up.

It is important that policymakers make informed decisions when considering whether or not to promote CSA practices. Recent research has revealed the critical role played by diverse factors in influencing farmers' decisions whether or not to adopt CSA practices. By taking into account a wide range of technical, economic, and sociocultural factors, the CSA-PF can help identify areas in which coordinated action is needed among the many domestic and international actors working on agricultural, environmental, and climate change initiatives.

The context-specific nature of CSA points to the need to ground efforts to promote CSA in holistic food system analysis, integrating landscape, ecosystem, and value chain approaches. Incentives to adopt CSA practices usually are influenced by a combination of economic, sociocultural, environmental, and political considerations, meaning that governance arrangements, institutional structures, and financing mechanisms must be well aligned to ensure that desired outcomes can be achieved efficiently, taking into account the goals of multiple stakeholders.

For more information about climate-smart agriculture in Belize and other Latin American countries, visit https:// ccafs.cgiar.org/publications/csa-country-profiles.

Further reading

[1] WB (World Bank). 2018a. Belize Climate Smart Agriculture Country Profile. Washington, DC: World Bank.

[2] WB (World Bank). 2018b. Belize Climate Smart Agriculture Prioritization Framework. Washington, DC: World Bank.

[3] WB (World Bank). 2018c. Financing Strategies for Climate Smart Agriculture in Belize. Washington, DC: World Bank.

[4] The Statistical Institute of Belize (SIB). 2018. Annual Report 2017. Available at: http://sib.org.bz/wp-content/uploads/AnnualReport_2017.pdf

[5] The World Bank. 2016. World Development Indicators. Available at: http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#

[6] Ministry of Agriculture and Fisheries (MAF). 2011. Plan of Action for Disaster Risk Reduction. MAF-FAO. Belmopan, Belize.

[7] Ramírez, D. et al. 2013. Belize Effects of Climate Change on Agriculture. Economic Commission for Latin America and the Caribbean (ECLAC). Available at: http://archivo.cepal.org/pdfs/Mexico/2013/M20130001.pdf

[8] CIAT, World Bank. 2018. Climate-Smart Agriculture in Belize. CSA Country Profiles for Latin America and the Caribbean Series. International Center for Tropical Agriculture (CIAT); World Bank, Washington, D.C. 31 p.

9] Revised National Agricilture and Food Policy 2015-30. Ministry of Agriculture, Forestry, Fisheries, the Environment and Sustainable Development and Immigration (MAFFESDI). 2018. Damage Assessment 2018. Unpublished report.

[10] CSA 101. 2018. Targeting and prioritization. Available at: https://csa.guide/csa/targeting-and-prioritization

[11] Scherr, S.J., Shames, S., and Friedman, R. 2012. From climate-smart agriculture to climate-smart landscapes. Agriculture & Food Security 1:12. DOI: 10.1186/2048-7010-1-12

[12] Sain, G., Loboguerrero, A.M., Corner-Dolloff, C., Lizarazo, M., Nowak, A., Martínez-Barón, D., and Andrieu, N. 2017. Costs and benefits of climate-smart agriculture: the case of the dry corridor in Guatemala. Agricultural Systems 151:163–173. DOI: 10.1016/j.agsy.2016.05.004

[13] Andrieu, N., Sogoba, B., Zougmored, R., Howland, F., Samake, O., Bonilla-Findji, O., Lizarazo, M., Nowak, A., Dembele C., and Corner-Dolloff, C. 2017. Prioritizing investments for climate-smart agriculture: Lessons learned from Mali. Agricultural Systems 154:13–24. DOI: 10.1016/j.agsy.2017.02.008

[14] Wollenberg, E., Zurek, M., and De Pinto, A. 2015. Climate readiness indicators for agriculture CCAFS Info Note. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

[15] Farid, K.S., Tanny, N.Z., and Sarma, P.K. 2015. Factors affecting adoption of improved farm practices by the farmers of Northern Bangladesh. J. Bangladesh Agric. Univ. 13(2):291–298.

[16] Liu, T., Bruins, R., and Heberling, M. 2018. Factors Influencing Farmers' Adoption of Best Management Practices: A Review and Synthesis. Sustainability 10:432. DOI: 10.3390/su10020432

[17] UNW-DPV. 2015. Proceedings of the Regional Workshop on Capacity Development to Support National Drought Management Policies for Latin America and the Caribbean Countries UN-Water Decade Programme on Capacity Development (UNW-DPC). Tsegai, D., and Ardakanian, R., editors. Proceedings Series No. 14. Bonn, Germany.

[18] Andrieu, N., Howland, F., Acosta A.I., Le Coq J.F., Osorio A.M., and Chia, E. 2018. Innovation platform for small farmers facing climate change. International Center for Tropical Agriculture (CIAT). Available at: https://ccafs.cgiar.org/blog/innovation-platform-small-farmers-facing-climate-change#.WyfiY1VKhhF

[19] Echeverría, J. 2018. Benefit-Cost Analysis of Climate Smart Agricultural Practices in Belize. Report prepared for the International Center for Tropical Agriculture (CIAT). Cali, Colombia.

[20] IICA. 2018. Strengthening Belize National Extension Service Capacity Building workshop. Available at: https://www.iica.int/en/press/news/strengthening-belize-national-extension-service-capacity-building-workshop

[21] Meyer, R. 2011. Subsidies as an instrument in agriculture finance: a review. The International Bank for Reconstruction and Development/The World Bank. Washington, DC. 72 p.

[22] Wreford, A., Ignaciuk, A., and Gruère, G. 2017. Overcoming barriers to the adoption of climate-friendly practices in agriculture. OECD Food, Agriculture and Fisheries Papers. No. 101, OECD Publishing, Paris. DOI: 10.1787/97767de8-en

[23] CCCCC, NCCO, MNRA, 2014. A National Adaptation Strategy to Address Climate Change in the Agriculture Sector in Belize. Belmopan, Belize.

[24] Ministry of Agriculture, Forestry, Fisheries, the Environment and Sustainable Development and Immigration (MAFFESDI). 2015. The National Agricultural and Food Policy of Belize (2015–2030) Agriculture – Bedrock of the Economy. Belmopan, Belize. Available at: http://med.ict.gov.bz/wp-content/uploads/2016/10/

[25] Townsend, R., Ronchi, L., Brett, C., and Moses, G. 2018. Future of Food : Maximizing Finance for Development in Agricultural Value Chains. World Bank, Washington, DC.

The document was prepared under the co-leadership of Andrew Jarvis (CIAT, CCAFS), Ana María Loboguerrero (CIAT-CCAFS), Miguel Lizarazo (CIAT-CCAFS), Sebastian Grey (CIAT), Armando Martínez (CIAT), and Evan Girvetz (CIAT).

Main authors (in alphabetical order): Alfred Serano (independent consultant), Michael Morris (WB), Miguel Lizarazo (CIAT-CCAFS) and, Victoriano Pascual (MAFFESDI)

Editors: Bill Hardy (independent editor) and Victoria Rengifo (CIAT)

Original graphics: Fernanda Rubiano (independent consultant)

Design and layout: Fernanda Rubiano (independent consultant)

This document should be cited as:

CIAT; World Bank. 2018. Climate-Smart Agriculture in Belize: Identifying Investment Priorities. International Center for Tropical Agriculture (CIAT); World Bank, Washington, D.C. 16 p.

Acknowledgments

This document has benefited from comments received from Julia Navarro (World Bank).