Climate-Smart Agriculture in Belize

Climate-smart agriculture (CSA) highlights

Agriculture in Belize is susceptible to weather variability and vulnerable to climate hazards, such as hurricanes, floods, and droughts. Weather variability caused by climate change will likely increase over time, potentially resulting in rainfall decreases ranging from about 7% in the northern zone to around 10% in the southern zone. The most detrimental effects on agriculture are likely to come from increased variability in the seasonal distribution of rainfall, which is expected to lead to more frequent droughts and floods. Additionally, projected rises in temperature of 1.3 °C by the 2030s will increase stress on crops and livestock, impacting agricultural systems, forcing changes in management practices, and threatening food production.

Climate-smart agriculture (CSA) practices have potential to deliver "triple wins" in contributing to Belize's agricultural development goals by sustainably increasing productivity, enhancing resilience, and reducing/removing greenhouse gases (GHGs). Promising crop-based CSA practices for Belize include the use of cover structures, installation of drip irrigation systems, application of nutrients through irrigation water (fertigation), use of water-harvesting techniques, adjustment of planting dates to match rainfall patterns, crop rotation, intercropping, planting of agroforestry systems, and adoption of drought- and heat-tolerant varieties. For livestock, promising CSA practices include the adoption of improved animal breeds, improvement of pastures, and use of hay and silage for livestock production, among others.

Many farmers in Belize are already using CSA measures to some degree. However, more widespread adoption of many CSA technologies has been hindered by a lack of information and technical knowledge, as well as the scarcity 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.

Mainstreaming CSA into national policies and programs requires systematic identification of technically effective, financially profitable, and environmentally sustainable CSA practices, careful diagnosis of barriers to adoption, evaluation of strategies for overcoming those barriers, and ensuring the presence of institutional and financial enablers. This Country Profile provides a snapshot of a set of promising CSA practices, assesses their climate-smartness taking into account a range of potential hazards, identifies organizations currently working to promote CSA in Belize and policies under implementation, and discusses possible sources of financing needed to implement CSA at scale.

A Adaptation | M Mitigation | P Productivity | I Institutions | $ Finance

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.

Climate-smart agriculture (CSA) is agriculture that has been transformed and reoriented to support development and ensure food security in the face of climate change. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and farmers' incomes, adapting and building resilience to climate change, and reducing and/or removing greenhouse gas emissions[4]. The CSA approach can help to identify and address synergies and trade-offs involved in pursuing the three objectives by addressing the environmental, social, and economic dimensions of sustainable development across agricultural landscapes. The approach helps to align the needs and priorities of different stakeholders to achieve more resilient, equitable, and sustainable food systems.

In Belize, CSA is understood to be agriculture that sustainably increases productivity and incomes, improves the ability of producers to adapt to climate change and build community resilience, and enhances food and nutrition security, while achieving mitigation co-benefits in line with national development priorities. While the CSA concept is still evolving, many of the practices and technologies that make up CSA already exist worldwide and are being used successfully [5]. Mainstreaming CSA in Belize will require systematic identification of locally effective CSA practices, diagnosis of barriers to adoption of those practices, evaluation of strategies to overcome the barriers, and ensuring the presence of institutional and financial enablers.

This CSA Country Profile describes the risks posed by climate change to agriculture in Belize, discusses the potential of CSA to mitigate those risks, identifies factors that can influence adoption of CSA practices, and points to potential entry points for investing in CSA at scale.

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National context

Economic relevance of agriculture

Agriculture is critical to Belize's development. It is a major source of growth, employment, foreign exchange earnings, and food and nutrition security. The agricultural sector is important both economically and socially. During 2011–2015, agriculture contributed 15% of GDP on average, with exports of approximately US$ 232 million per year [6, 10]. The leading agricultural exports were sugar (23% of agricultural exports by value), orange concentrate (21%), banana (20%), papayas (4%), and animal feed (3%). By contrast, agricultural imports were very modest, averaging only US$ 15 million per year during the same period. The leading agricultural imports included wheat, corn (mainly corn flour), malt, potatoes and rice. In addition, live cattle were imported as breeding stock, and specialty cuts of meat were imported for the tourism market. [7,10].

The 2015 National Adaptation Strategy to Address Climate Change in the Agriculture Sector in Belize (NAS) highlights that Belize is self-sufficient in staples (rice, corn, beans, and livestock products), as well as in seasonally available vegetables and fruits. As history has shown, however, the agriculture sector has often been significantly affected by climate-related natural disasters. During 2000-2016, agricultural losses due to hurricanes and tropical storms totaled more than US$ 232 million [8]. In February 2018 alone, losses to the sector from excessive rain and flooding amounted to US$ 1.9 million [9]. Looking ahead, therefore, food production and food security should not be taken for granted.

The population of Belize is estimated at approximately 387,800 inhabitants (2017 data), 55% of whom reside in rural areas [10]. According to the 2011 agriculture census, the most recent source of reliable information about the rural economy, 19,236 people identified themselves as farmers [11]. Of these, about one-quarter (24%) owned fewer than 5 acres; one-third (33%) owned between 5 and 20 acres; and the remaining two-fifths (43%) owned more than 20 acres [12].

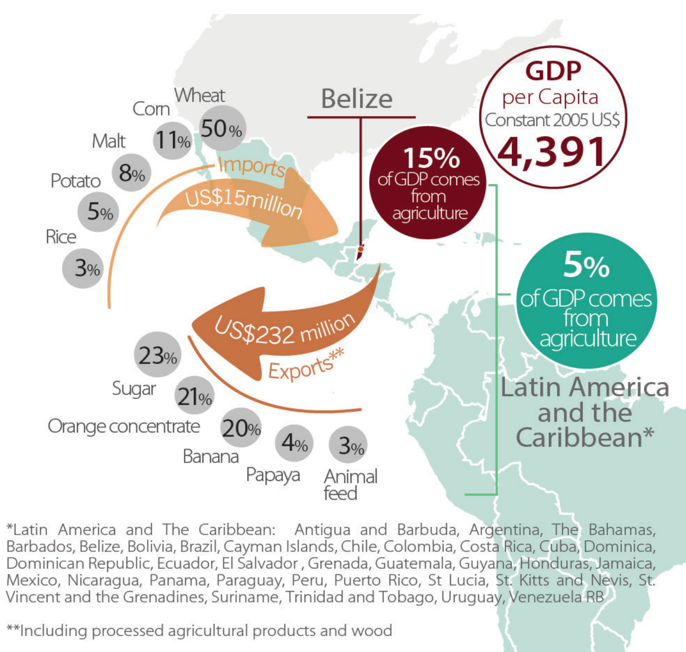
Toledo District contains 25% of all farms in Belize, with a high concentration of small farms (77% below 20 acres). Orange Walk District is next with 22% of all farms, followed by Corozal with 21% of all farms [12].

Agricultural production systems in Belize are quite diverse. Approximately 92,000 acres are planted to sugarcane, 48,000 acres to citrus, and 48,500 acres to corn [13]. Additionally, 351,700 acres in pastures are grazed by approximately 135,400 head of cattle [14].

Crops considered staples (corn, beans, and vegetables) are produced in all districts throughout the country using various practices, ranging from subsistence-oriented shifting cultivation ("milpa") to fully mechanized commercial operations.

Approximately 23,400 people (16% of the labor force) are employed in agriculture. Of that total, 9.4% are women, working mainly in the agro-processing sector [15]. Male labor is concentrated in the main traditional crops.

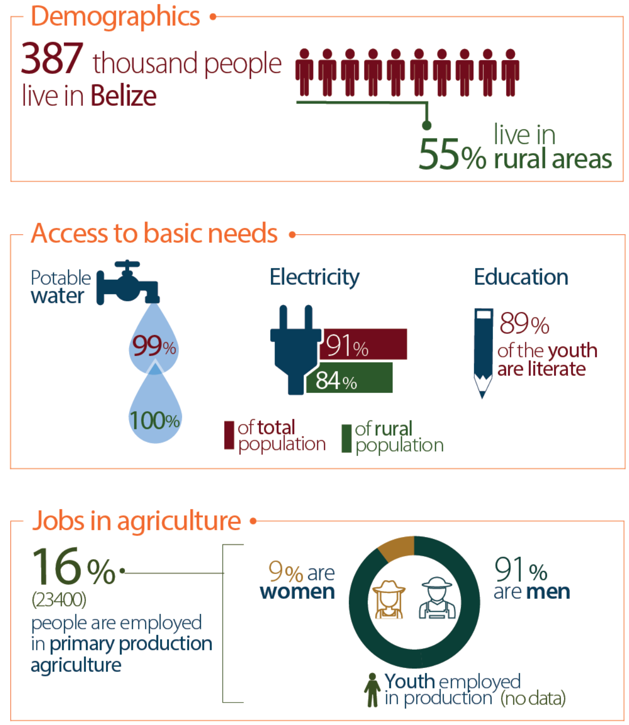
Economic relevance of agriculture in Belize [6, 7, 10, 16]

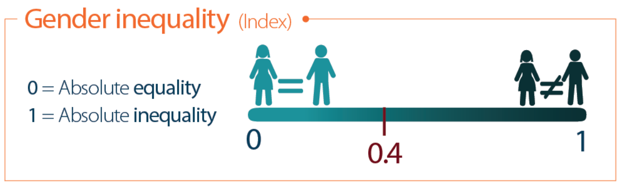


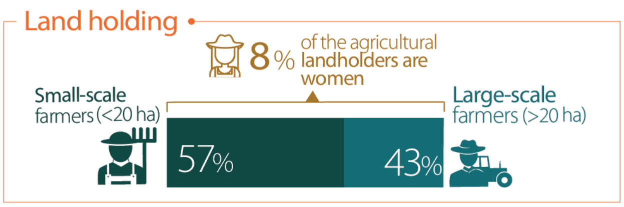
*Latin America and The Caribbean: Antigua and Barbuda, Argentina, The Bahamas, Barbados, Belize, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador , Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, St Lucia, St. Kitts and Nevis, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela RB

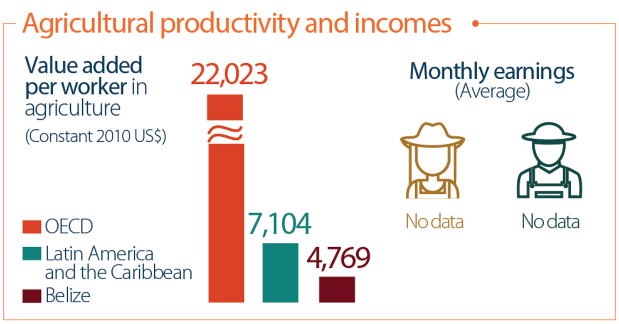
**Including processed agricultural products and wood

People, agriculture, and livelihoods in Belize [7, 10, 15, 16, 17]









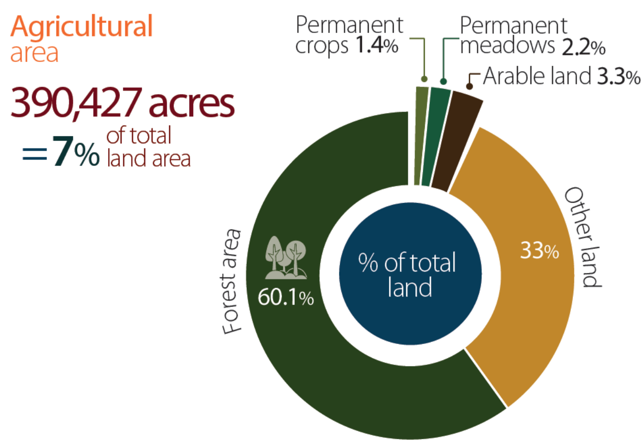
Land use

Belize comprises an area of 5,676,011 acres. Approximately 1,977,000 acres (about 38% of the land area) are suitable for agriculture. Only 390,427 acres (7% of the total land area) are actively being used for agriculture. Of the total land area, 1.4% is planted to permanent crops, 2.2% consists of permanent meadows, and 3.3% is arable land [7].

Belize's land is classified into five grades, based on the land's potential for use and limitations. Grade 1 and Grade 2 land, together covering about 16% of the country's land area, is suitable for mechanized agriculture and can be used for cultivating most food and cash crops, including citrus, banana, and sugarcane. Grade 3 land, covering about 20% of the country's land area, requires substantial investment to generate acceptable returns and can be used for smallholder development. Grade 4 land, which also covers about 20% of the country's land area, is marginal land that can be used for the production of forest and plantation crops. Grade 5 land, covering about 44% of the country's land area, is extremely marginal for agriculture and is mostly covered by forest. Grade 4 and Grade 5 land is prone to erosion due to its uneven topography. Cultivation of these two grades is discouraged, because it increases runoff, reduces groundwater replenishment, and leads to degradation [18].

With nearly two-thirds of the national land area classified as Grade 4 or Grade 5, Belize is extremely vulnerable to land degradation. In Belize as in other countries, land degradation is caused mainly by anthropogenic drivers, especially the expansion of the agricultural frontier through deforestation combined with the use of unsustainable crop and livestock production practices. Climate change is likely to amplify the forces driving land degradation, in several ways. Sea level rise will lead to more extensive saltwater intrusions, resulting in salinization of low-lying lands that will reduce their ability to support agriculture. Meanwhile, changes in temperatures and precipitation patterns could promote the appearance of invasive species of plants, animals, insects, and pathogens that could similarly reduce the ability of some lands to support agriculture. As a result, pressure will increase to meet the growing demand for food by ever more intensively cultivating existing agricultural land and by expanding production into marginal lands that are ill-suited for sustaining agriculture.

Land use in Belize [7]



Agricultural production systems

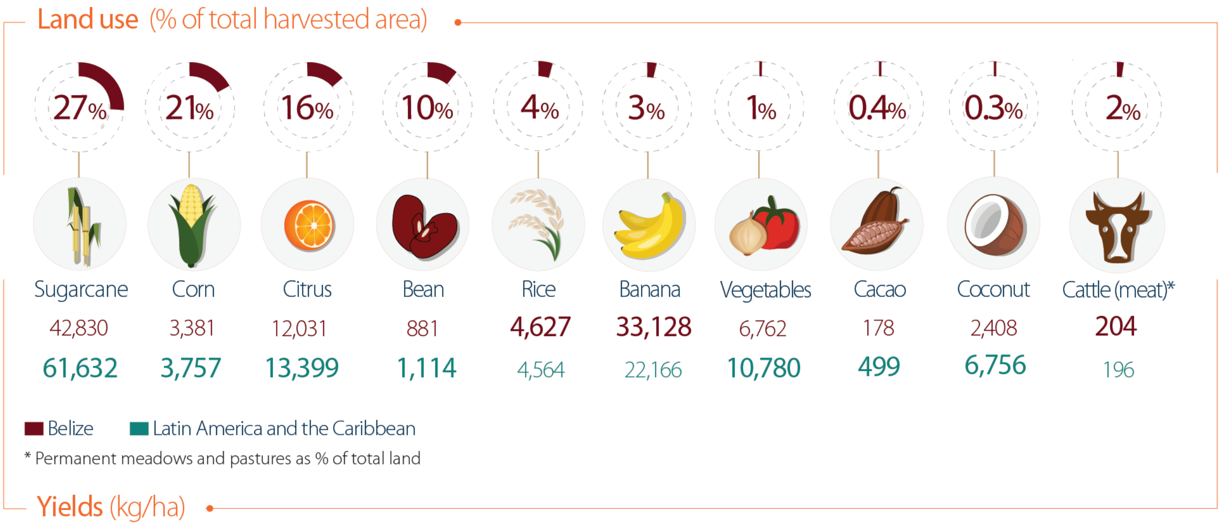
Belize is divided into six administrative districts. For agricultural purposes, four agro-climatic zones or areas are distinguished:

1) Northern Zone (Corozal and Orange Walk districts), 2) Central Coastal Zone (Belize District), 3) Central Inland Zone (Cayo District), 4) Southern Zone (Stann Creek and Toledo districts) [19].

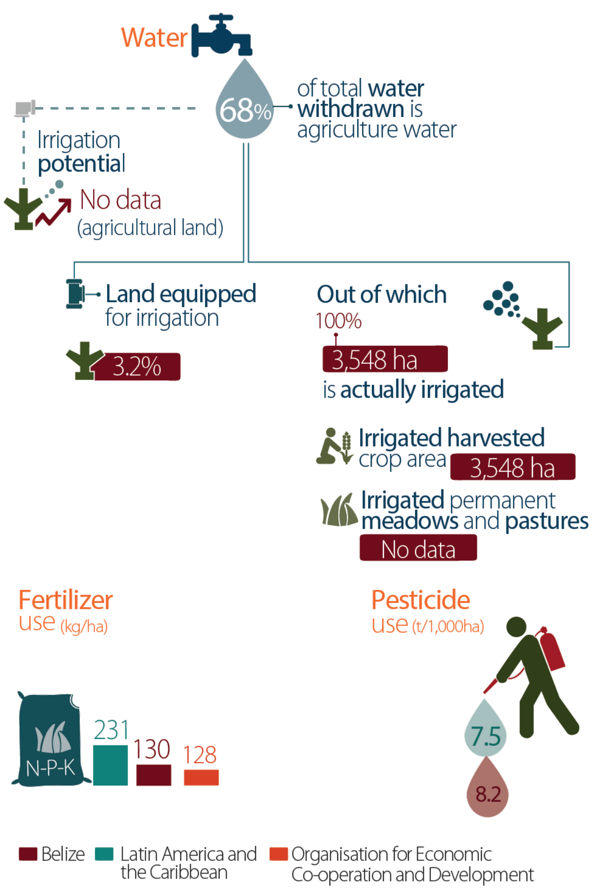
Agriculture in Belize is characterized by three main subsectors: (a) a well-organized export-oriented commercial subsector specializing mainly in banana, citrus, and sugar; (b) a highly diverse, subsistence-oriented smallholder subsector producing a wide range of food crops, especially vegetables, mainly for local consumption; and (c) a vertically-integrated large-scale commercial subsector (dominated by Mennonites) producing cereals and livestock products for both local and export markets [20].

Agricultural policies in Belize have generally used market-led strategies in seeking to increase diversification and achieve self-sufficiency in food products. They have been successful in expanding the food crops and livestock subsectors and in promoting the development of non-traditional export crops. A notable success has been the development of the Habanero pepper industry; Habanero peppers are grown for processing into hot sauces destined for both the domestic and export markets [20].

Production systems of importance to food security in Belize [7]



Agricultural input use in Belize [7, 16, 21]



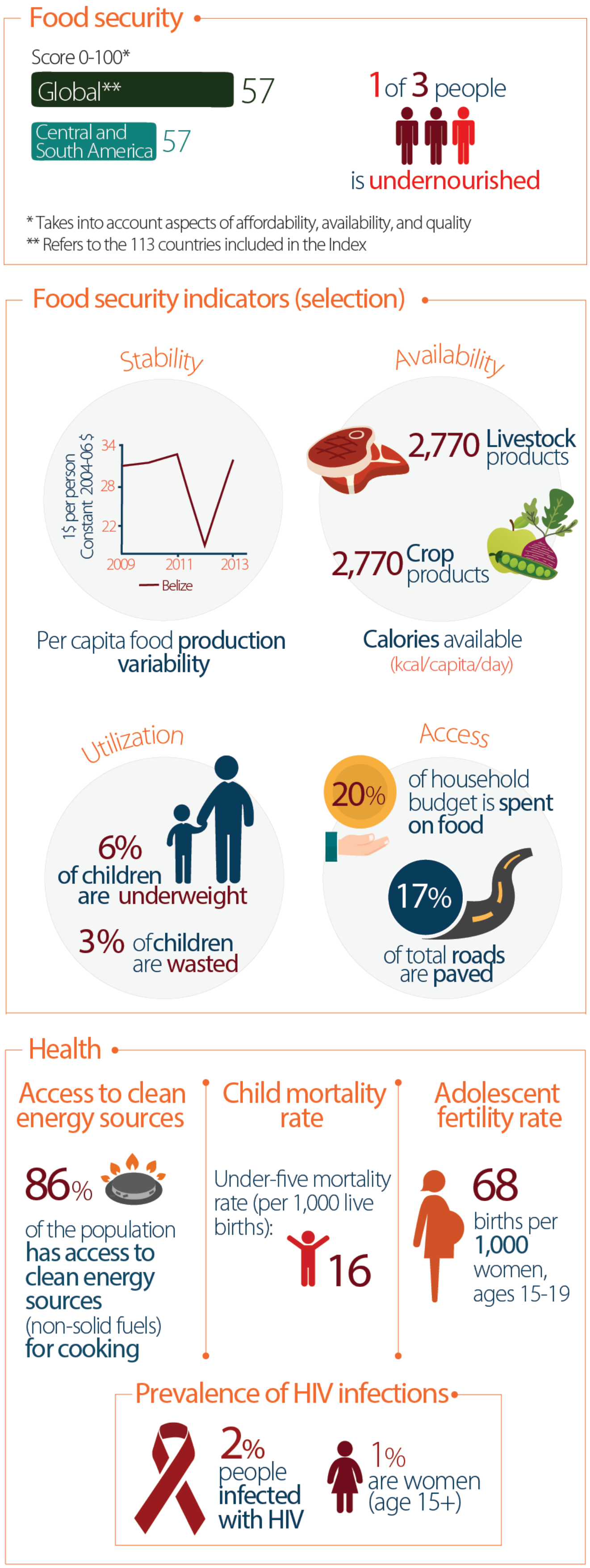
Food security and nutrition

Despite being self-sufficient in basic grains, livestock, and many vegetables and fruits, Belize continues to suffer from high levels of poverty.

The 2009 Country Poverty Assessment for Belize carried out by the World Bank shows that the share of the population living below the poverty line increased from 34% in 2002 to 41% in 2009, and the share of households living below the poverty line increased from 25% in 2002 to 31% in 2009. Rural poverty stands at 43%, with the ranks of the poor dominated by smallholder farmers and agricultural workers [22]. Despite the nation being considered self-sufficient in staples, food insecurity and malnutrition remain persistent threats, as reflected by an under-five mortality rate of 16.3 deaths per 1,000 live births. Undernourishment is present among children in Belize: 6% of all children are underweight, and 3% suffer from wasting [6].

Health problems common to Belizeans above 30 years include obesity and related noncommunicable diseases such as diabetes, hypertension, stroke, and heart diseases. Many of these problems have been exacerbated by dietary and epidemiological shifts resulting from changing food consumption patterns [23]. This can be attributed to high food costs, inflated in some cases by border taxes and other measures imposed on imported agricultural and food products. The increase in the average cost of living during 2007–2014 was 6.8%, while the increase in the cost of the food basket (which represents 21% of the total CPI) was 32.5%. High food prices substantially affect lower income consumers, who spend a larger portion of their income on food [24].

Food security, nutrition, and health in Belize [7, 16, 25, 26, 27, 28]



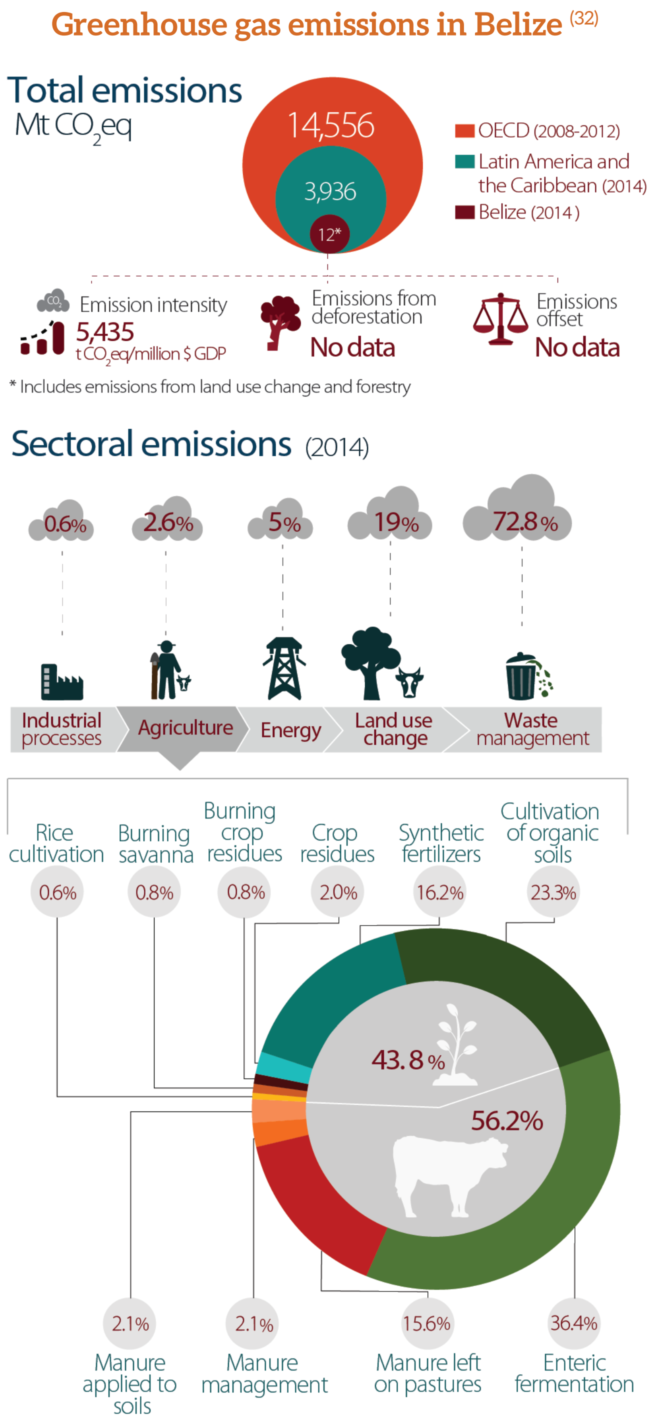
Agricultural greenhouse gas emissions

Compared to many other countries, in Belize the contribution of agriculture to greenhouse gas (GHG) emissions is quite modest. In 2014, agriculture accounted for only about 3% of the country's total GHG emissions. Of that total, livestock were responsible for 56.2% and crops for 43.8%.

The main sources of GHG emissions in the country are waste management/burning of garbage (responsible for 73% of emissions), land-use change (19%), and energy and industrial processes (5% and 0.6%, respectively) [29].

Belize has moderately low CO_2 intensity (5,435 tons CO_2eq/ million US$ of GDP). Its annual CO_2 footprint is among the lowest in the world. About 0.54 million metric tons (MMt) of CO_2 were released in 2011, ranking Belize 182nd among 216 countries. With per capita CO_2 emissions of 1.67 MMt per year, its CO_2 intensity (kg per unit GDP 2005 PPP $) is 0.18, which is lower than the average of 0.47 for its income group, the upper middle income countries. Regarding the trend, total CO_2 emissions decreased by 45% during 2010–2011. Over the past five years, total CO_2 emissions have decreased by 45%, and, over the last decade, total CO_2 emissions have fallen by 38% [30]. CO_2 emissions for the country in 2014 were 12.08 Mt, a tiny fraction of the Latin America and the Caribbean total of 3,936 MMt.

In the Nationally Determined Contributions submitted to the United Nations Framework Convention on Climate Change (UNFCCC), Belize's sectoral mitigation potential is estimated assuming an action-based approach that depends on the availability of cost-effective technology, strong implementation capacity, and adequate financial support [31]. Practices that would potentially reduce GHG emissions in the agricultural sector include capturing carbon (for example, by increasing tree cover in crop and livestock systems) and reducing soil disturbance (for example, by scaling up use of conservation tillage) [31].



Challenges for the agricultural sector

At the national level, Belizean agriculture faces multiple challenges. On the demand side, a number of preferential export markets have been lost since 2000 (e.g., sugar, banana, papaya), and rapidly evolving consumer preferences require vastly increased attention to product mix, quality standards, and timeliness of delivery [33]. Many farmers are struggling to keep up with these changes in demand, constrained by lack of knowledge, technology, productive assets, and/or finance.

Meanwhile, on the supply side, climate change poses an increasing threat that is likely to manifest itself in the coming years in the form of ever more extreme weather events. In recent years, a number of initiatives based on the CSA approach have been launched in Belize to address the challenges affecting the agricultural sector due to climate change. Policies have been enacted to promote sustainable agriculture and to encourage adoption of risk management strategies that can mitigate the effects of climate change, and practices have been introduced for the sustainable management of natural resources. Such practices include the use of cover structures, which significantly reduce the carbon footprint of agriculture by increasing fertilizer use efficiency and reducing pesticide use. Other practices that can help to mitigate GHG emissions include agro-forestry, conservation tillage, and alley cropping using Inga trees (*Inga* spp.).

Many options are available to enhance the productivity, competitiveness, and viability of Belizean agriculture in the face of climate change [33]. It is essential that the government foster an enabling environment for CSA by strengthening all stages of the agricultural value chain: input supply, primary production, harvesting, transportation, storage, processing, packaging, and wholesale and retail distribution.

Senior officials in the Ministry of Agriculture, Forestry, Fisheries, the Environment and Sustainable Development and Immigration (MAFFESDI) have highlighted the need for adequate drainage and irrigation systems, a disaster recovery action plan, as well as the need for financing and commodity insurance for the sector. In addition, improvements in post-harvest management activities, especially storage, could help to overcome the constraints that limit the expansion of the agricultural sector and reduce expected returns on private sector agricultural investments.

A comprehensive, multi-faceted approach is needed to make CSA successful in Belize. The National Agriculture and Food Policy of Belize 2015–2030 identifies five actions that can play a vital role in advancing the CSA agenda:

(1) Adopting innovative approaches to develop efficient small-farm production systems.

(2) Developing new approaches to financing agriculture.

(3) Improving the incentive system to attract both local and foreign investment.

(4) Simplifying regulations and bureaucratic procedures to reduce the costs of doing business.

(5) Investing in support services and basic infrastructure [34].

If the Government of Belize (GOB) is to realize its commitments made under the Growth and Sustainable Development Strategy (GSDS) to reduce poverty while increasing the productivity and competitiveness of the agricultural sector, it will have to do several things [35].

First, it will have to strengthen the capacity of agricultural research, development, and extension services to conduct relevant adaptive research and development activities and to provide sound technical assistance and technology transfer to the agricultural community. Second, it will have to strengthen information systems to allow for evidence-based decision-making on climate change adaptation and mitigation. Third, it will have to establish a national CSA coordination mechanism to support knowledge sharing, avoid overlapping work, and add value to ongoing work.

Agriculture and climate change

Belize is vulnerable to the effects of climate change. The country's geographic location leaves it exposed to the risk of rising sea levels and more frequent and more intense tropical storms, both of which lead to flooding that frequently results in human and material losses, including substantial losses within the agricultural sector [36]. Smallholder farmers, many of whom do not have any kind of insurance to protect against weather-related risks, are most vulnerable and stand to suffer the most.

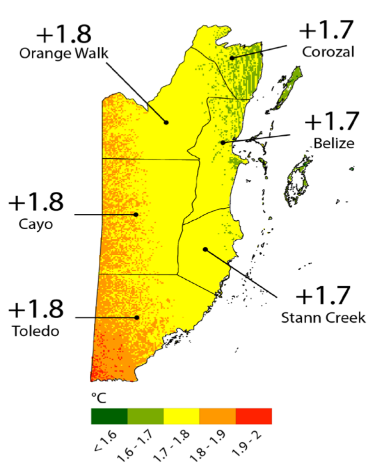
Climate change is already affecting agricultural production and productivity in Belize. Mean annual temperatures have increased at an average rate of 0.10°C per decade since 1960, and as a result today there are nearly 70 more hot days or hot nights each year compared to 1960. Also since 1960, mean annual rainfall has decreased at an average rate of 3.1 mm per decade, although this trend is not statistically significant [37].

The effects of climate change are projected to intensify in future. Climate projections for Belize suggest that temperatures could rise 1.3 °C by the 2030s, 1.8 °C by 2050, and 2.1 °C by 2070. Climate models also show that rainfall is likely to decrease throughout the country, with decreases ranging from 7% in the northern zone to 10% in the southern zone [38, 39, 40].

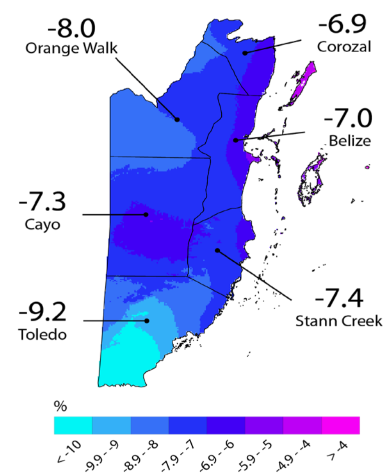
These changes in temperature and precipitation patterns will interact and produce effects that will severely impact crop and livestock production. The Intergovernmental Panel on Climate Change Coupled Model Intercomparison Project Phase 5 multi-model ensemble projects that severe drought likelihood will increase 0-67% by 2050 and 0-95% by 2100 compared to the historical baseline; the number of hot days will increase 19-87 days by 2050 and 83-196 days by 2100 compared to the historical baseline; and the daily probability of heat wave will increase 13-41% by 2050 and 35-75% by 2100 compared to the historical baseline [37].

Projected changes in temperature and precipitation in Belize by 2050 [38, 39, 40]

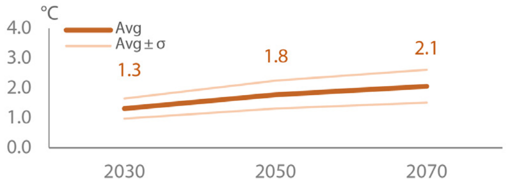
Changes in annual mean temperature (°C)



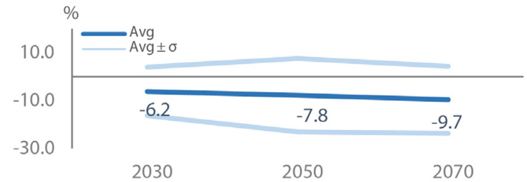
Changes in total precipitation (%)



Average temperature (°C)



Average precipitation (%)



Potential economic impacts of climate change

The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) developed by IFPRI [41] enables the assessment of future changes in yields, cropped area (or livestock numbers), and net trade under scenarios with and without climate change (CC and No-CC scenarios, respectively).

The IMPACT model shows that over the period 2020 to 2050, the area planted to beans, corn, and vegetables is likely to be smaller under the CC scenario than under the No-CC scenario. In contrast, the area planted to sugarcane, tropical fruits, rice, and banana is likely to be larger under the CC scenario than under the No-CC scenario.

The IMPACT model shows also that over the same period, while yields of most crops will continue to rise in absolute terms due to adoption of improved technology, the rate at which yields increase will be affected by climate change. For banana, beans, corn, rice, sugarcane, and vegetables, yields will continue to rise, but they are projected to be lower by 2.5 pp, 20.1 pp, 26.6 pp, 2.7 pp, 12.3 pp, and 8.5 pp, respectively, under the CC scenario as compared to the No-CC scenario. In contrast, yields of cacao and tropical fruits will decrease in absolute terms under both scenarios, with the decline being 7 pp and 6.8 pp greater under the CC scenario compared to the No-CC scenario).

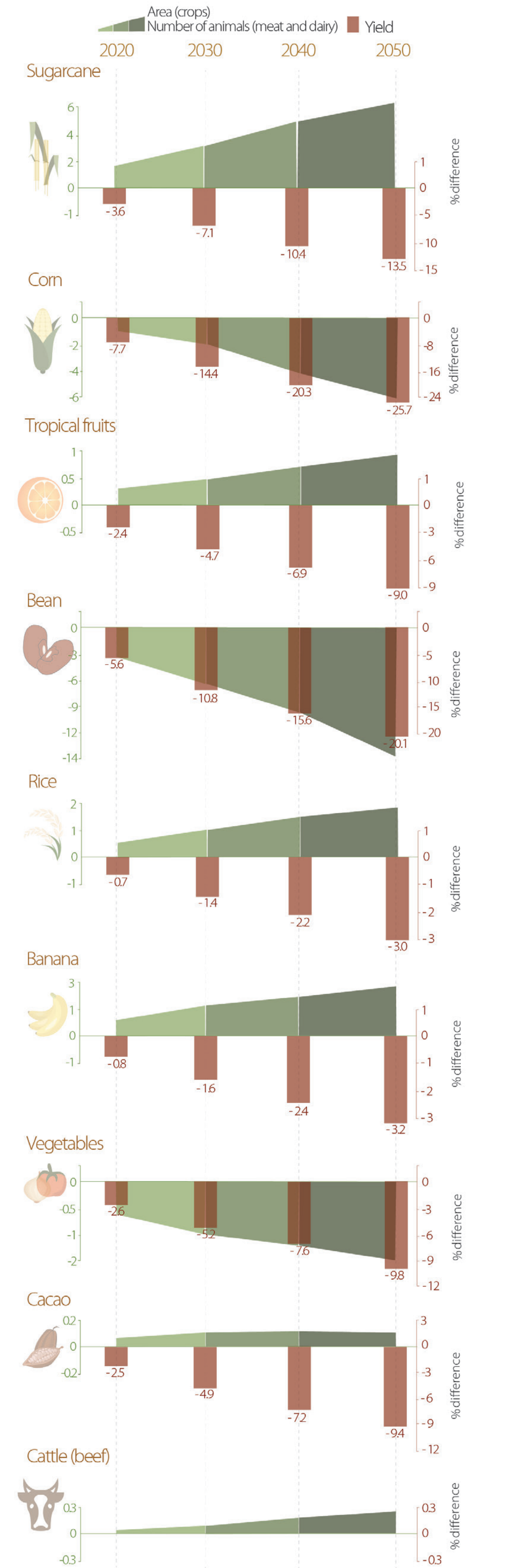
In the livestock sector, the impacts of climate change are projected to be modest. For example, the number of cattle is likely to increase by about 14% under both scenarios, with a very small positive net impact of only 0.26 pp between the No-CC and CC scenarios.

The projected changes in production caused by climate change are expected to affect Belize's trade balances. Climate change will likely cause imports of cattle, cacao, corn, and rice to go down, because for these commodities, productivity in Belize will increase compared to productivity in other countries and because local consumption patterns will evolve. On the other hand, imports of vegetables are likely to increase by 2 pp under the CC scenario compared to the No-CC scenario.

The anticipated changes in temperature and precipitation caused by climate change are expected to have differential impacts on the production of several export commodities that are important for foreign exchange. Exports of banana, beans, and tropical fruits are all projected to increase under both CC and No-CC scenarios. For beans and tropical fruits, exports will be 40.3 pp and 7.7 pp higher under the CC scenario compared to the No-CC scenario, but, in the case of banana, exports will be slightly lower (0.2 pp under the CC scenario compared to the No-CC scenario).

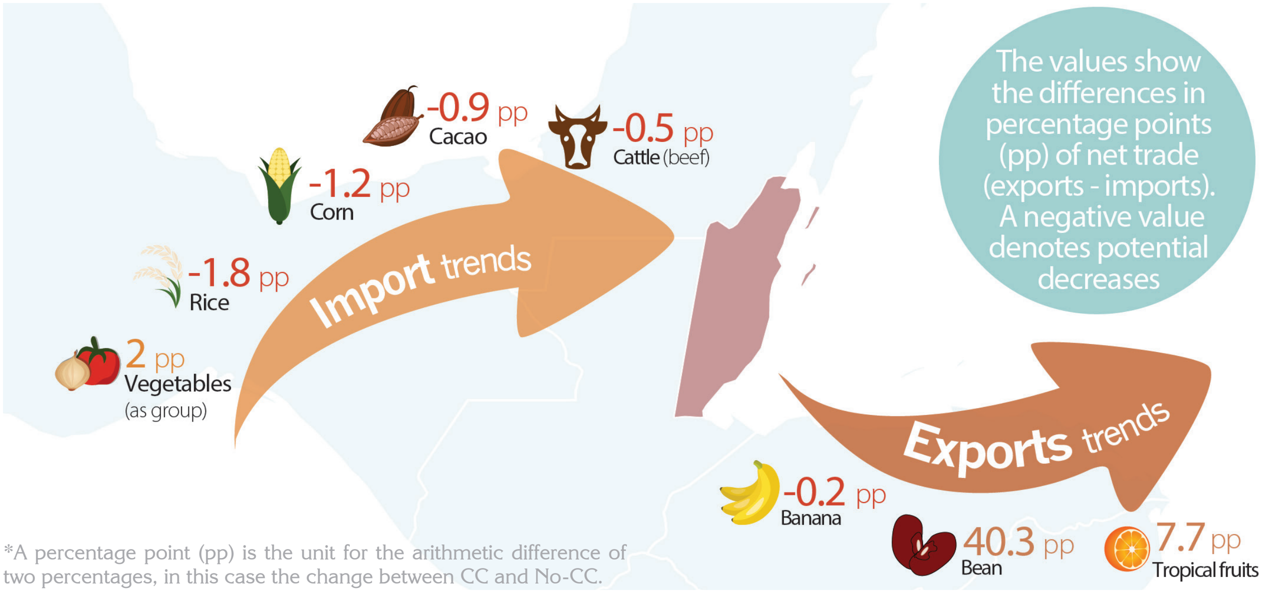
In view of the projected impacts of climate change on productivity, a vibrant research, development, and extension service is needed that can target commodities most at risk of being negatively affected, especially staple crops that are important for food security in the country.

Climate change impacts on yield, crop area, and livestock numbers in Belize [41]



*A negative value denotes potential decreases in area and yield expressed as percentage change in a climate change scenario vs. non climate change

The impact of climate change on net trade in Belize (2020–2050) [41]



CSA technologies and practices

Agricultural technologies and practices are considered CSA if they enhance food security while addressing at least one of the three other objectives of CSA (sustainably increasing agricultural productivity and farmers' incomes, adapting and building resilience to climate change, and reducing and/or removing greenhouse gas emissions).

In collaboration with its regional and international partners, the Ministry of Agriculture (MoA) has confirmed its commitment to enhancing farmers' resilience to climate change, and it has identified key entry points for future interventions. Priority areas include (i) sustainable production, productivity, and competitiveness; (ii) market development, access, and penetration; (iii) national food and nutrition security and enhanced rural livelihoods; and (iv) sustainable agriculture and risk management [42].

To address these priority areas, government agencies and NGOs have implemented several CSA-related initiatives. Promising CSA practices that are being promoted include construction of drainage and irrigation infrastructure, construction of cover structures, use of improved varieties and certified planting material, fertigation, crop rotation, intercropping, integrated soil and land management, and agroforestry. In the livestock sector, efforts are being made to promote the uptake of improved breeds, improvement of pastures, establishment of forage banks, adoption of forage conservation techniques, expansion of agro-forestry, and feeding with silage and hay.

Initiatives to promote farm-level adoption of CSA practices are being complemented by efforts to introduce early warning systems that can alert producers about impending climatic irregularities, allowing them to take defensive measures to reduce the risk of losses from weather-related shocks.

CSA practices such as those described above differ from the practices typically used for intensive mono-cropping, which often involve extensive soil disturbance, wasteful use of water, application of large amounts of agro-chemicals, and high consumption of energy. These so-called conventional practices can lead to soil fertility declines, water scarcity, on- and off-site pollution, and increased GHG emissions—effects that are likely to worsen in future as farmers compensate for increasingly challenging climatic conditions by ramping up input use.

CSA practices can be particularly important in slowing and reversing soil erosion and land degradation, because one of the most effective ways to increase the productivity and enhance to stability of crop and livestock production in the face of increasingly variable climatic conditions is to adopt soil and water conservation measures to increase vegetative cover, enhance soil water retention capacity, improve soil structure and soil health, and increase soil fertility.

The infographic on page 11 presents a selection of CSA practices with high climate smartness scores according to expert evaluations. The average climate smartness score is calculated based on the individual scores of the practices, on eight climate smartness dimensions that relate to the CSA pillars: yield (productivity); income, water, soil, and risks (adaptation); and energy and carbon and nitrogen (mitigation). A practice can have a negative/positive/zero impact on a selected CSA indicator, with 10 (+/–) indicating a 100% change (positive/negative) and 0 indicating no change (for details, see Annex 2).

The practices depicted in the infographic have been selected with the help of the CSA Prioritization Framework, using a participatory, multi-phase process to capture the experiences of a diverse set of national actors. The process uses workshops, interviews, surveys, and focus group discussions to ensure that the practices identified through a comprehensive literature review are well aligned with reality on the ground. Based on this comprehensive process and multiple criteria, an initial long list of CSA practices is distilled down into a set of "best-bet" CSA portfolios deemed to be the most promising for Belize [35, 43].

Case study: Building resilient communities in Belize through climate-smart agricultural practices [44]

Ya'axché Conservation Trust is a Belizean conservation organization founded in 1997, whose mission is to maintain a healthy environment with empowered communities by fostering sustainable livelihoods, protected area management, biodiversity conservation, and environmental education within the Maya Golden Landscape (MGL) of southern Belize. Ya'axché's geographic focus area, the MGL, is a 770,000-acre mosaic landscape of globally important protected areas, communities, private land, and state land covering a diverse range of ecosystems. Within this landscape, Ya'axché works with eight local communities made up of mostly Mopan and Q'eqchi Mayas and Hispanic members under its Community Outreach and Livelihoods (COL) program. This program focuses on empowering communities in conservation through environmental education; capacity building; training in leadership, governance, and micro-enterprises; and ongoing extension support to mentor farmers to implement sustainable agriculture.

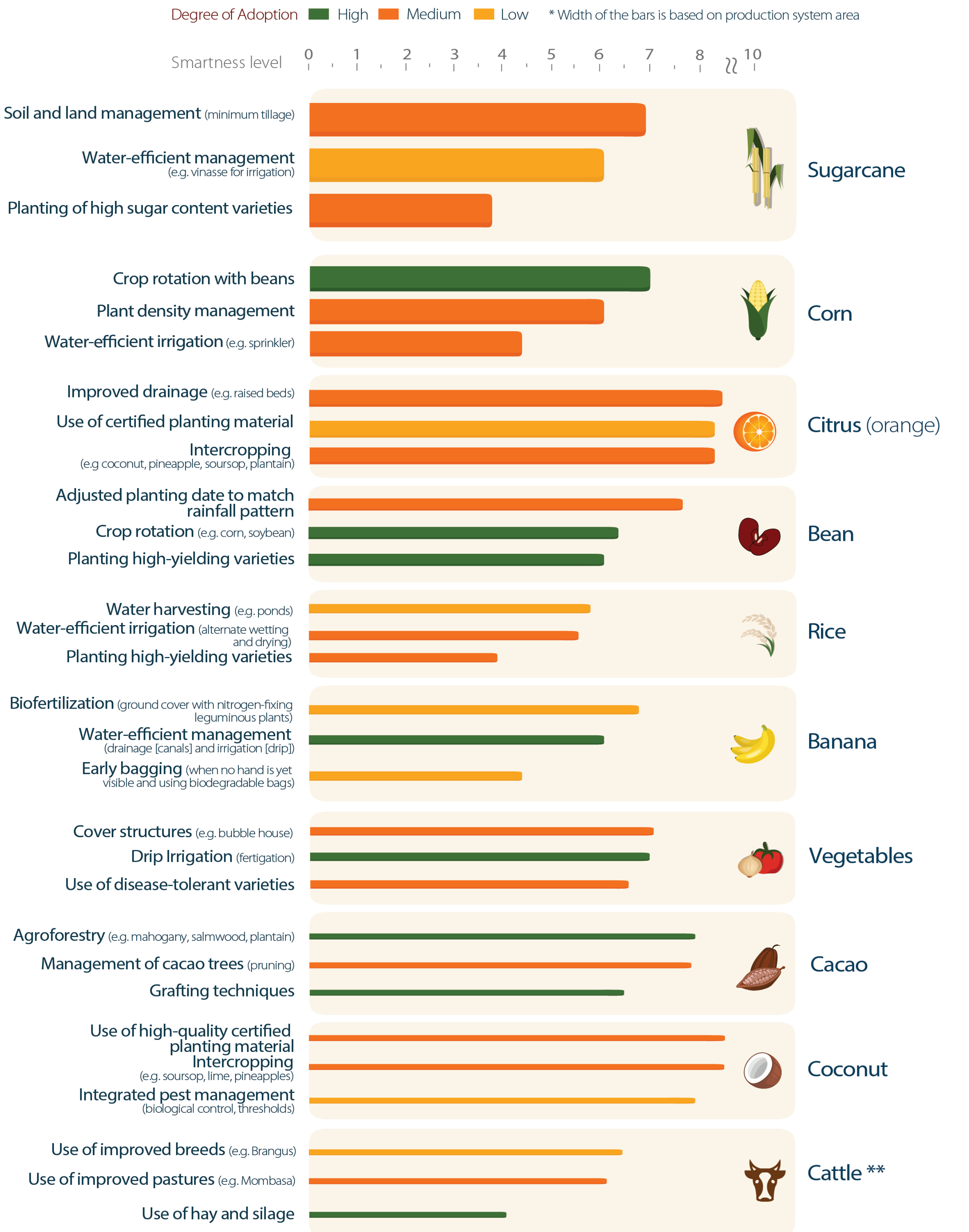
Ya'axché promotes the adoption of sustainable agricultural practices, namely, cacao agroforestry, Inga alley cropping (growing of crops between rows of Inga trees), and beekeeping with agroforestry, to improve the economic and food security of disadvantaged farmers and improve wildlife connections between fragmented forests. Farmers are provided with materials, equipment, training, and technical support to shift to environmentally friendly farming techniques. A one-acre demonstration plot of Inga alley cropping is located within a 936-acre community agroforestry concession land within the MGL. This plot is used to restore the degraded soil and as a platform in promoting peer-to-peer learning among farmers. Farmers learn from each other about agro-ecology and alternatives to conserving soil in this innovative way.

As of 2017, 31 farmers from the Trio Farmers Cacao Growers Association (TFCGA) had converted 18% of the concession land into cacao-based agroforestry farms. Here, farmers are engaged in the development of integrated farming systems with agroforestry and Inga alley cropping. These smart agriculture practices involve planting in rows and also integrating a variety of commodities such as bees, 58,000 cacao trees, 3,000 plantain trees, fruit trees, vegetables, corn, and timber, which are harvested at different intervals, resulting in short-, medium-, and long-term income for concession farmers. Projections thus far are that in 2019 more than 10,000 pounds of cacao will come from this area. In addition, each farmer will increase his/her concession area by planting an additional 4 acres of cacao, thereby using 31% of the concession area. Ya'axché's goal is to have the concession generate at least 75% of the income of participating farmers, which will benefit 175 individuals directly as well as the larger community indirectly.

Ya'axché has been instrumental in establishing the community agroforestry concession and supporting the development of the TFCGA governing board and its by-laws by seeking investments and providing technical and material support. The relationship between the two organizations is strong, and all decisions relating to the agroforestry concession are made through consultations by relevant Ya'axché staff and TFCGA members, led by their board of directors. The success of this community agroforestry concession is important not only to Ya'axché and TFCGA but also to the entire country since this model could be replicated in other forest reserves to engage communities in the management of natural resources and improving livelihoods.

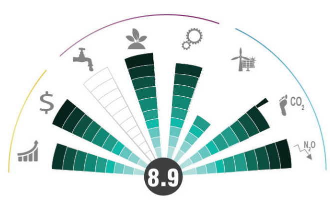
Photo: Maximiliano Caal- Ya'axche

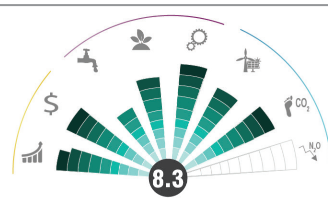
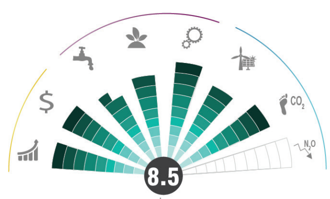
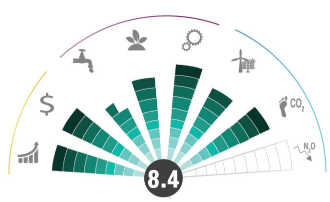
Selected CSA practices and technologies for production systems of importance to food security in Belize

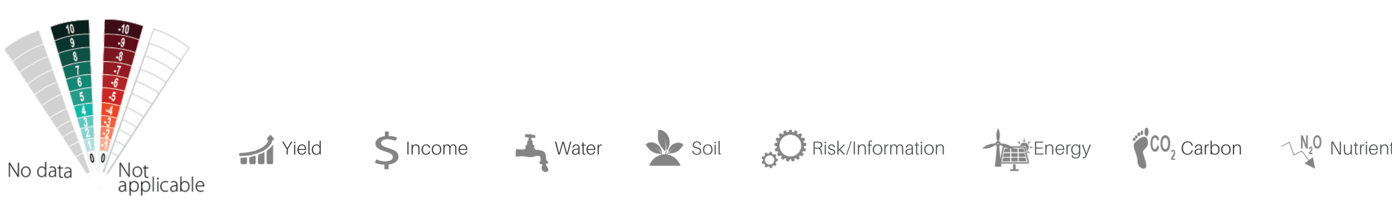


** Unidentified production system area

Table 1. Detailed smartness assessment for top ongoing CSA practices by production system as implemented in Belize.

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Sugarcane (27% of total harvested area)				
Soil and land management (minimum tillage)	Northern <30%	L		**Productivity** Medium- to long-term increases in yield. Reduces production costs. **Adaptation** Minimizes erosion and nutrient losses through leaching. Conserves soil biota, structure, and in situ moisture. **Mitigation** Promotes soil carbon stocks and organic matter accumulation. Reduces GHG emissions attributed to minimum soil disturbance and the use of fossil fuels.
	Western	L		
Water-efficient management/ reuse of waste water (e.g., vinasse for irrigation)	Northern <30%	L		**Productivity** Potential increases in yield due to increased soil fertility. **Adaptation** Increases efficient use of nutrients and water, therefore increasing resilience to drought. Reduces eutrophication of water bodies by giving alternative management to industry waste. **Mitigation** Integrated with fertigation and properly managed reduces use of synthetic fertilizers, thus reducing related GHG emissions.
	Western	L		
Corn (21% of total harvested area)				
Crop rotation with beans	Northern (Orange Walk) and Western (Cayo) >60%	S M L		**Productivity** Increases yield as a result of enhanced soil health and fertility. Reduces use of external inputs, hence reducing production costs and increasing farmers' income. **Adaptation** Enhances soil health, water retention, and long-term fertility. Minimizes soil erosion. Increases on-farm diversification. Reduces pest incidence. **Mitigation** Reduces use of nitrogen-based synthetic fertilizer when leguminous crops are introduced, thus reducing related GHG emissions.
	Western (Cayo) and Southern (Toledo) >60%	S M L		

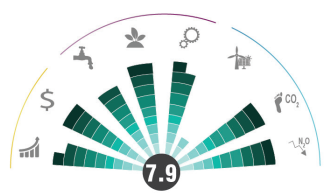
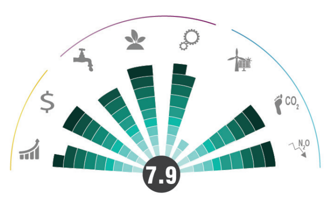
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Corn (21% of total harvested area)				
Plant density management	Northern (Orange Walk) and Western (Cayo) 30-60%	S M L		**Productivity** Increases production per unit area and income through greater product quality. **Adaptation** Reduces soil erosion. Promotes efficient use of water and nutrient cycling, hence long-term fertility. Enhances resilience to dry spells. **Mitigation** Reduces GHG emissions per unit of output. Maintains and/or improves soil carbon stocks and soil organic matter. Reduces use of energy per unit of product.
	Western (Cayo) and Southern (Toledo) 30-60%	S M L		
Citrus (16% of total harvested area)t				
Improved drainage (e.g., raised beds)	Southern 30-60%	L		**Productivity** Increases yield due to enhanced soil drainage. Higher income through greater product quality. **Adaptation** Promotes soil structure conservation and water infiltration. Reduces soil erosion. Reduces the risk of crop losses caused by temporary or permanent flood conditions. **Mitigation** Provides moderate reduction in GHG emissions per unit of food produced. Maintains or improves soil carbon stocks and organic matter content.
	Western >60%	L		
Intercropping (e.g., coconut, pineapple, soursop, plantain)	Southern <30%	L		**Productivity** Enhances production per unit area. Diversifies income and food sources. Allows constant production throughout the year. **Adaptation** Reduces soil erosion. Increases water and nutrient use efficiency per unit of output. Improves soil fertility. **Mitigation** Enhances above- and below-ground carbon sinks and organic matter content. Promotes energy use efficiency. Minimizes the use of synthetic fertilizers.
	Western <30%	M		

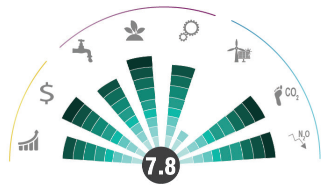
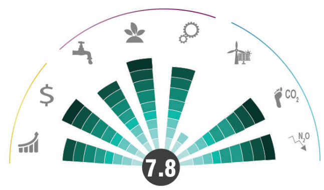
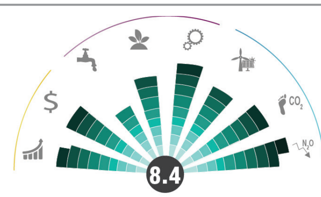
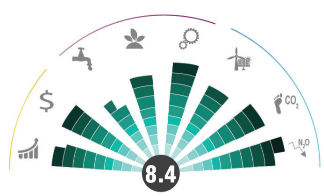


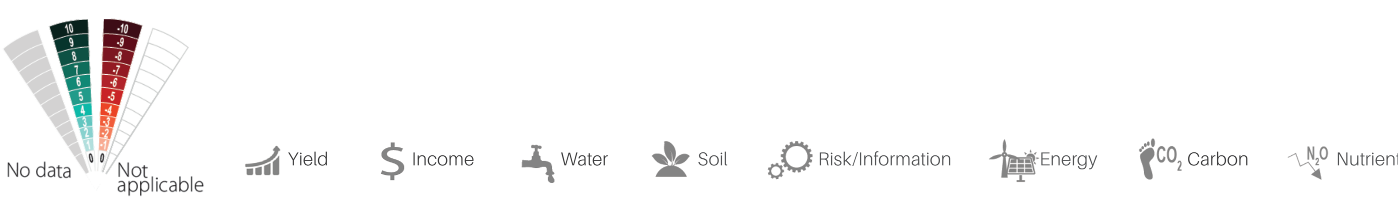
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Bean (10% of total harvested area)				
Adjusted planting date to match rainfall pattern	Western (Cayo) & Southern (Toledo) 30-60%	M		**Productivity** Increases land and crop productivity per unit of water. Increases food availability and income. **Adaptation** Increases farmers' capacity to limit crop exposure to climate risks. Reduces soil runoff and erosion during the rainy season. **Mitigation** Maintains or improves soil carbon stocks and organic matter content. Reduces GHG emissions attributed to synthetic fertilizer volatilization. Reduces energy needs for irrigation.
	Western (Cayo), Southern (Stann Creek), & Northern 30-60%	L		
Crop rotation (e.g., corn, soybean)	Western (Cayo) & Southern (Toledo) >60%	M		**Productivity** Increases crop yield stability throughout the year and produce quality, hence improving household income. **Adaptation** Because of crop diversitification, reduces the risk of total crop failure under climatic shocks. Reduces soil runoff and erosion and incidence of pests and diseases. **Mitigation** Promotes indirect reductions in GHG emissions in the medium and long term per unit of output. Legume rotation can reduce the use of synthetic nitrogen-based fertilizer.
	Western (Cayo), Southern (Stann Creek), & Northern >60%	L		
Rice (4% of total harvested area)				
Water harvesting (e.g., ponds)	Northern (Orange Walk) 30-60%	L		**Productivity** Increases yield and quality of produce. Allows constant production throughout the year. **Adaptation** Increases farmers' capacity to limit crop exposure to climate risks. Ensures water availability, therefore increasing resilience to drought. **Mitigation** Provides moderate reduction in GHG emissions per unit of food produced due to reductions in energy use.
	Western (Cayo) & Southern (Toledo) <30%	S L		

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Rice (4% of total harvested area)				
 Water-efficient irrigation (alternate wetting and drying)	Northern (Orange Walk) >60%	L		**Productivity** Increases productivity per unit area. Reduces irrigation costs. **Adaptation** Enhances nutrient and water use efficiency. Enables larger crop development even under limited water availability. Reduces runoff and erosion. **Mitigation** The shorter flooding period reduces methane emissions. Reduces fuel consumption needed for water pumping.
	Western (Cayo) & Southern (Toledo) 30-60%	S M L		
Banana (3% of total harvested area)t				
 Biofertilization (ground cover with nitrogen-fixing leguminous plants)	Southern <30%	M		**Productivity** Increases yield and household profit due to soil fertility restoration. **Adaptation** Promotes soil and water conservation. Reduces environmental pollution. Increases biodiversity in the soil as well as on the farm. **Mitigation** Reduces the need for nitrogen-based fertilizer application when inoculants are introduced. Reduces related GHG emissions.
	Southern (South Stann Creek and Northern Toledo) <30%	M		
 Water-efficient management (drainage [canals] and irrigation [drip])	Southern >60%	M L		**Productivity** Potential increases in crop yield and quality, hence greater farmer profits. Allows continuous production throughout the year. **Adaptation** Increases farmers' capacity to limit crop exposure to climate shocks (drought or flooding). Reduces soil erosion and incidence of pests and diseases. Increases employment for women and youth. **Mitigation** Reduces energy required for irrigation, hence reducing GHG emissions related to bumping and water transportation.
	Southern (South Stann Creek and Northern Toledo) >60%	M L		

No data Not applicable Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Vegetables (1% of total harvested area)				
 Cover structures (e.g., bubble house)	Northern region and west region 30-60%	M	 	**Productivity** Increases yield per unit area. Allows constant production throughout the year. **Adaptation** Reduces crop exposure to adverse climatic conditions. Enhances efficient use of water per unit of produce. Minimizes soil erosion and enhances pest and disease management. **Mitigation** The practice may contribute to reductions in GHG emissions by reduced energy use and GHG emissions per unit of food produced due to greater nutrient use efficiency.
	Northern 30-60%	M	 	
 Drip irrigation (fertigation)	Northern region and west region 30-60%	M	 	**Productivity** Increases productivity and income through greater product quantity and quality. **Adaptation** Increases farmers' capacity to limit crop exposure to drought. Increases water and nutrient use efficiency per unit of output. Reduces soil erosion. **Mitigation** Reduces use of synthetic fertilizers and energy for pumping, thus reducing related GHG emissions.
	Northern 30-60%	M	 	
Cacao (0.4% of total harvested area)				
 Agroforestry (e.g., mahogany, salmwood, plantain)	Southern >60%	S	 	**Productivity** Diversifies income sources. Increases productivity per unit area. Allows for year-round production. **Adaptation** Creates microclimate, hence promoting resilience in the face of dry spells. Increases soil fertility (bio-chemical and physical) and soil moisture. **Mitigation** Increases above- and below-ground biomass and carbon stocks. Reduces requirement for synthetic fertilizers.
	Southern (Stann Creek and Toledo) >60%	S	 	

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Cacao (0.4% of total harvested area)				
Management of cacao trees (pruning)	Southern 30-60%	S		**Productivity** Increases productivity by increasing flowering and fruiting. Greater income through greater product quality. **Adaptation** Reduces high humidity and fungus development. Promotes adequate plant development and architecture. Reduces competition for nutrients and soil erosion. **Mitigation** Maintains or improves soil organic matter content. Provides reduction in GHG emissions per unit of food produced.
	Southern (Stann Creek and Toledo) 30-60%	S		
Coconut (0.3% of total harvested area)t				
Intercropping (e.g., soursop, lime, pineapples)	Southern >60%	L		**Productivity** Increases total productivity per unit area. Allows constant production throughout the year. Multiple crop harvesting increases income and food availability. **Adaptation** Crop diversification reduces the risk of total crop failure under unfavorable biotic and climatic conditions. Contributes to soil fertility. Promotes nutritional diversity. **Mitigation** Maintains or improves above- and below-ground carbon stocks. Promotes efficient use of energy and related GHG emissions.
	Western (Cayo) & Northern (Orange Walk) <30%	L		
Use of high-quality certified planting material	Southern >60%	L		**Productivity** Increases crop production and quality, hence increasing income. **Adaptation** Reduces vulnerability to crop losses caused by pests and diseases. Enhances water use efficiency. Increases resilience to moisture stress and other adverse climatic conditions. **Mitigation** Reduces use of synthetic pesticides and/or fertilizers, thus reducing related GHG emissions and carbon footprint.
	Western (Cayo) & Northern (Orange Walk) 30-60%	M		



CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA pillars
Cattle (meat) (NA)				
Use of improved breeds (e.g., Brangus)	Southern <30%	L		**Productivity** Ensures animal quality and health, thereby increasing household profits. Reduces production cost per unit area. **Adaptation** Increases resilience to extreme climate conditions, without compromising animal production or quality. **Mitigation** Reduces fodder/forage required for attaining maximum yield, hence promoting indirect reductions in GHG emissions per unit of output.
	Northern and Western <30%	L		
Use of improved pastures (e.g., Mombasa)	Southern 30-60%	M		**Productivity** Increases animal yield and income through high-quality food. Reduces production costs, hence potential increases in income. **Adaptation** Provides alternative food source, decreasing vulnerability to drought and feed scarcity. Reduces the volume of medications used. Reduces pressure on natural resources. **Mitigation** Reduces GHG emissions (carbon footprint) due to higher stocking rates. High-quality feed reduces methane emissions from ruminants.
	Northern and Western 30-60%	M		

Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

Limitations

The CSA practices described here as "best-bet" clearly hold promise, but the list should not be considered definitive, for several reasons. To begin with, factors of potential policy relevance were not taken into account during the prioritization process. Very importantly, data were not available to allow systematic assessment of the extent to which the CSA practices are likely to have gendered impacts. In Belize as in most countries, men and women perform different roles in agriculture, so CSA practices are likely to have differential impacts on the two groups. For example, construction of an irrigation system is likely to require additional labor contributions by men during the construction phase (for digging canals and building water control structures) and additional labor contributions by women during the maintenance phase (for removing weeds from water courses).

It is important to recognize also that the results of any prioritization exercise reflect the judgments of those who participated in the prioritization process, and while in this case the participants represented a wide range of views, a different set of participants would likely produce a slightly different outcome.

Institutions and policies for CSA

What efforts are currently underway to promote the uptake of CSA practices? Many institutions are working on CSA-related initiatives in Belize. These include government, United Nations agencies, NGOs, the private sector, and farmers' organizations, among others. Their CSA-related work involves farmer capacity building through training activities and extension services, policy advocacy, and awareness raising.

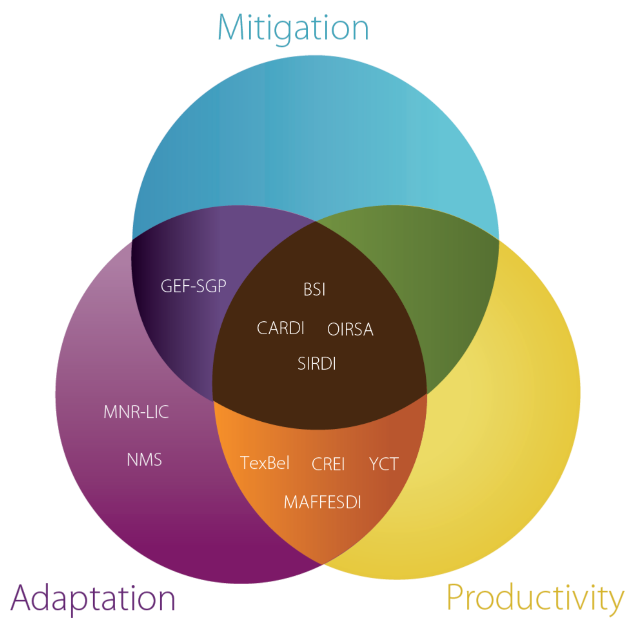
Institutions

MAFFESDI is the main government ministry working on CSA topics. The Ministry of Economic Development, Petroleum, Investment, Trade and Commerce (MEDPITC) is the National Authorizing Office (NAO) for all UN-funded projects, as well as the National Designated Authority (NDA) for the Green Climate Fund (GCF). Therefore it is a crucial player that must play a leading role in attracting and directing international climate finance for CSA in Belize. UN agencies working on CSA-related activities include the Food and Agriculture Organization (FAO), United Nations Development Programme (UNDP), International Fund for Agricultural Development (IFAD), and the Global Environment Facility – Small Grants Programme (GEF-SGP). Other UN agencies have been involved in broader agricultural climate change adaptation projects and programs. For example, UNDP supported the formulation of the National Climate Change Adaptation and Mitigation Strategy (ENAMMC) and the National Climate Change M&E Framework.

Other institutions involved in CSA in one way or another include local organizations such as Belize National Climate Change Office (BNCCO), Belize Enterprise for Sustainable Technology (BEST), Sugar Industry Research and Development Institute (SIRDI), Citrus Research and Education Institute (CREI), and Ya'axché Conservation Trust (YCT). YCT, with funding from various stakeholders including GEF-SGP, has an ongoing project titled "Promoting CSA for CC resilience, food security and landscape connectivity in Maya Golden Landscape of Belize," which focuses on productivity and adaptation.

The figure "Enabling institutions for CSA in Belize" highlights the key institutions whose main activities relate to one, two, or three CSA pillars (productivity, adaptation, mitigation). Few institutions are addressing all three pillars of CSA. On the other hand, most institutions are addressing productivity and adaptation, while almost no institution is tackling mitigation and adaptation exclusively. Opportunities therefore exist for synergies among institutions working on CSA-related activities, whereby joint effort can be made to align initiatives/projects to maximize the use of their resources to cover a broader scope and have greater impact.

Enabling institutions for CSA in Belize



BSI Belize Sugar Industries Limited **CARDI** Caribbean Agricultural Research and Development Institute **CREI** Citrus Research and Education Institute **GEF-SGP** Global Environment Facility – Small Grants Programme **MAFFESDI** Ministry of Agriculture, Fisheries, Forestry, the Environment, Sustainable Development and Immigration **MNR-LIC** Ministry of Natural Resources-Land Information Center **NMS** National Meteorological Service **OIRSA** International Regional Organization for Plant and Animal Health **SIRDI** Sugar Industry Research and Development Institute **TexBel** TexBel Agricultural Investments Ltd. **YCT** Ya'axché Conservation Trust

Policies

Belize has introduced numerous policies relating to climate change adaptation and/or mitigation. Belize ratified the UNFCCC in 1994 and the Kyoto Protocol in 2003. To date, it has submitted three national communications to the UNFCCC (2002, 2011, and 2016). These communications highlight the need for education, training, and public awareness with reference to the causes, impacts, and consequences of climate change.

The National Climate Change Policy, Strategy and Action Plan (NCCPSAP) 2015–2020 provides policy guidance for the development of an appropriate administrative and legislative framework, in harmony with other sectoral policies, for the pursuit of a low-carbon development path for Belize. In addition, the NCCPSAP seeks to encourage the development of the country's Nationally Determined Contribution (NDC) and to communicate it to the UNFCCC [45]. In October 2015, Belize submitted a new climate action plan to the UNFCCC, in advance of the new universal climate change agreement, known as the Paris Agreement, which was ratified on 4 November 2016 [46]. The 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 technological developments relevant to crop production, better soil management practices, diversification into drought-resistant crops and livestock, and farm production adaptations that include, but are not limited to, land use, land topography, and increasing use of low-water irrigation systems. The NDC, however, falls short of mentioning more specific practices in the agricultural sector to support agricultural adaptation and mitigation and more could be done to elaborate on the key practices along specific agricultural value chains to support practical financing and implementation of the NDC. A key issue is that the country's NDC and the action plans to address adaptation and mitigation will largely depend upon national circumstances, capacity, and support.

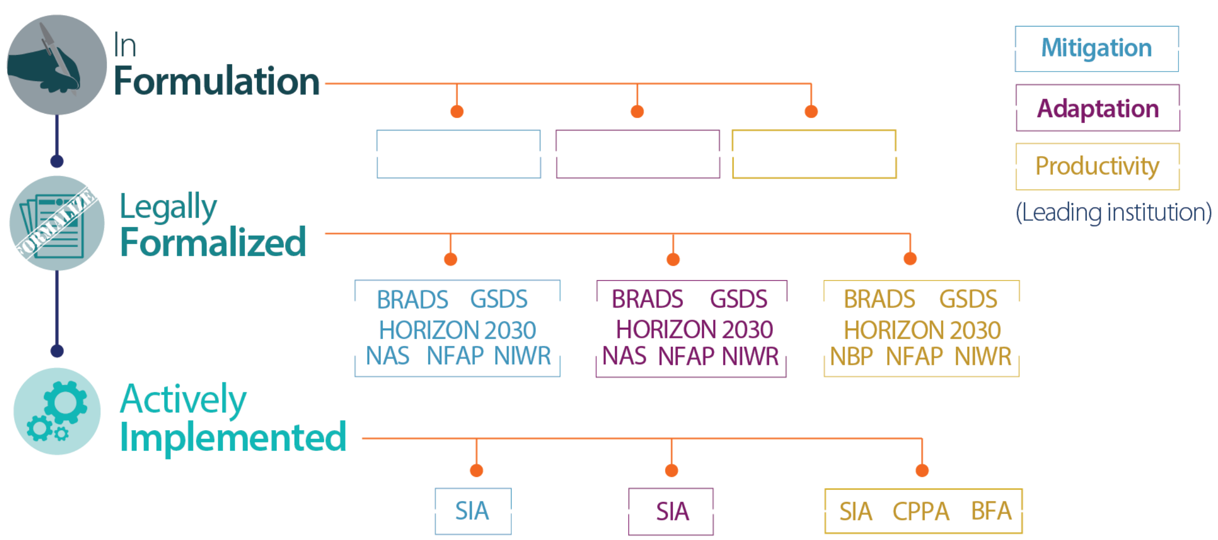
In addition to the policy initiatives being undertaken as part of Belize's commitment to global climate action, other policies and strategies are more internally focused, such as the National Adaptation Strategy (NAS) produced with help from the Caribbean Community Climate Change Centre (CCCCC), which is designed to protect Belizean producers from the detrimental effects of climate change. The NAS recommendations include both short- and long-term measures to address critical gaps in technological developments relevant to crop production, sustainable soil management practices, diversification into drought-resistant crops, and farm production adaptation measures such as increasing the use of water-efficient irrigation systems.

Concrete actions to promote CSA in Belize are still limited, but policies in the agriculture, environment, and forestry sectors have created an enabling environment that should prove favorable for future CSA-related initiatives. Intersectoral dialogue will be needed, however, to ensure that synergies can be realized and duplication avoided. In addition, investments will have to be made in strengthening human and institutional capacity, to support programming and eventual ground-level implementation of CSA interventions.

The figure "Enabling policy environment for CSA in Belize" shows a selection of policies, strategies, and programs related to agriculture and climate change that are considered key enablers for CSA adoption in the country. The figure distinguishes three main stages in the policy process: (1) **formulation** (policy is in an initial formulation stage/consultation process), (2) **formalization** (mechanisms are being put in place to enact the policy), and (3) **implementation** (activities under way, with visible progress toward achieving larger policy goals). For more information on the methodology, see Annex 3.

Currently in Belize, no major policies are being formulated relating to individual CSA pillars. Several policies have been formulated, however, whose objectives cut across the different pillars, such as the GSDS, NAS, and the National Food and Agricultural Policy (NFAP). The major barrier that seems to be affecting the implementation of those legally formalized policies is the lack of financing for the implementation of the laid-out policy actions, and coordination among relevant ministries. Still, attractive opportunities exist for coordination among all relevant stakeholders to assist in addressing and financing the implementation of those policies.

Enabling policy environment for CSA in Belize



BFA Belize Forest Act (1927, revised 2003) (FD) **BRADS** Belize Rural Area Development Strategy (2013) (Ministry of Rural Development) **CPPA** Citrus Production and Processing Act (2013) (CGA, MOA) **GSDS** Growth and Sustainable Development Strategy (2016) (MED) **HORIZON 2030** The National Development Framework of Belize (Horizon 2030) (2010) (MED) **NAS** National Adaptation Strategy to Address Climate Change in the Agriculture Sector in Belize (2015) (NCCO, CCCCC) **NBP** Moratorium for the Genetically Modified Organisms (Belize National Biosafety Policy) (2009) (BAHA) **NFAP** National Food and Agriculture Policy (2002-2020) (2003) (MOA-PU) **NIWR** National Integrated Water Resources Act (2014) (MNR) **SIA** Sugar Industry Act (2003) (SIB)

Financing CSA

What incentives exist for investing in CSA? How will the costs associated with scaling up CSA practices be financed? It is important to have answers to these questions, as they have major implications for the prospects of scaling up of CSA.

Economic analysis carried out as part of the prioritization exercise revealed that the investments needed to adopt CSA practices vary widely, as do the expected returns to those investments. Some CSA practices are relatively inexpensive and can be expected to generate attractive returns, very quickly suggesting that farmers will have the means and the incentives to finance them. But other CSA practices are relatively expensive and may take time to generate returns, suggesting that policy reforms and/or public investments may be needed to encourage implementation.

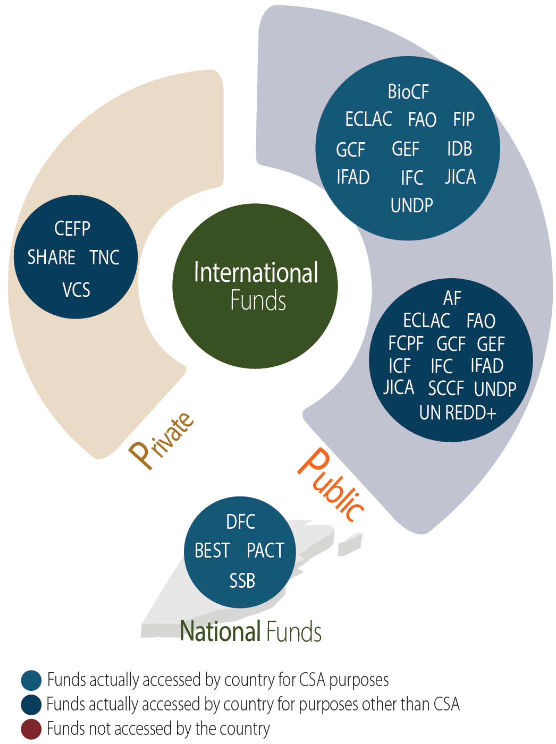
Belize's Third National Communication (TNC) to the UNFCCC highlighted that Belize's adaptation and mitigation goals are highly conditional on the availability of international technical and financial support. It further states that approximately US$ 13 million are required to diversify livestock, increase access to drought-resistant crops and livestock feed, adopt better soil management practices, and provide early warning/meteorological forecasts and related information to be competitive in the region [47].

Currently, several development partners are supporting climate action in the country. For example, a key source of climate finance for Belize is the Global Environment Facility (GEF), from which Belize has so far accessed an estimated amount of US$ 38.1 million for projects related to agriculture, forestry, and adaptation in coastal areas, focusing on climate change, land degradation, and biodiversity [48].

During 2015–2017, the Inter-American Development Bank (IDB) supported Belize through the Technical Cooperation Fund for CSA in the Agriculture and Rural Development and Environment and Natural Disasters Sectors, allocating US$ 3.23 million. These funds included the following: (i) Improving Livestock Sector Productivity and Climate Resilience in Belize; (ii) National Agricultural Statistics System (NASS) – Exchange of Experiences between Belize and Mexico; (iii) Strategic Planning to Strengthen Agricultural Trade and Food Safety; (iv) Creating a Sustainable Sugarcane Industry in Northern Belize; (v) Capacity-Building for Climate Vulnerability Reduction in Belize; and (vi) Preparation Support for Climate Vulnerability Reduction Program [49]. Additionally, UN agencies, such as UNDP, FAO, and IFAD, have been providing funds for agricultural climate change projects. One such project, funded by FAO and titled "Improved National and Local Capacities for Hurricane Related Disaster Mitigation, Preparedness and Response in the Agricultural Sector in Belize," focused on vulnerability and capacity assessment, and training needs assessment and technical assistance to farmers in selected villages.

Foreign direct investment in Belize's agricultural sector has been growing. This is encouraging, but more effort is needed to ensure that a larger share of foreign investment goes to support CSA practices in smallholder value chains.

Financing opportunities for CSA in Belize



AF Adaptation Fund **BEST** Belize Enterprise for Sustainable Technology **BioCF** World Bank BioCarbon Fund **CEFP** Critical Ecosystem Partnership Fund **DFC** Development Finance Cooperation **ECLAC** Economic Commission for Latin America and the Caribbean **FAO** Food and Agriculture Organization of the United Nations **FCPF** Forest Carbon Partnership Facility **FIP** Forest Investment Program **GCF** Green Climate Fund **GEF** Global Environment Facility **IDB** Inter-American Development Bank **ICF** United Kingdom International Climate Fund **IFAD** International Fund for Agricultural Development **IFC** International Finance Protected Areas Conservation Trust **JICA** Japan International Cooperation Agency **PACT** Protected Areas Conservation Trust **SHARE** Sending Help and Resources Everywhere **SCCF** Special Climate Change Fund **SSB** Social Security Board **TNC** The Nature Conservancy **UNDP** United Nations Development Programme **UN REDD** United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation **VCS** Verified Carbon Standard

Potential sources of finance for CSA

As pointed out earlier, the cost of investing in CSA practices varies from low to high. While some farmers will be able to finance selected CSA investments using their own resources, depending on the socioeconomic status of the farmer and the nature of the CSA practice, many CSA investments will remain beyond reach for many farmers. Supplementary sources of investment financing will therefore be needed to ensure that CSA practices are taken up.

Some farmers in Belize are able to access financing from commercial banks, credit unions, or microfinance institutions to support investments in agricultural activities that use CSA practices. This group is still very small, however, because commercial lending agencies consider agricultural investments to be extremely risky, especially in the absence of agricultural insurance. The constraint posed by the lack of agricultural insurance will only become more binding in the face of climate change. The National Agriculture Sector

Adaptation Strategy to Address Climate Change in Belize states: "Commodity insurance is considered critical to maintain levels of production under the predicted climate change scenarios. The need for insurance services to farmers and producers in the sector increases substantially as the impacts that are expected with climate change become increasingly evident" [50].

In certain commercial crops including sugar, citrus, banana, and cocoa, private sector-led outgrower schemes have proved successful in supporting CSA investments. But such schemes generally are feasible only where there is a large, well-established commercial enterprise that is seeking to source large quantities of product.

Private agricultural finance remains generally scarce and expensive in Belize, and even when it is available, uptake by farmers is often limited. Therefore, more needs to be done to ensure that small-scale farmers can access affordable finance to invest in CSA practices.

In the absence of sufficient amounts of private finance, the public sector has a role to play in facilitating access to finance to support investments in CSA practices. A few initiatives are already under way. For example, the Agricultural Supply Chain Adaptation Facility (ASCAF) is a credit enhancement and technical assistance facility that aims to strengthen the ability of small and medium-sized farmers and processors to make climate-resilient investments. But these initiatives are very limited, and more effort is needed.

Where might additional finance come from? The figure "Financing opportunities for CSA in Belize" shows existing and potential sources of CSA finance for Belize, distinguishing between private and public, domestic and international. Sources of private finance include commercial finance institutions (banks, savings and loan associations, microfinance institutions), as well as agribusiness firms that work with outgrower contracts. Domestic sources of public finance are very limited and include Development Finance Cooperation (DFC), BEST, Protected Areas Conservation Trust (PACT) and the Belize Social Security Board (SSB). International sources of public finance are more plentiful. Sources that are currently being accessed by the country for CSA purposes come from the group on the very top (GCF, BioCF, FAO, IFAD).

The GOB is already accessing various funds that support CSA-related activities, but additional financing is needed. Further work on assessing and showcasing the benefits and costs of various CSA interventions promoted by different policies and strategies will be an important step toward ensuring that CSA receives priority in the national agricultural budget allocations. Adopting CSA practices sometimes involves incremental costs compared to conventional production practices, but in the cases of the "best-bet" CSA practices, the incremental costs are outweighed by incremental benefits in the form of lower management costs, reduced use of inputs, and increased productivity and income.

Risk management

Increasing the availability of financing will be necessary to ensure widespread uptake of CSA practices in Belize, but it will probably not be sufficient. Farmers will likely be unwilling to take out loans to support investments in CSA unless they are able to manage the risks associated with these investments. A range of insurance products—at micro, meso, and macro level—could be considered to help farmers protect against these risks [3]. However experience worldwide tells us that no single instrument can help a country to overcome shocks. Policy makers in Belize therefore need to be thinking about developing multi-dimensional risk financing strategies, identifying combinations of financing instruments (i.e., catastrophe funds, insurance, contingency funds, etc.) that provide an acceptable level of coverage at the lowest possible cost. It will be important to accept this "bottom line" recommendation as point of departure for developing a national disaster risk management strategy.

Outlook

CSA has the potential to contribute to Belize's agricultural development goals by sustainably increasing productivity and production, building resilience to climate change, and enhancing food and nutrition security, while achieving mitigation co-benefits in line with national economic development priorities. Given these potential benefits, more needs to be done to scale up CSA practices.

To counteract the country's high vulnerability to climate change and related hazards, the GOB has taken several steps to incorporate and institutionalize climate action in its development agenda, by ratifying climate-related international agreements and developing national strategies and plans for operationalizing commitments. Likewise, many actors have already begun to improve resilience and productivity in the agricultural and natural resources sectors, which will be key to addressing climatic challenges. Many smallholders have limited access to basic services and opportunities for development; however, poverty rates are still high among rural farming communities, especially in the southern part of the country. In light of the country's economic growth, harmonization of sectoral policies is thus important to achieving inclusive, equitable, and sustainable social development.

Faced with the prospect of climate change, the GOB will need to mobilize additional financing so it can meet its commitments under the GSDS while helping to increase productivity and competitiveness of the agricultural sector. This additional financing will be critical for unlocking Belize's considerable potential to serve as a driver of economic growth.

The public sector will be called upon to provide the public goods and services (e.g., research, capacity strengthening, coordination, market coordination) that create the enabling environment needed to encourage private investment in CSA. Specifically, the public sector will have a role to play in several areas: (i) strengthening the capacity of research, development, and extension services to conduct relevant adaptive research for development activities, and to provide sound technical assistance and technology transfer to the agricultural sector; (ii) strengthening information systems to allow for evidence-based decision-making on climate change adaptation and mitigation; and (iii) establishing a national CSA coordination mechanism to support knowledge sharing, avoid overlapping, and add value to ongoing work. These measures can help CSA adaptation and scale-out across the country.

Increased engagement of the private sector in promoting CSA will be critical to ensure widespread adoption of CSA practices, especially in situations where CSA practices and technologies are too capital intensive for farmers to afford the initial investment.This requires institutional dialogue, joint planning of interventions, and availability of and access to accurate farm data to allow for analysis and further prioritization of interventions and pathways for scale-up.

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