Climate-Smart Agriculture in Nicaragua

Climate-smart agriculture (CSA) considerations

- Changing temperature and precipitation patterns are shifting crop suitability patterns. Current coffee-producing regions may be more apt for cocoa production in the future. When communicated effectively, climate modeling and agrometeorological information can help farmers diversify or adapt.
- Varieties of beans, maize, and staple grains that are resistant or tolerant to drought and heat support adaptation to climate change.
- Forests account for nearly one-quarter of Nicaragua's total land area. Protecting against deforestation and land-use change from commercial agriculture improves net carbon storage and reduces greenhouse gas (GHG) emissions.
- Establishing improved forages through practices such as silage production for forage conservation, protein banks of hay, shrubby and/or herbaceous legumes, and sugarcane energy banks provide critical feed reserves for cattle and allow for soil restoration during the dry season.
- No-burn, use of green manure, and improved seed varieties for basic grains are CSA practices that bring important benefits to productivity and climate resilience and are promising practices for adoption at scale.
- Quesungual agroforestry systems and intercropping are smallholder CSA practices that provide income diversification and contribute to household food security while improving adaptability to heat and drought conditions.

A Adaptation M Mitigation P Productivity
Institutions $ Finance

- Smallholder farmer cooperatives use CSA practices, including pruning, shade canopy, agroforestry, and bio-management of pests and diseases, for export crops such as cocoa and coffee. Scaling-up by the participating smallholder farmers is limited due to investment costs, legal constraints, extension services, and market instability.
- Agricultural technology transfer systems could assist farmers to cope with different market failures, such as credit restrictions and missing production information, and to adapt to differentiated contexts, such as food security in marginal areas and market-based initiatives in areas with high productive potential.
- Development of an action plan for the agricultural sector to adapt to climate change could improve cooperation between public and non-public institutions by defining clear roles and goals for institutions addressing climate change in the agricultural sector.
- Understanding gender roles related to on-farm labor is critical for addressing equity when scaling out CSA. Male rural labor is concentrated in ranching, forestry, and hired agricultural work. Women play important roles in agricultural production for household food consumption. Including rural women, especially the poor, in the participatory design of programs aimed at ensuring food sovereignty and promoting food security (e.g., Zero Hunger, Agro-Seeds) ensures appropriate targeting.
- The agricultural sector is especially susceptible to natural disasters and extreme weather events, including hurricanes, droughts, and fires. Multilateral support for catastrophe response could be strengthened by disaster preparedness and disaster risk mitigation programs in high-risk areas.

The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove greenhouse gases (GHGs), and require planning to address tradeoffs and synergies between these three pillars: **productivity, adaptation, and mitigation** [1]. The priorities of different countries and stakeholders are reflected to achieve more efficient, effective, and equitable food systems that address challenges in environmental, social, and economic dimensions across productive landscapes. While the concept is new, and still evolving, many of the practices that make up CSA already exist worldwide and are used by farmers to cope with various production risks [2]. Mainstreaming CSA requires critical stocktaking of ongoing and promising practices for the future, and of institutional and financial enablers for CSA adoption. This country profile provides a snapshot of a developing baseline created to initiate discussion, both within countries and globally, about entry points for investing in CSA at scale.

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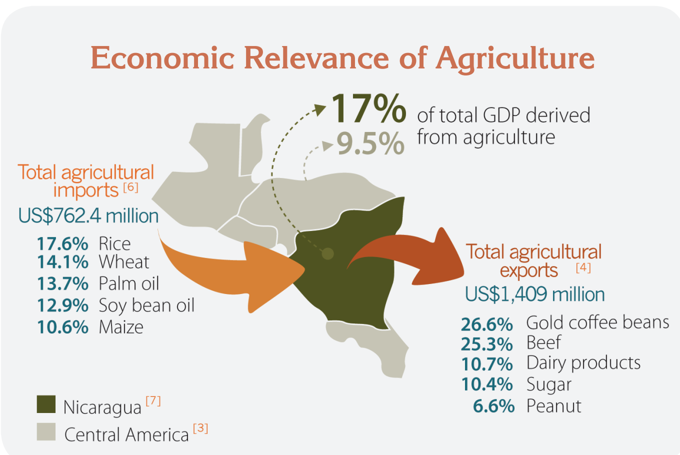
National context:
Key facts on agriculture and climate change

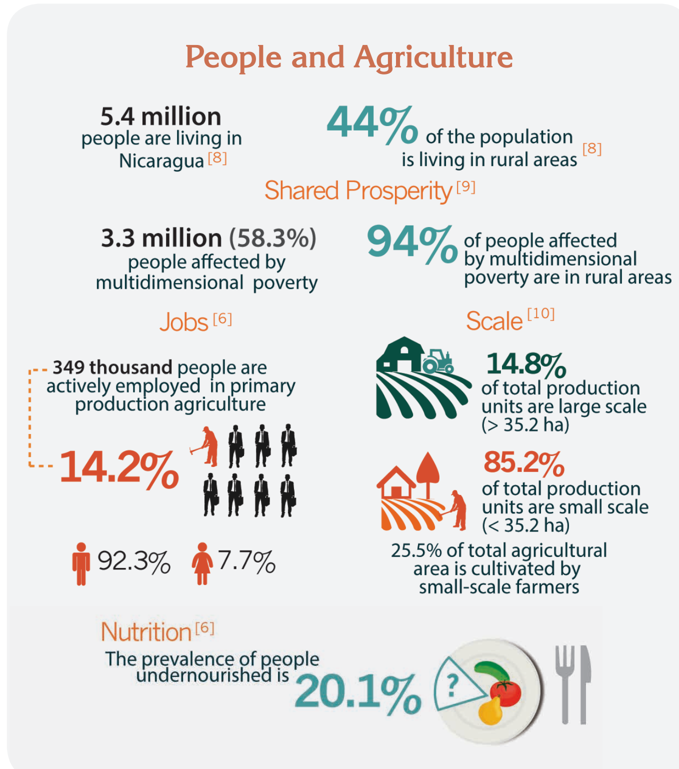
Economic relevance of agriculture

Agriculture is a key sector in the Nicaraguan economy. On average, the agricultural sector (including agriculture, forestry, and fisheries) contributes about 17% to the Gross Domestic Product (GDP), compared to other sectors such as trade (14%) and manufacturing (13%) [3]. The average value of agricultural exports for the period 2009–2013 was US$1,409 million, representing 77% of total exports [4]. The main export products include: coffee (mainly produced by smallholders in agroforestry systems), livestock products (meat, dairy and live cattle), sugar cane, peanut, and beans (the basic staple food crop of the Nicaraguan diet) [5].



The five (5) most imported food products amount to approximately US$760 million (2009–2013), and include rice (with 17.6% of the total import value), wheat (14.1%), palm oil (13.7%), soybean oil (12.9%), and maize (10.6%) [6].

An estimated 349,000 jobs are generated by primary production in agriculture [6]. Agricultural work, including ranching, forestry, hunting, and fishing, thus constitutes 32% of the national job market and the overwhelming majority of rural labor efforts [7].

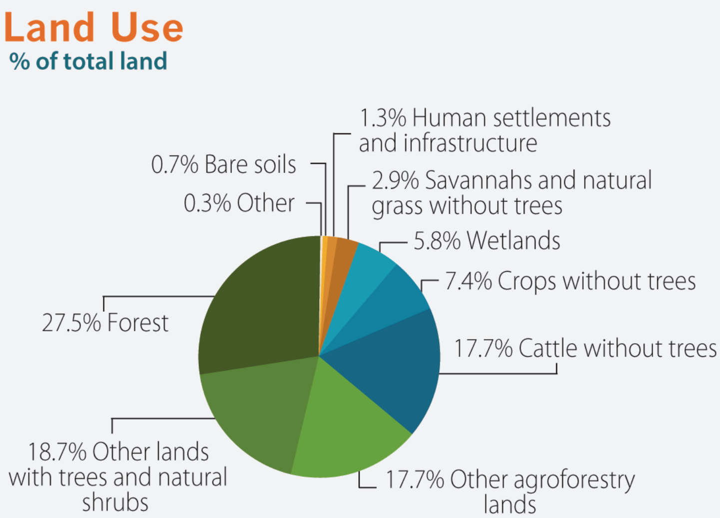


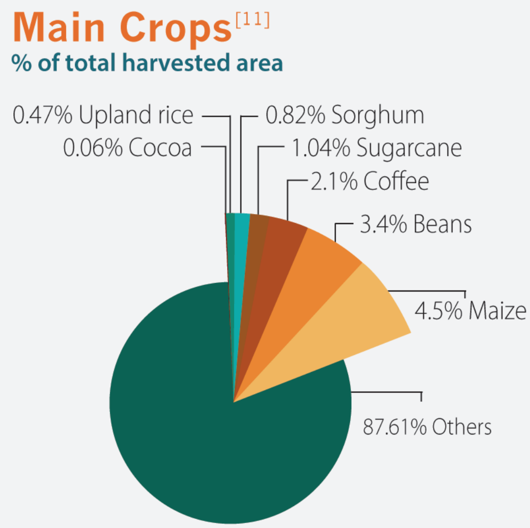
Land use

Nicaragua's total agricultural area is estimated at approximately 6 million hectares, or 45% of the country's total land surface [11]. The majority of agricultural land (54%) is dedicated to grazing areas for dual-purpose cattle, followed distantly by maize (4.5%) and beans (3.4%). Another 40% of Nicaragua's total land area is dedicated to cropland and pastures. While 27.5% of the country is covered by forests, deforestation rates are around 70,000 ha/year, which, added to natural and anthropogenic degradation, constitutes a serious threat to forest ecosystems. Nicaragua has the second highest rate of deforestation in Central America after Honduras (120,000 ha/year) [12]. The main factors that contribute to forest land change are: farmer migration; resettlement of people displaced by war; policies and development programs that prioritize basic grains; and extensive livestock systems [11]. Protected areas account for approximately 2 million hectares, of which 50% is devoid of forests and threatened by the expansion of the agricultural frontier [11].

Land and income distribution, particularly in the agricultural sector, is very unequal in Nicaragua: in 2009, the Gini index was 45.7 [7]. More than half of the country's farmers (55%) cultivate on less than 7 hectares of land, and yet they own just 5.6% of the country's total farmland. Small-scale farmers owning less than 1.75 hectares make up approximately 33% of all farmers, while subsistence farmers with 0.7 hectares or less account for 18.5% [10]. The disparity between small- and large-scale farming operations largely accounts for discrepancies between, on the one hand, the high commercial importance, and on the other hand, the low productivity of the agricultural sector.

Land Use

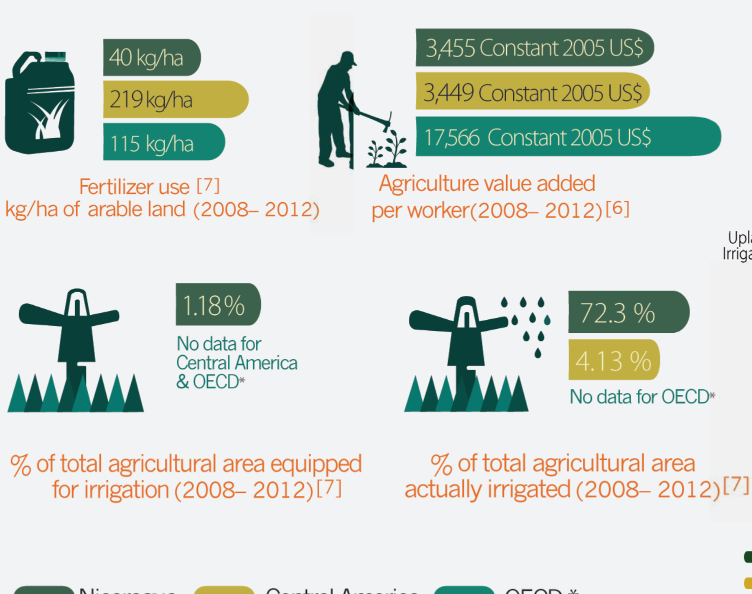




Agricultural production systems

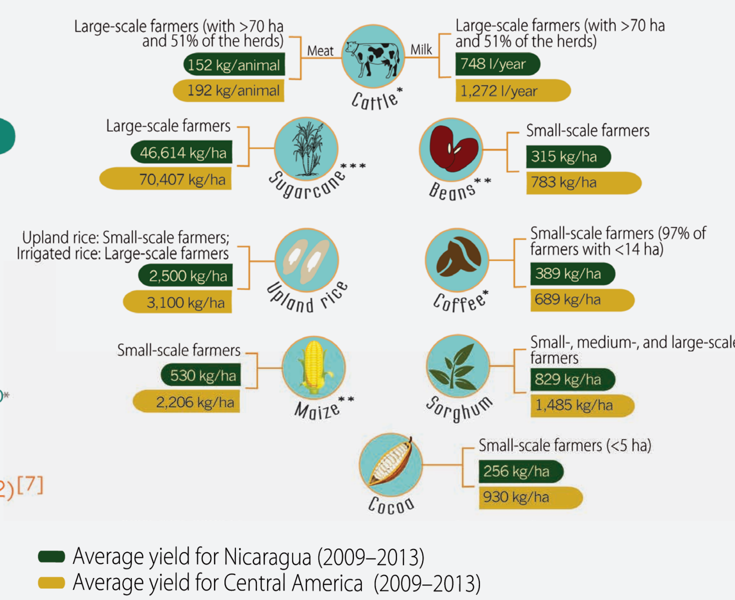
Plantation production systems, such as coffee, sugarcane, cattle (meat and dairy), peanut, tobacco, and banana, are key to Nicaragua's economy, as they constitute the bulk of export revenues. Basic grains, such as maize, rice, sorghum, and beans, primarily cultivated by small-scale farmers, are part of the basic diet and important for ensuring national food security. Compared to export crops, the production of basic grains is based on low-cost, traditional technologies, resulting in very low yields (see Annex II).

Productivity Indicators



* Organization for Economic Co-operation and Development

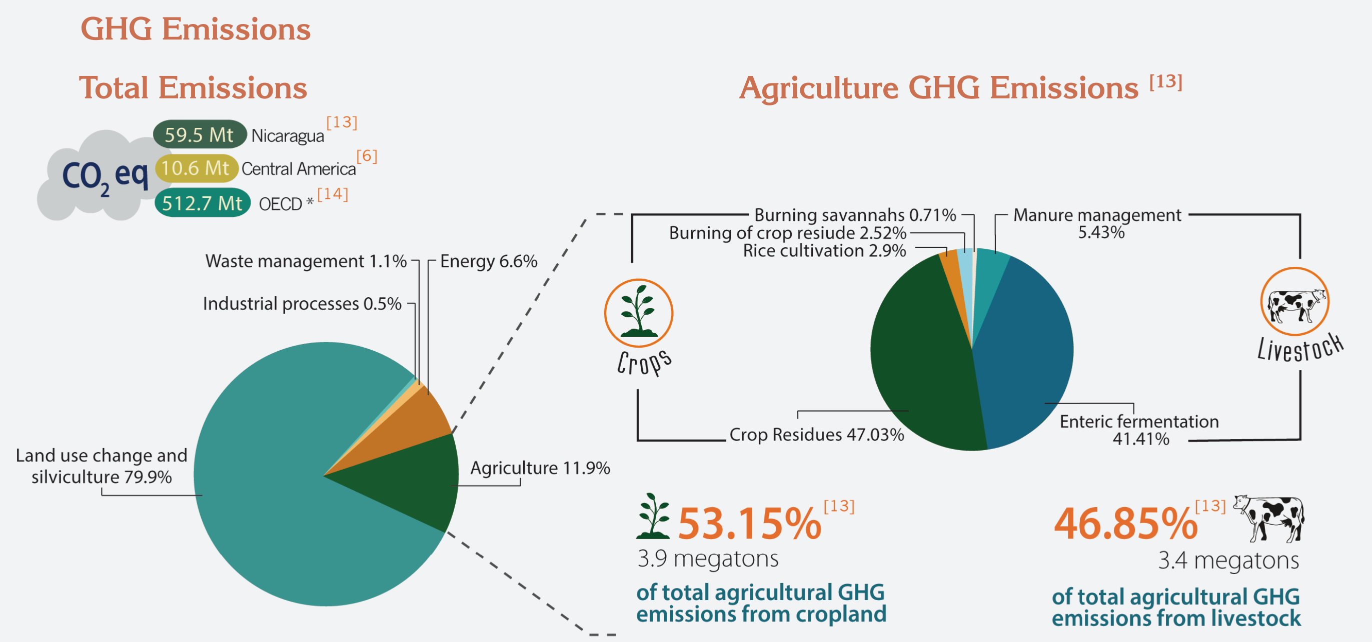
Important Agricultural Production Systems [6] [10]



* For coffee and cattle, small-scale farming occurs on plots smaller than 7 ha in the Northern and Central regions.
** Maize and beans small-scale plots are less than 1.75 ha.
*** For sugarcane medium- and large-scale farming occurs on areas larger than 7 ha in the Pacific region.

Agricultural greenhouse gas emissions

The agricultural sector contributes 12% to total greenhouse gas emissions (GHG) in the country, while the remaining 79% come from land-use change and forestry, mainly due to the loss of forestland converted to other uses, e.g., agricultural crops and extensive livestock systems. Nitrous oxide emissions from nitrification and denitrification,[1] mostly coming from crop residues and related processes in agricultural soils, represent 47% of total agricultural emissions, while methane emissions from enteric fermentation[2] make up another 41%. Other sources of agricultural emissions include manure management (5% of agricultural emissions), rice (3%) and field burning of crop residue (3%) [13].



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Challenges for the agricultural sector

Nicaragua's agricultural sector faces many challenges in terms of productivity, knowledge transfer, vulnerability, and market access. Strengthening the agricultural technology transfer system could help improve the uptake of new practices and technologies with the potential to increase yields and improve livelihoods for smallholders.

Cattle ranching for meat and dairy production occupies 27% of Nicaragua's total land area and is a major cause of forest land conversion. The majority of ranching land is non-forested and without trees, contributing to erosion, soil degradation, and water reserve depletion. Silvopastoral and agroforestry systems are supported by national legislation but have not yet led to the expansion of forested ranching land.

At the same time, land-change resulting from the expansion of export crops, such as coffee and sugarcane, may overtax the soil and threaten precious water reserves. More intensive cultivation practices, such as the introduction of non-indigenous varieties, denser planting patterns, burning or clearing indigenous shade and canopy crops, and the addition of non-organic fertilizers and pesticides, are often not compatible with sustainable productivity increases. Balancing the trade-offs between productivity and higher incomes, on the one hand; and ecological sustainability, on the other, will require targeted policy and education initiatives. Indigenous communities that control 49% of the forested areas in Nicaragua – including 71% of the tropical forests – must play a key role in determining appropriate land use [11].

1 Nitrification and denitrification are processes that imply N_2O loss from agricultural soils to atmosphere. Mostly coming from mineralization of animal excreta or soil organic matter.

2 Enteric fermentation is a process that takes place in animals' digestive systems.

Many farmers have limited access to consistent, targeted technical assistance. State efforts to provide training and capacity building are fragmented or limited in scope. Particularly amongst smallholders, the adoption of new technology and climate-smart practices is low. Low adoption rates affect not only productivity and food security, but also compromise the sector's ability to respond and adapt to severe weather and climate conditions. Various public (e.g., Crissol) and multi-lateral (e.g., Social Environment for Forestry Development Program-POSAF) programs have demonstrated that community-based training and extension services can result in higher rates of adoption for productive and adaptive practices. Scaling up these programs will require institutional support.

The agricultural sector is not well equipped to respond to natural disasters, such as hurricanes, floods, and fires. For example, many of the 162,000 people in the North Caribbean coast who suffered significant or total damages to their crops and homes to Hurricane Felix in 2007 have yet to recover. Weather forecast and information systems as well as agrometeorological bulletins can be better coordinated and publicly communicated by public institutions such as the Nicaraguan Institute for Territorial Studies (INETER).

Between 2007 and 2013, Nicaragua experienced on average 2,759 annual forest fires and agricultural burns that affected some 193,981 hectares [16]. Agricultural and biomass burning and the use of firewood as a primary energy source in 38% of households contribute to the extreme incidence of fire in Nicaragua. Missing insurance markets for the rural and agricultural sectors undermine farmers' ability to prepare for, and cope with, fire damages [11].

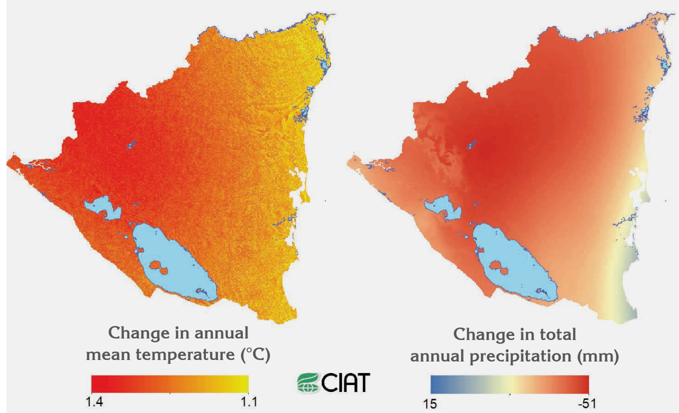
National programs aimed at promoting the preservation of genetic heritage plant varieties, such as Zero Hunger (*Hambre Cero*) and Agro-Seeds (*Programa Agroalimentario de Semilla-PAS*), are often at odds with Nicaraguan trade policies and international treaties. Free-trade agreements, such as the Dominican Republic-Central America Free-Trade Agreement (CAFTA-DR) and the Association Agreement with the European Union, and international conventions, such as the International Union for the Protection of New Varieties of Plants (UPOV), place adverse pressure on CSA practices concerning the use, sharing, and preservation of native varieties. Programs aimed at identifying the current and potential adaptability of indigenous grains and legumes, such as those carried out by the Nicaraguan Institute for Agricultural Technology (INTA), may help to address related food security challenges.

Agriculture and climate change

Agricultural productivity in Nicaragua is highly affected by droughts, floods, and erratic variations in climate. These climatic factors result in reduced annual productivity (total and partial crop losses) and add to the negative impacts caused by poor agricultural practices, such as burning and low soil quality in marginal areas.[3] Pests and diseases as well as the limited availability of water in the dry corridor further aggravate this situation [17].

A study analyzing historical climate data found that there is a strong warming trend across the country, manifest through diurnal temperature increases (~0.40 °C per decade) in deforested areas. These rates are more than 50% higher than average temperature change rates in tropical areas [18].

Projected Change in Precipitation and Temperature in Nicaragua by 2030 [20] [21]



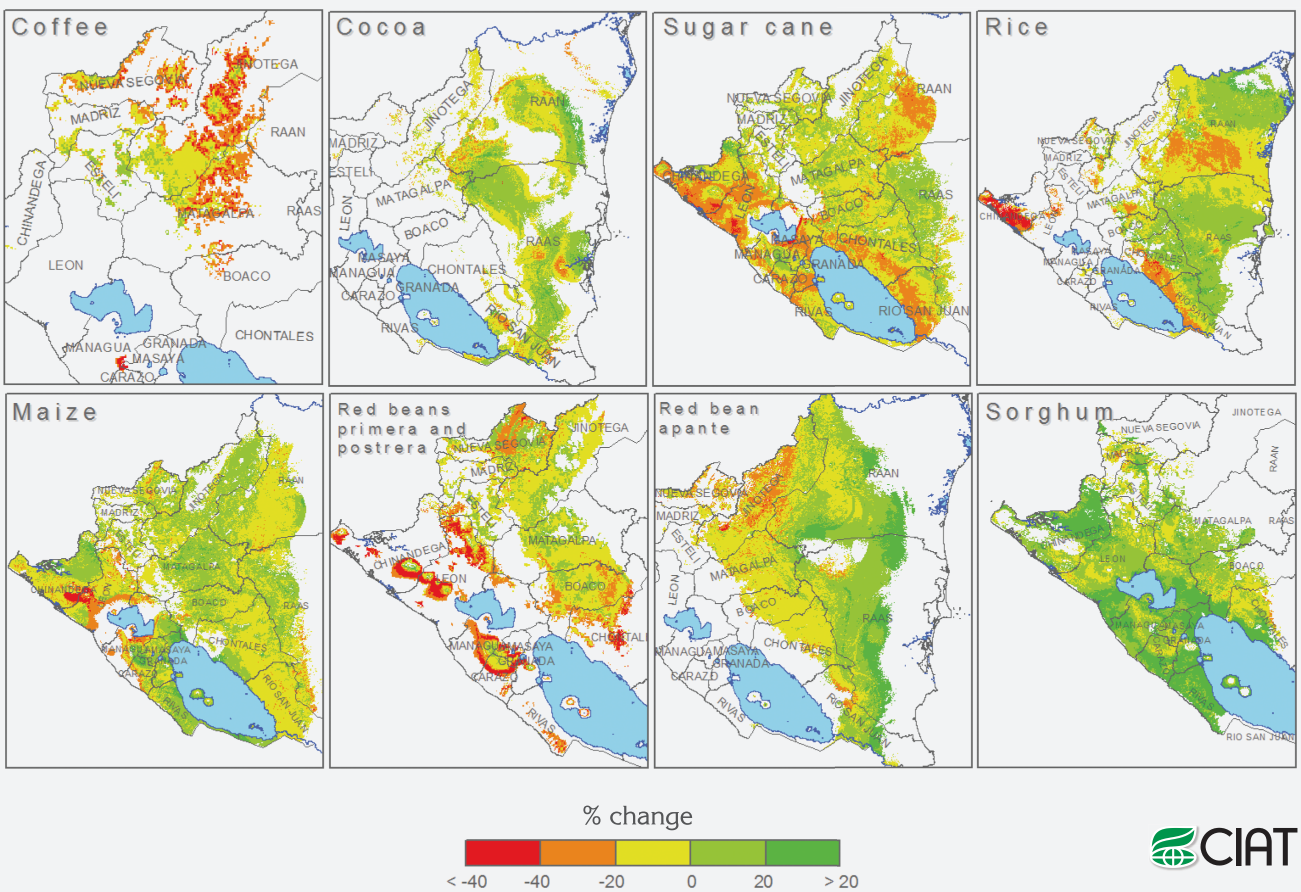
Climate change does not impact all regions of the country and all production systems equally. Some examples of how climate change impacts Nicaragua's most important export crops and dietary staples include:

- In Las Segovias, municipalities in north central Nicaragua, the dry season now lasts up to 6–7 months, threatening water supplies and food production for subsistence agriculture crops such as maize, sorghum, and beans [24].
- Rising temperatures and more frequent droughts and floods will present a major challenge for the country's production systems by 2030. Deforestation aggravates the temperature and precipitation changes in microclimates [18], with potentially strong implications for crops cultivated using traditional practices and commercial, instead of adapted, seed varieties.

3 Marginal areas refer to more remote lands that are not easily accessible and less utilized for the commercial production of export crops. They are typically occupied by small-scale, subsistence farmers.

- As temperatures increase above the current suitability range (18–28 °C) for coffee production, cocoa may become an important alternative crop. Heat tolerance can be further improved with agroforestry, which may become an important practice in hot areas, such as Waslala, Jinotega, and Río Blanco in the central region [15].
- For cocoa producers in the southeastern corridor, changing precipitation increases their crops' vulnerability to cryptogrammic illnesses such as Monilia and Black pod. This is especially true on the Atlantic coast in Bluefields, El Castillo, Laguna de Perlas, and El Rama [15].
- As much as 68% of the total area under bean production (148,836 ha) could be susceptible to heat stress of 25 °C or more by 2030. Introducing common varieties to cooler, more climatically suitable regions could improve smallholder adaptation [19].
- Rainfed sugarcane and rice crops along the Pacific coast face future suitability challenges. The efficient use of rainwater harvesting and/or catchment facilities, plus the adoption of drought-resistant varieties, will be key to productivity.

Projected Change in Climate Suitability of Production Zones by 2030



Climate projections based on the average of 30 global climate models for RCP 4.5 and for the period 2020–2049. Calculations include presence data for coffee and cocoa, and data sourced from the Ministry of Agriculture (MAG) about the potential for the other crops [22]. Changes in suitability were estimated using MaxEnt model [23]. Soil variables were not used (see Annex III).

CSA technologies and practices

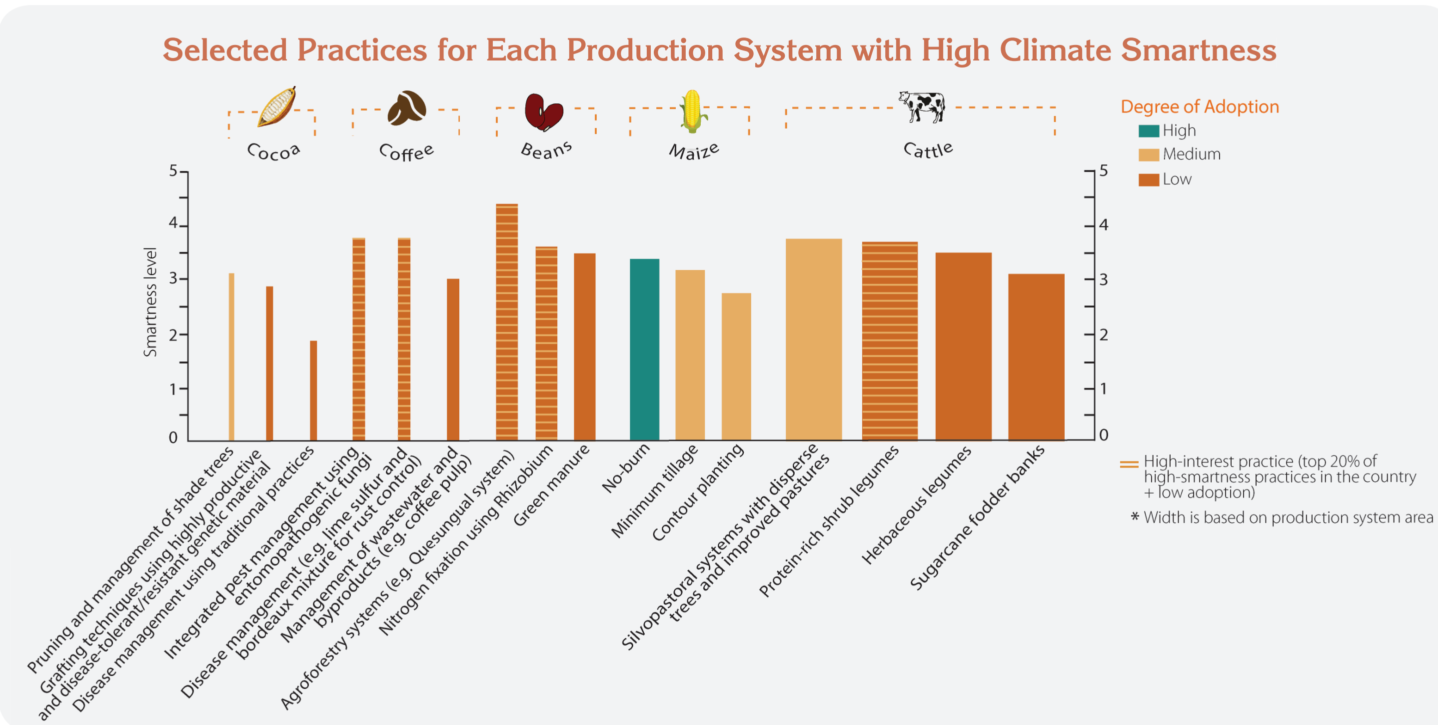
CSA practices present opportunities for addressing climate change challenges, while simultaneously supporting economic growth and development of the agriculture sector. For this profile, practices are considered CSA if they maintain or achieve increases in productivity as well as at least one of the other objectives of the CSA (adaptation and mitigation). Hundreds of technologies and approaches around the world fall under the heading of CSA [2].

Table 1 lists a selection of CSA practices that ranked high in climate smartness for the prioritized production systems.[4] While many of the practices included are institutionally or internationally supported, their levels of adoption vary significantly.

Because of the relative importance of dairy and meat to the agricultural sector, CSA practices that are adopted by the cattle production system can have a profound impact. The use of silvopastoral systems with dispersed trees and improved pastures promotes soil recovery, while the introduction of shrub legumes improves the retention of water and increased carbon storage. Other CSA practices that are less adopted but considered highly climate smart for the dairy and meat production systems include: establishing grass and hay silage to preserve forage for the dry season; introducing sugarcane energy banks for alternative feed; and producing green manure for integrated farm management.

Ensuring food security in spite of unreliable market and climate conditions leads many farmers to combine the cultivation of dietary staple grains and commercial crops. Smallholder farmers often dedicate stand-alone or integrated parts of their farms to *milpa* or combined maize and bean planting [24]. At the same time, climate-adapted seeds or grafted plant varieties have been adopted throughout the country, regardless of farms' scale and commercial orientation. Bean, maize, and staple grain varieties that are drought, flood, and heat resistant and tolerant are increasingly common, thanks in part to public outreach programs. In addition, many farmers practice no-burn, minimum tillage, contour planting, agroforestry, indigenous canopy shade planting, and bio-fertilization techniques in the production of staple crops.

More frequent and severe droughts coupled with rising temperatures have brought water conservation to the fore. For commercial crops like coffee and cocoa, various certification schemes have encouraged the adoption of water and soil conservation practices, such as water harvesting and storage, biofilters and industrial wastewater management, as well as agronomic practices such as pruning, shade cover, and



This graph displays the smartest CSA practices for each of the key production systems in Nicaragua. Both ongoing and potentially applicable practices are displayed, and practices of high interest for further investigation or scaling out are visualized. Climate smartness is ranked from 1 (very low positive impact) to 5 (very high positive impact).

4 Climate smartness reflects the performance of a practice regarding: carbon stocks and emissions (Carbon smart), nitrogen stocks and emissions (Nitrogen smart), energy-use efficiency (Energy smart), weather-related risk reduction (Weather smart), water-use efficiency (Water smart), and local knowledge promotion (Knowledge smart). For more information see Annex IV.

agroforestry to promote water retention and heat mitigation. Scaling-up may require more reliable and secure markets, as these practices often require costly investments in terms of time and resources.

Recognition of the damages already incurred by essential mangrove and coastal ecosystems has inspired the adoption of mitigation and adaptation strategies. Urban waste, agricultural runoff, and mining and deforestation pollutants exacerbate the damages caused by fishing and shrimping industries. Creating legal protection for mangrove estuaries, improving the recognition of ecosystem stress indicators, and implementing limitations to individual resource consumption support the sustainable use of coastal ecosystems.

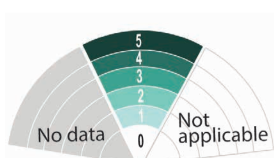
Following is a series of practices and technologies, their levels of smartness, and their contribution to the three CSA pillars. These practices and technologies have been compiled through interviews with national experts in different production systems. They represent the practices that ranked high in climate smartness for the prioritized production systems, many of which are currently being widely implemented and other with potential for increased adoption.

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

The assessment of a practice's climate smartness uses the average of the rankings for each of six smartness categories: water, carbon, nitrogen, energy, weather, and knowledge. Categories emphasize the integrated components related to achieving increased adaptation, mitigation, and productivity. For more information, see Annex V.

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Dual-purpose cattle 54% land-use area	Silvopastoral systems with disperse trees and improved pastures Medium adoption (30–60%) Medium- and large-scale farmers		Recovery of degraded soils, reduced soil erosion, water and biodiversity conservation.	Net carbon storage during the growth of forest species.	Production diversification: wood, fruit, wooden posts with potential for improved incomes and profit.
	Protein-rich shrub legumes Low adoption (30%) Small-, medium-, and large-scale farmers		Improved livestock resilience to climate variability as shrub legumes' deep roots reduce erosion and optimize recycling of nutrients.	Increased carbon sequestration.	With controlled feeding, may increase protein content in cattle's diet without negative effects of tannins. Potential source of food, timber and medicines.
Maize 4.5% harvested area	No-burn Medium adoption (30–60%) Small-, medium-, and large-scale farmers		In conditions of drought or excessive rains, favors crop adaptation and allows greater water infiltration and reduces soil erosion.	Reduced GHG emissions (CH_4 and N_2O).	Protection of soils permits the current or future production of commercial crops.
	Minimum tillage Medium adoption (30–60%) Small- and medium-scale farmers		Increased water retention and reduced soil erosion. Maintains biochemical and physical conditions of the soil, while reducing damages to microfauna.	Reduced GHG emissions by limiting the use of farming machinery and keeping carbon stock on soils.	Increased productivity due to the retention of nutrients in the soil. Greater yields may be associated with higher incomes.

Water smart
CO_2 Carbon smart
N_2O Nitrogen smart
Energy smart
Weather smart
Knowledge smart



Calculations based on qualitative ranking, where positive change was noted as 5=very high; 4=high; 3=moderate; 2=low; 1=very low; 0=no change; N/A=not applicable, and N/D=No data. Additional analysis – where no change, not applicable, and no data are all treated at 0 – and an alternative list of high-interest practices are available in supplemental materials.

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Beans **3.4% harvested area**	Agroforestry systems (e.g., bean Quesungual system) Low adoption (30%) Small-scale farmers		Greater resilience to extreme natural events such as drought or floods.	Reduced GHG emissions and increased carbon storage.	Sustainable productivity increases through improved soil quality and water availability.
	Nitrogen fixation using Rhizobium Low adoption (30%) Medium-scale farmers		Increased nitrogen content in crops. Reduced pollution in aquifer layers and soils.	No use of synthetic fertilizer, thus reducing energy consumption needed to decompose the nitrogen molecule and produce fertilizer.	It is an economically and ecologically sustainable option for agriculture in improving crops, soils, and ecosystems.
Coffee **2.1% harvested area**	Integrated pest management using entomopathogenic fungi Low adoption (30%) Small-scale farmers		Increased crop resistance to rust.	Reduced use of chemical inputs.	Increased coffee bean yields by at least 40%.
	Disease management (e.g., lime sulfur and bordeaux mixture for rust control) Low adoption (30%) Small-scale farmers		Increased crop resistance to climate-related increased threat of rust.	No significant benefits.	Increased yields and reduced investment in fungicides.
Cocoa **0.1% harvested area**	Pruning and management of shade trees in cocoa systems Medium adoption (30–60%) Small- and medium-scale farmers		Management to allow the entry of sunlight and air, control the growth and development of productive sectors, and reduce the presence of pests and diseases.	Increased carbon storage.	May increase yields from 5 to 20%.
	Grafting techniques using highly productive and disease-tolerant/ ressistant genetic material Low adoption (30%) Small- and medium-scale farmers		By incorporating genetic material that is tolerant or resistant to pests and diseases associated with climate change, such as brown rot, farmers are better able to adapt to their increased prevalence.	Reduced use of chemicals.	Proper treatment of brown rot can improve yields by 5–30%, with potential income gains.

Case Study:

Improved Bean Varieties

Beans play a key role in the economy and diet of Nicaraguans at both the national and household level. Beans are produced intensively as a valuable commodity export, and extensively as a dietary staple that contributes significantly to food and nutrition security. In particular, beans are essential for poor families that rent land or practice sharecropping, since beans can be intercropped with other commercial plants or grown independently to provide a source of nutrition with minimal space requirements [19]. However, because many smallholders and sharecroppers rely on traditional bean varieties cultivated extensively, they are especially prone to variable climatic conditions, particularly drought and soil depletion.

In an effort to provide solutions to farmers whose crops are severely affected by increasingly frequent and extreme droughts, INTA and CIAT have been working together to adapt bean varieties to new climatic conditions. Using germplasm provided by CIAT's genebank (2004–2014), INTA has promoted the adoption of varieties such as INTA Vaina Roja, INTA Nutritivo (Fe and Zn), and INTA Negro Precoz. As of 2014, more than 250 red and black bean varieties have been promoted by INTA, including many that are resistant to common mosaic and drought, give good yields under low soil fertility conditions, and adapt better to acidic soils.

For example, the variety INTA Fuerte Sequía can be used in dry areas, where, with proper management, yields of 615 kg/ha [26] can be expected. The INTA Norte bean is both drought and golden mosaic tolerant and is projected to provide high yields in three zones that are particularly influenced by drought: Las Segovias (2,313 kg/ha), south Pacific (2,091 kg/ha), and the north central zone (1,159 kg/ha) [27].

CIAT 2009

Some of the key factors motivating farmers' adoption of CSA practices include: tangible benefits derived from implementation; improved efficiency; material availability and ease of implementation; manageable economic costs; external support; and changing agroecological farm conditions. Alternatively, the failure to adopt and/or the abandonment of CSA practices is motivated by: resource and time constraints; trepidation and resistance to change; improper targeting of farms and/or farmers; and lack of technical knowledge required for implementation and management of CSA technologies [28].

Institutions and policies for CSA

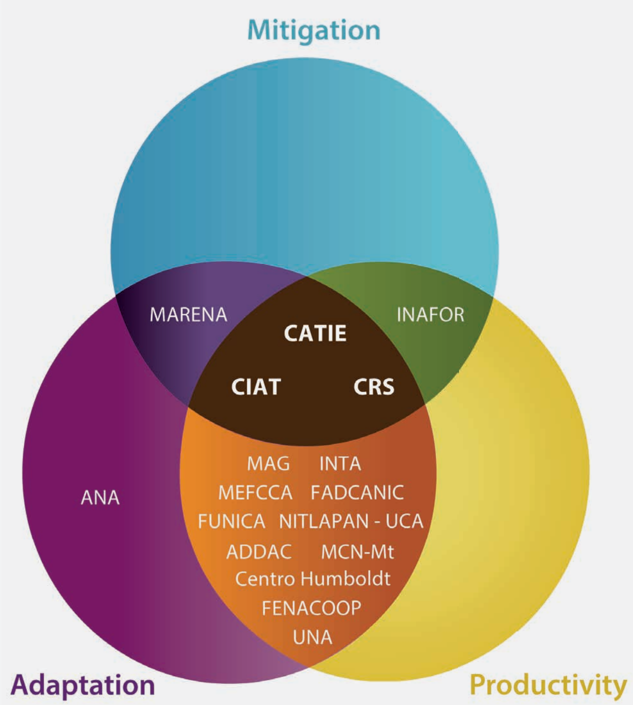
Nicaragua has been formally committed to international climate change policies since the ratification of the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol in 1995 and 1999, respectively. It submitted two national communications to the UNFCCC, one in 2001 and another in 2008. Nicaragua signed and ratified the Central American Regional Convention on Climate Change, which has led to a series of policy documents, including the Regional Strategy on Climate Change (ERCC) (2010). Nicaragua was also the first country to sign the Universal Declaration of the Common Good of the Earth and Humanity.

The climate change focal point in Nicaragua is the Ministry of Environment and Natural Resources (MARENA), through the General Directorate for Climate Change. In 2010, MARENA created the National Environmental and Climate Change Strategy (ENACC). This policy paper was then taken up by the Ministry of Agriculture (MAG) with the support of: the Nicaraguan Institute for Agricultural Technology (INTA), National Forestry Institute (INAFOR), Nicaraguan Institute for Territorial Studies (INETER), Ministry of Energy and Mines (MEM), National System for Disaster Prevention, Mitigation and Response (SINAPRED), and Nicaraguan Institute for Fisheries and Aquaculture (INPESCA). Together, these organizations have agreed upon and assumed responsibility for a range of cross-cutting climate change adaptation, mitigation, and response actions outlined in the National Climate Change Adaptation Plan (PNACC) for the agriculture, forestry, and fisheries sectors, 2010–2015.

Each of the departments and ministries mentioned above have direct mandates to address one or several of the CSA pillars. MAG is responsible for enforcing legislation that supports agroecological practices such as: the Nicaraguan Mandatory Technical Standard (NTON) for ecological agriculture, which outlines management practices for ecological fertilizer, pesticide, and agricultural products; or the Law for the Promotion of Ecological or Organic Agriculture (Law 765), which supports land restoration, clean production, and ecosystem preservation. INTA is responsible for supporting this legislation through research and knowledge-sharing extension services. Combining adaptation and productivity goals, INTA has spearheaded the campaign for the identification and adoption of climate-adapted varieties of beans, maize, and other staple crops.

The National Human Development Plan (PNDH 2012–2016) is the document that sets out the policy guidelines for the education, health care, social security, sports, youth, and culture sectors. It also encompasses the strategies for other sectors such as: production (tourism, mining, food, agriculture, and forestry), infrastructure, environment, and climate change. Those strategies include the three national flagship programs: Zero Hunger, Crissol (Christian, Socialist, and Solidarity Program), and Agro-Seeds [25].

Primary Focus of Institutions Engaged in CSA



Recognizing that Nicaragua's human development goals are closely tied to agricultural progress, the PNDH dedicates a section to climate-sensitive agriculture. The PNDH's agricultural strategy prioritizes productivity growth under changing climate conditions by promoting agricultural diversification, technology access, capacity building through technical assistance, and investment in productive infrastructure (roads, electricity, and agro-enterprises), with the aim of adding value to production systems. To this end, the government provides grants and resources for its flagship programs (Zero Hunger, Crissol, and Agro-Seeds), which seek to reduce rural poverty by boosting smallholder farmers' productivity and resilience. Often by complementing these programs, diverse non-governmental organizations (NGOs) support the adoption of CSA practices at the farm level through financial, technical, or organizational aids. Those NGOs include:

- Social agencies, such as Catholic Relief Services (CRS), Christian Aid, and the Swiss Agency for Development and Cooperation (SDC).
- Research organizations, such as CIAT-CGIAR and the Tropical Agricultural Research and Higher Education Center (CATIE).
- Producers organizations, such as the Central Association of Northern Coffee Cooperatives (CECOCAFEN), Nicaraguan Association of Small-scale Coffee Producers Cooperatives (Cafenica), Union of Agricultural Cooperatives (Soppexcca), National Union of Farmers and Ranchers (UNAG), and Nicaraguan Agricultural and Livestock Producers Union (UPANIC).

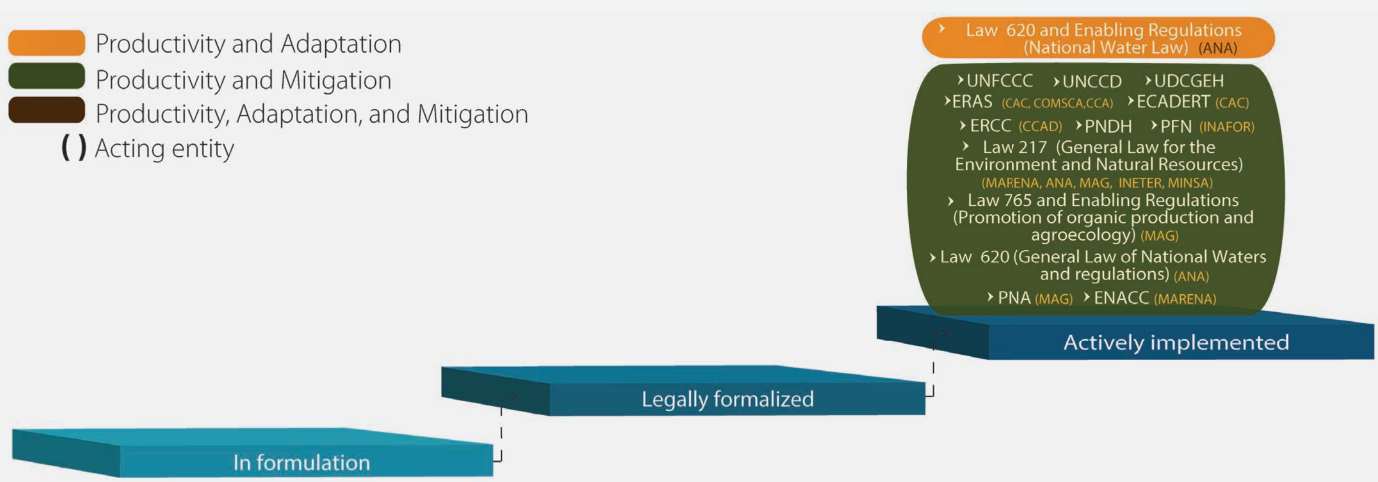
Nicaragua's mitigation and adaptation strategies largely address the preservation of the country's natural resources, including forests, minerals, land, and water. Both the General Law of Environment and Natural Resources (Law 217) and the General Law of National Water (Law 620) establish limitation and safeguards for the use of Nicaragua's natural resources under the jurisdiction of MAG, INAFOR, MEM, and other institutions. Likewise, SINAPRED's policies for disaster preparedness encourage adaptation in light of intensifying climatic disasters and the mitigation of environmentally compromising activities.

MAG, MARENA, and the Ministry of Family, Community, Cooperative and Associative Economy (MEFCCA) promote CSA through different environmental restoration and production conversion programs, including: agroforestry and silvopastoral systems; water harvesting; and water and soil conservation practices. These programs provide input supplies, technical assistance, and subsidies. Despite the integrated approach proposed in the PNDH, there is still ample opportunity to harmonize the efforts of these various entities in order to harness mutually reinforcing activities to ensure productivity and sustainability outcomes.

Under the PNDH and ENACC, the government must develop an action plan for the agricultural sector to adapt to climate change and achieve greater synergy between the efforts already made by MARENA and MAG.

Enabling Policy Environment for CSA

Policies listed are related to maintaining and/or enhancing **agricultural productivity** and at least one of the other CSA pillars:



ERAS Regional Agro-Environmental and Health Strategy (2009) **ECADERT** Central American Strategy for Rural Area-based Development 2010 - 2030 (2010) **ENACC** National Environmental and Climate Change Strategy Action Plan 2010-2015 (2010) **ERCC** Regional Strategy on Climate Change (2010) **PFN** National Forest Program (2008) **PNA** National Food Program (2008) **PNDH** National Human Development Plan 2012 - 2016 (2012) **UDCGEH** Universal Declaration on the Common Good of the Earth and Humanity (2010) **UNCCD** United Nations Convention to Combat Desertification (1996) **NC-UNFCCC** National Communication under the United Nations Framework Convention on Climate Change (1994)

Financing CSA

National finance

Financing for most CSA-related policy is tied to either the ENACC Action Plan or the PNDH. Funding for ENACC policies is generally channeled through MARENA and other multilateral partners, and then distributed to specific institutions, such as INTA, INAFOR, or INPESCA. For example, the National Forest Development Fund (Fonadefo) supports sustainable development of forest resources with funding provided by MARENA's and INAFOR's multilateral partners. Funding for PNDH programs that support smallholder agriculture and food security are often channeled through the Cabinet of Production, Consumption and Trade (GPCC) and directed to specific public programs. For instance, state funds for the food production program Zero Hunger have provided capital for approximately 100,000 rural female farmers; Crissol has funded 110,765 farmers in the establishment of more than 114,000 hectares of maize, beans, rice, and sorghum; and the Agro-Seeds program has provided seeds to 248,759 small-scale farmers.

There are few examples of private initiatives for CSA in Nicaragua. One such example in the insurance market typifies the challenges and potentials of private initiatives. Agricultural Insurance, specifically index-based weather insurance, was promoted by the World Bank, Inter-American Development Bank (IDB), and Inter-American Federation of Insurance Companies (FIDES) through the public insurer (Nicaraguan Institute of Insurances-INISER) and a private insurance company (LAFISE) [29]. This index-based model was ultimately undermined by the lack of weather stations and accurate climate monitoring, and was finally discontinued.

International finance

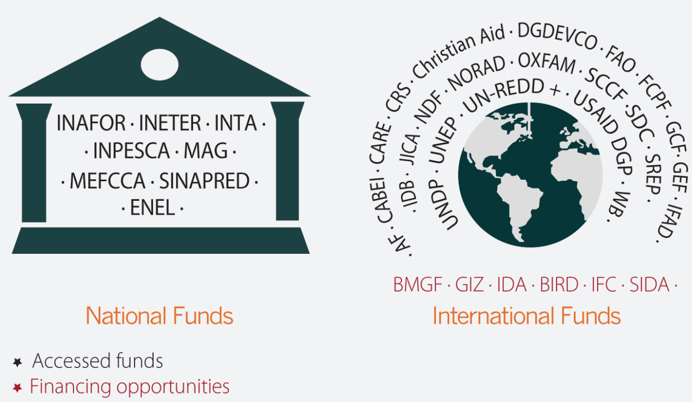
Nicaragua has access to several sources of financing through multilateral entities and bilateral international cooperation. Funding for activities related to climate change during the past decade has focused on climate change management and risk reduction, adaptation, and mitigation. The graphic below represents the various international entities that provide funding for CSA in the country. In general, emphasis has been placed on integrated watershed management (GEF funding), adaptation to climate change through water harvesting (SDC), adaptation in the drinking water and sanitation sector (WB), flood and drought risk reduction (AF), environment and disaster risk management under climate change (IDB), integrated pest management (JICA), among others.

Potential finance

Although Nicaragua has received support for CSA practices through various bi- and multi-lateral partnerships, there are several other potential funding channels that the country has not made use of yet. Nicaragua might focus on climate change mitigation, especially as it relates to deforestation and the destruction of biomass and carbon stocks. Entities that support such efforts are the Special Climate Change Fund (SCCF), UN Collaborative Initiative on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD+), United Nations Environmental Programme (UNEP), Scaling Up Renewable Energy in Low-Income Countries (SREP), among others. Strengthening supply chains through niche and specialty markets, such as major certification and organic distributors, may provide sustainable revenues in support of CSA practices for some export crops.

Funds for Agriculture and Climate Change

AF Adaptation Fund **CABEI** Central American Bank for Economic Integration **BMGF** Bill & Melinda Gates Foundation **CARE** Cooperative for Assistance and Relief Everywhere **CRS** Catholic Relief Services **DG DEVCO** Directorate-General for International Cooperation and Development **ENEL** Nicaraguan Electricity Company **FAO** Food and Agriculture Organization of the United Nations **FCFP** Forest Carbon Partnership Facility **GEF** Global Environment Facility **GCF** Green Climate Fund **GIZ** German Agency for International Cooperation **IBRD** International Bank for Reconstruction and Development **IDA** International Development Association **IDB** Inter-American Development Bank **IFAD** International Fund for Agricultural Development **IFC** International Finance Corporation **INAFOR** National Forestry Institute **INETER** Nicaraguan Institute for Territorial Studies **INTA** Nicaraguan Institute for Agricultural Technology **INPESCA** Nicaraguan Institute for Fisheries and Aquaculture **JICA** Japan International Cooperation Agency **MAG** Ministry of Agriculture **MEFCCA** Ministry of Family, Community, Cooperative and Associative Economy **NDF** Nordic Development Fund **NORAD** Norwegian Agency for Development Cooperation **SCCF** Special Climate Change Fund **SDC** Swiss Agency for Development and Cooperation **SIDA** Swedish International Development Cooperation Agency **SINAPRED** National System for Disaster Prevention, Mitigation and Attention **SREP** Scaling Up Renewable Energy in Low Income Countries Program **UNDP** United Nations Development Programme **UNEP** United Nations Environment Programme **UN-REDD+** United Nations Collaborative Initiative on Reducing Emissions from Deforestation and Forest Degradation **USAID DGP** USAID Development Grants Program **WB** The World Bank



Outlook

Two of Nicaragua's most economically beneficial production systems – coffee and beans – are seriously threatened by rising temperature. Other principal production systems, such as small-scale livestock, currently use practices adverse to the environment. The Nicaraguan government has made significant progress towards defining an appropriate policy framework to address these challenges, focusing on adaptation-based mitigation.

Climate variability is a major challenge and one that requires accurate and reliable information to ensure appropriate decision-making from national-level policymaking to households. Key institutions such as MAG, INETER, and MEFCCA are essential for providing information and capacity building services to help farmers respond to climatic and market changes. Both national and multilateral actors can achieve significant impacts by investing in proven adaptation and mitigation practices at scale through tailored and targeted outreach programs.

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For further information and online versions of the Annexes, visit:
http://dapa.ciat.cgiar.org/csa-profiles/

Annex I: Acronyms

Annex II: Top production systems methodology

Annex III: Climate impacts on agriculture in Nicaragua

Annex IV: Climate smartness methodology

Annex V: Detailed assessment of impacts of ongoing CSA practices on CSA pillars in Nicaragua

This publication is a product of the collaborative effort between the International Center for Tropical Agriculture (CIAT) – lead Center of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) – and the World Bank to identify country-specific baselines on CSA in Africa (Kenya and Rwanda), Asia (Sri Lanka), and Latin America and the Caribbean (Nicaragua and Uruguay).

The document was prepared under the co-leadership of Andrew Jarvis, Andreea Nowak, and Caitlin Corner-Dolloff (CIAT); and Holger Kray and Carlos Arce (World Bank). The main author of this profile is Armando Martínez Valle, and the team was comprised of Andreea Nowak (CIAT), Caitlin Corner-Dolloff (CIAT), and Miguel Lizarazo (CCAFS).

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