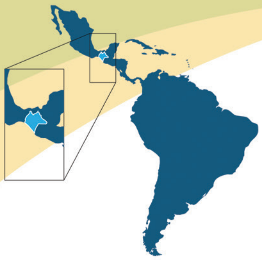


Climate-Smart Agriculture in Chiapas, Mexico

Climate-smart agriculture (CSA) considerations

M The high biodiversity and environmental services in Chiapas can be maintained through diversified activities, such as **agroforestry** and **silvopasture,** as means for securing livelihoods and bolstering climate mitigation potential, diminishing trade-offs between development and conservation.

A $ **Climate risk management strategies,** such as early weather notifications, warning systems, and agricultural insurance, can help farmers cope with the floods, pest infestations, and other climate extremes that are common in Chiapas.

M P **Minimum tillage** in Chiapan maize systems can help increase carbon capture in soil while boosting productivity.

Knowledge exchange strategies are essential for increasing the productivity and resilience of Mexico's agricultural sector. A formalized innovation system with public, private, and academic actors is important for knowledge generation, collection, and dissemination.

A M The identification of suitable adaptation and mitigation options can be enhanced by development and access to **Integrated Decision Support Systems** that compile and analyze weather, agronomic and market information, and deliver results to a range of stakeholders and decision makers.

Strengthening governance and democratic landscape management of farmers associations, *ejidos*,* and communities can help increase productivity by creating economies of scale that bring connectivity to the fragmented landscape of numerous small land holdings in Chiapas.

$ Chiapas receives considerable **support from external entities,** both federal and otherwise, on initiatives that integrate the three pillars of CSA. This institutional landscape will likely prove vital to Chiapas' ability to scale up CSA for the purposes of rural development and resilience to climate change.

$ Although federal financing for CSA is extensive, **supporting farmer-led investment and entrepreneurship** can go a long way towards ensuring shared prosperity and long-term feasibility of CSA at scale.

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

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.

* An ejido is an area of communal land used for agriculture, on which community members individually possess and farm a specific parcel. Regularly, land use decisions are made by community consensus.

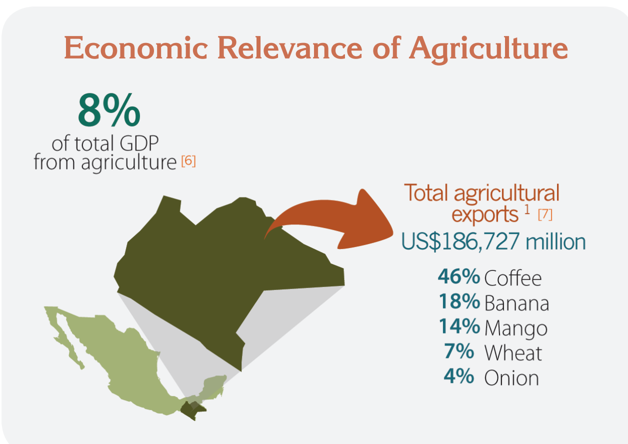
WORLD BANK GROUP
CGIAR
RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security CCAFS
CIAT
CATIE Solutions for environment and development Soluciones para el ambiente y desarrollo

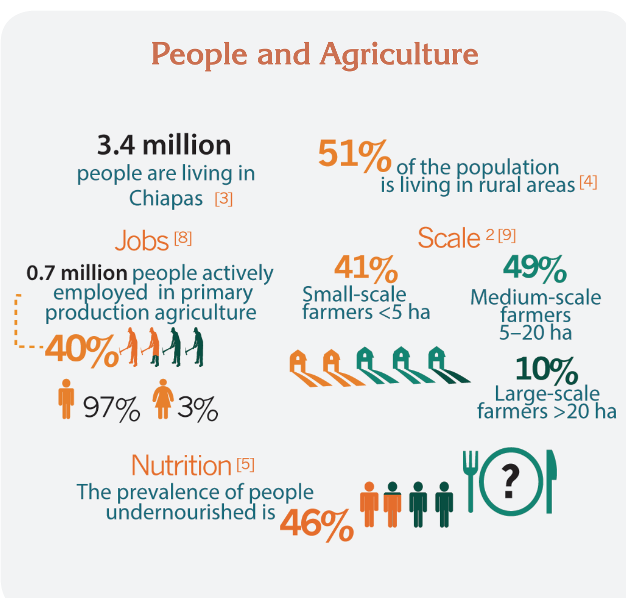
National context:
Key facts on agriculture and climate change

Economic relevance of agriculture

Agriculture contributes to 8% of the GDP in Chiapas [3] and employs 40% of the economically active population in the state [4]. Chiapas is the state with the second most marginalized population in Mexico, and small rural localities depend solely on agricultural activities [5].

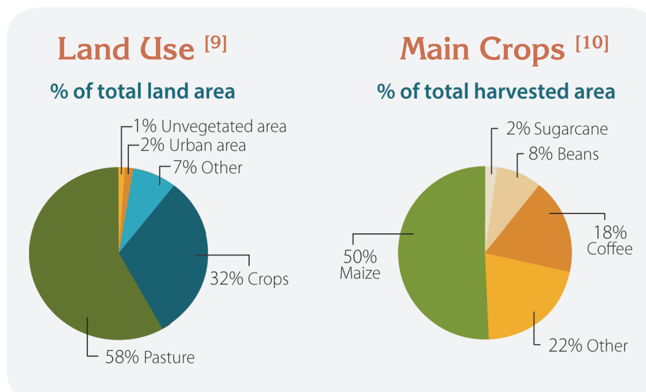
Chiapas faces socio-economic challenges and high inequity. Almost half of the population is food insecure (46%) and only 3% of people working in agriculture are women.





Land use

The average size of agricultural landholdings in Chiapas is among the smallest in Mexico. According to national agricultural census data, 41% of farmers in Chiapas are smallholders (0–5 hectares), 49% are medium-sized farmers (5 to 20 hectares) and 10% are large scale (more than 20 hectares) [10].[1] Low agricultural productivity in Chiapas can be associated with the size of agricultural landholdings and related socio-economic conditions in rural areas. The small size of plots impedes economies of scale unless effective farmers organizations are in place. Low productivity coupled with high production costs results in limited income potential for many farmers. Where farming in small plots is isolated, productivity and competitiveness are compromised [11].



Agricultural production systems

Chiapas is located in the maize–bean region of southern Mexico. The maize–bean farming system is historically and culturally based on the production of these two products on a subsistence basis [12]. The region is populated largely by indigenous communities. The historical small size of land holdings and lack of productive capacity has led to extensive poverty and severe land degradation in many areas.

Important agricultural products in Chiapas are maize, coffee, sugarcane, beans, and cattle. The four crops are considered important due to their 2012 production values (US$426 million, $268

1 Estimation for January to September 2011 by SAGARPA.
2 Computed by dividing total surface by the number of production units reported by scale in the National Agriculture, Livestock and Forestry inventory of 2007.

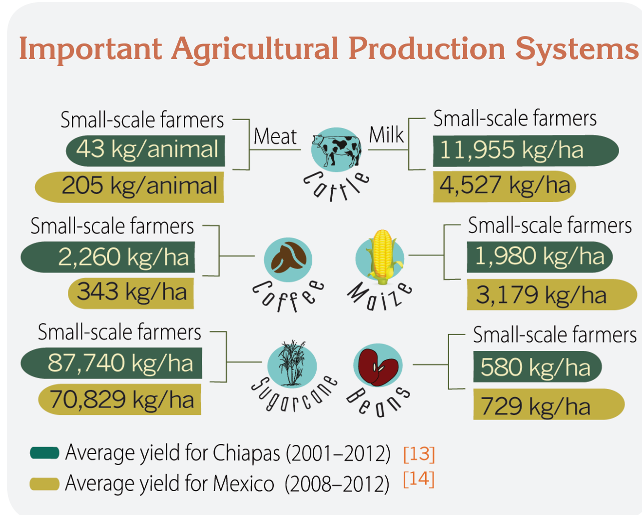
million, $152 million, and $72 million, respectively) and their harvested areas (50%, 18%, 2%, and 8% of total agricultural area respectively) [12]. The dairy bovine production system is considered important due to its contribution to average daily consumption of kilocalories per capita.

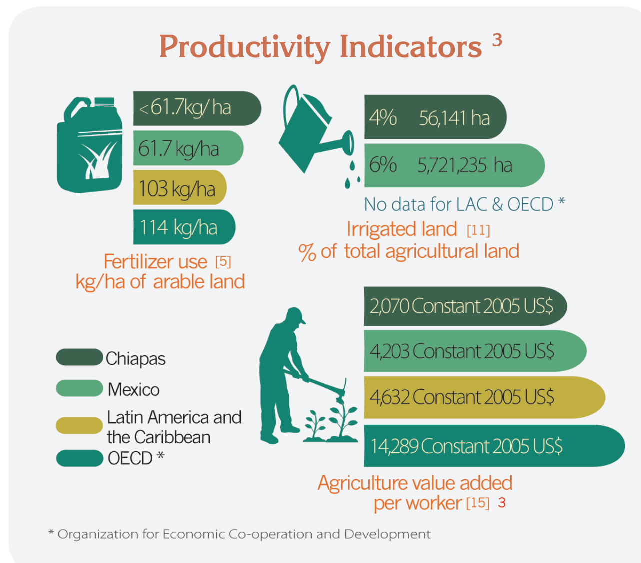
Agricultural greenhouse gas emissions

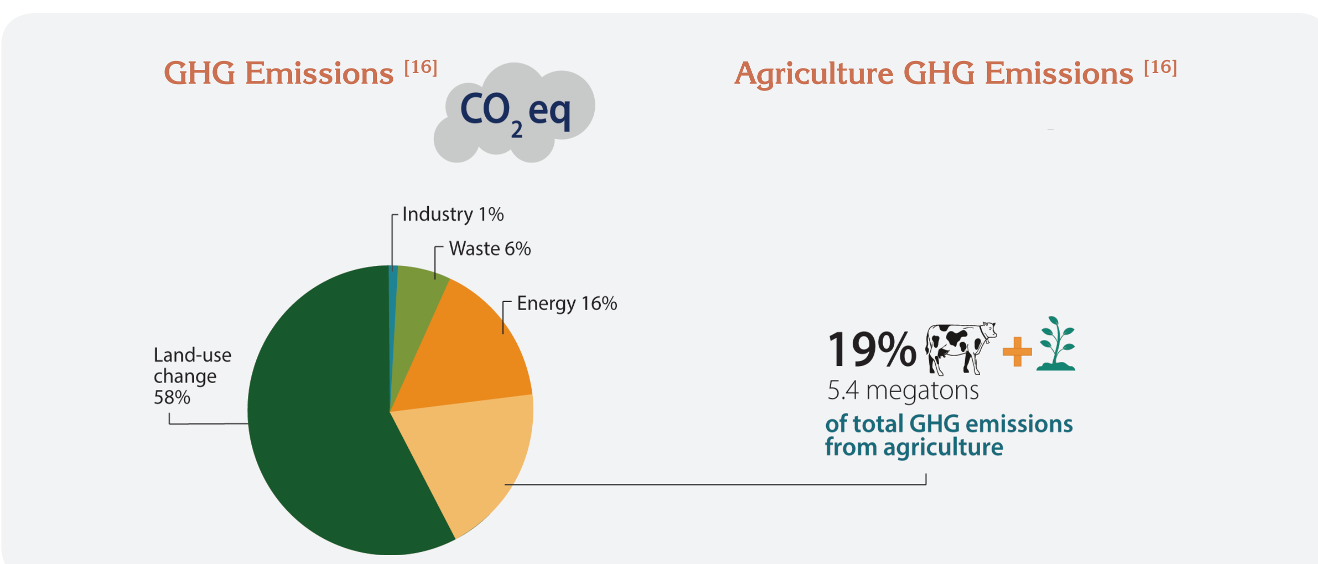
According to the 2011 GHG emissions inventory for Chiapas [16], 19% of the total state emissions came from the agricultural sector. This percentage includes both livestock and other agricultural activities, but no disaggregated information per activity is reported. The sector with the highest contribution to GHG emissions was land-use change (58% of total emissions).

Challenges for the agricultural sector

Challenges with the agriculture sector in Chiapas are complex and linked with social, ecological, productive, and institutional aspects. In a workshop by the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) and the Food and Agriculture Organization of the United Nations (FAO) in 2010, farmers identified almost 40 problems related to the sector (see list of Annexes), the three central ones being: 1) low productivity, 2) low organizational capacity in farmers organizations, and 3) barriers to access financial products [17].







3 Computed as number of people employed in agriculture divided by the production value in the state (2012)

Key problems related to institutional capacity are: insufficient entrepreneurial support, low access to technical assistance, low support in the acquisition of production technologies, misalignment of government programs with the production cycles, programs that incentivize subsistence from the government, low institutional coordination, and scarce research aligned to rural needs [17].

Soil in Chiapas is mostly suitable for forest activities and the forestry sector faces problems. Forest management has limited effectiveness due to the lack of integral development schemes, and the persistence of illegal wood and non-wood extraction activities. Furthermore, there are several kinds of natural protected areas in the state, including seven biosphere reserves, which form a biological corridor. The natural protected areas have proven ineffective to ensure conservation of key species, such as the xate palm and orchids. These problems were expressed in the workshop mentioned above. Farmers mentioned deforestation and an inadequate management of natural resources as key problems [17].

Soils for agriculture in Chiapas are of low productive nature. Rendzinas (17% of territory) are claylike with low productivity and acrisols (16.2% of territory) have an acid pH, which also limits productivity [17].

Size of farming plots in Chiapas is reduced as land is passed from generation to generation. As a common practice, farmers subdivide the land they possess to grant tenure to each of their successors, who in turn subdivide it when they pass it on to their next generations. This phenomenon results in low productive connectivity and minimizes the chances of economies of scale [17].

In relation to climate, high relative temperature and humidity promotes pest infestations and diseases, especially in coffee systems [5]. Similarly, increasing climate variability makes investing heavily in agricultural production a financial risk for farmers. Part-time jobs and other off-farm sources of income are replacing agricultural entrepreneurship.

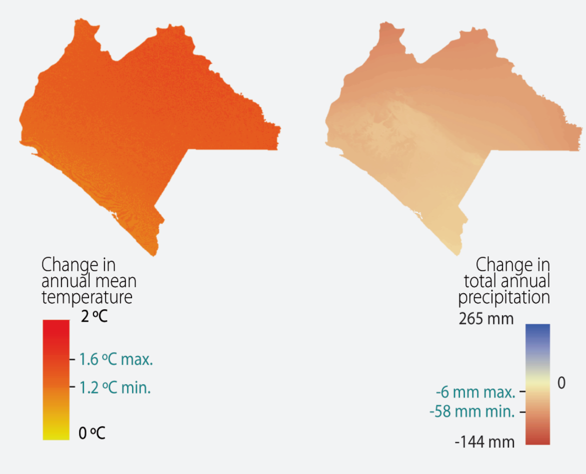
Agriculture and climate change

Climate projections indicate that future temperatures in Chiapas are likely to increase 1.6 °C by 2030 [18, 19]. Precipitation reductions in 2030 will be in the range of -6 mm to -53 mm.

Extreme climate events affecting Chiapas include extended periods of drought and persistent flooding during critical periods of crop growth [5]. While tropical cyclones are likely to become more intense under a warmer climate as a result of higher sea surface temperatures, there is uncertainty as to changes in frequency [18].

Chiapas' small coffee producers have already experienced production losses due to climate change. Warming of soil organic matter results in degradation, suppressed root growth, and decomposition of organic matter [20]. Coffee production is additionally at risk from rising temperatures, as these will favor proliferation of pests and diseases, such as coffee berry borer, leaf miner, nematodes, and coffee rust [21].

Projected Changes in Temperature and Precipitation in Chiapas by 2030 [4]



4 Projections based on RCP 4.5 emissions scenario [22] and downscaled using the Delta Method [23].

CSA technologies and practices

CSA technologies and practices present opportunities for addressing climate change challenges, as well as for economic growth and development of agriculture sectors. 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 CSA (adaptation and/or mitigation). Hundreds of technologies and approaches around the world fall under the heading of CSA [2].

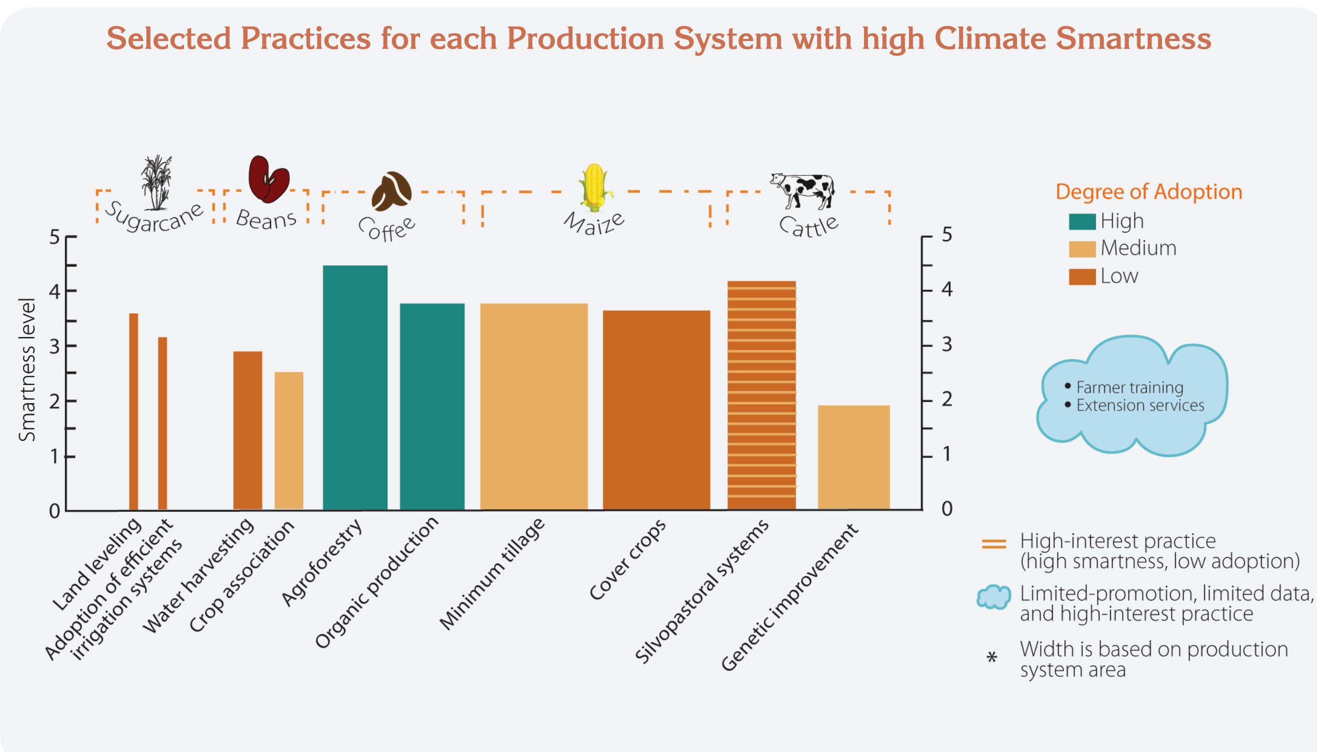
Farmers in Chiapas are already utilizing a variety of CSA techniques. These include: agroforestry and organic production in coffee; silvopastoral systems and genetic improvement in livestock; conservation agriculture activities, such as minimum tillage, cover crops, and organic fertilizers in maize; crop associations and water harvesting for bean production; land leveling and irrigation for sugarcane.

Furthermore, the use of reclaimed water for irrigation purposes in Chiapas has been assessed by the National Institute for Forestry, Agriculture and Livestock Research (INIFAP) and the National Coordinator of Fundaciones Produce (COFUPRO). Critical programmatic practices, such as agricultural insurance, loans, guarantees, and small but growing farmers organizations are being implemented to a certain degree but are in need of further organization and investment at the institutional level.

Practices with high climate-smartness rankings and the potential to be applied across a large land area, but that currently exhibit low adoption rates, offer opportunities for increasing the overall climate smartness of the state. These practices of high interest for further investigation and promotion in Chiapas are:

- Silvopastoral systems
- Agricultural insurance
- Farmers organizations
- Minimum tillage
- Cover crops

In addition, CSA stakeholders emphasize the need of capacity building and knowledge transfer through farmers networks, as well as supporting private innovation, agriculture insurance services, early warning systems, and overall awareness of CSA technology and management options.



This graph displays three of the smartest CSA practices for each of the key production systems in Chiapas. 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 in category) to 5 (very high positive impact in category).

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

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

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Sugarcane 2.16% harvested area	Land leveling ■ High adoption (>60%)		Reduces water consumption. Improves drainage after rains, which protects farmers against floods.	More efficiency in fertilizer use which leads to less N_2O emissions. Leveled land requires less energy for pumped irrigation.	More efficient labor, which reduces costs; higher yields. Higher profitability and incomes.
	Adoption of efficient irrigation systems ■ High adoption (>60%)		Protects farmers against rain shortages.	Zero energy requirements (and thus CO_2 emissions) for irrigation. However, gravity irrigation can affect soil quality.	Can be developed at the farm level with minimal capital investment. Easy to manage. Higher yields compared to non-irrigated land.
Beans 8.38% harvested area	Water harvesting ■ Low adoption (<30%)		Ground water recharge and check dams can be used for domestic purposes and irrigation and be utilized in times of water scarcity.	In certain contexts can reduce energy needs for irrigation pumping.	All areas of water harvesting can provide extra water for more arid as well as flood-prone areas.
	Crop association ■ Medium adoption (30–60%)		Double cropping decreases risk due to diversification strategy.	Limited, if any.	Intercropping may give a bonus crop of beans without affecting maize yields.
Coffee 18.14% harvested area	Agroforestry ■ High adoption (>60%)		Reduced temperatures in coffee canopy, reduced pressure of rust and insect-borne yield losses.	Significant carbon sequestration and carbon storage in system.	Diversification in farm income can enhance livelihoods. No major productivity benefits, but shade can enhance coffee quality leading to higher income.
	Organic production ■ High adoption (>60%)		In certain contexts, enhanced soil quality can enhance water retention and soil functioning to overcome climate-related stresses.	Reduced nitrogen fertilizer use resulting in less N_2O emissions.	Product differentiation can enhance income.

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Maize 50.22% harvested area	Minimum tillage ■ Medium adoption (30–60%)	 	Increased water retention reduces crop losses due to drought.	Promotes carbon storage in soil. Water retention increases, which in turn reduces energy needs for irrigation.	Increases productivity due to higher content of nutrients in soil. Higher productivity and less input use translate into higher incomes.
	Cover crops ■ Low adoption (<30%)	 	Legume cover crops reduce the nitrogen requirements of the subsequent maize crop.	When the cover crop is ploughed in, it promotes carbon storage in soil.	Better yields due to improved soil quality.
Cattle 58% land-use area	Silvopastoral systems ■ Low adoption (<30%)	 	Increased productivity and less vulnerable to climate change.	Promotes carbon storage in soil and in the tree component.	Part of LivestockPlus, which offers higher production with improved forage species.
	Genetic improvement ■ Medium adoption (30–60%)	 	Context specific - could increase or decrease risk depending on genetic improvement focus.	Can result in intensification contributing to land sparing and increased demand for grain-based feed.	Higher productivity per animal.

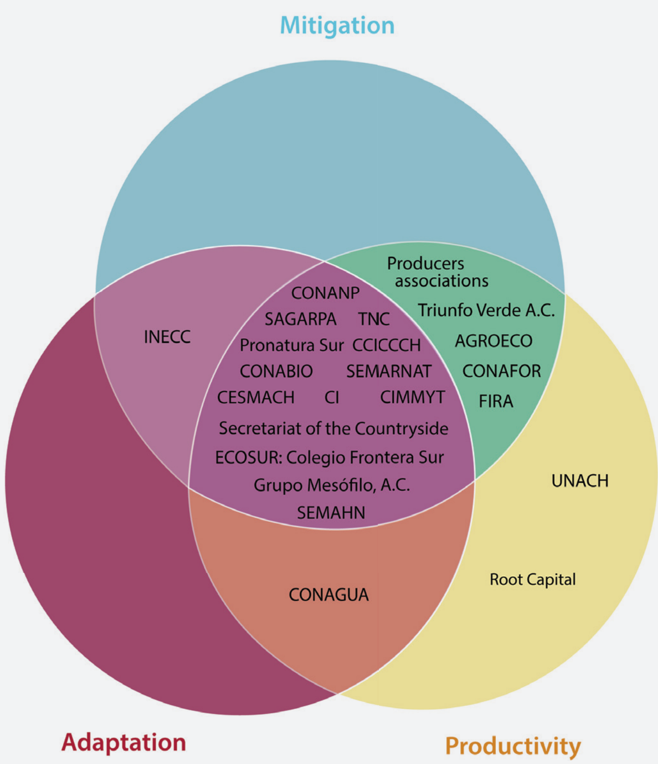
CO_2 Carbon smart · Water smart · Weather smart · N_2O Nitrogen smart · Energy smart · Knowledge smart

Institutions and policies for CSA

Due to Chiapas' relative underdevelopment, the state is an intervention priority for the Mexican government. A variety of non-government organizations (NGOs) and international organizations also have ongoing CSA-related projects in the state. Due to extensive support from multiple levels of government, Chiapas is committed to climate change management. Key CSA-related policies and programs include:

- State-Level Greenhouse Gas Emissions Inventory (IEGEI).
- Feasibility studies for REDD+[5] in Chiapas.
- Climate Change Action Program for the State of Chiapas - PACCCH, 2011.
- REDD+ Chiapa's strategy.
- Chiapas State Environmental Law for Adaptation and Mitigation of Climate Change (2009).

Primary Focus of Institutions Engaged in CSA



5 REDD+: United Nations Programme for Reducing Emissions from Deforestation and Forest Degradation, plus conservation and sustainable management of forests and enhancement of forest carbon stocks.

- Chiapas Climate Change Action Program (PACCCH, 2009).
- Interinstitutional Coordination Commission on Climate Change of the State of Chiapas (CCICCCH).
- Technical Consulting Council for REDD+ (CTC-REDD Chiapas).
- Water Law for the State of Chiapas.
- Law for the Sustainable Forest Development of Chiapas.
- Environmental Law of the State of Chiapas.
- Law for Civil protection for management of disaster risks.

The graphic on the left represents the main thematic foci of public and private institutions in Mexico related to the three pillars of CSA: adaptation, mitigation, and productivity. Unlike the national institutional landscape, CSA-related institutions in Chiapas show a high degree of cooperation and integration of climate change initiatives. Many of them address more than one, and even all three CSA pillars, as part of their agenda.

In the productivity pillar, Root Capital, an international non-profit organization, provides microloans and climate information technologies to farmers. The Autonomous University of Chiapas (UNACH) provides education on agricultural technologies and promotes research in agriculture for development.

Synergies between mitigation and productivity are promoted by the National Forestry Commission's (CONAFOR) forest-focused activities, including REDD+ development. Chiapas is one of the three early action areas for REDD+ development, which makes the state eligible for relative additional funding for sustainable forest management. The Nature Conservancy, with funds from the US Agency for International Development (USAID), further supports REDD+ development in the state. Similarly, Triunfo Verde is a coffee cooperative that works on sustainable agroforestry.

Synergies between productivity and adaptation are led by the National Water Commission (CONAGUA), the water institution in Mexico. In Chiapas, CONAGUA supports infrastructure projects to improve water provision in rain-fed plots and leads investment in public infrastructure for water capture and storage.

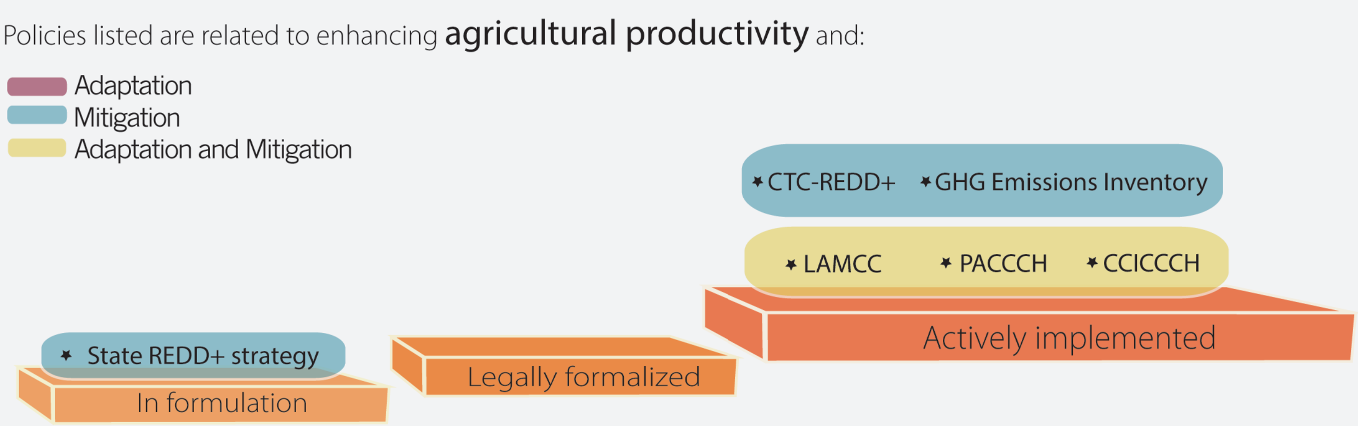
Institutions promoting synergies across all three pillars of CSA include the Secretariat of the Environment and Natural Resources (SEMARNAT) and the Natural Protected Areas Commission (CONANP), which are both environmentally focused institutions that work on sustainable land management initiatives, such as Natural Protected Areas and Sustainable Land Management Units. SAGARPA works closely with the state-level Secretariat for the Countryside. These two institutions, in addition to leading the agricultural agenda in the state, are involved in several productive initiatives and agriculture subsistence programs. These include energy cogeneration in sugar mills, production reconversion, and livestock production development, which are particularly relevant to Chiapas.

NGOs, such as Pronatura Sur and Grupo Mesófilo A.C., The Nature Conservancy (TNC), Conservation International (CI), among others, promote sustainable coffee production practices, such as agroforestry and organic coffee. They also implement sustainable forestry projects and REDD+ assessments and promote practices such as silvopastoralism. The National Commission for Knowledge and Use of Biodiversity (CONABIO) implements a program aimed at biodiversity-friendly production funded by the Global Environment Facility (GEF).

Colegio Frontera Sur (ECOSUR) researches payments for ecosystem services, livestock, climate change, agro-ecology, pest management, and sustainability. The Ecological Farmers of the Sierra Madre of Chiapas (CESMACH) is a farmers organization dealing with sustainable coffee production.

The state government has an Interinstitutional Coordination Commission on Climate Change (CCICCCH) that leads climate change policy development. The Secretariat of the Environment and Natural History (SEMAHN) is Chiapas' environmental ministry, spearheading work on conservation, Natural Protected Areas, and climate change issues. The state State Secretariat for the Countryside (Secretaría del Campo) implements federal programs, provides agricultural subsidies, and administers Environmental Management Units.

Enabling Policy Environment for CSA



CCICCCH Interinstitutional Coordination Commission on Climate Change of the State of Chiapas **CTC-REDD+** Technical Consultant Group for REDD+ **GHG Emissions Inventory** Chiapas' GHG Emissions Inventory **LAMCC** State Law for Adaptation and Mitigation of Climate change **PACCCH** Chiapas Climate Change Action Program

Financing CSA

National finance

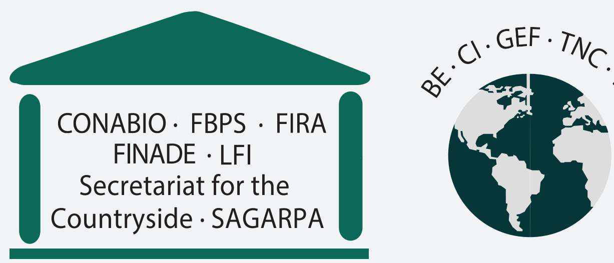
Funds to support CSA practices and related projects in Chiapas are generally sourced from the federal level. National sponsors such as the Trust Funds for Rural Development (FIRA) and SAGARPA are the most common source of CSA financing. The role of state-level institutions is to leverage their own funds, with federal-level resources, for regional and municipal implementation schemes.

For example, in 2010 the Chiapan government was financed through the federal budget to establish an office dedicated to climate change in its Ministry of the Environment. Similarly, Chiapas obtained financial support from the British Embassy in Mexico for the development of its PACCCH in 2009.

Furthermore, international organizations, such as USAID and Starbucks, have invested in CSA coffee and mango production in Chiapas through long-term financing of microcredit, microloans, and structured repayment schemes.

Funds for Agriculture and Climate Change

BE British Embassy **CI** Conservation International **CONABIO** National Commission for Knowledge and Use of Biodiversity **FBPS** Federal Budget Participation for the State **FINADE** National Financing Board of Agricultural, Rural, Forestry and Fisheries Development **FIRA** Trust Funds for Rural Development **GEF** Global Environment Facility **LFI** Local financial intermediaries **SAGARPA** Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food **TNC** The Nature Conservancy **WB** The World Bank



National and State Funds

International Funds

Accessed Funds · Financing opportunities

Outlook

Chiapas' most important development needs are related to food security, livelihood strengthening, and environmental degradation. CSA strategies that focus on these aspects should be considered priorities. Many Chiapan farmers are already using CSA practices, such as agroforestry and mixed cropping. However, for CSA to have a long-term impact on farmers' resilience and productivity in the face of climate change, there is a need to bolster technological capacity and farmer-led innovation. Doing so will require diversification of financial support to include more sources outside the government, as well as programmatic support to improve technical know-how. Fortunately, Chiapas' extensive external support network can draw on its strong history of CSA-related initiatives to ensure that these challenges are met.

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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: Production systems selection

Annex III: Ongoing CSA practices

Annex IV: Problems identified for the agriculture sector in Chiapas

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