Climate-Smart Agriculture in Uruguay

Climate-smart agriculture (CSA) considerations

- P $ Uruguay's agricultural sector contributes 7% to the GDP. The exports of agricultural products account for 71% of total exports of goods, supplying key products for the population's basic food needs and generating significant export surplus.
- A P Agriculture-related land use in Uruguay has undergone profound changes in the past decade, which reflects directly and indirectly the importance of developing sustainable production systems through policies and practices that promote CSA.
- A P In recent years, farmers have been affected by increased climatic variability, reflected in periods of excessive precipitation and flooding and more intensive and frequent drought.
- P A M Uruguay has long been considered on the forefront of natural resource management and conservation, particularly soils. Uruguayan producers, supported by public policies and a relevant system of applied research have been using many CSA practices including direct seeding in agricultural and forage crops, utilization of natural grasslands as a primary resource for meat production, and rainwater harvesting for livestock.
- M Opportunities for emissions removal/reduction come from forests, especially through commercial afforestation, which offset 57% of the country's total carbon dioxide emissions in 2010. Additionally, increasing the adoption of CSA practices related to manure, feed, and pasture management in livestock production systems, especially related to cattle, can contribute to reductions in the intensity of greenhouse gas (GHG) emissions of the sector.

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

- M Uruguay has a clear opportunity to adopt a low-carbon growth agenda, thus contributing to the national commitments to the United Nations Framework Convention on Climate Change (UNFCCC). Considering the agriculture sector's contribution to national emissions, CSA technologies and practices provide opportunities for sustainable intensification consistent with climate change adaptation and mitigation needs, thus enhancing development with considerations of environmental, social, and economic sectors.
- A M P Significant potential exists for adoption of CSA practices by farmers, and also a unique pro-CSA synergy between the national political vision, strategic guidelines, public action, and the generation of technologies, which provides an enabling environment for scaling CSA.
- A The Ministry of Livestock, Agriculture, and Fisheries (MGAP) has prioritized adaptation to climate variability and change in its policies and actions, incorporating it as one of the key pillars in the process of sustainable intensification.
- $ Financial institutions play an important role in adapting intensive fruit and vegetable production to climate change and variability, by consolidating initiatives that offer insurances against extreme events (e.g., hydrological events, storms, hail, wind, etc.), as well as unconventional insurances based on weather indices, in order to mitigate the effects of water and drought excesses. National public funding is vital for the sustainable implementation of CSA policies and practices on the field, and international cooperation (with existing and/or new partners) can further stimulate the expansion of CSA and help diminish barriers to implementation, particularly in the context of actions aimed at goals set out in the Intended Nationally Determined Contributions (INDC).

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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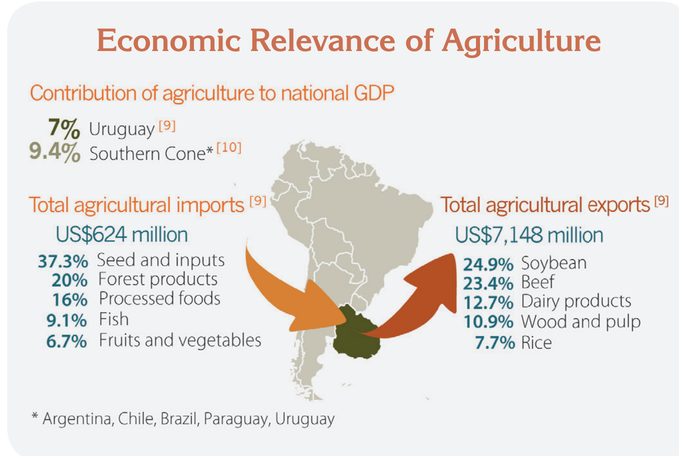
National context:
Key facts on agriculture and climate change

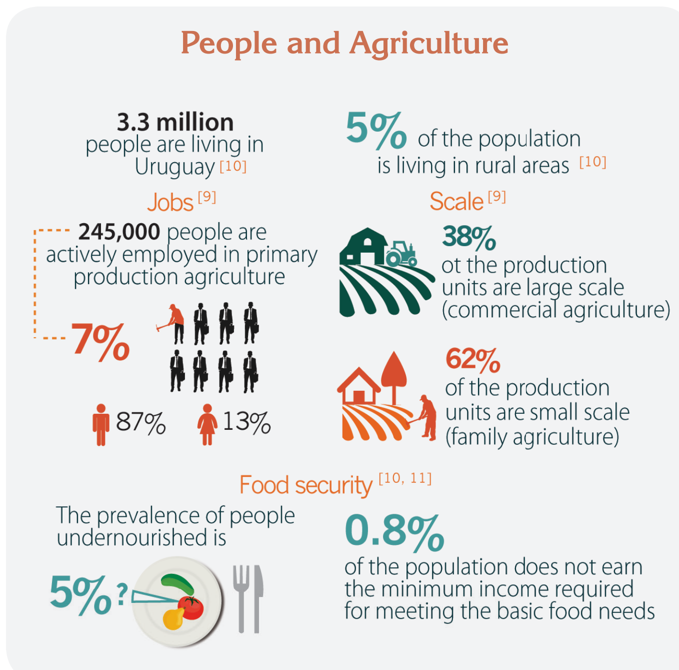
Economic relevance of agriculture

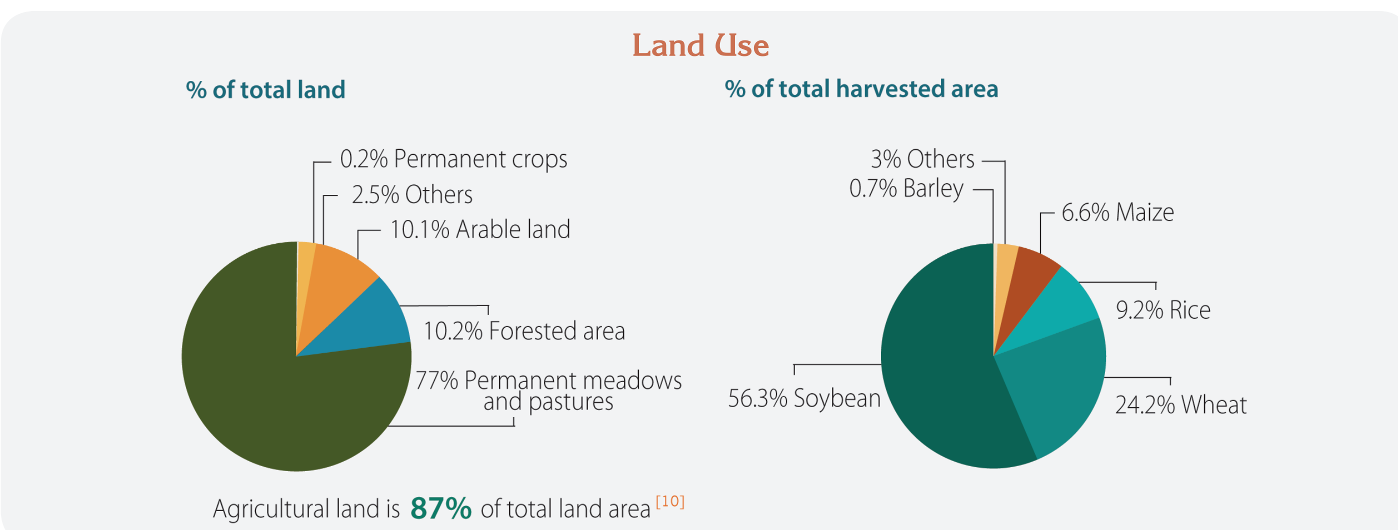
The agriculture sector contributes 7% to Uruguay's gross domestic product (GDP) and as much as 25% when indirect contributions are included [3] [4]. The sector provides the key products for the population's food basket (dairy, meat, flours, oils) [5], and generates more than 245,000 jobs, or 14% of the total domestic workforce [6]. As a result of a sustained process of intensification, agriculture exports have increased (in value) by 300% since 2005 and now exceed US$7 billion, representing 71% of the country's total exports [7]. At the same time, annual agricultural imports average US$624 million and include production inputs, tropical commodities (coffee, fruit, etc.), and other consumer products that are not domestically produced, such as *yerba mate* [8].

Land use

Agricultural activities extend over 16,357,298 hectares throughout the entire country. There are a total of 41,357 rural agricultural operations, of which 62% are family run[1] and 38% are commercial (large scale) [8]. These family operations occupy 15% of the total agricultural land and account for 15–20% of total production [8] [9]. In the last 15 years, the total number of producers (family and non-family farmers) has decreased by 12% [12], while the average size of agricultural establishments has increased by 27% (from 287 to 365 hectares).







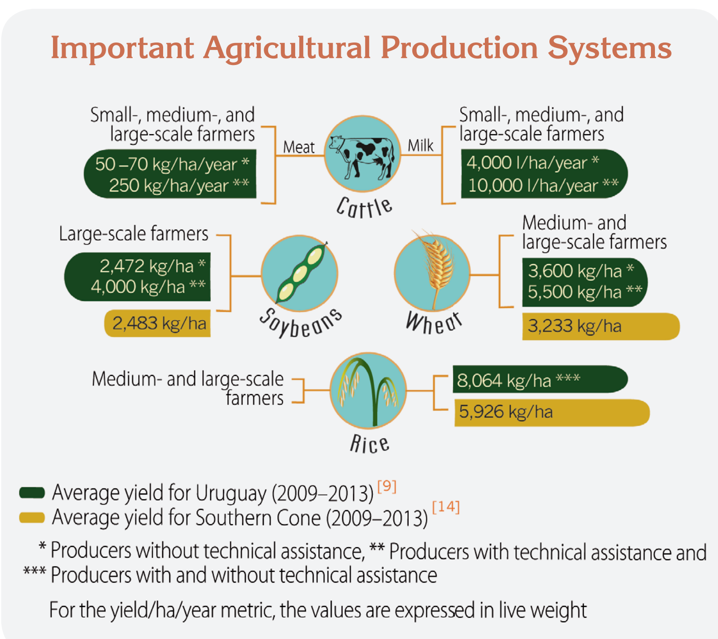
1 Uruguay has developed a legal definition of "family farmers" based on the following criteria: work a property smaller than 500 hectares CONEAT100 equivalent; reside on the farm or at a distance no greater than 50 km from it; get their main income from the activity and/or complete the workday on the farm; and perform productive activities in collaboration with up to two permanent salaried employees, or its equivalent in daily harvest wages.

Agricultural production systems

Uruguay's different land uses include annual crops, pastures, native grasslands (commonly referred to as "natural grasslands") and forests, with the following distribution by subsectors [13]:

- Natural grasslands dedicated to livestock rearing, occupying 11,201,212 hectares of predominantly pastoral lands across the country (68.5% of the country's total area).
- Natural forests and forest plantations occupy 1,634,610 hectares (10%), mainly in the central and northern areas of the country.
- Cereal and industrial crops comprise approximately 1,545,889 hectares (9.5%), mainly on the west coast and in the south-central region, while rice is grown on 196,000 hectares (1.2%) in the country's eastern plains and northern deep soils.
- Dairy farming is practiced mainly in the South and Southwest, on 890,000 hectares (5.4%).
- Fruit (citrus trees, deciduous plants, and vineyards) and field and greenhouse horticulture occupy 58,354 hectares, mainly in the metropolitan region and on the west coast, as well as around the departmental capitals.

Recent trends indicate an increase in agricultural cropland (mainly soybean) and a decline in land devoted to livestock grazing. However, livestock production has remained stable and even increased slightly, suggesting improved production efficiency in the subsector [14].



While there is a significant upward trend when it comes to productivity per unit of input for the main production systems in the country, there is an observed gap between average yields obtained by non-specialized and specialized producers. Examples of this gap are reflected in meat and milk production (specialized producers, most of whom benefit from technical assistance [through CREA groups] reach annual yields 5 times higher for meat and 2.5 higher for milk, compared to non-specialized farmers), soybeans, and wheat [9]. Uruguayan producers face significant challenges with respect to all dimensions – environmental, social and economic. For instance, 30% of the total land area and 80% of the country's arable land present some degree of erosion [19].

Agricultural greenhouse gas emissions

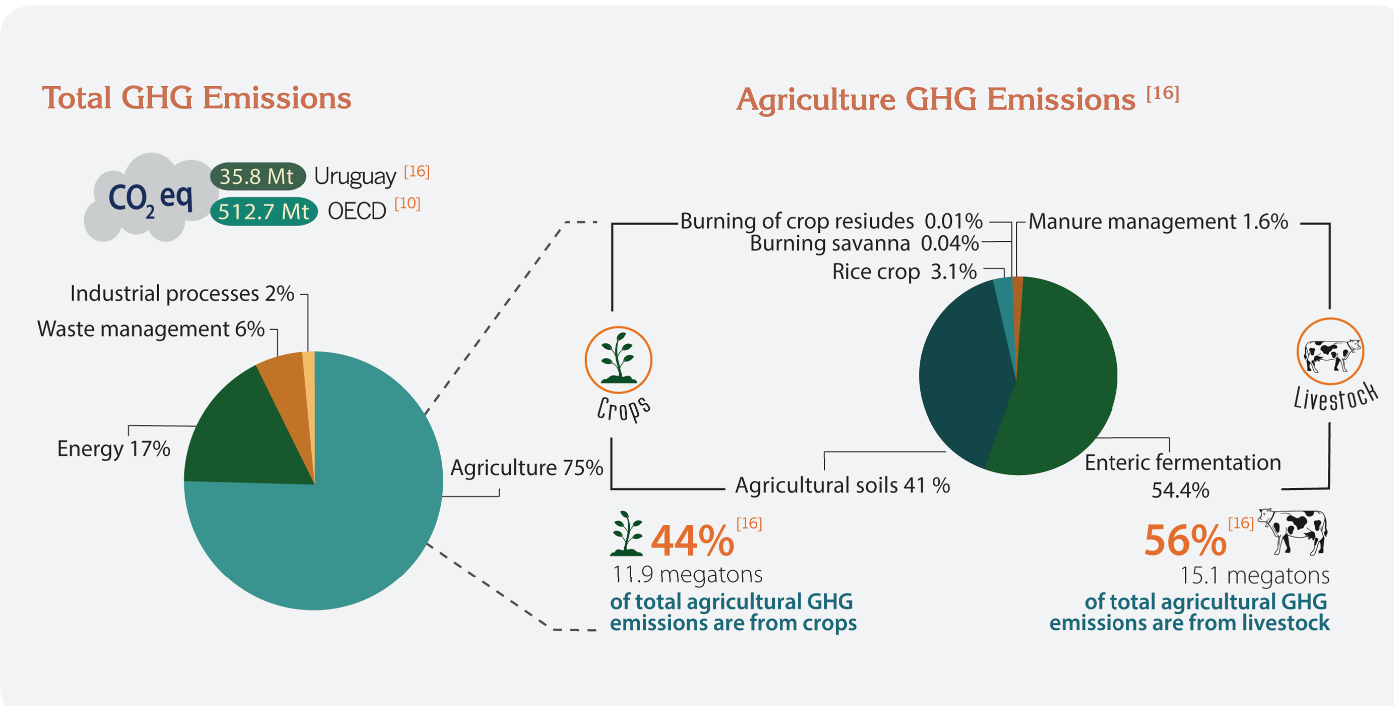
Uruguay has a carbon footprint of 1.6 tons of CO2 per capita, a relatively low value compared with Latin America (2.6 tons of CO_2 per capita) and the global average (4.5 tons of CO_2 per capita).[2] In accordance with the National Climate Change Response System (SNRCC), Uruguay emits only 0.04% of the total planet emissions. However, looking at national emissions levels, the agriculture sector contributes about 75% to the country's total GHG emissions, expressed as CO_2 equivalent. In comparison, the energy sector accounts for 17.3%, industrial processes 1.5% and waste management 6.5%. Land Use, Land-Use Change and Forestry (LULUCF) account for reach 10.2% of total emissions [16] [17].

2 While Uruguay is ranked 89th in the world in terms of total GHG emissions, according to data from the Third Communication (2010), it ranked 30th in per capita GHG emissions. Therefore, a clear opportunity exists for Uruguay to adopt a low-carbon growth agenda, fulfilling its commitment to the UNFCCC.

Enteric fermentation contributes more than 50% to the total agriculture sector emissions. This unusually high proportion is related to the predominance of the livestock cattle sub-sector, and its reliance on direct grazing on pastures and natural grasslands. Other sub-sectors contributing to agriculture emissions are: agricultural soils (41%), rice cultivation (3.1%), manure management (1.6%), and savanna burning (0.04%) [16] [17].

In general, there is a tendency towards higher productivity through increased intensity of land management and production practices. Although this intensification is expected to increase baseline agricultural emissions through 2035, emissions intensity will actually decline in many cases. More specifically, while the total emissions associated with agricultural production are rising, as productivity is rising faster than emissions, the ultimate result is lower emissions per unit of output. In global terms, this additional production on the same area means that this volume of the demand for food will not have to be met by expanding agricultural production somewhere else in the world, where it is likely to result in deforestation. As such, Uruguay's agricultural intensification would contribute to an overall reduction in GHG emissions worldwide.

Importantly, commercial afforestation contributes significantly to emissions removal in the country. In 2010, the LULUCF sector removed 3.6 megatons of CO_2, which offset 57% of the country's total CO_2 emissions. It is noteworthy that Uruguay is not affected by deforestation; on the contrary, the country's forested area has increased sharply in recent times [18].



Challenges for the agricultural sector

Uruguay's agriculture sector has undergone profound changes in land use in the last decade, providing opportunities to promote the adoption of CSA policies and practices towards sustainable production systems. The main challenges facing the agricultural sector in Uruguay are related to:

- Changing availability and use of natural resources due to the expansion of the area dedicated to annual crops (especially soybeans)[3] [19].
- Land erosion and expansion of arable land on more fragile soils, associated with the conversion of land that historically supported livestock into commercial and/ or export crop production, as a response to the global demand[4] [19].

3 The area allocated to soybean crops increased in the last decade from 35,000 hectares (2004/2005) to 1,000,000 hectares (2014/2015).

4 In 2000, 30% of the country's agricultural land area showed some sign of water erosion, concentrated mainly in the agricultural regions of the south and west coast.

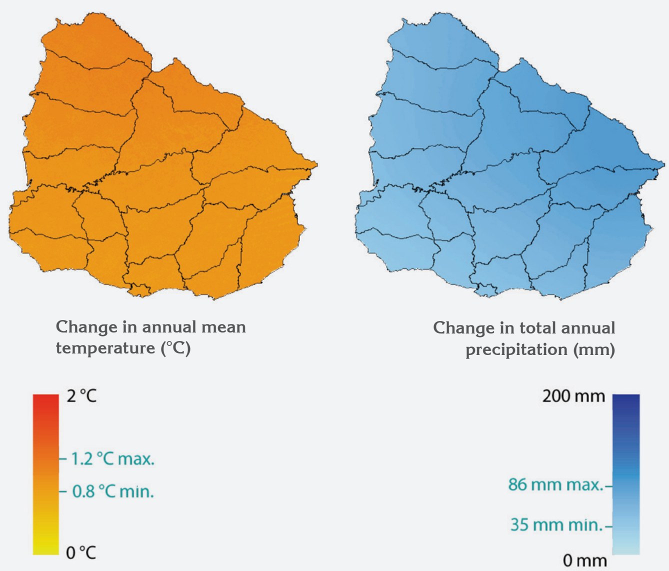
- An increased overall efficiency of the sector, associated with the modernization of the agricultural machinery pool and the adoption of agricultural techniques by agricultural enterprises (commonly called planting "pools"), which has come with significant side-effects on soils' health.
- Existing and potential environmental impacts due to agricultural expansion and intensification that rely on increased pesticides and fertilizer use. For instance, the use of pesticides and fertilizers tripled between 2005 and 2014, generating high volumes of waste, among others.
- The underutilization of rainwater supply, through irrigation and water harvesting systems, which challenges water availability in major production systems [21].
- Insufficient resources (e.g. knowledge, financial capital) affecting small-scale farmers' capacity to recover from adverse periods of water stresses (shortages and excesses), contributing to a significant decrease in family agriculture establishments. Between 2000 and 2008, 54% of the area occupied by farms of less than 200 hectares was sold [22].
- The country's exposure to fluctuations and increased volatility of international markets,[5] as evidenced by the recent fall in prices of some products (2014) and reduced demand of key markets for Uruguay, such as China. This has significantly affected the agricultural sector, especially dairy and soybeans production.
- The increased market competitiveness as countries seek access to "premium" market niches, challenging Uruguay's position as an internationally recognized supplier of high-quality products.

Agriculture and climate change

Uruguayan producers experience the effects of climate variability and change. Threats to agricultural production will likely increase in the future if temperature increases and the hydrological regime changes. Based on projected climate scenarios, the country is expected to experience diverse plausible scenarios of increased or decreased average temperature (between 0.3–0.5 °C by 2020, 1–2.5 °C by 2050, and up to 3.4 °C by 2100) and precipitation (112 mm/month, a 12% increase by 2020, and 157 mm/month by 2100 or 57%). Medium-term projections (by 2030) do not show significant change in temperature and precipitation in the country.[6] However, an increase in climate variability and in the frequency and intensity of extreme weather events (rain, wind, storms, and prolonged periods of droughts) is likely to occur. These phenomena can cause significant changes in agricultural yields, accelerating soil erosion by water, affecting water availability and use, and increasing pressure from pests and diseases. These, in turn, have significant economic impacts, especially affecting the livelihoods of family farmers [22].

In the last 10 years, Uruguay's floods and droughts have been characterized by greater intensity and frequency, as compared to historical records. Severe and repeated droughts and floods have had a strong negative impact on production, accentuating soil erosion by water and the availability and use of water for agricultural production. In 2008, the summer drought that affected the departments of the south-central region (Canelones, San José, Florida, and Flores) and the East (Maldonado, Rocha, and Treinta y Tres) was followed, months later, by heavy rains that caused flooding that resulted in losses of approximately US$340 million. In 2015, a winter drought in the same region affected more than 2,000 cattle farmers.

Projected Change in Precipitation and Temperature in Uruguay by 2030



Projections based on the RCP 4.5 (Representative Concentration Pathways) emissions scenario [23] and downscaled data using the Delta method [24].

5 About 75% of Uruguayan exports come from the agri-food sector.

6 Increased precipitation in the summer and in winter are also expected, but it is worthwhile mentioning that such seasonal projections vary significantly across the climate models used.

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].

Uruguayan producers have been using, adapting and refining many CSA practices over the course of time. For meat production, which covers most of the agricultural area of the country, one of the most commonly used practices is the integrated management of pastures (use of natural grasslands), which incorporates activities aimed at ensuring drinking water availability for livestock. Despite its high climate-smartness scores (given its contributions to adaptation and mitigation efforts), only a small percentage of family farmers actually manage natural grasslands. The differential adoption of the practice by farmers is related to the producer's livelihoods, knowledge, and investment capacity.

For dairy production, the majority of practices are focused on water distribution throughout the property and the use of supplementary irrigation in strategic areas of the dairy farm (on approximately 10% of the total area). Strategic water management stabilizes production and enhances manure management, however, it has low adoption levels.

In the case of rain-fed agriculture (soybean, maize, wheat), given that more than 70% of the area is cultivated by medium and large-scale[7] companies, CSA practices such as direct seeding and land use and management plans have higher levels of adoption. This sub-sector is already practicing site-specific agriculture, where, by means of computers, planting densities and fertilization doses are adjusted on the basis of yield potential of each site [25].

For intensive vegetable production (citrus, deciduous plants, horticulture) the most common CSA practices fall under the umbrella of integrated crop management and include techniques for soil, pests and disease management that contribute to more stable and/or increased production and to reduced use of agrochemicals. For instance, techniques of sexual confusion in fruit trees for managing *Grapholita molesta* in peaches and *Carpocapsa pomonella* in apples and quince allow for a reduction in insecticide use from 12 applications to 2 (on average per season), while soil solarization for pest and disease management in horticulture reduces the amount of agrochemicals used by 40–50% [26]. Moreover, the use of water-efficient systems, such as drip irrigation, crop-specific water supply (adapted to crop demand), automatized equipment, as well as technical trainings for producers and technicians are also common, especially in rice production systems. However, in the southern production regions, where water supplies are limited, efficient irrigation systems are difficult to implement and less common, which hinders an adequate water supply for the implementation of these irrigation systems.

Other opportunities with high impact potential

Uruguay has a clear opportunity to scale out CSA practices that bring important benefits to productivity, adaptation, and mitigation, complementing existing efforts. For instance, improving management of and access to relevant climate information would encourage the adoption of integrated resource management techniques and allow farmers to prepare for potential extreme events (water shortages, droughts).

Moreover, comprehensive CSA practices for the livestock production system (especially meat) such as the "technological ladder methodology" [27], developed by the Plan Farming Institute (IPA), including farm planning (mapping the sites, land-use capacity, etc.), and management (of forages, water, shade, risks) are common among large-scale farmers but rarely adopted by small-scale farmers. Scaling adoption will require targeted incentives.

Formalizing the Plans for Sustainable Dairy Production (PLS, Spanish acronym), now in pilot phase, represents another entry point for CSA scale out in Uruguay.[8] By promoting rotations or successions of crops and/or pastures on a specific land use and management area, and by emphasizing the need for responsible management of organic and chemical fertilizers, these plans are intended to avoid soil loss rates higher than the acceptable threshold. However, more focus on the reuse of effluents as biofertilizers is recommended, as a strategy to enhance the quality and promote the conservation of water bodies around the farm.

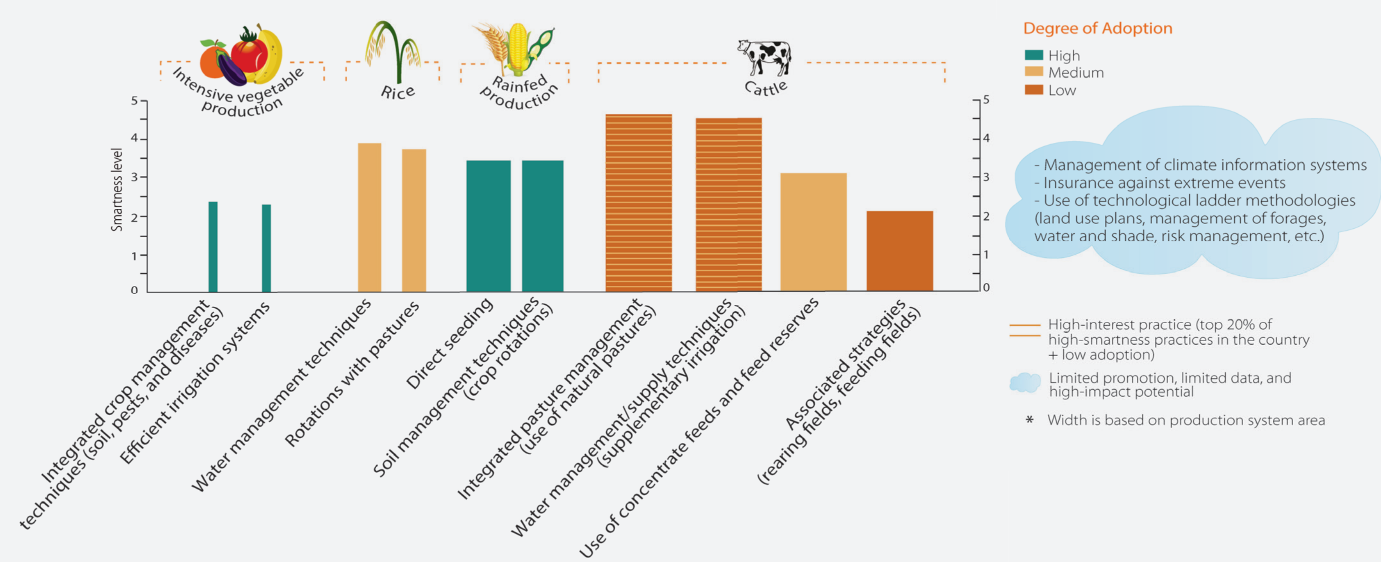
For Uruguay's rain-fed agriculture, there is high potential for improving water harvesting from surface runoff and increasing water-use efficiency, which would not necessarily imply an increase in the agricultural area but, on the contrary,

7 Nearly 84% of the total volume is handled by ten companies.

8 Dairy production in Uruguay is based on grazing over different periods of time (2 to 4 years), as well as on summer and winter crop production, which indicates the need for medium-term land-use planning (5 to 6 years).

would allow for greater productivity and a better carbon balance in the soil. To this end, there are various initiatives to expand supplementary irrigation, such as: (i) credit programs that facilitate irrigation projects, (ii) associative water strategies, (iii) tax exemptions for irrigation projects, and (iv) revision of the irrigation law (Law No. 16.858 and regulatory decrees). Moving forward, intensive vegetable production systems will need to strengthen existing initiatives related to insurances against extreme weather events. Currently, 20% of the horticultural area of the country is insured against excess water (with uninterrupted rains that last for more than 48 hours), another 70% against storms, hail, wind, etc. (in the case of deciduous trees), while around 55% of total greenhouse horticulture production is insured against wind and hail storms.

Selected Practices for Each Production System with High Climate Smartness



This graph displays the smartest CSA practices for each of the key production systems in Uruguay. 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).

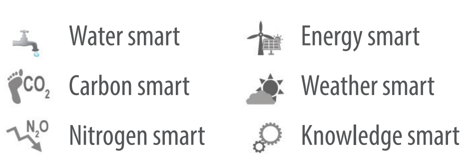
Table 1. Detailed smartness assessment for top ongoing CSA practices by production system as implemented in Uruguay

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 III.

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Beef cattle 68.5% of land-use area	Integrated pasture management (natural pastures) Low adoption (0–30%) for small-scale farmers High adoption (>60%) for medium- and large-scale farmers		Improves management of natural pasture; efficient use of pasture ensures increased availability of forages during periods of climate variability.	Reduces emissions, improves quality of livestock fodder. Increases levels of carbon and nitrogen in soil.	Biomass calculations inferred from high altitude forages and green index match the productivity of the natural grazing field. The comprehensive management of natural pasture by selective grazing (based on animal category) and forage conservation improves productivity indexes of livestock breeding and rearing.

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Beef cattle 68.5% of land-use area	Water management/ supply techniques (supplementary irrigation) ■ Low adoption (0–30%) Higher adoption levels in the departments in the East and Northeast		Maintenance of natural pastures ensures water availability during periods of water scarcity, maintains cattle's physical and productive condition.	Contributes to mitigation of emissions through the improved management of natural pastures.	Improved and/or constant amount of livestock/ area unit, independent of climate conditions.
Dairy cattle 5.4% of land-use area	Use of concentrate feeds and feed reserves ■ Medium adoption (30-60%)		Increases food availability during extreme climate conditions.	Does not contribute directly to emissions reductions. Reduces emissions per unit of product.	Ensures, maintains, and improves the productive structure.
	Associative strategies (rearing fields, feeding fields) ■ Low adoption (0-30%)		Decreases dependence on food and water throughout establishment.	Reduces emissions through increased efficiency of inputs and machinery.	Improves productivity by expanding the area for cattle production.
Rainfed agriculture (soybean, maize, wheat)	Direct seeding ■ High adoption (>60%)		Reduces labor-related soil degradation, increases water availability. Allows for time for decision-making.	Increases carbon stock when implemented comprehensively.	After 5 years, productivity continues to increase.
	Soil management techniques (crop rotations) ■ High adoption (>60%)		Improves and better maintains soil quality. Crop rotation promotes system's sustainability (decreasing likelihood of pests, diseases, weeds).	Increases levels of carbon and nitrogen in soil.	Production is maintained in both medium and long term.

	CSA Practice	Climate Smartness	Adaptation	Mitigation	Productivity
Rice 9.2% of total harvested area	Water management techniques Medium adoption (30–60%)		Improves resource efficiency. Permits larger sowing area.	Reduces methane emissions up to 40%.	Research shows yield decreases.
	Rotation with pastures Medium adoption (30–60%)		Reduces soil degradation. Boosts system sustainability.	Contributes to increased levels of carbon sequestration in soils, while diminishing the need for nitrogen fertilizer.	No increases in productivity, but does improve system sustainability over time.
Intensive vegetable production (citrus, fruit, horticulture) 3.0% of total harvested area	Efficient irrigation systems High adoption (>60%) in Salto and Artigas (Bella Unión), San José Medium adoption (30–60%) in Canelones		Assures availability of water in periods of water scarcity.	Contributes to reduced emissions per unit of product.	Establishes and improves product's productivity and quality. Maintains and/ or improves producer's income.
	Integrated crop management (soil, pests, and diseases) High adoption (>60%)		Promotes maintenance and conservation of natural resources.	Contributes to reduced emissions, primarily through reduction of agrochemicals.	No influence.



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; not applicable; no data.

Case study:

An Agro-Smart and Sustainably Intensified Uruguayan Agricultural Sector

Uruguay is seeking to expand its actions within the agricultural sector, based on five strategic public policy approaches for 2015–2020. These guidelines include: a) promotion of competitiveness; b) sustainable intensification; c) climate change adaptation; d) rural development; and e) strengthening institutional coordination. Many of these actions are rooted in improved quality and access to relevant and useful information for decision-making and planning.

To this end, Uruguay is in the process of modernizing its information services. This is partly driven by the National Agency for e-Government and Information Society (AGESIC), which in recent years has established the legal basis for information access, protection and security, transparency promotion, and improved client services quality.

Within this process, the Ministry of Livestock, Agriculture and Fisheries, with support from the World Bank, is implementing the National Agricultural Information System (SNIA, Spanish acronym). SNIA intends to integrate data from distinct public and private organizations and provide them as a public good, thus ensuring that the entire society is provided with accurate and timely information. Ultimately SNIA will contribute to improved decision-making related to national-level agricultural and fishery production.

Given the importance of climate information for agricultural and fishery production systems, SNIA generates needed information interoperability with relevant national data with providers, such as the National Institute for Meteorology (INUMET) and the Agro-climate and Information Systems Unit (INIA/GRAS), with the aim of supplying agro-climatic services. Ongoing climate monitoring for livestock provides an example where activities include monitoring precipitation levels and distribution, related anomalies and drought indices, surface temperature, the state of vegetation using vegetation indices, such as the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Water Index (NDWI), water balance, pasture productivity, and livestock inventories.

SNIA's products are focused on generating tools that facilitate decision-making and impact verification. For example, during the autumnal drought of 2015, SNIA facilitated the exchange of information between relevant institutions, which led to an informed declaration of a drought emergency. SNIA integrated data from different sources, ultimately supporting the distribution of food supplements for affected livestock.

Finally, SNIA supports public policy efforts aimed to improve sustainable intensification and resource conservation. Current initiatives include integrating information from land use and management plans into assessments of agriculture's impact on the environment in the Santa Lucia river basin, into road network planning, and into infrastructure development for production collection.

Photo: Michael Carroll

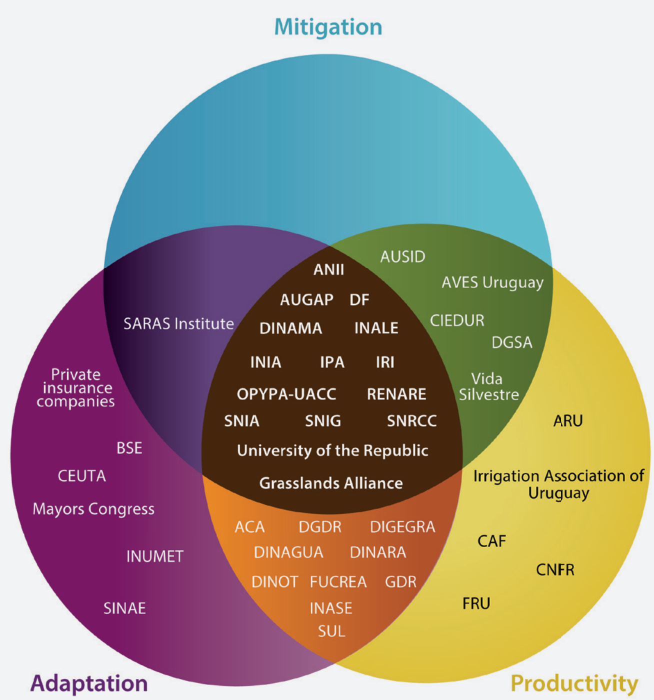
Policies and institutions for CSA

Uruguay actively participates in numerous regional and international forums related to environmental issues of global importance. Uruguay has ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and the Kyoto Protocol in 2000 (through Law 16.517 and Law 17.279, respectively). Uruguay submitted three National Communications under the Convention (1997, 1998, and 2010), and is in the process of drafting the Fourth Communication. Regionally, Uruguay is an active member of the Southern Agricultural Council (CAS) and coordinates the Intergovernmental Working Group on Public Policies linked to Climate Change[9] (GT4) and forms part of the Cooperative Program for the Development of Agricultural Technology in the Southern Cone (PROCISUR). In this group, mitigation and adaptation to climate change have been included as prioritized agenda.

In Uruguay, national institutions have crosscutting mandates, with the dual function of (1) developing and implementing actions to respond to climate change, and (2) coordinating the actions being advanced by sectoral institutions in climate-related matters. Key sectoral institutions include: the National System of Response to Climate Change (SNRCC), currently operating under the National Directorate of Environment (DINAMA) (dependent of the Ministry of Housing, Spatial Planning and the Environment [MVOTMA]); the National Emergency System (SINAE) and the Environmental Cabinet. Assisted by the Climate Change Unit (UCC) of the DINAMA, SNRCC proposes policies and actions at the national level and establishes the country's position on matters of climate change at international forums. MVOTMA also serves as Uruguay's focal point before the UNFCCC and the Kyoto Protocol. By sector, all production-related ministries have units or technical advisory committees aimed specifically at climate change issues. In 2000, the MGAP became one of the first ministries of agriculture in Latin America to create a unit dedicated to climate change (the Climate Change and Agriculture Unit [UACC]), housed under the Agricultural Programming and Policy Office (OPYPA).

Together with IPA, the academic sector (University of the Republic/Faculty of Agronomy – UDELAR/FAGRO – and private academic institutions), and a growing number of agreements and activities of South-South cooperation, MGAP coordinates crosscutting actions of innovation and technological training, information management, and organization and institutional strengthening. The National Agricultural Research Institute (INIA) has a leading role in generating technologies for the sustainable development of agriculture and livestock and has been a pioneer institution in the region, conducting adaptive research to reduce emissions from bovine cattle.[10] INIA runs the Agro-climate and Information Systems Unit (GRAS) and works with other specialized institutions both nationally and internationally.

Primary Focus of Institutions Engaged in CSA



Given that the goal of sustainability has environmental, social, and economic dimensions, there are numerous entities that cooperate to provide research, extension, technical assistance, and training programs. They include institutes such as the National Milk Institute (INALE), IPA, Uruguayan Wool Secretariat (SUL), the Uruguayan Federation of Regional Consortia for Agricultural Experimentation (FUCREA), the Uruguayan Association of Direct Seeding (AUSID), the Campo Limpio Civil Association; academia (the South American Institute for

9 Uruguay is also a member of other inter-governmental groups engaged in CSA themes, such as the Group for Agricultural Risk and Insurance Management, Ad-hoc Group for Agricultural Water, and Ad-hoc Group for Soils.

10 Projects of INIA-GRAS include the "Climate and Climate Change" and "Modern Information Systems and Support for Decision Making" (SISTD), which use modern tools such as remote sensing, geographic information systems (GIS), global positioning systems (GPS), and simulation models for the access, analysis, and management of information on weather events.

Resilience and Sustainability Studies (SARAS), FAGRO and FIECN (of UDELAR); private universities; central and local structures of producers' associations (the Federated Agricultural Cooperatives [CAF], the National Commission for Rural Development [CNFR], the Rural Association of Uruguay [ARU], the National Association of Milk Producers [ANPL], the Rice Growers Association [ACA], the Uruguayan Association of Milk Producers [IPL], the Uruguayan Grasslands Cattlemen's Association [AUGAP] and the Grasslands Alliance).

Climate change is a highly significant factor for the Uruguayan agricultural sector. As such, the MGAP has prioritized adaptation to climate change (with emphasis on climate variability) in its policies and actions, incorporating it as one of the pillars of the process of productive sustainable intensification that it promotes. Institutionally, this priority has led to strengthening all MGAP agencies involved in the development of public policies and/or the use and management of the different components of the productive matrix of each subsector.

Uruguay has a long and proven track record as a leading country in the management and conservation of natural resources. In the 1960s, Uruguay was the first country in Latin America to develop a detailed map of soil suitability, covering the country's total agricultural and livestock production area, a map which is still in use today.[11]

This focus on conservation of natural resources has become even more relevant with the changes in land use in the past decade. The productive transformation of land (fostered by favorable conditions for commodities, technological advances, and the significant growth of foreign investment) has led the authorities to develop a strategy known as "Agro-Smart Uruguay" (Uruguay Agro Inteligente) [30], which, since 2010, has guided the public policies of the agricultural sector based on five strategic areas: competitiveness, sustainable intensification, adaptation to climate change, rural development and institutional strengthening and integration.

Uruguay not only exhibits a favorable outlook in terms of adoption of CSA practices by producers, but also demonstrates a unique pro-CSA synergy that combines political vision, strategic guidelines, technology advancement, and public support. Some of the principal actions taken by Uruguay in general and the MGAP in particular include:

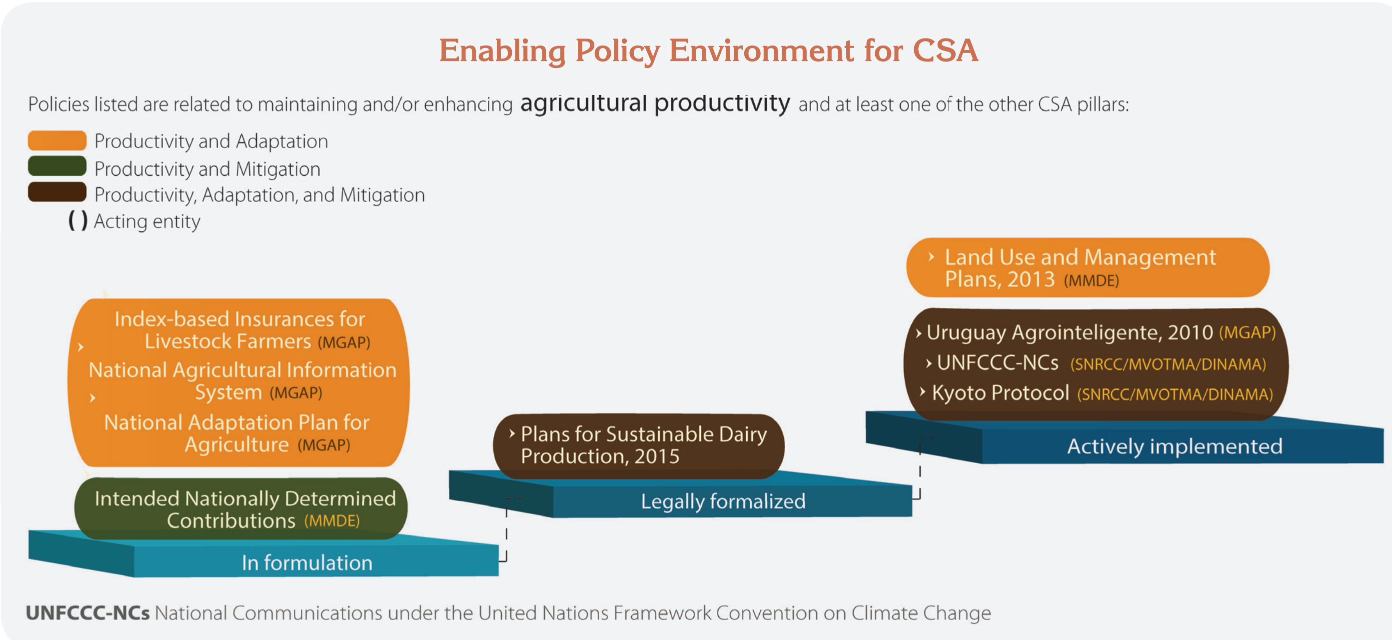
- **Land-use and management plans** implemented by farmers, which promote crop rotation and ground cover to minimize erosion and land degradation.
- **Weather insurance plans** developed for horticulture, dairy and livestock breeding that are pilot rate-based and considerate of farm scale.
- **Agro-climate and Information Systems** (GRAS) focusing on assessing and determining the impact of and vulnerability to climate change and identifying possible adaptation measures.
- The **National Agricultural Information System** (SNIA) providing an integrated information system platform to improve decision-making related to climate variability, for both the public and the private sector.
- **Regulatory adjustments** aimed to reduce emissions and improve the use of agrochemicals, including product registration, satellite monitoring of applications, recycled packaging, and promotion of biological products.
- **Policies aimed at sustainable intensification of the livestock sector** through actions that are expected to reduce methane and N_2O emissions by 33% and 31%, respectively, per kilogram of meat produced, by 2030 compared to 1990.[12]

In relation to mitigation efforts, several recent studies have identified mitigation actions aimed at reducing the intensity of emissions, consistent with the strategy to reduce emissions per unit of production. These studies include: the carbon footprint studies [31] – led by MGAP – the Low-Carbon Growth Study – prepared by the Uruguayan government and the World Bank [18] – the preliminary studies for the Fourth National Communication under the UNFCCC, and the first draft of the expected INDC. Not only have these works contributed to the consolidation of the sector's strategic guidelines for GHG emissions, but they have also made it possible to identify a series of mitigation actions for the agricultural sector, mainly aimed at reducing the intensity of emissions, consistent with the strategy to reduce emissions per unit of product. Exemplary practices include: improving productivity and efficiency in meat, milk, and rice production; reducing the intensity of emissions from manure deposited in soils; increasing native and planted forest land and reducing degradation; increasing carbon stock in soils under natural grasslands; increasing the area under irrigation; reducing methane emissions from rice production by managing flooding; efficient use

11 The soil categorization uses a CONEAT index (Comisión Nacional de Estudio Agronómico de la Tierra [National Commission for the Agricultural Study of the Earth]).

12 According to the country's position to be formalized in the Intended Nationally Determined Contributions (INDC) document, mitigation efforts are focused on improving the sector's efficiency, measured in emissions per unit of product.

of nitrogen fertilizers; improving effluent treatment and recycling systems in intensive animal production facilities. These instruments are described in more detail in Annex IV.



CSA funding

National funding

Support for the agricultural sector is commonly linked to effort to improve adaptation to short-term climate change, namely, increasing seasonal climate variability. Financial incentives provided by the MGAP include promoting supplementary irrigation totaling US$28 million for more than 6,000 family farmers[13] and securing water sources for more than 3,000 family livestock producers (12% of the country's livestock producers) occupying 30% (703,000 hectares) of the family livestock area.[14] MGAP also works towards the conservation of natural grasslands through the introduction of subdivisions, fodder reserves, and native leguminous species that have benefited more than 1,700 family farmers (442,000 hectares).[15] The Agricultural Emergency Fund (FAE) and the Fund for Farm Development (FFG) fund prevention and early warning programs for producers affected by weather emergencies. The National Response Plan to Climate Change and the development of innovations to facilitate the national response to climate change and variability (implemented with INIA, UDELAR-CIRVCC, and the SARAS Institute) are underway. In 2012, the SARAS Institute was also responsible for preparing a detailed study of the country's adaptation needs [33].

International funding

Both bilateral and multilateral international financial institutions cooperate with Uruguay in initiatives related to climate change. While there are no initiatives that identify CSA as a specific objective, the vast majority of existing initiatives are aligned with the strategic priorities of MGAP and, therefore, includes activities associated with CSA. In this context, MGAP channels most of the financial support from multilateral organizations towards the adaptive capacity of family farmers. Technical support is mainly used to strengthening institutions and develop technologies and decision-making tools. Some examples of topics and projects with international funding include:

13 In addition, tax exemptions worth US$76 million have driven investment in irrigation equipment worth over US$140 million.

14 With a contribution of US$18.8 million, these programs encouraged the construction of rainwater capture structures (dams) and on-farm distribution systems.

15 The same programs mentioned in the previous item allocated a total of US$12 million to support technologies that improve management of natural pastures.

- Sustainable management of natural resources and adaptation to climate change (DACC Project, funded by the World Bank).[16]
- Resilience-building and ecosystem-based adaptation among livestock producers located in the country's most superficial soil areas (funding from the Adaptation Fund [AF]).
- The National Adaptation Plan for the Agricultural Sector (NAP), in its early implementation phase (funding from Germany, with support from FAO and UNDP).
- Climate-smart livestock (GCI Project, in early stage of development and with support from GEF).

Outlook

In recent years, authorities, technical actors, and farmers have worked together to improve Uruguay's productivity levels through agricultural intensification that took into account the efficient use of natural resources. This strategy, termed "Agro-Smart Uruguay," incorporates climate change resilience as one of its pillars. The involvement of technical, political and farming actors in the development and adoption of CSA technologies has positioned Uruguay as a leader in CSA.

Consolidating this sustainable production model will require Uruguay to overcome several challenges, namely:

- Better use of surface water runoff for supplementary irrigation of agricultural crops and fodder and the intensification and resilience of extensive livestock systems.
- Reduction of contamination caused by effluents and agrochemicals stemming from intensive agricultural and livestock activities, especially in critical watersheds.
- Definition of concrete courses of action to reduce absolute and relative GHG emissions from the agricultural sector, particularly livestock.
- Promotion of livestock production systems based on the use and conservation of natural grasslands and associated ecosystems.
- Advance the development, integration, and dissemination of specific information systems (SNIA-GRAS, etc.) to improve decision-making in the public and private sectors.
- Improved inter-agency cooperation, including international resources such as the UNFCCC, for applied research for the development of technological packages of CSA and the formulation of policies based on territorial and productive multi-sectoral planning by landscape units and/or basins.

Funds for Agriculture and Climate Change

AECID Spanish Agency for International Development Cooperation **AF** Adaptation Fund **AUGAP** Uruguayan Association of Grassland Ranchers **BSE** State Insurance Bank **CEUTA** Uruguayan Center of Appropriate Technologies **CIEDUR** Inter-disciplinary Development Studies Center **DINAMA** Uruguayan National Environment Directorate **FAO** Food and Agriculture Organization of the United Nations **GEF** Global Environment Facility **IDB** Inter-American Development Bank **IFAD** International Fund for Agricultural Development **INIA** National Agricultural Research Institute **IPA** Plan Farming Institute **KFW** German Development Bank **MGAP** Ministry of Livestock, Agriculture and, Fish **SNRCC** National Climate Change Response System **UNDP** United Nations Development Programme **UN-REDD+** United Nations Collaborative Initiative on Reducing Emissions from Deforestation and Forest Degradation **WB** The World Bank

16 Some actions of the project are related to: design and implementation of soil conservation policies, with more than 11,000 plans covering almost the entire agricultural area presented by 400 accredited agronomists; the construction of a satellite images system that enables monitoring and analysis of the plans submitted; the direct transfer of resources to family and middle-sized producers through public calls for submitting property and multi-property proposals. In this sense, the project supported more than 600 dairy-related proposals worth US$5 million and proposals for water solutions amounting to US$18 million and reaching farmers in all main production systems in the country.

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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: Methodology for identifying major production systems
Annex III: Calculations of climate intelligence of agricultural practices in Uruguay
Annex IV: Institutions, policies and instruments for CSA in Uruguay

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