Climate-Smart Agriculture in Costa Rica

Supplementary material

This publication is a product of the collaborative effort between the International Center for Tropical Agriculture (CIAT), the lead Center of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); the Tropical Agricultural Research and Higher Education Center (CATIE); and the World Bank to identify country-specific baselines on CSA in seven countries in Latin America: Argentina, Colombia, Costa Rica, El Salvador, Grenada, Mexico, and Peru. The document was prepared under the co-leadership of Andy Jarvis and Caitlin Corner-Dolloff (CIAT), Claudia Bouroncle (CATIE), and Svetlana Edmeades and Ana Bucher (World Bank). The main author of this profile is Andrew Halliday (CATIE), and the team was comprised of Andreea Nowak (CIAT), Miguel Lizarazo (CIAT), Pablo Imbach (CATIE), Beatriz Zavariz-Romero (CIAT), Rauf Prasodjo (CIAT), María Baca (CIAT), Claudia Medellín (CATIE), Karolina Argote (CIAT), Chelsea Cervantes De Blois (CIAT), Juan Carlos Zamora (CATIE), and Bastiaan Louman (CATIE).

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Contents

This Supplementary Material is in support of the Climate-Smart Agriculture in Costa Rica profile within the Country Profiles for Latin America Series. The annexes below are references where relevant in the text. The Supplementary Material cannot and should not be read in isolation. It can only be read in association with the chapter.

Annex I: Acronyms

ACICAFOC	Association of Indigenous and Community Agroforestry in Central America
AECID	Spanish Agency for International Cooperation
AR5	IPCC Fifth Assessment Report
ASAP	Adaptation for Smallholder Agriculture Program
C	Carbon
CAC	Agricultural Council of Central America
CANAPEP	National Chamber of Pineapple Producers and Exporters
CATIE	Tropical Agricultural Research and Higher Education Center
CCAD	Central American Commission on Environment and Development
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CEPF	Critical Ecosystem Partnership Fund
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIF	Climate Investment Funds
CO_2 eq	Carbon dioxide equivalent
Coopedota	Coffee Growers Cooperative of Dota
CoopeTarrazú	Coffee Growers Cooperative from Tarrazú
CORBANA	National Banana Corporation
CORFOGA	National Cattle Corporation
CSA	Climate Smart Agriculture
DCC	Climate Change Directorate of the MINAE
EARTH	Earth University
ECADERT	Central American Rural Development Strategy
ENCC	National Climate Change Plan
ERAS	Regional Agro-Environmental and Health Strategy
ERCC	Regional Strategy on Climate Change
ERPA	Emission Reductions Payment Agreement
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCPF	UNFCCC Forest Carbon Partnership
FONAFIFO	National Forestry Finance Fund
FONTAGRO	Regional Fund for Agricultural Technology
FTZ	free-trade zone
FUNDECOOPERACIÓN	Foundation for Sustainable Development
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Gigagrams
GHG	Greenhouse gas
GIZ	German Agency for International Cooperation
ICAFE	Costa Rica Coffee Institute
ICF	UK´s International Climate Fund
IDB-MIF	Multilateral Investment Fund of the Inter-American Development Bank

IICA	Inter-American Institute for Cooperation on Agriculture
IKI	International Climate Initiative of the German Federal Environment Ministry
IMN	National Meteorological Institute
INBio	National Biodiversity Institute
INEC	National Institute of Statistics and Censuses
INTA	National Institute for Innovation and Agricultural Technology Transfer
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
KfW	German Development Bank
LAICA	Industrial Sugarcane League
LECBP	Low-Emission Capacity Building Programme of the UNPD
MAG	Ministry of Agriculture and Livestock of Costa Rica
MINAE	Ministry of Environment and Energy of Costa Rica
MRV	Monitoring, Reporting and Verification
N_20	Nitrous oxide
NAMA	Nationally Appropriate Mitigation Action
NGO	Non-governmental organization
NH_4	Methane
NICFI	Norway´s International Climate and Forest Initiative
NORAD	Norwegian International Climate and Forest Initiative
OECD	Organisation for Economic Co-operation and Development
OTC	over-the-counter
PACA	Central American Agricultural Policy
PAHO	Pan American Health Organisation
PES	Payment for Environment Services
PFPAS	Program to Develop Sustainable Agricultural Production
PROCOMER	Foreign Trade Corporation of Costa Rica
RCP	Representative Concentration Pathway
REDD+	Reduction of Emissions from Deforestation and Degradation Plus
SAIP	Sustainable Agriculture Initiative Platform
SENARA	National Irrigation Service
SEPSA	Executive Secretariat for Agricultural Sector Planning
SIDA	Swedish International Development Cooperation Agency
SME	Small and medium enterprises
UCR	University of Costa Rica
UNA	National University
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNDP-LECB	Low Emission Capacity Building Program of the UNDP
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

Annex II: Agriculture and foreign trade in Costa Rica

According to the last Statistical Yearbook of Foreign Trade Corporation of Costa Rica (PROCOMER), exports of agricultural products (raw goods) contributed to 21% of the total value of national exports in 2013. In the last five years, the most important agricultural products exported by value were bananas, pineapples, and coffee (although coffee rust caused a decrease in exports of the latter). The main importers of Costa Rica's agricultural products in this period were the United States of America and Europe.

Table 1 Major export products of the agricultural sector (2009 – 2013)

Agricultural products	Millions of US $					Var % 2012 - 2013	Average participation % (2009 – 2013)
	2009	2010	2011	2012	2013		
Bananas	624	739	778	815	828	2	33
Pineapples	573	666	726	791	816	3	32
Coffee	198	259	374	411	302	-27	14
Ornamentals	130	139	135	128	120	-5	3
Melon	75	74	67	65	61	-6	3
Cassava	45	52	67	61	65	7	3
Leaves and others	64	61	54	45	41	-8	2
Flowers and buds	33	34	33	36	36	-1	2
Others	131	148	177	171	179	5	7
TOTAL	1,824	2,140	2,389	2,511	2,448	-2	100

Source: Statistical Yearbook of Foreign Trade, PROCOMER

According to the same source, imports of agricultural products constituted 4% of the total value of national imports in 2013. In the last five years, the most important agricultural products imported by value were maize, soybeans, and wheat. Imports are sourced mainly from the USA and Mexico.

Table 2. Major import products of the agricultural sector (2009 – 2013)

Agricultural products	Millions of US $ CIF					Var % 2012 - 2013	Average participation % (2009 – 2013)
	2009	2010	2011	2012	2013		
Maize	106	144	206	211	201	-5	27
Soybeans	67	114	128	166	151	-9	19
Wheat	65	70	90	91	86	-6	12
Rice	37	40	33	42	60	43	6
Beans	30	40	40	42	35	-15	6
Fruits	55	67	82	92	88	-4	12
Others	203	253	308	307	286	-7	42
TOTAL	452	593	722	767	731	-5	100

Source: Central Bank of Costa Rica.

CIF: [Cost, Insurance and Freight], the price includes insurance and all other charges up to the named port of destination.

Annex III: Land use in Costa Rica

Land use patterns in Costa Rica are a reflection of changes in land tenure and economic policies over the last five decades that have led to an increase in agricultural productivity. During this period cultivated lands have not shifted geographically, but the location and type of crops has changed. Grazing land, which once covered almost half of the country, has either been replaced by reforested areas or abandoned for its low productivity, promoting the regeneration of tree cover. Most of the flat and fertile land areas belong to large-scale producers, while small- and medium-scale producers occupy less fertile soils in sloping areas[1]. The country has developed a strong system of protected natural areas that cover 24% of the territory. The largest protected areas are in the mountainous regions that are important for the provision of water and other ecosystem services.

The country can be divided into four productive regions: the Caribbean, the North, the Pacific, and the Central Valley.

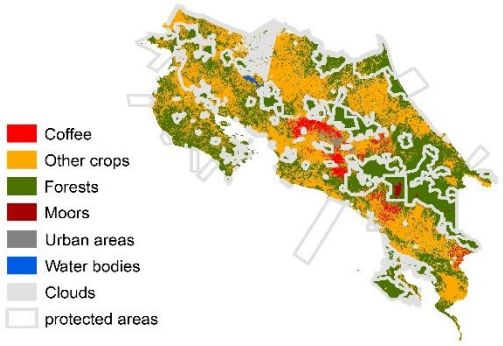


Figure 1 Land use in Costa Rica, 2005. Source: FONAFIFO

The northern Caribbean region is dominated by exportation crops cultivated in flat areas such as bananas and – more recently – pineapple, as well as ranching. The southern Caribbean region encompasses the provinces of Limón and Talamanca, where subsistence crops, cocoa, plantain, and banana are the predominate crops.

The light slopes and flat areas of the Northern region support the production of export crops (pineapple, citrus, and ornamentals), combined with areas of ranching, subsistence crops (grains, tubers, and tropical roots), and patches of natural forest and forest plantations.

The Pacific region is the most extensive and is characterized by logging, subsistence crops (mainly basic grains), and large expanses of agro-industrial or export crops such as sugarcane, melon / watermelon, and rice. The Central Pacific sub region is dominated by extensive oil palm monoculture, although some rice and livestock are produced. The South Pacific sub region encompasses large areas of highly mechanized crops like pineapple and palm oil as well as less mechanized crops such as coffee and sugarcane. These are combined with livestock and subsistence crops such as tubers and grains. Fishing and tourism are another important aspect of livelihoods in the Pacific region.

Finally, the Central Valley region is where the country's coffee and vegetable production is concentrated. Livestock, basic grains, and other crops are produced to a lesser extent. This region also encompasses the principle urban area of the country.

[1] Bertsch F. 2006. El recurso tierra en Costa Rica. *Agronomía Costarricense*, 30(1), 133–156.

The definition of small-, medium-, and large-scale producers has been established by Decree No. 37911-MAG of 16 September 2013. This decree defines the size classes differently for different categories of agriculture. For example:

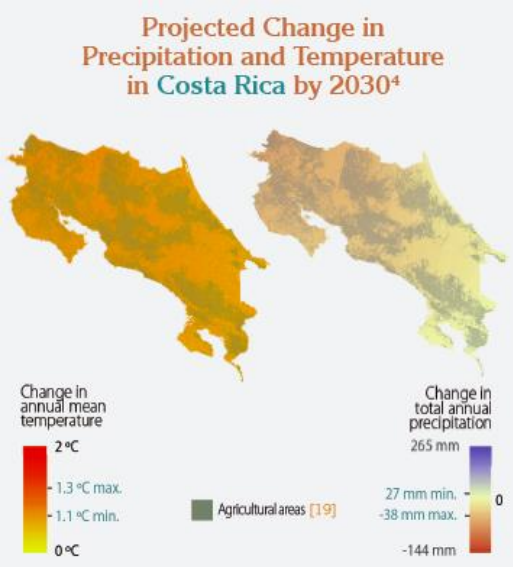
1. Beef cattle: small-scale is <75 ha; medium-scale is 75–200 ha
2. Milk cattle: small-scale is < 50 ha, medium-scale is 50–125 ha
3. Vegetables: small-scale is < 1 ha, medium-scale is 1–5 ha.
4. Basic grains group 1 (rice, sorghum): small-scale is <25 ha, medium-scale is 25–100 ha.
5. Basic grains group 2 (maize, beans): small-scale is <10 ha, medium-scale is 10–50 ha.

In total 22 categories of agriculture are defined, each with a different size class definition.

Annex IV: Climate change projections for Costa Rica

Future expected climate in Central America shows a consistent drying trend across models and global warming scenarios[2] in agreement with historical observed trends of increased temperatures[3]. Drier conditions are the result of an increase in mean annual temperature combined with reduced precipitation[4]. Although the northern part of Central America has larger agreement on future precipitation reduction across climate models relative to southern Central America (Costa Rica and Panama), the whole region is expected to experience reduced water availability[5]. Larger precipitation reductions are expected during the rainy season[6] resulting in a longer and stronger mid-summer drought[7], with important implications for the agricultural sector.

CIAT extracted annual rainfall and mean annual temperature data for Costa Rica for 2050 from 19 global climate models (GCMs) forced with IPCC RCP 4.5. The RCP database aims to document the emissions, concentrations, and land-cover change projections of the Representative Concentration Pathways (RCPs). The data provided for the RCPs are extensive and have undergone several procedures to assure quality and consistency, synchronize regional base year emissions with recent inventories, and downscale the projections to 0.083 x 0.083 degrees (approximately 1 km^2). Projections are derived from the GCMs and compared to a baseline period from 1960 to 2000.



Left: Changes in annual mean temperature in Costa Rica in 2050 (source: CIAT)
Right: Changes in annual mean precipitation in Costa Rica in 2050 (source: CIAT). Shaded region: agricultural area, according the latest land-use map available.

Mean precipitation in Costa Rica is likely to decrease in some areas and increase in others by 2050. In general, mean precipitation will decrease in the northwestern part of the country by 12 mm/year, while in the Southeast it could increase by as much as 182 mm/year by 2050. The largest projected decreases in annual precipitation are in the provinces of Guanacaste, Puntarenas (north), and Alajuela, and the largest increases will likely be in Puntarenas (south) and Limón.

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[2] Neelin JD, Münnich M, Su H, Meyerson JE, Holloway CE. 2006. Tropical drying trends in global warming models and observations. *Proceedings of the National Academy of Sciences*, 103(16), 6110–5.
[3] Aguilar E, Peterson T, Ramírez Obando P, Frutos R, Retana J, Solera M, … Mayorga R. 2005. Changes in precipitation and temperature extremes in Central America and northern South America, 1961–2003. *Journal of Geophysical Research*, 110(D23107).
[4] Biasutti M, Sobel AH, Camargo SJ, Creyts, TT. 2012. Projected changes in the physical climate of the Gulf Coast and Caribbean. *Climatic Change*, 112(3-4), 819–845.
[5] Imbach P, Molina L, Locatelli B, Roupsard O, Mahé G, Neilson, R, Ciais P. 2012. Modeling potential equilibrium states of vegetation and terrestrial water cycle of Mesoamerica under climate change scenarios. *Journal of Hydrometeorology*, 13, 665–680.
[6] Biasutti et al. 2012.
[7] Rauscher SA, Giorgi F, Diffenbaugh NS, Seth A. 2008. Extension and intensification of the Meso-American mid-summer drought in the twenty-first century. *Climate Dynamics*, 31(5), 551–571.

Overall, mean annual temperatures are projected to increase by 1.5–1.7°C by 2050. Although mean annual temperatures will probably increase in all provinces, the largest anomalies are expected in the provinces of Guanacaste, Puntarenas (north), and Alajuela.

Sensitive crops such as coffee and beans may be affected by the higher temperatures and changes in precipitation patterns. Most of the areas under 1,500 m altitude will became less suitable for both crops, while areas above this altitude – only a few mountain peaks – become more suitable. Some crops, like banana, sugarcane, and cassava, will be less impacted by these changes.

Annex V: CSA practices in Costa Rica: a detailed list

Table 3 CSA Practices in Costa Rica

Production system	Sub-system	Practice	Degree of adoption
	Coffee	Climate Information System	4
	Coffee	Traditional shade coffee	5
	Coffee	Sun dried coffee	3
	Coffee	Controlled use of fertilizers	3
	Coffee	Incorporation of legumes into shade systems	3
	Coffee	Carbon capture shade systems: incorporation of fruit crops	3
	Coffee	Solar powered drying systems	1
	Processing	Treatment of sub-products (hulls and pulp) to produce fuel for drying ovens	3
Coffee	Processing	Discharge of waste water onto grassland (instead of into anaerobic lagoons)	4
	All	Controlled use of agrochemicals (correct timing, quantities)	4
	All	Use of slow release fertilizers	2
	All	Calibration and improved efficiency of machinery	3
	All	Training staff in efficient use of machinery	3
	All	Composting organic waste	3
	All	Associated forestry plantations	3
	All	Reduced water use, water recycling	3
	Banana, pineapple	Drip irrigation	2
	Pineapple	No tillage / minimum tillage	3
	Pineapple	Erosion prevention in drainage ditches	5
	Banana	BANACLIMA - meteorological program	5
	Banana	Dykes to prevent flooding	3
	Banana	Recycling plastic bunch covers	5
	Banana	Organic , UV and pest resistant bunch covers	1
	Banana	Biological purification of waste water	1
	Banana	Development of drought resistant varieties	1
Industrial	Rice, sugarcane	Power generation from plant by-products	2
	Family agriculture	Composting - organic fertilizers	3
	Family agriculture	Climate smart cultivation techniques for family farms8	2
	Family agriculture	Integrated irrigation and drainage systems	3
Family	Family agriculture	Agroforestry	2
agriculture	Dual purpose cattle	Stabled cattle with cut-and-carry forage production	2
	Dual purpose cattle	Rotational grazing and forage banks	3
Cattle	Dual purpose cattle	Water capture and protection of water sources	2

[8] A range of explicitly climate smart techniques promoted by the project "Development of local capabilities in low carbon and environmentally friendly agricultural technologies," implemented by INTA in partnership with Fundecooperación and ACICAFOC http://www.inta.go.cr/index.php?option=com_content&view=article&id=112:tranferencia-tecnologia-en-el-cambio-climatico&catid=1:latest-news

	Dual purpose cattle	Silvopastoral systems	5
	Dual purpose cattle	Improved diet to reduce enteric fermentation	2
	Milk	Use of slow release fertilizers	2
	Milk	Biodigestors	2
	Milk	Organic fertilizers (from cow dung produced by stabled milk cattle)	2

Source: Expert opinion supplemented experts and Government of Costa national communications for the UNFCCC.

Table 4 Criteria for degree of adoption scores

Score	**Criteria for practices**	**Criteria for information services**
0	Suggested by interviewee as a good idea	Suggested by interviewee as a good idea
1	Research and development / policy commitment	Information exists but cannot be accessed
2	Validation in field trials / small project / new measures being adopted by one or a few companies / new ideas being promoted by agencies	Information not readily available
3	Scattered adoption across the sector(s)/ large project / not known - default score	Some information available to producers / not known - default score
4	Widespread adoption	Information widely available to producers
5	80 to 100% adoption	Information available to all producers

Source: Based on information from expert informants