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Cocoa Landscape Mapping in the Orinoquía

Cocoa Production in the Orinoquía Region

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For International Finance Corporation - IFC

16 December 2019

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1. Background

The cultivation of cocoa has a long history in Colombia, tracing its biological origins to the upper Orinoco region of northeastern Colombia, and has since served as a culturally important part of the national diet. But despite this history and the country's high land suitability to cocoa cultivation, Colombia ranks 10th in global production, accounting for only 1.1% of the market share (table 1), most of which is consumed domestically.

Table 1: Global cocoa bean production by country in 2017

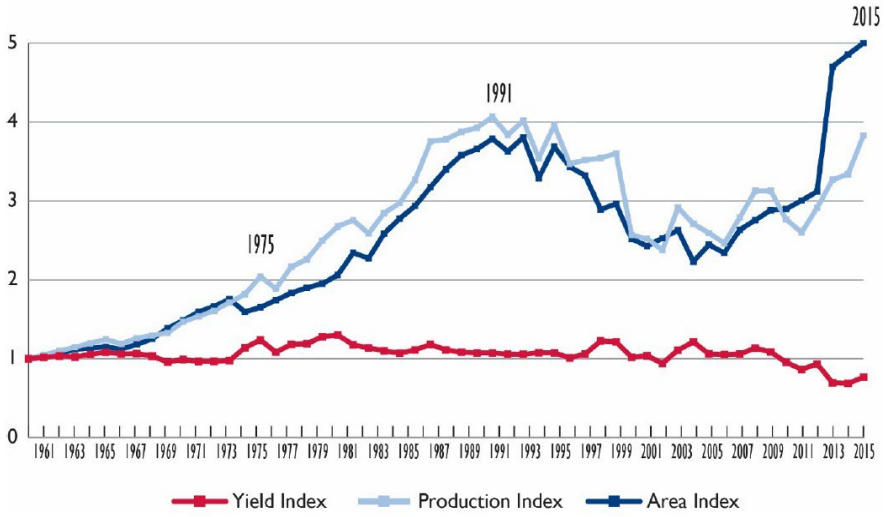
Rank	Country	Production (ton)	Market share
1	Côte d'Ivoire	2,034,000	39.1%
2	Ghana	883,652	17.0%
3	Indonesia	659,776	12.7%
4	Nigeria	328,263	6.3%
5	Cameroon	295,028	5.7%
6	Brazil	235,809	4.5%
7	Ecuador	205,955	4.0%
8	Peru	121,825	2.3%
9	Dominican Republic	86,599	1.7%
10	**Colombia**	**56,808**	**1.1%**
11	Papua New Guinea	44,504	0.9%
12	Uganda	31,312	0.6%
13	Mexico	27,287	0.5%
14	Venezuela	23,349	0.4%
15	Rest of the world	166,943	3.2%
Total		**5,201,110**	**1000%**

Source: Faostat, 2019.

Cocoa cultivation is seen as an important opportunity for sustainable economic development of Colombia's rural areas that remain dominated by extensive cattle ranching. Market conditions for cocoa cultivation and export are considered favorable and incomes generated from the cultivation would significantly contribute to the country's agricultural economy. Given its suitability to be grown in agroforestry systems, cocoa can have important benefits in terms of carbon sequestration, soil enhancement and erosion reduction.

The cultivation of cocoa has been promoted by the Government of Colombia for several decades as a productive alternative to illicit crops. Recent efforts over the past decade have led cacao production to surpass the historic levels of the 1990's. The country's production has increased over the past 50 years, but mainly through area expansion, since productivity per hectare has remained relatively stable (figure 1).

Figure 1: Indices of Colombian cocoa production (area harvested, yield and annual average ICCO price [base year 1961])

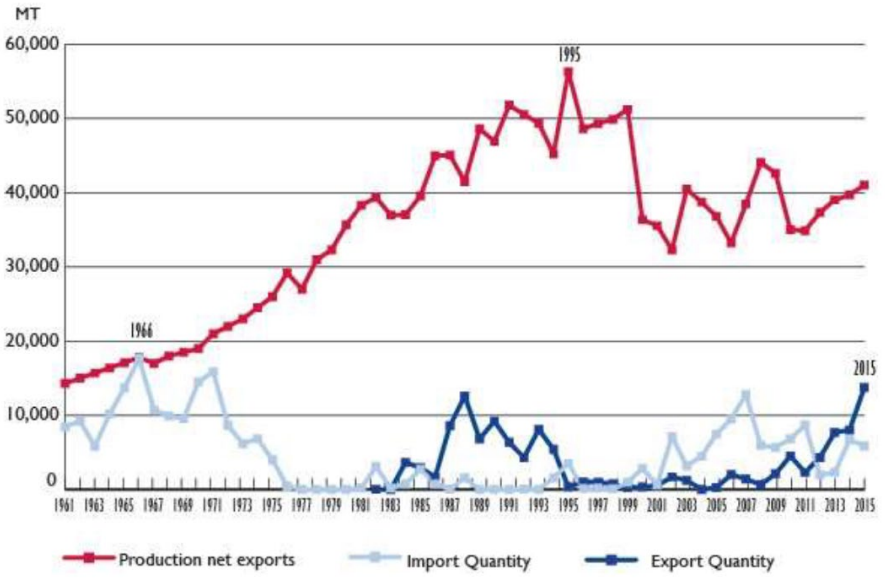


Source: Abbott and others, 2018.

The sharp increase in cultivated areas between 2012 and 2014 is a result of the development of municipal projects to promote sustainable development (e.g., Areas for Municipal-Level Alternative Development Program and Additional Investment for Sustainable Alternative Development) (Abbott and others, 2018).

In 2015, the production of cacao (net of exports) slight exceeded 40,000 metric tons (MT), exports accounted for slightly over 15,000 MT and imports exceeded 5,000 MT to meet domestic demand in that year (figure 2). It is important to highlight that exports have increased significantly since 2011, which may be a sign of greater recognition of the Colombian brand in international markets, greater export capacity, and potentially the improved stability in the country.

Figure 2: Colombian cacao exports and imports



Source: Abbott and others, 2018.

Seventy percent of Colombian cocoa varieties are considered “fine and flavour”, which could be considered an important competitive advantage internationally (box 1).

In 2018, key actors in the Colombian cocoa value chain signed the Framework Agreement for Joint Action on Cocoa, Forests and Peace in Colombia, whose goals include deforestation-free production of cocoa, protection and restoration of forests, promotion of sustainable livelihoods for farmers, community participation and social inclusion, and a contribution to the implementation of the Peace Agreement signed in 2016. The Agreement is an important commitment and an effort to position Colombia as a zero-deforestation producer country internationally to attract buyers and investors.

Box 1: Market opportunities for "fine and flavor" cocoa

The International Cocoa Organisation (ICCO) estimates that around 95% of Colombia's cacao exports (and 70% of cocoa varieties) are 'fine and flavour.' However, global statistics on production, exports and imports do not differentiate between bulk and 'fine and flavour' cacao. Even in countries designated as 'fine and flavour' by the ICCO, cacao is typically blended to meet international standards based on bean size, fermentation and defects, making the exact determination of 'fine and flavour' volumes challenging.

In terms of prices (unit values), exports focused on 'fine and flavour' had a high and similar 'premium' (over $400 per ton) in 2012 compared to bulk cacao exported from Colombia. Unfortunately, this 'premium' has not been stable, even during years where the global cocoa price had been relatively stable (2012 – 2015). This instability suggests that producers of 'fine and flavour' cocoa cannot rely on such premiums by default (Abbott and others, 2018) but might still rely on preferred market access to higher quality market segments.

According to available data from 2014, the main producing departments in Colombia are Santander (40% of national production), Nariño, Tolima, Arauca and Antioquia. Cocoa is a crop that benefits around 35,000 families, as 98% of cocoa crops are in the hands of small producers with less than five hectares.

In 2017 the Orinoquía region, mainly in the Departments of Arauca and Meta, accounted for 29,470 hectares of cocoa plantations, equivalent to 16% of the national area under production.

The Orinoquía region has significant potential for the expansion of cocoa cultivation. According to UPRA (Agricultural Rural Planning Unit), almost 1.3 million hectares are considered highly suitable for cocoa cultivation in the departments of Orinoquía (mainly in Meta) (figure 3).

Studies have shown that soil characteristics can influence or affect the quality of cocoa (Kongor, 2016). However, there is no particular soil type that is deemed more suitable to cultivation of 'fine and flavour' compared with conventional cacao varieties.

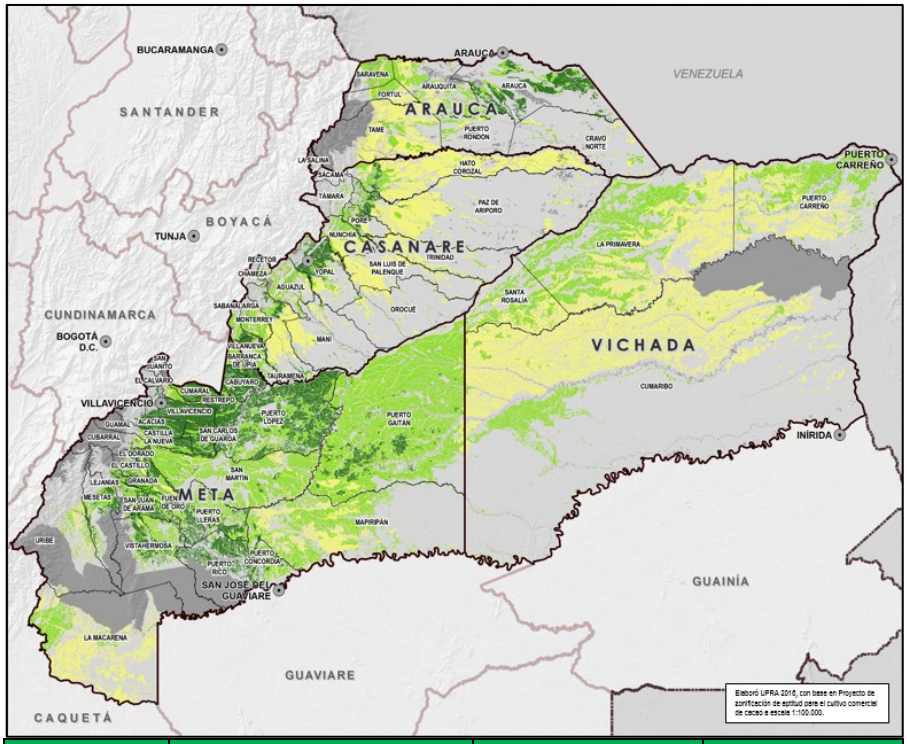


Figure 3: Soil aptitude for cocoa cultivation in the Orinoquía

Category		Description	Area (hectares)	Percentage
	A1	High	1,284,757	5%
	A2	Medium	3,785,639	15%
	A3	Low	4,005,096	16%
	N1	Technically unsuitable	13,566,021	53%
	N2	Not legally eligible	2,739,543	11%

Source: Adapted from UPRA (2016).

The vast majority of areas deemed suitable to cocoa cultivation are currently utilized for extensive cattle ranching, which provides little return for farmers but is the least risky land-use alternative.

Even though there is significant potential to transition these lands to diversified plantations including cocoa, the majority of landowners have little to no prior experience in its cultivation, nor the resources or risk appetite required. Any effort aimed at significantly expanding cocoa cultivation in the region will have to offer practical solutions (i.e., through sophisticated outgrower models) that shift the risk-return perception from a farmer's perspective.

2. Introduction to the Orinoquía region

The Orinoquía region is one of the five natural regions of Colombia that belongs to the Orinoco River watershed. It is also known colloquially as the Eastern Plains from the Spanish term "Llanos Orientales." The region covers most of the area of the departments of Meta, Arauca, Casanare and Vichada (figure 4).

Figure 4: Map of the Orinoquía region

Source: https://www.lifeder.com/.

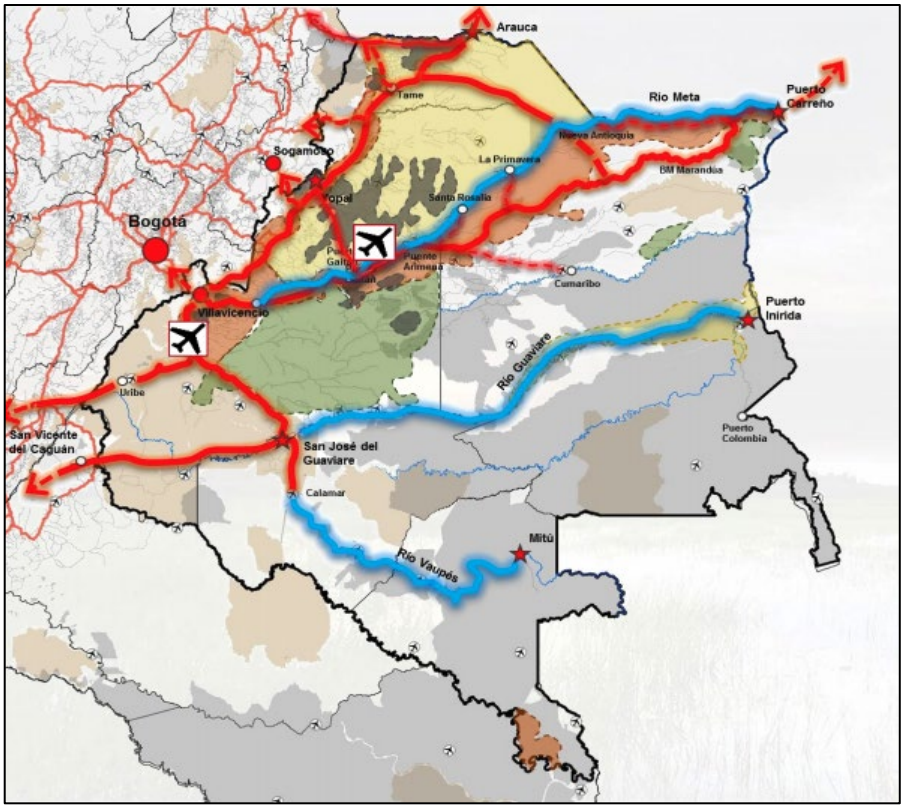
2.1 Factsheet of the Orinoquía

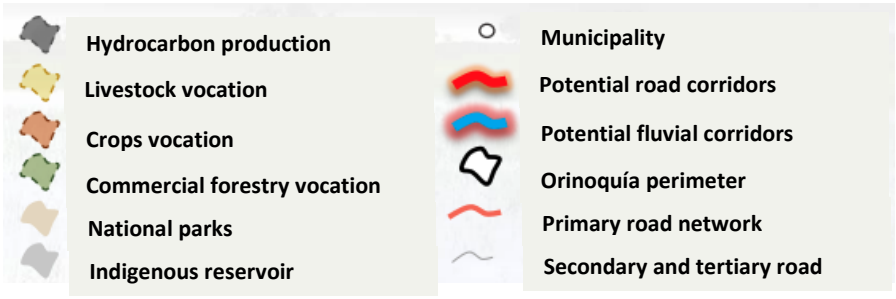
- **Area**: 347,713 km^2, equivalent to 30.4% of Colombia's total land area
- **Population**: 1,830,208 inhabitants, equivalent to 4% of the total population in Colombia (DANE, 2018)
    - Urban population: 70%
    - Rural population: 20%
- **Economic overview**: In 2018, the Orinoquía's GDP accounted for $16.5 billon, equivalent to 6.5% of Colombia's total GDP. The main economic activities developed in this region are oil extraction, agriculture, livestock and mining.
- **Socioeconomic aspects**: According to the latest information available for 2019, in the Orinoquía the Multidimensional

Poverty Index (MPI)was around 34% on average, mainly impacted by Vichada with a MPI of 75,6, followed by Arauca with 26,1, Casanare with 19,6 and finally Meta with 14,1 (DANE, 2021)..

- **Weather**: The Orinoquía is located at an average altitude of 175 meters above sea level, characterized by an equatorial tropical climate with maximum temperature peaks above 27°C throughout the year. The region is also characterized by high rainfall which reaches between 2,500– 6,000 mm annually.
- **Infrastructure**: Poor access is one of the greatest barriers to rapid economic development of the region. The majority of areas deemed highly suitable to cocoa cultivation are found in relative proximity to paved roads (figure 5). The road network of the Orinoquía comprises 20,340 km, 10% of which corresponds to the primary network, 29% to the secondary network and 61% to the tertiary network. Sixty percent of the tertiary road network is unpaved and in poor condition (DNP, 2016). According to the Orinoquía Master Plan (Plan Maestro de la Orinoquía), there is the potential for significant infrastructure development with over 1,800 km in new and improved roads, as well as the potential for 2,700 km of river navigation (DNP, 2016). However, the timelines for these developments are unclear.

Figure 5: Expansion map of the Orinoco's transport network



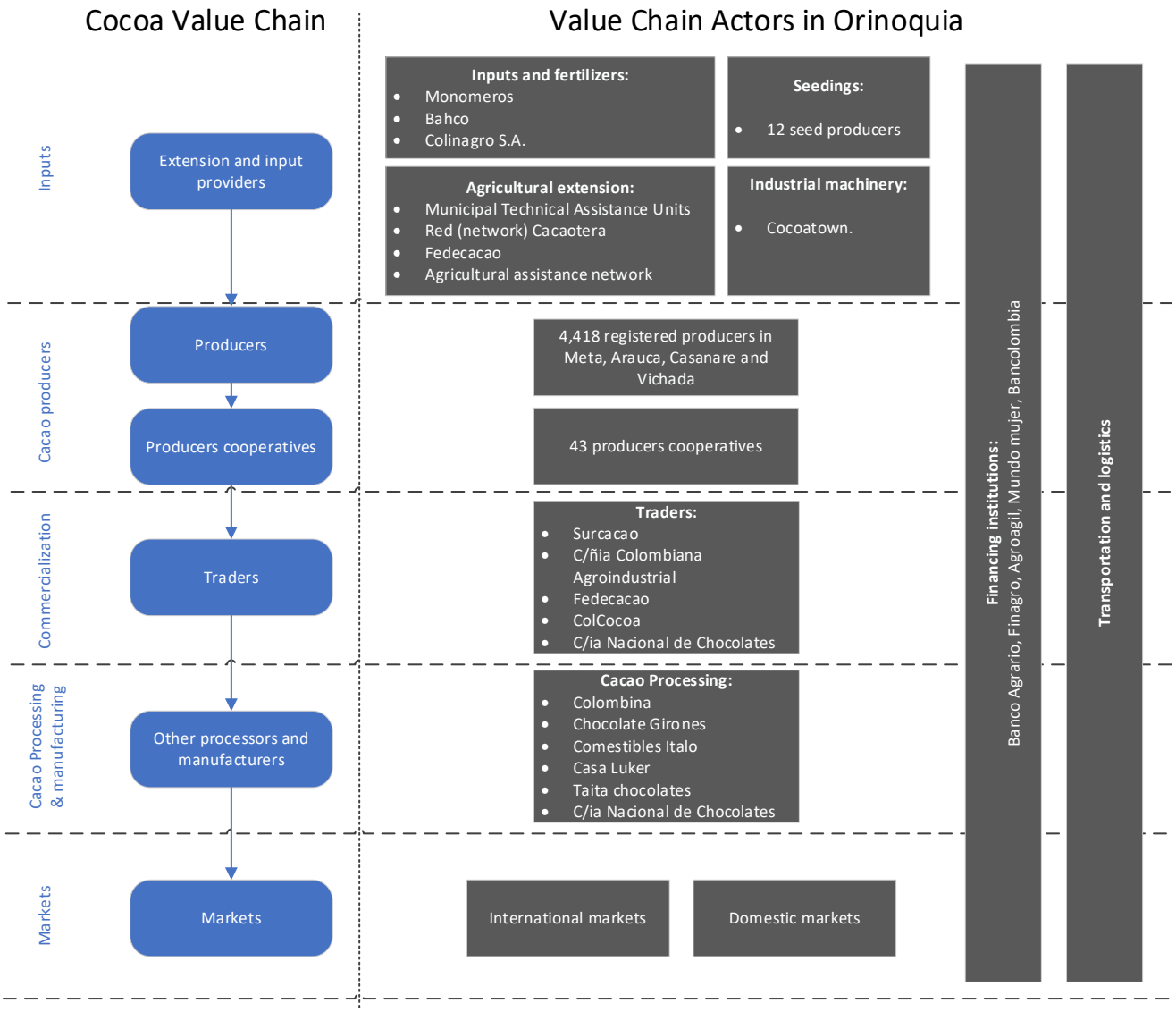


Source: Adapted from DNP (2016).

3. The cocoa value chain in Orinoquía

The Colombian cacao value chain includes input provision, production, postharvest, aggregation and transport, processing, marketing, internal consumption and export (figure 6). The value chain includes numerous companies, organizations and institutions that collaborate formally or informally.

Figure 6: Cocoa value chain in the Orinoquía



3.1 Inputs provision and extension services

Inputs provision corresponds to activities related to seedlings, inputs such as soil corrective, fertilizers, herbicides, pesticides, and agricultural machinery. For the Orinoquía the team identified eleven

providers of seedlings (table 2) and three different providers of fertilizers, tools and machinery, which have a national presence (table 3). In addition, most basic inputs and tools are available and can be procured from local input shops.

Table 2: Seedling providers in the Orinoquía

Name	Seedlings	Location
Vivero El Porvenir	FSA 11-12, ICS 95-1-60, MON 1, TSH 565, CCN-51, FEAR 5, IMC 67	Pore, Casanare
Jardín Clonal El Jardín	FEAR 5, TSH 565, ICS 1, FTA 2, CCN 51, ICS 60	Fuentedeoro, Meta
El Tablón de Papá Juan	CCN51, TSH565, MON1, ICS1, IMC67, ICS95, FTA2, FSA13, ICS60	Granada, Meta
Gambitana	CCN51-IMC67-EET8-ICS95	Puerto López, Meta
Las Almendras	FEAR 5, FTA 2, FTA 13	Granada, Meta
Vivero Yireth Innovador	FEC 2, FSV 41, FLE 2, FLE 3, FTA 2, FEAR 5, FSA 12, FSA 13	Granada, Meta
Frutales del Castillo	FEAR 5, FTA 2, FTA 13	El Castillo, Meta
El Samán	FEC 2, FSV 41, FLE 2, FLE 3, FTA 2, FEAR 5, FSA 12, FSA 13	Cumaral, Meta
Mi Terruño	FEAR 5, FTA 2, FTA 13	Guamal, Meta
Frutales Del Llano	FEAR 5, FTA 2, FTA 13, ICS 67	Lejanias, Meta
Frutiaguacates	FEAR 5, FTA 2, FTA 13, ICS 67	Lejanias, Meta

Source: Data collection from the authors.

Table 3: Fertilizers and hand tools providers in the Orinoquía

Name	Products/inputs	Location
Monomeros	Chemical products for the agricultural sector	National coverage
Bahco	Hand tools	National coverage
Colinagro S.A.	Agricultural fertilizers	National coverage
Cocoatown	Industrial machinery	International coverage

Source: Data collection from the authors.

Extension services for cocoa cultivation are largely absent from the region. Public sector programs aimed at driving cocoa cultivation have so far remained sporadic (linked primarily to achieving short-term targets in agricultural development plans for increasing plantation areas). In order to drive a sustainable expansion of cocoa cultivation and achieve improvements in productivity, the development of extension services in tandem with market access will be key (see next section).

3.2 Production

3.2.1 Current status of cocoa production in the Orinoquía

In 2017, the Orinoquía accounted for 29,470 hectares of cocoa plantations, equivalent to 16% of areas planted nationally (181,392 hectares). The region produced an estimated 14,800 tons of cocoa,

equivalent to 16% of total national production (91,825 tons). The production in the region increased sevenfold between 2010 and 2017 - from 2,000 to 14,800 tons. Average yields are low (0.36 – 0.55 tons per hectare) due to diseases, aging, and less productive plants but are comparable to national averages (table 4).

Table 4: Cocoa production in the Orinoquía in 2017

	Area (hectares)	Production (tons)	Yield (tons per hectare)
Arauca	18,080	9,927	0.55
Casanare	1,137	415	0.36
Meta	9,232	4,034	0.44
Vichada	1,021	424	0.42
Total	**29,470**	**14,800**	**0.50**

Source: https://datos.gov.co/ (2019).

Cacao production in Colombia can be classified in three different types according to their yields: agricultural practices, geographies and socio-economical aspects. Although the average yields of the Orinoquía suggest that most of the production is marginal, other types of production can also be found in the region.

Marginal

This type of farm typically lacks adequate water and irrigation and the plants lack nutrition, which results in high tree mortality and low productivity. These areas are either not suitable for growing cacao or the plants fail due to poor agricultural practices. Farms typically have between 800 – 1,000 total cacao trees per hectare, with an annual production of below 300 kg per hectare. There tends to be some level of intercropping with other food and market crops, but these often face difficulties due to water scarcity. The cacao from these farms is not profitable, as costs exceed income, and so it is perceived as an additional income rather than the main source of income.

Traditional

This type of farm is common throughout Colombia. While the ecological conditions, mainly rainfall patterns, exceed those found on marginal farms, cacao management remains rudimentary. Plants receive occasional fertilization, pruning, and phytosanitary management, but generally as an immediate response to the presence of pests and diseases. These farms typically have between 800 to 1,000 cacao trees per hectare and annual yields of between 300-500 kg per hectare (i.e., yield per plant is between 0.2 - 0.5 kg). Oftentimes, cacao on these farms is not managed as a single crop but rather as part of a diverse agroforestry system from which farmers extract different products throughout the year. Income from cacao constitutes less than one minimum wage over a 10-year period.

Technified

The technified approach prioritizes cacao as a cash crop. Technified producers have access to capital and periodic technical assistance. These farms have access to water and irrigation systems and apply technological packages in accordance with the planted genetic

material. Annual yields fluctuate between 1,200 – 1,800 kg per hectare but can be higher. The technified approach is the most common type of system promoted by development interventions, but it is also the most rarely encountered in the field. A technified cacao farm requires an investment of COP 12 - 15 million ($3,980–4,975) per hectare, depending on the terrain and the irrigation requirements. These types of farms can be found in the departments of Arauca, Santander, Huila and Tolima in areas with decent road access, functioning land markets and improved security, and are typically run by companies in sizable plantations.

3.2.2 Cacao producers, associations and other enablers

The Orinoquía has registered 4,418 cocoa farms and 63,199 hectares with cocoa plantations (table 5). Of the total number of farms with cocoa plantations in the Orinoquía, 57% are located in Arauca, 28% in Meta, 9% in Casanare and 6% in Vichada.

Table 5: Cacao producers for municipalities in the Orinoquía

Municipality	Department	Number of cocoa farms	Size of the farms with cocoa plantations
Acacías	Meta	14	146
Castilla La Nueva	Meta	24	246
Cubarral	Meta	25	290
El Castillo	Meta	79	703
El Dorado	Meta	104	842
Fuente de Oro	Meta	51	867
Granada	Meta	258	1,711
Guamal	Meta	29	306
Lejanías	Meta	74	634
Mapiripán	Meta	9	4,935
Mesetas	Meta	16	246
Puerto Concordia	Meta	22	1,081
Puerto Lleras	Meta	9	227
Puerto Lopez	Meta	1	75
Puerto Rico	Meta	71	1,789
San Juan De Arama	Meta	21	192
San Martín	Meta	25	255
Uribe	Meta	2	45
Vistahermosa	Meta	209	3,042
Not identified	Meta	212	435
Arauca	Arauca	126	1,656
Arauquita	Arauca	827	15,456
Cubará	Arauca	2	5
Fortul	Arauca	331	6,478
Saravena	Arauca	460	7,185
Tame	Arauca	757	12,438
Aguazul	Casanare	12	13
Chameza	Casanare	6	7
Hato Corozal	Casanare	20	33
Maní	Casanare	12	24
Monterrey	Casanare	3	8
Nunchía	Casanare	20	46
Orocué	Casanare	7	8
Paz de Ariporo	Casanare	24	34
Pore	Casanare	16	27
Sabanalarga	Casanare	31	56

Sácama	Casanare	5	6
San Luis de Palenque	Casanare	50	24
Támara	Casanare	3	3
Tauramena	Casanare	78	115
Trinidad	Casanare	49	7
Villanueva	Casanare	49	84
Yopal	Casanare	24	43
Cumaribo	Vichada	202	1071
La Primavera	Vichada	32	93
Puerto Carreño	Vichada	9	97
Santa Rosalía	Vichada	8	116
Total		**4,418**	**63,199**

Source: Data collection from the authors.
Note: The total size of the farms includes not only the areas with cocoa plantations, as well as but the total size of the farms including the areas for to other agricultural activities.

According to primary information gathered by the authors, through interviews with stakeholders in the area, the Orinoquía has 47 cacao associations (table 6). The available information regarding the level of professionalization of each association is limited. If associations were to be considered as entry points in supporting existing producers to grow the producer base, dedicated assessments of each candidate association (e.g., within a certain radius from a buyer's nucleus plantation) would have to be conducted. Given the current market structure with few dominant buyers, associations currently tend to have little leverage regarding price and other terms (see section 3.4).

Table 6: Cacao producers association in the Orinoquía

Name	Location
Cacao de Arauquita EU	Arauca, Arauca
Asociación de productores y comercializadores de cacao de Sabanalarga Casanare APROCAS	Sabanalarga, Casanare
Asociación Regional del Sarare para exportación de cacao	Arauca y Saravena, Arauca
Asociación de cacaoteros y chocolateros de Tame	Tame, Arauca
Asociación de productores y comercializadores de cacao Araucano	Arauca
Asociación de productores de cacao la esperanza	Mani, Casanare
Asociación productiva de cacaoteros del cerro APROCACER*	Tauramena, Casanare
Asociación de cultivadores y productores de cacao de Villanueva Casanare	Villanueva, Casanare
Asociación de cultivadores de Mani Casanare	Mani, Casanare
Asociación de productores de cacao del municipio de Trinidad	Trinidad, Casanare
Asociación de cacaoteros del Pauto	San Luis de Palenque, Casanare
Asociación de Cacaocultores del Norte del Departamento de Casanare ASOCANORTE	Nunchia, Pore, Trinidad, San Luis, Hato Corozal, Casanare
Comercializadora Cacao del Guaviare SAS	Castilla la Nueva, Meta
ASPECMEAGRUPIT	Villanueva, Casanare
Asociación de Cacaocultores de Tauramena ASOCATA	Tauramena, Casanare

Asociación de Cacaoteros del Aguamaco ASOCAGUA	Tauramena, Casanare
ASOPROA	Aguazul, Casanare
Asociación de Cacaocultores de Yopal ASOCAYO	Yopal, Casanare
Asociación de Cacaocultores de Mani Casanare	Mani, Casanare
Asociación de Pequeños Productores de Cacao del Ariari ASOPCARI	Granada, Meta
Asociación de Productores Agropecuarios del Bajo Ariari ASPRABARIT	Puerto Lleras, Meta
Asociación de Productores de Cacao de Vistahermosa	Meta
Asociación de Productores de Cacao del Municipio de Puerto Rico APROCACAO	Meta
Asociación de Cacaoteros de Mesetas	Meta
Asociación de Productores de Cacao del Dorado	Meta
Asociación de productores de cacao de San Luis de Cubarral	Meta
Cooperativa de Productores Agropecuarios del Ariari	Meta
Asociación agropecuaria Costa Rica	Vistahermosa, Meta
Asociación agropecuaria de productores de Guamal	Meta
Asociación de Agricultores de Guapaya	Meta
Asociación de productores agropecuarios de Vista Hermosa	Meta
Cooperativa multiactiva agropecuaria de cacaoteros del departamento de Arauca COOPCACAO	Saravena, Arauca
Asociación de Productores y comercializadores de platano de Arauquita	Arauquita
Cooperativa Multiactiva de productores y comercialización Agropecuaria de Arauquita COOMPROCAR	Arauca
Asociación de mujeres emprendedoras y cacaoteras del Sarare	Arauca
Asociación de Usuarios del Distrito de Adeuación de Tierras de Pequeña Escala	Arauca
Asociación ASOALPES	Saravena, Arauca
Asociación de cacaocultores del municipio de San Luis de Cubarral ASOCCUBA	Cubarral, Meta
Asociación Agropecuaria de Guamal AGROGUAMAL	Guamal, Meta
Cooperativa agroindustrial de cacaoteros del Meta CACAOMET	Meta
Asociación de familias acacireñas agropecuarias AFAAGRO	Meta
Nodo Cacaotero - WORKAKAO	Cubarral, Granada, Guamal, El Dorado y el Castillo, Meta
Asociación de fruticultores de El Dorado ASOFRUD	El Dorado, Meta
Cooperativa de productores agropecuarios del Ariari COOPASOPADRA	El Castillo, Meta
Asociación de campesinos del Ariari ASOCARI	Granada, Meta
Asociación de mujeres campesinas de Lejanías ASMUCALE	Lejanias, Meta

Asociación de cacaoteros del Alto Vichada PROAGRO	Cumaribo, Vichada
Asociación de Cacaoteros de Cabuyaro, ASOCABUYARO	Cabuyaro, Meta

Source: Data collection from the authors.

3.3 Fermentation and drying

Fermentation and drying are critical to the quality of cacao beans sold. Currently, the vast majority of cacao in the Orinoquía is fermented and dried on farms as opposed to being sold wet (or "en baba") to collection centers for professional fermentation and drying. If a farmer were to ferment and dry the beans on a farm to a certain level of professionalization, investments in machinery, access to credit, and training would be required (Abbott, 2018). Companies interviewed for this analysis preferred buying wet cocoa from farmers and centralizing the fermentation and drying process in order to enhance efficiency and achieve harmonized quality.

3.4 Cacao processing and chocolate manufacturing

Once fermented and dried, cocoa grains are transformed into different intermediary products such as cocoa liquor, butter, and powder that are sold to manufacturing industries domestically and abroad. Colombian processors and manufacturers produce and export both intermediary and finished products such as chocolate bars.

The two largest Colombian companies – Compañía Nacional de Chocolates of the Nutresa group and Casa Luker – purchase between 80-90% of the national cacao production. Both companies are vertically integrated, managing processes from cocoa cultivation to processing into intermediary and finally to manufacturing of the finished products for domestic and export markets.

3.5 Cross-cutting issues

3.5.1 Policies and regulations affecting the sector

Table 7 presents the most relevant policies and regulations related to cacao production in the Orinoquía.

Table 7: Policies and regulations related to cacao production in the Orinoquía

Regulation	Description	Nexus with the cocoa sector in the Orinoquía
Plan Maestro de la Orinoquía (Orinoquía Master Plan)	Long-term strategic proposal of the national government that seeks to promote the economic and social growth of the Orinoquía.	This plan promotes the cultivation of cocoa in the Orinoco region in order to contribute to economic and social growth.
Zoning for cocoa cultivation by UPRA	Identifies the areas of the country that are most suitable for cocoa cultivation.	The Orinoquía region is one of the areas with the largest potential for cocoa cultivation in Colombia.

Recommendation of cocoa clones in Colombia	This agreement defines the genetic material for the use of clones in the different agro-ecological regions of Colombia.	It recommends the use of clones in order to increase national cocoa production.
Departmental Land Use Plan (POTD) and Municipal Land Use Plan (POT)	An instrument through which each department or municipality establishes guidelines and orientations for land use planning, according to environmental, economic and social considerations.	Departmental and municipal plans can contribute to the development of departmental projects (i.e., by promoting cocoa cultivation in a specific area).
Good agricultural practices for cocoa production.	These are guidelines and regulations that seek to guide food producers, with the purpose of ensuring the innocuousness of the final product.	Good agricultural practices in cocoa cultivation define the minimum conditions necessary to ensure the safety of production and the proper use of chemicals as fertilizers.
Cocoa Promotion Quota - Law 67 of 1983	The Cocoa Promotion Quota, established by Law 67 of 1983, is a collection of 3% on the selling price of each kilogram of cocoa in Colombia.	The resources collected through the quota are intended to strengthen the cocoa sector in Colombia.

Source: Data collection from the authors.

3.5.2 Transportation and logistics

Table 8 describes the main transportation and logistics stages along the cacao value chain in the Orinoquía.

Table 8: Description of transportation and logistics for the cocoa value chain the Orinoquía

Stage	Description
Input suppliers - producers	Primary producers are responsible for transporting inputs and plant materials from the point of purchase to their property.
Producers – Collection center	In most cases, the transportation of cocoa beans (dry or wet) is undertaken by the producer, unless there is an agreement for a transportation service on the part of the collection center.
Collection center - Intermediary	The cocoa collected in warehouses or temporary storage sites is repackaged and transported to departmental collection centers and transported nationally or internationally. Collection centers and intermediaries tend to assume responsibility for the transportation logistics and associated costs.
Intermediary - processors	Intermediaries prepare cocoa for shipment to the points defined by cocoa processors, mainly in Bogotá, Santander and Antioquia. Dry grain transportation to these cities range between $23-35 per ton.

Source: Data collection from the authors.

3.5.3 Financing requirements for cocoa plantations

The financing needs for cocoa plantations can be divided into three main categories: i) financing the establishment of new plantations (table 9); ii) financing the renovations of existing cacao plantations (table 10); and iii) financing the improvement needs of existing renovations (table 11). For the former two categories, the estimated

revenue and internal rate of return (IRR) has been included. For the third category however (improvement needs), these estimations are not included, as revenue may vary according to the level of productivity and maintenance of the existing cocoa plantations.

Table 9: Estimated financing requirements for new cacao plantations in the Orinoquía

	New plantations	
	Year 1	Year 2 - 15
Productivity (y/ha/year)	-	1.51
Price ($)	2,333	3,177
Revenue ($)	-	4,929
Costs - Establishment ($)	7,894.17	-
Costs - Maintenance ($)	-	2,234.15
Cash flow ($)	(7,894.17)	2,694.66
IRR (20 years)	17,38%	

Table 10: Estimated financing requirements for cacao plantation renovations in the Orinoquía

	Renovations	
	Year 1	Year 2 - 15
Productivity (y/ha/year)	-	0.81
Price ($)	2,333	3,177
Revenue ($)	-	2.600
Costs - Establishment ($)	4,503.02	-
Costs - Maintenance ($)	-	1,568.65
Cash flow ($)	(4,503.02)	1,031.50
IRR (20 years)	15.69%	

Table 11: Estimated financing requirements for improvement of existing cocoa plantations in the Orinoquía

Intervention	Description	Cost per ha/year
Fertilization	This intervention is focused on adult plantations or those in the productive phase. Its variation in costs would be related to the type and availability of organic matter to be applied and the general conditions of the crop.	$350 – 600
Tree pruning	This practice is oriented to the recovery of abandoned or poorly managed cocoa fields. The intervention consists of managing the pruning, plant architecture and the removal or treatment of diseased trees.	$350
Grafting and crown change	This intervention is oriented to the change of crown in adult plantations through a grafting technique in thick wood. This practice can be used both in frank trees (per seed) or with clones of low production or with low sexual compatibility.	$600

3.5.4 Financing for the sector

The Colombian government has a history of subsidizing credit for agricultural activities, mostly through FINAGRO (The National Fund for Financing for the Agricultural Sector), which are deployed through regular financial institutions. However, many farmers cite difficulties in accessing credit, despite assistance offered by some extension services and producer associations. The credit terms stipulated by local banks with branches in the region highlight an obvious mismatch with the cash-flow profile of cocoa plantations (table 12). The main barriers to accessing credit for the establishment of cocoa plantations include the following:

1. High upfront investment and lack of short-term cash flow to service debt
2. Frequent lack of credit worthiness and collateral
3. Difficulty in managing loan application processes from farmers' perspectives

Table 12: Financing options for cocoa production in the Orinoquía

Institution	Interest	Tenor	Grace period	Collateral
Banco Agrario*	4.8-10.8%	<96 months	24 months***	Land + other farm income
Bancolombia	DTF + 10%**	<60 months	24 months***	Loan insurance (FAG)
Davivienda	12%	Depends on profile	Depends on profile	Loan insurance (FAG)**** + land if >200MM COP
Mundo Mujer	25.5%	Depends on profile	Depends on profile	2-year track record and demonstrate cash-flow
Bancamia	30-33.6%	<36 months	Depends on profile	2-year track record and demonstrate cash-flow

*Banco Agrario exclusively deploys FINAGRO credit lines. All other institutions deploy FINAGRO and their own resources.

**DTF = deposito a termino fijo (central bank fixed-term deposit rate)

***Only applicable to principal. *

***FAG: Agricultural Guarantee Fund *Source:* Data collected by the authors at local branches.

Some cocoa buyers advance cash to associations for the purpose of buying beans from producers (typically on a week-by-week basis) but do not offer longer-term credit for the establishment or maintenance of plantations.

In conclusion, there remains a significant gap in accessible financing for new plantations that could be tackled by partnerships of individual companies, associations, financial institutions and public institutions.

4. Climate Smart production practices

4.1 Description of Climate Smart production practices

According to the Food and Agriculture Organization of the United Nations (FAO)[1], climate-smart agriculture (CSA) targets three main objectives:

1. Sustainably increasing agricultural productivity and incomes;
2. Adapting and building resilience to climate change; and
3. Reducing and/or removing greenhouse gas emissions.

Table 13 outlines the Climate Smart production practices identified in Colombia. The following sections provide an overview of CSA practices that are being practiced in Colombian cocoa cultivation and could be further assessed with and promoted among companies developing cacao supply chains in the Orinoquía. The focus of this assessment is on production-level practices; however, it is worth noting that additional potential to reduce emissions exists in the transportation and processing of beans.

Table 13: Climate Smart production practices identified in Colombia

Name	Description	Benefits and disadvantages
Prioritization of cultivation in high irradiance areas	Prioritization of cocoa plantations in areas with the highest irradiance or natural light supply areas, in combination with Good Agricultural Practices (GAP).	**Benefits:** - Improved photosynthesis leading to higher productivity and CO_2 absorption - Lower incidence of diseases **Disadvantages:** - Damage to plants, especially to trunks or growth points due to poor management
Litter and dead-wood management mature cocoa plantations	A common practice for soil conservation in adult cocoa fields is to maintain decomposing litter and deadwood under the canopy of trees rather than removing it.	**Benefits:** - Improved water and nitrogen cycle - Increase in organic matter and microorganisms in the soil - Reduction in the use of synthetic sources of fertilizers and lower costs for weed management **Disadvantages:** - Slower rate of fertilizer absorption

[1] http://www.fao.org/climate-smart-agriculture/en/.

		- Cadmium previously absorbed in litter - Deadwood remaining in the system
Establishment of agroforestry systems	The activity consists of establishing cocoa plantations in combination with trees for shade, wind breaks, timber and fruit.	**Benefits:** - Increased carbon sequestration - Improved resilience to winds and other adverse weather - Reduced erosion - Longer life span of cocoa trees compared to full-sun exposure -Potential for additional income **Disadvantages:** - Competition for light and nutrients if non-cocoa trees are not properly managed-Increased incidence of pests and diseases due to increased moisture
Grafting with clones in adult plantations	This practice consists of maintaining the plants' rootstock and replacing the scion with preferred generics from the perspective of fine and flavor varieties, enhanced disease resistance or adaptability to withstand extreme conditions (pH, hydric deficit, salinity, others).	**Benefits:** - Less invasive and quicker productivity than replanting - Uniformity of plants in terms of bean quality, structure and ease of management **Disadvantages:** - Risk of disease due to improper grafting or external factors such as humidity
Targeted synthetic fertilization	This activity consists of the application of cocoa-specific fertilization regimes. The Colombian industry offers two types of synthesis fertilizers specifically adjusted to the demand of the cocoa tree in its adult phase. The amounts of cadmium in fertilizers must be considered in the process to avoid high accumulation in cocoa beans.	**Benefits:** - Greater plant efficiency and productivity - Reduced leaching **Disadvantages:** - Adverse effects on plants and soils due to improper application at inadequate doses and timing
Coverage of synthetic fertilizers with litter	This practice consists of removal of litter and deadwood around the plant before the application of the granular fertilizer and covering the fertilized area with litter.	**Benefits:** - Reduced loss of fertilizers and reduced oxidation - Increased efficiency by solubilizing microorganisms present in organic matter **Disadvantages:** - Additional cost of labor required for its execution

4.2 Considerations for introducing Climate Smart practices in the region

4.2.1 Technical and operational considerations

Table 14 outlines the technical and operational considerations of Climate Smart practices.

Table 14: Technical and operational considerations of Climate Smart practices

Type of practice	Technical and operational requirements
Prioritization of cultivation in high irradiance areas	- Irradiance meters - Nearby weather station with historical records of temperature, precipitation, evapotranspiration and water balances - Tools for pruning and management of plant architecture - Trained personnel for proper crop management
Litter and dead-wood management mature cocoa plantations	The implementation of this measure is quite simple, as it only requires trained labor to perform pruning and dispersion of leaf litter or harvest residues as vegetation cover.
Establishment of agroforestry systems	- Availability of suitable plants for agroforestry systems - Historical records of temperature, precipitation, evapotranspiration and water balances - Trained workforce to manage agroforestry systems - Availability of irrigation
Grafting with clones in adult plantations	- Available genetic material, tolerant to diseases, pests, fine taste and aroma or another characteristic required by the producer - Seedlings registered with the ICA for commercialization in the area of interest - Trained technical personnel and grafting tools
Targeted synthetic fertilization	- Laboratories for the analysis of soil samples - Agrochemical inputs in specific grades for cocoa - Trained labor for fertilizer application - Areas conditioned according to GAP for disposal and handling of agrochemical products
Coverage of synthetic fertilizers with litter	The implementation of this measure is quite simple, as it only requires trained labor to cover the chemical fertilizer with leaves.

4.2.2 Cost implications

Table 15 outlines the cost implications.

Table 15: Cost implications

Type of practice	Costs
Prioritization of cultivation in high irradiance areas	The cost of a portable irradiance measuring device ranges from $150 - 200. Additional costs include labor for the establishment and maintenance of a cocoa crop.
Litter and dead-wood management mature cocoa plantations	The cost of an adult crop, for pruning and waste management, is estimated between three and five daily wages per hectare per year, depending on topography, genotype and soil conditions, among others. In 2019, the cost of a day's wage was COP 40,000 ($12), and therefore the total estimated cost is $36-60 per hectare per year.
Establishment of agroforestry systems	The additional cost per hectare for transitional shade establishment is normally included in the overall plantation budget, as it is essential in the first 12-18 months of cocoa

	cultivation. The cost of forest cultivation for permanent shade varies according to the characteristics of the area and its cost can range from COP 3-5 million ($900-1,500) per hectare.
Grafting with clones in adult plantations	When grafting is done in a nursery, the estimated cost for 1,100 plants required for one hectare is COP 500,000 ($150). When grafting is done in the field, the cost ranges from COP 1.5-2 million ($450-600) per hectare, due to the additional logistics required.
Targeted synthetic fertilization	The cost of synthetic fertilization is approximately COP 1.3 million ($400) per hectare per year (assuming the application of 500-600 g of fertilizer per tree).
Coverage of synthetic fertilizers with litter	In order to cover the fertilizer with litter, two daily wages per hectare are required. In 2019, the cost of a day's wage was COP 40,000 pesos ($12), and therefore the total cost is $24 per hectare per year.

4.3 Available methodologies to assess the mitigation benefit of these practices

A range of methodologies and tools exist to assess the mitigation benefit of agricultural production systems and specific CSA practices.

Mitigation benefits are calculated as the difference in carbon stocks and emissions between the *business-as-usual* (also known as a *baseline*) and *project* scenario. For example, the exact mitigation benefit of a cocoa agroforestry production system differs, depending on whether it is being implemented on land previously managed for cattle grazing, full-sun cocoa cultivation, or conservation of natural forests (the latter of which would cause significant emissions). Similarly, the mitigation benefit of applying a certain fertilizer would depend on the type of fertilizer previously used (if any). Readily available data regarding the mitigation benefit of specific cocoa cultivation systems in the Orinoquía region is limited; however recent assessments of emissions associated with cocoa production have been carried out by CIAT in the Guaviare department[2]; the high-level mitigation potential of cocoa agroforestry systems on degraded pasturelands was conservatively estimated by Climate Focus in collaboration with IUCN[3] as 33.12 tCO2e/ha over a rotation period of 20 years (not including below-ground biomass, soil organic carbon, or emissions from harvesting, transportation, and processing).

The International Panel on Climate Change (IPCC) defines three tiers (Tier 1, 2, and 3) for emission factors and activity data that increase in reliability and complexity from Tier 1 to Tier 3.

Automated tools such as the Ex-Ante Carbon-Balance Tool (EX-ACT) present **a good starting point for carrying out calculations of the potential mitigation benefit of given land-use transitions** (e.g. conversion of grassland to cocoa agroforestry if the main goal is to

[2] https://cgspace.cgiar.org/bitstream/handle/10568/91548/Vision_Amazonia_Cacao_Guaviare_web-definitivo.pdf?sequence=1&isAllowed=y.
[3] https://infoflr.org/sites/default/files/2019-09/colombia_flr_and_ndcs.pdf.

obtain an ex-ante estimate of the mitigation potential).[4] EX-ACT allows the user to use Tier 1 (default) methods for quick calculation or to define Tier 2 data manually. Therefore, there is a certain ability for users to tailor calculations to the project being analyzed by modifying emission factors and carbon stock accumulation rates from literature or projects that more accurately reflect the specific conditions.

If alignment with national GHG estimation and reporting processes and the Nationally Determined Contributions (NDCs) is desired, users are encouraged to identify the competent authorities (in the case of Colombia, the Institute of Hydrology, Meteorology and Environmental Studies - IDEAM) to obtain information on emission factors and carbon stocks being applied in national inventories.[5]

If the project goal is not only to estimate mitigation potential but to explore the potential to generate emission reduction certificates under national or international programs such as Colombia's domestic carbon market, then the Clean Development Mechanism (CDM), the Verified Carbon Standard (VCS), and other applicable methodologies must be used. The methodologies commonly applied to quantify mitigation benefits of cocoa production systems (agroforestry in particular) under the VCS and CDM include AR-AMS2007[6], AR-AMS0001[7], and AR-ACM0003.[8]

[4] http://www.fao.org/tc/exact/ex-act-home/en/#targetText=EX%2DACT%20is%20a%20land,2%20per%20hectare%20and%20year.
[5] https://portals.iucn.org/library/sites/library/files/documents/2019-029-En.pdf.
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5. Opportunities and challenges

As discussed in the previous sections, the Orinoquía region holds significant potential for the sustainable expansion of cocoa cultivation – primarily on lands presently used for extensive cattle grazing. Land suitability to cocoa, availability of sufficiently large plots of land, comparative affordable land, and the potential of the Colombian cocoa brand are precisely the reasons why some chocolate off-takers are investing in the region with an eye for expanding their supply chain.

While there are clear opportunities for chocolate companies to expand their sourcing base in the region, numerous existing challenges would need to be addressed. These include:

1. **Cocoa cultivation does not have a strong tradition in most of the region despite land suitability**. Thus, knowledge of optimal production techniques among landowners is limited and networks of input providers and buyers are somewhat underdeveloped compared with other regions.
2. **The majority of existing producers have planted cocoa on a small scale to provide a supplement rather than a main source of income.** As a result, these plantations are typically not managed professionally (pruning, fertilization, irrigation, pest and disease management), resulting in low productivity that is considered marginal or traditional (refer to section 3.2.1). In addition, cocoa beans are not consistently fermented and dried, resulting in varying levels of quality.
3. **Prospective producers face substantial risks in establishing new plantations.** High up-front costs, limited financing options, and lack of experience with cocoa cultivation contribute to maintaining the status quo (mostly extensive cattle ranching) rather than expanding.
4. **Associations exist but few are sufficiently strengthened to service all members' needs.** If they are to serve as entry points, IFC clients would need to make a serious commitment to working with associations to develop and finance full support packages that include training, inputs, irrigation infrastructure, and efficient transportation arrangements for wet cocoa beans.

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