Food systems, land use change and mitigation initiatives in Caquetá, Colombia

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1. Introduction

Globally, food systems are responsible for a third of the total anthropogenic emissions of Greenhouse Gases (GHG) (Crippa *et al*, 2021; FAO 2021a) and cover 37% of the Earth's area (FAO, 2021b). According to the national and departmental inventory of GHG (IDEAM *et al*, 2016), 61% of GHG emissions in Colombia come from agriculture, forestry and other land uses (AFOLU), which corresponds to 158.6 Mt of CO^2eq. In the case of the department of Caquetá, the change from natural forest to pastures contributes 84% of the department's total emissions, while the agricultural sector contributes 11.56%. Caquetá is the third largest producer of CO^2 in the country, after Antioquia and Meta, with 18.61 Mt of CO^2eq of net emissions (IDEAM *et al*, 2016)[1]. However, this department can play a central role in GHG mitigation at the national level, since it still maintains 72% of the area in forests (FAO & ADR, 2021).

Food systems are key to the economy of Caquetá as agriculture, livestock and fishing represent 15.2% of the departmental gross domestic product (GDP) – 60% of which comes from livestock alone –, a percentage that is well above the national average (7.4%) (DANE, 2021). However, the departmental contribution to national GDP during the first two decades of the 21st century has been 0.4% (Campos, Quintero & Ramírez, 2013; DANE, 2021) which represents a setback compared to the previous two decades where its contribution was at 0.6% and 0.7% (Campos *et al*, 2013). This has been explained by the preeminence of the primary sector, mainly livestock, which has been the predominant productive system in the department, constituting one of the bastions of the colonization processes (Centro Nacional de Memoria Histórica, 2017). It is mainly an extensive activity with low levels of

[1] This is mainly due to deforestation, which generates 17.2 Mt of CO^2eq, followed by 2.29 Mt of emissions caused by the agricultural sector, for a total of 19.84 Mt; on the other hand, its absorption level is very low (-1.23 Mt), which leads to net emissions of 18.61 Mt of CO^2eq (IDEAM *et al*, 2016).

productivity (Enciso *et al*, 2018) which has been the main driver of environmental change in the department.

In this document we present a general characterization of the food systems in the department of Caquetá, Colombia, based on a review of the literature, with a particular emphasis on livestock and cocoa. It is worth mentioning that, according to our findings, most of the studies have a departmental emphasis[2] which highlights the importance of deepening in local studies, that provide more specific information on the functioning and features of food systems, their articulation to local, national and international value chains, as well as their potential and challenges in terms of mitigation and adaptation to climate change. Likewise, we observed a gap in the development of research that addresses differential approaches regarding gender, youth and other relevant population groups for the discussion of food systems sustainability.

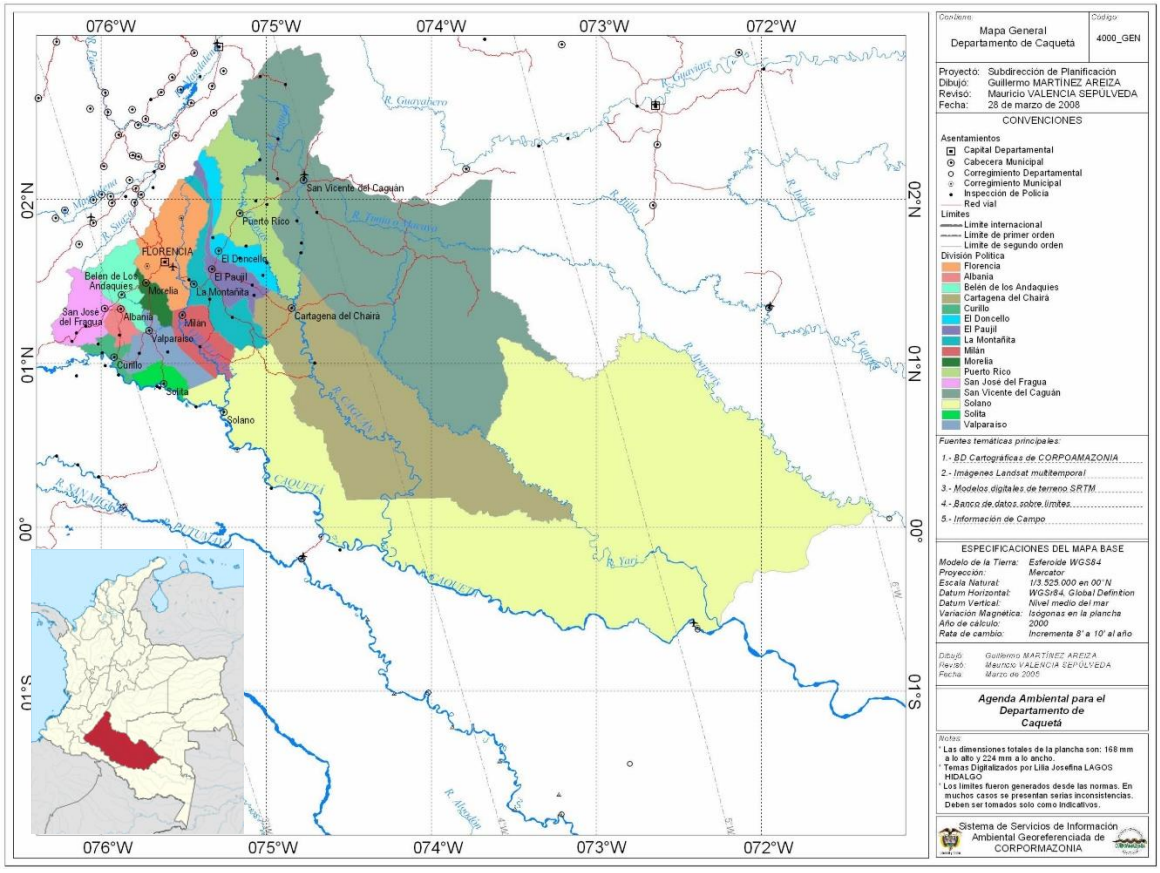
This document is organized as follows. Following this introduction, in the second part we present the main social and environmental features of the department, necessary for the understanding of the representative food systems. In the third part, we delve into the department's food systems with an emphasis on livestock and cocoa and include a discussion on issues of gender, youth and social inclusion. The fourth part refers to the historical dynamics in the department, related to land use change and, therefore, to GHG emissions and climate change. In the fifth part we present a summary of the mitigation initiatives in the department and the potential role of social organization. The sixth part is the conclusion.

2. Context: Department of Caquetá, Colombia

Caquetá is located in southern Colombia, in the Amazon region. It comprises 16 municipalities (map 1) and occupies an area of 9,010,823 hectares, which corresponds to 7.8% of the national territory and 22% of the Colombian area within the great Amazon basin (FAO & ADR, 2021). It limits to the north with the departments of Huila and Meta, to the south with Amazonas and Putumayo and to the east with Guaviare and Vaupés, and to the west with Cauca and Huila (Gobernación del Caquetá, Instituto SINCHI & PNUD, 2020). The agricultural frontier covers an area of 1,479,367 hectares (16.41% of the total area) (UPRA, 2019). The foothills zone corresponds to the Andean-Amazon transition.

[2] With the notable exception of Gutiérrez, Moreno & Barrera (2019) *"Sistemas de producción en el medio Caquetá (Cartagena del Chairá) GEF Corazón de la Amazonia"* which studied and characterized the food systems in the municipality of Cartagena del Chairá.

According to the National Population and Housing Census (Censo Nacional de Población y Vivienda), the population of the department is 359,602 people, of which 67.6% (243,242 inhabitants) are located in the urban area – concentrated in the city of Florencia, the capital of the department – and 32.4% (116,360 people) are in the rural area (DANE, 2018). Florencia is connected to 14 out of the other 15 municipalities of the department – which are predominantly rural and concentrated in what is known as the piedmont[3] – by the *Carretera Marginal de la Selva* (Gobernación del Caquetá *et al*, 2020).



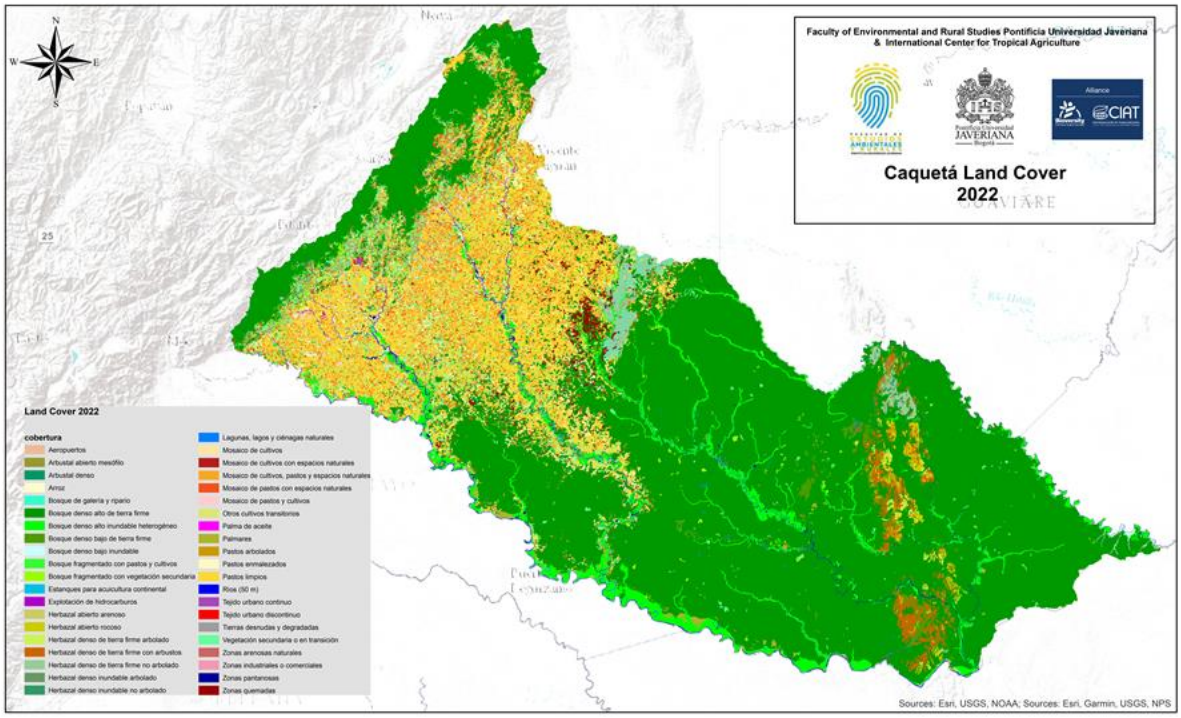
Map 1. Municipalities in the department of Caquetá

Source: https://www.corpoamazonia.gov.co/region/caqueta/cartografia/01_4000_cqt_gen.jpg

Natural ecosystems in the department correspond to 79.91% of the area while lands with human intervention correspond to 23.08% (IDEAM *et al*, 2017). The main ecosystems in the department are the humid basal forests, with an area of 47,846.23 km^2 (53.11% of the

[3] While the piedmont only corresponds to the 17.7% of the area of the department, it concentrates more than 90% of the population.

department) and grassing lands with an area of 11,623.92 km^2 (12.9% of the department). In terms of land coverage, by 2018, dense forests occupied an area of 61,976.20 km^2, which represented 68.8% of the territory, while clean pastures occupied 13,212.18 km^2, equivalent to 14.67% of the department (map 2). It is important to note that 80.6% of the area of the department is under a legal figure of protection or conservation (i.e., national or regional natural parks, indigenous reservations, forest reserves, etc.) (Gobernación del Caquetá *et al*, 2020).



Map 2. Land cover in Caquetá 2022
Source: Authors' elaboration based on open data geoportal SIATAC https://datos.siatac.co/pages/coberturas

One of the main problems in the department are land use conflicts, given that, following the studies of land vocation and use conflicts carried out by IGAC (2014), 13% (1,191,817 hectares) of the area of the department is being overused[4], mainly due to livestock (Gobernación del Caquetá *et al*, 2020; Gobernación del Caquetá, 2019). The pasture area in the department covers around 2.4 million hectares, of which silvopastoral systems only represent 0.1% (Enciso *et al*, 2018) despite only 15,795 hectares are potentially usable for

[4] Overutilization refers to the situation in which the current use of land surpasses its natural capacity which causes soil and land degradation. In Colombia, it has been set according to the methodology for land vocation assessment and classification developed by IGAC & CORPOICA (2002).

livestock (IGAC, 2014). This contrasts with the 12,672 hectares used for agriculture, out of 148,685 ha potentially usable for this activity (Gobernación del Caquetá, 2019)[5]. The municipalities of Morelia (84%), Albania (79%), Valparaíso (76%), Milán (69%), El Paujil (57%), Montañita (57%), Solita (56%) y Curillo (52%) are the most affected by land overuse (Gobernación del Caquetá *et al*, 2020).

Nevertheless, most of the department is still conserved as most of its territory is covered by forests and semi-natural areas. During the last decades, a process of expansion of the agricultural frontier has taken place, causing the replacement of natural covers by pastures, mainly located in the northwestern sector of the Amazon. The roads and rivers that connect this region and the interior of the country have facilitated the transformation of the territory (Gobernación del Caquetá *et al*, 2020).

3. Food systems in Caquetá

Livestock is mainly an extensive activity with low levels of productivity (Enciso *et al*, 2018), which has been the main driver of environmental change in the department. Regarding agricultural production, the main products are plantain, corn, cassava, cane, rubber, cocoa, coffee, rice, pineapple and beans (FAO & ADR, 2021). According to data from the National Agricultural Census (DANE, 2014), 58% of the Agricultural Production Units (UPA for its initials in Spanish) have lots for self-consumption and 51% of the UPA correspond to family agriculture. Despite this, food insecurity is at 54.4%, 10 percentage points above the national average (FAO & ADR, 2021).

Caquetá occupies the 25th position among the 33 departments in the Competitiveness Index, being innovation and business dynamics, and higher education and training for work, the variables with the lowest scores (FAO & ADR, 2021). The lack of production technification and the low added value of the products reflect this low competitiveness, which is also reflected in the decline in the department's participation in the national Gross Domestic Product (GDP), which went from 0.6% and 0.7% during the last two decades of the 20th century to 0.4% in the first two decades of the 21st century (Campos, Quintero & Ramírez, 2013; DANE, 2021). Among the reasons that explain the low complexity of the productive

[5] The total area with potential agroproductive uses is 2,078,502 hectares (23,1%) but most of it has a vocation to agroforestry uses (1,883,925 hectares) (Gobernación del Caquetá, 2019, based on UPRA (2019) and IGAC 2014).

systems are the problems associated with the concentration and formality of land[6], low access to productive factors, credit and technical assistance[7], and the insufficiency and poor condition of the road network in the department (FAO & ADR, 2021). These factors also explain the persistence and preeminence of extensive livestock farming as the main productive system.

Agroecologically, food systems in the department have been classified according to their presence in five physiographic units (mountain, piedmont, *lomerío* and alluvial valleys). The mountain landscape is located on the eastern flank of the eastern cordillera and its characteristic production systems – that include livestock and diversified agricultural production – concentrate an important part of the peasant economy of the department. The physiographic landscape that follows the mountains is the piedmont, which is characterized by production systems concentrated in livestock production and plantations of cocoa and rubber, among other agroforest systems. Most of the department corresponds to *lomerío* (90% of the Amazon region and 70% of the intervened area in Caquetá) which is characterized by hillocks, low ridges, plateaus, valleys and depressions. Production systems in this landscape are classified according to the level of human intervention in high, medium and low, with high intervention systems characterized by business-type livestock production units while low intervention units are predominantly diversified and familiar economic systems (Jiménez, Mantilla & Barrera, 2019).

Thus, production systems with agricultural vocation are located mainly in the mountain landscape and alluvial valleys; properties with both agricultural and livestock activities are present in the landscape of *lomerío;* and livestock production units are present across all physiographic units, corresponding to 68% of the production units identified in the department (Jiménez, *et al*, 2019). While peasant and family economy systems are located mostly in less intervened areas of the *lomerío* landscape and in mountainous landscapes, more intensified business-type livestock production is located in the highly intervened zones of the *lomerío* (Gobernación del Caquetá, 2019).

3.1.Livestock production systems

Livestock has been the predominant productive system in the department since the beginning of the 20th century, constituting one of the bastions of colonization processes (Campos, *et*

[6] 11% of the rural properties, which correspond to 5,381 properties of less than one hectare, covers a total area of 880 ha; while 0.06%, which corresponds to 30 properties larger than 5,000 ha, add up to 2,490,593 ha. The Gini coefficient for land tenure for the department is 0.70 (FAO & ADR, 2021, citing UPRA, 2019).

[7] According to the National Agricultural Census (DANE, 2014), only 1,459 (7.1%) out of the 20,293 agricultural production units (UPA) in the dispersed rural area surveyed received technical assistance.

al, 2013). The economy of the department is basically sustained by the production of bovine meat and milk, with some contributions from transitory and permanent crops. Livestock contributes 8.5% to the departmental GDP and 60% to the agricultural GDP (Enciso *et al*, 2018).

The department has about 14,000 families whose main economic activity is cattle ranching. They carry out this activity in a traditional way based on extensive and semi-extensive grazing systems (Enciso *et al*, 2018). The Colombian Agricultural Institute (ICA, 2017) indicates that 91.2% of the properties correspond to small and medium producers, where 6,165 small livestock units represent 43.2% of the total properties of the department, 6,838 are medium producers (48% of the total), and the remaining 1,248 producers are large producers, with more than 250 animals (8.8%). Torrijos (2021) specifies that 42.2% of the farms have less than 50 heads and only 0.3% register a population of more than 1,000 cattle.

This activity is mainly carried out extensively, with diets based on pastures with poor nutritional quality, lack of technical assistance and training, low technology and little or no management of productive and reproductive records (Earth Innovation Institute, Fondo Patrimonio Natural & Fondo Acción, 2015; Pallares, 2014)[8]. The carrying capacity is between 0.4 and 1 head of cattle per hectare given the low productivity of the livestock and the low quality of the forage (Enciso *et al*, 2018; Pallares, 2014). Despite being the main income generation activity, livestock production is not necessarily a profitable activity due to the high production costs – particularly if family labor costs are taking into account –, its extensive nature and the lack of technification[9] (Gutiérrez *et al*, 2019). Producers' low association level is also a problem that restricts their negotiation capacity and collective action, as only 25% belongs to an association or a local committee; a percentage that can be as low as 9% in some municipalities like Montañita and 8% in Belén de los Andaquíes (Pallares, 2014). Such organizations, on the other hand, face structural problems such as few economic resources and technical capacities to identify and manage better market conditions for associates (Enciso *et al*, 2018; Pallares, 2014).

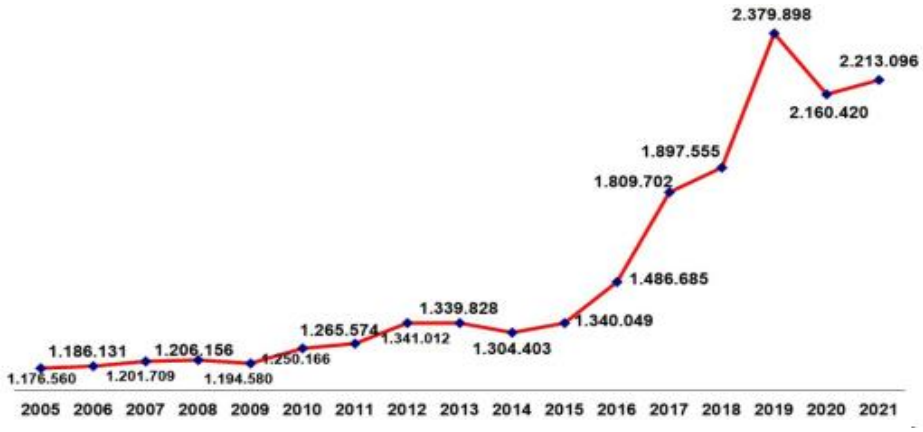
Livestock in the department is developed through productive models aimed at four ends: raising cattle, specialized fattening, specialized dairy and dual purpose (milk and meat). Milk production is the predominant income-generation activity and double purpose systems are

[8] According to the National Federation of Cattle Ranchers (Federación Nacional de Ganadeross – FEDEGAN), in 99% of cases milking is done manually and only one farm implements good manufacturing practices, out of more than 10 thousand farms surveyed in 2013 (Pallares, 2014).

[9] Milk production, for instance, is around 3-4 liters/cow/day for low-tech family production systems, while it could reach 8 liters/cow/day in high-tech business type production systems, which only represent a small proportion of producers in the department (Pallares, 2014).

predominant (67% of the livestock production systems)[10]. Producers derive their livelihood mainly from the commercialization of milk (52% of their income), followed by the sale of cattle (30%), cheese production (13%) and agricultural products (4%) (Pallares, 2014). According to Torrijos (2021), the size of the herd in the department is 2,213,096 individuals, of which 88% correspond to dual purpose, 9% for breeding and 3% for dairy and specialized fattening.

Figure 1 shows the behavior of the number of bovines in the department during the last 16 years. Until 2015, the bovine inventory in the department remained relatively constant, presenting a growth of 14% between 2005 and 2015 but, since 2015, the bovine population has increased by 65.1% (Torrijos, 2021). In 2022 there were a total of 2,198,256 cattle



throughout the department (not counting buffaloes) (ICA, 2022).

Figure 1. Bovine stock Caquetá
Source: Torrijos (2021)

Enciso *et al* (2018) analyze the meat and milk value chains in the department and identified the actors corresponding to the different links of the value chains. In the case of the dairy chain, the links identified are production, gathering, transformation, marketing and final consumption. There are four channels through which the product circulates until it reaches the final consumer: national industry (Nestlé de Colombia), regional industry (100 dairy companies), rural cheese and *cruderos*[11]. The distribution of milk for 2021 was as follows: Nestlé 4%, processing industry 51%, rural cheese factories (44%), self-consumption (1%)

[10] Pallares (2014) using data of the survey *Colombia Responde* which was implemented in 2013.

[11] These are marketers who, without guaranteeing the cold chain, collect the milk on the farms and are in charge of taking it directly to consumers or selling it to shopkeepers. These players market around 1% of the department's total production (Enciso *et al*, 2018).

(Torrijos, 2022). Most of the milk is marketed as cheese in its variety of salty chopped cheese and *quesillo* (Enciso *et al*, 2018)[12]. Milk production in the department is based on small and medium size livestock production units, with less than 150 animals. Most of them are traditional family livestock systems – mainly double-purpose – that produce 58.78% of milk, followed by non-traditional double-purpose systems that cover 39.34% of milk production, while specialized dairy producers only cover 1.88% (Pallares, 2014).

In the case of the meat chain, the links are primary producer, commercialization of live cattle, transformation, commercialization and distribution, and final consumer. Two marketing channels are identified: production for the local markets and extra-regional markets. In the first, the participants are local intermediaries and marketers of the outlets for the benefit and distribution of meat; in the second, intermediaries, such as commission agents or dealers who negotiate the cattle with the producers for their subsequent transfer to extra-regional markets. The commercialization of cattle for meat is carried out mostly on foot and is intended to supply extra-regional markets, such as in the departments of Valle del Cauca and Huila (Enciso *et al*, 2018).

It is important to mention that the expectation within the sector is that the department becomes the main producer of milk at the national level (with a target of 3.000.000 lt./day) through the transformation of production systems towards silvopastoral systems (1.000.000 hectares) and market differentiation through denomination of origin, clean production practices and zero deforestation commitments (Enciso *et al*, 2018; Gobernación del Caquetá, 2019).

3.2. Cocoa production systems

Colombia ranks tenth as a cocoa producer worldwide with a participation of 1.1%; however, the main destination of the production is the domestic market (Charry *et al*, 2017). In the country, between 80% and 90% of cocoa production is purchased by two Colombian companies (Casa Luker and Nutresa), followed by small domestic chocolate manufacturers (Abbot *et al*, 2018).

In the department of Caquetá there has been an increase in the planted area, which does not correspond to the behavior in production (figure 2). The explanations for this result provided by Charry *et al* (2017) are related to the abandonment of crops, the aging of plantations, the

[12] All of the cheese production is consumed locally or nationally. None of the cheese-producers in the region sells their production to international markets, despite having the brand *Caquetá cheese* with the denomination of origin approved by the Superintendence of Industry and Commerce in 2010 (Pallares, 2014).

higher incidence of pests and diseases, the mismanagement of plantations and the marketing record of cocoa outside the departmental limits.

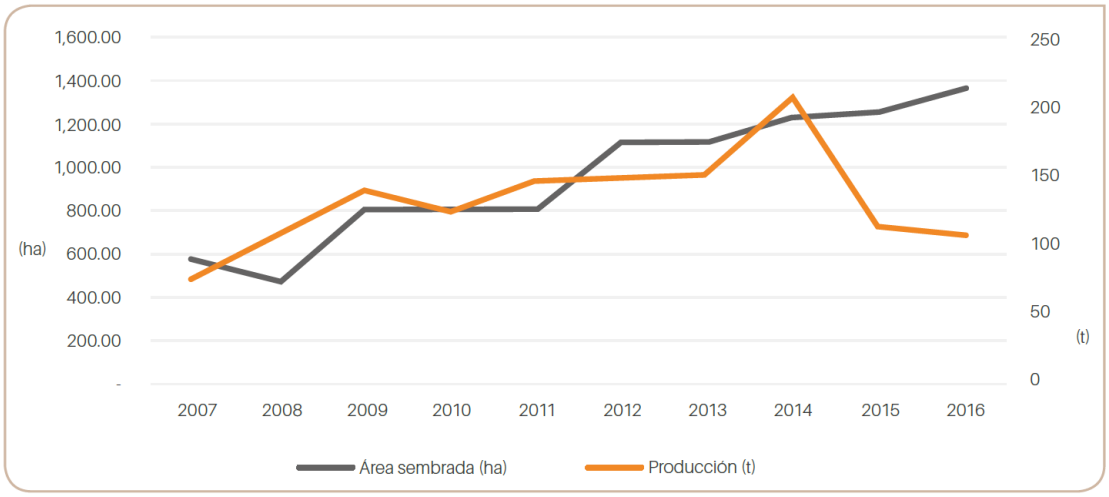


Figure 2. Planted area and cocoa production in Caquetá
Source: Charry et al (2017)

In a longer timeframe, figure 3 shows the behavior of cocoa production (in tons of dry beans) in the department between 1987 and 2017. As can be seen, according to the recorded data, the year 1994 had the lowest production in the entire period of analysis with only 11 tons. The year 2009 is the turning point in cocoa production, as between 1994 and 2009 production did not exceed 200 tons, but it went from 140 tons in 2009 to 899 tons in 2014.

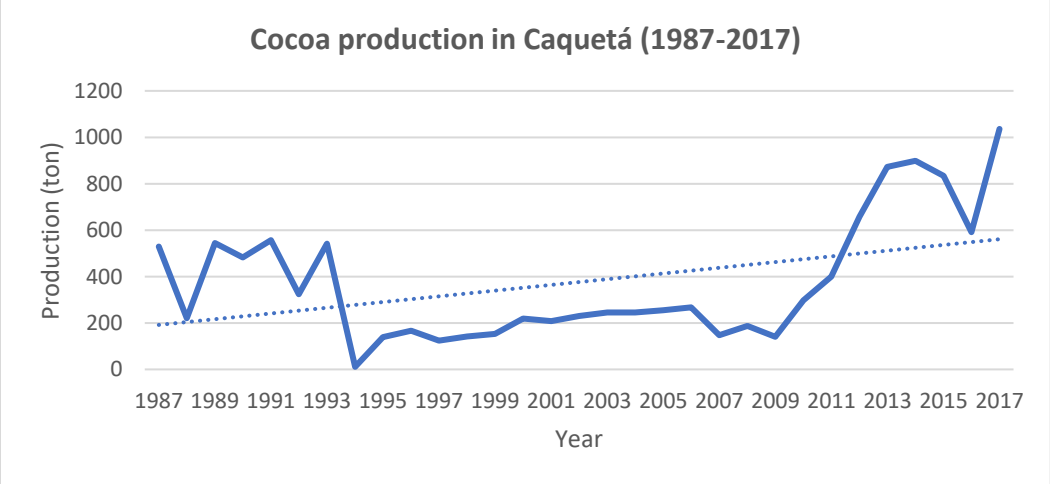


Figure 3. Cocoa production in Caquetá 1987-2017

Source: Authors' elaboration based on data from Evaluaciones Agropecuarias Municipales (EVA) -Ministerio de Agricultura y Desarrollo Rural, Colombia.

The department of Caquetá has close to 1,200 cocoa-producing families, mainly with small plantations in agroforestry systems associated with species that provide them with shade and income during non-productive years, and most of them belong to producer associations that make part of a second level organization (ACAMAFRUT), which appears as legal representative of the producers in the Regional Committee of the Cocoa Chain (Charry *et al*, 2017). These are diversified farms of between 5 and 15 hectares, where cane, beef and milk, plantains, citrus fruits, wood, cassava, etc. are also produced (Abbott *et al*, 2018).

According to the Municipal Agricultural Evaluation (EVA), the municipality with the largest area harvested for cocoa was Montañita with 616 hectares, followed by San José del Fragua, El Doncello, Cartagena del Chairá and Solano. Although municipalities such as Montañita and San José del Fragua had the largest harvested area, their yields were lower than municipalities such as El Doncello and Puerto Rico, which had better yield in smaller harvested areas (Ministerio de Agricultura y Desarrollo Rural, 2018).

Regarding the value chain, Charry *et al* (2017) identified the actors corresponding to the different links. The first link corresponds to the actors in charge of the provision of inputs and plant material; the main producer of plant material is ACAMAFRUT. In the second link refers to the primary producers, many of whom are linked to municipal committees and/or cocoa grower organizations; they are mainly diversified family production systems. The third link is made up of local dry grain marketers, which brings together both producer associations, agribusiness purchasing agents, and private merchants.

The fourth link corresponds to agribusiness, which includes large processors, the specialized chocolate industry, and the small local table chocolate industry. It is important to note here that main destination of cocoa grain production is the domestic market. The most important buyers of cocoa in the department are the large chocolate-producing companies in the country: *Nacional de Chocolates* from *Grupo Nutresa* and *Casa Luker*; both transform the cocoa and sell a variety of products such as cocoa beans, coverage, liquor, cocoa powder and butter in the national and export markets. The fifth link is the final market, made up of the various distribution channels of the final product that address the consumers of processed products[13] both in the national and international markets. The national market of cocoa value-added products has expanded in the last years which has reflected in an improvement in the

[13] Such as sweet chocolate, table chocolate and by-products such as cocoa butter, cocoa liquor, nibs, cholate couverture and cocoa powder.

market price. Regarding the international market, the main destinations of the final products are the neighboring markets and not international markets of greater purchasing power (except the USA) (Charry *et al*, 2017).

3.3. Gender approach in food systems

Gender perspective aims to provide a more comprehensive vision of social relations which does not imply talking only about women but recognizing historical inequities and inequalities. Gender perspective offers the possibility, from different categories of analysis, to understand social dynamics behind the relationships among genders and to consider aspects like the differences in access to natural resources and capital. The analysis from this perspective integrates the roles (productive, reproductive and community), identifying gender differences in access and control of resources and benefits, in order to analyze how social relations, actions and public policies address practical needs and differentiated strategic interests of different genders (Maya *et al*, 2006).

The study *"Situation of rural women in Colombia 2010-2018"* (Ministry of Agriculture, 2020) finds that, at the national level, rural women represent 47.2% of the population that inhabits rural areas. However, women have a lower participation in the labor market – almost 30% less than men – and also get lower incomes, as they have less access to paid jobs and productive assets. One of the reasons behind this result is that women are the main caregivers within households: 93% of women compared to 61% of men, who dedicate on average 8 hours a day compared to 3 hours a day for men.
In rural production systems, women and youth generally have limited access to income and production actives, particularly land (Dulci & Guraná, 2021). In terms of land ownership, women own less than 15% of the land and less than 2% of registered rural properties. They receive only 10% of all global income, although they are responsible for two-thirds of the work. In rural areas, 60% of households headed by women are located on marginal land, devoid of basic sanitation, machine inputs for production (IICA, 2018). In Colombia, the study carried out by OXFAM (2017) analyzing the National Agricultural Census (DANE 2014), concludes that 26% of the farms managed by natural persons are run by women, 61.4% are run by men and 12.6% is handled by both men and women together. Farms run by women are smaller and have less access to machinery, credit and technical assistance.

For youth, on the other hand, Abbot *et al* (2018) indicate that there are few incentives to get engage in the agricultural production sector as it does not generate a stable income while it is highly unlikely for young people to inherit land during their productive years, and buying

their own land is not a viable option in most cases. Additionally, both illicit economies and activities in the transportation, construction, and services sectors tend to pay higher wages than agricultural activities, making it more attractive for young people to engage in such activities.

In general, there are few studies disaggregated by gender and focused in youth in Colombia and in other Latin American and Caribbean countries related to food systems, despite the fact that, given the inequalities and gaps, it is important to approach for their analysis. For the food systems that are central to this research (cocoa and livestock), the National Federation of Cocoa Growers is addressing the issue of gender around the systems of production (Cardona, et al 2021; FEDECACAO, 2022). In the characterization of FEDECACAO (2022) for the department of Caquetá, 493 cocoa farmers were surveyed, of which 403 were male and 90 were female. Regarding the distribution by age ranges, the highest percentage is concentrated between 27 and 59 years and it is observed that the range of 18 to 26 (young people) barely reaches 0.20%. The levels of schooling show gender differences, with women having a higher level of schooling than men, an aspect that appears repeatedly in different studies but does not yet represent changes in the position of women in decision-making.

Similarly, there are some advances in the livestock sector – for example, within the framework of the proposals for *Sustainable Colombian Livestock* – where the participation of women in the sector is highlighted. In the dairy chain, women participate more actively in the processing and sales of dairy products, but they also play an important role in different livestock and pasture management activities (Arora *et al*, 2017). Nevertheless, the role of women continues to be invisible in this sector. In the case of Caquetá, it is estimated that between 30% and 50% of the activities in the farms are developed by women (for instance, records keeping, accounting, cleaning, milking and provision of food to the family); women are also communal leaders and owners or co-owners of the production units, despite which their role and human capital has not been properly recognized socially or economically (Pallares, 2014).

As for cocoa, given the lack of information in the livestock context, it is important to deepen our understanding and recognition of gender roles and practices within the value chains. It also applies for young people as in terms of innovation, they can play a key role in moving towards more sustainable systems, but the patterns of generational change require to ensure the conditions for them of taking root to the territory. The implementation of mitigation actions in food systems undoubtedly has to have a systemic approach from a gender perspective, given the differentiated effects of climate change and the differentiated impacts

of conservation, adaptation and mitigation actions and policies. Equity in this sense implies actions that recognize differences to avoid increasing inequality gaps.

4. Historical dynamics[14], changes in land use and climate change

The changes in the natural ecosystems in the department of Caquetá are closely integrated into the land occupation model and the need of local producers to use and manage the land. The food systems in the department have been forged, mainly through historical processes of peasant colonization, which have occurred in different waves and following different inducing factors. The first wave of colonization had to do with the extraction of natural resources, mainly cinchona and rubber, in the last decades of the 19th century and the first three decades of the 20th century, where large numbers of workers mainly from the Andean zone of the country, established in the areas of the Caguan, Yarí, Guayas, Orteguaza, Pescado and Caquetá rivers, in what became known as the rubber route, which would connect the Amazon with the center of the country, and which would later allow the entry of more settlers (Uribe, 1992). This resulted in the displacement of the indigenous communities that inhabited the region (Solarte *et al*, 2017).

During the decades of 1930 to 1950, colonization was driven by various factors; particularly, the forced displacement during *La Violencia* – the period in Colombian history were the political conflict between liberals and conservatives took place –, or as a consequence of agrarian conflicts in the interior of the country, that led peasants in search of land to settle in the vacant land of this border region. In 1959, the National Government established a *"directed colonization"* program in order to give land and settle families displaced by violence in the frontier. Unfortunately, this program ended up being a failure, because it failed in improving the quality of life of the settlers who arrived in Caquetá, since the location of the colonization fronts was not the most appropriate in terms of land quality; also, the products cropped were not the most appropriate type of crops to plant in this region and families have no possibilities of trading these products (CHMH, 2017).

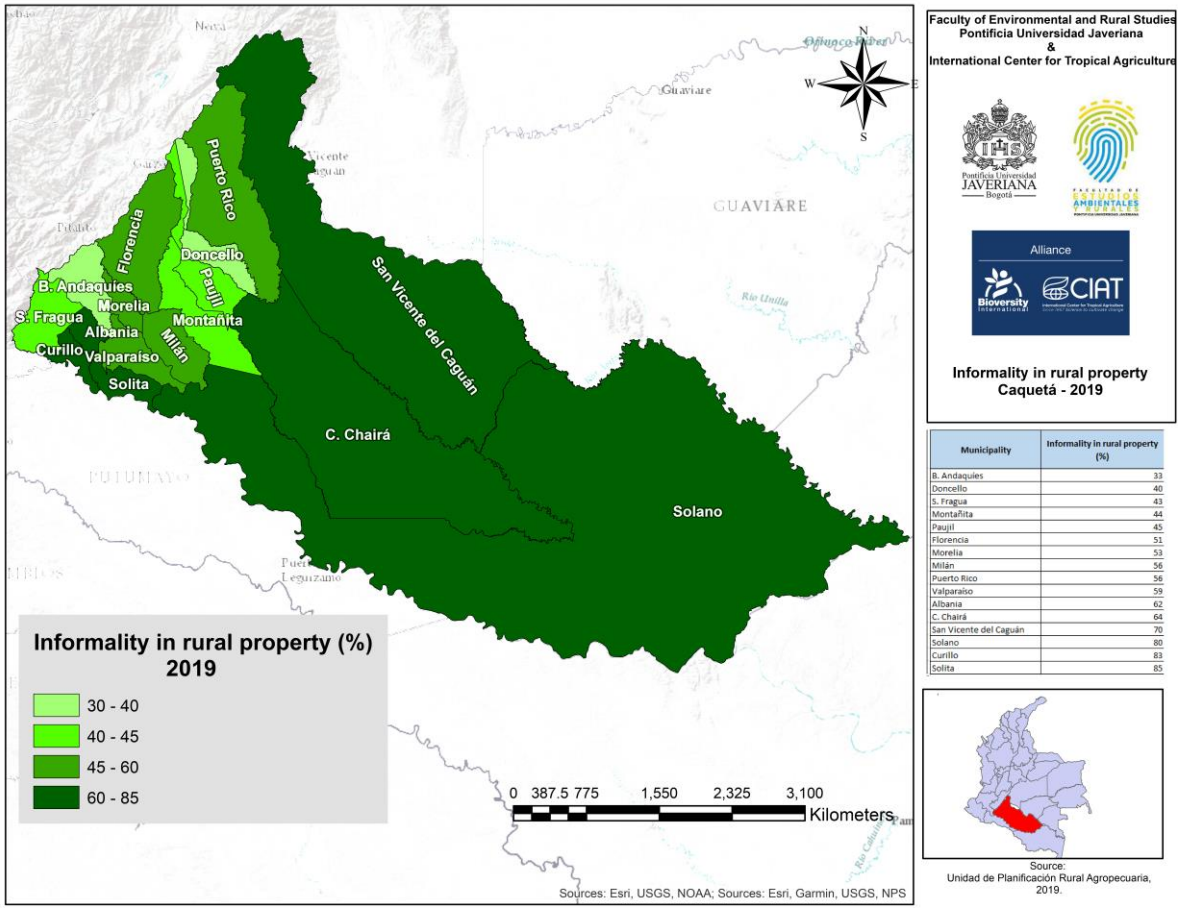
As the unsuccessful *"directed colonization"* ended, the peasantry migrated within the same territory and took over the vacant areas, promoting what became known as *"spontaneous colonizations"*. In 1963, the national government authorized the National Institute of Agrarian Reform (INCORA) to support the processes of spontaneous colonization that were

[14] See Appendix 1 for a timeline with the principal events on Caquetá's history.

taking place. During the 1970s, this resulted in two projects called Phase I and Phase II, whose main purpose was to settle settlers through the expansion of the agricultural frontier, in an area of 500,000 hectares of vacant land, as well as their titling and the construction of penetration roads (Uribe, 1992). These projects stimulated the clearing of forests, together with the planting of corn and rice, which prepared the soil for the dispersion of pastures, since each hectare converted to pasture translated into credit for the introduction of cattle. Faced with the inability to solve the problems of land distribution within the agricultural frontier, the state opted for its expansion in areas where few activities were suitable in economic terms, which resulted in the promotion of livestock farming and, consequently, the clearing of forests and the deterioration of ecosystems without a considerable improving in the living condition of the rural population of the frontier regions. Livestock was consolidated as the dominant food system in the territory thanks to the policies promoted by the state.

A subsequent period of colonization was framed in the internal armed conflict between the Colombian state and the leftist guerrillas (FARC, M-19, EPL, ELN, among others), the consolidation of the coca leaf market for illegal uses and the so-called *"war on drugs",* which included aerial spraying with glyphosate and led settlers to move further and further into the agricultural frontier. Cattle ranching became the main legal economic activity in which the profits from the coca leaf were invested, which further promoted this activity as a driver of change in the territory.

These processes of expansion of the agricultural frontier have had important consequences, such as the concentration of land, informal ownership and conflicts in its use. Regarding the concentration of rural property, 11% of the rural properties, which correspond to 5,381 properties of less than one ha, sum up to 880 ha; while 0.06% properties that corresponds to 30 properties larger than 5,000 ha, add up to 2,490,593 ha. The Gini coefficient for land tenure for the department amounts to 0.70 (FAO & ADR, 2021) and, even today, informality in land ownership exceeds 50% of the properties in most of the municipalities (map 3).



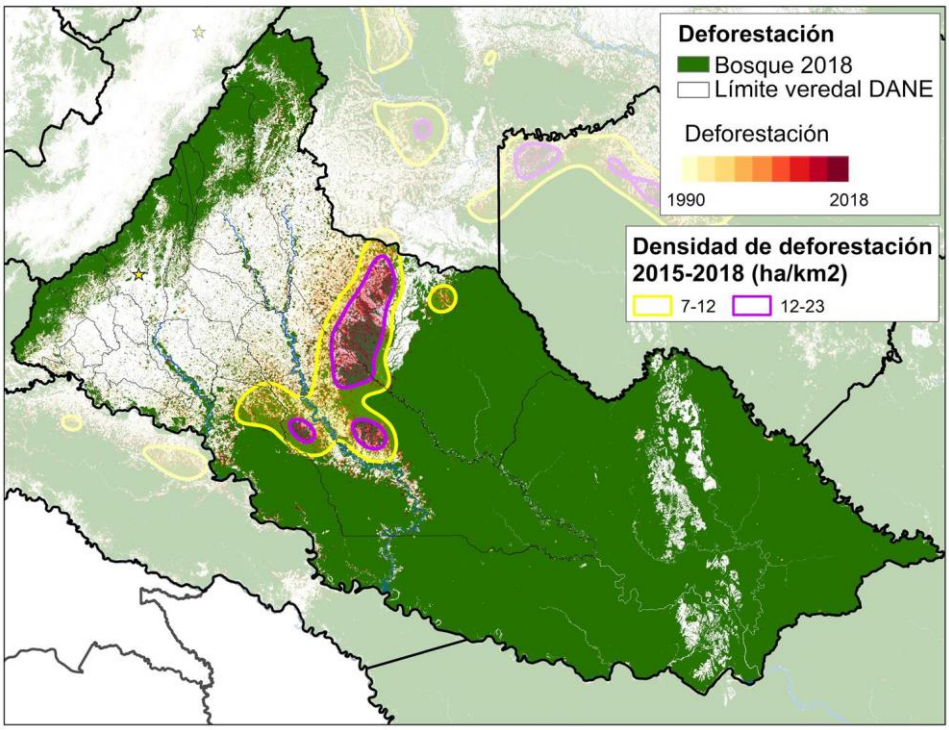
Municipality	Informality in rural property (%)
B. Andaquíes	33
Doncello	40
S. Fragua	43
Montañita	44
Paujil	45
Florencia	51
Morelia	53
Milán	56
Puerto Rico	56
Valparaíso	59
Albania	62
C. Chairá	64
San Vicente del Caguán	70
Solano	80
Curillo	83
Solita	85

Map 3. Informality in rural property of municipalities in Caquetá, 2019
Source: Authors' elaboration based on data from UPRA (2019)

In 2016, after four years of negotiations, the Colombian government, under the leadership of former President Juan Manuel Santos, signed the Final Peace Agreement with the FARC-EP. Given the disarmament and disappearance of this guerrilla as an armed group with control of the territory, a new opportunity arose for the construction of life projects for rural communities, but with great challenges, including post-conflict and peace consolidation, as well as the environmental transformations resulting from the end of *"gunpoint conservation"* (Murillo Sandoval et al, 2020).

It is estimated that 70% of deforestation in Colombia is generated in the Amazon, with the department of Caquetá registering the highest deforestation rate at the national level (26.29% of the total) (IDEAM, 2019). Only in 2018, about 46,765 hectares were deforested in the department, with three municipalities – San Vicente del Caguan, Cartagena del Chairá and

Solano – concentrating the largest areas logged (map 4). These three municipalities contribute to 22% of deforestation at the national level (FCDS et al, 2022).



Map 4. Deforestation in Caquetá 2018
Source: Earth Innovation Institute (2020). Data IDEAM.

Additionally, according to the latest deforestation report from the Foundation for Conservation and Sustainable Development (FCDS, 2022), from 2018 to 2021, the Department of Caquetá led the loss of forest cover in the Amazon biome, with 34% of total deforestation and approximately 147 thousand hectares in the last four years (figure 4). The increase in deforestation since 2015 coincides with an increase in cattle ranching in Caquetá, after the peace agreements were signed (figure 1).

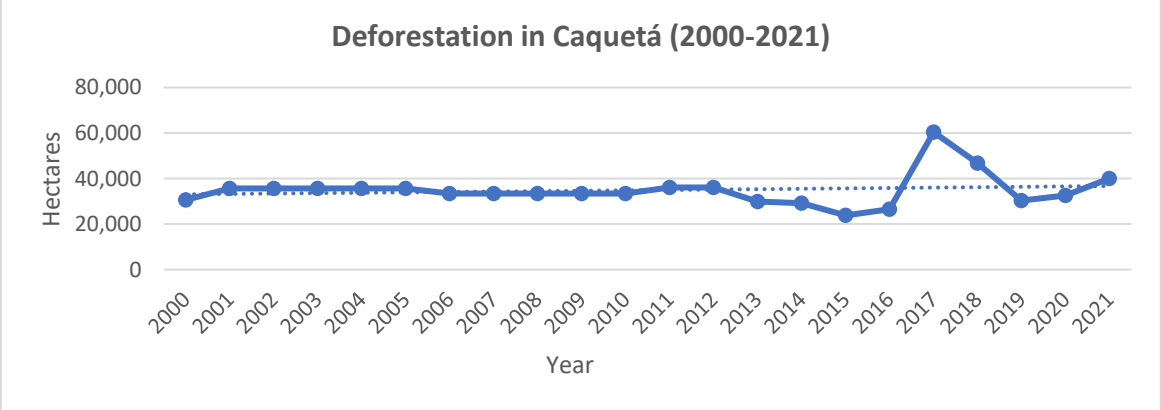


Figure 4. Annual deforestation in Caquetá
Source: Authors' elaboration. Data: IDEAM

5. Mitigation initiatives and social organization

In terms of climate change mitigation, to reach its Nationally Determined Contribution (NDC)[15], Colombia has established a reduction in emissions from deforestation equivalent to reducing the deforestation rate to 50,000 ha/year in 2030. Within the framework of these commitments, various mitigation initiatives are developed at the national, regional and municipal levels by public and private actors[16]. The most important of these initiatives has been *Visión Amazonía*, which is an initiative designed by the Ministry of Environment with the goal to reach zero deforestation in the Amazon region by 2020 (Gobernación del Caquetá *et al*, 2020). *Visión Amazonía* is funded by the *REDD+ for Early Movers* (REM) program through the mechanism of payment for results, mainly by the governments of the United Kingdom, Norway and Germany (Gobernación del Caquetá, 2019).

Visión Amazonía is focused in five action fronts: 1) improve forests' governance, 2) sectorial sustainable development, 3) agri-environmental development, 4) environmental development in indigenous lands and 5) enabling conditions. Within those fronts, one of the purposes of *Visión Amazonía* is to progress in the transformation of food systems into *zero deforestation value chains*, which implies to address the issues related to both food systems low competitiveness and their environmental impacts (Charry *et al*, 2018). Within this process, the Alliance Biodiversity-CIAT developed a sectoral strategy for both livestock (Enciso *et al*, 2018) and cacao (Charry *et al*, 2017) which included the calculation of the carbon footprint for both sectors. In addition, an executive board was formed for each value chain which was in charge of monitoring the strategy and to disclosure information to incumbent in order to include the strategy into future policies and programs.

Despite the proliferation of initiatives, it has been highlighted that most initiatives and resources are concentrated in a group of municipalities: Florencia, Belén de los Andaquíes,

[15] The NDC is a public declaration where each of the 198 signatory countries of the Paris Agreement (2015) define their commitments to prevent the increase in global temperature from exceeding 2°C. For this, each country defines its measures and actions that allow adaptation to climate change and the reduction of GHG emissions.

[16] See Appendix 2 for a summary of the main initiatives and actors involved in mitigation efforts in the department.

San José del Fragua, San Vicente del Caguán, Cartagena del Chairá, Solano and Albania (Climate Focus, Fundación Natura, REDCaquetáPaz & CINDAP, 2018). The main actions aimed at tackling GHG emissions and meeting mitigation objectives revolve around:

- Strengthening forests' governance.
- Promote sustainable development models with cero deforestation.
- Reduce greenhouse gases, conservation of forests, restore degraded landscapes and improve livelihoods.
- Reduce deforestation, forest degradation, habitat loss and deterioration of environmental services and functions.
- Identify, prioritize, and implement adaptation actions for climate change and climate variability.
- Strengthening technical, productive, associative, technological and innovation capacities and skills in value chains.
- Promoting sustainable use of natural resources and their conservation.
- Creation of productive initiatives for local rural development.
- Improve connectivity and conservation of biodiversity by strengthening local institutions and organizations for low-carbon management and peacebuilding.
- Development, coordination and implementation of regional and local measures for sustainable forest management.

In terms of social organization, as noted above, for the livestock sector it has identified a low level of association that their negotiation capacity and collective action, as only 25% belongs to an association or a local committee (Pallares, 2014). Nevertheless, our own research allows us to identify an important number of social organizations of producers in the 16 municipalities that represent an important base for the transition towards more sustainable systems. We were able to identify 80 organizations, distributed in the livestock, cocoa and other agricultural sectors, as well as women organizations and peasants' organizations (chart 1). It is important to note, nevertheless, that we did not develop an exhaustive search and that our data is based mainly on secondary sources.

Type of organization	Livestock	Cocoa	Other agricultural and peasants	Women
Number of organizations	23	26	23	8

Chart 1. Producers' organizations in Caquetá

Source: Authors' elaboration.

In addition, according to Charry *et al* (2017), the cocoa sector includes 18 regional associations of producers and ACAMAFRUT, a second level organization, which appears as a representative of the producers on the Regional Committee of Cacao Chain. In the case of livestock, there are also second level organizations like the Departmental Committee of Ranchers and the Regional Committee of Double Purpose Livestock Chain.

6. Conclusions

Through the proper management of food systems, the department of Caquetá can play a central role in GHG mitigation since, in addition to still maintaining 72% of the area in forest (FAO & ADR, 2021), basically the total of the department's emissions is associated with the management of food systems: the change from natural forest to pasture contributes 84% of the department's total emissions while the agricultural sector contributes 11.56% (IDEAM *et al*, 2016). This can be done by also generating co-benefits such as an improvement in socioeconomic conditions since the primary sector occupies a preponderant role in the departmental economy – agriculture, livestock and fishing represent 15.2% of the departmental GDP (DANE, 2021) – but whose importance at the national level has been declining due to the limited productive advances in agricultural activity, particularly livestock, which continues to be an extensive activity with low levels of productivity (Enciso *et al*, 2018).

The department has about 14,000 families whose main economic activity is livestock and which carry out the activity in a traditional way with extensive and semi-extensive grazing systems; only 0.1% of the productive systems correspond to silvopastoral systems (Enciso *et al*, 2018)[17]. While 91.2% of the parcels correspond to small and medium producers (ICA, 2017), the biggest landowners in the department own an area of 2,490,593 ha (FAO & ADR, 2021, citing UPRA, 2019). Livestock generates significant conflicts in land use as of the more than 2 million hectares devoted to pastures, only around 15,000 have this aptitude, which contrasts with the 12,672 hectares used for agriculture, out of 148,685 potentially usable for this activity (Gobernación del Caquetá *et al*, 2020; Gobernación del Caquetá, 2019).

[17] In this regard, Castro-Nunez et al (2021) warn about the risks of scaling silvopostorile systems and the need to implement safeguards to prevent deforestation from displacing to other places.

As for cocoa, the department of Caquetá has about 1,200 producing families, mainly in diversified systems, with farms of between 5 and 15 hectares, where sugar cane, beef and milk, bananas, citrus fruits, wood, cassava, etc. (Charry *et al*, 2017). Abbott *et al* (2018) state that the main challenges of the cocoa sector are its low levels of productivity, since the increase in volume has occurred mainly through the expansion of the cultivated area. In addition, the variable quality and low or no profitability of these systems which requires to reassess the relevance of development strategies, both for public and private institutions.

As described above, there are several historical and current processes that have led to the reduction of forests in the department and the consolidation of livestock as the main food system in the region. There is also a large number of current programs, projects and initiatives aimed at mitigating and adapting to climate change. However, these initiatives are concentrated in some municipalities, particularly Florencia, Belén de los Andaquíes, San José del Fragua, San Vicente del Caguan, Cartagena del Chairá, Solano and Albania (Climate Focus *et al*, 2018). Regarding studies and research on food systems, most have been developed at a departmental scale. At the municipal level, the study on Cartagena del Chairá developed by researchers from the SINCHI Institute (Gutiérrez, Moreno & Barrera, 2019) stands out. Likewise, the gap in the development of research that addresses differential approaches in agri-food chains is highlighted, in particular, regarding to women and youth. The diversity of producer organizations in the department (80 identified in the framework of this project) can constitute a potential base for the development of sustainable food systems.

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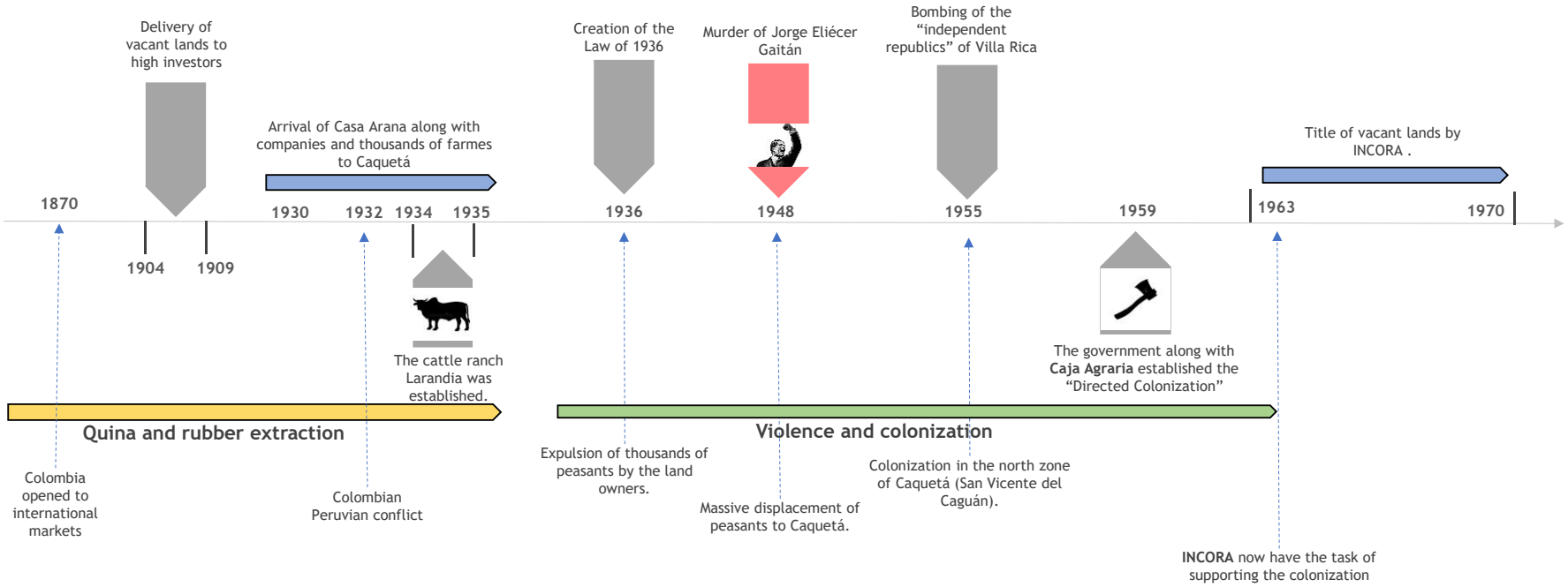
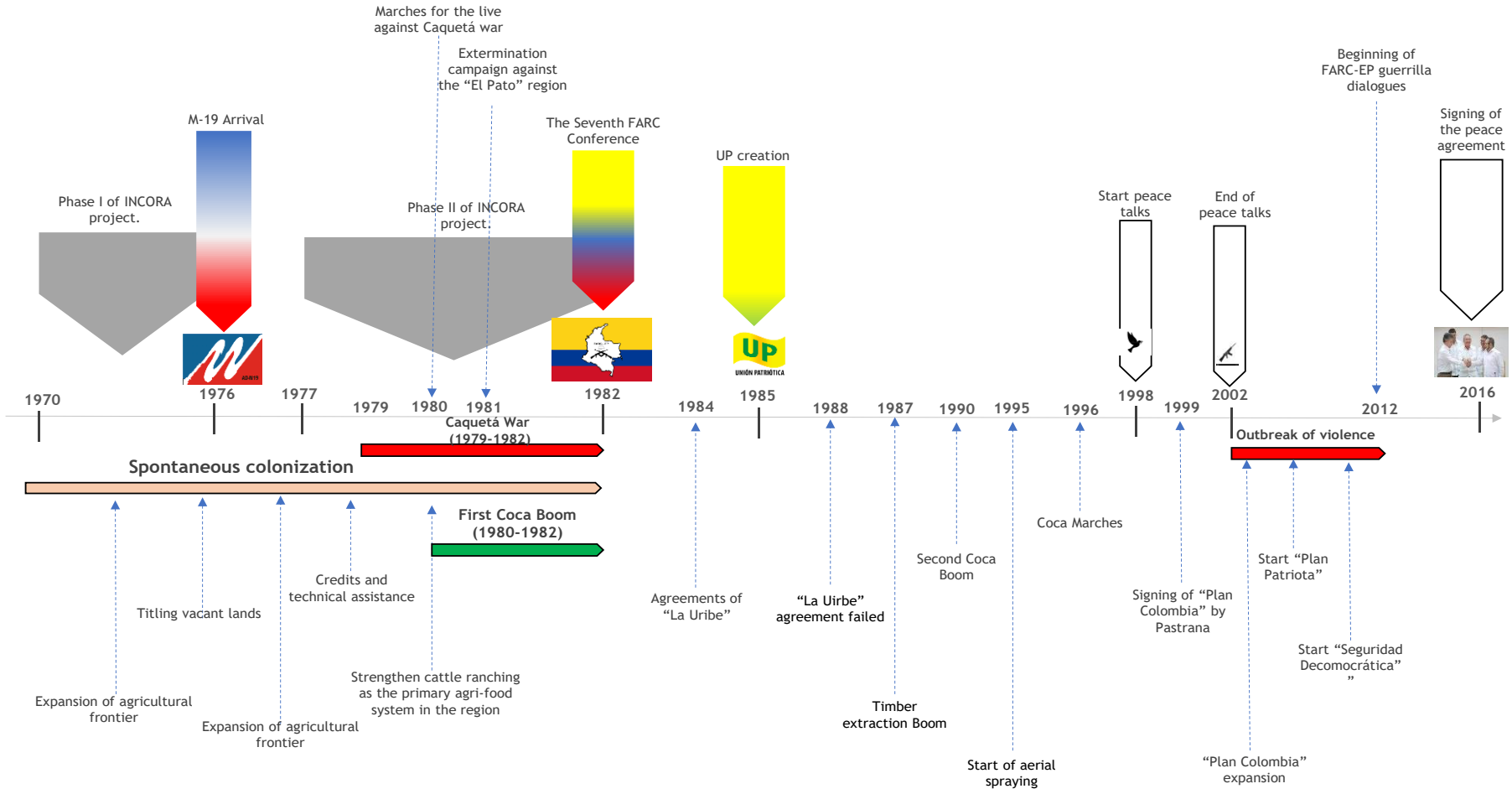
Appendix 1. Timeline of Caquetá's history



Source: Authors' elaboration based on the different sources consulted.



Source: Authors' elaboration based on the different sources consulted.

Appendix 2. Timeline of Caquetá's history

Mitigation initiatives	Implementing parties		
	International	**National**	**Regional and local**
National government: • *Visión Amazonía:* reach zero deforestation by 2020. • *Intergenerational pact for life in the Amazon*: Implementation of the Sentence STC-4360 de 2018 that declares the region as subject of rights. • Plan Environmental Bubble: early warnings to prevent deforestation. • *Forests territories for life*: Integral strategy to control deforestation. • National strategy for low carbon development. **Regional and local authorities:** • Caquetá's Integral Plan for Climate Change Management 2050. • Environmental management plan for the southern region of the Colombian Amazon (PGAR). • *Forests for future* **Research institutes, NGOs and international cooperation:** • ONU REDD+ • Project ABRIGUE • *Visión Amazonía* REM portfolio • Connected landscapes of Caquetá • Project Pro-Bosques. • Agroforestry for conservation	**International cooperation:** • German Agency for International Cooperation (GIZ) • The Nature Conservancy (TNC) • USAID • United Nations Development Program (UNDP) • International Center for Tropical Agriculture (CIAT) • World Wildlife Fund (WWF) • European Fund for Peace	**National Government:** • Ministry of Environment • Ministry of Agriculture • Departamento Nacional de Planeación • Instituto Colombiano Agropecuario • National police. **National NGO:** • Fondo Acción • Fundación Patrimonio Natural • Fundación Natura • Fundación Picachos	**Regional and local authorities:** • Gobernación de Caquetá • Corpoamazonía • Alcaldías **Research institutes and universities:** • Instituto SINCHI • Universidad de la Amazonía **Sectorial and civil society organizations:** • Comité departamental de ganaderos • Comité regional de la

• Sustainable Amazon for peace • Sustainable territories for peace • Forest conservation and sustainability in the Amazon's heart. • Conservation and governance in the Amazon piedmont. • *Visión Amazonía* sectorial strategies. • Amazonía 2.0 strengthening environmental governance. • Project *Amazonía Joven* **Sectorial** • Zero deforestation and reconciliation livestock pact in Caquetá.	• Amazon Conservation Team (ACT) • Earth Innovations Institute • UICN • FAO	• Corporación para el Desarrollo Sustentable del Piedemonte Andinoamazonico CORDESPA	cadena del cacao. • Comité regional de la cadena de ganadería doble propósito. • Comité de Caucheros de San Vicente del Caguán • Comité de cacaoteros de San Vicente del Caguan – COMICACAO

Source: Authors' elaboration based on Climate Focus et al (2018) and other sources.