QUALITATIVE LONGITUDINAL ANALYSIS OF LIVESTOCK FARMING IN THE IBAGUÉ FAN REGION (TOLIMA, COLOMBIA) †

[ANÁLISIS LONGITUDINAL CUALITATIVO DE LA GANADERIA EN LA REGIÓN DEL ABANICO DE IBAGUÉ (TOLIMA, COLOMBIA)]

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SUMMARY

Background. The Fan of Ibagué is one of the most important livestock and agricultural regions in the country, which faces a sustainability crisis and whose origins can be a critical point for understanding it. **Objective.** To understand the historical processes of settlement of the Ibague fan and the development of the rice and livestock industries in the region. **Methodology.** This historical perspective is constructed from agroecology, a transdisciplinary science that seeks to understand the multidimensional nature of current environmental problems. Qualitative analysis is thus relevant at this point since it provides means to analyze ecosystem transformations and the consequences derived from contemporary production practices. Oral testimonies by diverse actors (producers, members of institutions, traders, researchers in the region) were gathered through semi-structured interviews after field visits and later analyzed in the search for agricultural production milestones and their role in the ecological transformation of the region. The findings were contrasted with written sources and documentary records such as agricultural censuses, institutional files, and fieldwork evidence. **Results.** Four crucial events in the local agricultural development of the Ibagué Fan were reported: the extensive livestock farming around 1900, which lead to the consolidation of four generations of producers; the construction of irrigation channels which benefited large-scale rice production in the area by the mid-twentieth century; the combination of rice production, livestock farming and all its associated crops; and finally, the introduction of sustainable livestock farming projects. **Implications**. Historical analyzes show the need to know the perspective of the actors involved in the development of agriculture and livestock in the region over the years; these milestones are fundamental for the development of public policies that recognize the historical, social and geographical particularities. **Conclusions**. The history of the colonization of the Colombian territory from the seventeenth century was characterized by the introduction, adaptation, and expansion of the livestock farming culture, together with the populating of the territories near the plains of the Magdalena river, as it was the main connecting route in the region.

Keywords: Livestock activity; agriculture practices; local perceptions; agricultural crops.

RESUMEN

Antecedentes. El abanico de Ibagué es una de las regiones ganaderas y agrícolas de mayor importancia en el país. Esta enfrenta una crisis de sostenibilidad hídrica, productiva y ganadera que ser analizada desde una referente histórico; lo cual permitiría predecir escenario de futuro para la comprensión de dicha crisis. **Objetivo.** Comprender los procesos históricos del poblamiento del abanico de Ibagué y el desarrollo de las industrias arrocera y ganadera en la región**. Metodología.** Esta perspectiva histórica se construye desde la agroecología, ciencia transdisciplinar que busca comprender el carácter multidimensional de los problemas ambientales

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actuales. Por lo tanto, el análisis cualitativo es relevante en este punto, ya que proporciona medios para analizar las transformaciones longitudinales de los ecosistemas y las consecuencias derivadas de las prácticas productivas contemporáneas. Se recogieron testimonios orales de diversos actores (productores, integrantes de instituciones, comerciantes, investigadores de la región) a través de entrevistas semiestructuradas posteriores a las visitas de campo y luego se analizaron en la búsqueda de hitos productivos agrícolas y su papel en la transformación ecológica de la región. Los hallazgos fueron contrastados con fuentes escritas y registros documentales como censos agropecuarios, archivos institucionales y evidencias de trabajo de campo**. Resultados.** Se reportaron cuatro hechos cruciales en el desarrollo agrícola local del abaníco de Ibagué: la ganadería extensiva hacia 1900, que propició la consolidación de cuatro generaciones de productores; la construcción de canales de riego que beneficiaron la producción de arroz a gran escala en la zona a mediados del siglo XX; la combinación de la producción de arroz, la ganadería y todos sus cultivos asociados; y finalmente, la implantación de proyectos de ganadería sostenible. **Implicaciones:** Los análisis históricos evidencian la necesidad de conocer la perspectiva de los actores partícipes en el desarrollo de la agricultura y la ganadería de la región a lo largo de los años; estos hitos son fundamentales para el desarrollo de políticas públicas que reconozcan las particularidades históricas, sociales y geográficas.. **Conclusión.** La historia de la colonización del territorio colombiano a partir del siglo XVII se caracterizó por la introducción, adaptación y expansión de la cultura ganadera, junto con el poblamiento de los territorios aledaños a las llanuras del río Magdalena, por ser la principal ruta de conexión en la región. Este, se desarrolló entre procesos de arroceras vinculadas a los sistemas de riego que irrigaron zonas poco aptas para la producción y el retorno de ganados criollos bajo sistemas de ganados sostenibles.

Palabras clave: Actividad ganadera; prácticas agrícolas; percepciones locales; cultivos agrícolas.

INTRODUCTION

The Ibagué fan is located in the upper Magdalena river valley, between the Central and Eastern Ranges of Colombia at 4°26'40.69" N and 75°14'34.93" W. It extends over an area of 149800 ha, at an average altitude of 1225 m, an average temperature of 24°C and an average annual rainfall of 1620mm (CORTOLIMA and Universidad de Ibague, 2018). It is a tropical dry forest area (bs-T) as defined by the life zones classification (Holdridge, 1978). The fan is the resulting formation of Pleistocene volcanic emissions from the Nevado del Tolima volcano. Lahars and pyroclastic material flowed down diverse channels through the Magdalena River plains, forming this fluvial-volcanic fan that covers an area of more than 450 km^2 in the municipalities of Ibagué, Piedras and Alvarado (CORTOLIMA and Universidad de Ibague, 2018). Twenty-four percent of the municipality of Ibagué is located over sloping and slightly undulating soils of the fan (Peláez-Martínez and Santamaría-Ayala, 2010). On the other hand, most of the flat morphology in the fan is located in the municipality of Alvarado, at 4°34'7" N and 74°57'24" W, over 353 km^2. It has an average altitude of 400 m.a.s.l., an average temperature of 26ºC and an average annual rainfall of 1360 mm. The fan represents the main geological unit of the municipality of Piedras, which is located at 4°32'36" N and 74°52'40" W over an area of 355.15 km^2, at 403 m.a.s.l., with an average temperature of 26°C and an average annual rainfall of 1250 mm (CORTOLIMA, 2022).

These soils are generally poor in organic matter, low-fertility, shallow and sandy loam textured, although there is report of hardpan or impermeable clayey layers of soil hard constitution and appearance on the surface or just below it, resulting from cementation of soil particles composed of silica, iron, iron oxide and organic matter (Allaby, 2008). Such soils are suitable for vegetable and fruit crops of temperate climates and require integral management based on legumes and grasses that provide a balanced supply of nitrogen, organic matter, and mineral content. Traditionally, this is an area of commercial mechanized agriculture associated with irrigated rice crops as a main economic activity. In turn, the vegetation cover consists of natural or naturalized pastures and managed grasses for livestock farming (Salazar *et al*., 2015; Peláez-Martínez and Santamaría-Ayala, 2010). Indeed, agricultural production is considered one of the most relevant sectors of the municipalities of Abanico, where domestic food consumption is satisfied in the region and the country. However, at the local level, the intensive use of agro-inputs is linked to the incidence of environmental contamination in the soil and water matrices. On the other hand, local environmental authorities register the development of productive activities in unsuitable or conservation areas, therefore, the use of biological resources is carried out without a sustainability plan. In contrast, the development of systems with clean production technologies are highly valued in the area, and producers recognize the environmental and economic advantages of these systems. (Concejo Municipal de Ibagué, 2020; Concejo Municipal de

Piedras, 2020; Concejo Municipal de Alvarado, 2020).

Considering hydrology in the studied area, part of the large Magdalena river and Totare river basins are located in the municipality of Alvarado, while another section is in the municipalities of Ibagué and Piedras (CORTOLIMA *et al.*, 2018). Some of the streams in the hydric network are diverted or dammed for irrigation of rice and sorghum crops, which are consumed by livestock in some farms.

The discussion on contemporary environmental problems has given rise to complexity approaches that respond to the crisis civilization is facing. By integrating qualitative and quantitative approaches to address reality, the new sciences overcome atavisms of the classical models of scientific research. Agroecology, as one of such sciences, has emerged as a scientific alternative to understand the multidimensional character of agroecosystems (Alvarez *et al.*, 2014). At this point, qualitative analysis becomes relevant, given the means, it provides to analyze the trend of ecosystem transformations and the consequences of contemporary production practices. Particularly, livestock is associated with severe ecosystem effects, that range from soil compaction and increased GHG emissions, to ecosystem loss derived from the transformation of jungles in livestock pastures (Pearson, 1949).

The qualitative analysis reported in this article aimed at understanding the processes that led to the populating of the fan and the subsequent development of the rice and livestock industries in the area and explain how the land is used for production.

MATERIALS AND METHODS

Data collection

Studies from the perspective of qualitative analysis seek to understand the interactions of humans with society and nature over time and that is why it considers the interrelationship between nature and human life in diverse historical periods (Worster, 2008; McNeil, 2005). Qualitative analysis is interested in: 1) The way societies depend on nature while adapting their economic, social and cultural dynamics to their surroundings. 2) How humans have modified and intervened ecosystems through various techniques and technologies, migrations, populating processes and utilization of natural resources. And 3) how different perceptions about nature have affected the way communities relate to it (Leal, 2002).

The fieldwork took place from January 2013 to March 2015. The information was obtained from different actors in different institutions during one-week visits, made once a month from January to June 2013. The oral testimonies from the diverse actors -producers, members of institutions, traders, researchers in the region- were gathered through semi-structured interviews. The application guide for the tool employed in this qualitative research included semi-structured interviews due to their useful role as openers for conversations about specific topics (Hernández-Sampieri *et al.*, 2010). Informed consent was obtained from the interlocutors, where free, spontaneous participation in the research was declared. It was privileged that, due to the characteristics of the information, opinions and observations, the interviewees must preserve their anonymity, therefore the contributions of the interlocutors were cited as "key actors" using a consecutive number accompanied by the date of the interview. The analysis was centered on the main events related to agricultural production in the region and its influence on the ecological transformation. The findings were then contrasted with literature and documentary records such as agricultural censuses, institutional files [CER-UT; IGAC, FEDEGAN, University of Tolima], and both fieldwork and evidence. The information about the qualitative analysis of livestock farming in the Ibagué fan was registered in accordance with the categories of analysis described in Table 1.

RESULTS AND DISCUSSION

Agriculture is a human activity that has allowed man to produce food, textiles and other commodities necessary to survive. According to Angel-Maya (1995), this activity is directly affected by the environmental conditions that surround this practice. In this sense, agriculture and nature have always been directly related.

Pre-Columbian Era and sixteenth century

The Pre-Columbian Era was characterized by a tendency towards hunting local species such as tapirs and deer in the American continent. The Andean communities made significant advances in local camelids raising, which were employed as ceremonial animals, to transport people and goods or as a source of proteins, pelts, and wool (Patiño, 1990). Regarding the local diet, historians established that the diet was rich in proteins, minerals and vitamins from plant species such as corn (*Zea mays*), beans (*Phaseolus* spp.), cucurbits (*Cucurbita* spp. and *Sechium edule* and *S. chayote*)

and potato (*Solanum* spp) and a variety of tropical fruits. In addition, the inhabitants developed a diet of animal origin that included fish, birds, insects and domesticated species. (Martínez and Manrique, 2014; Saldarriaga, 2011; Serna, 2007).

Table 1. Categories of analysis defined for the description of the qualitative analysis of livestock farming in the Ibagué fan.

Categories of analysis	Content
Demographic processes	Quantitative variations related to the distribution of the territory among occupants. Thus, information about population changes, movements and migrations, foundation of towns, communities, villages, provinces, rural settlements, municipalities, cities, departments, etc. extracted from institutional files (CORTOLIMA, historical files, testimonies by key actors).
Organization, government and control dynamics	Descriptive dynamics of social institutions at international, national, regional, and local levels, state-owned or established by society, represented in structures, policies, or agreements. Also, diverse ways of control and power exertion, as well as the economic, social, and cultural policies.
Production and extraction processes	Utilization, production, distribution and consumption initiatives regarding local livestock and rice farming. Thus, facts and other economic activities of the inhabitants.

After the Conquest, the Indo-European culture, based on the cultivation of cereals and grains such as wheat, barley, oat and rice, and livestock breeding, was the origin of the dietary transformation in the country (Patiño, 1990). In turn, the first contingents of cattle, goats, equines, and swine introduced during Columbus's second expedition in 1493 -1494 were employed as a food supply for the conquerors, thus playing a role in the populating and land occupation processes. In particular, the first bovines unloaded in La Española came from cattle herds which were deficient in comparison with the technical characteristics and the quality of English, Breton, Swizz, and French produce at the time. The breeds included in Table 2 have been recently defined as the conquering breeds (Yepes, 2001), and as influential in the conformation of creole breeds in the continent:

After arriving and dispersing through the American continent, these cattle breeds eventually adapted to the tropic and to the new ecosystem conditions. Cross-breeding was one of the events that favored this process of adaptation. MV explains that *"six or seven Spanish breeds that arrived in La Española [nowadays, Haiti and Santo Domingo] adapted and then were brought, some through Venezuela and others through the Sinu and stayed there. Those are breeds that have completely adapted to tropical conditions. There are also crosses like the Velasquez, that may have come through the south from Peru."* (16/10/2014).

Such highly important cattle for livestock farming was transported from La Española onto the mainland by Rodrigo de Bastidas in 1525, through what is today Santa Marta. Historians report the subsequent introduction of cattle through the Port of Cartagena by the Heredia brothers, and in Guajira and Cesar by Rodrigo de Luego in 1534. The gradual process of occupation of the region with livestock started on the Atlantic coast towards the savannas of Bolivar, Tolu, Calamari, Turbaco and the lower Sinu (Yepes, 2001). From then on, specimens moved inland from the savannas of the Sinu and San Jorge rivers. In 1542, Alonso de Luis Lugo and 300 men with horses, cows, and bulls traveled through Guajira, the Valley of Upar and Tamalameque, where they embarked on the Magdalena river towards Tunja, Tocaima, and Velez (Yepes, 2001). In 1517, Marcelo Villalobos took cattle to Margarita Island. Later, in 1532, Pedro Hernandez de Serpa brought the animals to the continent by way of the Venezuelan plains of Tocuyo, the Carola savanna and the Southern plains, where there were better quality pastures. From there, livestock extended to Acaricuara, Cojedes, Barinas, and Apure and then to the east by Cucuta and by the Arauca River to Casanare, the Santanderes, Boyacá, and Santa Fe. Livestock scattered all over the country from Santa Fe, in particular to the Pijao region, due to both colonizing strategies and cattle rustling (Saldarriaga, 2011).

On the other hand, the arrival of livestock to the Colombian southwest is linked to the Pizarro's route. This started in La Española and continued

Table 2. Conquering breeds in the American continent and characteristics of production.

BREEDS	DESCRIPTION
Andalusian Black	Also known as *Negra Campiñesa* or *Negra de las Campiñas*. Their body built made them more suitable for beef production and farming labor than local breeds considering their hardiness, dynamogenic capacity, and strength.
Tudanca	Native from Cantabria. They have the characteristics of mountain breeds and high dairy potential. They share some of their features with creole cattle breeds from the Colombian coast and plains.
Murcian cattle	Native from the South of Spain. In the past, they were used for both meat and labor. Highly appreciated for field labor because of their adaptability to crops and their extreme docility. They are currently considered in danger of extinction.
White Caceres	Native from Africa and taken to the Iberian Peninsula as an isolated group, given their employment in religious practices. As part of an extensive exploitation system, they are appreciated because of their labor potential. Once their breeding cycles were observed, they started to be used for meat production.
Andalusian Berrenda	Females were used for farming and males for transport. Their purpose changed and have been destined for meat production.
Galician Blond	Considered one of the most important breeds in Spain and directly related to the beginning of colonial livestock farming in the Americas. The arrival of the Barbarian to Galicia triggered political, social and agricultural development in the area, leading to improved medieval crops. This affected positively the meat conformation of the Galician Blond breed, which scattered all over Europe.

through Panama and down the Pacific to the port of Guayaquil, where it went on towards the Nueva Granada and Peru. Historians agree on Sebastian de Belalcazar's crucial role in the process since 1538, given his establishment of a route for livestock in the south of the country and his conquest of the territories of Nariño, Cauca, and Huila. He also founded the cities of Cali and Popayan and discovered the headwaters of the Cauca and Magdalena rivers (see Figure 1) (Patiño, 1990; FEDEGAN, 2003).

Seventeenth and eighteenth centuries

The seventeenth and the eighteenth centuries saw the consolidation of large estates, where wild livestock (*cimarron)* was replaced by hot-iron branded or ear-notched specimens. According to Yepes, this livestock, which used to be freed over large areas without any control over its breeding and reproduction, evolved after dietary conditions were optimized (Yepes, 2001). These wild cattle were the product of cross-breeding between a high number of animals that were brought during the Conquest (Table 2) and that grew and reproduced without any control by their owners. Branding and the establishment of more controlled livestock farming forced the estate owners to get manpower that could control and manage cattle herds, which eventually consolidated one of the most important economic activities during the first half of the seventeenth century. Saldarriaga (2011) claims that the success of the livestock expansion originated in the *"abundance of pasture lands; the use of better quality and high-performance fodder such as corn; also in the Spanish intention of increasing the size of the herds so that it became basic in the settlers' diet".* All things considered, the ensuing increase in the amount of meat available to Indigenous, Black and Spanish inhabitants led to a positive transformation of their diet.

The main purpose of livestock farming was the production of leather for commercialization since this was exported to other American colonies. At the time, bulls and steers were preferred over cows for the provision of leather, as those were sold at better prices (Patiño, 1990). In fact, pelts were for a long time the only product coming from bovines (Arcila-Farias, 1946). The large demand came from the use of leather in mining and agriculture to make flexible containers, shoemaking, garments, warm clothing, saddles, among others (Tudela de la Orden, 1993). Meanwhile, beef was considered waste produced by low costs and the increasing supply from local markets.

Figure 1. Routes of livestock expansion. Prepared by the authors based on the 1538 political division map (Codazzi,1890).

In turn, the settlers labeled the food coming from local species as low-category, bland or with a bad taste. Bushmeat was associated with uncivilized customs, and this progressively triggered the consumption of beef, pork, and horsemeat. Besides meat, milk and dairy products were included as a new dietary component in the American continent and this certainly was the starting point of an adoption process to new alimentary customs during these centuries, initiated by the inclusion of new species of bovines and preparations (Patiño, 1990).

During the eighteenth century, livestock farming started to concentrate on the large estates located on the Atlantic coast, the plains of Meta and Casanare and the Bogota savanna. The estate owners in Neiva supplied the markets in Popayan and the mining zones in Antioquia, Cali, and Buga were supplied with livestock from Valle del Cauca (Saldarriaga, 2011).

Other important colonial estates were owned by religious orders who received donated lands for exploitation. The Jesuit order, for example, produced livestock, sugar cane (*Saccharum officinarum)*, plantain (wild species *Musa balbisiana* and *Musa acuminata)* and cocoa (*Theobroma cacao*) all over the Nueva Granada. Guzmán (1996) explains that during this century, the traditional land-owning economy was established throughout the Tolima region and lands were officially granted to the estate owners after the Pijao tribes were annihilated. In this way, the livestock economy took solid root and this occupation of the lands of the region by landowners and religious communities characterized the times.

Nineteenth century

During the nineteenth century, livestock farming kept growing, as well as the agricultural expansion and land appropriation by large estate owners, who introduced rudimentary technology that would eventually improve the performance in the new herds (Van Ausdal, 2009). Specifically, in the hot lowland forests such as those near to the Magdalena River and towards Lerida (Tolima), landowning was linked to the introduction of guinea grass (*Panicum maximum*) and para grass (*Brachiaria mutica*), employed to stop the growth of local weeds and ensure large areas to be populated with almost wild livestock. (Van Ausdal, 2009). Meanwhile, the tobacco boom brought along the conformation of pastures where the fed

livestock supplied the leather for the sacks to carry the exported leaf, the meat for the workers in the farms and goods for the marketplaces in Bogota (FEDEGAN, 2003). On the other hand, Guzmán explains that in 1820 the value of the land in San Sebastian del Rio Piedras (current municipality of Piedras) rose because of the commercialization of jerky meat (1996: 97) to remote areas and the production of pelts for mining zones.

At the time, livestock cross-breeding caused diverse developments to take place in the country. In Antioquia, the establishment of extensive livestock farming related to the colonization process. On the Atlantic coast, the first uses of para grass (*B. mutica*) caused the farms allocated for extensive practices to be fenced (Van Ausdal, 2009). In the plains of Casanare and San Martin, more primitive and low-quality livestock farming practices persisted and cattle needed to be hunted for its slaughter while in the Cundiboyacence region, dairy farming was established in smaller areas with better care and more numerous crosses with European breeds to optimize production (FEDEGAN, 2003).

According to FEDEGAN (2003)[15] the livestock production fast growth during the nineteenth century, motivated the creation of the first trade associations during its latter years. In this way, the Association of Agricultural workers of Colombia, created in 1871, promoted the dissemination of imported breeds with more production attributes, aimed at improving creole breeds like the *Blanco orejinegro* -adapted to the coffee region- *Romosinuano* -in the dry tropical forest-, *Lucerna del Valle*, and *Costeño con Cuernos* (MV, 16/10/2014). Other breeds can also be included, such as the *Harton del Valle*, *Chino Santandereano*, *San Martinero* from the west of Colombia, *Velasquez* from the Magdalena River valley, *Casanareño* from the flood-prone areas in Casanare and *Caqueteño* from the Caqueta river (Moreno *et al*., 2001). Later, this association gave rise to the Board of Agricultural Workers of Bolivar, which became highly influential in the Alto Magdalena regions and the Association of Agricultural workers of Cundinamarca. Both organizations were aimed at managing agricultural and livestock productions in the country (FEDEGAN, 2003).

An informant mentioned some of the characteristics of this type of cattle: "*My family had some cattle, we called it creole and kept it in pastures with Jaragua grass [Hyparrhenia rufa], Bahia grass [Paspalum notatum], wiregrass [Eleusine indica] and some places with gramma grass [Bouteloua repens] and forage for cattle. They ate guava leaves, myrtle, mango leaves, and congo that was a legume, with some red seeds that they ate too. It was some fattened cattle, very good, heavy, bulky, also fed with cane treacle and water"* (Excerpt of the interview with the key actor 1, 19/10/2014).

Twentieth century and early twenty-first century

During the twentieth century, the already ongoing livestock expansion was strongly promoted by associations. It is considered the modern age of livestock settlement in Colombia, given the processes aimed at improving breeds, pastures and reproduction strategies with genetic improvement. Up to 1950, livestock farming kept playing a significant role in land expansion, aided by the introduction of pastures in the border areas (Kalmanovitz and López-Enciso, 2006). The utilization and tenure of flatlands kept depending on large landowners and estates, which determined the organization of the territory. Territories were rather associated with the establishment of pastures and arable lands and it did not matter whether there was livestock (Van Ausdal, 2009). In contrast, the small landowners were able to keep control over the colonized lowlands in Antioquia through their consolidation in extensive property rights. Much of the strife between livestock farmers and peasants revolved around the possession of lands, water, and forests (Álvarez, 2016).

During the second half of the twentieth century, the centralized state strengthened both coffee growers and livestock farmers who kept advancing towards the modernization of the farms in the regions. Both livestock breeds and livestock fairs gained more attention. The associations of producers became the center of the regional power. As meat consumption expanded, the cultural and political patterns related underwent a transformation (Flores-Malagón, 2008). Regulations on the slaughter of animals for human consumption were either created or modified, and fairs and livestock butcher shops were opened for business. The Colombian Federation of Livestock Breeders – FEDEGAN was created in 1963, after the 9th National Convention of Livestock Breeders and thanks to the action of Banco Ganadero and the Minister of Agriculture at the time (FEDEGAN, 2003).

From this century onwards, the testimonies contain a historical relation of livestock farming in the Ibagué fan. Four milestones were found: the extensive livestock farming around 1900, leading

to the consolidation of four generations of producers; the construction of irrigation channels, which aided large-scale rice production in the area by the mid-twentieth century; the combination of rice production, livestock farming and all its associated crops; and finally, the introduction of sustainable livestock farming projects.

Production up to 1900

According to the actors interviewed, the lands in the fan are suitable for rice but they are not fit for other types of crops or livestock. The producer GK, interviewed on October 15th, 2014, claims that "*crops such as tobacco, chili pepper, and sugar cane have failed because they are not profitable*", he believes that livestock farming is hindered by problems associated with water and the type of soils, emphasizing on agroclimatic limitations rather than on institutional aspects related to the regulations on land use. Castro-Franco (1996) explains that the physical characteristics of the soils in the fan are not adequate for its utilization on crops other than rice. The hardpan layers near the surface mean insufficient ground depth for species like cotton, legumes and when some fruit trees are cultivated the soil must be broken with a chisel and plowed to improve the physical conditions.

In the department of Tolima, the historical process related with livestock farming started at the end of the nineteenth century and the beginning of the twentieth century, with the fundamental role of the Magdalena river in the dispersion of the economy in the Magdalena Medio Valley region. This river was the gateway to the country, with its principal port in Ambalema. Tobacco cultivation and exportation, together with the circulation of livestock, characterized the dynamics in the territory during the nineteenth century. As one of the interviewees said: *"Now that I try to remember, my father told me that during the Thousand Days War around 1900, my grandfather inherited his parents' farm, near Honda Tolima, on the Magdalena riverside. Livestock was there a long time ago. Also towards Mariquita, because the first livestock stayed there, really near. You need to remember that everything came in through the Magdalena river. I still remember that my uncles used to buy the cattle over there in the Magdalena Medio. They worked in Honda, at a place called Caracoli, the port on the shoreline. The cattle arrived there, they moved it out and it was very near to the railway"* (Excerpt of the interview with the key actor 2, May 2014). As the speaker reports, the Caracoli port in Honda and the Ambalema port keep a historical significance related to trade in the area (Neira, 2012). In particular, this port is recognized as the arrival point for vessels of different draughts loaded with tobacco, supplies, goods and *"wild livestock. Tobacco was exported from this port and fabrics and cloth materials were brought from Europe to be then transported to the mountain range in municipalities with larger markets"* (Excerpt of the interview with the key actor 3, 22/10/2014).

An important event at the time was the introduction of the Zebu breed, coming from Brazil, during the first decade of the century. An interviewee reported: *"Between 1908 and 1910, the Zebu arrived in Colombia from Brazil. This was how, the creole breeds started to disappear. The breeds that were 50% creole and 50% Zebu were excellent and that is why there was genetic absorption of creole breeds by Zebu resulting in 72% of the Colombian livestock being Zebu today. After this first arrival 40 or 50 years ago, specialized dairy breeds were introduced. The El Puente estate in Armero brought Zebu livestock to Tolima This was land for livestock until rice replaced extensive livestock farming. Economic power was measured by the number of hectares and cows. Rice was introduced during the 1950s, then the green revolution and technology applied to rice crops"* (Excerpt of the interview with the key actor 4, 21/10/2014). In this regard, Dávila-Ladrón de Guevara (2003) states that in 1914 the German businessman Adolf Held imported the first Zebu bulls (*Bos taurus indicus*) for its management at the Jesus del Rio estate in the municipality of Zambrano. According to the Colombian Association of Zebu Livestock Breeders– ASOCEBÚ (2014a), new pure Nellore cattle arrived in 1927 from Brazil. This way, after thirty years, the herds reached 15000 specimens, both pure and high-quality crossbred. Viloria de la Hoz (2003) claims the breed affected the Colombian livestock industry in such a significant way that by 2003, 95% of the herds in the country had Zebu blood to some extent.

Later, the construction of channels for the water of the Combeima river to be distributed would become one of the most important transformations in the fan regarding the economic and the production contexts. This process would clear the way for the implementation of large-scale crops and the establishment of new agricultural areas through the construction of irrigation channels in areas where water was not available. *"Water outlets started to be built, and those outlets were started by the Lasernas and the Rochas families, and they made ditches [channels] to transport the water from the Combeima river. With them, the electricity came to Ibagué, because the electricity I*

knew as a child was the Lasernas's electricity. Then, the electricity came to the municipality from the El Papayo hydroelectric power plant, but the Lasernas´s did not work for long". (Excerpt of the interview with the key actor 5, 22/10/2014). Accordingly, (Peláez Martínez, and Santamaría-Ayala, 2010) reports that in 1948, the electricity service in the city of Ibagué was provided by Luz Laserna and Luz Municipal, two companies which covered about 40% of the population. The channel Laserna-Sarmiento was built in the late 1930s and was supplied with the waters from the Combeima river. Federico Arbelaez, an engineer from Antioquia oversaw these works and was economically supported by the Laserna and Sarmiento families, whose principal objective was to optimize arable lands far from the basin. An interviewee said: *"God created water but the Lasernas owned it."* (Excerpt of the interview with the key actor 2, 16/10/2014). Over the years, and due to the settlements in the region, the number of users increased to over 1000, yet the river flow pressure exerted was under-reported (Excerpt of the interview with the key actor 6, 6/05/2015).

Afterward, the Ambafer irrigation channel was built to transport water from the Chipalo river: *"The Ambafer channel came later, they got water from the Chipalo river and took it to the Doima station, which was a railway station. Then, this channel was made to transport water to the railway. I know where the pump is here in Ibagué, the water is fetched from there. When the railway ended and the station disappeared, people started to get water there. Today, there is a series of farms around the channel that are supplied with that water. The San Jose farm, for instance"* (Excerpt of the interview with the key actor 7, 10/05/2013). Besides, another channel was built for the water from the Alvarado river: *"The La Guaria farm shares its pump with the El Chaco farm and both get water from it. The water was fetched from there to Alvarado. I talked to a friend in the '48 when Gaitan died, they were working in the channels of the farm for the water to be redistributed"* (Excerpt of the interview with the key actor 7, 10/05/2013).

These channels still provide the service of water redistribution in the area, just as an informant said: *"This is what I tell my friends, the rice farmers- you are a bunch of slackers farming the same lands with the same water and the same people and the same rice, nothing has changed"* (Excerpt of the interview with the key actor 7, 10/05/2013). Peláez-Martínez and Santamaría-Ayala (2010) remark that there are some regulations over the water from the Combeima and Chipalo river basins employed for irrigation, namely that the granted irrigation flow for the Laserna-Sarmiento and El Aceituno channels is 3075 and 1564 l sec^{-1} respectively, for a total of 4639 l/ sec^{-1}, whereas the gauged flow for these two channels is 2900 and 1430 l sec^{-1}, respectively, for a total of 4330 l sec^{-1}. The water demand of the municipality of Ibagué, in terms of human consumption and domestic use, is 7518.31 l sec^{-1} and is met by the Coello, Totare, and Opia rivers.

The channels made a large area of the fan productive since access to water had been limited. This enabled the consolidation of irrigation districts, where substantial amounts of water were collected to be later redistributed. In turn, rice cultivation was boosted, bringing significant technological and agro-industrial developments to the region during the second half of the twentieth century.

Rice and the green revolution

Given the agro-ecological characteristics of the area and the favorable conditions for its commercialization in the main consumption centers, rice became the most important transitional crop in the region (Kalmanovitz and López Enciso, 2006). As a result, the livestock industry and other agricultural activities related to corn were quickly relegated despite their structural role in the local dietary culture, as an interviewee said: *"my grandmother told me that before the 50s there was no rice and that tamales were made with corn. That is why the traditional "lechona" (traditional dish from Tolima) does not have rice, only rolos (people from Bogota) do that; in Tolima, it only had peas and spices and the trick for a good "lechona" is bitter orange peel."* **(**Excerpt of the interview with the key actor 8**,** 19/10/2014). Cardona-Valencia (2008) describes the link between corn and the food from Tolima, tamales specifically. IICA *et al*. (1980) report that rice arrived in Armero in Tolima between 1940 and 1945, overshadowing extensive livestock farming and corn crops, which were less profitable. Tolima became an important production center, before the industrialization and expansion that came with the success of rice crops established by the Spanish in the 30s. This kind of activity became so widespread in the fan, that during the 50s livestock became less important as it was second in the national production classification (Kalmanovitz and López-Enciso, 2006).

The interviewees still remember that the *"business of rice was so good that even though it was a difficult land, it was manually prepared. It was plowed and stones were removed to clear the plots*

and then the stones were carried by hand. You see, to clear the plots, they found the heap of stones to make the fences, the stone corrals that are still standing. For example, San Isidro was a farm that was full of stones like mine, I remember that I was a very small boy when they took a lot of stone out. Also, they hired some technicians and made irrigation systems with the water from the Combeima [river]. Also, all the Sarmientos's lands in Picaleña, Piamonte, all these farms have water from the Combeima [river], the Lasernas made their channel and split" (Excerpt of the interview with the key actor 7, 10/05/2013). According to IICA *et al*. (1980), the first irrigation districts (Cobeima and Saldaña rivers) were built by landowners and afterward, the government took over the construction of other neighboring systems, which made the rice business even more profitable.

The irrigation systems and its channels triggered water supply in such a way that it allowed the implementation of a flooding system. This enabled the entry of rice varieties and the technological package imported from Asia, under the green revolution model. An interviewee says: *"In Asia, they farmed like that and as we Latins are experts on copying models, we sometimes copy but do not adapt, and that is what happened in the fan"* (Excerpt of the interview with the key actor 9, 19/10/2014). At this early stage, rice output and performance at the fan were better than in Taiwan and China (Kalmanovitz and López-Enciso, 2006).

It was later possible for the livestock industry to enter the production system again when entities such as CIPAV (Research Center on Sustainable Systems of Agricultural Production) who promoted the use of rice chaff as cattle feeding (CIPAV, 1987). Creole breeds like romo zinuano and blanco orejinegro (Spanish names) were employed again, and then gradually crossbred with white or Zebu cattle; such crosses are still predominant (Excerpt of the interview with the key actor 10, 20/10/2014). Even if it was considered a promising strategy, some producers realized that the employment of rice chaff for feeding could have an increasing effect on the production costs due to the utilization of herbicides for control of weeds stemming from seeds contained in the bovines' feces (Excerpt of the interview with the key actor 7, 10/05/2013). Yet many producers in the fan still carry out both production activities. On the other hand, according to Zamora (2008) the use of harvest by-products in the bovine diet has advantages such as: low prices, abundant supply of rice straw and reduction of contamination by burning the straw at the end of the harvest. Additionally, it was found that steers fed in Espinal (Tolima) with diets supplemented with 36.8% chaff-gallin manure presented weight gains of 1.0 kg/animal/day and a financial return of 12.5%.

Regarding the quality of the milk, it is important to consider that although the use of rice chaff is an important strategy for livestock in economic and nutritional terms, it can present drawbacks in terms of contamination due to the use of herbicides for weed control. Contamination has been evidenced in soils and its accumulation in plant tissues, however, studies in milk sometimes show low levels of the pesticide that can be accepted by some state regulations. According to Boudebbouz *et al.* (2022), the most found pesticide residues in raw milk samples are Organochlorines (OC), Dichlorodiphenyltrichloroethanes (DDT) and Drins and some Organophosphates (OP) and Carbamates (CB). Although these compounds have been banned in developed countries, they are still used in developing countries where they are detected at high levels in raw cow's milk.
In recent history, there have been reports of decreasing rice production in the Ibagué fan, as well as of many rice producers returning to technological livestock practices to compensate for their main economic activity. In some cases, this situation favors land fragmentation for urbanization, especially at the peri-urban areas (Excerpt of the interview with the key actor 11, 15/10/2014).

Introduction of the Brahman in the fan

ASOCEBÚ (2014b) reported that the Brahman breed was brought from the United States around 1860 through multiple crosses between diverse *B. indicus* cattle, native from India. The Guzerat, Nellore, Khrisna Valley and Gyr breeds were employed in the synthesis. Ded Pollel and Indubrasil specimens were later added. Although the breed imports started in 1915, the interviewees report their arrival to the fan around 1960 and consider it one of the most important events related for tick control in local recent history (Excerpt of the interview with the key actor 9, 19/10/2014).

About the introduction of genetically improved breeds another interviewee commented: *"New cattle was brought by frontmen with dirty money, with the intention of laundering assets. Those people came and spent a lot on cattle and horses. They brought breeds that eventually crossed with creole ones, resulting in those very well-defined current breeds"* (Excerpt of the interview with the key actor 7, 10/05/2013). This phenomenon has been described by Kalmanovitz and López-Enciso (2006) who also explain the relation between drug

dealing with the expansion of cattle in Colombian hot lowlands. In contrast, another interviewee claimed that many traditional families are landowners in the Ibagué plateau and this, in a certain way hindered the influence of drug dealing in the region (Excerpt of the interview with the key actor 11, 15/10/2014).

Sustainable cattle ranching project

Considering the typical livestock farming practices in the region and the changes systems have been going through, an interviewee says: *"Now they have started to change the perception of the system, [they want to see it] as a profitable business that requires different management. It is not like my father used to do it when I was a child, back then all cows were kept until the smallest animal in the lot was ready, and then the whole lot was offered for sale, without keeping records or anything, nobody knew how many animals] there were"* (Excerpt of the interview with the key actor 12, 15/10/2014).

Many interviewees refer to this change of perception when mentioning the Sustainable Colombian cattle ranching project and the way it has impacted the region and the cattle production systems. According to Uribe *et al*. (2011) the Sustainable Colombian cattle ranching project promotes the incorporation of environmentally friendly silvopastoral systems (SSP) in Colombian cattle farms to improve management of natural resources, optimize the provision of environmental services (biodiversity, soil, water and carbon sequestration) and increase productivity in the farms.

FEDEGAN – FNG, CIPAV, the Environmental Action and Childhood Fund, The Nature Conservancy (TNC), and the Ministries of Agriculture, Rural Development and the Environment, Housing and Territorial Development presented the Sustainable Colombian cattle ranching project to the Global Environment Facility (GEF) and the World Bank Board, with the objective of promoting sustainable use of natural resources in cattle farms. In this way, there is a contribution to the Strategic Plan of Colombian Livestock Farming 2019, specifically to its aim of establishing regional centers of silvopastoral arrangements. This is simultaneously linked to the objective of carrying out research on local production models and agroforestry arrangements, besides including an adaptive research component.

The opening of the project was announced in 2012 for all livestock breeders from 83 prioritized municipalities, who would be interested in participating. Livestock breeders need not be members of FEDEGAN but they must: (i) be located at any of the prioritized regions or municipalities (see Table 3), (ii) be Colombian citizens, (iii) must not have been convicted of crimes related to genocides; terrorist acts; displacement or enforced disappearance; kidnapping; trafficking, fabrication or possession of narcotics; trafficking of substances for narcotics processing; torture; rebellion; extortion; asset laundering; conspiracy to commit a crime; acting as a front man and other connected offenses (in accordance with the definitions established in the Law 599 of 2000 and its amends); and not belong to illegal armed organizations, (iv) not be included in the Clinton list, (v) be small, medium or large livestock breeders in accordance with the following classification, which has been adopted to this effect (see Table 3); (vi) demonstrate possession, holding in good faith or tenure over the plot; (vii) declare there is no legal dispute, claim or lawsuit over the farm, (viii) declare that the possession, holding or tenure of the farm is not associated with forced displacement processes or any other forms of illegal tenure (FEDEGAN, 2022).

Considering the effect of the project on the region, one of the interviewees said: *"We are used to the government coming and giving us things, this time they are being given by […] the World Bank, I think those are resources from three ministries, of course, FEDEGAN from what the National Livestock Fund has. There are the strategic projects*

Table 3. Prioritized regions and types of livestock breeders according to plot area (ha).

Region	Department	Small (ha)	Medium (ha)	Large (ha)
Lower Magdalena	Bolivar and Atlantico	4 to 70	71 to 200	>200
Cesar river Valley	Cesar and La Guajira	4 to 70	71 to 200	>200
Boyaca and Santander	Boyaca and Santander	2 to 10	11 to 50	>50
Coffee Ecoregion	Quindio, Risaralda, Caldas Valle, Tolima*	2 to 25	26 to 100	>100
Orinoco Foothills	Meta	4 to 70	71 to 200	>200

Source: FEDEGAN, 2022.

* Ibagué, Alvarado, Venadillo, Piedras, Ambalema and Lerida

for science, technology, and innovation, and a part goes to the sustainable Colombian cattle ranching. Then, one wanted to see that during these long years there has already been a lot of support, but things are not concrete, some little trees have been planted and maybe there is actually training, and people are more aware of sustainability but enough to boast. There are other projects working well, maybe with CORTOLIMA, we are about to complete three agreements, with the town hall whose purpose is to make a common fund, FEDEGAN hands over some money and the town hall some more, last year it was 100 million and at the end we set 40 plots, meaning we set up the silvopastoral systems, demonstration plots" (Excerpt of the interview with the key actor 13, 21/10/2014). It is inferred that the informant thought that the project could have had a greater impact than what he perceives, yet it is important that people are changing their points of view and their behavior. For this informant, there are other more successful projects, however, it is still not possible to measure the real impact of the program in Tolima and the Ibagué Fan.

CONCLUSIONS

The history of the colonization of the Colombian territory from the seventeenth century was characterized by the introduction, adaptation, and expansion of the livestock farming culture, together with the populating of the territories near the plains of the Magdalena river, as it was the main connecting route in the region. Livestock expansion and its establishment started with the introduction of meat and dairy breeds from Spain and Brazil. However, the constraints related to water availability hindered the development of livestock farming by the end of the nineteenth century and early twentieth century, making the Ibagué fan one of the most important regions for rice production. The situation gave rise to the constitution of power dynamics around the management of water and the construction of efficient irrigation channels that allowed the productive handling of the rice crops despite water scarcity.

All things considered, it can be stated that both rice cultivation and the livestock farming associated with it originated in processes beyond ecological and qualitative analysis, and that the utilization of the land depends of economics logics related to the exertion of the economic and political power that underlies tenure of lands, the historic permanence of the inhabitants, the cultural conditions in the region and the political and institutional characteristics of the territory. In this logic of constant transformation of herds, the notion of sustainable production systems based on the integration of agricultural systems with the ecosystem also emerges. Due to their complex structure, they allow to restore and maintain the ecological dynamics degraded by agriculture and livestock observed in the fan.

In that regard, the qualitative analysis did not only facilitate the reconstruction of the main events that led to the emergence of the Ibagué fan but were useful to establish the direct relation between landscape and institutional culture. Also, the presentation of four noteworthy events that determined the course of the local livestock industry in the region proves how history is a means to understand the process of creation of a productive culture in a territory.

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Compliance with ethical standards. Informed consent was obtained from the interlocutors, where free, spontaneous participation in the research was declared. Due to the characteristics of the information, opinions and observations, the anonymity was preserved by citing contributions as "key actors" using a consecutive number and accompanied by the date of the interview.

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