CHAPTER 40

The cacao monoculture and the atlantic forest biome in the municipality of Gandu, baixo sul baiano

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ABSTRACT
The present research aims to study the analysis of the presence of the cocoa crop in the municipality of Gandu, in Bahia's Southern Lowlands, and its interaction with the permanence and use of the dense ombrophile forest, which dominates the Atlantic Forest biome. As a methodology, theoretical and empirical surveys were carried out on phytophysiognomic diversity, land use and some species of the Atlantic Forest biome, in addition to cocoa cultivation, according to the conceptions of several authors from different areas of science. Interviews and questionnaires were carried out on the relationship between cocoa production and the forest, field visits to cocoa farms, photographs of the forest, of cocoa cultivation in the municipality and also the identification of species with higher incidence in the landscape, collection of information in a letter topographic and thematic maps of the environment and use of satellite images provided by Google. The results obtained show that most interviewees say that there has been degradation in the vegetation cover of the biome in the last decades, the vast majority of the surveyed public affirms the influence of the witches' broom pest with environmental degradation, they also claim to have worked in cocoa plantations and having contact with genetically modified seedlings, the overwhelming majority claim that the preservation of the forest is associated with the cultivation of cocoa, and that without it, the devastation of the forest was greater for the implantation of other crops such as livestock, bananas and subsistence crops during the broom season -of-witch. The fieldwork, together with the satellite images, show that the forest is quite altered, consisting of several stages of ecological succession, called capoira, capoira and capoeirão and more or less preserved fragments of the native ombrophilous forest in mountainous areas. Exotic shading (cacao-cabruca) is still widely used and considered a sustainable practice. It is concluded that the relationship between cocoa culture and dense rainforest is a common practice and has increased after the partial elimination of witches' broom and genetically modified cocoa seedlings.

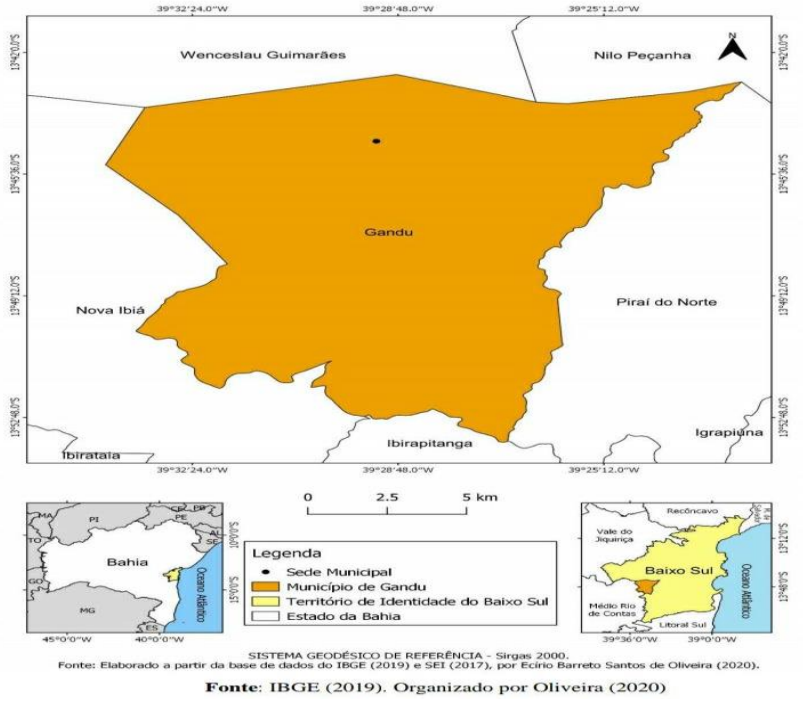
Keywords: Agroforestry, Cocoa production, Atlantic Forest, Phytophysiognomy, Gandu.

1 INTRODUCTION

The municipality of Gandu is located in the mesoregion of Southern Bahia. Its headquarters are at the 13th coordinate. 74'S and 39º.47'W (Figure 1). Its development is directly linked to the cocoa culture (*Theo broma cacao* L.) in southern Bahia. In 1903, Colonel Barachísio Lisboa was in the present region

observing its geographic, phytogeographic and climatic aspects. It was found to be a humid tropical climate with a rainfall regime without a dry season and dense and leafy rainforests. At the time, the municipality of Gandu was part of the municipality of Santarém.

Figure 1 - Municipality of Gandu - BA



Source: Map made in the Map program View .

In 1907, the first incursions were made by farmers José Amado Costa, Gregório Monteiro da Costa and owners of the first farms that started the construction of the first regional urban centers. The city of Gandu was founded in 1958 and its urban development was due to the cocoa culture due to the potential that the Atlantic Forest has for the production of this culture.

In the study of the Atlantic Forest biome, there are several studies carried out by several researchers and government agencies. One of these surveys, carried out by INPE (Instituto Nacional Pesquisa Espacial) in 2019, shows that the State of Bahia led the ranking of deforestation in the ombrophilous forest with a decrease of 12,228 hectares. It is a serious fact because the Atlantic Forest biome only has 7% of the original vegetation cover left, according to some data from researchers. It can be seen that since the colonization process in Brazil, particularly in the southern region of Bahia, there has been a great degradation of forests and elimination of the biodiversity found initially. Among other factors that involve the creation of regional urban centers, there is the degradation derived from plant extractivism, such as Pau-Brasil, and monocultures such as sugarcane, however the cocoa monoculture has a peculiar aspect. among the others, it needs the shading of larger trees for the management and quality of the cocoa bean , and with that, the economic progression creating a favorable space for such agricultural production.

From the observance of the local phytogeographic aspects, great biodiversity and beauty of the remnants of the original plant cover can be seen. It is noted that the main factor for urban development was based mainly on cocoa agricultural production.

In this perspective, this research comprises the investigation of elements and relationships that permeate the Baixo Sul micro-region of Bahia, specifically, in the municipality of Gandu, among these, characteristics of the local phytophysiognomy and its influence on the microclimate within the domain of the Atlantic Forest biome and its connection with the cocoa monoculture system in deforestation and preservation of forest biodiversity. Considerations were also made about the historical process of cocoa culture, the colonization of the region and the exploitation of the Atlantic Forest for economic purposes with impacts on the forest, in addition to the regional dissemination of witches' broom (*Crinipellis perniciosa*) from 1989. A case study was also shown on the implantation of the cocoa monoculture, " cacao-cabruca system " and its relationship with local phytophysiognomic attributes, the relationship of the production of fine beans (select cocoa) with the preservation of the Atlantic Forest, through of the “ cabruca method ” in that municipality.

The degradation of the Atlantic Forest biome in the municipality of Gandu and its relationship with cocoa production, presents, compared to other areas, a higher rate of environmental preservation given to the agroforestry system “ cacao-cabruca ”, which consists of the selective cutting of trees for the shading of the cacao crop (understory) within the forest. However, in the 1990s, the disease known regionally as witches' broom (*Crinepelis perniciosa*) brought a time of economic recession, causing the price of almonds to drop a lot. Several producers turned their crops into sawmills or implemented extensive livestock farming, logging activities marked by fires, a time of sustainable setback within the Atlantic Forest biome.

The development of large urban centers and other economic practices in the national territory is noticeable through spatial changes, among them, consequently, the degradation of ecologically diverse environments such as the Atlantic Forest, a historical process spatially registered in the colonization and development of extractive and agricultural practices. The cocoa plantation, despite being conceptualized as a monoculture practice, preserves the Atlantic Forest biome. This culture, as already mentioned, was devastated by the plague of the witches' broom, so named by the producers for the devastation generated mainly in the economy and for the way that it spread throughout the south of Bahia, causing many of the rural workers to degrade crops (fires and deforestation) accelerating the deforestation of the original forest cover.

About this event, Rocha Lourdes, 2008, describes:

> Since 1986, this region has been suffering the impacts of a long-term price crisis due to a global overproduction of cocoa. To make matters worse, in 1989, the spread of the fungus Crinipellis perniciosa, which causes witches' broom , began to spread . As a result, the crisis deepened, cocoa producers went into debt, plantations were abandoned, and rural and urban unemployment increased. Many municipalities lost population in the 1990s, as was the case of Camacan , among others (Rocha, L, 2008, p.50).

Regarding the human/environment interaction, it can be seen that the practice of cocoa cultivation is based on the principles of partial preservation of natural resources (medium and large fragments of forests of tens of km²) that the Atlantic Forest biome has in the region. This fact contributes to its economic development and also to the permanence of areas with a high level of biodiversity, thus contributing to the functioning of the forest ecosystem. The revitalization of the production and productive value of the almond from the work of the Executive Committee of the Cacaueira Crop Plan (CEPLAC) contributed to the preservation of the forest, highlighting the "ecological method of cabruca " that partially respects the original forest in the current analysis.

> Currently, with a new national and global scenario, CEPLAC is redirecting its mission in order to face the new challenges. The current priority is the recovery of the regional economy, with an emphasis on combating witches' broom, a disease that is decimating cocoa plantations, leaving a legion of more than two hundred thousand unemployed and causing irreparable damage to nature. (Rocha, L, 2008, p.58).

2 METHODOLOGY

To carry out the research, the following methodological procedures were adopted: studies and theoretical surveys and field work on phytophysiognomic diversity , land use and some species of the Atlantic Forest biome, in addition to the cocoa crop. Regarding the cocoa culture, interviews were carried out and questionnaires were applied to the producers of the culture and their relationship with the forest. The initial data collection was carried out through a bibliographic research such as books, articles, theses, dissertations, etc. All this material used was of a varied theme, such as cocoa production in the Bahia South Lowlands, Atlantic Forest biome, phytophysiognomies, flora, historical process of occupation of the region, formation of the municipality of Gandu, the interaction of cocoa production with deforestation and preservation of the native biome, in addition to a survey of the physical environment based on topographical maps and environmental themes, such as climate, geology, topography, geomorphology, soils, potential for use of renewable natural resources and plant cover.

As guiding axes, questions were used to identify the interviewee (gender, age and schooling), questions for the characterization of the degraded biome and residents' impressions about changes in the plant landscape, a case study on the relationship between cocoa production and the implementation of " cocoa-cabruca systems " and "total clearing system" introduced by the Executive Committee of the Cocoa Crop Plan (CEPLAC), and economic practice of the cocoa crop.

After these observations, a face-to-face monitoring of cocoa farms in the municipality of Gandu was carried out, as a characterization of species with the highest incidence of landscapes with herbaceous vegetation and forest edges through the Planet application . This is based on a worldwide catalog of species identified in the field by a wide range of botanical researchers and other scholars in the area. The application immediately presents the most likely species, but it is necessary to have a prior knowledge of taxonomy, ecology and biogeography of the species that is intended to be identified in the landscapes that comprise

the Atlantic Forest biome. Topographic maps and thematic maps from the RADAMBRASIL Project (1981) (scale 1:100,000 and 1,000,000) were used in the study of the topography, together with images provided by satellite images provided by Google.

Different types of areas in the municipality or land use were considered, such as pastures, capoeirinha (vegetation up to 3 meters), capoeira (vegetation up to 5 meters high), capoeirão (vegetation around 15-20 m) and forest areas. dense ombrophilous with species of remaining trees of the primary forest up to 50 meters (emergent trees), in addition to trees that make up the forest canopy (up to 30 meters). (ANDERSON, et al . al - 1979; VELOSO, FILHO & LIMA, 1992; NOBREGA, MA – 1993). Also areas with cocoa plantations that make up the forest understory in consortium with other cultures (banana, rubber tree), areas with a greater degree of degradation due to local economic practices such as cattle raising.

The classes were not delimited in the satellite images, only texture and shape patterns were observed in the images, then checked in the field with the help of a GPS and an application called " My Elevation ". This consists of locating the place with the geographic coordinates and nearby areas with tens of km² and altitude of the place. The altitude of the field of view of the images is 2.3 km high, and the images are from the year 2019.

Interviews and questionnaires were carried out with 100 residents in different parts of the municipality of Gandu, including local farmers, small producers, owners of cocoa shops and agricultural technicians from the Executive Committee of the Cocoa Crop Plan (CEPLAC), questionnaires were distributed in order to understand cocoa production and interaction with the forest. The action of the revitalization plan (combating witches' broom, generation of cloned cocoa seedlings and grafting) of the crops was also verified, which contributes to the permanence and not total degradation of the native forest.

Regarding the flora table, it was presented in two, one shows the native arboreal flora in the Atlantic Forest biome, and the other, pioneer species found in pastures and forest edges. The tables show the family, the scientific name of the species and a common name best known in the region, in addition to the way of life according to VELOSO, FILHO & LIMA (1992). Scientific names are according to the organization *World Flora Online (WFO - 2021)* **.**

3 RESULTS AND DISCUSSIONS

An important result observed in the field work was the degradation of the forest, deforested areas with cities, villages and pastures. Environmental degradation is characterized by the loss of the environmental potential of a given area or even a geographic unit such as a biome, so the capacity and natural recovery time are overcome by the impacts caused by man. The field work showed that in the area of the municipality of Gandu the vegetation is secondary and degraded mainly in flat and gently undulating topography. In the strongly undulating and mountainous areas, on the summits and steep slopes, the vegetation is more preserved. The fact that steep areas are less degraded is due to the difficulty of occupying

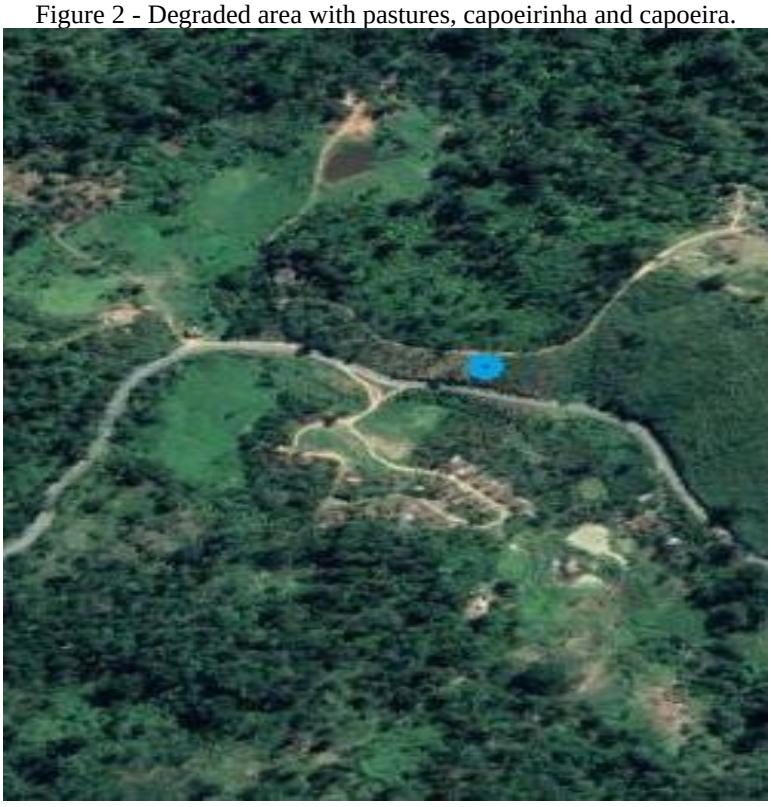
these areas, either because of the steep slope or because of the shallow soils making agriculture difficult. (NOBREGA, MA & VILAS BOAS, AM , 2020).

Degradation in the municipality of Gandu was initiated by the colonizers, exploitation of natural resources for human occupation, deforestation for the implementation of agricultural practices, cattle raising and fires permeate the history of the region. The use of wood from trees for the implementation of sawmills or even its use for firewood in the process of preparing cocoa beans for trade, loss of quality and quantity of water due to the continuous use of fertilizers by agricultural producers in general. Contamination of water, loss of volume of rivers due to deforestation, consequently the silting of rivers and the decrease of the water table and aquifers.

> For the Ministry of Environment – MMA (2016), the main environmental problem is deforestation (67%). The other main environmental concerns are: water pollution (47%); air pollution (36%); increase in solid waste generation (28%); water waste (10%); ozone layer (9%); and climate change (6%); among other aspects mentioned less frequently. (Pereira, 2017, p.3).

This whole process contributed to the de-characterization of the biome in terms of phytophysiognomies and areas occupied by them, making the Gandu region very fragmented, in addition to the loss of local biodiversity, the habitat of several species of fauna and flora, mainly endemic ones. (Figures 2 and 3). The removal of vegetation cover also contributes to the increase in temperature, since there is a loss of moisture released by evapotranspiration. It was also observed the silting of the Gandu and Alma river beds that cut through the municipality and adjacent areas.

Figure 2 - Degraded area with pastures, capoeirinha and capoeira.



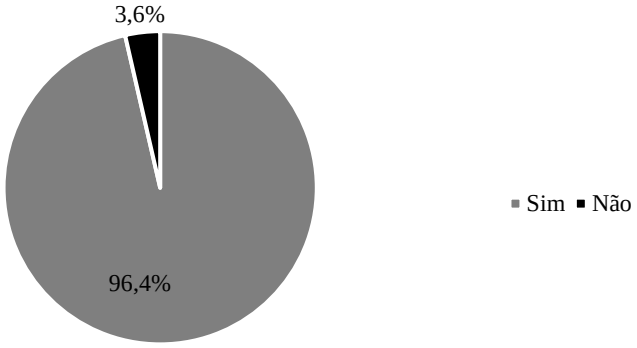
Source: Google Earth Pro (2021).

Figure 3 – Capoeira and remnants of dense ombrophilous forest (capoeirão).

Source: Google Earth Pro (2021).

Regarding the questionnaires carried out with the residents about their perception of the changes in the landscape comprised by the Atlantic Forest biome, the following results were obtained:

Graph 1- Changes in the landscape in recent years/decades.



Source: Field survey, 2021.

Currently, the Atlantic Forest biome covers only 12.4% of its original extension (INPE, 2019) resulting from a succession of environmental impacts since the colonizer's contact with the landscape potential found. In this scenario, the current environmental profile is a mosaic of fragmented areas of forest that in some places form ecological corridors, pastures, villages, subsistence crops and cocoa. It is necessary to increase the number of forest environments that resist human activity. The fragments vary greatly in size, some of tens of km², others of a few hectares. The smaller the fragment, the greater the edge effect, observed in the presence of species collected such as certain lianas, epiphytes and pioneer species (Table 1).

Table 1 - Pioneer and epiphytic species

FAMILY	SPECIES	VULGAR NOME	HABITAT
Bromeliaceae	*Nidularium billbergiodes* (Shult and Shult.F)	Bromeliads	Herbaceous carpet
Verbenaceae	*Lantana triphobia* (L)	Fruit of cricket	Aerial epiphytes
Poaceae	*Bothiochloa ischaemun* (L.) Why	bluestem attachment	Herbaceous carpet
Cyperaceae	*Cyperus esculentis* (L)	juncinta	Herbaceous carpet
Violaceae	*Rape worships* (L.)	violet	Herbaceous carpet
Leguminoseae	*Mimosa pudica (L.)*	dormideira	Herbaceous carpet
Apiaceae	*Heracleum sphondylium (L.)*	Canabras	Herbaceous carpet
Poacea	*Digitaria sanguinalis* (L.) Scop .	Capim mattress	herbaceous carpet
piperaceae	*piper hispidum sw* _	jaborandi	Forest edge (Liana).

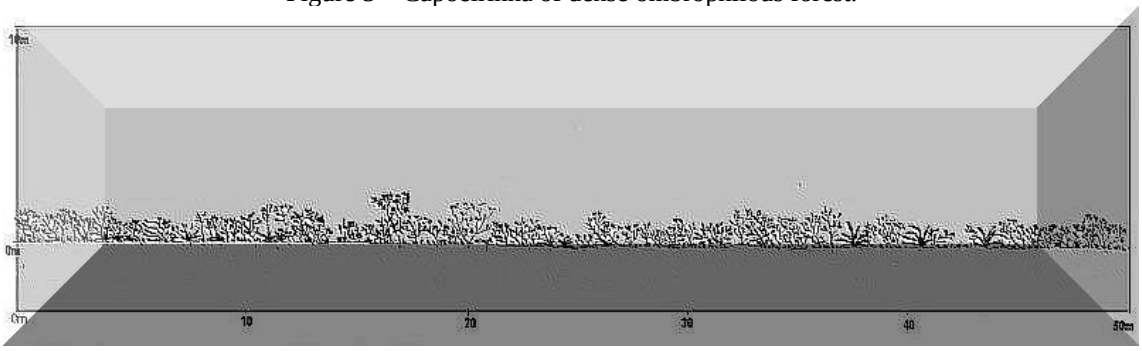
Source: Fieldwork, Planet *and World Flora Online (WFO) – 2021.*

These fragments are quite altered in their physiognomy as can be seen in Figure 5, where it is possible to see some life forms such as chamaephytes, nanophanerophytes, but mainly microphanerophytes. In some places the vegetation is in its initial phase of regeneration called capoeirinha by the locals, that is, they are pioneer species of the Atlantic Forest and also cosmopolitan species. These are mainly nanophanerophytes and chamaephytes (Figure 6). Law nº 11.428 defends the preservation of the Atlantic Forest, corroborating the need to implement conservation units U.C's, for the preservation of native species and also to serve to maintain the functions of the ecosystem, although partially.

Figure 4 – Canopy of dense ombrophylous forest.

Source: NOBREGA, 2003.

Figure 5 – Capoeirinha of dense ombrophilous forest.



Source: NOBREGA, 2003.

There are no precise data on the total diversity of plants in the Atlantic Forest, however, considering only the group of angiosperms, it is believed that Brazil has between 55,000 and 60,000 species, that is, 22% to 24% of the total that esteem to exist in the world. Of this total, the projections are that the Atlantic Forest has about 20,000 species, that is, between 33% and 36% of those existing in the country. Some of these species can be seen in Table 2.

> Despite all the efforts made to conserve biodiversity, Grandi et al. (2014) warn that it must be understood that biodiversity goes beyond the fragmented view of each of the structural axes (species, genetics and ecological), as it is not a simple catalog of genes, species or environments, but the result of the dynamic interaction between these three hierarchical levels. Analyzing the concept more deeply, it is noted that this dynamic highlights the genetic fluctuations between species along with variations in the environment in which they live, that is, it explains, in a way, the evolutionary processes related to the diversification of species and ecosystems. (Pereira, 2017, p.4).

Table 2 – Some Atlantic Forest tree species found in Gandu.

FAMILY	SPECIES	COMMON NAME	LIFESTYLE
Lecythidaceae	*Cariniana legal* (Mart .) Kuntze	Jequitibá	macrophanerophyte
Moraceae	*Ficus Insipid (Willd)*	Gameleira	Mesophanerophyte
Fabaceae	*Erytrina verna (Vell)*	Allethrin	Mesophanerophyte
Bignonecea	*Tabebuia chrysotricha* (Mart . Ex A.DC.)	Duck	Mesophanerophyte
Rutaceae	*Balfourodendron riedelianum*	Guatambú	Macrophanerophyte
Anacardiaceae	Myracrodruon urundeuva German	Aroeira Preta	Mesophanerophyte
Fabaceae	*Bauhinia forficata* Link	Pata-de-Vaca	Microphanerophyte
Fabaceae	*Caesalpinia Echinacea* Lam .	Pau-Brasil	Mesophanerophytes
Meliaceae	*Cedrela fissile* Vell	Cedar-rose	Macrophanerophyta
Fabaceae	*Caesalpinia ferrea* C. Mart	Pau-iron	Mesophanerophytes
Fabaceae	*Peltophorum doubt* (Sprang .) Taub .	Canafistula	microphanerophyte
Bignoniaceae	*Rosewood micrantha call* _	cabobo	microphanerophyte
malvaceae	*Luehea divaricate* Mart .	Little horse whip	Mesophanerophyte
Myrtaceae	*psidium cattleianum Mart . & Zucc .*	Araçá-rosa	microphanerophyte
Boraginaceae	*Hearts proud* Cham .	Baba-de-boi	Microphanerophytes
Boraginaceae	*Hearts ecalyculata* Vell _	Beard-of-the-bug	Microphanerophytes
Lauraceae	*Ocotea velutina* (Nees) Rohwer	Canelão	Microphanerophytes
Lauraceae	*ocotea puberula* (Rich .) Nees ;	aloe cinnamon	microphanerophyte
Arecaceae	*Euterpe edulis* Mart .	palmito-jussara	Mesophanerophyte

Source: *Fieldwork and World Flora Online (WFO)* - ***2021***

The relationship between cocoa plantations and dense ombrophilous forests is more than an agricultural practice, it is a crop or agroforestry system. The first system implemented was the " cacao-cabruca " or exotic shading system, which contributed to a better evolution of cocoa plants, soil conservation, in addition to the meso and microclimatic elements, favoring greater humidity in the region due to the great evapotranspiration that occurred in the rainforests. dense degraded vegetation, found in the municipality of Gandu (Figure 7). The circulation of humid air masses coming from the Atlantic Ocean is the main factor for the abundant rainfall in the area, around 1,700 mm/year, essential for production, since cocoa is endemic to the Amazon biome.

> The main determinant of the distribution of plant formations in the Atlantic Forest domain is certainly the macro-climate (tropical and humid), influenced by the relief, by the proximity of the sea, by the predominant pattern of circulation of coastal air masses from east to west and by the ocean currents of the South Atlantic, which move predominantly counterclockwise, that is, from the equator to the south along the Brazilian coast, redistributing heat. Therefore, the latitudinal variation in temperature is subtle, but relevant when added to interiorization or altitude. Thus, in the southern portion, starting from the State of Paraná, temperatures drop a lot in the interior plateaus and favor the mixed ombrophilous forest, with a predominance of pine - do - paraná , while the Atlantic Forest is compressed even more in the narrow coastal strip towards to Rio Grande do Sul. (Frank et al , 2005, p 49).

Figure 6 – Cocoa plantation in the midst of degraded dense ombrophilous forest.

Source: Field survey, 2021.

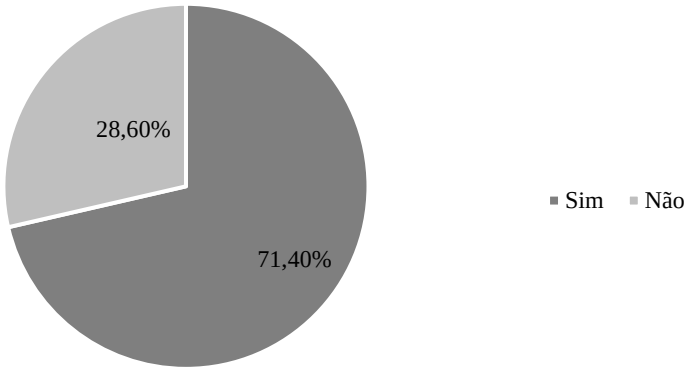
Empirical knowledge about cocoa production in the municipality of Gandu and region, above all, knowledge about the relationship between the forest and cocoa farming is not so widespread. Despite the "

cabruca-cabruca system ” being a less aggressive practice for the biome, the issue of environmental preservation in the region is little addressed, this is a problem in the short and long term. Many producers, despite using native tree shading, fight ecological regeneration by cutting down trees. It is also necessary to take into account the fires for the creation of pastures, a situation intensified with the spread of the witches' broom plague from 1989 onwards, causing a crisis not only economic but also environmental, since it was necessary to resort to other sources of income, such as livestock.

> Since 1986, this region has been suffering the impacts of a long-term price crisis due to a global overproduction of cocoa. To make the situation worse, in 1989 the spread of the fungus *Crinipellis perniciosa* , which causes witches' broom, began to spread. As a result, the crisis deepened, cocoa producers went into debt, plantations were abandoned, and rural and urban unemployment increased. Many municipalities lost population in the 1990s, as was the case of Camacan , among others (Rocha, L, 2008, p. 50).

Regarding the guideline that seeks to assess the interviewees' knowledge about the relationship between cocoa production and the Atlantic Forest, 71.4% of them report not understanding this process, while 28.6% understand the agroforestry interaction, as shown in Figure 7. .

Figure 7 - Relationship between cocoa production and the Atlantic Forest.

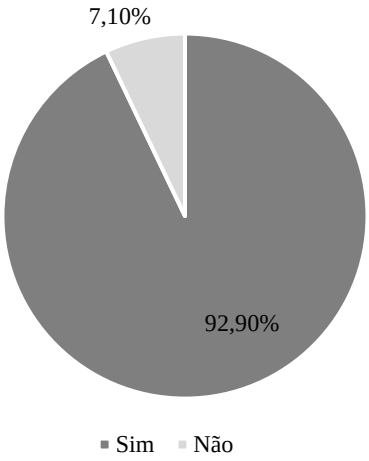


Source: Field Survey, 2021.

Despite the implementation of agroforestry systems such as “ cabruca cocoa ” being less aggressive to the biome, the occurrence of devastation of crops due to the witches’ broom fungus contributed to the deforestation of native areas for the use of other crops such as livestock, the use of wood, bananas and subsistence crops. On many occasions the wood is used to make fences, rafters and slats for the structure of houses or even its use for firewood in cocoa roasting and implementation of sawmills. The preservation of already fragmented areas of the Atlantic Forest biome is of paramount importance for their permanence, in addition to the conservation of biodiversity, habitats for endemic species of fauna and flora.

The witches' broom plague devastated the entire cocoa region, contributing to the destruction of crops, the decline of the regional/local economy and mainly to the deforestation of forest areas. On this topic, 92.9% of the public affirms the pest's influence on environmental degradation. (Figure 8)

Figure 8 - Relation between deforestation and witches' broom.



Source: Field Survey, 2021.

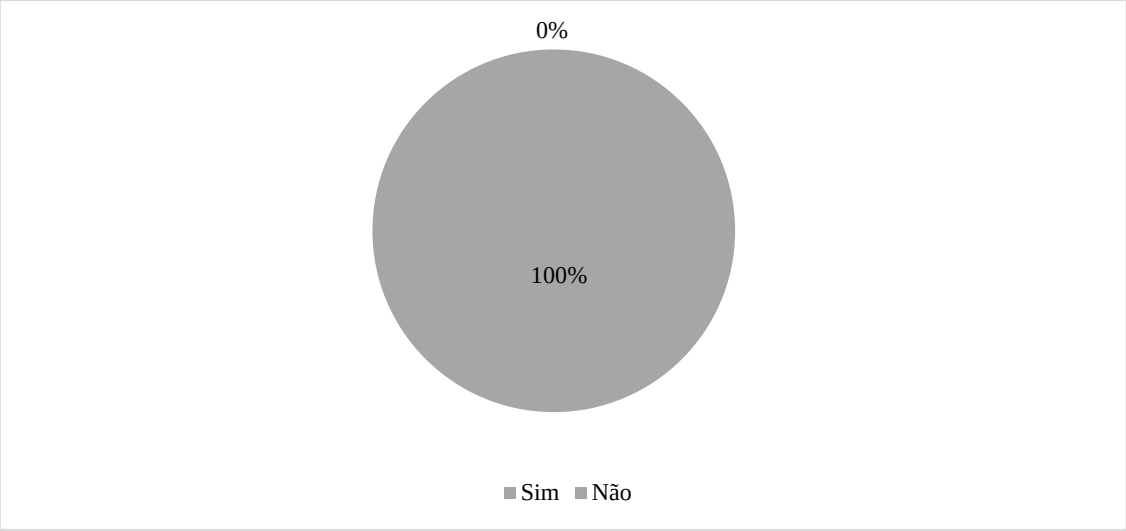
Since the implementation of CEPLAC in the revitalization of cocoa plantations in 1957, there has always been a concern to ensure that the beans reach the final consumer with a competitive quality standard in the international market, as it is known as "fine cocoa", which is part of the of the plan of the Executive Committee of the Cocoa Crop Plan for the economic reintegration of the cocoa region from the 1990s.

> Currently, with a new national and global scenario, CEPLAC is redirecting its mission in order to face the new challenges. The current priority is the recovery of the regional economy, with an emphasis on combating witches' broom, a disease that is decimating cocoa plantations, leaving a legion of more than two hundred thousand unemployed and causing irreparable damage to nature. (Rocha, L, 2008, pg 58).

The “fine cocoa” has extreme value, being highlighted by Rocha (2008) a price that varies from 75% to 100% higher than the price of the common cocoa bean, this is a very important data for the regional economy, because cocoa is still it is the main agricultural product of many municipalities, such as Gandu.

The relevance of the relationship between fine cocoa and the revitalization of crops (production) was expressed by 100% of respondents. (Figure 9)

Figure 9 - Influence of fine cocoa production on the municipal economy.

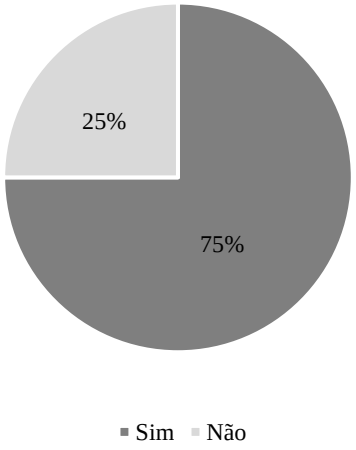


Source: Field Survey, 2021.

The survey carried out in the field reveals that 64.3% of respondents work or have had some contact with cocoa production, this data points to the reality of people who provide the interface of cocoa farming with the Atlantic Forest biome, the practice of production under the exotic shading says a lot about the conservation of the dense rainforest that dominates the region. The search for agroforestry systems is an alternative for the valorization and regional economic diversification as well as the preservation of already degraded areas with a high rate of biodiversity.

The relationship between the agroforestry systems used in the municipality plays an important role in the partial conservation of the biome, as it uses the structure of the dense ombrophilous forest for the implantation of cocoa in the understory of the forest. In this survey, it was reported that 75% of respondents recognize the importance of partial preservation of the forest using cocoa cultivation, while 25% do not understand this relationship. (Figure 10)

Figure 10 - Relationship between cocoa production and preservation of the Atlantic Forest biome.



Source: Field Survey, 2021.

The interface of cocoa farming with the Atlantic Forest biome, the practice of production under exotic shading says a lot about the conservation of the dense rainforest that dominates the region. In this scenario, the search for a balance between production and conservation can be achieved through the implementation of agroforestry systems. These provide soil recovery for agricultural and livestock development, socioeconomic and sociocultural production and environmental preservation, thus the management of agroforestry should also trigger the economic strengthening of local/regional farmers as well as the expansion of production and diversification of agricultural products in association with the preservation of biodiversity in the domain of the native biome promoting sustainability. This production system can positively contribute to the revitalization of crops and preservation of the genetic bank that is under threat, making it as similar as possible to the local ecosystem in structure, composition and functionality (Aquino, 2015).

Some residents report the agroforestry relationship between cocoa production and the forest, addressing the influence of the pest with environmental degradation in the deforestation process, the modernization of production with the development of genetically modified seedlings that results in the evolution of a product that is more resistant to pests and with the greatest potential for participation in the competitive market, fine cocoa. The revitalization of crops can contribute to an economic restructuring of the municipality of Gandu, but also foster the issue of preservation or less intensive practice in the aforementioned biome. Despite the great fragmentation of the biome in the municipality of Gandu, there are still forest reserves and biodiversity that are associated with exotic shading (cacao-cabruca) that is still widely used, causing part of the native forest to be preserved. The degree of preservation can be optimized with the adoption of an agroforestry system that conserves the soil, is more resistant to pests through forest diversification and conservation of dense rainforests.

4 FINAL CONSIDERATIONS

It can be concluded that the Atlantic Forest biome in the municipality of Gandu is very altered and degraded as a result of a series of anthropic impacts, among them, it is worth mentioning deforestation due to the expansion of agricultural practices, pastures for livestock, and use of wood from large native trees for various purposes. Other problems were found in reports by former residents, such as loss of water quality and quantity due to the continuous use by agricultural producers, loss of river volume due to deforestation and the decrease in the water table.

These facts contribute to the de-characterization of the Atlantic Forest biome since the beginning of the exploration of the landscape potential and natural resources by the colonizers that caused environmental impacts and are still happening. The spatial structure of the forest found is a set of fragmented areas of different sizes. These areas form important points to maintain basic ecosystem functions and maintain forest biodiversity, conserving fauna and flora gene banks. These fragments are considered as Atlantic Forest biodiversity hotspots by some researchers, despite the forest being degraded and fragmented.

Relating the issue of cocoa production with the issue of environmental preservation of the Atlantic Forest biome, agroforestry systems (SA F's) act in the interaction between agricultural/livestock development, local socioeconomic development and environmental conservation. Despite the presence of the " cacao-cabruca agricultural system " in the municipality acting less aggressively, many producers remove native trees from the forest canopy and also emerging trees, saying that ecological competition can be harmful to production. Because of this, another non-exotic shading system was adopted , such as the shading by the consortium with the banana tree, which exposes the cocoa trees to a stronger degree of solar radiation, to which the cocoa does not present so much resistance, as evidenced in the research of field held.

Exuberant landscapes were seen that provided a reflection of how complex and extraordinary nature is in the region. The biodiversity and landscape potential found tells the story of geological eras, but also carries the story of a people who have a very strong relationship with the land in terms of cocoa culture. The interaction between man and the environment, within this analysis, must be mediated by agroforestry systems that provide both the conservation of native ecosystems and the optimization of cocoa production in Gandu. From the bibliographic and empirical studies, it is concluded that agroforestry systems are the best solution for the economy and less aggressive to the rainforest ecosystem.

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