

Exploring socio-biodiversity alternatives in Sergipe's Sertão – Brazil: the leading role of women, family farmers, and traditional groups in Caatinga conservation

Brotam alternativas de sociobiodiversidade no Sertão Sergipano – Brasil: o protagonismo de mulheres, agricultores familiares e grupos tradicionais na conservação da Caatinga

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ABSTRACT

This article seeks to examine the dynamics of socio-biodiversity in the Caatinga biome of Sergipe's Sertão within the context of biome fragmentation and the transmission and emergence of ecological, socioeconomic, and cultural practices that aid in the conservation of this heritage. The study focuses on municipalities within Sergipe's Sertão. The methodology incorporates theoretical, documentary, and field research, including semi-structured interviews employing the snowball sampling technique and the formation of focus groups comprising researchers and stakeholders engaged in Caatinga conservation strategies. The findings reveal a concerning advance in biome degradation, primarily driven by the expansion of agricultural activities. Nevertheless, countering this trend, there is a notable emergence and consolidation of experiences, knowledge, and practices endorsed by social groups and traditional communities, which contribute to the preservation and enhancement of socio-biodiversity.

Keywords: The Caatinga. Patrimony. Socio-biodiversity. Traditional groups.

RESUMO

Este artigo tem como objetivo analisar a dinâmica da sociobiodiversidade da Caatinga no sertão sergipano, antevendo para o contexto de fragmentação do bioma, mas também para a transmissão e emergência de práticas ecológicas, socioeconômicas e culturais que contribuem para a conservação desse patrimônio. Como recorte espacial, foram delimitados os municípios do sertão sergipano. A metodologia está fundamentada na realização de pesquisas teóricas, documentais e de campo, bem como na realização de entrevistas semiestruturadas, por meio do uso da técnica snowball, e

na formação de grupos focais entre pesquisadores e os sujeitos que protagonizam as estratégias de manutenção da Caatinga. Os resultados deste estudo apontam para o avanço predatório da destruição do bioma associado, sobretudo, à expansão de atividades agropecuárias. Todavia, em contraposição a esse cenário, brotam e se consolidam experiências, saberes e práticas legitimadas por grupos sociais e povos tradicionais que contribuem para a construção da sociobiodiversidade.

Palavras-chaves: Caatinga. Patrimônio. Sociobiodiversidade. Grupos tradicionais.

1 INTRODUCTION

Since the mid-20th century, the configuration of the rural landscape has undergone significant transformations. Productive restructuring, evident through agricultural modernisation, has resulted in scenarios of socio-spatial exclusion. However, these changes have not affected rural territories uniformly, nor have they eradicated the diversity of local economic systems or the traditional cultural and symbolic practices that define the identity and socio-biodiversity of the communities residing in the Caatinga.

Among the changes is the expansion of modern paradigms that alter land use and, consequently, create disruptions, including migratory movements. The scarcity of arable land and employment opportunities in rural areas leads to financial hardships, which in turn drive population mobility (Andrade, 1970). Migration, conceptualised as the movement of "survival of the Self in territories of Others" (Almeida, 2009, p. 208), gives rise to constraints resulting from the abandonment of territory and the processes of deterritorialisation and exclusion.

Farmers who are able to remain in their territory develop and implement different strategies. They share experiences of solidarity with peers, identify antagonistic forces and common interests, form bonds of identity and belonging, and establish new practices. These practices are further reinforced by territoriality, which manifests as a profound desire for continuity in the physical space associated with spatial and symbolic references. This continuity is sought through the modification and creation of new forms of production (Bonnemaison, 2002).

In this context, this analysis of the territory seeks to examine its practices and the dynamics connecting economic activities with processes of environmental appropriation. The objective is to identify the motivations of both men and women regarding the Caatinga biome, with a particular emphasis on public policies affecting the region, the impacts of predatory use, strategies developed for adapting to the semi-arid environment, historical and contemporary consumption of Caatinga resources, and the interactions between leisure, art, and traditional recreation within the biome. Investigating these relationships with socio-biodiversity is crucial for understanding the current context.

In response to these changes, concerns emerge that drive the investigation of human-nature relationships and the actions leading to the decline of native plant species in Sergipe's semi-arid region. To what extent have public policies and government programs facilitated the expansion of livestock farming and the cultivation of commodities such as corn? In light of spatial alterations, how do Caatinga species adapt? Moreover, how do farmers, traditional communities, and local social groups devise alternatives for coexisting with socio-biodiversity?

To address these questions, this article aims to analyse the dynamics of Caatinga socio-biodiversity in Sergipe's Sertão, considering both biome fragmentation and the transmission and emergence of ecological, socioeconomic, and cultural practices that contribute to the conservation of this heritage. Consequently, the discussions presented in this text directly engage with the broad thematic area of "Conservation of Socio-biodiversity, Ecosystem Services, and Sustainable Productive Restoration Models," as proposed for the development of the dossier on "Biocultural Diversity and Bioeconomy(s)."

The methodology employed is grounded in fieldwork carried out by the Research Group on Food and Traditional Manifestations (Grupam) from 2019 to 2023 in Sergipe's Sertão, which facilitated visits to eleven rural communities. During this period, three focus group meetings (Fraser; Gondim, 2004) were conducted with researchers and eight family farmers from the Women's Association of the Lagoa da Volta Settlement in Porto da Folha/SE.

Additionally, during the empirical investigations, semi-structured interviews (Gil, 1999) were conducted with various social and traditional groups from the Sertão. These interviews gathered insights from twelve land reform settlers, eight members of *quilombola* communities, seven members of the *Xokó* indigenous people, and seven cowherds who manage small cattle herds and participate in "*pegas de boi no mato*", cattle roping events (Menezes; Almeida, 2008; Silva, 2023). The sample was determined using the snowball technique (Vinuto, 2014), which entails conducting interviews until information saturation is reached. The sampling process concludes when subsequent interviews no longer yield new information or elements for the analysis framework.

The empirical data collected in the field were compared with documentary research obtained from the Brazilian Institute of Geography and Statistics (IBGE), the Palmares Foundation, and a network of NGOs, universities, and technology companies, including Mapbiomas. This comparative analysis provided insights into the transformations occurring within the biome and the interactions between productive, social, and cultural activities concerning the conservation and fragmentation of natural resources.

The research underpinning this article is also supported by literature reviews that explore socio-biodiversity as an analytical framework, emphasising the integration of ecological, social, and economic paradigms (Diegues, 2005). This perspective highlights the interconnections between the sustainable use of natural resources, the appreciation of traditional cultures, the development of socially equitable markets, and the autonomy of social groups in managing productive activities (Cavalheiro; Araújo, 2015; Irigaray; Martins, 2016).

As a theoretical framework, this article adopts the conceptions surrounding environmental conservation. According to Sachs (1986), this approach involves constructing sustainability through interactions between efficient economic practices, social justice, and the prudent and appropriate use of natural heritage. In this context, Silvino, Viglio, and Ferreira (2016) observe that, despite the controversies and reinterpretations surrounding conservation, its foundational goal is to reconcile ecological dynamics with sustainable human interventions. This contrasts with preservationist approaches that emphasise the inviolability of nature.

The structure of the article begins with this introduction and progresses through discussions on public policies and the expansion of pastures and corn monocultures. It then examines the productive strategies related to socio-biodiversity, explores the consumption of flora and its derivatives, highlights the role of traditional peoples and artistic movements in preserving the biome, and concludes with final considerations.

2 POLITICAL ACTIONS AND THE REFUNCTIONALISATION OF RURAL AREAS: FROM THE DOMINION OF PLANTED PASTURES TO A SEA OF CORN

Sergipe's Sertão is situated at the confluence of the northeastern states of Alagoas, Bahia, and Pernambuco (see Figure 1) and is influenced by the Intertropical Convergence Zone (ITCZ), resulting in elevated temperatures throughout the year.

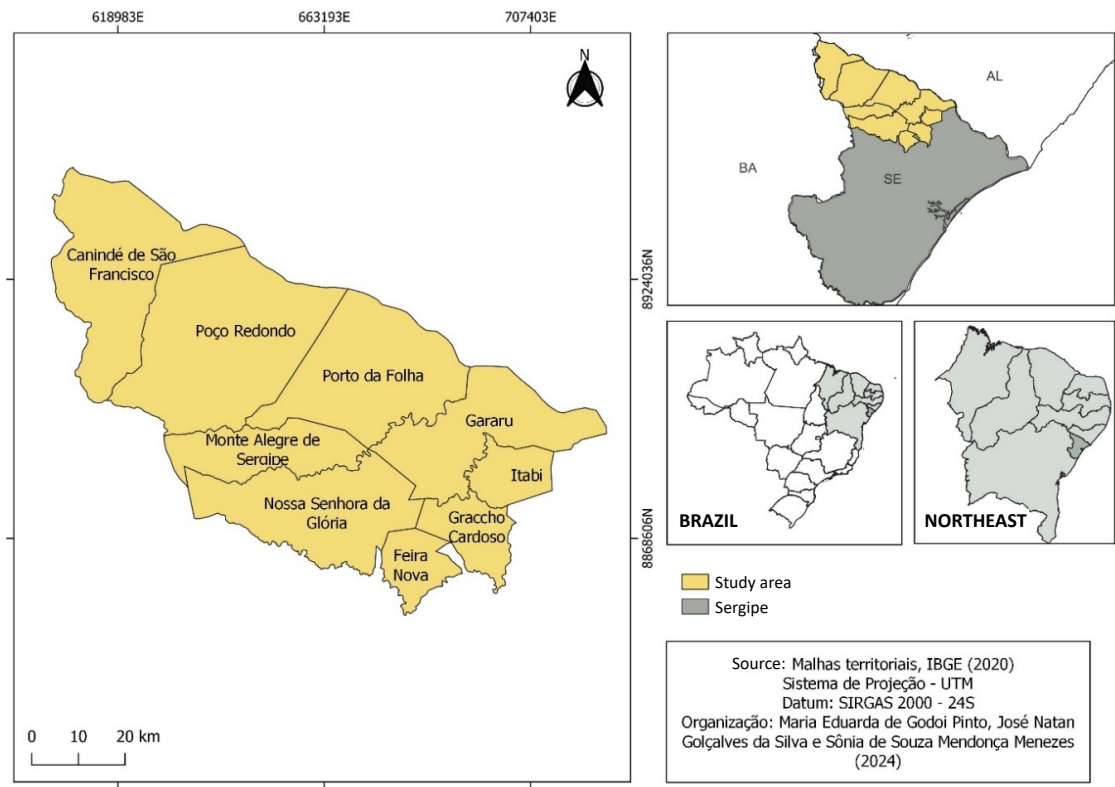


Figure 1 – Map of the spatial scope of the research, Sergipe Sertão, 2024.

In the territory, the climate is predominantly semi-arid, characterised by seven to eight months of dryness, temperatures exceeding 20°C, and irregularly distributed rainfall concentrated between April and July, which corresponds to the fall-winter season. The irregularity of precipitation during this period often leads to drought conditions that can persist for two to three years. Annual rainfall ranges from 365 mm to 630 mm. Another notable feature of the semi-arid climate is high evaporation rates, which contribute to water scarcity, particularly during the spring-summer period, and can extend throughout the year.

In terms of relief, which reflects both the climate and geological structure, the region is situated on the Sertão Piediplain. This area is characterised by "dissected and flattened surfaces that rise from east to west" (França; Cruz, 2007, p. 78). The relief is generally flat but exhibits significant undulation in the incised zone of the São Francisco River and in regions drained by its tributaries.

This region is traversed by the São Francisco River basin and its tributaries, with the São Francisco being the only perennial river. Its waters are utilised for human consumption across all municipalities in the area and beyond, facilitated by the installation of several pipelines. The irrigated perimeters of Projeto Califórnia and Jacaré-Curituba are established for the cultivation of vegetables, fruits, and tubers in the municipalities of Canindé do São Francisco and Poço Redondo. However, the primary economic use of the river's waters is for electricity generation through the Xingó Complex, which has caused profound and irreversible changes in the region. The other tributary rivers are intermittent, and their waters have high salinity, rendering them unsuitable for human consumption and irrigation.

Reflecting the climatic conditions, the Caatinga biome is predominant, characterised by tree and shrub species that typically shed their leaves during the dry season to minimise evapotranspiration. The loss of green foliage results in a reduced photosynthetic rate, leading plants to enter an energy-saving state that conserves reserves (see Figure 2). Hyperxerophytic vegetation dominates the driest areas, while more humid environments are characterised by hypoxerophytic types. Due to intensive exploitation for various purposes, these plant formations have been significantly devastated (França; Cruz, 2007; Santos; Andrade, 1992).

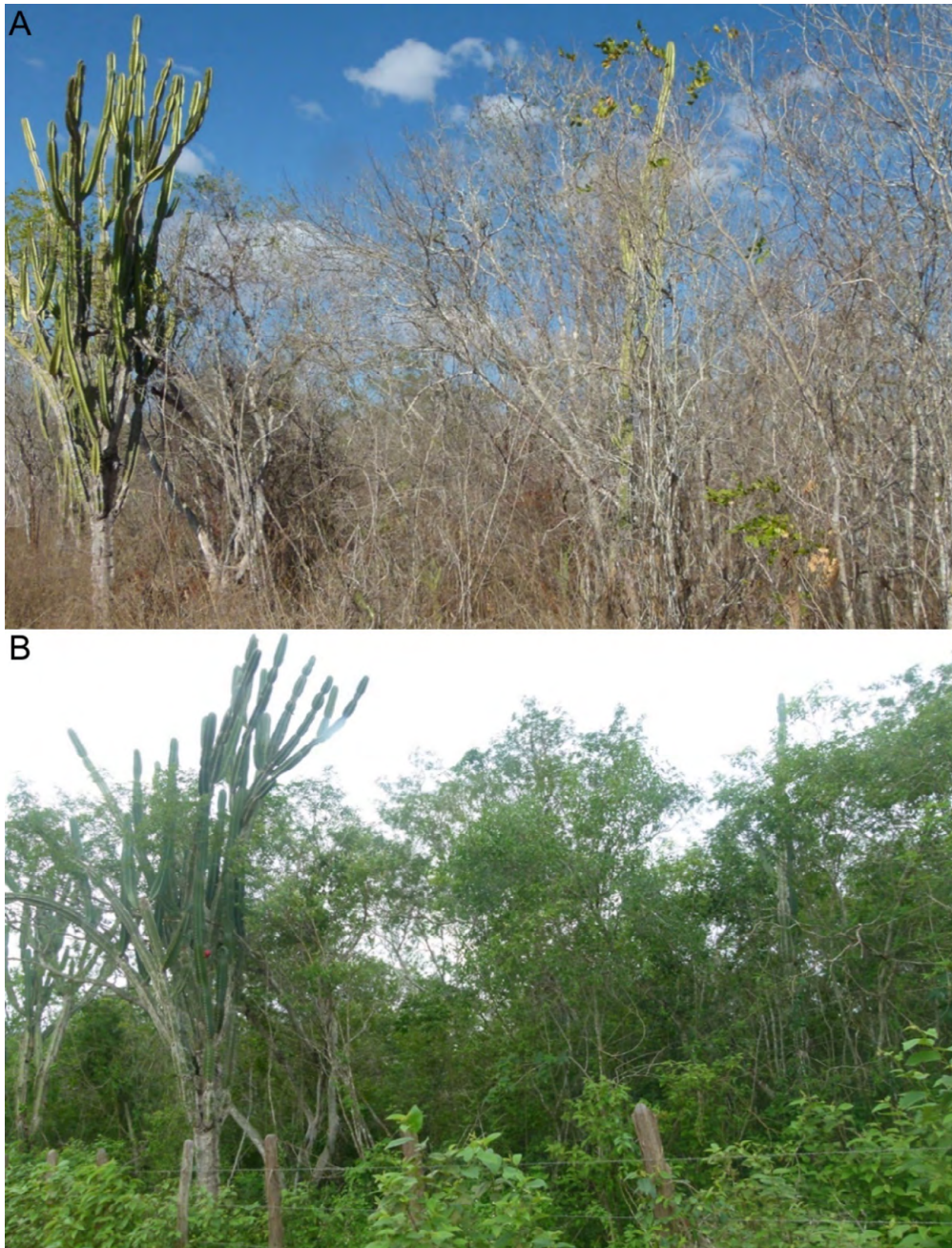


Figure 2 – Phytogeographic transformations of the Caatinga biome due to the variability of dry (A) and rainy (B) periods characteristic of the semi-arid climate, Porto da Folha/SE, 2023.

Source: Silva and Menezes (2023)

During the 17th and early 18th centuries, the Sertão do São Francisco was not considered an economic frontier of the State, a period described by Teixeira da Silva (1981) as *Terra de Refúgio* (Land of Refuge). This designation reflected the sparse settlement and the predominance of indigenous peoples, escaped slaves, and impoverished individuals from other regions. The *quilombola* communities in the Sergipe's Sertão illustrate the migration of enslaved or freed Black people from other regions moving inward.

According to Andrade (1986), although livestock farming was the primary activity in the region, it remained relatively non-intensive until the mid-20th century, with cattle raised extensively and causing minimal disruption to native vegetation. Due to its limited productivity, the state introduced and promoted public policies aimed at expanding livestock farming, a sector that offered higher income and fewer financial losses compared to agriculture. This process requires an examination of the development policies implemented by the state in the region and their impact on the rural environment of Sergipe.

The economy of the Sertão was a primary concern for the Superintendence for the Development of Brazilian Northeast (Sudene). In this context, master plans were created and developed with the initial aim of reducing regional disparities and addressing structural barriers in the area. However, from 1964 onward, during the Civil-Military Dictatorship and the absence of democratic governance, which persisted until 1985, the initial proposals of the working group that established Sudene were sidelined in favour of accelerating capitalist production methods. Consequently, the implementation of these master plans did not yield significant improvements in the standard of living for the majority of the population in Sertão regions. Andrade (1970, p. 118) details the following investments by the agency directed at the productive model:

Sudene prioritised investments focused on intensifying the cultivation of tree cotton through the propagation of selected seeds and enhancing livestock farming through programs aimed at multiplying grasses, promoting forage cacti, and increasing water supply through well drilling.

Beginning in the 1970s, the state undertook initiatives aimed at dismantling barriers that hindered and constrained agricultural development. Nevertheless, interests that diverged from those of the diverse group of farmers—engaged in varied production practices and capital reproduction—advocated for and facilitated projects favouring agricultural enterprises and large landholdings.

This situation became apparent with the establishment of the Land Redistribution and Agroindustry Promotion Program for the North and Northeast (Proterra) in 1971, which sought to expropriate land and advance agroindustry in the Northeast (Menezes, 1999). Due to its lack of credibility and its failure to meet the objective of improving the social status of small producers, Proterra was terminated in 1974.

In the same year, the Integrated Areas Development Program (Polonordeste) was launched with the objective of fostering rural development hubs in the region (Sorj, 1986). However, while the program facilitated the modernisation of rural establishments, it paradoxically contributed to increased land valuation and concentration, ultimately accelerating rural exodus.

According to Menezes (2009), another public policy introduced between 1976 and 1986 was the Special Support Program for the Development of the Semi-Arid Region of the Northeast (Sertanejo Project). This program facilitated the mechanisation of agricultural activities, the conservation of reservoirs, and, most notably, the expansion of livestock farming. It promoted the cultivation of pastures and the establishment of feed reserves for animals during dry periods.

The economic focus of public policies led to the rapid expansion of cattle ranching in Sergipe's Sertão. To establish planted pastures, ranchers would lease land to landless family farmers for one to two years. In exchange, the farmers would cultivate their crops and leave behind the developed pasture (Diniz, 1996; Menezes, 1999). As a result, these workers, whether landless or with insufficient land, began migrating in search of new areas for cultivation. Almeida and Vargas (1998, p. 473) highlight that "the intensification of the agro-pastoral system has been transforming the Sertão landscape into a vast pasture." Consequently, the remnants of the Caatinga biome have been confined to valleys and slopes, significantly diminished since the 1970s, particularly with the recent promotion of dairy farming (Menezes, 2009). This situation is reflected in the data on vegetation cover in the territory (Table 1).

Table 1 – Vegetation Cover in Caatinga Areas (ha), Sergipe, 1985-2022.

<i>Types of Cover</i>	1985	1995	2005	2015	2022
Agriculture and Livestock Farming	960,464	961,695	967,482	1,009,536	1,018,997
Forests	239,062	236,389	232,554	187,601	175,504
Water Bodies	6537	9461	9696	7656	8572
Non-Forest Area	2141	2835	3657	8302	8382
Natural Non-Forest Formation	5,522	3,345	336	630	2.271

Source: MapBiomias (1985-2022).

According to MapBiomias, the Caatinga areas in Sergipe experienced a continuous decline from 1985 to 2022, shrinking from 239,062 to 175,504 hectares, which represents a 26.58% reduction in forested vegetation cover. In contrast, areas dedicated to agriculture and livestock farming expanded significantly during this period, increasing from 960,464 to 1,018,997 hectares, a rise of 6.09%. It is also important to note that areas classified as non-forested typically consist of environments in disuse, resulting from degradation caused by intensive agricultural exploitation or deforestation, with future utilisation directed towards agricultural and livestock activities. For these non-forested areas, there was an increase of 291.5% between 1985 and 2022.

Field research corroborates that the decline in Caatinga vegetation cover, as shown in Table 1, is predominantly driven by the expansion of pastures and, more recently, by the cultivation of corn monocultures. This trend was reinforced by agricultural credit policies that promoted the cultivation of forage and grain corn. These policies were aimed at producing silage for cattle nutrition and providing cereal for cornmeal agro-industries and farms in the states of Sergipe, Alagoas, Bahia, and Pernambuco.

The advancement of these activities is largely driven by federal programs outlined in the Safra Plan. For the 2023/2024 biennium, the Ministry of Agriculture and Livestock (Mapa) has established 13 programs aimed at promoting the modernisation, infrastructure development, and productivity enhancement of agriculture and livestock farming, with a primary focus on medium and large-scale rural producers (Brasil, 2024). In the case of family farming, agricultural restructuring is supported through access to credit lines provided by the National Program for Strengthening Family Agriculture (Pronaf).

The expansion of corn monoculture involves the indiscriminate use of agrochemicals, leading to soil and freshwater contamination. This practice results in the elimination of herbaceous species native to the biome and disrupts the natural composition of insect and microorganism populations integral to the Caatinga's biodiversity (Menezes; Silva; Silva, 2019).

In discussing conservation strategies for this biome, Silvino, Viglio, and Ferreira (2016) note that, from an economic and state perspective, the semi-arid conditions of this environment are often seen as obstacles to development. This perception has fueled political and economic initiatives aimed at modernising productive activities with the aim of overcoming climatic limitations. However, technological specialisation in agriculture has proven contentious, as it has intensified economic disparities between agribusiness and family farming sectors and exacerbated environmental issues associated with the predatory exploitation of natural resources. In contrast, the authors emphasise that various economic and social strategies for adapting to the semi-arid climate have facilitated the sustainable use and conservation of the Caatinga biome. Despite these challenges, evidence remains of the ongoing practice of cultural traditions, the transmission of knowledge and skills across generations of local residents, and the emergence of alternative production paradigms driven by social movements, organisations, and traditional communities.

3 STRATEGIES FOR SOCIO-BIODIVERSITY IN LIVING WITH THE SEMI-ARID CLIMATE

The development of agro-pastoral activities, exemplified by the expansion of dairy cattle and corn monoculture under the Green Revolution paradigm, represents the predominant economic model that has significantly impacted the socio-biodiversity of the Caatinga biome in Sergipe's Sertão (Menezes; Silva; Silva, 2019). The intense reliance on conventional agriculture's natural resources has exacerbated local and global environmental issues. These include climate change, disruptions in biogeochemical cycles, alterations in ecosystem dynamics, and challenges to food provisioning (Nolasco; Lahsen; Ometto, 2016).

In contrast to the prevailing emphasis on criminalisation and genetic modification in production processes, Silva (2016) highlights that agrarian reform settlements, quilombola communities, and the Association of Women from Povoado Lagoa da Volta, Porto da Folha showcase alternative approaches. These experiences emphasise collective labour, the adoption of practices adapted to the semi-arid climate, the restoration of local agroecosystems, and the promotion of the agroecology paradigm (see Figure 3).



Figure 3 – Agroecological garden at the Association of Women from the Povoado Lagoa da Volta, Porto da Folha/SE, 2022.

Source: Silva and Menezes (2023)

Altieri (2004) observes that agroecological production is grounded in a biosystemic and diversity-oriented approach. This paradigm emphasises the management of agricultural ecosystems through mechanisms that ensure the conservation of natural resources, respect farmers' traditional knowledge, and support the social sustainability of farming communities.

The synergy between agroecology and the biome is reflected in the production system itself: 1) agroecological practices diverge from intensification, thus preventing the expansion of activities into large cultivable areas and the encroachment upon Caatinga reserves; 2) the use of natural repellents and manual field cleaning, rather than chemical pesticides, avoids the removal of herbaceous vegetation in the Caatinga biome and the destruction of small animals and microorganisms in the soil; and 3) techniques such as crop rotation, intercropping, and the application of animal manure and compost from worm farms improve the natural fertility of the soil.

The women's association, which consists of 20 members, engages in several initiatives beyond agroecological practices, including the development of productive backyards, the cultivation of Caatinga species seedlings for reforestation, and beekeeping. According to Kiill (2021), "the apicultural fauna of the Caatinga biome comprises 187 bee species, distributed across 77 genera," with endemic species being predominant. Beekeeping aligns well with conservation efforts in the biome, as the plant strata offer both floral resources for nourishment and support for hive establishment. The ecology of Caatinga plants supports beekeeping due to the variety of species that flower at different times of the year. While flowering is most prevalent during the rainy season, certain trees, such as the juazeiro (*Ziziphus joazeiro*), aroeira (*Myracrodruon urundeuva*), baraúna (*Schinopsis brasiliensis*), umburana de cheiro (*Amburana cearensis*), and quixabeira (*Sideroxylon obtusifolium*), bloom during the dry season, providing essential food sources for bees when floral resources are otherwise scarce.

According to the IBGE agricultural censuses conducted in 2006 and 2017, Sergipe's Sertão emerged as the leading region in the state for the number of beekeeping establishments. Of the 308 beekeeping establishments identified in Sergipe, 53.57% were located in the Sertão. Additionally, this region experienced the highest growth rate in productive units between the censuses, at 79.35%. However, this increase was not mirrored in the volume of honey sold, which saw only a modest variation of four tons (16.67%) between 2006 and 2017 (Table 2).

Table 2 – Beekeeping, Sergipe (2006-2017).

Year	2006	2017	Growth rate between censuses (%)
Number of agricultural establishments			
Sergipe	267	308	15.36
Sergipe's Sertão	92	165	79.35
Sergipe's Agreste	82	96	17.07
Sergipe's East	93	47	-49.46
Quantity of honey sold (tons)			
Sergipe	63	87	38.10
Sergipe's Sertão	24	28	16.67
Sergipe's Agreste	23	47	104.35
Sergipe's East	16	12	-25.00

Source: IBGE – Agricultural Census (2006-2017).

Several factors contribute to this scenario, including the prolonged droughts that persisted throughout the 2010s, which adversely affected the flowering capacity of vegetation. As indicated by the data, in 2017, the Agreste region of Sergipe, with a notably smaller number of beekeeping establishments, managed to sell 47 tons of honey, compared to 28 tons sold in the Sertão. The more regular rainfall in the Agreste created a more favourable environment for honey production. Additionally, the lack of technical guidance in beekeeping practices exacerbated the situation. During droughts, it is crucial to provide artificial feeding for bees to compensate for the reduced nectar and pollen availability due to climatic extremes. This practice helps to prevent issues such as swarm dispersal and socio-environmental imbalances, including aggressive behaviour towards people and livestock.

Despite these challenges, beekeeping plays a crucial role in preserving the socio-biodiversity of the Caatinga biome. The transmission of traditional knowledge regarding the medicinal uses of honey—whether consumed raw or incorporated into products such as lollipops and syrups—coupled with a scientific acknowledgement of its health benefits, drives demand for honey in the region. This demand is vital for supplementing the income of family farmers. In the women's association in Porto da Folha,

producers benefit from access to an industrial kitchen and facilities for packaging and labelling honey. The ecological, nutritional, aesthetic, and socially equitable attributes of the honey enhance its commercial value.

Another economically promising but relatively niche activity in the region is the cultivation of Caatinga plants for ornamental purposes. Prominent species include *Melocactus bahiensis* (Cabeça-de-frade), *Cereus jamacaru* (Mandacaru), *Pilosocereus pachycladus* (Facheiro), and *Pilosocereus gounellei* (Xique-xique) from the cactus family, as well as *Bromelia laciniosa* (Macambira) and *Bromelia antiacantha* (Gravatá) from the bromeliad family. This practice was initially encouraged by public institutions and government agencies to link aesthetics with regional identity. Additionally, in a semi-arid environment characterised by limited rainfall and water scarcity, the use of native plants reduces the need for frequent watering. Recently, Caatinga species have gained popularity in domestic landscaping due to the growing interest in *natural* and indigenous design approaches.

Heiden, Barbieri, and Stumpf (2006) argue that the use of ornamental plants for aesthetic purposes has been a longstanding aspect of human culture. However, beyond their contribution to environmental harmony, the integration of these plants into the landscaping market has sparked significant environmental and economic discussions. Promoting native species can help counteract the proliferation of non-native (alien) plants, which often leads to landscape homogenisation and acts as an invasive force threatening the preservation of biodiversity. The unchecked spread of exotic species disrupts environmental balance, can adversely affect human health, and fosters economic and social fragmentation due to the competitive nature of invasive flora against native and traditional agro-food species.

Private enterprises have adopted ornamental cultivation practices providing landscaping services and offering a variety of native and non-native plant species. These planting techniques have also been extended to agrarian reform settlements. In these contexts, family farmers manage the commercialisation of these plants at rural establishments and local markets. Sustainable cultivation methods and the reduction of unregulated extraction of native species contribute to the conservation of Caatinga flora and reinforce the locals' identity, which is deeply rooted in the social and political discourse of resistance.

In contrast to this dynamic, the Caatinga region in Sergipe has also been affected by the spread of invasive species. Notable examples include the algaroba (*Prosopis juliflora*), which has dispersed throughout the northeastern semi-arid region since the early 20th century, and neem (*Azadirachta indica*), introduced to Brazil in the 1980s and widely cultivated in the Northeast from the 2000s onward. Despite the significant temporal variation in the spread of these species, it is noteworthy that their proliferation has been paradoxically promoted by institutional policies and government rural extension programs.

Nascimento (2008) highlights that the algaroba tree, native to Central America, the Caribbean, and northern South America, was introduced to the semi-arid region under the pretence of combating drought. The purported benefits included: 1) use in livestock feed supplementation; 2) human consumption in the form of flour, gum, coffee, liqueur, and jelly made from its fruit; 3) provision of wood for fence posts and stakes; and 4) energy use through firewood and charcoal. Despite these advertised advantages, the algaroba tree has spread extensively into Caatinga areas, especially in lowlands and riparian zones. Its drought resistance and expansive growth have led to landscape homogenisation, reduced water availability, altered soil fertility, and the displacement of arboreal and shrubby species due to its competitive nature (Fabricante *et al.*, 2015; Nascimento, 2008).

The neem tree, native to India, has also adapted well to the semi-arid climate of the region. According to Santos and Fabricante (2020), the neem is notably used for wood production and possesses bioinsecticidal properties. While its leaf juice and seed oil have been promoted for pest control among agroecological and organic producers, this promotion has been inconsistent. The introduction of neem into the biome has compromised environmental resilience due to its competitive nature with native

species, leading to decreased survival rates of pollinating organisms. The fragmentation of socio-biodiversity is evident in the disruption of natural flora and fauna dynamics and potential impacts on food production, as bees are crucial for pollinating agricultural crops.

Both algaroba and neem, with their extensive canopies and significant shading, have been used at different times for the afforestation of streets and the landscaping of public squares. Recently, however, environmental advocacy and legal actions have shifted focus toward managing invasive plant species by eradicating them from public spaces and replacing them with native species.

4 CONSUMPTION OF CAATINGA FLORA AND DERIVATIVES

Residents who remain in their small rural establishments continue to engage with the Caatinga biome by utilising its natural resources. Almeida and Vargas (1998) highlight the various uses of the biome, including medicinal, food, wood/firewood, and crafts. While the use of medicinal plants has decreased with the advancement of the chemical and pharmaceutical industries, they remain commonly used for preparing teas, lozenges, compresses, and baths. This traditional knowledge is perpetuated by social movements, health pastoral care, traditional communities (such as Indigenous and quilombola groups), and individuals with expertise in traditional practices despite the growing presence of pharmacies in municipal centres and rural settlements.

Research on the botany of the Caatinga biome has underscored the medicinal and therapeutic potential of its plants, particularly in the Sergipe's Sertão and other regions of the Northeast (Alves *et al.*, 2017; Roque; Rocha; Loiola, 2010). Various parts of the plants from the arboreal, shrub, and herbaceous strata are utilised, including stems, seeds, leaves, roots, flowers, and fruits.

In interviews, members of *quilombola* communities, the Xokó indigenous people, and traditional farmers discussed various health treatments utilising the flora of the Caatinga biome. Their accounts emphasised the use of these ecological resources as anti-inflammatories, antibacterials, and analgesics for treating a range of conditions, including respiratory, digestive, renal, cardiac, epidermal, and neurological diseases, as well as ailments associated with the "evil eye" (such as fever, nausea, diarrhoea, headache, and malaise). The "evil eye" is believed to result from the intentional or unintentional actions of individuals motivated by envy or extreme admiration. Explanations for these phenomena are rooted in metaphysical and popular beliefs, with diagnoses performed by the increasingly rare *curandeiras* (healers) and *rezadores* (prayers), who hold ancestral healing knowledge.

Regarding fruit flora, certain foods such as *quixaba*, *juá*, *araticum*, *mari*, and *maracujá-do-mato* have become less common or restricted in dietary practices. Castro (1984, p. 184) observes that, despite their nutritional potential, these fruits were primarily consumed "during the dire times of drought, when all available food was utilised." This perspective is echoed in the narratives of interviewees, who reflect on past experiences where food scarcity and hunger—exacerbated by severe droughts and social exclusion—forced them to consume whatever was available for survival, even if it was not particularly preferred.

In contrast, the consumption of *ouricuri* and *umbu* remains deeply embedded in traditional Sertão cuisine. Rural inhabitants can readily access these fruits within their natural habitat. The presence of the ouricurizeiro (*Syagrus coronata*) in the Caatinga biome is associated with the migration routes of the hyacinth macaw (*Anodorhynchus hyacinthinus*) and Lear's macaw (*Anodorhynchus leari*). These macaw species, threatened with extinction, possess large, curved, and powerful beaks capable of breaking open fruits with hard shells. Among the seeds dispersed by these birds, those from palms, including the *ouricuri*, are particularly prevalent.

The preparation of this fruit for consumption involves a cooking process. Additionally, the consumption of *ouricuri* requires cracking the seed with the aid of rock fragments. Once the shell is broken, the edible pulp, which resembles a small coconut, can be extracted.

However, it is observed that these goods are not as readily available as they once were. Menezes (2013, p. 14) notes: "In Sergipe, as a consequence of deforestation, the umbuzeiro (*Spondia tuberosa* Arr. Cam.), a species described by Euclides da Cunha (1963) as the 'sacred tree of the sertão,' is in decline." Consequently, it is common for individuals to seek these fruits at weekly markets, where local and regional food networks facilitate the acquisition of products primarily from the state of Bahia.

Despite the significant devastation of the Caatinga biome, the consumption of umbuzeiro fruit (*Spondia tuberosa* Arr. Cam.) remains prevalent among locals. The fruit is harvested between March and April, often coinciding with the Lenten period. It is consumed in various stages of ripeness: raw when green, swollen (partially green), or ripe. It is also enjoyed with *aguardente* (a type of Brazilian liquor) and used to make juice. Among the people of Sertão, the most sought-after umbu-derived food is *umbuzada*. This dish is prepared by cooking umbu with cow's milk or coconut milk, sweetening it with sugar, and seasoning with a pinch of salt. *Umbuzada* is typically served with midday meals and can be enjoyed as a dessert, either plain or with the addition of cassava flour.

The roots of the umbuzeiro (*Spondia tuberosa*) are also highly valued. As Castro (1984, p. 223) describes: "The root—*cuca*—of the umbuzeiro consists of spongy tissue densely saturated with water. The water content is so high that the product is more accurately described as a beverage rather than a food." Although it is seldom consumed today, historically, the water extracted from the umbuzeiro's root provided essential hydration for cowhands tending cattle and *Cangaceiro* people seeking refuge in the Caatinga biome.

The aqueous roots of the umbuzeiro also yield a type of sweet known as *cocada*. After peeling, washing, and squeezing the roots, they are cooked with sugar to produce this confection. Although *cocada* has seen limited consumption in recent times, it has recently been revived and is now featured in traditional dishes served in restaurants in the municipalities of Poço Redondo and Canindé de São Francisco, which are emerging as ecotourism hubs in Sergipe's Sertão. A similar revival is observed with the *cabeça-de-frade* (*Melocactus bahiensis*), a cactus from which a version of *cocada* is made by cooking its pulp with sugar, cloves, and cinnamon. These examples underscore the role of socio-biodiversity in the recovery and promotion of foods with environmental, cultural, identity, artisanal, and historical significance.

Some plants native to the Caatinga, such as *Talinum paniculatum* (manjogome) and *Amaranthus viridis* (brede), were traditionally consumed in various dishes, including stews, fried preparations, and broths, often cooked with vegetables such as pumpkins, squash, okra, and maxixe. These vegetables, introduced to the biome, have become integral to the agroecosystems of the Sertão and are typically included in the diet during the rainy season. However, the extensive use of herbicides in pastures and maize cultivation has led to the decline of native herbaceous species and eudicotyledonous crops. While *manjogome* and *brede* have become less common in the sertanejo diet, vegetables like maxixe, pumpkin, squash, and okra remain staple components.

5 CULTURAL AND ARTISTIC ACTIVITIES: THE VALORIZATION OF THE CAATINGA BIOME BY THOSE WHO CULTIVATE TRADITIONS AND ART

In Sergipe's Sertão, the conservation of the Caatinga's socio-biodiversity is significantly supported by the leadership of traditional community members. Notably, the ecological, identity-based, symbolic, and cultural connections that Indigenous peoples and *quilombolas* have with the forest, waters, and land are prominent in these territories. Within the region, the state is home to the only legally recognised Indigenous village and three certified *quilombola* communities. One of these

communities is currently in the process of formal establishment and, therefore, lacks data on its area and population (see Table 3).

Table 3 – Traditional Communities, Sergipe's Sertão (2024).

Community	Municipality	Social Group	Area (ha)	Self-declared Residents in the Territory
Xokó people	Porto da Folha	Indigenous	4.316,7768	329
Serra da Guia	Poço Redondo	Quilombola	9.013,1831	614
Mocambo	Porto da Folha	Quilombola	2.100,5400	428
Rua dos Negros	Canindé de São Francisco	Quilombola	-	-

Source: *Fundação Palmares (2024); IBGE – Demographic Census (2022).*

In the territories of *quilombola* and Indigenous lands, near-pristine Caatinga reserves are predominant. These communities demonstrate a profound respect for nature conservation. They derive roots, barks, leaves, flowers, and seeds from the Caatinga biome to treat physical ailments within their communities. Additionally, some plants are employed in rituals conducted by healers to address spiritual maladies. From the soil that supports this vegetation, Xokó women gather clay, which is used in the artisanal crafting of pots.

Oliveira (2018, p. 40) notes that animist religious practices and Catholicism serve as "the main vectors of the intercultural identity characteristic of the Xokó people." The community leaders, including the chief and the shaman, are believed to be chosen through the mediation of their ancestors and deities, represented by elements of nature. The *Ouricuri* ritual, a private ceremony restricted to the indigenous community, involves practices such as drinking *jurema* and performing the *Toré* dance, which facilitate communication with deities and ancestors.

According to Silva (2023), for these communities, the Caatinga biome represents an ecological, symbolic, and sacred heritage that is integral to the preservation of their identities. Therefore, the conservation of the forests is not only a matter of environmental stewardship but also a process that upholds ancestral traditions. This conservation effort plays a crucial role in reinforcing cultural identity and legitimising the existence of both *quilombola* and Xokó peoples.

In the territorial configuration of Sergipe's Sertão, the distinctive relationship between traditional cowherds and the Caatinga is particularly notable. Among the cultural practices of these individuals, the "*pegas de boi no mato*" cattle roping events stand out as the primary symbolic expression of the cowherd culture (Menezes; Almeida, 2008; Silva, 2023).

An ecological-cultural symbiosis exists between these individuals and the Caatinga. The forest plays a critical role in the ritualistic framework of cattle roping events, as it is within this environment that cowherds display their skill and courage by navigating through the vegetation to obtain a tag or cord hanging from the loose bovine. Historically, the practice involved capturing the animal itself.

Maintaining the biodiversity of the Caatinga biome is crucial for preserving the tradition of "cattle roping in the forest." In recent decades, cowherd groups have advocated for the acquisition of biome reserves for recreational purposes. In the municipality of Porto da Folha, the Sociedade Recreativa Parque Nilo dos Santos, established by cowherds, holds 400 hectares of Caatinga land dedicated to the conservation and promotion of this tradition. The society was officially recognised as a public utility by State Law No. 2574 in 1985, with this status reaffirmed by State Law No. 6.953 in 2010.

A similar development occurred in the municipality of Nossa Senhora da Glória in 2023, where the municipal government secured 155 hectares of Caatinga biome from the National Institute for

Colonization and Agrarian Reform (Incra) for the João do Vale Settlement. This agreement aimed to establish a municipal conservation unit dedicated to environmental education and the promotion of cultural, sports, and recreational activities (Incra, 2023). Among these activities is "cattle roping in the forest," organised by the Association of Cowherds of Nossa Senhora da Glória – Raid da Amizade. Agricultural establishments in the Sertão, managed by cowherds and rural producers who support this rodeo tradition, also maintain Caatinga reserves on their properties where these events take place.

In the municipality of Nossa Senhora da Glória, the Caatinga biome also serves as a source of inspiration for the visual artist Cícero Alves dos Santos, known as Véio. The raw materials for his artwork consist of trunks, roots, and branches from deceased vegetation within the biome. According to Maciel, Santos, and Leal (2017, p. 4), the artist employs two distinct techniques to create his sculptures:

In the first method, Véio selects what he refers to as "open trunks," which are pieces of vegetation scattered throughout his region. He makes only a few precise artistic interventions on these natural forms. By using specific colours and cuts, Véio shapes these trunks into representations of animals, humans, and other fantastical figures, drawing out the expressive potential inherent in their natural twists and existing forms. In the second method, he works with what he calls "closed trunks." Véio carves the wood to reveal the form he has envisioned within the trunk, creating compositions that explore various themes and range in size from one millimetre to twelve meters in height.

Despite his expertise in woodworking, the artist refrains from participating in the commercial extraction of wood, advocating instead for the conservation of biodiversity. The representations in Véio's works reflect human dramas, social and political critique, labour, lifestyles, and traditions of the Northeastern people. His rural property features the Sertão Museum, which holds a collection of over 17,000 pieces.

Véio's art, classified as naïve in the artistic domain—referring to works created by self-taught artists with distinctive personal expression—has been showcased in prominent contemporary art venues in Brazil and Europe. His works are part of the collections at the *Fondation Cartier pour l'art contemporain* in Paris, France, and the *Pinacoteca do Estado de São Paulo*. Additionally, the artist participated in the Venice Biennale in Italy in 2015 (Maciel; Santos; Leal, 2021).

Véio's artistic acclaim facilitates the examination and questioning of the perceived dichotomy between primitive, scholarly, and popular art. It also aids in the dissemination of elements from the socio-biodiversity of the Caatinga biome in Sergipe's Sertão, reaching local, national, and international audiences.

6 FINAL CONSIDERATIONS

The Caatinga, the only biome exclusively found in Brazil, is experiencing severe degradation due to the expansion of exploitative agricultural practices. In Sergipe's Sertão, this is particularly apparent through the proliferation of extensive cattle ranching, illegal logging, and, more recently, the expansion of monoculture maize under the Green Revolution model. These practices result in reduced vegetation cover, diminished water resources in river systems, and soil degradation, which, in conjunction with climate change, contribute to the development of areas prone to desertification.

The consequences of these issues are alarming, given the ongoing loss of flora and fauna, the challenges to natural regeneration of the biome—exacerbated by ineffective environmental policies—and the resulting social, economic, and food production impacts. Frequent droughts and the adoption of harmful agricultural technologies, such as pesticides and genetically modified seeds, are severely affecting traditional agroecosystems. Consequently, there is an increasing reliance on ultra-processed foods and intensive agricultural practices among the population.

Despite these challenges, strategies for coexisting with the semi-arid environment and sustainably utilising the forests have been developed by social movements, traditional communities, and segments of family farming. Prominent among these strategies are agroecology, beekeeping, and, more recently, the cultivation of native species. The conservation of the Caatinga biome is further supported by social groups that regard the biome as essential for preserving their festive, ritualistic, therapeutic, medicinal, agroalimentary, and artistic practices.

Therefore, it is posited that the conservation of the Caatinga necessitates legitimising cultural and traditional activities that define lifestyles in the Sertão. The experiences of adapting to the semi-arid environment are rooted in practices inherited from the ancestors of the Sertão people. Their spatial perceptions, agroalimentary knowledge, and the reciprocal relationship between humans and nature are crucial elements that should be incorporated into social, cultural, and productive innovation processes.

Emerging approaches in socio-biodiversity, such as agroecology, ecotourism, endemic landscaping, and the sustainable use of flora in cuisine, must incorporate the contributions of social movements and traditional groups. These groups, through their daily and cultural practices over time, have been pivotal in ecological stewardship within the territory. Such integration is essential for developing conservation strategies and territorial frameworks that are inclusive, environmentally sound, socially equitable, and economically viable.

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