

## VALIDATION OF CABRUCÁ SYSTEM IN PASTURES

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The objective of this work was to verify the adequacy of the silvopasture system of Farm Hiawatha to the cabruca system scope, evaluating its tree phytosociology, its main method of validation. The study area was a lowland cacao-cabruca swamp with high broom infestation, thus transformed into pasture for service animals (muare) and production (bovine) animals. The evaluated pasture area of Farm Hiawatha (62 ha), located in the Municipality of Arataca (BA), has 2.6 ha. In these, 76 arboreal individuals belonging to 21 species and 12 botanical families were diagnosed. Among the species cataloged, *Cariniana legalis* (jequitibá) and *Artocarpus heterophyllus* (jaqueira) stood out. The total AD value was 29 ind ha<sup>-1</sup> and the total DoA was 10 m<sup>2</sup> ha<sup>-1</sup>. It was also verified the presence of *Dalbergia nigra* (jacaranda da bahia), a species considered immune to cutting. Pasto-cabruca presented a phytosociological structure (richness, frequency, density, dominance and volumetry) distinct from conventional pastures (full sun), with characteristics that fit the parameters established for the pastoral model of the regional agrosilvicultural system. In this way, it can and should have the same “legal discipline” proposed for the cabruca cacao in the Bahia Forest Decree of 15.180 / 2014 and the INEMA / BA Decree of 10.225 / 2015.

**Key words:** Agrosilvicultural system, cabruca system, phytosociology, native tree, Atlantic forest.

**Validação do sistema cabruca em pastagens.** O objetivo deste trabalho foi verificar a adequação do sistema de silvicultura a Fazenda Hiawatha ao escopo do sistema cabruca, avaliando sua fitossociologia arbórea, seu principal método de validação. A área de estudo foi um pântano cacau-cabruca de planície com alta infestação por vassouras, transformado em pasto para animais de serviço (muare) e animais de produção (bovinos). A área de pastagem avaliada da Fazenda Hiawatha (62 ha), localizada no município de Arataca (BA), possui 2,6 ha. Nessas, foram diagnosticados 76 indivíduos arbóreos pertencentes a 21 espécies e 12 famílias botânicas. Entre as espécies catalogadas, destacaram-se *Cariniana legalis* (jequitibá) e *Artocarpus heterophyllus* (jaqueira). O valor total de DA foi de 29 ha<sup>-1</sup> e o total de DoA foi de 10 m<sup>2</sup> ha<sup>-1</sup>. Também foi verificada a presença de *Dalbergia nigra* (jacaranda da bahia), espécie considerada imune ao corte. Pasto-cabruca apresentou uma estrutura fitossociológica (riqueza, frequência, densidade, dominância e volumetria) distinta das pastagens convencionais (pleno sol), com características que se ajustam aos parâmetros estabelecidos para o modelo pastoral do sistema agro-agrícola regional. Dessa forma, pode e deve ter a mesma “disciplina legal” proposta para o cacau cabruca no Decreto da Floresta da Bahia de 15.180 / 2014 e no Decreto do INEMA / BA de 10.225 / 2015.

**Palavras-chave:** sistema agro-silvícola, sistema cabruca, fitossociologia, árvore nativa, Mata Atlântica.

## Introduction

The dominant primary plant formation in the Cacaueira is a dense ombrophilous forest, known like Atlantic rainforest or simply Atlantic forest. This biome is found along of the Brazilian coast, covering the coastal plains and eastern slopes of the Serra do Mar and Serra General, at altitudes of up to 600-700 m. The Forest Atlantic had as its basic characteristic, luxuriant vegetation, high and developed, whose structure and composition varied by region; presented individuals with more than 40 feet tall (CEPLAC, 1976; Setenta et al. 2005; Lobão et al, 2011).

The Cacao Region of Bahia is part of the Central Atlantic Forest Corridor and is responsible for conserving and protecting important remnants of forest fragments, both in the conservation units and in the legal reserve and agroforestry areas of its cocoa farms. These, in turn, are of fundamental importance in the preservation of unique specimens of arboreal individuals that coexist with cacao trees for more than 200 years under a process of sustainable regional development recognized internationally as Productive Conservation, based on the regional agroforestry arrangement *cabruca* where the cocoa plantations were planted and established in the rainforest understory (Lobão et al, 2009a; Lobão et al, 2011; Setenta and Lobão, 2012).

It is worth highlighting the role of *cabruca* demonstrated by Lobão et al. (2001), in a study carried out in one of the many farms traditionally covered by *cabruca*s. The *cabruca* preserved important specimens at different succession stages, rare, noble and of commercial value. Noble species were identified (*Arappatiella psilophylla*, endemic to the cocoa region, *Melanoxilon brauna*, threatened with extinction). The floristic diversity of both forest and cacao *cabruca* is rich, demonstrating the efficiency of the system in conservation of tree species under anthropogenic pressure. This agroforestry system has potential to be managed for timber production on a sustainable income regime (Lobão et al., 2011).

Among the most sought alternatives for the diversification of regional land use caused by the regional crisis caused by the *Moniliphthora perniciososa* fungus, disease commonly known as witch's broom,

was conventional extensive livestock farming with a higher bias for beef cattle, although regional potential had greater ability for dairy farming, due to the easiness of establishment of pastures and acquisition of animals (Lobão et al, 2009). However, a new problem occurred, the degradation of arboreal vegetation and the impoverishment of the soils in areas where the pastures completely replaced the cacao plantations (Setenta & Lobão, 2012). Already in the areas where the producers retained the remaining tree individuals present in the *cabruca*, the so-called silvopastoral production and service pastures were established, or they could be recognized as pasture grass. Among the options for recovering degraded pasture areas, the implementation of the silvopastoral system is one that has been highlighted as a viable option to revert the problems cited and promote sustainability (Lobão et al., 2002; Lobão et al. 2009).

Conceptually, the *Cabruca* system is a model of an agroforestry system (agrosilvicultural) that requires the inclusion of native species, allowing different arrangements integrating the components of crop-livestock-forest, having as precursor the *cabruca* cacao arrangement. It accommodates all possible variations and compositions, including in agricultural areas that were not planted under native, Atlantic or not, thinned forest, as well as in open and managed areas as an agroforestry system in which native tree individuals were planted or regenerated allowed and supervised. According to article 15 of the Bahia Forest Decree No. 15.180 / 2014, "Cabruca is understood as the agrosilvicultural system with tree density equal to or greater than 20 (twenty) individuals of native species per hectare, which is based on cultivation in association with trees of native or exotic species in a discontinuous and random manner in the Atlantic Forest Biome" (Sambuichi, 2002; Van-Belle, Lobão and Herrera, 2003; Lobão et al., 2012). The concept of pasture-*cabruca* presented by Lobão, Lobão and Setenta (2002) followed the same previous framework.

The objective of the present work was use the phytosociological analysis as a tool to validate the *cabruca* system arrangement of the silvopasture system implanted in the area of chopped and substituted *cabruca* cacao in Hiawatha Farm, used to the product of cattle and feed service animals (muare).

## Materials and Methods

The study was developed at Fazenda Hiawatha (Figure 1), located in the region of Anuri, Municipality of Arataca-BA. The pasture area used for the study is 2.65 ha.

The scientific taxonomy of the inventoried individuals was made at the Center for the Study of Productive Conservation (NECOPRO), Environmental Resources Sector of the Cacao Research Center (SERAM/CEPEC/CEPLAC), listing the common names of the individuals identified in the field, scientific names of each native species cataloged in the Herbarium André Maurício V. de Carvalho of CEPEC /CEPLAC. The field identification of the tree individuals was done by a field worker and a mate of the Hiawatha farm, supervised by two field technicians, specialists in identification and registration of native species of the Atlantic Forest, provided by SERAM. For the study of diversity, the population descriptors were used for abundance (A), richness (R), density (DA) and dominance (DoA), according to the methodology described by Martini and Prado (2010).

The biometric evaluation (Figure 2) was performed according to a methodology proposed by Finger (1992). The circumference of chest height (CAP) was determined at 1.30 m of soil height and measured directly on the trunk of the trees, using a tape measure.



Figure 2 - Biometric Evaluation.

The diameter (d) chest height (DAP) is calculated by the ratio between the perimeter (C) and the Archimedes coefficient  $\Pi(3.1415)$ , also known by circular constant or Ludolph number, using the equation  $d = C / \Pi$ . In order to obtain the commercial height (hc) and total height (h), the aid of a graduated rod was necessary.

For the validation of the cabruca system in the pastures studied, a review was carried out consulting specialized literature on the system, establishing the framework value of the concept presented by Lobão, Lobão and Setenta (2002) and legitimized by Decree 15,180, published by the Government Palace of the State of Bahia, on June 2, 2014.



Figure 1 - Map for Hiawatha Farm extracted from Google Earth.

## Results and Discussion

In this work, the family Fabaceae was the one with the highest number of genera, a total of 09 (nine), each represented by only one arboreal individual, while Euphorbiaceae was the family with the highest frequency, 25 individuals of the species *Hevea brasiliensis* (Rubber tree). It was possible to observe the presence of species with good quality wood in the use of fine woodworking, with high market value, such as *Tabebuia serratifolia* (pau-d'arco). Among the species listed, *Cariniana legalis* (jequitibá) and *Artocarpus heterophyllus* (jaqueira) stand out. According to Lobão, Lobão and Setenta (2002), jaqueira, despite being an exotic species, is incorporated into the local agrosystem. Because of its versatility as to the environmental function, it must be managed in a way that can externalize its potentiality without allowing it to become dominant.

In the area of the pasture cabruca (Figure 3) studied in Faz. Hiawatha, the total value of DA was 29 ind ha<sup>-1</sup>, respectively, and was therefore considered a low density cabruca, according to Lobão et al. (2012). This result differs from that reported by Lobão (2007)

in Ibirapitanga, Pirai do Norte and Ubatã municipalities, respectively, 148, 132 and 100 ind \* ha<sup>-1</sup> in the area of cacao cabruca, considered high tree density cabrucas. In the studied grass pasture, the value of total DoA was 10 m<sup>2</sup> \* ha<sup>-1</sup>, lower than 16 m<sup>2</sup> \* ha<sup>-1</sup> found by Lobão (2007) in the cabruca system of cacao trees in Santa Luzia, more than 6 m<sup>2</sup> \* ha<sup>-1</sup> of a cabruca from Ilheus.

Observing the variable class of use of the inventoried individuals, it is noted that 10 individuals are representing the class BS (B - white wood; S - sawmill) and one individual is representing the class IC (Immune to Cut). When it comes to wood intended for carpentry, there were six individuals, one white (BR) and five noble (NR). Of the 76 individuals, 36 are of exotic origin and 40 of native origin. As for the use, among the inventoried species, we can highlight *Tabebuia* sp., *Andira anthelmia*, *Plathymenia foliolosa*, *Artocarpus heterophyllus* and *Simira* sp., Because they are species with noble wood of high commercial value and fine woodworking.

The validation of the cabruca pasture system in the study area was performed on a legal and technical basis (Lobão et al., 2002; Lobão et al. 2009), promoting consensuality regarding the validity of the Cabruca

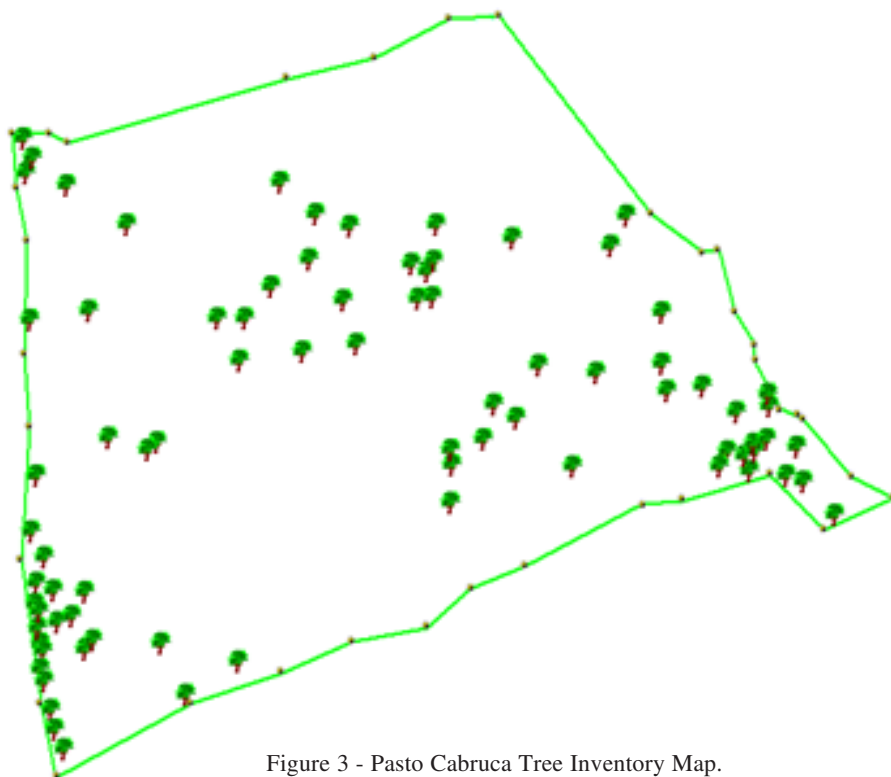


Figure 3 - Pasto Cabruca Tree Inventory Map.

pasture system, in relation to population characteristics of spatial diversity and distribution, as well as its environmental function, ensuring the in loco presence of key examples of the Atlantic Forest, as prescribed and established by the Bahia Forest Decree No. 15180/2014 and by INEMA / BA Ordinance No. 10255/2015, which govern the minimum criteria for understanding what a cabruca is and for technical management plan. Otherwise, we have to test this methodology in others studies to validate it as a trustworthy protocol for validation the cabruca system on the scope of silvopasture systems arrangements in the future.

## Conclusions

Besides to validate this methodology as definitive way to validate the cabruca systems from psilvopastures arrangements, we need to test it exhaustively in others studies, the present study allows us to consider that this Cabruca silvopasture system specifically: a) presents forest structure (richness, frequency, density, dominance and volumetry) similar to that of cacao cabruca; b) serves as a model for tropical farming systems analogous to the cabruca cacao system, providing a more assertive environmental relationship; c) can be classified as a reference model of Cabruca System for pasture agroecosystem; d) it presents advantages when compared to the conventional system (traditional pasture) of production, since it has a greater vegetal diversity, it promotes more comfort and animal well-being, it favors greater rate of cycling of nutrients in the system; provides added value to the final product; e) can and should have the same “legal discipline” proposed for cocoa nut in the Bahia Forest Decree of 15.180/2014 and INEMA/BA Ordinance No. 10.225/2015.

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