Supporting riverside açaí production: field data from Breves DAT for remote sensing applications

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Abstract

The municipality of Breves, located in the Marajó Archipelago - Pará State, is a strategic area for açaí production in the Brazilian Amazon. However, the characterization of its productive environments using remote sensing still represents a significant methodological challenge, due to the scarcity of field data, logistical difficulties and high cloud cover. This paper presents the collection of georeferenced data carried out by the Embrapa Digital Agriculture team during a field campaign in October 2024, using the AgroTag application. The results highlight the importance of using high-resolution data and advanced techniques for mapping land use in the Amazon. This study provides valuable reference data for future classification models and reinforces the importance of integrating remote sensing and fieldwork in data-poor regions.

Keywords: High-resolution data, Euterpe oleracea, Agrotag, Amazon.

1. Introduction

The municipality of Breves, located in the “marajoara” region of the state of Pará, is part of the Science Center for Development in Digital Agriculture (Semear Digital) project, run by Embrapa and FAPESP, as one of the Agrotechnological Districts (DATs). Inserted in the Amazon biome, the municipality has an extensive alluvial plain, associated with the water dynamics of the Parauaú River, which acts as the main watercourse in the region and favors the presence of hydromorphic soils, which, despite their natural

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limitations related to water saturation, offer potential for production systems adapted to these conditions, such as the cultivation of native species of economic interest - such as açaí (Bayma et al., 2024). The Marajó archipelago, especially the Breves region in Pará, represents one of the most important ecosystems for açaí production in the Brazilian Amazon. Proper characterization of these productive environments is fundamental for public policies, sustainable management and regional socio-economic development. However, obtaining primary data in these locations is one of the biggest methodological challenges facing remote sensing researchers.

Field sampling represents the main bottleneck for remote sensing studies. As Lin et al. (2022) point out, although essential for use and cover classifications, collecting field data properly is a major challenge. Ideally, this data should be obtained through surveys that collect targeted, first-hand information (Lin et al., 2022), but such efforts are often hampered by the substantial cost of time and availability for lengthy fieldwork. In addition, the lack of samples for training and validation makes Deep Learning (DL) modeling unfeasible and significantly impairs the performance of Machine Learning (ML) models due to the problem of unbalanced learning (Parreiras et al., 2025). In the Breves region, this challenge takes on even more significant proportions, as access to the natural occurrence and cultivation areas of açaí requires considerable logistical resources, including specialized river transport and teams prepared for long periods in the field. In addition, the phenological characterization of the açaí tree and its seasonal variations require periodic visits, intensifying the demand for human and financial resources.

Remote sensing has emerged as a potentially transformative tool in this context, offering the possibility of extrapolating specific data to wider areas. However, its application in the Amazon region faces the persistent obstacle of cloud cover. The high rainfall characteristic of the biome results in almost constant cloud cover, significantly reducing the availability of usable orbital images. This high cloud cover also compromises the radiometric quality of partially affected images, introducing noise and uncertainty into spectral analyses, compromising the quality of mapping and mainly affecting minority classes (Salgado et al., 2019) or those outside the sampling concentration areas (Kuchler et al., 2022). The challenge becomes even more complex when we consider that certain phenological phases of the açaizeiro coincide with periods of higher rainfall, precisely when obtaining good quality images becomes more problematic. In this context, the main objective of this work is to describe the process of collecting points and information

carried out by the Embrapa team at the Breves DAT in October 2024. The data are important inputs for future work involving remote sensing in the region, such as estimating productive areas and biomass or classifications of the main crops.

2. Methods

The points were acquired in October 2024 by the Embrapa Digital Agriculture team on a visit to the municipality of Breves, from 29/10/2024 to 31/10/2024. For the acquisition, the AgroTag application was used, a tool developed by Embrapa Digital Agriculture and the ABC Platform that allows the georeferenced recording of information in the field, with functionalities aimed at collecting agricultural and environmental data in a practical and standardized way (Plataforma [...], 2025). The application makes it possible to fill in personalized forms, insert photos and GPS locations, making it easier to monitor specific areas and crops. After collection, the data was exported and processed in QGIS software, version 3.32.2-Lima, where the spatial visualization of the points was carried out, as well as the organization and initial analysis of the information collected.

3. Results and Discussion

In all, there were 139 açaí points (Figure 1) collected along the Parauhaú River, the main river passing through the region and widely used by the population for commerce and leisure (Carmo et al., 2013).

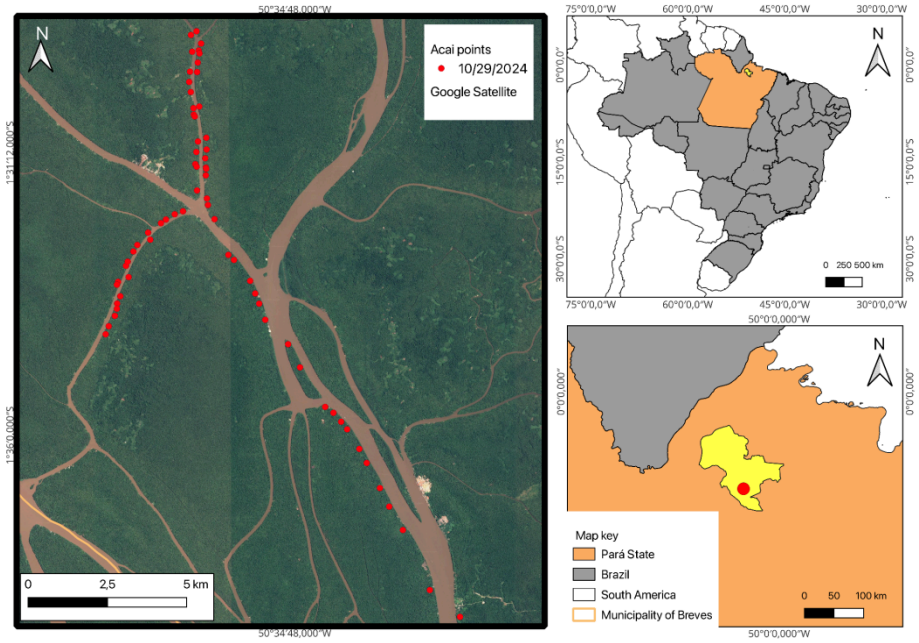


Figure 1. Distribution of açaí points recorded on October 19, 2024, along riverine areas in the municipality of Breves, Pará State, Brazil.
The map shows a Google Satellite imagery with the georeferenced açaí points; the location of Pará State within Brazil; and the geographic position of the municipality of Breves in Pará.

As well as collecting the points, the team captured images of some of them (Figure 2). These show the strong presence of native açaí trees in the floodplain landscape, directly associated with the riverside houses. The houses, built on the banks of the Parauaú river, are surrounded by dense clusters of açaí trees, which shows the integration between land use and açaí extraction, which is fundamental to local subsistence.

Thus, in the context of remote sensing, it is essential to understand the criteria used to recognize a particular target in images, generally based on attributes such as tone/colour, texture, shape, size, pattern, shadow and association with other landscape elements (Anderson et al., 1976). In the specific case of açaí, these criteria through visual interpretation of the points collected were: the tone/color varies from dark green to medium green, depending on the vigor of the vegetation; the texture is medium to fine, being less rough than that of dense forest; the shape can be punctual, representing isolated trees, or form irregular patches in cultivated areas; the size is considered medium, with trees reaching between 15 and 25 m in height; the distribution pattern is

semi-organized in plantations (lines or clusters) and dispersed in natural floodplain areas; the shade cast by the crowns is moderate and can be observed in high-resolution images; and finally, the spatial association generally occurs in regions close to bodies of water, floodplains and floodplain soils.

Figure 2. Examples of açaí trees in Breves (PA).
Photos: Édson Luis Bolfe

Recognizing açaí in satellite images represents a significant challenge, especially in places like the Breves DAT, where production occurs mostly on a small scale and in a dispersed manner, without formal traceability. This fragmented characteristic of the production chain makes it difficult to identify plantations, which are often confused with native vegetation or other forms of perennial cultivation. The image below (Figure 3) shows a comparison between the Google Satellite view, with a spatial resolution of 0.5 m, and the panchromatic image from the CBERS-4A satellite, with a resolution of 2 m. In addition, imagery captured by the research team using a DJI Phantom drone — with a spatial resolution of approximately 5 cm — further emphasizes the limitations of both Google Satellite and CBERS-4A data. This difference in resolution illustrates how medium-resolution sensors may not be enough to capture the details needed to distinguish açaí areas, requiring advanced techniques and images of extremely high spatial resolution.

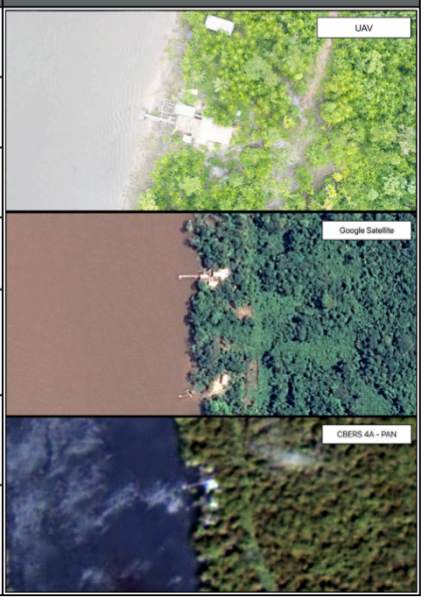
Element	Characteristic for Açaí	Figures
Tone/Color	Dark green to medium, depending on vigor	
Texture	Medium to fine (not as rough as dense forest)	
Shape	Point features (isolated trees) or irregular patches when cultivated	
Size	Medium (trees about 15–25 meters tall)	
Pattern	In plantations: semi-organized pattern (lines or clusters); in natural areas: scattered in floodplains	
Shadow	Trees cast moderate shadows, visible in high-resolution images	
Association	Close to water bodies, floodplain areas, or waterlogged soils	

Figure 3. Table of criteria and comparison between Google Satellite and CBERS 4A images.
Source: Adapted from Google Earth (2025) and Instituto Nacional De Pesquisas Espaciais (2024).

4. Conclusion

The collection of points carried out in Breves (PA) represents an essential step towards strengthening remote sensing studies aimed at characterizing açaí production in Amazonian wetlands. Despite the technical and logistical challenges faced, the data obtained provides important input for future studies, contributing to the development of more accurate and sustainable technological solutions for agri-environmental monitoring in the region.

Acknowledgements

The authors would like to thank Fapesp (Proc. 2022/09319-9; 2025/01750-0, 2024/13150-5) for the funding.

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