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ASSESSMENT OF THE STRUTURE OF FOREST IN BURITICUPU URBAN HOMEGARDENS, ON THE AMAZON REGION OF MARANHÃO, NORTHEASTERN BRAZIL

AVALIAÇÃO DA ESTRUTURA DA ARBORIZAÇÃO EM QUINTAIS URBANOS DE BURITICUPU, NA REGIÃO AMAZÔNICA DO MARANHÃO, NORDESTE DO BRASIL

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ABSTRACT

Homegardens play a vital role in urban ecosystems, impacting climate regulation, soil conservation, and biodiversity. Investigating these microecosystems is crucial for better understanding their role in biodiversity conservation. This study assessed the diversity and structure of urban homegardens in Buriticupu, a city in the Amazon biome, Maranhão, Brazil. Information on tree species in the homegardens, including taxonomy (richness, abundance, diversity, and equitability), ecological aspects (use and origin), and structural characteristics (size and crown area), was collected. The sampling of 51 homegardens yielded 476 trees from 26 botanical families and 62 species. Cocos nucifera, Mangifera indica, and Carica papaya were the most common species. Edible species predominated, and exotic species represented 63.07% of the recorded species. Homegarden size was positively correlated with species richness, diversity, and abundance. The variations in composition and species richness between the homegardens are likely linked to terrain size and property owner planting preferences. Urban homegardens in Buriticupu, particularly native species used for food, were found to contribute significantly to tree biodiversity conservation. However, the prevalence of exotic species raises concerns about their potential impacts on natural Brazilian ecosystems. These findings emphasize the importance of managing urban homegardens to balance biodiversity conservation and exotic species introduction.

Keywords: Urban planning; Green areas; Floristic structure; Urban Forest.

RESUMO

Quintais urbanos desempenham um papel crucial nos ecossistemas urbanos, influenciando fatores como regulação climática, conservação do solo e biodiversidade. Este estudo investigou a diversidade e estrutura dos quintais urbanos em Buriticupu, cidade da região amazônica do Maranhão, Brasil. Foram coletadas informações sobre as árvores nos quintais, considerando aspectos taxonômicos (riqueza, abundância, diversidade e equitabilidade), ecológicos (uso e origem) e características estruturais (tamanho e CAP). Em 51 jardins foram registrados 476 indivíduos pertencentes a 26 famílias e 62 espécies. Cocos nucifera, Mangifera indica e Carica papaya foram as mais frequentes. Espécies exóticas representaram 63,07% do total. Espécies frutíferas foram predominantes. Observou-se uma correlação positiva entre o tamanho dos quintais e a riqueza, diversidade e abundância. As variações observadas na composição e riqueza de espécies entre os quintais podem estar relacionadas ao tamanho do terreno e/ou preferências de plantio dos proprietários. Os quintais urbanos em Buriticupu desempenham um papel importante na conservação da biodiversidade arbórea, especialmente das espécies nativas usadas para alimentação. No entanto, a predominância de espécies exóticas suscita preocupações sobre seu impacto nos ecossistemas naturais brasileiros. Isso enfatiza a necessidade de uma gestão adequada dos quintais urbanos para equilibrar a conservação da biodiversidade com a introdução de espécies exóticas.

Palavras-chave: Planejamento urbano; Áreas verdes; Estrutura florística.

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INTRODUCTION

Urbanization causes several environmental problems, including adverse changes in the microclimate and landscape, which affect the quality of life and health of the population (CAJAIBA; SILVA, 2017). In addition, urbanization is a major threat to biodiversity and is responsible for species extinctions and biotic homogenization (ELMQVIST et al., 2013). In this context, urban forest has emerged as a strategy to minimize such problems, providing benefits such as improving the microclimate, mitigating atmospheric pollution (ARAÚJO et al., 2020) and improving the aesthetic of the urban environment (SIVEIRO et al., 2014). Urban forest also plays an ecological role, as it contributes to regional biodiversity conservation, providing shelter and food for animal species (CAJAIBA; SILVA, 2017).

In cities, homegardens are natural spaces containing elements such as gardens, vegetable gardens, and domestic creations, which represent an exchange of genetic material that associates the diversity contained in natural ecosystems with the traditions of local human populations (LOBATO et al., 2017). Homegardens also contribute directly to climate control, soil protection, and the conservation of local and regional biodiversity of plants, animals, and microorganisms (KUMAR, 2011). Studying these urban spaces have fundamental importance since it produces important information about the role of these in preserving biodiversity, contributing to the planning of conservation actions (AKINNIFESI et al., 2010).

Research involving the biodiversity of urban areas has intensified in recent years and highlights the importance of identifying places that maintain the richness of vegetation and animals in these areas, such as parks, arboretums, and flower gardens (EICHEMBERG et al., 2009). The species found in homegardens are vital for the urban population and are commonly used for food, decoration, construction, and medicinal uses (SEMEDO; BARBOSA, 2007). Despite their importance, homegardens have become increasingly rare in most large metropolises, but they continue to be, for some residents, the closest link with nature (TOURINHO; SILVA, 2016). The intensification of plant biodiversity conservation in urban centers is necessary since there has been a progressive increase in the urban population over the years (EICHEMBERG et al., 2009; TOURINHO; SILVA., 2016)

In this sense, the objective of the present study was to carry out a qualitative and quantitative survey of homegarden forest in the city of Buriticupu, a city located in the Amazon region of the state of Maranhão. The main goal was to analyze the composition of tree species in homegardens, to determine their origin (native or exotic), to identify their respective uses by the population, and to verify the possible spatial variation between the homegardens. From these data, it will be possible to establish the pattern of afforestation in these microecosystems and understand its importance for urban centers.

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MATERIALS AND METHODS

The study was carried out in the urban area of the city of Buriticupu, located in the Amazon region of Maranhão state, under the coordinates 4°20'34 "S 46°24'6''W, approximately 430 km from the capital São Luís (Figure 1). This region has a warm and humid climate with two well-defined seasons, a rainy season from December to June and a dry season from July to November. This region of the Amazon becomes susceptible to fires during periods of extreme drought due to the low rainfall and high temperatures induced by the anomalous heating of the sea surface (SILVA-JUNIOR et al., 2019). According to the Instituto Brasileiro de Geografia e Estatistica (IBGE), the primary economic activities in the region include vegetable extractive production, livestock farming, and fruit. The population of Buriticupu in 2022 was 55,507 people, with a demographic density of 21.81 inhabitants/km^2 (IBGE, 2022). The city covers a total area of 2,544.857 km^2, with 13.90 km^2 dedicated to urban areas.

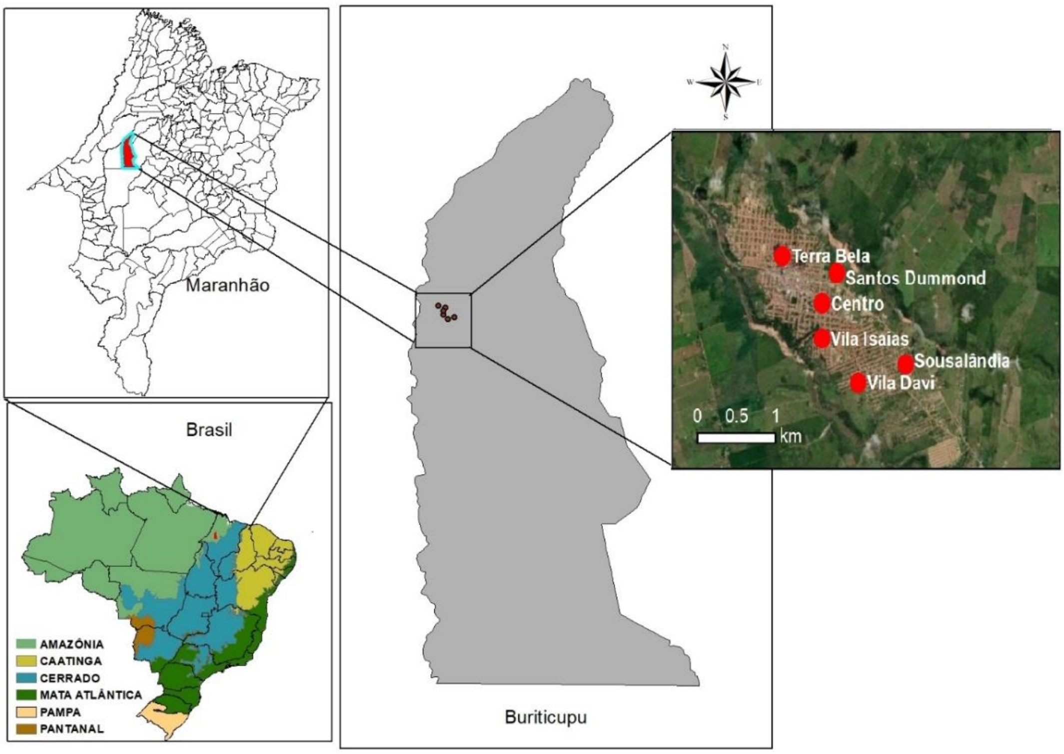

Figure 1. Sampling areas in the central region of Buriticupu city, Maranhão state, Brazil. The lower left corner shows the biome delimitation of Brazil according to IBGE (2010).
Figura 1. Áreas amostrais na região central do município de Buriticupu, Maranhão, Brasil. O canto inferior esquerdo mostra a delimitação do bioma do Brasil segundo IBGE (2010).

Data collection

The data were collected in five areas (named Centro, Vila Isaias, Terra Bela, Santos Dumont, Sousalândia and Vila Davi) of the central region of Buriticupu. These regions represent most of the city's urban area and are characterized by a high population density. The areas were chosen to ensure a random and robust spatial representation of the urban portion of the city.

Semistructured interviews were conducted with homegarden owners to gather information regarding the vernacular names of trees, as well as their respective uses and functions.

The tree individuals in each homegarden were analyzed considering the following aspects:

a) Taxonomic parameters: Individuals were identified to the lowest taxonomic level using the scientific nomenclature proposed by APG IV (Angiosperm Phylogeny Group IV). The spelling, synonymization, origin, and phytogeographic distribution of the species were verified using the Flora do Brasil (floradobrasil.jbrj.gov.br) and W3 Tropicos (Tropicos.org) databases. The local popular name of each identified species was also referenced.
b) Ecological parameters: The species were verified for their phytogeographic origin. For this purpose, the following categories were considered: i) exotic species (occurring in ecosystems other than those found in the Brazilian territory) and ii) native species (originating from biomes in Brazil).
c) Use for population: Medicinal (MED); Shading (SHA), Fruit (FRU), Shading/Fruit (SHA/FRU), Ornamental (ORN).
d) Structural parameters: a) Total height (m): Distance from the ground surface to the leaves at the apex of the highest branch. The classification of tree vegetation height followed the method adapted from Santos and Teixeira (2001), namely, i) seedling: < 1 m; ii) small size: > 1-3 m; iii) medium size: > 3-6 m; and iv) high: > 6 m. b) Circumference: measured at 50 cm above the ground so that individuals at different stages of development (from seedlings to adults) were included in the sampling.

All arboreal individuals found in visited homegardens were included in the data collection, and palm species were also categorized as trees for the purposes of this study.

Data analysis

Initially, the relative frequencies of individual tree species were computed. According to Schneider and Finger (2000), the frequency indicates how the individuals of a given species are distributed across the sampled area, which is estimated by the following formula: FR = (ni/N) × 100, where FR = relative frequency; ni = number of individuals of species i; and N = total number of individuals. The relative frequency was also calculated for families in relation to the entire city. Rarefaction curves were used to assess whether the sampling effort was sufficient to monitor all the species in urban homegardens in the city. To analyze species diversity, all the individuals in the homegardens were counted, and the Shannon–Wiener index (H´) and Pielou index (J') of equitability were calculated. The relationships between homegarden size and richness, abundance, diversity, and equitability were assessed using Pearson correlation.

To analyze the variability among homegardens, they were categorized into three distinct groups: large (>100 m^2), medium (100 m^2 to 200 m^2), and small (<200 m^2). To assess dissimilarities in tree species composition among the homegardens, a multivariate analysis using PERMANOVA with 999 permutations was employed. This analysis was conducted utilizing a Bray-Curtis distance matrix generated from the previously transformed abundance data using the Hellinger method. Variability in diversity indices (richness, abundance, diversity, and equitability) and structural parameters (CAP) was examined through ANOVA. The significance threshold for

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the statistical tests was set at 5% (α=0.05). All the statistical analyses were performed with R version 4.2.1.

RESULTS AND DISCUSSION

In general, the urban homegardens of Buriticupu presented relatively high diversity, with 62 tree species distributed in 26 botanical families, which were recorded within an abundance of 476 individuals in a total of 51 urban homegardens (Table 1). Nevertheless, the asymptotic species accumulation curve indicated that the sampling effort (51 homegardens) was not sufficient to observe most of the species (Figure 2), suggesting that the diversity of tree species in homegardens of the city could surpass the levels documented here. The species richness found in the present study is consistent with the results found in other works in Brazil. Semedo and Barbosa (2007), analyzing urban homegardens in Boa Vista (Roraima state), found only 42 species of edible trees. Akinnifesi et al. (2010), in turn, found 63 home garden species from São Luís city, northeastern Brazil. Although the sampling effort was not sufficient to reach the asymptote (Figure 2), not representing the total diversity of tree, we believe that the data collected here are adequate for revealing the patterns of the forest structure of homegardens, main goal of the present study, since it represents a great part of the tree diversity registered in other studies in the same city (e.g. SOUSA et al., 2019)

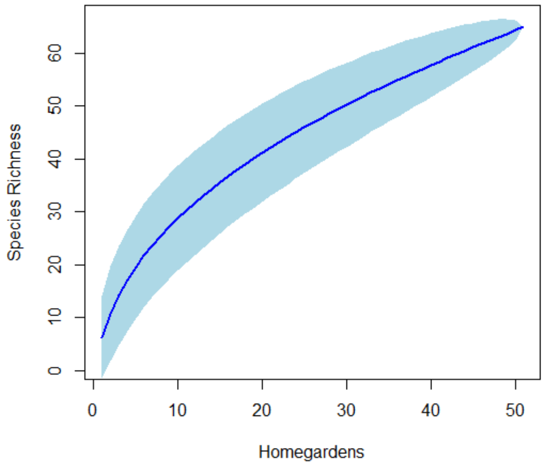

Figure 2. Accumulation curve of tree species in homegardens in Buriticupu, Maranhão, Brazil (center line). The outer lines indicate 95% confidence intervals.
Figura 2. Curva de acumulação de espécies de árvores em quintais de Buriticupu, Maranhão, Brasil (linha central). As linhas externas indicam intervalos de confiança de 95%.

Sousa et al. (2019), evaluating the urban forest of public streets in Buriticupu, reported the presence of 33 species distributed among 544 individuals. The greater tree diversity recorded in urban homegardens compared to that recorded in the forested areas of public streets shows how homegardens are important units within the urban landscape and are relevant areas for biodiversity conservation, even though their origin comes only from the population’s taste for nature and from the utilitarian character of the vegetation. Trees in homegardens also function as habitats for other components of biodiversity, such as birds (nest sites), ants and other invertebrates (AKINNIFESI et al., 2010). In addition, urban homegardens function as a means of

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exchanging genetic material that associates the diversity contained in natural ecosystems with the traditions of local populations (LOBATO et al., 2017).

Tabela 1. Lista de espécies com suas respectivas famílias, nomes populares, origem fitogeográfica, número de indivíduos (N) e frequência de ocorrência (FR%) em quintais de Buriticupu, Maranhão, Brasil. NaBr: espécies nativas originárias de formações vegetais presentes no Brasil. Espécies exóticas; ExBr: espécies exóticas, que ocorrem em biomas diferentes daqueles encontrados no território brasileiro. Uso para população: Medicinal (MED), Sombra (SHA), Frutos (FRU), Sombra/Frutos (SHA/FRU), Ornamental (ORN)

Table 1. List of species with their respective families, popular names, phytogeographic origins, numbers of individuals (N) and frequencies of occurrence (FR%) in homegardens of Buriticupu, Maranhão, Brazil. NaBr: native species originating from biomes occurring in Brazil. Exotic species; ExBr: exotic species that occur in ecosystems different from those found in the Brazilian territory. Use for population: Medicinal (MED); Shading (SHA), Fruit (FRU), Shading/Fruit (SHA/FRU), Ornamental (ORN).

Family/Scientific name	Popular name Portuguese/English	Origin	Uses	N	FR (%)
Anarcadiaceae					
Anacardium occidentale L.	Cajuzeiro/cashew	NaBr	SHA/FRU	17	3.41
Mangifera indica L.	Mangueira/mango	ExBr	SHA/FRU	6	13.45
Spondias mombin L.	Cajá	NaBr	FRU	1	0.20
Annonaceae					
Annona cherimola Mill.	Berimbau/cherimola	ExBr	FRU	2	0.40
Annona muricata L.	Graviola	ExBr	FRU	3	0.60
Annona squamosa L.	Ata	ExBr	FRU	35	7.02
Morinda citrifolia L	Noni/Indian	ExBr	MED/ORN	2	0.40
Apocynaceae					
Plumeria pudica Jacq.	Jasmim do Caribe/	ExBr	ORN/FRU	5	1.00
Plumeria rubra L.	Jasmim-manga/nosegay	ExBr	ORN	1	0.20
Arecaceae					
Cocos nucifera L.	Coqueiro/coconut	ExBr	FRU/ORN/ MED	76	15.25
Euterpe oleracea Mart.	Açaí/assai palm	NaBr	FRU/MED	11	2.20
Bignoniaceae					
Crescentia cujete L.	Cujuba/calabash	ExBr	FRU	1	0.20
Handroanthus albus (Cham.) Mattos	Ipê	NaBr	zFRU	5	1.00
Handroanthus chrysotrichus (Mart. ex DC.)Mattos	Ipê	NaBr	SHA	1	0.20
Handroanthus heptaphyllus (Vell.) Mattos	Ipê-rosa	NaBr	ORN	1	0.20
Jatropha gossypiifolia L.	Ipê	NaBr	FRU/ORN	2	0.40
Bixaceae					
Bixa orellana L.	Urucum/lipstick-tree	NaBr	FRU	3	0.60
Caricaceae					
Carica papaya L.	Mamão de corda/papaya	ExBr	FRU	57	11.44
Chrysobalanaceae					
Licania tomentosa (Benth)	Oiti	NaBr	SHA	1	0.20
Combretaceae					
Terminalia catappa L.	Amêndoa/Indian almond	ExBr	SHA	1	0.20
Euphorbiaceae					
Codiaeum variegatum (L.) Rumph. ex A.Juss.	Croton/garden-croton	ExBr	FRU	1	0.20
Euphorbia tirucalli L.	Cachorro pelado	ExBr	FRU	1	0.20
Jatropha curcas L.	Pião branco/Barbados nut/	ExBr	FRU	3	0.60
Jatropha gossypiifolia L.	Pião roxo/Barbados nut	ExBr	FRU	3	0.60
Fabaceae					
Acacia saligna (Labill.) Hl Wendl	Acácia	NaBr	FRU	1	0.20
Adenanthera pavonina L.	Pau-brasil-falso/Red Bean Tree	ExBr	FRU	1	0.20
Bauhinia forficata Link	Pata de vaca	NaBr	SHA	1	0.20
Paubrasilia echinata (Lam.) Gagnon,H.C.Lima & G.P.Lewis	Pau-brasil/Brazilwood	NaBr	SHA	1	0.20
Cassia grandis L.f.	Cássia-rosa	NaBr	FRU	1	0.20
Inga edulis Mart.	Ingá	NaBr	FRU	1	0.20
Libidibia ferrea (Mart. ex Tul.) L.P.Queiroz	Jucá	NaBr	FRU	2	0.40
Tamarindus indica L.	Tamarindo/Tamarind	ExBr	FRU	4	0.81
Lauraceae					
Persea americana Mill.	Abacateiro/Avocado	ExBr	FRU	13	2.61
Lythraceae					
Lagerstroemia indica Pers	Resedá/crape-myrtle	ExBr	FRU	1	0.20
Malpighiaceae					

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Byrsonima crassifolia	Murici	NaBr	FRU	1	0.20
Malpighia glabra L.	Acerola/Barbados cherry	ExBr	FRU	15	3.01
Malvaceae					
Gossypium hirsutum L.	Algodão/cotton	ExBr	SHA	2	0.40
Hibiscus rosa-sinensis L.	Hibisco/Chinese hibiscus	ExBr	ORN/MED	1	0.20
Theobroma cacao L.	Cacau/cocoa	NaBr	FRU	1	0.20
Theobroma grandiflorum (Willd. ex Spreng.) K.Schum.	Cupuaçu	NaBr	FRU	10	2.01
Meliaceae					
Azadirachta indica A.Juss.	Nim indiano	ExBr	ORN	32	6.42
Moraceae					
Artocarpus heterophyllus Lam.	Jaqueira/jackfruit	ExBr	FRU	5	1.00
Ficus thonningii Blume	Pé-de-angola	ExBr	FRU	1	0.20
Morus nigra L.	Amoreira/mulberry	ExBr	FRU	3	0.60
Moringaceae					
Moringa oleifera Lam.	Moringa	ExBr	SHA	3	0.40
Myrtaceae					
Eugenia involucrata DC.	Cerejeira/cherry tree	NaBr	FRU	1	0.20
Psidium guajava L.	Goiabeira/guava	NaBr	FRU	30	6.02
Syzygium cumini (L.) Skeels	Azeitona jamelão	ExBr	FRU	1	0.20
Syzygium jambolanum (Lam.) DC.	Azeitona jambolão	ExBr	FRU	4	0.81
Syzygium jambos (L.) Alston	Jambo	ExBr	FRU	23	4.61
Oxalidaceae					
Averrhoa bilimbi L.	Limãozinho/bilimbi	ExBr	FRU/SHA	6	1.20
Averrhoa carambola L.	Carambola/star fruit	ExBr	FRU	2	0.40
Piperaceae					
Piper aduncum L.	Pimenta-de-macaco	NaBr	FRU	1	0.20
Punicaceae					
Punica granatum L.	Romã/Pomegranate	ExBr	FRU	2	0.40
Rubiaceae					
Morinda citrifolia L.	Noni	ExBr	FRU	4	0.81
Rutaceae					
Citrus aurantifolia (Christm.) Swingle	Laranja-da-terra/orange tree	ExBr	ORN	1	0.20
Citrus limon (L.) Osbeck	Limoeiro/lemon tree	ExBr	FRU	4	0.81
Citrus sinensis (L.) Osbeck	Laranjeira/orange tree	ExBr	FRU	9	1.81
Murraya exotica L.	Jasmim laranja	ExBr	FRU	9	1.81
Urticaceae					
Cecropia sp	Embaúba	NaBr	SHA	1	0.20

The families with the highest frequency were Arecaceae (2 species and 87 individuals), Anarcadiaceae (3 species and 85 individuals), and Myrtaceae (5 species, 59 individuals) (Figure 3). The family with the greatest richness was Fabaceae, with 8 species. The most frequent species were *Cocos nucifera* (coconut tree) (15.25%), *Mangifera indica* (mango tree) (13.45%), and *Carica papaya* (rope papaya) (11.44%). These results are similar to those found by Medeiros et al. (2015) for urban homegardens in the municipalities of Paraíba (northeastern Brazil), where coconut (*Cocos nucifera*), acerola (*Malpighia glabra*), guava (*Psidium guajava*) and mango (*Mangifera indica*) were the most frequent species. Previous studies have demonstrated the predominance of *Cocos nucifera* and *Mangifera indica* in urban homegardens and in urban green areas in general (LOBATO et al., 2021). The predominance of this species could be explained by the interest in its fruits, mainly for consumption of coconut water and mango, in addition to being a species with commercial value.

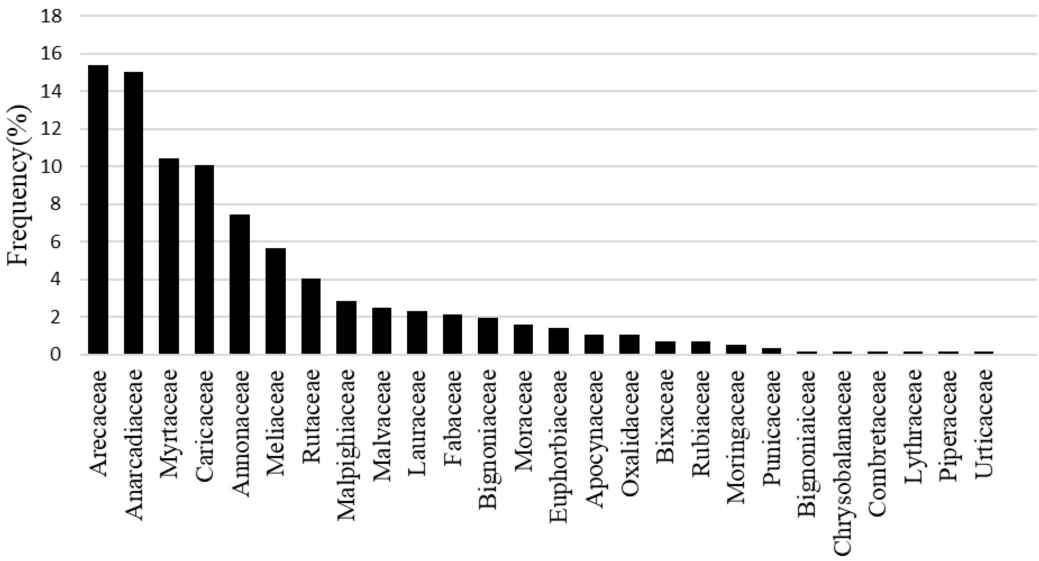

Figure 3. Frequency of occurrence of botanical families in urban homegardens in the city of Buriticupu, Maranhão, Brazil
Figura 3. Frequência de ocorrência de famílias botânicas em quintais urbanos na cidade de Buriticupu, Maranhão, Brasil

Most species were classified as exotic (62.30%). Exotic species were also the majority in terms of the absolute number of individuals, with a total of 381, compared with 95 for native species. These results differ from the pattern found by Akinnifesi et al. (2010), who studied urban home gardens in São Luis, Maranhão, and found more native species (54.5%). Notably, these authors evaluated other plant species in addition to trees. Albuquerque et al. (2005), in turn, found an equal number of native and nonnative species (27 each). These authors also reported that the absolute number of individuals of nonnative species was greater than that of individuals of native species, a result similar to that found in the present study. Sousa et al. (2019) reported a slightly greater number of exotic species (17) than native species (16) in streets in the municipality of Buriticupu. Exotic plants, such as those used for global food supply, landscape restoration, biological pest control, the availability of sports, and the provision of pets, are introduced into Brazilian ecosystems to benefit society (STUMPF et al., 2015). The most commonly introduced plants are ornamental, which are attractive because of their flowers, leaves, fruits, stems, aroma, texture, and a set of aesthetic attributes that stand out for exhibiting a variety of shapes, sizes, and colors and for being adapted to different climate conditions and landscapes (HEIDEN et al., 2006). However, when exotic plants replace the native vegetation of the environment or invade the remaining native vegetation, they negatively affect biodiversity (MAGALHÃES; SILVA-FORSBERG, 2016). According to Alencar et al. (2014), the use of exotic plants in urban forest is a worrying situation due to the lack of knowledge of their adaptation potential, competition with native species, and potential for toxicity to local fauna.

We found positive relationships between homegarden size and richness ($p \leq 0.001$, $r = 0.54$), abundance ($p<0.001$, $r = 0.57$), and diversity ($p<0.001$, $r=0.203$). This directly proportional relationship between the size and richness of homegardens has already been observed elsewhere in Brazil by Siviero et al. (2011). However, some studies indicate that the available

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area does not necessarily indicate greater plant richness in urban homegardens (ALBUQUERQUE et al., 2005; EICHEMBERG et al., 2009). Other factors, such as the owner's availability of time and their relationship with the plants, the age of the homegardens, and socioeconomic factors, influence the richness of trees in these spaces (EICHEMBERG et al. 2009). There was no correlation between homegarden size and equitability (p=0.06, r=0.28).

PERMANOVA revealed significant differences in species composition among homegardens categorized by size (p=0.110, F=1.21). *Azadirachta indica* and *Carica papaya* were more common in smaller home gardens than in larger home gardens. The larger homegardens exhibited the presence of rarer species (only a single individual) (Figure 4).

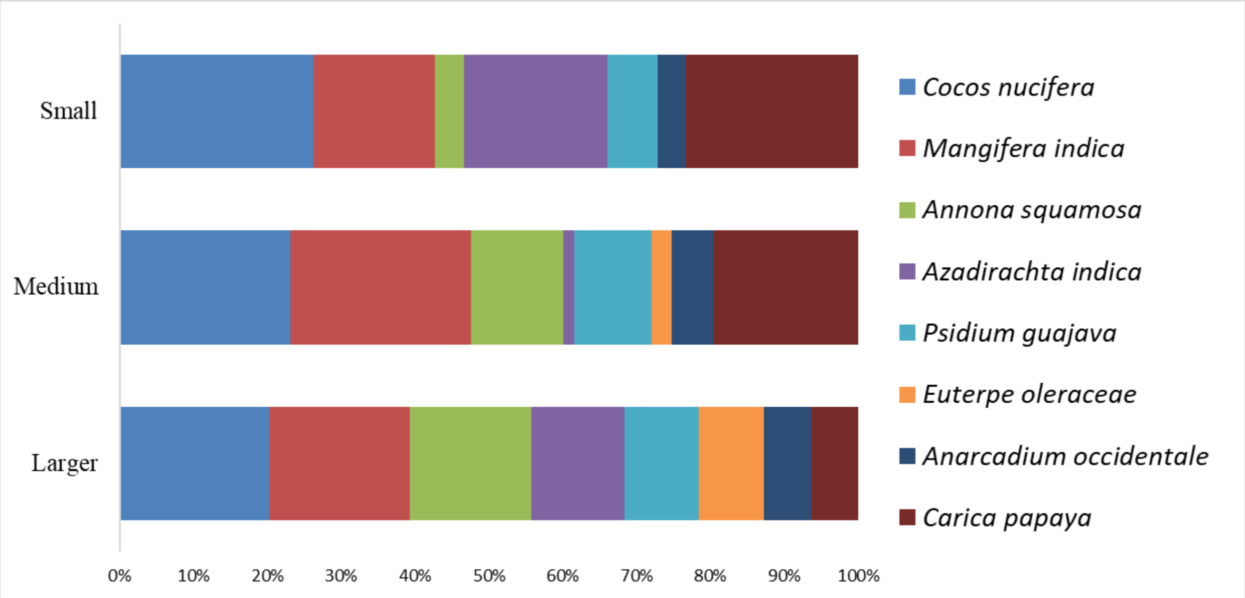

Figure 4. Predominant species representation (as a percentage of individuals) in the homegardens, categorized by size (small, medium and large), in Buriticupu, Maranhão, Brazil.
Figura 4. Espécies predominante (como percentual de indivíduos) nos quintais, categorizada por tamanho (pequeno, médio e grande), em Buriticupu, Maranhão, Brasil.

ANOVA revealed significant differences among the homegardens categorized by size in terms of richness (F=15.4, p<0.001), abundance (F=18.83, p<0.001), and diversity (F=15.71, p<0.001). Larger homegardens exhibited greater numbers of species and individuals and greater diversity (Figure 5). No variation was observed concerning equitability (F=4.60, p=0.56). As highlighted by Eichemberg et al. (2009), variations in the size of homegardens and individual characteristics among their owners may account for the observed heterogeneities in these spaces.

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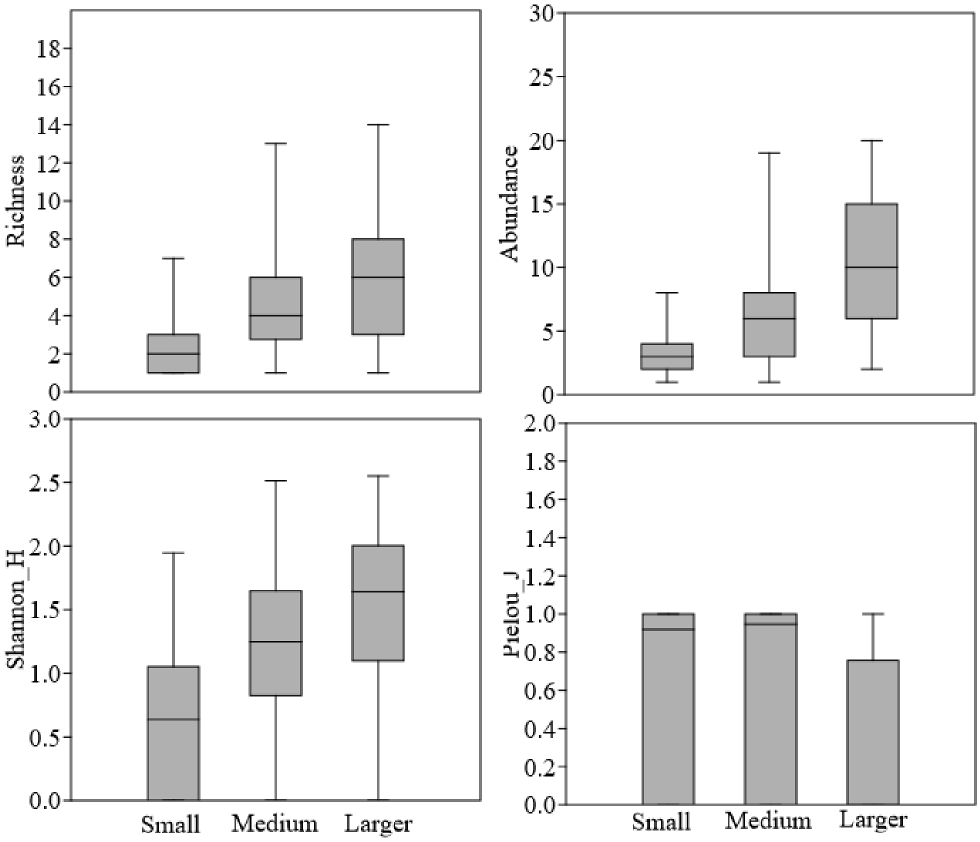

Figure 5. Variation in richness (number of species), abundance (number of individuals), diversity index (Shannon), and equitability (Pielou) of tree species within urban homegardens, categorized by size (small, medium and large), in the central area of Buriticupu, Maranhão, Brazil.

Figura 5. Variação na riqueza (número de espécies), abundância (número de indivíduos), Índice de Diversidade (Shannon) e equitabilidade (Pielou) de espécies de árvores em quintais urbanos, categorizados por tamanho (pequeno, médio e grande), na área central de Buriticupu, Maranhão, Brasil.

The accessibility of certain plants, whether easily obtained or cultivated, plays a crucial role in shaping the fundamental composition of these homegardens (EICHEMBERG et al 2009). Amorozo (2002) described the proximity of homegardens to urban centers as another factor that influences the choice of plant species found in those centers, verifying a change in the basic purpose of homegardens, which pass from a stock of plants used in food to plants intended mainly to improve the aesthetic aspects of the residences and well-being of the owners. The homegarden composition of trees can also be influenced by many factors, such as socioeconomic factors, spatial factors (e.g., soil variation), the age of the homegardens, management strategies, and the degree of urbanization (KUMAR; NAIR, 2004).

In most of the assessed homegardens, for all sizes, the botanical species are used to produce food (fruits) and shade (Figure 6), in media, 73% of the trees are used to produce fruits, and 19% are used for shanding. In urban homegardens, each tree species is planted and managed mainly in terms of what it provides to the human population. Among the categories of plants listed in this study, the use of food, that is, edible trees, stands out in all regions of the city. Other studies carried out in different regions of Brazil have reported the predominance of fruit trees in urban homegardens (SEMEDO; BARBOSA, 2007; SILVA et al., 2019). Lobato et al.

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(2017) also found a high percentage of edible trees in urban homegardens in other cities of the Amazon region, with *Euterpe oleracea*, *Mangifera indica* and *Cocos nucifera* being the most representative. In the present study, the most prominent fruit trees were *Cocos nucifera* (coconut tree) and *Mangifera indica* (mango tree). However, the prevalence of fruit species differed from that reported by Eichemberg et al. (2009) in Rio Claro, Southeast Brazil, where ornamental species were predominant. As indicated by Nair (1993), the aesthetic function of homegardens in urban areas is linked to urban forest, particularly as those spaces are not primarily utilized for subsistence, except within low-income communities.

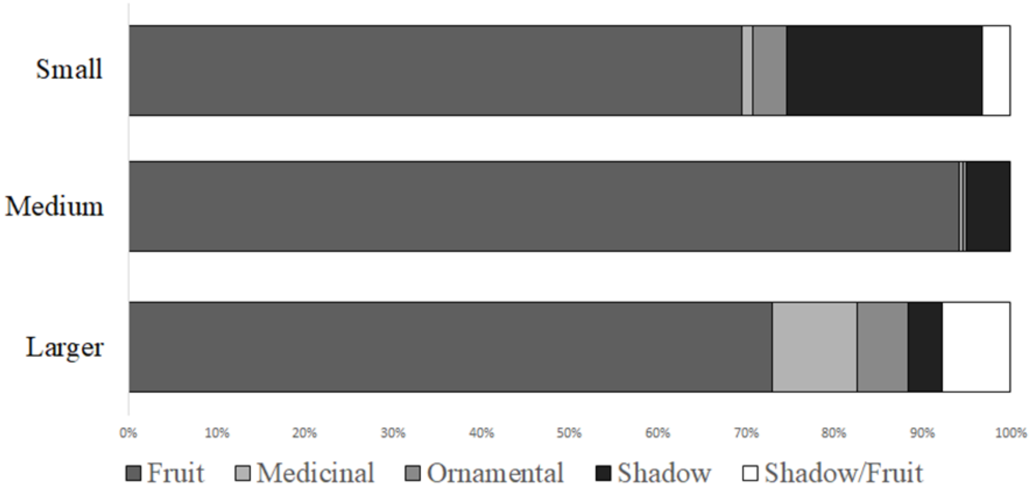

Figure 5. Proportion of use classes of tree individuals of homegardens in five regions in Buriticupu, Maranhão, Brazil.
Figura 5. Proporção em classes de uso de indivíduos arbóreos em quintais de cinco regiões de Buriticupu, Maranhão, Brasil.

The circumference (cm) of the trees in the homegardens varied from 0.35 to 190 cm (average of 48.20 cm). ANOVA indicated no significant differences in relation to the CAP of the arboreal individuals between the homegardens, categorized by size (F=0.1587, p=0.8533) (Figure S2). Regarding the size of the trees, in general, there was a predominance of individuals classified as medium-sized (50.44%), followed by small-sized (28.65%) and tall individuals (19.86%) (Figure S3). This predominance of medium-sized trees, which are still considered young, suggests that tree planting in most urban yards in Buriticupu is relatively recent. According to Tourinho and Silva (2016), Brazilian urban yards underwent transformations in the early 20th century.

The increasing urbanization led to higher urban land prices and rents, contributing to the reduction, and sometimes the complete elimination, of large yards in larger cities. These authors also highlighted that for some property owners, homegardens became superfluous spaces that were difficult to maintain and better for other more ‘modern' purposes, such as garages, swimming pools, and barbecue areas. Those new uses discourage the planting of trees, as they have become aesthetically impractical. However, for other residents, yards continue to play a significant role, at least in terms of climate moderation and as spaces for relaxation, thermal comfort, tradition, culture, and family interaction.

CONCLUSION

The urban centers are growing without adequate planning suppressing vegetation and without considering the risks to the functioning of the ecosystem and biodiversity. In this context homegardens can contribute to the sustainable use of natural resources and reduce pressure on native vegetation. The results of this study demonstrate that urban homegardens in Buriticupu are crucial for preserving tree biodiversity in the city. These homegardens serve as shelters for some native plant species and are primarily utilized by the population for food. However, the prevalence of exotic species is a matter of concern due to the unknown impact of these species on Brazilian natural ecosystems. Therefore, the need for urban planning that encourages the cultivation of native plants is urgent for the recovery and maintenance of the natural characteristics of the Amazon biome in which the municipality is located.

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