Caderno de Ciências Agrárias
Agrarian Sciences Journal

CADERNO DE CIÊNCIAS AGRÁRIAS
Agrarian Sciences Journal

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Analysis of the adequacy of landscape composition to the semi-arid of squares in Montes Claros

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DOI: https://doi.org/10.35699/2447-6218.2022.40530

Abstract

Public green areas such as squares, especially in semi-arid regions, should be planned with the choice of more resistant species that require less labor and water for irrigation. This study is aimed at analyzing the suitability of three public squares of Montes Claros to local climatic conditions and the potential for the introduction of sustainable gardens in this municipality. Three squares of Montes Claros, Southeastern Brazil, whose biome is the Cerrado, were evaluated in terms of the total number of individuals (trees, palms, shrubs, vines, and herbaceous plants) and analyzed according to the literature regarding their classification in relation to origin (exotic or native), drought tolerance, and the benefits they bring to fauna. Among the squares studied, it was observed that Duque de Caxias was the one with the highest percentage of drought-tolerant plants and that bring benefits to the fauna proportionally to the total number of plants. This square was also the one with the highest percentage of native plants (25.93%), however this value is still low for the edaphoclimatic conditions of the region, which, due to the scarcity of water, requires a greater number of drought-tolerant native plants. It is concluded that the studied squares have many exotic plants that are demanding in maintenance and therefore there is a need for their gradual replacement in sustainable landscaping projects, especially with the use of a greater number of native species suitable for semi-arid conditions.

Keywords: Afforestation. Gardens. Native plants. Sustainability.Urban environment.

Análise de adequação da composição paisagística ao semiárido de praças em Montes Claros

Resumo

Áreas verdes públicas como praças, principalmente em regiões semiáridas devem ser planejadas com a escolha de espécies mais resistentes e que exijam menos mão de obra e água para irrigação. O objetivo desse trabalho foi analisar a adequação de três praças públicas de Montes Claros às condições climáticas locais e o potencial para a inserção de jardins sustentáveis nesse município. Três praças de Montes Claros, Sudeste do Brasil, cujo bioma é o Cerrado, foram avaliadas quanto ao número total de indivíduos (árvores, palmeiras, arbustos, trepadeiras e plantas herbáceas) e analisadas de acordo com a literatura quanto a sua classificação em relação à origem (exótica ou nativa), tolerância à seca e aos benefícios que trazem à fauna. Dentre as praças estudadas, observou-se que a Duque de Caxias foi a que apresentou maior porcentagem de plantas tolerantes à seca e que trazem benefícios à fauna proporcionalmente ao

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Recebido para publicação em 29 de julho 2022. Aceito para publicação em 07 de setembro de 2022
e-ISSN: 2447-6218 / ISSN: 2447-6218.

número total de plantas. Essa praça também foi a que apresentou maior porcentagem de plantas nativas (25,93%), entretanto esse valor ainda é baixo para as condições edafoclimáticas da região, que devido à escassez de água, requer maior número de plantas nativas tolerantes à seca. Conclui-se que as praças estudadas apresentam grande número de plantas exóticas e exigentes em manutenção e por isso há necessidade da substituição gradual das mesmas em projetos paisagísticos sustentáveis, principalmente com o uso de maior número de espécies nativas adequadas às condições semi-áridas.

Palavras-chave: Arborização. Jardins. Nativas. Sustentabilidade. Ambiente urbano.

Introduction

Green areas are an important factor in people's quality of life, as it provides well-being for residents, restores mental fatigue, reduces stress, and causes positive changes in mood and self-esteem. They reduce the harmful effects of over-urbanization and heat islands, promote people's contact with nature, offer leisure to the population and favors social interaction among those who frequent the environment, especially the elderly (Amato-Lourenço et al., 2016; Boldrin et al., 2016; Martelli, 2016; Person et al., 2019). It also contributes to urban drainage actions, improving the microclimate, reducing the daylight, and providing shelter and food to avifauna (Sabadini, 2017; Alves et al., 2018; Jin et al., 2021).

One of the main structures that comprise the green areas are the squares, as a result, municipalities must be provided with careful and detailed plans for the implementation and maintenance of this green areas. Thus, it is important that studies be conducted of their characterization and distribution in space, so that urban planning can be performed efficiently (Bento et al., 2018). The garden designs must be well-planned thought and implemented considering the local characteristics and population, the infrastructure and the species that will make up, with their different sizes, textures, shapes, and colors (Paiva et al., 2008). In addition to the aesthetic issue, it is necessary to study the plant's role in the urban ecosystem, its interactions and benefits, and prioritize species adapted to the region, especially native plants.

As the technological advance and the exploitation of natural resources cause the degradation of formerly balanced bio systems, society is led to live with unsustainable environments and threatened ecosystems (Paula et al., 2017). To counterbalance this problem, sustainable development arises, combining in a harmonious way the progress of cities and environmental conservation (Bento et al., 2018). Thus, the optimization of water use constitutes one of the main factors to be taken into consideration.

Due to the current water crisis, it is becoming urgent that irrigation projects and other forms of water use be structured and tailored to the climatic conditions of each region, such as the implementation of carefully planned green areas to reduce the impacts to the environment and the population. As a result, studies focused on landscape projects using species adapted to drought and that allow the constitution of an environment with freshness and increase of biodiversity are of great importance. From this perspective, this study is aimed at analyzing the suitability of three public squares of Montes Claros to local climatic conditions and the potential for the introduction of sustainable gardens in this municipality.

Material and Methods

The methodology of the study was exploratory and descriptive, and the research was carried out in Montes Claros, Minas Gerais (latitude 16º40'59.7''S, longitude 43º50'21.9'' W, altitude 680 m). According to the Köppen climate classification (Alvares et al., 2013) it is an area with a dry tropical climate; with annual precipitation between 1000-1300 mm, with dry winter and average temperature of 23.1 ºC. Montes Claros is located in the Cerrado which is the second largest Brazilian biome, constituting the richest tropical savanna in the world (Brasil/MMA, 2020). The soils in the Cerrado areas are characterized mainly by having high acidity and nutrient deficiency, with the most common soils being oxisols, present in 46% of the area (Ribeiro and Walter, 1998).

Three squares of the city of Montes Claros: Duque de Caxias Square, Flamarion Wanderley Square, and Rotary Square were chosen for evaluation because of their importance to the population. The squares were evaluated regarding the identification of species present, counting all individuals of ornamental plants that composed the landscape (tree, palm, shrub, climber plants and herbaceous species) and identifying pests and diseases observed in the species. The Microsoft Excel 2013 software was used to calculate the analyses of abundance and absolute frequency of species (Felfili et al., 2011), calculate the percentage of species native to the Cerrado (Flora do Brasil, 2020; Reflora, 2020) and attractive to fauna, as well as the classification of drought-tolerant species following the description of the literature (Lorenzi, 2002; Lorenzi et al., 2003; Lorenzi, 2008; Lorenzi et al., 2010). The quantity and physical state of structural elements in each square were also observed.

Through descriptive statistics it was possible to evaluate the occurrence of species in percentage and determine the benefits and possible damage that may arise with the distribution and quantity of species introduced in the environment, maintenance conditions of the squares and their potential for the incorporation of sustainable gardens in the municipality.

Results and Discussion

Duque de Caxias Square

The Duque de Caxias Square has an approximate area of 3,457 mZ, is paved with straight paths (Figure 1 and 2) and a total of 54 individuals distributed among 14 botanical families, composing a total of 22 species. Among these, the one with the highest frequency is the amendoeira which corresponds to 14.81% of the total species, followed by hibisco, flamboyant and palmeira real, each comprising 11.11%. The table 1 lists all the species found in Duque de Caxias Square with their abundance, absolute frequency, and tolerance to drought. The plants that are highly tolerant to drought represent 63.63% of the total number of species found in this square. Ideally, most species planted should have this feature, for the built environment to be sustainable and maintain its beauty over time, with reduced maintenance needs.

Figure 1 – Duque de Caxias Square map, Montes Claros, MG, Brazil (Google Earth, 2021).

Figure 2 – Partial view of Duque de Caxias Square in the rainy season on the left and in the dry season on the right. Images: Luana Rocha

The Duque de Caxias Square houses fruit species such as araçá, pitangueira and romãzeira trees (Table 1) that are attractive to fauna, benefiting them with their fruits and the microclimate of the green space. Additionally, these fruit species do not represent any danger, because their fruits are small and light, and when fall, they do not make the ground slippery. These species are ideal in landscaping projects for promoting a pleasant urban environment, bringing the pleasant presence of birds, and increasing biological diversity (Lourenço and Biagolini, 2018). However, the fruit species must be carefully chosen to avoid the attraction of insects that can cause inconvenience to passersby, such as wasps, and should be established in specific locations so that accidents do not occur, such as fruit falling in undesirable places (CEMIG, 2011). In this case, the square has examples of mangueira and goiabeira, which are not recommended for urban afforestation.

On the landscaping characterization it was found the use of deciduous species that reduce shading in certain periods of the year, which is unfavorable for the climatic conditions of northern Minas such as amendoeira, paineira, flamboyant, aroeira-do-sertão and tamboril (Santin and Leitão Filho, 1991; Lorenzi, 2002; Thomson and Evans, 2006; Khongkaew et al., 2021). Although the trees do not cause any cracks in the sidewalks, some of them have exposed roots in the flowerbeds, which represents risks for passersby. It was observed that in areas of great movement species with succulent flowers, such as paineira, were used, which may cause accidents by making the floor slippery for the people who use the space.

Table 1 – Species found in Duque de Caxias Square, with their abundances (AB), corresponding absolute frequencies (AF) and tolerance to drought

Survey of all species in Duque de Caxias Square					
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**	**Drought Tolerance**
Hibisco	Hibiscus rosa-sinensis	Malvaceae	6	11.11%	Low
Goiabeira	Psidium guajava	Myrtaceae	2	3.70%	Average
Romanzeira	Punica granatum	Lythraceae	1	1.85%	Average
Assa peixe	Vernonia polyanthes	Asteraceae	1	1.85%	Average
Pitangueira	Eugenia uniflora	Myrtaceae	1	1.85%	Average
Flamboyant-de--jardim	Caesalpinia pulcherrima	Fabaceae	2	3.70%	High
Amendoeira	Terminalia catappa	Combretaceae	8	14.81%	High
Paineira	Ceiba speciosa	Malvaceae	4	7.41%	High
Flamboyant	Delonix regia	Fabaceae	6	11.11%	High
Oiti	Licania tomentosa	Chrysobalanaceae	4	7.41%	High
Tamboril	Enterolobium contortisiliquum	Leguminosae	1	1.85%	Low
Mangueira	Mangifera indica	Anacardiaceae	1	1.85%	Average
Aroeira-do-sertão	Myracrodruon urundeuva	Anacardiaceae	1	1.85%	High
Mutamba	Guazuma ulmifolia Lam.	Malvaceae	1	1.85%	High
Araçá	Psidium cattleianum	Myrtaceae	2	3.70%	High
Algaroba	Prosopis juliflora	Malvaceae	1	1.85%	High
Iuca	Yucca guatemalensis	Agavaceae	1	1.85%	High
Sanquésia	Sanchezia oblonga	Acanthaceae	1	1.85%	High
Macaúba	Acrocomia aculeata	Arecaceae	2	3.70%	High
Palmeira real	Roystonea oleracea	Arecaceae	6	11.11%	High
Grama-batatais	Paspalum notatum	Poaceae	1	1.85%	High
Grama-esmeralda	Zoysia japonica	Poaceae	1	1.85%	Low
22 species		13 families	54	100%	

Nine species native to the Cerrado were found, spread over seven families. There is a variation in absolute density with a maximum of 4 units for the paineira species with a frequency of 28.57% and a minimum absolute density of 1 unit for the other 6 species, which comprise a frequency of 7.14% (Table 2). Contrary to these results, Guilherme et al. (2018), identified that Cerrado trees prevailed in the afforestation of four cities in Mato Grosso do Sul and emphasize the importance of choosing native species not only for the ecosystem, but also to preserve the region's identity.

When counting the absolute density of native species found in the area and the absolute density of all species found in the square, we found a percentage of only 25.93% of native species, which may be one of the reasons for the incidence of insects and diseases and the greater need for water of some plants. Native species are naturally more resistant to the attack of predatory insects, more adapted to the local climate, and consequently less prone to disease. The valuation of native flora over other species brings the benefit of having a richer and healthier environment with low maintenance (Zanuncio Junior et al., 2018).

Table 2 – Native Cerrado species found at Duque de Caxias Square with their abundance (AB) and respective absolute frequencies (AF)

Survey of native species at Duque de Caxias Square				
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**
Paineira	Ceiba speciosa	Malvaceae	4	28.57%
Tamboril	Enterolobium contortisiliquum	Leguminosae	1	7.14%
Aroeira-do-sertão	Myracrodruon urundeuva	Anacardiaceae	1	7.14%
Mutamba	Guazuma ulmifolia Lam.	Malvaceae	1	7.14%
Araçá	Psidium cattleianum	Myrtaceae	2	14.29%
Pitangueira	Eugenia uniflora	Myrtaceae	1	7.14%
Grama-batatais	Paspalum notatum	Poaceae	1	7.14%
Assa peixe	Vernonia polyanthes	Asteraceae	1	7.14%
Macaúba	Acrocomia aculeata	Arecaceae	2	14.29%
9 species		7 families	14	100%

The structural elements found in Duque de Caxias Square were gym equipment's (outdoor gym), an access ramp for the disabled, benches and two lamp posts (Table 3).

Table 3 – Structural elements of Duque de Caxias Square with its quantity and state of conservation

Survey of structural elements at Duque de Caxias Square		
Structural element	**Quantity**	**Physical state**
Benches	13	Good condition
Sculptures	1	Good condition
Lamp post	2	Good condition
Gym equipment's	1	Good condition
Accessibility ramps	1	Good condition

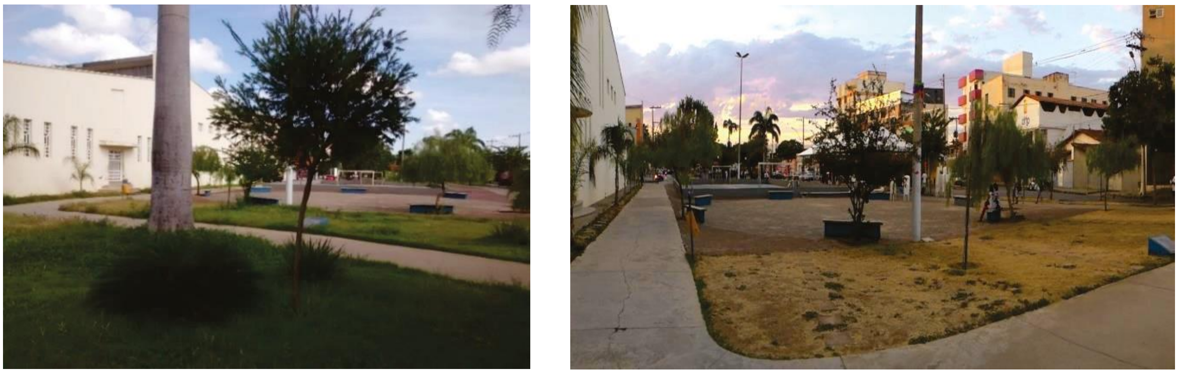
Flamarion Wanderley Square

Flamarion Wanderley Square has an area of approximately 10,881 mZ is paved with straight paths (Figure 3 and 4) and a total of 112 individuals distributed among 18 botanical families that make up a total of 27 species. Among these species, the one with the highest frequency is sibipiruna, which corresponds to 26.79% of the total observed, followed by resedá gigante and palmeira areca, comprising 14.29% and 11.61% respectively. Table 4 lists all the species found in this square with their abundance, absolute frequency, and drought tolerance.

Flamarion Wanderley Square is very rich in species of different colors and textures. The flowers with shades of red, pink, lilac and yellow make a beautiful contrast with the different shades of green, adding balance to the landscape composition. Diversity promotes a variety of colors throughout the year due to different species flowering times (Toledo et al., 2021). The different shapes of the leaves and height of the trees create a sensation of movement in the environment (Paiva et al., 2008), calling for contemplation. The only species which provides quality shade throughout the day is the mangueira, but the other species do not have this property, a consequence of the lack of landscape planning for this purpose. The deciduous species such as plátano and ipê were used, which lose their leaves at a certain time of the year, further reducing the shaded area.

Figure 3 – Flamarion Wanderley map, Montes Claros, MG, Brazil (Google Earth, 2021).

Figure 4 – Partial view of Flamarion Wanderley Square in the rainy season on the left and in the dry season on the right. Images: Luana Rocha



The species that are highly tolerant to drought and, consequently, ideal for the Montes Claros climate, comprise 46.15% of the total that were observed. These are an important component in sustainable squares and gardens and have great potential to be used in this region. Four species native to the Cerrado were found in the square, distributed among two families. The absolute density varied with maximum of 8 units and frequency of 72.73% for the palmeira jerivá species and a minimum of 1 unit for the other species, with a frequency of 9.09% (Table 5). By computing the absolute density of the native Cerrado species found in the area and the absolute density of all species present in the square, it was possible to observe a percentage of native species of 9.82%, which is considered insufficient to maintain the balance of the ecosystem.

This square has structural elements such as trash cans, adequate lighting, access ramp for the physically challenged, many benches, two courts, walks for walking, playground, and outdoor gym equipment. The entire structure of the square is very well used by residents of the neighborhood and by people who come from other places because they consider the square a good place for entertainment and sports. Table 6 shows the structural elements present in the square and their quantity and physical state.

Rotary Square

The Rotary Square is home to 27 individuals, distributed in 22 families, totaling 105 species spread over an area of 4,541 mZ, paved with straight paths (Figure 5 and 6). Among the species, the most frequent is the sibipiruna, accounting for 28.57% of the total species, followed by the hibisco with 11.43%. This Square is very rich in ornamental and fruit species and has the potential to house insects and birds of different species. The Table 7 lists all the species found in the Rotary Square with their abundance, absolute frequency, and drought tolerance.

As can be seen in Table 7, the Rotary Square has a great diversity of fruit plants that are attractive to fauna. In its uniqueness, it includes 59.25% of highly tolerant species to drought, such as agave-dragão, espada-de-são-jorge, espadinha and iuca, ideal for the climatic conditions of the region and for the use in sustainable gardens. This Square has a great diversity of species of various sizes, which is adequate from the landscaping point of view. Flowerbeds at different levels create a sensation of movement together with species of different crown heights (Paiva et al., 2008).

Table 4 – Species found in Flamarion Wanderley Square, with their abundance (AB), respective absolute frequencies (AF) and tolerance to drought

Survey of all species at Flamarion Wanderley Square					
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**	**Drought Tolerance**
Celósia	Celosia argentea	Amaranthaceae	1	0.89%	Low
Hibisco	Hibiscus rosa-sinensis	Malvaceae	3	2.68%	Low
Primavera	Bougainvillea spectabilis	Nyctaginaceae	1	0.89%	High
Resedá gigante	Lagerstroemia speciosa	Lythraceae	16	14.29%	Low
Sibipiruna	Poincianella pluviosa	Fabaceae	30	26.79%	High
Ipê-roxo	Handroanthus impetiginosus	Bignoniaceae	1	0.89%	High
Mangueira	Mangifera indica	Anacardiaceae	1	0.89%	Average
Ipê-amarelo-do-cerrado	Handroanthus chrisotrichus	Bignoniaceae	1	0.89%	High
Oiti	Licania tomentosa	Chrysobalanaceae	1	0.89%	High
Escova-de-garrafa	Callistemon imperialis	Myrtaceae	3	2.68%	High
Plátano	Platanus acerifolia	Platanaceae	1	0.89%	Low
Calicarpa	Callicarpa reevesii	Myrtaceae	3	2.68%	Low
Eritrina verde-amarela	Erythrina variegata	Fabaceae	1	0.89%	Low
Aroeira salsa	Schinus molle	Anacardiaceae	6	5.36%	High
Ipê-rosa	Handroanthus sp	Bignoniaceae	2	1.79%	Low
Sanquésia	Sanchezia speciosa	Acanthaceae	4	3.57%	High
Cica	Cycas revoluta	Cycadaceae	3	2.68%	Average
Moreia	Dietes bicolor	Iridaceae	3	2.68%	Average
Cordiline	Cordyline terminalis	Angiospermae	1	0.89%	Low
Iuca	Yucca guatemalensis	Agavaceae	1	0.89%	High
Palmeira areca	Dypsis lutescens	Arecaceae	13	11.61%	Low
Coquinho azedo	Butia capitata	Arecaceae	1	0.89%	High
Palmeira-rabo-de-peixe	Caryota urens	Arecaceae	3	2.68%	Low
Palmeira imperial	Roystonea oleracea	Arecaceae	2	1.79%	High
Palmeira fênix	Phoenix roebelenii	Arecaceae	1	0.89%	Low
Palemira jerivá	Syagrus romanzoffiana	Arecaceae	8	7.14%	High
Grama-esmeralda	Zoysia japonica	Poaceae	1	0.89%	Low
27 species		17 families	112	100%	

Table 5 – Native Cerrado species found at Flamarion Wanderley Square with their abundance (AB) and respective absolute frequency (AF)

Survey of native species at Flamarion Wanderley Square				
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**
Ipê-roxo	Handroanthus impetiginosus	Bignoniaceae	1	9,09%
Ipê-amarelo-do-cerrado	Handroanthus chrisotrichus	Bignoniaceae	1	9,09%
Coquinho azedo	Butia capitata	Arecaceae	1	9,09%
Palmeira jerivá	Syagrus romanzoffiana	Arecaceae	8	72,73%
4 species		2 families	11	100%

Table 6 – Structural elements of Flamarion Wanderley Square with its quantity and conservation state

Survey of structural elements at Flamarion Wanderley Square		
Structural element	**Quantity**	**Physical state**
Benches	23	Good condition
Lamp post	21	8 burnt
Trash can	18	4 crooked trash cans
Public telephone	2	Good condition
Sport courts	2	Some cracks
Gym equipment's	12	Good condition
Kids toys	6	4 out-of-order toys
Monument/nameplate	1	Good condition
Accessibility ramps	17	Few damaged

Rotary Square

Figure 5 – Rotary Square map, Montes Claros, MG, Brasil (Google Earth, 2021).

Figure 6 – Partial view of Rotary Square in the rainy season on the left and in the dry season on the right. Images: Luana Rocha

Table 7 – Species attractive to fauna found in the Rotary Square, Jardim São Luiz, with their abundance (AB), respective absolute frequencies (AF) and tolerance to drought

Survey of all species at Rotary Square					
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**	**Drought Tolerance**
Pitangueira	Eugenia uniflora	Myrtaceae	1	0.95%	Average
Pigo-de-ouro	Duranta erecta	Verbenaceae	3	2.86%	High
Murta	Murraya paniculate	Rutaceae	1	0.95%	Average
Romanzeira	Punica granatum	Lythraceae	1	0.95%	Average
Primavera	Bougainvillea spectabilis	Nyctaginaceae	6	5.71%	High
Aceroleira	Malpighia emarginata	Malpighiaceae	1	0.95%	Average
Pitombeira	Talisia esculenta	Sapindaceae	1	0.95%	High
Hibisco	Hibiscus rosa-sinensis	Malvaceae	12	11.43%	Low
Sibipiruna	Caesalpinia peltophoroides	Leguminosae	30	28.57%	High
Jenipapeiro	Genipa americana	Rubiaceae	3	2.86%	High
Goiabeira	Psidium guajava	Myrtaceae	6	5.71%	Average
Jurubeba	Solanum paniculatum	Solanaceae	1	0.95%	High
Oiti	Licania tomentosa	Chrysobalanaceae	4	3.81%	High
Mutamba	Guazuma ulmifolia	Malvaceae	2	1.90%	High
Mangueira	Mangifera indica	Anacardiaceae	3	2.86%	Average
Aroeira	Myracrodruon urundeuva	Anacardiaceae	2	1.90%	High
Figueira-lacerdinha	Ficus macrocarpa	Moraceae	1	0.95%	Average
Angico branco	Albizia niopoides	Fabaceae	1	0.95%	Low
Resedá gigante	Lagerstroemia speciosa	Lythraceae	1	0.95%	Low
Trapoeraba-roxa	Tradescantia pallida	Commelinaceae	7	6.67%	Low
Flor-do-guarujá	Turnera subulata	Turneraceae	1	0.95%	High
Espada-de-são-jorge	Sansevieria trifasciata	Ruscaceae	7	6.67%	High
Iuca	Yucca guatemalensis	Agavaceae	1	0.95%	High

Continua

Survey of all species at Rotary Square					
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**	**Drought Tolerance**
Espadinha	Sansevieria trifasciata	Ruscaceae	4	3.81%	High
Agave-dragão	Agave attenuata	Agavaceae	3	2.86%	High
Macaúba	Acrocomia aculeata	Arecaceae	1	0.95%	High
Grama-batatais	Paspalum notatum	Poaceae	1	0.95%	High
27 species		21 families	105	100%	

Ten species native to the Cerrado were found in the square, distributed among 10 families. The maximum absolute density was 3 units, with a frequency of 21.43% for jenipapeiro species and a minimum of 1 unit and frequency of 7.14% for the other 7 species. When counting the absolute density of the native Cerrado species found in the area and the absolute density of all species present in the Rotary Square, a percentage of native species of only 13.33% was observed (Table 8).

The square has trash cans, access ramps for the disabled, benches and tables, ping-pong tables, court with bleachers, toys, and poles with adequate lighting. Table 9 shows the structural elements present in the square and their quantity and physical state.

Table 8 – Native Cerrado species found at Rotary Square with their abundance (AB) and respective absolute frequencies (AF)

Survey of native species at the Rotary Square				
Common Name	**Scientific Name**	**Botanical Family**	**AB**	**FA**
Jenipapeiro	Genipa americana	Rubiaceae	3	21,43%
Jurubeba	Solanum paniculatum	Solanaceae	1	7,14%
Mutamba	Guazuma ulmifolia	Sterculiaceae	2	14,29%
Aroeira	Myracrodruon urundeuva	Anacardiaceae	2	14,29%
Angico branco	Albizia niopoides	Fabaceae	1	7,14%
Pitombeira	Talisia esculenta	Sapindaceae	1	7,14%
Pitangueira	Eugenia uniflora	Myrtaceae	1	7,14%
Flor-do-guarujá	Turnera subulata	Turneraceae	1	7,14%
Macaúba	Acrocomia aculeata	Arecaceae	1	7,14%
Grama-batatais	Paspalum notatum	Poaceae	1	7,14%
10 species		10 families	14	100%

In the three squares evaluated, most species are attractive to wildlife, either because of their fruits, flowers or because they provide shelter. In this regard, the guarantee of food supply and shelter for the attracted species promotes greater biological diversity at the site (Lourenço and Biagolini, 2018). The Figure7 compares the frequency of species attractive to fauna in the three squares studied. The highest frequency of fauna-attractive species was found in Duque de Caxias Square, with 81.82% of the total number of species, while Flamarion Wanderley and Rotary Squares had 70.37% and 74.07%, respectively. The Table 10 shows the species attractive to fauna found in the evaluated squares.

The squares evaluated presented few species native to the Cerrado biome, totaling 35 individuals and 22 species of 19 botanical families (tables 2, 6 and 8). In regions with climatic conditions like those found in Montes Claros, it is essential that the preference be for these species that are naturally more adapted and resistant, making the environment more sustainable with reduced irrigation and pest and disease control costs. The Figure 8 compares the quantity of native species of the Cerrado in each of the three squares in relation to their respective total population. Duque de Caxias Square presents 25.93% of native species, the highest percentage found among the three squares studied. Flamarion Wanderley Square presents 9.82%, while Rotary Square has 13.33%

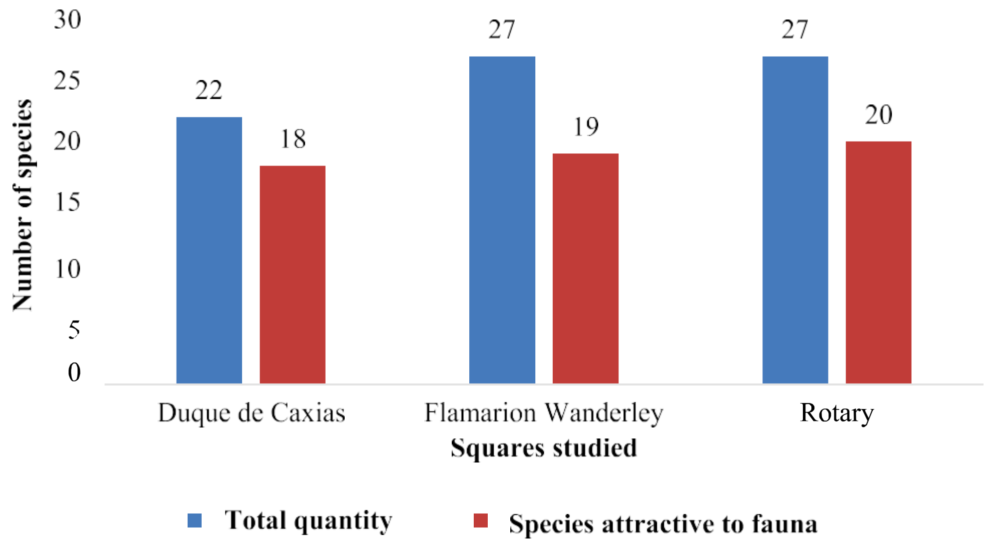
of species from the biome of the Cerrado. It is observed that the choice of plants used in the installation of the squares did not consider important issues such as resistance to pests and diseases, tolerance to drought and adaptation to the soil and climate of the region.

Table 9 – Structural elements of Rotary Square with its quantity and conservation state

Survey of structural elements at Rotary Square		
Structural element	**Quantity**	**Physical state**
Benches	49	Some broken/vandalism
Benches and tables	13	Some broken/vandalism
Ping-pong tables	3	Graffiti/vandalism
Lamp post	4	Good condition
Trash can	3	Good condition
Public telephone	2	Good condition
Sports courts	1	Deteriorated, but in use
Kids toys	2	Damaged, but in use
Monument/nameplate	1	Good condition
Accessibility ramps	4	Deteriorated

Comparative analysis between the three squares

Figure 7 – Comparison of the number of species appealing to fauna in Duque de Caxias, Flamarion Wanderley and Rotary Squares



The following phytophagous arthropods were observed in the evaluated squares: Trigona spinipes (abelha irapuá), Acromyrmex spp. or Atta spp. (formiga cortadeira), Orthezia praelonga (cochonilla ortézia), phytophagous mites and Planococcus citri (cochonilla branca) (Table 11). As for the diseases, an association of fungi of the genus Colletrochichum spp., was observed, causing anthracnose in individual species of primavera and resedá gigante and the presence of fungi of the genus Curvularia sp. causing helminthosporiosis (Silva et al., 2013; Jayawardena et al., 2016). The choice of tree species used in the three squares did not follow the recommendations in terms of the correct quantity and distribution of plants in the environment, with large quantities of a single species being found to the detriment of others that often had only one species (Jesus et al., 2015). The diversity of species brings countless benefits to green areas. The greater use of species attractive to fauna in squares, in addition to increasing biodiversity, can enable the benefit of pest insect control by natural enemies, such as ladybugs for example (Lourenço and Biagolini, 2018; Haan et al., 2019; Redhead et al., 2020).

Resedá-gigante is an exotic species and consequently less adapted to the climate of the region, which may be the answer for the appearance of pathologies. Native plants are more resistant to attack by pests and diseases because they attract specific insects as pollinators, promoting ecosystem balance (Heiden et al., 2006).

Table 10 – Attractive species to fauna in Duque de Caxias, Flamarion Wanderley and Rotary Squares

Common Name	Scientific Name	Botanical Family
Hibisco	Hibiscus rosa-sinensis	Malvaceae
Goiabeira	Psidium guajava	Myrtaceae
Romanzeira	Punica granatum	Lythraceae
Assa peixe	Vernonia polyanthes	Asteraceae
Pitangueira	Eugenia uniflora	Myrtaceae
Flamboyant-de-jardimr	Caesalpinia pulcherrima	Fabaceae
Amendoeira	Terminalia catappa	Combretaceae
Paineira	Ceiba speciosa	Malvaceae
Flamboyant	Delonix regia	Fabaceae
Oiti	Licania tomentosa	Chrysobalanaceae
Tamboril	Enterolobium contortisiliquum	Leguminosae
Mangueira	Mangifera indica	Anacardiaceae
Aroeira-do-sertão	Myracrodruon urundeuva	Anacardiaceae
Mutamba	Guazuma ulmifolia Lam.	Malvaceae
Araçá	Psidium cattleianum	Myrtaceae
Sanquésia	Sanchezia oblonga	Acanthaceae
Macaúba	Acrocomia aculeata	Arecaceae
Palmeira real	Roystonea oleracea	Arecaceae
Celósia	Celosia argentea	Amaranthaceae
Primavera	Bougainvillea spectabilis	Nyctaginaceae
Resedá gigante	Lagerstroemia speciosa	Lythraceae
Sibipiruna	Poincianella pluviosa	Fabaceae
Ipê-roxo	Handroanthus impetiginosus	Bignoniaceae
Ipê-amarelo-do-cerrado	Handroanthus chrisotrichus	Bignoniaceae
Escova-de-garrafa	Callistemon imperialis	Myrtaceae
Calicarpa	Callicarpa reevesii	Myrtaceae
Aroeira salsa	Schinus mole	Anacardiaceae
Ipê-rosa	Handroanthus sp	Bignoniaceae
Sanquésia	Sanchezia speciosa	Acanthaceae
Moreia	Dietes bicolor	Iridaceae
Coquinho azedo	Butia capitata	Arecaceae
Palmeira imperial	Roystonea oleracea	Arecaceae

Continua

Common Name	Scientific Name	Botanical Family
Palmeira fênix	Phoenix roebelenii	Arecaceae
Palmeira jerivá	Syagrus romanzoffiana	Arecaceae
Pingo-de-ouro	Duranta erecta	Verbenaceae
Murta	Murraya paniculate	Rutaceae
Aceroleira	Malpighia emarginata	Malpighiaceae
Pitombeira	Talisia esculenta	Sapindaceae
Jenipapeiro	Genipa americana	Rubiaceae
Jurubeba	Solanum paniculatum	Solanaceae
Figueira-lacerdinha	Ficus macrocarpa	Moraceae
Angico branco	Albizia niopoides	Fabaceae
Flor-do-guarujá	Turnera subulata	Turneraceae
Agave-dragão	Agave attenuata	Agavaceae

The lack of irrigation caused water deficiency symptoms in species such as trapoeraba-roxa, cordiline, and hibisco. It is important to have thorough planning about the ideal species for the climate, soil, and correct location for its implementation, so that expenses with irrigation and maintenance are reduced (Silva et al., 2013) and species do not show water deficiency symptoms. Also, lack of irrigation, caused lawns to become dry in the three squares evaluated. The use of grass species that are not very resistant to the climatic conditions of the region, such as grama esmeralda (Zoysia japonica), may have increased the difficulty of maintaining the evergreen flowerbeds. It is imperative that great attention be paid to the choice of grasses during planning, as these species are one of the most water and maintenance demanding in a garden (Gonçalves et al., 2018).

Figure 8 – Comparison of the number of plants native to the Cerrado between the Duque de Caxias, Flamarion Wanderley and Rotary Squares

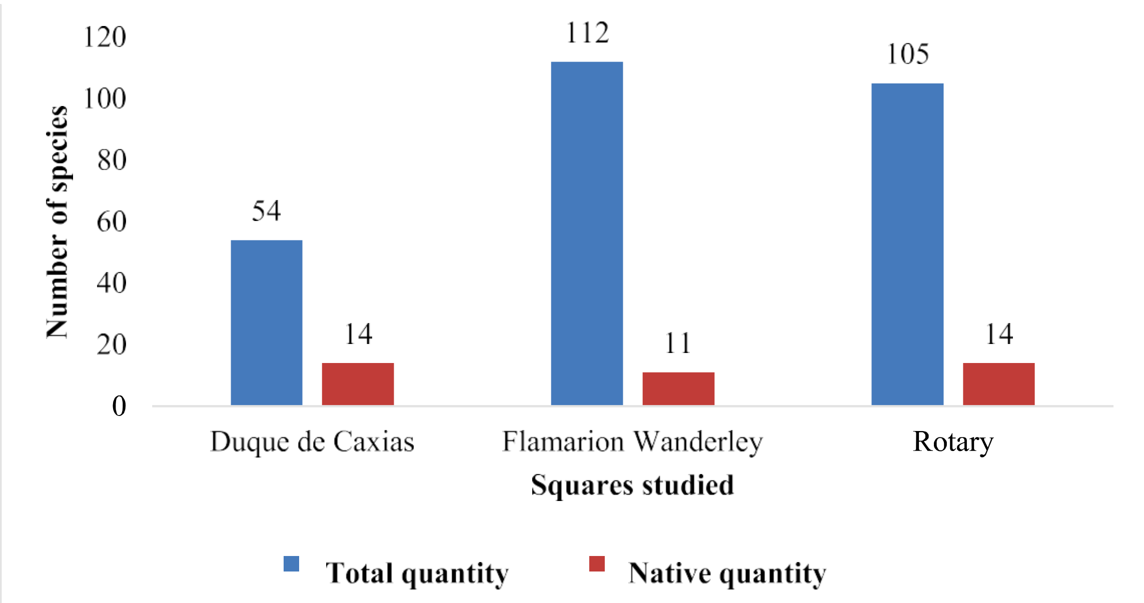


Table 11 – Pests found in Duque de Caxias, Flamarion Wanderley and Rotary Squares

Common Name	Scientific Name	Attacked Species	Symptoms	Square Detected
Abelha irapuá	Trigona spinipes	Callicarpa reevesii	Attack of flowers and young leaves in search of resinous substances that are transported for nest building	Flamarion Wanderley
Formiga cortadeira	Acromyrmex spp ou Atta spp	Hibiscus rosa-sinensis	Cutting leaves in the shape of a crescent or arch, causing defoliation of the plant	
Cochonilha ortézia	Orthezia praelonga	Punica granatum	Continuous suction of the sap with introduction of toxins, reduction of the photosynthetic activity, causing the thinning of the plant	Rotary
Ácaros fitófagos		Erythrina variegate	Deformed, twisted and shriveled leaves and sprouts, with yellowish coloration and whitish spots	
Cochonilha branca	Planococcus citri	Hibiscus rosa-sinensis	Suction of the sap which causes disturbances in the metabolism of the plants leading to withering and premature leaf fall and drying of the plant stems	Duque de Caxias

The implementation of sustainable garden in Montes Claros requires plant diversification associated with the use of native species. This is justified because the use of irrigation water in semi-arid region needs to be minimal. The squares studied have many exotic species and there is a need for their gradual replacement by native species resilient to the dry season that are a valuable option for public gardens.

Conclusions

The squares studied have a considerable number of species that demand a high need for water and maintenance, because they are not adapted to the climatic conditions of the municipality, turning the maintenance into an unfeasible practice. The municipality, in turn, has great potential for the implementation of sustainable landscaping projects for squares that are adapted to the climate and water availability of the region.

The use of native species of the Cerrado is an excellent alternative, since these plants are adapted to the local climate, have low water requirements, and are less susceptible to pathogen attack. As a result, they require less financial and water resources for their maintenance, enabling a viable alternative for the public sector and for the community, which will benefit from surprisingly beautiful and pleasant spaces.

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