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Agrobiodiversity of Homegardens in Maranhão, Brazil

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Authors' contributions

This work was carried out in collaboration between all authors. Authors LLPS, GSS and DLSS made the collections, analysis, identification and preparation of botanical material. Author DLSS performed the statistical analysis. Authors GSG, GMC, RFO and MFVA critically reviewed the manuscript, read and approved the final manuscript.

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ABSTRACT

There is limited information available on the agrobiodiversity of homegardens in Brazil. Thus research was initiated to investigate this aspect in the state of Maranhão (Brazil) during 2016. Twenty five homegardens were visited, with 105 specimens, distributed among 47 genera and 29

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families being catalogued. The families with the most representative species were Rubiaceae, Malvaceae and Lamiaceae, with four species each, followed by the Solanaceae, Euphorbiaceae (three species each), Myrtaceae, Crassulaceae, Anacardiaceae (two species each), other families had one species each. This study further elucidated how much households use these species and found that, 52% are used for food, 35% for medicinal and 13% for ornamental use. It is mostly women who were the primary care takers of the agroforest homegardens, as they had a good working knowledge of cultivation and garden maintenance in general. The survey also revealed that the homegardens had a strong cultural character, thus highlighting their value as an important community resource for the creation and transmission of traditional knowledge, thus serving as a source of information management for the preservation of community identity.

Keywords: Agroecosystems; plant cultives; food safety.

1. INTRODUCTION

The Agrobiodiversity is an integral component of agricultural systems that associate conservation and management with sustainable development, and consists of the diversification of plants, animals and microorganisms used directly or indirectly for food [1]. This definition includes all planned agrobiodiversity and the natural biodiversity of agroecosystems, as well as ecological services, interactions between living beings and way of dealing with the land and technologies of the social groups involved [2].

Domestic homegardens in rural or urban communities are agrobiodiversity reservoirs [3,4]. These garden are also used intentionally for the *in situ* conservation of germplasm of species of commercial interest. The genetic variability maintained in these homegardens, represent a considerable amount of genetic conservation of resources, improving the sustainability of the homegardens in relation to the environment [5]. According to Paiva [6], homegardens encompass a set of plants with arboreal, shrub, climbing and herbaceous species, providing species diversification and varied growth, forming multiple strata that resemble the structure of tropical forests [7].

Theodoro et al. [8], suggest that the use of homegardens and other agroforestry systems as models of family agricultural production associated with conservation are essential for a link between scientific and popular knowledge. Agroforestry homegardens are related to cultural factors, since they can be the result of traditional knowledge passed down by generations [7,9].

In this sense, homegardens constitute links between rural and urban settlements through products, germplasm and resident members [10]. Urban agriculture is an activity of tradition among families, in residences where the destination of the products is predominantly for self-consumption, with little trade [11]. As highlighted by Nair [12], homegardens have long stood out as the basic function of livelihood sustainability, especially in times of economic stress.

In Brazil, there is a considerable amount of floristic studies on homegardens, where the majority presents qualitative data with descriptions of structure, composition, organisation and maintenance of these practices [13-15]. In this sense, the objective of the research was to asses the agrobiodiversity of the homegardens in the municipality of Caxias, Maranhão, Brazil.

2. MATERIALS AND METHODS

The study was conducted during 2016 in homegardens of the Cohab complex (Fig. 1), Nova Caxias neighborhood, municipality of Caxias, in the state of Maranhão (Brazil), at coordinates 04° 52' 10" Latitude South and 43° 20' 26" Western Longitude. The study area is characterised by 58.82% of households residing houses or similar and 41.18% in buildings or residential units [16], with daily access to potable water and electricity. The climate is of the sub-humid to semi-arid type, with annual rainfall between 1,300- and 1,500-mm. The natural Vegetation cover has been to give way to agriculture and subsistence agriculture, and is represented by the contact of the cerrado with the forest, with the predominance of the former (Montes, 1997). The rainfall regimes are divided into two well-defined periods: rainy, centralised in the months of January to April and a drought mainly in the months of June and July. The rainy season usually begins in December and lasts until April or May.

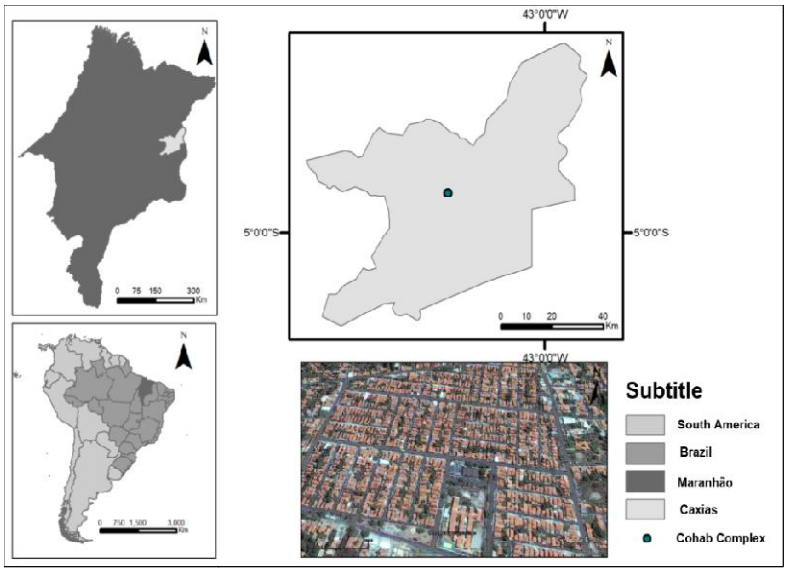

Fig. 1. Map of municipality of Caxias with reference to the Cohab complex, Maranhão/Brazil

Twenty five homegardens were randomly visited with the consent of residents, with the starting point at 01 Avenue. A form was applied in the resident's own residence, with a preference for the leader of the family group, regardless of the gender, when it was not in the place the same was applied to another member of the family group that presented the necessary conditions to answer the questions. Prior to the application of the form, the participant signed the free and informed consent term. Subsequently, the methodological processes consisted of interviews with residents on socio-economic issues as well as about the management techniques used in the homegardens. The answers were analysed via descriptive statistics. The initial botanical identification was carried out in the field, where possible with the help of specialised literature. The plant specimens were photographed in their growing habitat for later identification.

3. RESULTS AND DISCUSSION

I in the 25 homegardens visited, 105 specimens were identified belonging to 44 species, 41 genera and 29 botanical families, being six trees, 10 herbs, 13 shrubs and 16 subshrubs (Table 1). With two or more plant species found on each homegarden, only a botanical variety was found in three homegardens. The plant families with the largest number of species were Lamiaceae, with five species. Rutaceae, Malvaceae and Lamiaceae had four species each, followed by Solanaceae, Euphorbiaceae, with three species each; and Myrtaceae, Crassulaceae, Anacardiaceae, with two species, while the other families presented only one species (Fig. 2). The representativeness of these families is closely related to the various resources that they provide. In relation to the genera, the most representative were *Citrus* (Rutaceae) with four species, followed by *Hibiscus* (Malvaceae) and *Capsicum* (Solanaceae), both with two species each. The other genera were presented one species each.

Lamiaceae with five species were the most cultivated taxa. The importance of the species in this family mainly used to spice and flavor food. The representatives of the Rutaceae family cataloged in the research are of great economic importance, because of the number of *Citrus* species being cultivated, such as lemon, orange, tangerine and lime. These species do not suffer water deficiency during the inflorescence phase [17], a condition that affects other taxa.

Another family that stands out is the Malvaceae, with its representatives having cultural, economic and medicinal importance [18]. Species *Hibiscus* (*H. sabdariffa* and *H. esculentus*) listed in the homegardens are used to prepare typical dishes the region. The cuxá, for example, a Maranhense delicacy is made with vinegar leaves (*H. sabdariffa*); and caruru is typical food prepared with okra (*H. esculentus*). Other species of the family, *Plectranthus amboinicus* (Malva do reino) and *Gossypium arbadense* (cotton) stand out for

their medicinal use. Regarding the percent use of species found in homegardens were ornamentals (13%), medicinal 35%) and mainly food (52%). Carneiro et al. [19], emphasise the importance of homegardens, mainly due to the presence of fruits and vegetables, which allow the population to maintain a food autonomy, causing minimal impacts on the environment, conserving plant resources and cultural richness, based on the knowledge and culture of using natural inputs and promoting the recycling of natural elements.

Table 1. Inventoried plant species in homegardens agroforestry. Cohab complex, Nova Caxias neighborhood, Caxias, Maranhão, Brazil

Family	Scientific name	Popular name	Use	Growth habit
Anacardiaceae	*Mangifera indica* L.	Manga	Food	Tree
	Anacardium occidentale L.	Caju	Food	Tree
Ancanthaceae	*Chenopodium ambrosioides* L.	Matruz	Medicinal	Herb
Anonaceae	*Annonas quamosa* L.	Ata	Food	Shrub
Aracaceae	*Dypsis lutescens* L.	Palmerinha	Ornamental	Tree
Bignoniaceae	*Arrabidaea Chica* Verlot	Pariri	Medicinal	Herb
Bromeliaceae	*Ananas comosus* L.	Abacaxi	Food	Subshrub
Cactaceae	*Euphorbia ingens* L.	Cacto	Ornamental	Subshrub
Canaceae	*Canna indica* L.	Cana da Índia	Medicinal	Subshrub
Caricaceae	*Carica papaya* L.	Mamão	Food	Tree
Convovulaceae	*Ipomoea batatas* L.	Batata	Food	Shrub
	Bryophyllum calycinum Salisb.	Fortuna	Medicinal	Herb
Crassulaceae	*Bryophyllum calycinum* L.	Folha santa	Medicinal	Herb
Cucurbitaceae	*Cucurbita pepo* L.	Abóbora	Food	Subshrub
	Manihotes culenta Crantz.	Mandioca	Food	Subshrub
Euphorbiaceae	*Jatropha gossypiifolia* L.	Pião roxo	Medicinal	Subshrub
	Manihot sp.	Macaxeira	Food	Subshrub
	Rosmarinus officinalis L.	Alecrim	Medicinal	Herb
Laminaceae	*Venonia condensata* Baker	Boldo	Medicinal	Herb
	Ocimum basilicum L.	Alfavaca	Medicinal	Herb
	Lippia alba L.	Erva cidreira	Medicinal	Herb
	Plectranthus amboinicus Andrews	Malva do Reino	Medicinal	Herb
Liliaceae	*Aloe vera* L.	Babosa	Medicinal	Subshrub
Lomariopsidaceae	*Nephrolepis* sp.	Samambaia	Ornamental	Subshrub
Malpighiaceae	*Malpighia glabra* L.	Acerola	Food	Shrub
	Hibiscus sabdariffa L.	Vinagreira	Food	Shrub
	Hibiscus esculentus L.	Quiabo	Food	Shrub
Malvaceae	*Gossypium arbadense* L	Algodão	Medicinal	Shrub
	Morus alba L.	Amora	Food	Subshrub
Moraceae	*Musa paradisíaca* L.	Banana	Food	Subshrub
Musaceae	*Psidium guajava* L.	Goiaba	Food	Tree
Myrtaceae	*Eugenia uniflora* L.	Pitanga	Food	Shrub
	Averrhoa carambola L	Carambola	Food	Tree
Oxalidaceae	*Passiflora edulis* Sims.	Maracujá	Food	Subshrub
Passifloraceae	*Piper aduncum* L.	Pimenta de macaco	Medicinal	Shrub
Piperaceae	*Cymbopogon citratus* (DC) Stapf.	Capim Santo	Medicinal	Herb
Poaceae	*Punica granatum* L.	Romã	Medicinal/ food	Shrub
Punicaceae	*Rosa* sp.	Rosa	Ornamental	Subshrub
Rosaceae	*Citrus limonum* L.	Limão	food / Medicinal	Shrub
	Citrus aurantium L	Laranja	food / Medicinal	Shrub
Rutaceae	*Citrus nobilis* Lour.	Tangerina	Food	Shrub
	Citrus aurantifolia L.	Lima	Food	Shrub
	Lycopersi cumesculentum L.	Tomate	Food	Subshrub
Solanaceae	*Capsicum chinense* Jacq.	Pimenta de Cheiro	Food	Subshrub
	Capsicum frutescens L.	Pimenta malagueta	Food	Subshrub

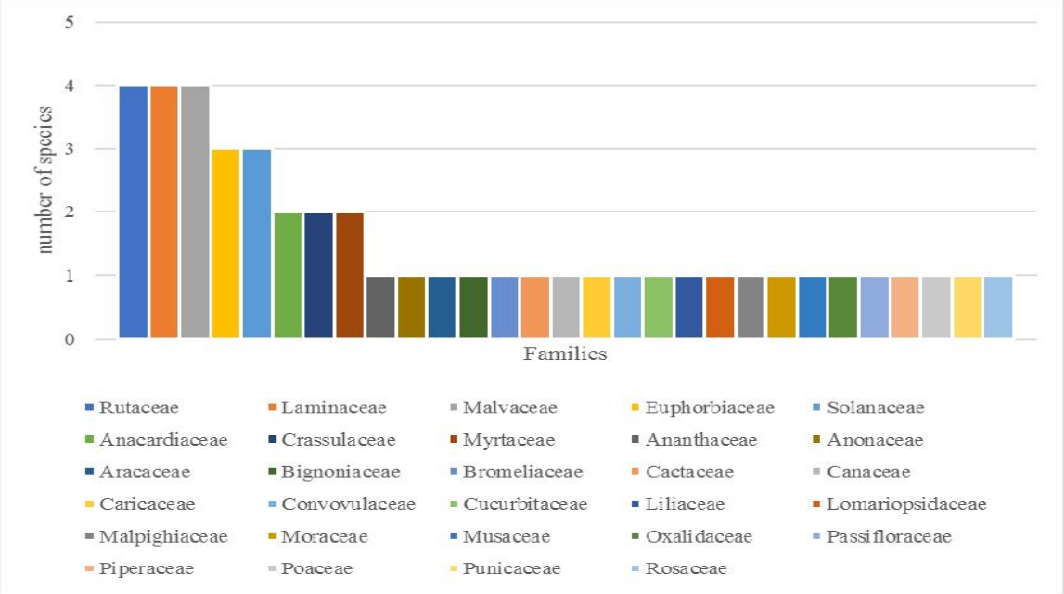

Fig. 2. Number of species per botanical family found in agroforestry homegardens in Maranhão, Brazil, 2016

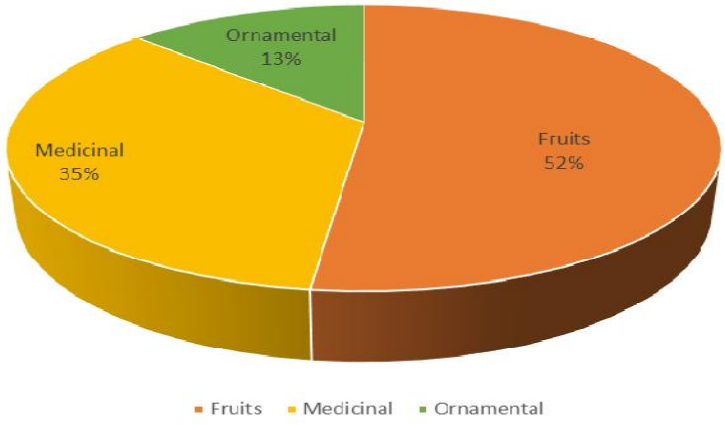

Fig. 3. Distribution of plant species according to the category of use in the agroforestry yards in Maranhão / Brazil, 2016

In the research, fruit species were the most frequent cultivated. Among them are *Malpighia glabra* (acerola), with 12 trees found in 11 homegardens, followed by *Pasidium guajava* (guava) with seven trees in seven homegardens, and *Mangifera indica* (mango) with five individuals in five homegardens. These species play an important role in livelihood sustainability. According to Sukopp and Werner [20], the presence of fruit trees in agroforestry homegardens also generates additional profits in the family income, as well as contributing to the increase of biodiversity and the recovery of degraded and / or abandoned areas. According to Sukopp and Werner [21], fruit species provide food sources to growers and places of refuge, shelter and food for animals, especially birds [22].

The age of homegarden care-takers ranged from 26 to 86 years, with an average age of 64 years. Women are mainly responsible for the management of the agroforestry homegardens, corroborating earlier studies [23,3,7]. The majority of women (n=22) lived in the neighborhood for between 10 and 30 years. The

homegarden structure relates to each owner's cultural experiences and life history. The particular background and history of an individual gardener defines the homegarden, which vary according to cultural aspects, available space, function and history of community formation.

The homegardeners have a good knowledge about cultivation. The time spent daily in homegardens by different households is difficult to quantify, which according to the owners takes place during their 'off-time'. Thus most of the home gardeners do not perform additional gardening activities outside their property due to time constraints. Perfecto [24] reveals that the benefits of planned agrobiodiversity are more easily perceived where there is care. Therefore, the benefits of natural and unplanned (associated) agrobiodiversity require dedication and proper stewardship of the agroforestry gardens.

The plants and trees grown in the home gardens were either managed manually with the use of hand tools, or the plants, such as fruit trees, were left unmanaged, with periodic harvests. The home-gardeners were in general satisfied with the demands for hand labor to manage the gardens such as the need for periodic manual during periods of drought. For the control of the materials such as pests there are minimal interventions other than the manual removal of insects, infected leaves and weeds. Fertilisation of soils was done with organic fertilisers, such as coal ash, aged or composted manure plant residues, such as dead palm trunks, and kitchen food-scraps [25].

4. CONCLUSION

The homegardens surveyed, presented a considerable diversity of botanical species, with the fruit tree species category in their predominance. However, it is noted that homegardens are spaces for growing fresh food, providing the family of growers with greater food security, providing a better lifestyle, and a family income alternative.

CONSENT

Twenty five homegardens were randomly visited with the consent of residents, with the starting point at 01 Avenue. A form was applied in the resident's own residence, with preference for the leader of the family group, regardless of the gender, when it was not in the place the same was applied to another member of the family group that presented the necessary conditions to answer the questions. Prior to the application of the form, the participant signed the free and informed consent term. Subsequently, the methodological processes consisted of interviews with residents on socio-economic issues as well as about the management techniques used in the homegardens.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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