Structure and Floristics of Home Gardens in an Altitudinal Marsh in Northeastern Brazil

Thamires Kelly Nunes Carvalho, Diego Batista de Oliveira Abreu, Camilla Marques de Lucena, Kamila Marques Pedrosa, Carlos Frederico Alves de Vasconcelos Neto, Carlos Antônio Belarmino Alves, Leonardo Pessoa Félix, Alissandra Trajano Nunes Florentino, Rômulo Romeu da Nóbrega Alves, Leonaldo Alves de Andrade, and Reinaldo Farias Paiva de Lucena

Research

Abstract

Home gardens are a traditional land use practice, which is very common in the tropics. The main goal of the home garden is to produce food for subsistence purposes. Therefore, they have been considered very important from an economic, cultural and ecological point of view. Despite their importance, there has been a lack in research of these environments in Northeastern Brazil. This research was carried out in a rural community belonging to Areia City (Paraíba, Brazil), and aimed to study the floristic diversity of home gardens and their contribution in the conservation of the local diversity. Semi-structured interviews were conducted, also using the technique of guided tours with the home garden maintainer. At the same time, the yards were measured, as well as all shrubby arboreal individuals present with DGL (diameter at ground level) ≥ 3 cm. A total of 19 yards were analyzed. 177 species were recorded, of which 155 were identified, representing 63 families and 131 genera. Fabaceae (16 spp.), Euphorbiaceae (10 spp.) and Myrtaceae (7 spp.) were the most represented plant families. 94 of the identified species are considered exotic and 83 are native, considering the origin at regional level. Structurally, the home gardens from Vaca Brava community have shown themselves as complex and rich in diversity, as a result of the association of crops and fruit, as well as the presence of native woody plants for which no uses were reported.

Introduction

Home gardens represent a very important agricultural production unit for local populations, especially in underdeveloped countries which depend of them. Most of the time these home gardens are used and managed based upon family agriculture, with excess produce being sold to generate family income (Florentino *et al.* 2007, Guarim Neto & Amaral 2010, Kumar & Nair 2004, Nair 2001).

As a type of agroforestry system, home gardens are a land use practice that combines the cultivation of trees associated, or not associated, with annual and perennial plants, which provide spaces for domestic animals breeding in the same area (Fernandes & Nair 1986). These systems are seen as an alternative for increasing the food supply (Soemarwoto *et al.* 1985), and are a pragmatic solution to diversify production. For Nair (1991), the concept of home garden systems implies that these systems: (1) involve two or more species of plants (or animals and plants), (2) always have two or more energy exits, (3) have cycles longer than one year, and (4) are ecologically more complex than monocultured systems. Besides these general features, Alcorn (1990) includes seven traditional aspects of home garden systems: (1) integration of native species of vegetation; (2) the agriculturists take advantage of natural variations of the present environment; (3) the processes of natural succession are used as management tools; (4), these systems include a great number of species; (5) the integration of agroforestry areas in diversified exploitation; (6) the variety is seen in the same system, and (7) each farm is conceived to satisfy

Correspondence

Thamires Kelly Nunes Carvalho, Diego Batista de Oliveira Abreu, Camilla Marques de Lucena, Kamila Marques Pedrosa, Carlos Frederico Alves de Vasconcelos Neto, Leonardo Pessoa Félix, Leonaldo Alves de Andrade, Reinaldo Farias Paiva de Lucena, Center for Agricultural Sciences, Federal University of Paraíba, João Pessoa, Paraíba, BRAZIL carvalhotkn@gmail.com, reinaldo@cca.ufpb.br
Carlos Antônio Belarmino Alves, Rômulo Romeu da Nóbrega Alves, State University of Paraíba, Paraíba, BRAZIL. c_belarminoalves@hotmail.com
Alissandra Trajano Nunes Florentino, Federal Rural University of Pernambuco, Recife, Pernambuco, BRAZIL. alibiol@hotmail.com

Ethnobotany Research & Applications 11:029-048 (2013)

Published: May 12, 2013

www.ethnobotanyjournal.org/vol11/i1547-3465-11-029.pdf

the necessities of a family, independent of the use of land and the standards of the local community.

Each home garden has its particularities, either the delimitations or the management practices, or the unique features found within (Guarim Neto & Amaral 2010, Kumar & Nair 2004). The knowledge which is passed from generation to generation, make the spaces around the house a true “ field” for the practice of the family tradition (Guarim Neto & Amaral 2010).

The importance of these home gardens in sustainable development and the conservation of biological diversity has been highlighted in several tropical regions (Albuquerque *et al.* 2005, Florentino *et al.* 2007, Fraser *et al.* 2011, Innerhofer & Bernhardt 2011, Kumar & Nair 2004, Zaldivar *et al.* 2002). However, many of these studies are focused on sustainability issues and very little is discussed about the contribution of home gardens to the conservation of local diversity. This discussion is necessary to understand the importance of native species in the context of such diversity. Florentino *et al.* (2007) discuss the importance of home gardens in an area of Caatinga, reducing the pressure of usage of the native vegetation through the cultivation of woody species for lumber purposes. Generally, many of the species from these home gardens are used for multiple purposes, such as an energy source (firewood and coal), medicinal, and alimentary, amongst others (Albuquerque *et al.* 2005, Beatriz 1998, Blanckaert *et al.* 2002, Fernandes & Nair 1986, Wezel & Bender 2003). This versatility is extremely important for the optimization and handling of home gardens and for increasing family income. Home gardens also promote the increase of agroforesty production, using sustainable practices. Home gardens may also act as components of a mosaic of functional vegetation in a matrix of fragmented forest areas.

Recently, an evaluation of the distribution of fragments of Brazilian rainforest has pointed out conservation priorities in the fragments of Northeastern Brazil, mainly due to the small area of these fragments and the great risk of population extinction of native species (Ribeiro *et al.* 2009). A result of this study may be a promotion of planting native species in home gardens, transforming them into seeds and germplasm bank (Galluzzi *et al.* 2010).

Ribeiro *et al.* (2009) also have cited the functionality of vegetal mosaics that may assist in the maintenance of ecological processes amongst forest fragments. From this perspective home gardens, when managed properly, can assist in the composition of this mosaic. This could reduce pressure on native areas and act as “corridors” for, at least some, animal species that assist forest ecological processes, such as pollination and seed dispersal. The formation of open ombrophilous forest, deciduous and semi-deciduous seasonal forests, as well as associated ecosystems, in Areia, Paraíba, where this study was conducted, were practically decimated, with only small fragments remaining. According to SNE (Sociedade Nordestina de Ecologia) (2002) and SUDEMA (Superintendence of Environment Development) (2004), devastation of native forests in this region happens in such an intense way that the current existing fragments represent only 0.12% of the original vegetal covering. It is noteworthy that this region is included amidst the priority areas for the Conservation of the Rainforest and Biodiversity in the state of Paraíba (Barros 2005, MMA 2004/2005).

The present study evaluated the structure of home gardens considering their size, occupied area, distribution and diversity of species, and function, which involves food production for complementing family nutrition and/or the commercialization of the excess from this production. The study also records the floristic composition, evaluating possible relationships amongst native and exotic species in the agroforestry home gardens of Vaca Brava rural community, located in an altitudinal marsh in Northeastern Brazil.

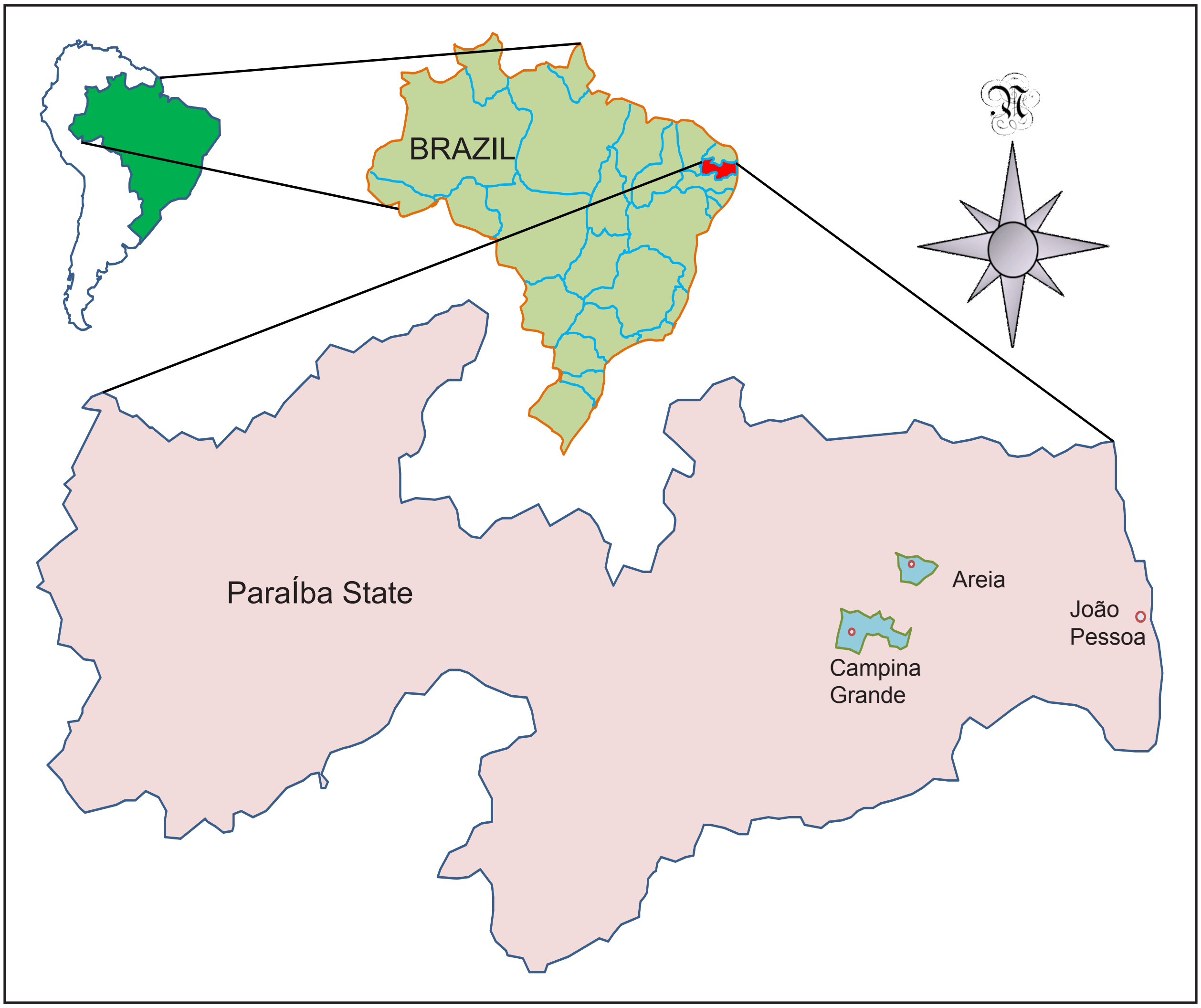
Methods

Area of study

The present study was developed in the agricultural community from Vaca Brava in Areia city, Paraíba, Northeastern Brazil (Figure 1). Located in an altitudinal marsh in the marsh microregion and the wasteland mesoregion of Paraíba state (8° 58‘ 12’ 19’’ S, 35° 42’ W). The area encompasses 269 km² of the region with mild climate and dry and humid forests, located at an altitude of 618 m ASL (Andrade & Lins 1964). This region is home to the 600 hectare Pau Ferro State Park, constituting a conservation unit of state domain. This park holds the most representative forest fragment of altitudinal marsh in Paraíba State, with an annual average temperature of 22 °C, relative humidity around 85% and monthly total rainfall averaging 1,200 mm (Mayo & Fevereiro 1982, Pôrto *et al*. 2004).

The community is divided into two localities, one standing next to the Pau Ferro State Park, called High Vaca Brava, and the other surrounding an excerpt of the secondary forest, called Low Vaca Brava. Their primary economic activity is agriculture; however some inhabitants work in the city in one of several economic sectors. The first locality is 5 km far away from the urban center (6º 59’ 40.24” S, 35º 45’ 07.08”), and the second 12 km (7º 00’ 52.27” S, 35º 44’ 44.06”). Both communities have a school which belongs to the city. Recently, High Vaca Brava’s school was closed down following visitation from health agents. Homes closest to town have electricity and a piped in water supply, while the more distant homes rely on artesian wells for their water.

Figure 1. Municipality of Areia, Paraíba State, Northeast Brazil, showing its position in relation to Joao Pessoa (State Capital) and Campina Grande (Regional Hub).



High Vaca Brava is composed of just six residences, while Low Vaca Brava consists of 20 family units (Abreu *et al.* 2011). Neither of these communities have a health center. Many residents of High Vaca Brava rely on cachaça production for ther income. The town is home to the Vaca Brava mill, a cachaça producer. The residences and farms in the area largely belong to the mill and were provided by the owner for planting and other services to be provided by residents.

Interviews

Data collection occurred from August 2010 to May 2011, in Vaca Brava community, where all residences having home gardens which were managed traditionally, and having an important role in the dietary intake of the resident family (Florentino *et al.* 2007) were visited. 26 residences were identified as being within the parameters of this study. Of those, 19 (73%) were visited and research was conducted on their home gardens.

Prior to beginning interviews, each informant was explained the goal of this research and then asked to sign the Term of Free and Clarified Assent, as required by the National Health Council through the Committee of Ethics in Research (Resolution nº 196/96). This term consists of an explanation by the researcher to the informant about the study and its goals, allowing the informants to assent or not to participate (Albuquerque *et al.* 2010). After this procedure, the measurements of the home garden area were taken (m^2), and all the plants present were analyzed.

The DGL (diameter at ground level) of plants was also recorded, along with the height of individuals with DGL ≥ 3. An estimation of the total number of individuals present (Florentino *et al.* 2007) was also calculated during this time. Measurements were not made of any cultivated species in plantations or hedges. A presence/abscence count was also made of small herbaceous species in each yard. This was done without measuring diameter or height, asthey did not fit in with the adopted minimum diameter.

The standards of each yard were traced based upon a profile diagram characterized in vertical and horizontal lines. The vertical lines correspond to the measurements of height and DGL and the horizontal lines to the localization and distribution of the individuals in home gardens (Millat-e-Mustafa 1998).

A semi-structured interview technique (Albuquerque *et al.* 2010, Vogl 2004) was applied to the manager of each home garden, containing questions about their age, occupation, duration of residency, use and origin of species, home garden purpose, etc. A total of 19 interviews were completed with 15 women and 4 men, varying in age from 17 to 83 years old. Part of the interview was conducted as a walk in the home garden with the manager, in order to facilitate voucher collection and local identification of the species (Florentino *et al.* 2007). All plants collected were processed, identified and deposited at the Herbarium Jaime Coelho de Moraes from the Federal University of Paraíba (EAN).

Data analysis

In order to evaluate the correlation between function, size, relative density and frequency of the species and age of the manager, Spearman's correlation coefficient was used (Sokal & Rolf 1995). In the same way, using a G-test (Williams' correction) the relationship between exotic and native plants regarding their abundance and occurrence was analyzed (Florentino *et al.* 2007). The use categories of these species (food, medicinal, ornamental, fuel, shade, hedge row, forage and others which include mystico-religious uses and personal hygiene, as well as "not useful" fodder plant) were compared with a G-test from Williams (Sokal & Rolf 1995). The analyses were carried out with the software Bioestat 5.0 and FITOPAC 2.1.2 (Ayres 2000). The criterion native/exotic was established regionally, that is, in Northeastern level, following the classification adopted by the Botanical Garden from Rio de Janeiro (Forzza *et al.* 2010).

Results

Floristic composition

From 177 recorded plants, 155 were indentified, encompassing 131 genera and 63 families. The 20 remaining plants were unidentified due to the lack of fertile material. The most representated families of this diversity were Fabaceae (16 species), Euphorbiaceae (10 species) and Myrtaceae (7 species). The species that best represented these families in the home gardens were *Phaseolus lunatus* L. (bean), *Jatropha gossypiifolia* L. (purple pinion) and *Psidium guajava* L. (guava) (Table 1).

In the 19 home gardens surveyed, 1,755 individuals were counted, of which 1,297 are exotic (74%) encompassing 94 species. Among the most common of these are *Musa acuminata* x *balbisiana* Colla (banana), *Artocarpus intergrifolia* L. (**jaca**) and *Dieffenbachia seguine* (Jacq.) Schott. (**comigo ninguém pode**). The 458 remaining individuals are native (26%), distributed into 83 species, such as *Spondias mombin* L. (**cajá**), *Acrocomia intumescens*

Table 1. Plants found in backyard home gardens of Community Vaca Brava, Areia, Paraíba State, Brazil. Occurence: number of homegardens where plant occurred; Status: E = exotic, N = native; Uses: 1 = food, 2 = forage, 3 = medicinal, 4 = ornamental, 5 = fuel, 6 = shade, 7 = others, 8 = not useful, 9 = hedge row; ** = no vernacular name given.

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Amaranthaceae				
Alternanthera sessilis (L.) R. Br. ex DC.	**	2	E	4
Celosia argentea L.	**Crista de galo**	2	E	4, 8
Chenopodium ambrosioides (L.) Mosyakin & Clemants	**Mastruz**	1	N	4
Amaryllidaceae				
Allium fistulosum L.	**	2	E	4
Griffinia sp.	**	1	N	4
Zephyranthes rosea Lindl.	**Beijo rosa**	1	N	4
Anacardiaceae				
Anacardium occidentale L.	**Cajú**, **Cajú vermelho**	11	N	1
Mangifera indica L.	**Manga**	17	E	1, 5
Schinus terebinthifolia Raddi	**Aroeira do brejo**	1	N	8
Spondias mombin L.	**Cajá**	2	N	1, 6
Spondias purpurea L.	**Seriguela**	13	E	1
Anonnaceae				
Annona crassiflora Mart.	**Ariticum**	1	N	1

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Anonnaceae con't				
Annona muricata L.	**Graviola**	3	E	1
Apocynaceae				
Catharanthus roseus (L.) G. Don.	**Boa noite/Bom dia**	6	E	3, 4
Hoya carnosa (L. f.) R. Br.	**Rosa cera**	1	E	4
Nerium oleander L.	**Espirradeira**	2	E	4
Araceae				
Anthurium andraeanum Linden	**Antúrio**	1	E	4
Caladium bicolor Vent.	**Tanharão**, **Diabinho**	1	N	4
Dieffenbachia amoena Bull.	**Comigo ninguém pode**	8	E	4, 7
Philodendron imbe Schott ex Endl.	**	1	N	4
Syngonium podophyllum Schott	**	1	E	4
Araliaceae				
Schefflera arboricola (Hayata) Merr.	**	1	E	4
Arecaceae				
Acrocomia intumescens Drude	**Macaíba**	3	N	8
Cocos nucifera L.	**Côco**	7	N	1
Dypsis lutescens (H. Wendl.) Beentje & J. Dransf.	**Coqueiro**	1	E	4
Syagrus oleracea (Mart.) Becc.	**Côco catolé**	1	N	4
Asparagaceae				
Asparagus densiflorus (Kunth) Jessop	**	1	E	4
Asparagus setaceus (Kunth) Jessop	**	1	E	4
Apiaceae				
Foeniculum vulgare Mill.	**Erva doce**	1	E	1, 3
Asteraceae				
unknown 1	**Manjericão de cavalo**	2	N	4
unknown 2	**Gebra**	1	E	4
Chrysanthemum sp.	**	1	E	4
Dahlia pinnata Cav.	**Dália**	1	E	4
Gerbera jamesonii Adlam	**Margarida**	2	E	4
Helianthus annuus L.	**Girassol**	2	E	4
Melampodium paniculatum (Gardner)	**	2	N	4
Tilesia baccata (L.) Pruski	**	2	N	4
Balsaminaceae				
Impatiens balsamina L.	**Maravilha cacheada**	1	E	4
Impatiens walleriana Hook. f.	**Beijo branco**	3	E	4
Begoniaceae				
Begonia sp.	**	1	N	4
Begonia sp.	**	1	N	4
Bixacaceae				
Bixa orellana L.	**Açafrão**	2	E	1

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Boraginaceae				
Cordia trichotoma (Vell.) Arráb. ex Steud.	**Louro**, **Louro Frei Jorge**	2	N	1, 3
Brassicaceae				
Brassica sp.	**Couve**	3	E	1
Bromeliaceae				
Ananas bracteatus (Lindl.) Schult. & Schult. f.	**Abacaxi rabo de raposa**	1	N	4
Ananas comosus (L.) Merr.	**Abacaxi**	2	E	1
Cactaceae				
Epiphyllum phyllanthus (L.) Haw.	**Dama da noite**	1	N	4
Epiphyllum caudatum Britton & Rose	**	2	N	4
Hatiora sp.	**	2	N	4
Melocactus zehntneri (Britton & Rose) Luetzelb.	**Coroa de frade**	2	N	4
Caricaceae				
Carica papaya L.	**Mamão**, **Mamão de coda**	14	N	1
Caryophyllaceae				
Dianthus barbatus L.	**	2	E	4
Dianthus chinensis L.	**Pé de cravina**	1	E	4
Dianthus sp.	**	2	E	4
Combretaceae				
Terminalia catappa L.	**Castanhola**	7	N	1, 4, 6
Comelinaceae				
Commelina benghalensis L.	**	2	N	4
Convolvulaceae				
Ipomoea batatas (L.) Lam.	**Batata doce**	1	N	1
Costaceae				
Costus pulverulentus C. Presl	**	2	E	4
Costus sp.	**	2	E	4
Crassulaceae				
Sedum morganianum E. Walther	**Bananinha**	1	E	4
Kalanchoe blossfeldiana Poelln.	**	2	E	4
Cucurbitaceae				
Cucurbita moschata Duchesne	**Jerimum**	2	N	1
Momordica charantia L.	**Melão de S. Caetano**	3	N	8
Sechium edule (Jacq.) Sw.	**Chuchu**	2	N	1
Davalliaceae				
Nephrolepis exaltata (L.) Schott	**Samambaia**	2	E	4
Euphorbiaceae				
Codiaeum variegatum (L.) Rumph. ex A. Juss.	**	2	E	4
Euphorbia cotinifolia L.	**Crote roxo**	7	E	4
Euphorbia sp.	**	1	E	4

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Euphorbiaceae con't				
Euphorbia tithymaloides L.	**	1	N	4
Jatropha gossypiifolia L.	**Pinhão roxo**	8	N	4, 7
Jatropha mollissima (Pohl) Baill.	**Pinhão brabo**	3	N	3, 4, 7, 8
Manihot dichotoma E. Ule.	**Maniçoba**	1	N	8
Manihot esculenta Crantz.	**Macaxeira**	4	N	1
Pedilanthus tithymaloides (L.) Poit.	**	1	E	4
Ricinus communis L.	**Carrapateira**, **Mamona roxa**	2	N	8
Fabaceae				
Bauhinia cheilantha (Bong.) Steud.	**Mororó**	2	N	4, 6
Bowdichia virgilioides Kunth	**Sicupira**	2	N	8
Caesalpinia pulcherrima (L.) Sw.	**Flamboyant mirim**	1	E	4
Cajanus cajan (L.) Huth	**Feijão gandú**	2	N	1
Calliandra brevipes Benth.	**Caliandra**	1	E	4
Delonix regia (Bojer ex Hook.) Raf.	**Flamboyant**	1	E	4, 6
Enterolobium contortisiliquum (Vell.) Morong	**Tambor**	1	N	8
Erythrina velutina Willd.	**Mulungú**, **Mulungú brasileirinho**	1	N	4, 6
Gliricidia sepium (Jacq.) Kunth ex Walp.	**Gliricídia**	1	E	4, 6
Machaerium aculeatum Raddi	**Espinheiro**, **Espinheiro roxo**, **Pé de espinho**	3	N	8
Mimosa caesalpiniifolia Benth.	**Sabiá**	2	N	5, 9
Phaseolus lunatus L.	**Feijão**	7	E	1
Prosopis juliflora (Sw.) DC.	**Algaroba**	2	N	6
Senna quinquangulata (Rich.) H.S. Irwin & Barneby	**	1	N	4
Stryphnodendron pulcherrimum (Willd.) Hochr.	**Camuzé**	4	N	5, 8
Vigna unguiculata (L.) Walp.	**Feijão macassar**	2	E	1
Geraniaceae				
Pelargonium x *hortorum* L.H. Bailey	**	1	E	4
Lamiaceae				
Plectranthus scutellarioides (L.) R. Br.	**Crote**	6	E	4
Lauraceae				
Persea americana Mill.	**Abacate**	6	E	1
Linaceae				
Linum sp.	**Linhaça**	1	N	4
Lythraceae				
Cuphea flava Spreng.	**	3	N	4
Lagerstroemia indica L.	**	1	E	4
Malpighiaceae				
Lophanthera lactescens Ducke	**Chorão**	1	E	4
Malpighia emarginata DC.	**Acerola**	12	E	1

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Malvaceae				
Gossypium sp.	**Algodão**	1	E	4
Guazuma ulmifolia Lam.	**Mutamba**	4	N	5, 8
Hibiscus rosa-sinensis L.	**Malvão**, **Pampola**	7	E	4, 9
Sida sp.	**	2	N	4
Marantaceae				
Calathea sp.	**	1	E	4
Moraceae				
Artocarpus altilis (Parkinson) Fosberg	**Frutapão**	1	E	1
Artocarpus integrifolius L. f.	**Jaca**	5	E	1, 2
Ficus calyptroceras (Miq.) Miq.	**Gameleira**	1	N	8
Ficus sp.	**Figo**	1	N	4
Morus alba L.	**Amora**	1	E	4
Musaceae				
Musa acuminata x *balbisiana* Colla	**Banana**	18	E	1
Myrtaceae				
Eugenia uniflora L.	**Pitanga**	4	E	1
Myrcia sp.	**Cupiúba**	1	N	8
Myrcia sp.	**Jaboticaba**	7	N	1
Psidium guajava L.	**Goiaba**	7	N	1
Psidium guianense Pers.	**Araçá**	3	N	1
Syzygium jambolanum (Lam.) DC.	**Oliveira**	6	N	1, 6, 8
Syzygium jambos (L.) Alston	**Jambo**	3	E	1
Orchidaceae				
Cattleya labiata Lindl.	**Orquídea**	1	N	4
Polystachya estrellensis Rchb. f.	**Orquídea branca**	1	N	4
Oxalidaceae				
Averrhoa carambola L.	**Carambola**	3	N	1
Oxalis triangularis A. St.-Hill.	**	1	N	4
Passifloraceae				
Passiflora edulis Sims	**Maracujá**	4	N	1
Turnera subulata Sm.	**	2	N	4
Phytolacaceae				
Petiveria alliacea L.	**	1	E	4
Poaceae				
Cymbopogon citratus (DC.) Stapf	**Capim santo**	6	E	1, 3
Saccharum officinarum L.	**Cana-de-açúcar**	6	E	1
Zea mays L.	**Milho**	7	E	1
Polypodiaceae				
Polypodium vulgare L.	**	2	E	4
Polygonaceae				
Antigonon leptopus Hook & Arn.	**Amor agarradinho**	2	N	4

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Portulacaceae				
Portulaca grandiflora Hook.	**	2	N	4
Portulaca umbraticola Kunth.	**	3	N	4
Rosaceae				
Rosa sp.	**Rosa miúda**	1	E	4
Rosa sp.	**Rosa**, **Roseira**	8	E	4
Rubiaceae				
Coffea arabica L.	**Café**	2	N	1, 3, 8
Genipa americana L. var. americana	**Genipapo**	3	N	1, 8
Ixora coccinea L.	**Pingo de ouro**	2	E	4
Rutaceae				
Citrus aurantiifolia (Christm) Swingle.	**Limão**	6	E	1
Citrus reticulata Blanco.	**Laranja cravo**, **Tangerina**, **Laranja pocã**	4	N	1
Citrus sinensis (L.) Osbeck	**Laranja**, **Laranja lima do céu**, **Laranja baia**	15	E	1
Citrus x *limon* (L.) Osbeck	**Limão galego**	3	N	1
Pilocarpus microphyllus Stapf ex Wardleworth	**Arruda**	1	N	3
Rhamnaceae				
Ziziphus joazeiro Mart.	**Juazeiro**	2	N	7, 8
Sapindaceae				
Cupania impressinervia Acev-Rodr.	**Cabatã de rego**	2	N	5
Talisia esculenta (A. St. Hil.) Radlk.	**Pitomba**	3	N	1
Selaginellaceae				
Selaginella sp.	**	2	E	4
Solanaceae				
Brugmansia suaveolens (Humb. & Bonpl. ex Willd.) Sweet	**Tulipa**	1	E	4
Brunfelsia uniflora (Pohl) D. Don	**Manacá da serra**	2	N	4
Capsicum cf. *frutenscens* L.	**Pimenta**	3	E	1
Nicotiana tabacum L.	**Pé de fumo**	1	N	3
Solanum capsicoides All.	**Gogóia vermelha**	1	N	8
Solanum rhytidoandrum Sendtn.	**Jurubeba roxa**, **Jurubeba vermelha**	1	N	8
Smilacaceae				
Smilax cissoides Mart. ex Griseb.	**Japecanga**	1	N	3
Urticaceae				
Cecropia pachystachya Trécul	**Imbaúba**	3	N	8
Verbenaceae				
Lippia alba (Mill.) N.E. Br. ex Britton & P. Wilson	**Erva cideira**	5	E	3
Verbena officinalis L.	**	1	E	4
Vitaceae				
Leea guineensis G. Don.	**Café ornamental**	3	E	4

Botanical Name	Vernacular Name	Ocurrence	Status	Uses
Xanthorrhoeaceae				
Aloe sp.	**Babosa grossa**	2	E	3, 7
Aloe vera (L.) Burm. f.	**Babosa fina**	1	E	3, 7
Unidentifieds				
Unidentified 1	**Agave**	2		4
Unidentified 2	**Avenca**	1	E	4
Unidentified 3	**Boldo**	2	E	3
Unidentified 4	**Cacho de noiva**	2	E	4
Unidentified 5	**Cacto**	1	E	4
Unidentified 6	**Cardeiro**	2	N	4
Unidentified 7	**Chapéu de Napoleão**	1	E	6
Unidentified 8	**Coração de homem**	1	E	4
Unidentified 9	**Espada de São Jorge**	2	E	4, 9
Unidentified 10	**Espriteira**	6	E	3, 4, 7
Unidentified 11	**Felicidade**	1	E	4
Unidentified 12	**Hortelã da folha grossa**	2	E	3
Unidentified 13	**Jasmim**	1	E	4
Unidentified 14	**Jasmim laranja**	2	E	4
Unidentified 15	**Jasmim prata**	1	E	4
Unidentified 16	**Rainha, Jasmim**	2	E	4, 9
Unidentified 17	**Romã**	1	E	1, 3
Unidentified 18	**Sabogueira**	7	N	3, 4
Unidentified 19	**Sombrilhão**	1	E	6
Unidentified 20	**Violeta**	1	E	4

Drude. (**macaíba**) and *Cupania impressinervia* Acev-Rodr. var. Revoluta Radlk. (**cabatã de rego**).

Analysis of the species and families in home gardens surveyed show the area of Vaca Brava to be the most important in terms of density, frequency and dominance. These gardens have a high correspondance between the most prominent species and the most prominent families, with the exceptions of Sapindaceae, Malvaceae, Euphorbiaceae and Malvaceae (Figure 2, Figure 3). Each of the gardens surveyed were placed into one of three groups based on the number of species present. Six gardens had 1-12 species, seven gardens had from 13-18 species, and the remaining six gardens had from 19-25 species present (Figure 4). No correlation was shown between the number of species present in a home garden with the size of the garden ($p < 0,05$). Relatively small home gardens were as equally diverse as much larger ones. An example of this is one of the home gardens visited (garden A17) had an area of 594 m², while containing just 18 species, placing it into the middle level group.

Uses

Each of the 177 plants recorded were organized into nine usage categories: food, fodder plant, medicinal, ornamental, fuel, shade, hedgerow, other, which includes mystical-religious use and personal hygiene, and not useful, indicating plants maintained in the home garden, however without any utility. These are often native species, such as *Myrcia* sp. (*cupiúba*) and *Cecropia pachystachya* Trécul. (**imbaúba**). Although not cutlivated as being useful, some individuals of this latter category may be used after they die, such as *Guazuma umifolia* Lam. (**mutamba**), which is then used as a fuel source.

The most prominent category was that of ornamental, with 104 species. These are used to decorate both the residences and the home gardens. The second most prominent category was food, with 46 species being used for the family diet. This is followed by medicinal, which had 16 species used in the production of home medicine, such as teas and syrups, and in therapeutical baths.

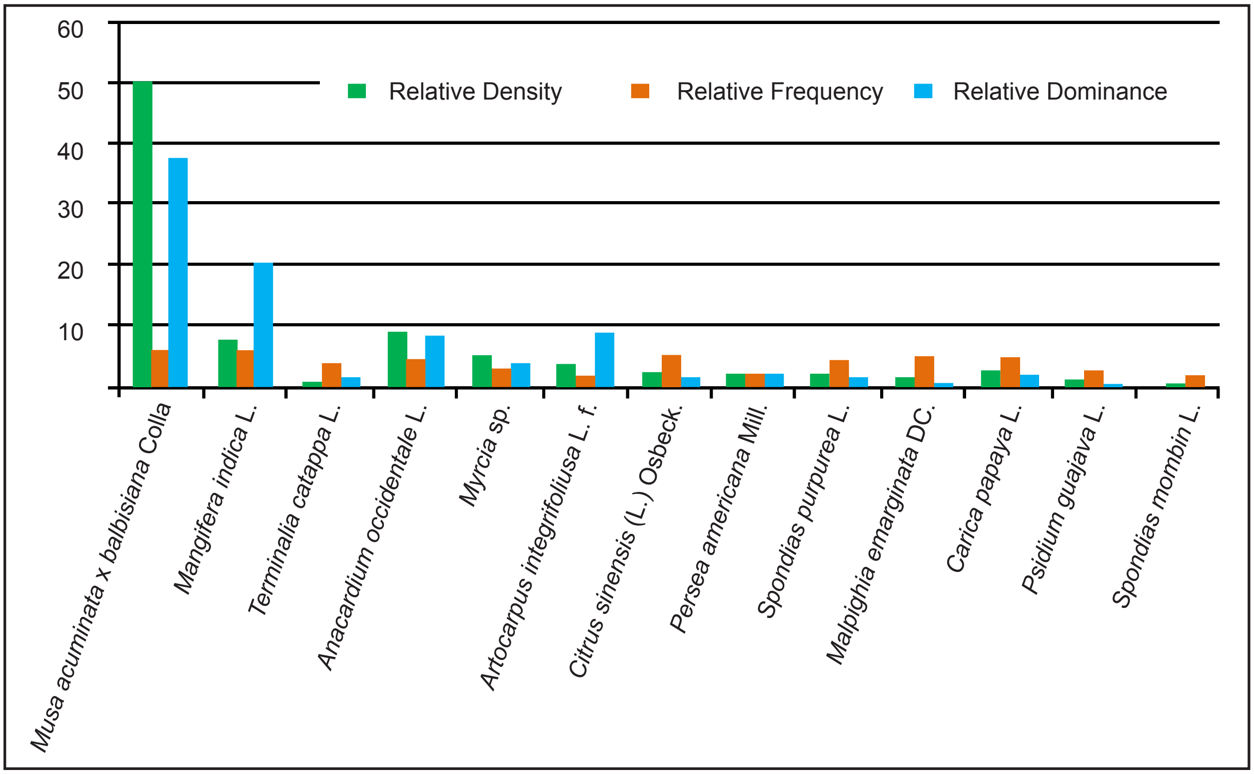


Figure 2. The most prominent species in phytosociological indices of home gardens, Community Vaca Brava, Areia, ParaÍba state, Brazil.

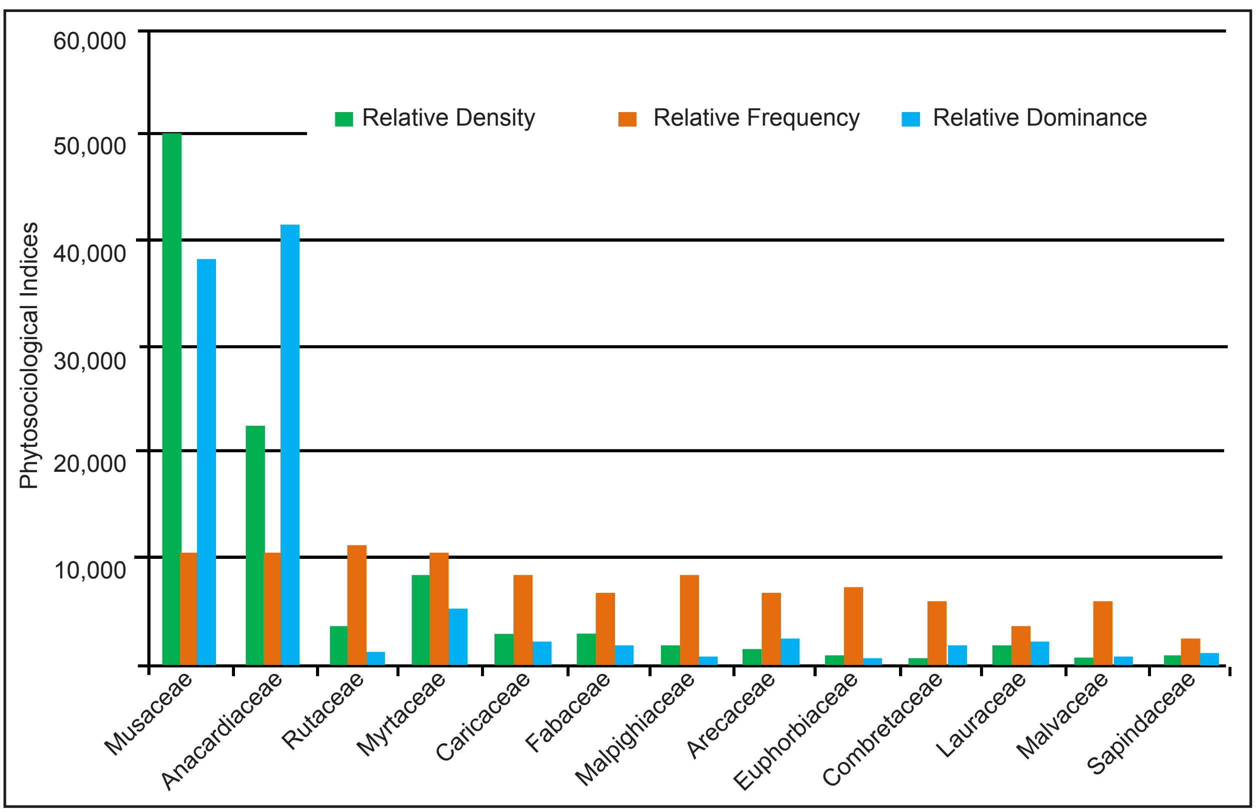


Figure 3. The most prominent families in phytosociological indices of home gardens, Community Vaca Brava, Areia, ParaÍba state, Brazil.

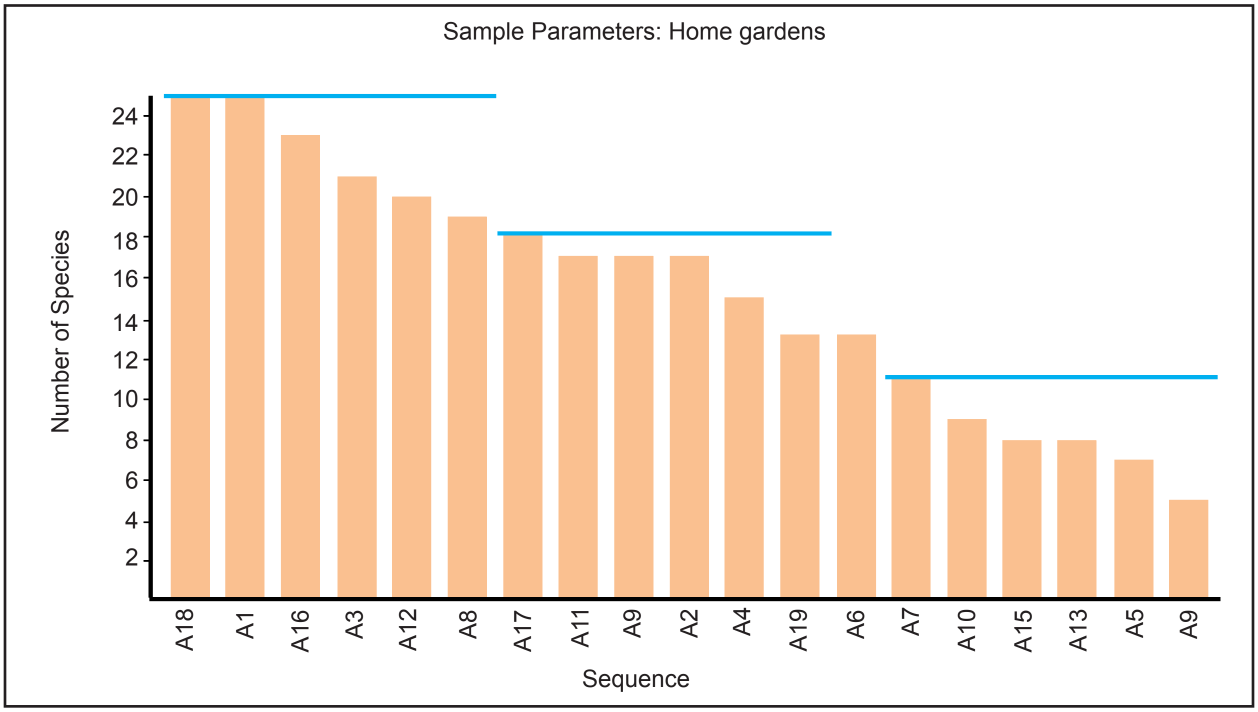


Figure 4. Number of species per home garden, Community Vaca Brava, Areia, ParaÍba state, Brazil.

A total of 116 plants presented only one use, such as *Spondias purpurea* L. (**seriguela**) which is only used as human food. The 30 remaining have multiple uses, such as *Jatropha mollissima* L. (**pinhão bravo**) which is used as an ornamental and as a medicinal, or *Jatropha gossypiifolia* L. (**pinhão roxo**) used for mysticism e.g., " to avoid the evil eye " or " to move spirits away ".

Structure

The home gardens of Vaca Brava were classified into three models based on the abundance and frequency of plant species and the manner of use of these species. These three models are: I) home gardens dominated by fruit plants, mainly used for complementing the family nutrition, and largely represented by *M. acuminata* x *balbisiana* (banana), *Mangifera indica* L. (mango), *Carica papaya* L. (papaya), *Malpighia emarginata* DC. (**acerola**), *Anacardium occidentale* L. (cashew), *Citrus sinensis* (L.) Osbeck (orange) and *S. purpurea* (**siriguela**); II) home gardens dominated by plants of multiple uses, often with low frequency and abundance, such as *Coffea arabica* L. (coffee), *Jatropha gossypiifolia* (purple pinion), *Mimosa caesalpiniaefolia* Benth. (**sabiá**), *Terminalia catappa* L. (castanets) and *S. mombin* (**cajá**) and III) home gardens dominated by grain crops and tubers that take up alot of land area. The most expressive representatives were *Phaseolus lunatus* (beans), *Cajanus cajan* (L.) Huth. (**guandú** beans), *Zea mays* L. (corn), *Brassica* sp. (kale) and *Ipomoea batatas* (L.) Lam. (sweet potato).

Regarding the horizontal distribution, starting from the record of each individual location within the home garden, it was noticed that the function attributed to each individual is decisive for tracking the individuals in Vaca Brava. Therefore, the function of each plant determines its location. This way, it was obtained the following logic distribution: 1) ornamental herbaceous plants in front of the house and those with shrubby ornamental size on the side of the house, 2) medicinal and culinary plants behind the house, 3) fruit plants close to the house, being on the side of and behind the house, 4) woody natives further away from the house, on the sides and in the back of the house, 5) shade plants and ones used for making fences are in front of the house and 6) cultivation areas that usually have their own space and may be on the back or on the side of the house. In some cases there are small associations like the planting of *C. cajan* and *P. lunatus*, or Vigna unguiculata (L.) Walp. (**macassar** beans) and *M. acuminata* x *balbisiana*.

The above-mentioned zones of cultivation were found only in the composition of the home gardens from Low Vaca Brava. In the other locality, these were out of the delimitations of the home gardens. Through the quantification of the individuals, the relative density of each home garden was traced. From this, it was noticed that formation of two distinct groups, the first composed of 16 home gardens, with a relative density varying from 0.1 to 5, and the second, composed only by three home gardens, with relative density of 10 to 23 (Figure 5). Analysis of all the home gardens present in this group, one (A18) was found

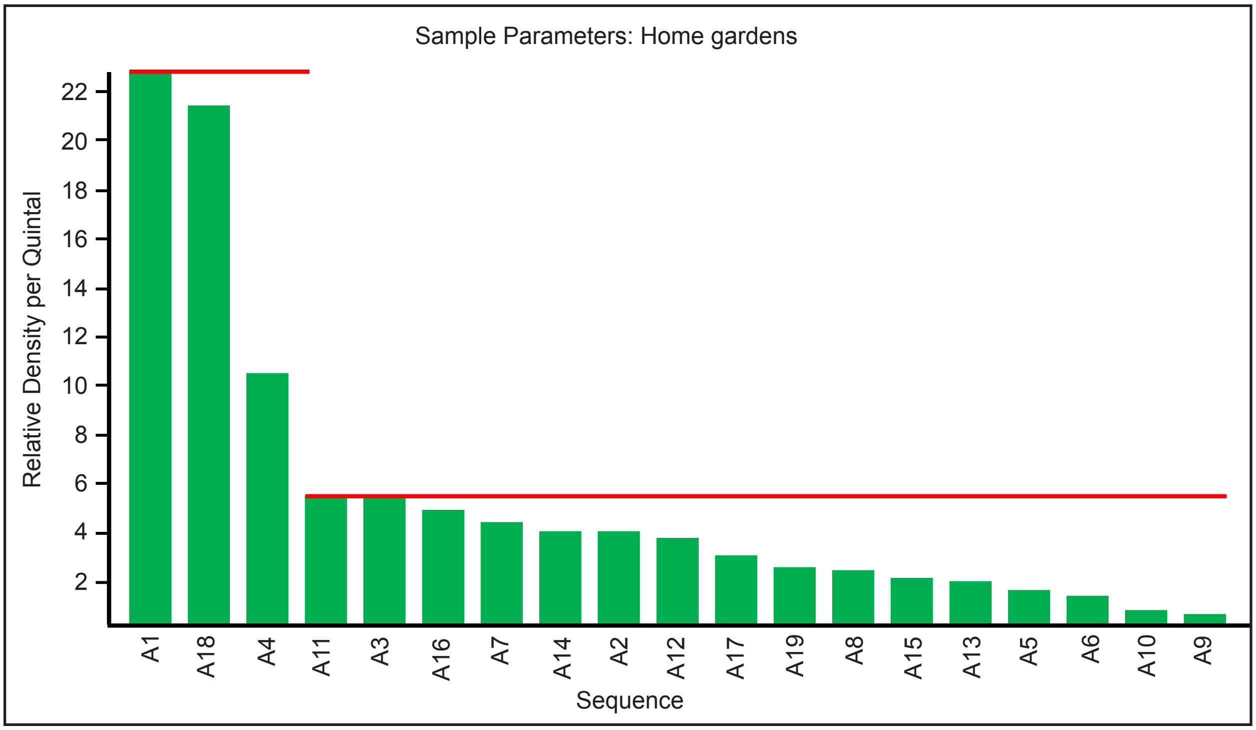


Figure 5. Relative density of species per home garden, Community Vaca Brava, Areia, ParaÍba state, Brazil.

to be cultivating *M. acuminata* x *balbisiana* in order to sell the excess produce.

The vertical distribution was analyzed according to the average height presented in each home garden. This revealed two distinct groups of home gardens, the ones from 0.1 to 4 meters (eight home gardens) with home gardens that include *Acrocomia intumescens* Drude. (**macaíba**). The second from 4 to 7 meters (11 home gardens), where the small fruitful crops are often found, like *Myrcia* sp. (**jaboticaba**) and *M. emarginata* (**acerola**) (Figure 6). This is evidence of an arboreal tendency for the home gardens in the studied community.

Regarding size, most of the time the home gardens are presented as rectangular and multi-stratified, measuring between 320m^2 and 15,982 m^2, with an average of 4608.85m^2 and a standard deviation of 5271.88m^2. There was no correlation between “size x function”, “size x age of the manager” and “function x age of manager” ($p >$ 0,05). However, when evaluated “size x relative density” and “size x relative frequency” separately for native species ($p <$ 0,05, density, $p =$ 0,0277; $p >$ 0,05, frequency, $p =$ 0,0845) and exotic ($p >$ 0,05, density, $p =$ 0,093; $p <$ 0,05, frequency, $p =$ 0,0104) showed that, with the exception of the relative frequency of the native species and density of the exotic ones, the size is generally related to the amount and the abundance of the species in the home gardens. Performing the G-test (Williams correction) for the parameters relative density ($p = 0.8980$), relative frequency ($p = 0.8815$) and category of use ($p = 0.0868$) between native and exotic species showed that there was a correlation between them.

The density and the frequency of the exotic species with the function of each home garden did not demonstrate a positive correlation ($p < 0.05$; density, $p = 0.0071$; frequency, $p = 0.0045$). One the contrary, the native ones did demonstrate a postive correlation ($p > 0.05$; density, $p = 0.2550$; frequency, $p = 0.1631$).

Discussion

Diversity and distribution of species

In general, the diversity of plants recorded in the altitudinal marsh home gardens was considerably high, when compared to other studies carried out in environments that share similar environmental features. Such comparisons include home gardens in humid forests (Lamont 1999, Fraser *et al*. 2011), and home gardens in dry forests (Albuquerque *et al*. 2005, Florentino *et al*. 2007). The marsh studied is located among areas of rainforest and Caatinga, and suffers direct influence of the landscape elements from both mentioned ecosystems, namely, the presence of *Ziziphus juazeiro* Mart. (**juazeiro**), typically from the phytogeographic domain of Caatinga, and *Schinus terebinthifolia* Raddi (**aroeira do brejo**), from the phytogeographic domain of rainforest.

Studies in tropical home gardens have indicated a high diversity of cultivated species both introduced and native.

This indicates possible coadjutants for conservation of local diversity (Watson & Eyzaguirre 2002). This tendency was observed in the present study, where a considerable number of native species has been recorded, although there is a predominance of the exotic ones. These species are especially destined to meet the human demand for food and medicine. This fact has been observed in other inquiries (Agelet 2000, Albuquerque *et al*. 2005, Florentino *et al*. 2007, Innerhofer & Bernhardt 2011, Lamont *et al*. 1999, Nair 2004, Reyes-García *et al*. 2010, Rico-Gray 1990, Vogl-Lukasser *et al*. 2010). Some authors strengthen the idea that the association of exotic plants with the native ones make these areas similar to natural forest complexes (Barrera 1980, Florentino *et al*. 2007, Galluzzi *et al*. 2010, Nair 2004, Wiersum 2004). A classic example in the literature that calls the researchers' attention is the case of home gardens in the Amazon cultivated by the Kaiapós indians which for a long time were confused with a fragment of natural forest, when in fact it was a result of the traditional handling throughout the years. The case was first perceived in the studies carried out by the researcher Darel Posey (1984).

According to Kumar and Nair (2004), the way in which the home gardens are managed is closely linked to the diversity found in each one. The association of cultivation with other herbaceous and woody species has created proper dynamics in these places. However, few comparative studies between home gardens and regions of surrounding forests are carried out with an attempt of measuring the level of their heterogeneity.

Home gardens were found in Vaca Brava that have sufficient complexity, both in number of species and organization. A comparison of both localities showed that the home gardens in Low Vaca Brava species diversity is associated with food production. In High Vaca Brava, the plants of multiple uses (food, medicine and ornamental) are the greater contributors of diversity. In similar way, Guarim Neto and Amaral (2010) mentioned the importance of food plants, which help in the composition of a mosaic of diversity in home gardens from Mato Grosso state. Most of the natives which are found in the stretch of surrounding forest belong to Mata do Pau Ferro State Ecological Reserve, reflecting the floristics of these places. This includes such species as *Cecropia pachystachya* Trécul. (*imbaúba*), *Machaerium aculeatum* Raddi. (**espinheiro**/**espinheiro roxo**/**pé de espinho**) and *Bowdichia virgilioides* Kunth. (**sucupira**).

Several research projects on home gardens reveals gardens existing behind each house are not merely agricultural systems, but rather true agro-ecosystems (Eyzaguirre & Linares 2004, Galluzzi *et al*. 2010, Gliessman 1990, Soemarwoto 1985). That is they work as sustainable micro systems which form an intimate relationship between nature and human traditions. In Vaca Brava, analyis of the structural and floristic complexity found confirms this proposal in that the individuals show themselves directly

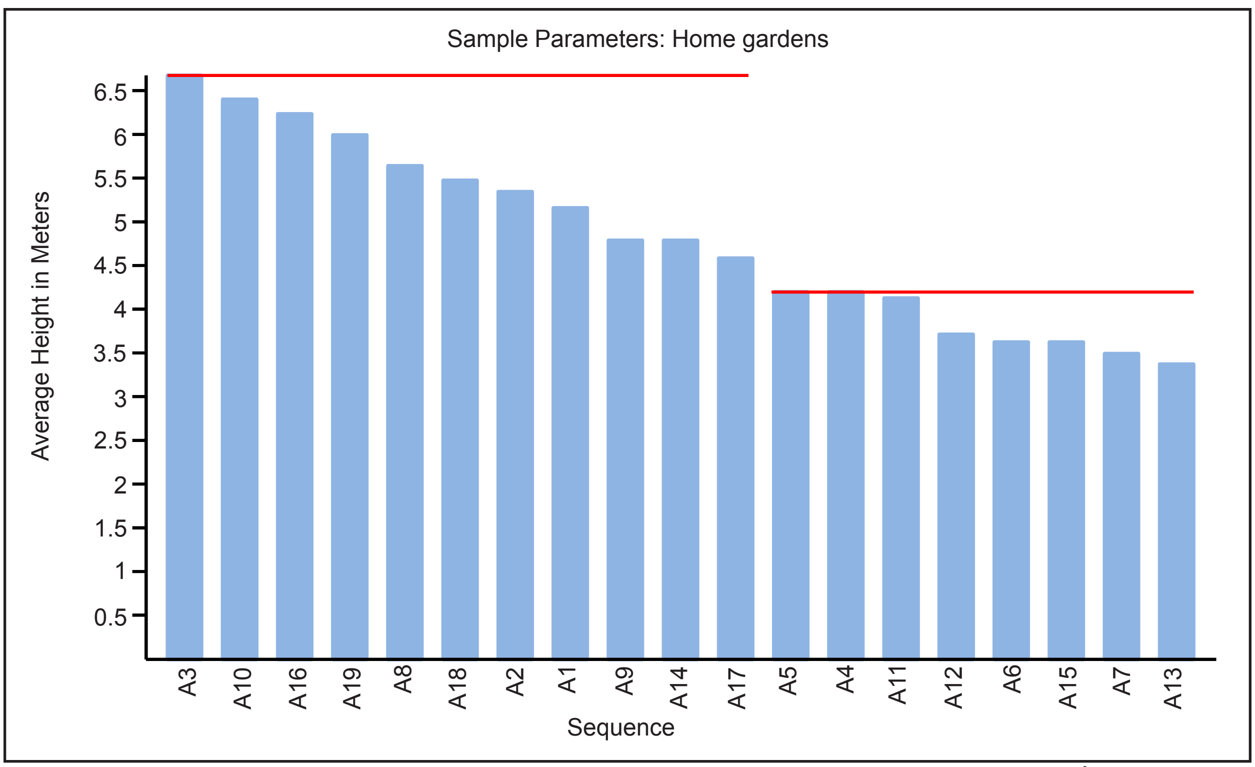


Figure 6. Average height, in meters, of species per home garden, Community Vaca Brava, Areia, ParaÍba state, Brazil.

linked to both necessity and the local culture. These home gardens are true agro-ecosystems as there is the association of plant and animal species, in proper dynamics in the studied community. Generally, plants meet both human and animals needs.

The species that demonstrate greater importance vary in these home gardens. In Vaca Brava the botanical families Anacardiaceae and Musaceae, with species *M. acuminata* x *balbisiana* var. and *M. acuminata* x *balbisiana* var., are highlighted in density, dominance and relative frequency different from that found by Florentino *et al*. (2007), in a Caatinga region where more than two families are highlighted, namely Euphorbiaceae, Anacardiaceae, Fabaceae and Myrtaceae, having a greater occurrence of the species *S. purpurea*, *P. guajava* and *M. glabra*. In a similar study, Albuquerque *et al*. (2005) found the families Fabaceae, Myrtaceae and Annonaceae, and the species, *A. squamosa*, *P. guajava* and *A. occidentale* to be more important. Therefore, it is noticed that even in relatively similar environments differences occur regarding the diversity and abundance of species. Such facts can be attributed to the region's seasonality, but also to reasons of local culture and economics.

Strengthening the previous discussion, Wezel and Bender (2003) in studies carried out in Cuba, emphasized that cultivation of food crops is responsible for about 50% of the floristic composition found in agroforestry systems. This is also true in the home gardens of Vaca Brava, where analysis of this study confirms the findings of Wezel and Bender (2003). Home gardens in this region dedicate a majority of their land to the cultivation of food plants, used for consumption by the family. On the other hand, Innerhofer and Bernhardt (2011) in studies in the Equatorial Amazon observed that the home gardens there were composed, to a large degree, of medicinal plants. This fact may be related to social/cultural contexts or environmental factors. Adding to these examples, Shavanas & Kumar (2003) discuss the home gardens in a region of India, where the function was to produce firewood to be used in the residences due the climatic conditions of the region, and the precarious conditions of survival.

Literature has shown that the distribution of the species in home gardens is sufficiently changeable, being able to be influenced by environmental factors, alimentary habits, along with social economic factors (Barrera 1980, Fernandes & Nair 1986). Albuquerque *et al*. (2005) and Vogl-Lukasser *et al*. (2010) call attention to the fact that this order is sufficiently random. The species distribution in Vaca Brava has use as the determinative factor, and it is attributed to each plant. For example, *Cataranthus roseus* (L.) Don., commonly known as **bom dia** (good morning), or **boa noite** (good night), which in two multi-functional home gardens have different locations according to their use, one in front of the house for ornamental purposes and other right behind the house for medicinal purposes.

Studies have shown that the vertical structure of the home gardens is related to their function (Albuquerque *et al*. 2005, Florentino *et al*. 2007, Kumar & Nair 2004, Nair 1986, Wezel & Bender 2003). In other words, those that have reached the highest stratus are generally composed of larger arboreal species, being related to subsistence. At the same time, the presence of ornamental and medicinal plants, and some small arboreal species have given the home garden a lower vertical stratum, corresponding to home gardens of multiple uses. In Vaca Brava, the predominance of fruitful plants is responsible for home gardens having a greater average height.

Shape and boundaries

Regardless of the regions, the home gardens' shape, generally are complex structures, varying between rectangular and stratified. In the Caatinga, Florentino *et al*. (2007) and Albuquerque *et al*. (2005), have defined the home gardens found in Caruaru and Alagoinha cities (both belongingto to the state of Pernambuco), as being multi-stratified rectangular shapes. Clerck and Negreros-Castillo (2000) said that these shapes vary, and although being generalizable, each individual home garden has specific place and function, similar to agro-forestry systems. The home gardens studied in this research were, in general, bigger and presented a variety of shapes and sizes, as compared to those of drier regions (Albuquerque *et al*. 2005, Florentino *et al*. 2007). However, comparing humid areas, the sizes were equivalent (Fraser *et al*. 2011, Perrault-Archambault & Coomes 2008).

The home gardens from Vaca Brava are used for subsistence purposes. They occupy less than one hectare of land, with only two exceptions where the area used as a home garden was a hectare and a half. This fact can show that the size of the home garden does not always correlate with its function. It was often observed in Vaca Brava that this fact occurs due to cultural and social economic factors. Many of the residents inherited their land from their families and they have the idea of cultivating on this site in order to assist their family's food demand.

According to Guarim Neto and Amaral (2010), the perspective of delimitation of defined areas as a home garden changes from place to place. In this aspect, the demarcation criteria found in Vaca Brava confirm the proposal of these authors, as it was noticed that between the two locations occurs variation regarding the criteria for inclusion/exclusion of plantations as part of the home garden area. In High Vaca Brava, there was a division between home garden and plantation, in other words, the home garden is demarcated by the house's immediacy, while the plantation exists in an area outside of the home garden. In Low Vaca Brava, plantations are included in the home gardens' area, in other words, there is no division between them.

Florentino *et al*. (2007), working in areas from Caatinga registered home gardens with sizes varying from 140m² to 12,500m², with an average size of 3,300m² and a standard deviation of 4,210m². In Albuquerque *et al*. (2005) in this exact biome, home gardens were found with sizes between 100m² and 3000m², and an average size of 496m² and a standard deviation of 754m². The sizes of the home gardens in Vaca Brava were sufficiently greater than the results of these authors, obtaining measurements between 320m² and 15,982m², with the average being 4,608.85m² and a standard deviation of 5,271.88m². This variation may occur regarding water availability which disfavors the cultivation of large areas.

Regarding the age parameters and the home garden richness, there was no correlation observed in the home gardens studied by Florentino *et al*. (2007). Albuquerque *et al*. (2005) however, found a positive correlation between the area of home gardens and their abundance. In Vaca Brava, comparisons were performed between area, function, age of manager, relative frequency and relative density, for both native and exotic plants. Both demonstrated a relationship with these parameters, with the exception of the frequency of native species and density of exotic ones. When the relationship between function, density and frequency was evaluated, only exotic plants correlated.

These data show that the area of the home gardens directly influences the amount and occurrence of individuals, except for the frequency of native species that did not correlate. However, it is understood that the bigger the home garden is, the more individuals that will be introduced to it. These may be mainly exotic, due the high demand for species used for food and medicine, or as ornamental plants. This suggests that the managers of these home gardens mainly try to add plants that are not naturally occuring in the garden area, in order to supply the necessities of the family.

Uses

According to previous studies (Albuquerque *et al*. 2005, Florentino *et al*. 2007, Innerhofer & Bernhardt 2011, Reyes-García *et al*. 2010, Styger 1999, Vogl-Lukasser 2010), the uses that each plant presents varies, mainly, by the particular culture of each community. Innerhofer and Bernhardt (2011), in their study in the Equatorial Amazon, create categories for the useful plants of the region, as plants that serve for medicine and rituals, construction and handicraft, fishing, hunting, dyes, etc. Vogl-Lukasser *et al*. (2010), in their study of home gardens in Austria, call attention to the idea that organization of the plants in categories varies from gardener to gardener. The usage categories, in the altitudinal marsh retrace, in the same way, this community reality, observing the ways in which the managers see the possible uses for each plant.

In Vaca Brava, the use of native species for lumber was represented in the fuel category. However, this doesn't demonstrate their importance in the community. It is only after senescence that the individuals have their wood used for firewood or charcoal. In areas of Caatinga, Albuquerque *et al*. (2005) and Florentino *et al*. (2007) found similar results regarding plants used as lumber being attributed to native species. In regards to other uses, the former authors identified medicinal and food plants as having the same importance, while the later observed that only food plants were of greater importance.

In Vaca Brava, food plants were the most highlighted, corroborating the results discussed above. Much as the findings of the present study, Fraser *et al*. (2011) and Wezel and Bender (2003), in study areas with high rainfall, observed that plants used for food purposes are distinguished. Regarding ornamentals, Vogl-Lukasser and Vogl (2004) recorded that the richness of these species in Austrian home gardens was due to the agriculturists' wives, who have introduced species that present embellishment potential for the garden. A great amount of plants destined for ornamentation were recorded, however, most of them were concentrated in just two residences, indicating that it is not a standard of local culture, but related to the preference of the producer.

The category of food plants was outstanding in the studied home gardens, mainly due to the species density of cultivated fruit bearing species. Valadão *et al*. (2006) discusses the role of small cultivations around the house sites in omplementation of the family diet. These small plots are also an important option for the improvement of the quality of life, since they serve as a source of subsistence for needy families, as well as, a source of added income. In their research on cultivated plants, Valadão *et al*. (2006), and Clerck and Negreros-Castillo (2000) cited the presence of plants commonly found in plantations as beans, maize, cassava, etc. These offer greater safety for the manager because they have a convenient productive cycle, which supplements the local food available for purchase, which in turn contributes to the localeconomy.

Some species are recognized as more important than others, like the banana (*M. accuminata* x *balbisiana*), according to Valadão *et al*. (2006), for being efficient in their production, throughout the year. This is an indispensable element in many home gardens with subsistence purposes. In this way, in Vaca Brava, *M. acuminata* x *balbisiana* occupied an important place in most of the residences. This is due to its convenience, nutritional values, practicality and low management cost. A similar observation for this species was recorded by Florentino *et al*. (2007) in Caruaru, evidenciary of certain species holding greater attention of the manager due to their nutritional importance for the family. Other food plants also support this dynamic, when they are used to supplement the family diet, providing high protein and caloric value for the consumers.

Conclusions

The typical agro-forestry home gardens found in Vaca Brava Community show themselves as structurally complex and floristically diversified, due to the variation in their sizes and number of species recorded. They are therefore perceived as effective spaces for maintaining several species, including native ones. The way in which these species are kept in the home garden is directly related to the socioeconomic and cultural conditions of their managers. The association of fruit crops and the permanence of native woody species makes these places sketches of small systems that can help in the conservation of the local diversity, depending on the style of management used upon them. Investigative studies about agro-forestry home gardens are increasingly needed, in order to understand them as a conservation option in terms of their structure and composition.

References

Abreu, D.B.O., R.B. Oliveira Filho, C.F.A. Vasconcelos Neto, C.M. Lucena, L.P. Félix & R.F.P. Lucena. 2011. Classificação etnobotânica por uma comunidade rural em um brejo de altitude rural em um brejo de altitude no Nordeste do Brasil. *Biofar* 6(1):55-74.

Albuquerque, U.P., L.H.C. Andrade & J. Caballero. 2005. Structure and floristics of homegardens in Northeastern Brazil. *Journal of Arid Enviroments* 62(3):491-506.

Albuquerque, U.P., R.F.P. Lucena, & L.V.F.C.Cunha. 2010. *Métodos e Técnicas na Pesquisa Etnobiológica e Etnoecológica*. NUPEEA, Recife, Brazil.

Alcorn, J.B. 1990. Indigenous agroforestry systems in the Latin America Tropics. Pp. 203-220 in *Agroecology and Small Farm Development*. Edited by M.A. Altieri & S.B. Hecht. CRC Press Inc., Boca Raton, Florida.

Agelet, A., M.A. Bonet & J. Vallès. 2000. Homegardens and their role as a main source of medicinal plants in mountain regions of Catalonia (Iberian Peninsula). *Economic Botany* 54(3):295-309.

Andrade, G.O. & R.C Lins. 1964. Introdução ao estudo dos “Brejos” Pernambucanos Universidade de Recife. *Arquivo do Instituto de Ciências da Terra* 2:21-34.

Ayres, M., M.J. Ayres, D.L. Ayres, D.L. & A.S. Santos. 2000. *Bioestat 2.0: Aplicações Estatísticas nas Áreas das Ciências Biológicas e Médicas*. Sociedade Civil Mamirauá, Brazil.

Barrera, A. 1980. Sobre la unidad de habitación tradicional campesina y el manejo de recursos bióticos en el área Maya Yucatense. *Biotica* 5(3):115-129.

Barros, M.J.V. 2005. *Estudo da cobertura vegetal do município de Areia - PB: Subsídios para a Gestão Ambiental.* Dissertação de Mestrado. Programa de Pos-Graduação em Agronomia. Universidade Federal de Paraíba, Areia, Paraíba, Brazil.

Blanckaert, I., R.L. Swennen, M.Paredes Flores, R.Rosas Lopez & R. Lira Saade. 2004. Floristic composition, plants uses and management pratices in homegardens of San Rafael Coxcatlán, Valley of Tehuacán-Cuicatlán, Mexico. *Journal of Arid Environments* 57(2):179-202.

Beatriz, R.A., G.S. Graciela, O.D.M. Isabel, O.C. Virgínia, P.P.R. Elvira, P.G. Estela, & R.H. Lídia. 1998. Theobroma bicolor Humb. E Bonpl. (Sterculiaceae, “cuapataxtle”) em el Municipio de Ayutla de Los Libres, Guerrero. Composición florística de loshuertos y aspectos etnobotánicos. *Boletim da Sociedade Botánica de México* 63:75-84.

Clerck, F.A.J. & P. Negreros-Castillo. 2000. Plant species of traditional Mayan homegardens of Mexico as analogs for multistrata agroforests. *Agroforestry Systems* 48(3):303-317.

Eyzaguirre, P.E. & O. Linares. 2004. Introduction. Pp. 1-28 in *Home gardens and agrobiodiversity*. Edited by P. Eyzaguirre & O. Linares. Smithsonian Books, Washington.

Fraser, F.A., A.B. Junqueira, & C.R. Clement. 2011. Homegardens on Amazonian dark earths, non-anthropogenic upland, amd floodplain soils along the Brazilian middle Madeira river exhibit diverging agrobiodiversity. *Economic Botany* 65(1):1-12.

Fernandes, E.C.M. & P.K.P. Nair. 1986. An evaluation of the structure and function of tropical homegardens. *Agricultural Systems* 21:279-310.

Forzza, R.C., P.M. Leitman, A. Costa, A. Alves de Carvalho Jr., A.L. Peixoto, B.M.T. Walter, C. Bicudo, D. Zappi, D. Pinheiro da Costa, E. Lleras, G. Martinelli, H. Cavalcante de Lima, J. Prado, J.R. Stehmann, J.F.A. Baumgratz, J.R. Pirani, L. da Silva Sylvestre, L.C. Maia, L.G. Lohmann, L. Paganucci, M. Silveira, M. Nadruz, M.C.H. Mamede, M.N.C. Bastos, M.P. Morim, M.R. Barbosa, M. Menezes, M. Hopkins, R. Secco, T. Cavalcanti, & V.C. Souza. 2010. *Catálogo de Plantas e Fungos do Brasil*. Volume Two. Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Rio de Janeiro, Brazil.

Florentino, A.T.N., E.L. Araújo, & U.P. Albuquerque. 2007. Contribuição de quintais agroflorestais na conservação de plantas da Caatinga, Município de Caruaru, PE, Brasil. *Acta Botânica Brasílica* 21(1):37-47.

Galluzzi, G., P. Eyzaguirre, & V. Negri. 2010. Home gardens: neglected hotspots of agro-biodiversity and cultural diversity. *Biodiversity and Conservation* 19(13):3635-3654.

Guarim Neto, G. & C.N. Amaral. 2010. Aspectos etnobotânicos de quintais tradicionais dos moradores de Rosário Oeste, Mato Grosso, Brasil. *Polibotânica* 29:191-212.

Gliessman, S.R. 1990. Integrating trees into agriculture: the home garden agro-ecosystem as an example of agroforestry in the tropics. Pp. 160-168 in *Agroecology: Researching the ecological basis for sustainable agriculture.* Edited by S.R. Gliessman. Springer-Verlag, New York, New York.

Innerhofer, S. & K.G. Bernhardt. 2011. Ethnobotanic garden design in the Ecuadorian Amazon. *Biodiversity and Conservation* 20(2):429-439.

Kumar, B.M. & P.K.R. Nair. 2004. The enigma of tropical homegardens. *Agroforestry Systems* 61:135–152.

Lamont, S.R., W.A. Eshbaugh, A.M. Greenberg. 1999. Composition, diversity, and use of homegardens among three Amazonian villages. *Economic Botany* 53(3):312-326.

MMA - Ministério do Meio Ambiente. 2004/2005. *Áreas prioritárias para a conservação, utilização sustentável e repartição de benefícios da biodiversidade brasileira*. Ministério do Meio Ambiente, Brasília.

Mayo, S.J. & V.P.B. Fevereiro. 1982. *Mata do Pau Ferro. A pilot study of the Brejo Forest of Paraíba, Brazil.* Royal Botanic Garden, Kew, London.

Millat-e-Mustafa, M.D. 1998. An approach towards analysis of homegardens. Pp. 39-48 in *Applied Ethnobotany in Natural Resource Management Traditional Home Gardens.* International Centre for Integrated Mountain Development, Kathmandu.

Nair, P.K.R. 1986. An evaluation of the structure and function of tropical homegardens. *Agricultural Systems* 21:279-310.

Nair, P.K.R. 1991. State-of-the-art of agroforestry systems. *Forest Ecology and Management* 45:5–29.

Nair, P.K.R. 2001. Do tropical homegardens elude science, or is it the other way around? *Agroforestry Systems* 53:239-245.

Nair, P.K.R. 2004. The enigma of tropical homegardens. *Agroflorestry Systems* 61:135-152.

Perrault-Archambault, M. & O.T. Coomes. 2008. Distribution of agrobiodiversity in home gardens along the Corrientes River, Peruvian Amazon. *Economic Botany* 28(2):109-126.

Pôrto, K.C., J.J.P. Cabral, & M. Tabarelli. 2004. *Brejos de altitude em Pernambuco e Paraíba: História natural, ecologia e conservação.* Ministério do Meio Ambiente, Brasilia.

Reyes-García, V., S. Vila, L. Aceituno-Mata, L. Calvet-Mir, T. Garnatje, A. Jesch, J.J. Lastra, M. Parada, M. Rigat, J. Vallès, & M. Pardo-De-Santayana. 2010. Gendered homegardens: a study in three mountain areas of the Iberian Peninsula. *Economic Botany* 64(3):235-247.

Ribeiro, M.C., J.P. Metzger, A.C. Martensen, F.C. Ponzoni, & M.M. Hirota. 2009. The Brazilian Atlantic forest: how much is left, and how is the remaining forest distributed? Implications for conservation. *Biological Conservation* 142:1141–1153.

Rico-Gray, V., J.G. Garcia-Franco, A. Chemas, A. Puch, & P. Sima. 1990. Species composition, similarity, and structure of Mayan homegardens in Tixpeual and Tixcacaltuyub, Yucatan, Mexico. *Economic Botany* 44:470-487.
Shanavas, A., & M. Kumar. 2003. Fuelwood characteristics of tree species in homegardens of Kerala, India. *Agroforestry Systems* 58:11-24.

SNE - Sociedade Nordestina de Ecologia. 2002. *Mapeamento da Mata Atlântica, Seus Ecossistemas Associados dos Estados da Paraíba e do Rio Grande do Norte.* Relatório técnico, São Paulo, Brazil.

Soemarwoto, O., E.M.E. Soekartadiredja, & A. Ralam. 1985. The Javanese home-garden as an integrated agroecosystem. *Food and Nutrition Bulletin* 7(3):44-47.

Sokal, R.R. & F.J. Rolf. 1995. *Biometry*. Freeman and Company. New York, New York.

SUDEMA - Superintendence of Environment Development. 2004. Atualização do Diagnostico Florestal do Estado da Paraíba. SUDEMA, João Pessoa, Brazil.

Styger, E., J.E.M. Rakotoarimanana, E.C.M. Fernandes, & R. Rabevohitra. 1999. Indigenous fruit trees of Madagascar: potential components of agroforestry systems to improve human nutrition and restore biological diversity. *Agroforestry Systems* 46:289-310.

Valadão, L.M., M.C.M. Amorozo, & D.G. Motta. 2006. Produção de alimentos na unidade domiciliar, dieta e estado nutricional: a contribuição dos quintais em um Assentamento Rural no Estado de São Paulo. Pp. 93-118 in *Tópicos em Conservação e Etnobotânica de Plantas Alimentícias.* Edited by U.P. Albuquerque & C.F.B. Almeida. NUPEEA, Recife, Brazil.

Vogl-Lukasser, B., & C.R. Vogl. 2004. Ethnobotanical research in homegardens of small farmers in the Alpine region of Osttirol (Austria): an example for bridges built and building bridges. *Ethnobotany Research & Applications* 2:111-137.

Vogl, C.R., B. Vogl-Lukasser, & R.K. Puri. 2004. Tools and methods for data collection in ethnobotanical studies of homegardens. *Field Methods* 16(3):285-306.

Vogl-Lukasser, B., C.R. Vogl, M. Gütler, & S. Heckler. 2010. Plant species with spontaneous reproduction in homegardens in Eastern Tyrol (Austria): perception and management by women farmers. *Ethnobotany Research & Applications* 8:1-15.

Watson, J.W., & P.B. Eyzaguirre. 2002. Editors of *Homegardens and In Situ Conservation of Plant Genetic Resources in Farming Systems.* Proceedings of the Second International Home gardens Workshop, July 17-19, 2001, Witzenhausen, Germany. International Plant Genetic Resources Institute. Rome.

Wiersum, K.F. 2004. Forest gardens as an intermediate land-use system in the nature-culture continuum: characteristics and future potential. *Agroforestry Systems* 61:123-134.

Wezel, A. & S. Bender. 2003. Plant species diversity of homegardens of Cuba and its significance for household food supply. *Agroforestry Systems* 57:39-49.

Zaldivar, M.E., O.J. Rocha, E. Castro, & R. Barrante. 2002. Species diversity of edible plants grown in homegardens of Chibchan Amerindians from Costa Rica. *Human Ecology* 30(3):301-316.