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O PAPEL DOS QUINTAIS URBANOS NA SEGURANÇA ALIMENTAR, BEM ESTAR E CONSERVAÇÃO DA BIODIVERSIDADE

JÉSSICA DE PAIVA BEZERRA

2014
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Brasil

Jéssica de Paiva Bezerra

O papel dos quintais urbanos na segurança alimentar, bem estar e conservação da biodiversidade

Dissertação apresentada ao Programa Regional de Pós-Graduação em Desenvolvimento e Meio Ambiente, da Universidade Federal do Rio Grande do Norte (PRODEMA/UFRN), como parte dos requisitos necessários à obtenção do título de Mestre.

Orientador: **Prof. Dra. Priscila F. M. Lopes**

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Canção Mínima

No mistério do sem-fim
equilibra-se um planeta.
E, no planeta, um jardim,
e, no jardim, um canteiro;
no canteiro uma violeta,
e, sobre ela, o dia inteiro,
entre o planeta e o sem-fim,
a asa de uma borboleta

Cecília Meireles

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De Passarinhos

Para compor um tratado sobre passarinhos
É preciso por primeiro que haja um rio com árvores
e palmeiras nas margens
E dentro dos quintais das casas que haja pelo menos goiabeiras
E que haja por perto brejos e iguarias de brejos
É preciso que haja insetos para os passarinhos
Insetos de pau sobretudo que são os mais palatáveis
A presença de libélulas seria uma boa
O azul é muito importante na vida dos passarinhos
Porque os passarinhos precisam antes de belos ser eternos
Eternos que nem uma fuga de Bach.

Manoel de Barros

RESUMO

O papel dos quintais urbanos na segurança alimentar, bem estar e conservação da biodiversidade

Os quintais residenciais, exercem papéis ambientais e sociais no ambiente urbano. Estes espaços verdes podem minimizar potencialmente os impactos causados pelo crescimento das cidades, por ser uma alternativa para conectar áreas fragmentadas ou oferecer refúgios à vida silvestre e assim apoiar a conservação da biodiversidade. Além disso, os quintais demonstram um papel destacado no aumento do bem estar humano, devido às possibilidades de socialização, contato com a natureza, cultura local e melhoria da segurança alimentar que estes ambientes permitem às famílias urbanas e rurais. Apesar disso, ainda não está claro quais características específicas dos quintais podem atuar de maneira efetiva na conservação da biodiversidade, bem como na construção da segurança alimentar e do bem estar dos mantenedores de quintais e de suas famílias. O primeiro capítulo desta dissertação analisou a diversidade de espécies de plantas (nativas e exóticas) e avaliou a contribuição de diferentes tipos de quintais urbanos (ornamentais e agroflorestais) na presença de vida selvagem, como aves, micos e lagartos. Já o segundo capítulo avaliou a contribuição desses mesmos quintais para o bem estar e segurança alimentar dos seus proprietários. Para isso, 41 quintais foram visitados em Pium, localidade do litoral sul do nordeste do Brasil, uma região periurbana em fase de rápida expansão urbana e pressão imobiliária. Realizou-se um levantamento de toda a biodiversidade planejada, bem como da fauna associada aos quintais. Os dados referentes à segurança alimentar e bem estar foram captados através de uma entrevista aplicada aos mantenedores dos quintais. Estas entrevistas abordaram questões sobre o aporte de alimentos proveniente do quintal e a ausência de insumos químicos, além de aspectos do indicador FIB (Felicidade Interna Bruta). Os resultados mostraram que estes quintais em geral contribuem pouco para a manutenção de espécies de plantas nativas (nativas locais = 29 espécies do total = 187). A partir de suas principais características, os quintais foram classificados em ornamentais, agroflorestais e agroflorestais alimentares, esses grupos apresentaram diferentes efeitos sobre a presença dos animais estudados e os dois últimos contém a maioria das espécies nativas amostradas. A diversidade de plantas e de árvores foi um bom preditor para a presença de pássaros e micos. Assim, a contribuição dos quintais para a conservação da biodiversidade depende do tipo de quintal, alguns inclusive, podem exercer efeitos negativos sobre a conservação. Esses resultados podem direcionar

novas abordagens para a compreensão detalhada dos quintais e também políticas públicas aplicadas ao planejamento urbano. Os resultados do segundo capítulo demonstraram que os dois tipos de quintais agroflorestais contribuíram com a segurança alimentar das famílias, por fornecer alimentos e ervas medicinais, que em sua maioria, não possuíam pesticidas e fertilizantes químicos. Mas os três grupos de quintais são importantes componentes para o bem estar de seus mantenedores, pois além de ajudarem na transmissão do conhecimento sobre agricultura, favorecem a socialização, o contato com a natureza e trazem à tona sentimentos relacionados à paz e harmonia. Dessa forma, os quintais agroflorestais podem ser considerados como importantes meios para projetos e políticas públicas que visem favorecer a biodiversidade, bem como promover a segurança alimentar e o bem estar em áreas urbanas.

PALAVRAS-CHAVE: espaços verdes urbanos, agroecologia, diversidade vegetal, índices de bem estar, agricultura urbana.

ABSTRACT

The role of urban homegardens in food security, well-being and conservation of biodiversity

Residential homegardens have environmental and social roles in the urban environment. These green spaces can potentially minimize the impacts caused by the growth of cities, being an alternative to connect fragmented areas or offer refuge to wildlife and therefore support the conservation of biodiversity. In addition, the homegardens demonstrate a leading role in increasing human well-being by promoting socialization opportunities, contact with nature, local culture as well as improvements in food security for the urban families. Nevertheless, it is still unclear what specific characteristics of homegardens can act effectively in the conservation of the biodiversity, as well as in the construction of food security and well being of the homegardeners and their families. The first chapter of this thesis analyzed the diversity of plant species (native and exotic) and assessed the contribution of different types of urban gardens (ornamental and forest gardens alike) in the presence of wildlife such as birds, monkeys and lizards. In the second chapter we evaluated the contribution of those gardens to the welfare and food security of their owners. In order to do this, 41 gardens were visited in Pium, a southern coastal town in the northeastern Brazil, which also happens to be in a periurban region undergoing rapid urban expansion and pressure from the real estate market. We surveyed the planned biodiversity and fauna associated with homegardens. The data related to food security and welfare were sampled through interviews with the person in charge of taking care of the gardens. These interviews covered issues on the supply of food from the garden and absence of chemical products, as well as aspects of the GNH indicator (Gross National Happiness). The results showed that these homegardens generally contribute little to the maintenance of native plant species (native species = 29/ total = 187). From its main features, the gardens were classified as ornamental, forest gardens and forest farms. These groups had a different effect on the presence of the animals studied and the last two contained most of the sampled native species. The diversity of plants and trees was a good predictor of the presence of birds and monkeys. Thus, the contribution of yards for the conservation of biodiversity depends on the type of garden: some even can have negative effects on conservation. These results can direct new approaches to detailed understanding of gardens and also of public policies applied to urban planning. The results of the second chapter showed that the two types of forest gardens contributed to household food security, for providing food and medicinal herbs, which mostly did not have pesticides and chemical

fertilizers. But the three groups of gardens are important components for the well being of their stakeholders. Gardens help promote the transmission of knowledge on agriculture, socialization, contact with nature and bring up feelings related to peace and harmony. Thus, forest gardens can be considered important means to get through public projects and policies designed to encourage biodiversity and promote food security and well-being in urban areas

KEYWORDS: urban green spaces, agroecology, plant diversity, welfare rates, urban agriculture.

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INTRODUÇÃO GERAL

O papel dos quintais urbanos na segurança alimentar, bem estar e conservação da biodiversidade

Os antigos quintais e a intenção renovada

Frente às atuais mudanças de valores que questionam a qualidade da alimentação proveniente do sistema agroindustrial e seus efeitos sobre o meio ambiente e saúde humana, antigos saberes e práticas tradicionais vêm sendo retomados e ganham importância. Estas práticas, vistas sob um olhar consciente de sua importância e unidas ao conhecimento científico podem gerar benefícios em ambientes urbanos e rurais. Uma das formas mais antigas de uso da terra, comum em diversas culturas do mundo (FERNANDES & NAIR, 1986) é a produção de alimentos tanto de origem vegetal, quanto animal nas proximidades das residências, este modo de vida (não se resume puramente a um modo de produção), além de receber nomes atuais como "quintais agroflorestais", "quintais mistos", "quintais produtivos", vem ganhando importância no meio científico, em estudos sobre agroecologia, etnoecologia, ecologia urbana, conservação da biodiversidade, segurança alimentar, economia solidária e qualidade de vida.

Os quintais agroflorestais (QAF) representam um tipo de sistema de produção entre outros diferentes tipos de agroecossistema (GARROTE, 2004). São espaços geralmente pequenos localizados no entorno de residências, mantidos pela mão de obra familiar em ambientes rurais e/ou urbanos. Nestes, é cultivada uma grande diversidade espécies vegetais herbáceas, arbustivas arbóreas, como as frutíferas, hortaliças, plantas condimentares e medicinais; além disso, podem ser criados animais domésticos tais como galinhas e porcos (HUERTA &VAN DER WAL, 2011). Os produtos cultivados nestes ambientes são utilizados especialmente no consumo da família e em trocas entre parentes, amigos e vizinhos, além disso, seu excedente pode ser comercializado (ANGEL-PÉREZ & MARTIN, 2004).

Este tipo de produção é encontrado comumente em regiões tropicais e sub-tropicais do mundo (FERNANDES & NAIR, 1986). Uma série de estudos indicou a forte relevância dos quintais agroflorestais em culturas mesoamericanas e no sudeste da Ásia (ANGEL-PÉREZ & MARTIN, 2004). Os estudos comprovam a contribuição significativa dos QAF na complementação e melhoria da dieta familiar em diferentes épocas do ano, além de possíveis ganhos econômicos, um exemplo disso são assentamentos rurais em Apodi, RN

(DANTAS, 2007), onde a produção de frutas e carnes para a alimentação das famílias é derivada inteiramente dos quintais.

Pesquisas realizadas na Amazônia (SARAUGOUSSI et al., 1990) também demonstraram a relação entre quintais agroflorestais, diversificação e melhoria da dieta de comunidades locais, tanto pelo consumo de vitaminas e sais minerais em diversas épocas do ano, quanto pela diminuição da ingestão de alimentos industrializados e com insumos químicos. Este fator favorece a melhoria da saúde das famílias que possuem quintais e a prevenção de doenças causadas pelo excesso de açucares, sal, gorduras, conservantes e outros componentes potencialmente perigosos.

Uma característica particular destes ambientes é uma comunidade vegetal estratificada, que inclui diversas espécies, variedades, alturas e tempos de vida e dessa forma permite a utilização ininterrupta de sua produção ao longo do ano (dependendo das espécies) e facilita sua manutenção (ANGEL-PÉREZ & MARTIN, 2004), por meio de relações ecológicas locais, como fluxo de nutrientes e polinização.

O manejo dos QAF é independente de insumos industriais e de maquinários, é realizado por técnicas e ferramentas simples e de baixo custo, além disso, não são necessárias grandes extensões de terra, estas características se contrapõem à agricultura convencional, o que conduz a um potencial de produção sustentável, saudável e autônomo. A proximidade da residência ao quintal favorece o acesso fácil e rápido dos moradores à produção, não há necessidades de transporte, isso reafirma a sustentabilidade e autonomia deste sistema.

Com efeito, a produção em QAF aproxima-se das perspectivas apregoadas nas discussões e conceitos referentes à segurança alimentar (Figura 1), pois possui o potencial de produção de alimentos saudáveis e diversificados para o autoconsumo familiar, em pequenos espaços e dentro da dinâmica urbana, logo, pode viabilizar a construção da segurança alimentar em bairros ou residências com restrições orçamentárias, que de outra maneira incluiriam em suas dietas pequenas quantidades e variedades de alimentos naturais ou orgânicos, ou não incluiriam.

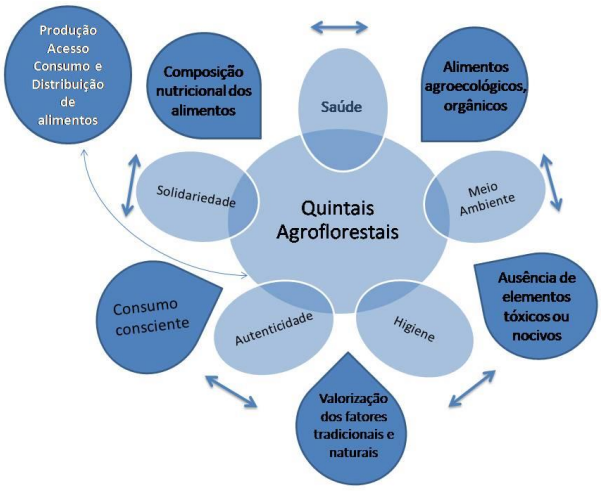

Fig. 1: Representação das correlações entre quintais agroflorestais, os eixos da segurança alimentar (saúde, solidariedade, autenticidade, higiene e meio ambiente) e as quatro esferas de atuação em políticas públicas para a segurança alimentar (produção, distribuição, acesso e consumo de alimentos), conforme Almeida et al, 2006.

O cultivo nos QAF pode gerar excedentes, que estendem seus benefícios a outros indivíduos através de doação, troca, ou venda. O processo de venda, comumente é realizado em circuitos curtos de comercialização, dessa forma os QAF incorporam-se ao quinto eixo da segurança alimentar, a solidariedade, que diz respeito ao consumo consciente - compra de um produto socialmente e ambientalmente correto, na qual o preço é justo tanto para o produtor quanto para o consumidor.

Por essas características, os quintais vêm sendo apontados como elementos que constroem resiliência socioecológica (VOGL et al. 2004). A resiliência, compreendida como a capacidade adaptativa de um sistema (social ou ecológico) se manter frente perturbações externas (ADGER, 2000), pode ser construída por diversos fatores, entre eles a "flexibilidade", que compreende a diversidade de fontes alternativas de recursos e habilidade de desenvolver outras fontes de renda (CINNER et al., 2009). Os quintais atuam dessa maneira por poderem fornecer alimentos e remédios em momentos de perturbações ambientais, variações econômicas e mudanças políticas, tais como secas, enchentes e aumento de preços (BUCHMANN, 2009).

Os quintais refletem as necessidades (de alimentos, temperos, medicinas naturais, lenha, sombras) dos seus mantenedores e também revelam os saberes tradicionais destes, sobre cultivo e o uso das espécies vegetais (FERNANDES & NAIR, 1986). Dessa forma, prestam também algumas funções sociais como a troca de conhecimentos agrícolas e de aspectos culturais, bem como o importante resgate no meio urbano da socialização entre vizinhos e parentes, através dos plantios, cuidados com os quintais, trocas de sementes,

mudas e alimentos. Assim estes espaços residenciais podem influenciar diretamente no bem estar de quem os mantêm, por despertar sentimentos de paz, satisfação com a vida e oportunidades de socialização (TZOULAS *et al*., 2007 & TSE, 2010); além disso, representam uma ponte entre as pessoas e a natureza no ambiente urbano (KIESLING & MANNING, 2010; PYLE, 2003). Esses benefícios sociais, econômicos e ambientais que os quintais podem proporcionar, vêm em sendo discutidos em pesquisas sobre bem estar e qualidade de vida.

Além das vantagens sociais, os quintais podem exercer diversos tipos de funções e serviços ecossistêmicos, como a proteção à vida silvestre em áreas urbanas, sequestro de carbono, fertilidade do solo e micro drenagem de águas pluviais (SWINTON et al., 2007). Em função destes e outros potenciais, nos últimos 30 anos pesquisadores vêm desenvolvendo estudos de caráter ecológico e botânico em quintais de diversas partes do mundo como Índia (SAHA, 2009), Brasil (AKINNIFESI et al, 2010), Espanha (CALVET-MIR, 2012) e México (GARCÍA-FRAPOLLI, 2007).

Uma grande parcela das pesquisas realizadas neste período se direcionou a compreender os usos de plantas e realizar levantamentos de composição de espécies botânicas (HUERTA & VAN DER WAL, 2011). Foram encontrados elevados índices de diversidade vegetal em quintais tropicais, como no Oeste de Java (FERNANDES & NAIR, 1986) e no Sul do Vietnam (WEBB & KABIR, 2009).

Estes altos valores de diversidade indicam que em alguns casos os quintais podem servir como um repositório de espécies raras e ameaçadas de extinção, mas está longe de se afirmar esse fato como um padrão, em função da diversidade de cultivos entre localidades e mesmo entre cada residência, já que os tipos de plantas cultivados estão diretamente associados aos interesses, necessidades, influências sociais de cada família e as técnicas de manejo utilizadas.

As influências dos quintais urbanos na conservação da biodiversidade ainda não estão claras, apesar desta informação ser importante para determinar o planejamento urbano (RAHEEM et al, 2008). Para isso, é necessário entender como polinizadores e dispersores podem persistir em quintais e quais as características que (por exemplo: os diferentes hábitos vegetais e a biodiversidade) atraem animais: como aves, mamíferos, anfíbios e répteis (WEBB & KABIR, 2009).

Frente ao crescimento das cidades, expansão da agricultura e pecuária de grande escala e consequente supressão dos ecossistemas naturais, os quintais podem representar a única opção de habitat para espécies silvestres em determinadas paisagens urbanas (RAHEEM et al, 2008). Para o desenvolvimento destes potenciais, são necessárias

pesquisas que procurem compreender em que medida os quintais urbanos podem exercer um papel viável para a conservação, em quais circunstâncias (WEBB & KABIR, 2009) e para que espécies. O conhecimento do valor ecológico, bem como dos insucessos, problemáticas e limitações relacionadas ao uso de quintais para esses fins, favorecem a tomada correta de decisões e o direcionamento de recursos quanto às ações de conservação e uso adequado da terra.

O presente trabalho teve como objetivo geral avaliar a contribuição de quintais na conservação da biodiversidade em ambientes urbanos, assim como a influência destes no bem estar e segurança alimentar de seus proprietários. Para isso, em seu primeiro capítulo, buscou avaliar a contribuição de quintais no cultivo de espécies nativas e o uso destes espaços como recursos e habitats para animais silvestres. Além disso, objetivou-se identificar possíveis fatores nestes quintais que promovem o uso e a visitação dos animais. Esperou-se que quintais com maior uso de plantas ornamentais, tivessem menor diversidade e atraíssem menos espécies de animais em relação aos quintais com múltiplos tipos de cultivo, como alimentos e ervas medicinais. Isso ocorreria porque usos múltiplos provavelmente implicam em múltiplas camadas de dossel e maior diversidade (KUMAR & Nair, 2004), oferecendo mais recursos e habitats para animais.

O segundo capítulo analisou a contribuição dos quintais para o bem estar e segurança alimentar das famílias que os mantêm. Esperava-se que quintais agroflorestais provessem maior segurança alimentar aos seus mantenedores, por contribuir na diversidade de itens alimentares, bem como na qualidade destes alimentos (como ausência de insumos químicos de cultivo). Por outro lado, não esperava-se diferença em outros aspectos do bem-estar proporcionados entre os diferentes tipos de quintais, como uso do tempo, educação não formal, vitalidade comunitária, autoavaliação da saúde física e psicológica, visto que todos permitiriam tempo de qualidade aos seus mantenedores e contato com a natureza.

Em atendimento aos objetivos e conforme padronização estabelecida pelo Programa, esta Dissertação se encontra composta por esta Introdução geral, uma Caracterização geral da Área de estudo, Metodologia geral empregada para o conjunto da obra (dissertação) e por dois capítulos que correspondem a artigos científicos submetidos à publicação. O capítulo 1, intitulado: “Urban Homegardens and Biodiversity Conservation”, foi submetido ao periódico Urban Ecosystems e, portanto, está formatado conforme este periódico (http://www.springer.com/life+sciences/ecology/journal/11252?detailsPage=pltci_1060256). O capítulo 2, tem como título: De sombra e frutas frescas: o papel dos quintais urbanos

no bem estar e segurança alimentar de seus proprietários, foi submetido ao periódico Human Ecology de acordo com suas normas (http://www.springer.com/social+sciences/anthropology+%26+archaeology/journal/10745).

CARACTERIZAÇÃO GERAL DA ÁREA DE ESTUDO

A coleta de dados foi conduzida no litoral sul do Rio Grande do Norte, nordeste do Brasil, na parcela urbana da localidade de Pium, inserida no município de Parnamirim. Pium está situado a 25 km ao sul da capital do Estado (Natal) (Fig. 2), limita-se a leste pelo Oceano Atlântico e está a 650m (a partir da área central do perímetro amostrado) da APA (Área de Proteção Ambiental) Bonfim/ Guaraíra, e a 500m do Monumento Natural Morro do Careca (Área de Proteção Integral), as quais protegem remanescentes de Mata Atlântica, que nesta região do país é influenciada pela vegetação do bioma Caatinga, em função de sua proximidade.

O clima da região é caracterizado conforme a classificação de Köppen como As (com estação seca de verão) (ALVARES *et al*., 2013), pluviosidade e temperatura média anual de 1.442,8 mm e 27C°, respectivamente (MME, 2005).

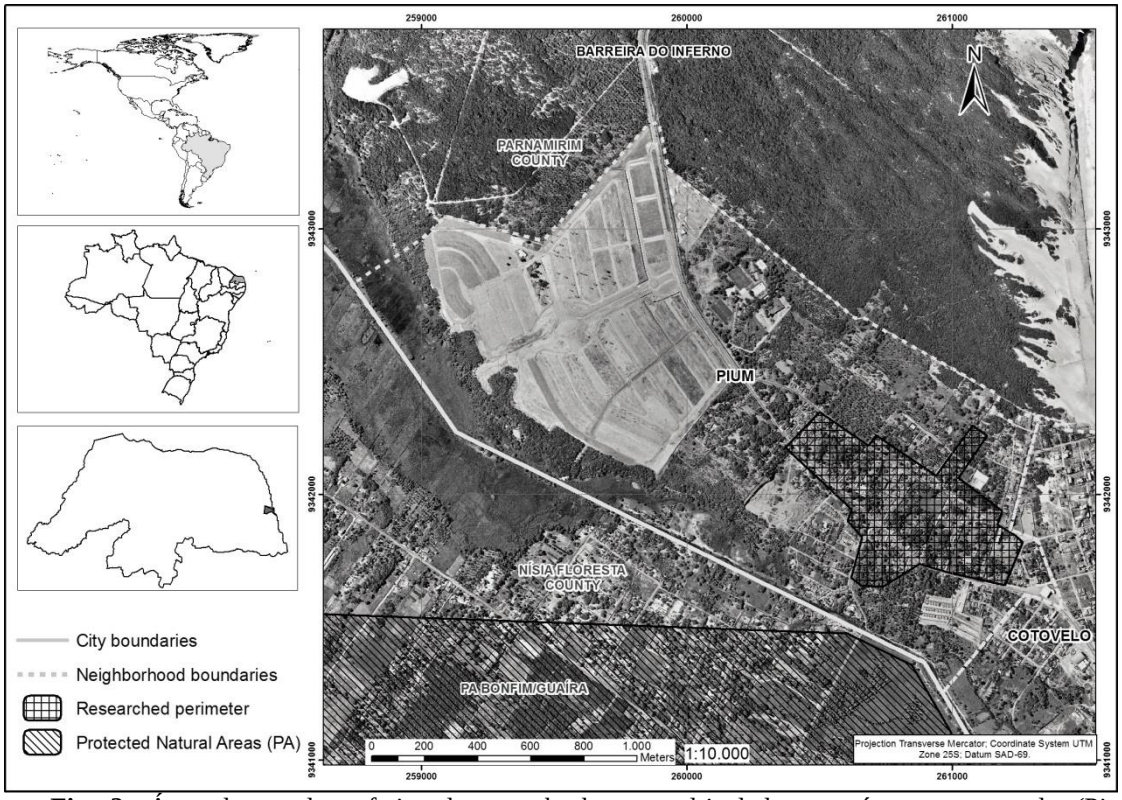

Fig. 2- Área de estudo enfatizando com hachura quadriculada o perímetro amostrado (Pium, município de Parnamirim, RN) e hachura listrada a área protegida que margeia a localidade.

A localização deste bairro entre Natal e as praias do litoral sul do estado, implica em elevado fluxo de pessoas na região, devido tanto à ocupação urbana dessas áreas, quanto aos atrativos turísticos, que intensificam o trânsito de carros durante os finais de semana e feriados. A duplicação da avenida que interliga as áreas mencionadas, em 1993, reforçou as modificações na forma de uso do espaço e na arquitetura das habitações de Pium, que se moldou para adequar-se à crescente demanda turística e comercial (LIMA, 2000), um exemplo é a modificação de residências e uso de calçadas para o estabelecimento de mercados, bares, lanchonetes e outros pequenos empreendimentos do setor terciário.

Adicionado a isso, a especulação imobiliária no litoral também atua como um forte agente de modificação da paisagem. Tornou-se prática comum no bairro, a diminuição de área das residências para venda e/ou aluguel de apartamentos e *kitinetes.* Este fator implica diretamente no corte de espécies arbóreas e redução das áreas de quintais residenciais, importantes espaços utilizados para o cultivo de plantas e criação de animais, bem como para microdrenagem de águas pluviais (observação pessoal). Paralelamente, estas transformações se estendem às esferas sociais, pois refletem na diminuição do contato dos jovens com práticas culturais que permearam gerações.

A Mata Atlântica e a Caatinga são biomas altamente ameaçados pelo desenvolvimento urbano e outros impactos humanos. A Mata Atlântica é considerada a segunda maior floresta pluvial tropical da América, assim como o segundo bioma mais ameaçado do mundo, incluso nos 25 hotspots mundiais de biodiversidade (MITTERMEIER et al., 2005). Em todo o território nacional, restam atualmente 8% da sua cobertura original e no nordeste do país esta quantia se reduz a 4% (MMA, 2012), repartida em diversos fragmentos desconectados pela matriz urbana e agroindustrial. A Caatinga, um bioma semiárido também rico em biodiversidade e altos índices de endemismos, é geralmente esquecido (GIULLIETI et al., 2004), tendo escassas áreas protegidas e políticas de conservação (LEAL et al., 2005). Dados sugerem que mais de 50% de sua área original sofreu mudanças significativas, devido à agricultura (baseada em atividades de corte e queima) e à pecuária (DRUMOND et al., 2000).

METODOLOGIA GERAL

Foi realizada uma revisão de literatura para compreender o histórico de trabalhos desenvolvidos na área, o estado da arte nas pesquisas científicas em nível nacional e internacional e as lacunas a serem respondidas por novos trabalhos. Assim, foram consultadas teses, dissertações, artigos nacionais, livros e projetos relacionados ao tema,

fizeram-se leituras da literatura internacional, que concederam as informações mais atuais no campo de pesquisa. Adicionalmente, foram realizadas pesquisas sobre bem estar, segurança alimentar e agroecologia para o refinamento da compreensão destes conceitos. Buscaram-se levantamentos florísticos do bioma local e regional bem como informações sociais e estruturais da área de estudo.

O trabalho de campo foi realizado durante os meses de março a julho de 2013. A maior parte dos quintais foi identificada através de observações nas ruas do bairro, embora indicações também tenham sido feitas por moradores antigos do lugar e por entrevistados.

Apesar da inexistência de dados concretos sobre a população da área de estudo, estimou-se aqui que haja cerca de 400 residências, entre as quais foram encontrados 56 quintais onde eram feitos cultivos com fins medicinais, alimentares (frutíferas, hortaliças, flores e condimentos), religiosos e ornamentais. Destes, 41 foram visitados, visto que em algumas casas seus responsáveis estavam ausentes ou se negaram a participar na pesquisa.

A metodologia referente aos objetivos específicos está detalhada em cada capítulo a seguir.

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Capítulo 1

URBAN HOMEGARDENS AND BIODIVERSITY CONSERVATION

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URBAN HOMEGARDENS AND BIODIVERSITY CONSERVATION

Abstract

Green areas in the urban matrix, such as home gardens, could potentially minimize impacts caused by urban development by providing an alternative for connecting fragmented areas or offering refuges and supporting biodiversity conservation. This study analyzed general and native plant species diversity to determine how the size and diversity of these gardens affect the presence of wildlife, namely birds, marmosets, and lizards. Forty-one home gardens on the northeastern Brazilian coast in a peri-urban region undergoing fast development and real estate pressure were visited. The results showed that in general, these gardens contributed very little to the maintenance of native plant species (native local = 29 species; total general = 187). Nevertheless, the gardens presented characteristics that allowed their classification as ornamental, agroforestry, and food agroforestry; these groups showed different effects in the studied animals, with the last two containing most of the native species sampled. The diversity of plants and the number of individual trees were good predictors of the presence of birds and marmosets. Hence, the contribution of home gardens to the conservation of biodiversity was not straightforward; it depended on the type of garden. In fact, some gardens had negative effects on conservation if they were cultivated with mostly exotic species close to natural fragments. Such results could direct new approaches to the detailed understanding of home gardens and also guide public policies to be applied to urban planning.

Keywords: Vegetation diversity, Agroforestry, Urban matrix, Ecosystem services, Species richness.

1. Introduction

Urban growth directly affects the natural ecosystems in place, causing habitat losses, changes in the dynamics of species populations, water flow, and nutrient cycles, and substituting the native vegetation for exotic species (Marzluff, 2001). Moreover, the effects of urbanization can reach areas beyond the city limits to influence negatively distant ecosystems through the use of natural resources demanded by cities and producing and releasing solid residues and pollutants. Such effects can influence areas 500 to 1,000 times larger than the originally urbanized ones (Colding and Barthel, 2013).

Such consequences of urban development bring to the forefront the need for specific studies focused on finding alternatives to improve the common contradiction between human occupation and biodiversity conservation. Agroecosystems and urban green areas, such as home gardens, have been presented as promising alternatives to the maintenance of ecosystem services and of species in areas fragmented by the urban matrix (Calvet-Mir et al., 2012; Kiboi et al., 2014; Webb and Kabir, 2009). Home gardens are an ancient way of using the land, common to multiple cultures worldwide (Fernandes and Nair, 1986) and could ameliorate the negative impacts on biodiversity and ecosystem services caused by urban growth (Marzluff, 2001) by playing different roles, such as wildlife protection in urban areas, carbon sequestration, soil fertility, and rain water drainage (Andersson et al., 2014; Swinton et al., 2007).

The impacts of home gardens on biodiversity conservation have yet to be clarified, even though this information could potentially be important for urban planning (Raheem et al., 2008). For this purpose, it is necessary to understand how pollinizers and dispersers persist in gardens, which features (e.g. biodiversity and canopy layers) attract the presence of animals, such as birds, mammals, amphibians, and reptiles, and in which circumstances gardens could be a complementary alternative to nature conservation (Webb and Kabir,

2009). Knowing about the ecological value of these gardens, as well as their failures, problems, and limitations to conservation, is important for supporting and directing policies aimed at conserving or adequately using the available land.

Most of the research done so far, however, has focused on the understanding of plant use and botanical lists (Huerta and van der Wal, 2012). Such studies show high plant diversity indexes in tropical gardens (Fernandes and Nair, 1986), typically in the range of 0.81 (Bernholt et al., 2009) to 2.8 (Kehlenbeck and Maass, 2004) (Shannon Index). These high diversity values suggest that, in some cases, home gardens could serve as a repository for rare or endangered species. Nevertheless, such findings cannot be considered standard, as there is high variation depending on the locality, the kind of plants being cultivated, and the types of households, as these can be affected by factors such as beliefs, habits, and gender (Kumar and Nair, 2004).

The Brazilian Atlantic Forest and the Caatinga, a semi-arid environment, are two biomes highly threatened by urban development and other human-induced impacts. While the Atlantic Forest is considered the second largest pluvial tropical forest in the Americas, it is also the second most threatened biome in the world, being one of the 34 world hotspots (Mittermeier et al., 2005). In Brazil, only about 8% of its original distribution is left, and only 4% of it is in northeastern Brazilian, with most of its remnants scattered through unconnected fragments isolated by the urban matrix or agribusiness. The Caatinga, a semi-arid biome also rich in biodiversity and high endemism, is generally overlooked, being scarcely protected by parks or by management policies (Leal et al., 2005). Some figures suggest that over 50% of its original area has undergone significant changes due to agriculture and cattle herding, which are based on clear cutting and burning (Leal et al., 2003).

This study evaluated the contribution of urban gardens to the maintenance of native plant species and to the use of these spaces as resources and habitats for wild animals. It

also aimed to identify possible factors in these gardens that affect their use and visitation by animals. Gardens with mostly ornamental plants were expected to show lower diversity and to attract fewer species of animals than gardens with multiple types of cultivation, such as food and medicine because multiple uses would likely imply multiple canopy layers and higher diversity (Kumar and Nair, 2004), offering more habitats and general resources to the animals.

2. Material and Methods

2.1. Study area

Data collection was carried out on the northeastern coast of Brazil, in the state of Rio Grande do Norte. The locality where all the samples were taken, Pium, lies 25 km south of the state capital, Natal (Fig. 1). According to the Köppen classification, the climate is classified as As (tropical with dry summers) (Alvares et al., 2013), with an average of 1,442.8 mm of rainfall each year and an annual average temperature of 27°C.

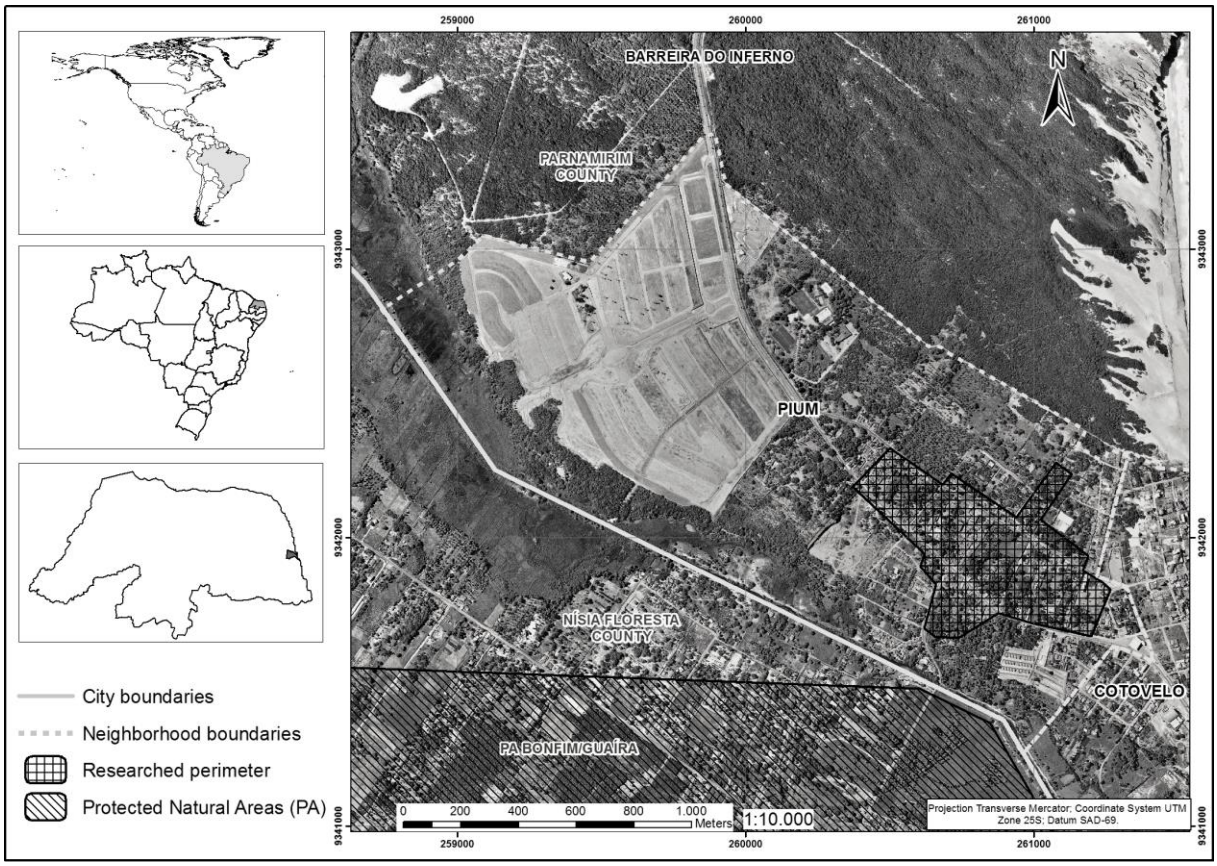

Fig. 1 – Map of the study area. The sampled home gardens are in the area delimited by the black hachured line. The white hachured line shows two protected areas nearby the sampled area.

Pium borders the Atlantic Ocean on its east side, and it is about 650 m (from the central point of the sampled area) from the Bonfim-Guaraíras Park (an area with over 42,000 hectares) and 500 m from the protected dune Morro do Careca (1,100 hectares). Both parks protect the remaining Atlantic Forest, and restinga (coastal shrubby forest on sandy environments) is the prevailing vegetation (Oliveira-Filho, 2009). The study area lies within the Atlantic Forest vegetation domain of coastal Brazil and suffers from the influence of the nearby Caatinga.

Due to being close to beaches, rivers, and lagoons, Pium is experiencing a fast expansion based on land speculation, which is leading to rapid population growth, urbanization, paving of streets and gardens, and division of the land into increasingly smaller lots for sale or rent mostly for second homes and for the construction of commercial establishments (personal observation). Such changes in land use impact the

area's environmental and social features, negatively affecting native species, sometimes with full suppression of the natural vegetation, and resulting in the loss of traditional knowledge regarding plant cultivation.

2.2. Data sampling

The fieldwork was performed from March to July 2013. Home gardens were identified through direct observations from the streets, although some older residents and interviewees also indicated where others could be found. At the time of the study, the population size of Pium was estimated to include about 400 houses, and 56 of these houses had gardens with plants cultivated for one or more of the following purposes: medicinal, food (fruit trees, greens, flowers, and spices), religious, and ornamental. Forty-one of these gardens were visited; the remaining gardens were not included in the study because no one was home or the owner did not wish to take part in the study.

The interviewees were asked about the plants they chose to cultivate (planned biodiversity) and about the associated biodiversity, meaning the animals that pass through, use, or live in the gardens without the interventions of the gardeners, such as bees, beetles, butterflies, spiders, and ants (Perfecto and Vandermeer, 2008).

To closely assess the planned biodiversity reported by the gardeners, we requested their permission to see each plant; garden owners also informed us of the plants' popular names and what they were for. All cultivated plants, including the numbers of individuals, were recorded and photographed. Plant samples were obtained for botanical identification, although this was frequently not possible with ornamental plants. In these cases, the specimen was either photographed or had a non-reproductive part (e.g. leaves) collected, instead of the flowers.

To estimate the associated biodiversity in the gardens, the interviewees were specifically asked about the presence of marmosets (*Callithrix jacchus*), large reptiles (*Tupinambis teguixin* and *Iguana iguana* lizards), amphibians (frogs), and invertebrates

(butterflies, bees, and beetles). The presence of birds was assessed with the support of an album containing pictures of the most common species in the region, which had been selected by a local ornithologist (Mauro Pichorim, personal communication). For each animal reported to visit the gardens, the interviewee was asked to classify the animal's presence as being due to nesting, housing, feeding, resting, or passing.

The plant species that were photographed or that were easily recognized had their identification done at the lowest possible level, through consultations to specialized guides and manuscripts about medicinal and ornamental species present in Brazilian gardens (Lorenzi and Souza, 2008, 1999). The current names and distribution areas were rechecked on the websites Tropicos® (2013) and Flora do Brasil (2013) (www.tropicos.org and www.floradobrasil.jbrj.gov.br). Plants that were less common and that had some material collected were identified and deposited at the Federal University of Rio Grande do Norte herbarium.

The species were classified as 1) local natives if they belonged to either the Caatinga or Atlantic Forest biome; 2) Brazilian exotic if they were found in any of the other biomes occurring in Brazil except for the two mentioned above; and 3) exotic, whenever they were from a different country.

The number of bird species cited by each interviewee was considered, while for the other animals only their presence/absence was registered, as differentiating these species was a difficult task for most informants and for some of these species, only one (e.g. marmosets) or two (e.g. the large-sized lizards) were present.

2.3. Data analysis

2.3.1. Characterization of the home gardens

To first test if the gardens were homogeneous or if they could be divided into groups, a non-hierarchical cluster analysis was performed using the Kmeans function. The final number of groups formed was determined based on the Calinski criteria (Borcard et al.,

2011). For this analysis, the variables used were as follows: area (m^2), tree diversity (Shannon Index), general plant diversity (Shannon Index), density of trees, shrubs, and herbs per hectare, the number of plants in a garden used for food, medicine, and for religious purposes and bird richness. All data were log transformed to reduce heterogeneity. This analysis was performed in R, using the Vegan 2.0-10 package (Oksanen et al., 2013).

2.3.2. The presence of animals

A linear correlation was performed to determine if the size of an area (m^2) was correlated with the diversity of plants and trees. The same analyses were also performed to check for correlations between the variety of plants in general and of trees specifically with the presence of the following: the marmoset (*Callithrix jacchus*), reptiles of the Squamata order (the lizards *Tupinambis teguixin* and *Iguana iguana*), amphibians of the Anura order (frogs), and invertebrates of the orders Lepidoptera, Hemiptera, Coleoptera, and Hymenoptera (namely butterflies, bees, and beetles). As the data were not normalized, Spearman correlations were performed. Based on the significant results found in the correlations, generalized linear models were developed to check the factors that would explain the presence and/or diversity, such as in the case of birds.

Two GLM (Generalized Linear Model) models analyzed the factors affecting the presence of the marmosets *Callithrix jacchus* and of the large lizards *Tupinambis teguixin* and *Iguana iguana.* As the dependent variables were binary (presence/absence of marmosets or lizards), the linking function used was *logit*, binomial family. For both groups of animals, multiple models were run, and the best one was chosen based on the Akaike criterion (AIC): the lower the AIC, the better the model.

The initial complete model used to understand the factors that explained the presence of marmosets in home gardens was as follows:

$$(1)\quad \ln[\hat{M}_c/(1-\hat{M}_c)] = \beta 0 + \beta 1 SP + \beta 2 ST + \beta 3 NT + \beta 4 SL + \beta 5 SB + \beta 6 NB + \beta 7 Pl + \varepsilon,$$

while the initial model to explain the presence of lizards was:

(2) $\ln[\hat{Pl}_g/(1-\hat{Pl}_g)] = \beta_0 + \beta_1 SP + \beta_2 ST + \beta_3 NT + \beta_4 SL + \beta_5 SB + \beta_6 NB + \beta_7 + \varepsilon$

In these models, M_c and Pl_g represent the dependent variable: the presence/absence of marmosets and lizards in a given garden, respectively. ST is the diversity of trees, and NT indicates the number of individual trees of any species in a garden. The diversity of native plant species is indicated by SL, and SB represents the diversity of Brazilian exotic plant species. NB suggests the richness of birds (number of species cited by a given interview); βs are the estimated explanatory coefficient for each variable, and ε is the residual error. All diversity measures represent values calculated through the Shannon Index. With the exception of the variables Mc and Pl (binary) and of NT and NB (discreet), the remaining were continuous variables.

To determine the factors that explain the richness of birds in a given home garden, another set of GLM models was carried following a Poisson distribution (a *quasipoisson* to improve overdispersion). Likewise, the starting point was a complete model, which was further reduced to multiple models and compared to the initial one. In this case, for being a Poisson model, the best model was chosen through an analysis of variance (ANOVA) and was the simplest significant one with the least number of variables in relation to other significant ones.

(3) $NB_g = \beta_0 + \beta_1 SP + \beta_2 ST + \beta_3 NT + \beta_4 SL + \beta_5 SB + \varepsilon,$

NB_g represents the richness of birds in a given home garden, while the independent variables were the same as the ones previously described. All models were developed in R.

3. Results

From the 41 interviews performed, 28 included women. The interviewees' age varied between 21 and 81 years old, with 51% of them being over the age of 50. The respondents had lived in the area between three and 60 years. In most cases (80%), this period also

corresponded to the age of the garden. The average home garden size was 409.65 m^2 (SD: 644.45 m^2).

3.1. Characterization of the home gardens

The sampled gardens contained 187 plant species: 80 herbs, 74 shrubs, and 33 trees (Appendix A). Among these, 43 were native plants from Brazil (although exotic in the study area) and 29 were native to the region, being either from the Caatinga (e.g. *Commiphora leptophloeos*, *Ziziphus joazeiro,* and *Spondias tuberosa*) or from the Atlantic Forest biome (e.g. *Caesalpinia echinata, Anacardium occidentale, Campomanesia dichotoma,* and *Manilkara salzmannii*). All the cultivated plants were identified: 65% were described as having ornamental use, and 20% were used for food. Medicinal use was cited in 8%, and 7% had religious purposes. Eight plants had multiple uses, such as food and medicinal or religious and medicinal. Two plants had additional uses: one for cosmetics (*Aloe vera)* and one as a plant pot (*Crescentia cujete*).

The Shannon Diversity Index varied among gardens between 1.074 and 3.453 for herbs and shrubs and from 0.6931 and 2.079 for trees.

3.2. Cluster analysis

The cluster analysis divided the gardens into three groups (Calinski Index = 35) (Fig. 2), which were named after their predominant feature. The "ornamental gardens" group included the smallest gardens (average area: 20 m^2) where most plant species were ornamental (92%) and where the diversity of shrubs and herbs was intermediary between the two other groups. The "agroforestry gardens" group included the three main kinds of plant uses (ornamental, food, and medicinal) more equally distributed among the gardens (average area: 193 m^2). It was also the group with the highest number of plants cultivated for medicinal purposes (42%), with the highest diversity of plants in general, among the three groups (average area: 783 m^2). The third group was named "food agroforestry

gardens," and it showed the lowest number of ornamental plants and the highest number of food plants (48%), as well as having the highest diversity of trees (Fig. 2).

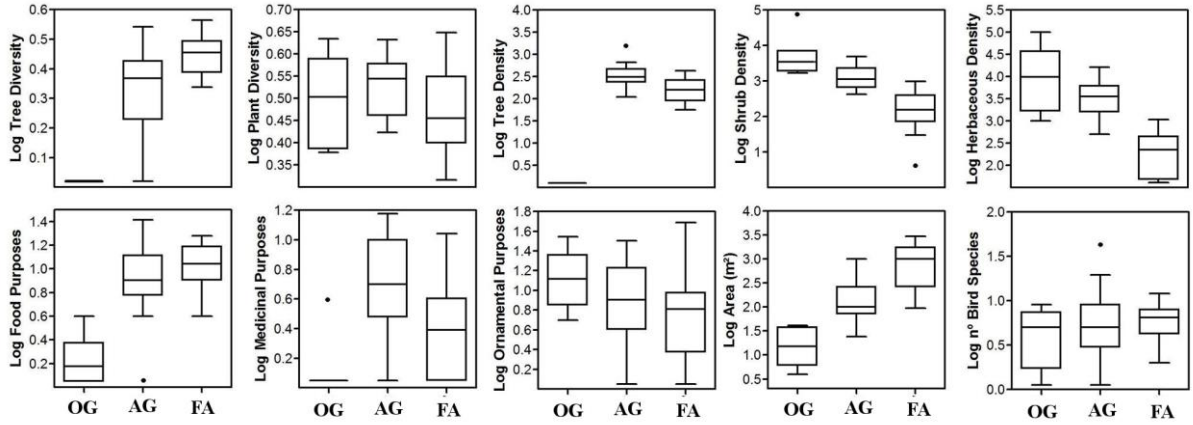

Fig. 2 – Box-plots of the features that characterize the three groups of home gardens chosen based on a cluster analysis: ornamental gardens, agroforestry gardens and food agroforestry gardens. Data was based on interviews and sampling performed in 41 home gardens on the Brazilian NE coast. All data was converted in log.

3.3. Plant diversity and the presence of animals in home gardens

According to the multiple logistic models, the presence of marmosets in a given garden was significantly related to the tree diversity of that location (p=0.00698) (final model: M_c = -3.551 + 1.8206 ST+ ε; AIC=41.87). The odds-ratio suggested that an improvement of one unit in the Shannon Index value for trees increased the chances of having marmosets in a garden by 6.2 times.

Lizards were not directly affected by the presence of plants but instead were influenced by the richness of birds in a garden (p=0.00425), despite a slight negative tendency observed in relation to the diversity of native plants in the best model (p=0.07970) (Y= -2.1117 -1.6892 SL + 0.5421 NB+ ε; AIC = 47.08). For each new species of bird that was present in a garden, the chances of a lizard being also being there increased by 1.72.

For birds, however, the diversity of shrubs and herbs (p=0.00176) and also the tree diversity (p=0.01387) explains the richness mentioned by the interviewees (NB= 0.1445+ 0.5017 SP + 0.2795 ST + ε).

Although the correlation analyses showed a significant relationship between garden area and tree diversity (p=0.0006), the size of an area did not directly affect the presence of animals or the general plant diversity in a given garden.

3.4. The biodiversity associated with home gardens

In addition to the animal groups considered in the analyses described above, the interviewees mentioned the occurrence of three other wild animal groups in the gardens (Fig. 3a-c). Through the popular names and descriptions provided by the interviewees, it was possible to identify the species: *Didelphis albiventris* (white-eared opossum), *Amphisbaena heathi* (a reptile), and *Micrurus ibiboboca* (a snake). Among the animals locally called "beetles," invertebrates from the orders Hemiptera and Coleoptera were cited.

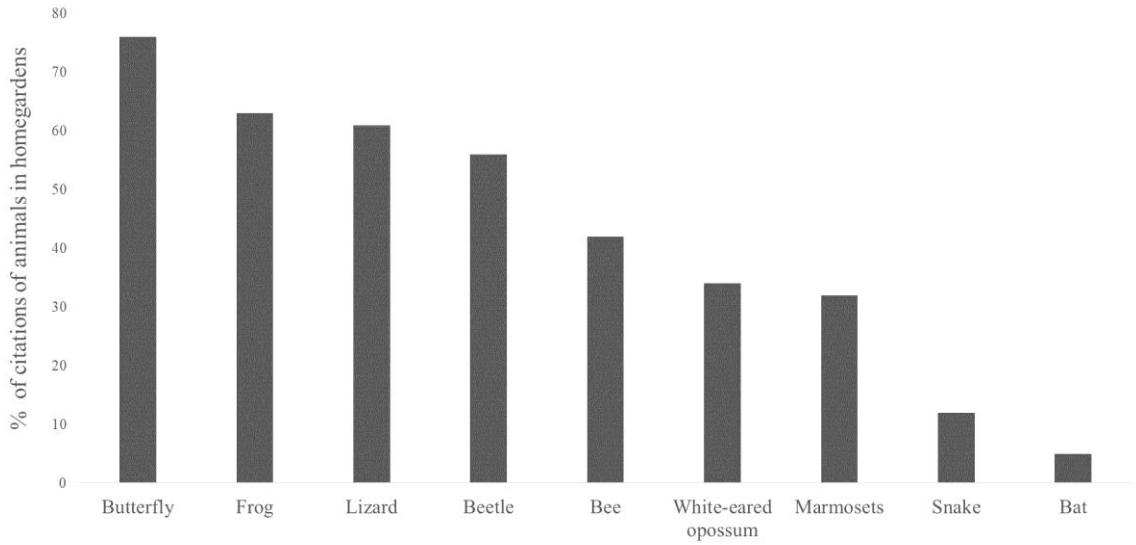

Fig. 3 – Percentage of citations of the different animal groups occurring in the 41 home gardens visited, according to the interviewees. Data were sampled on the Brazilian NE coast.

The interviewees (32%) mentioned that marmosets visited the gardens to feed on plants and animals. Two of the interviewees also said that marmosets were not welcome in

the gardens as, according to one of them, the animals even entered the houses to steal food. Mammals, such as the white-eared opossum, were mentioned by 14 interviewees, and 57% of these said the mammals visited the gardens to feed mostly on chicken eggs (50%). Bats were reported to occur in the gardens by only a couple of interviewees, and their visits were related to feeding and seed dispersal. Lizards, on the other hand, were seen by 34 interviewees to use the gardens in multiple ways, such as for passing through (48% of the total answers), feeding (26%), and using it as their habitat (26%). According to the interviewees, lizards feed both on fruits and on chicken eggs, when these are available in the gardens. The consumption of chicken eggs by lizards and marsupials is not a welcome activity in the gardens, resulting in some cases in the killing of the wild animals (two cases mentioned for white-eared opossum). Frogs were not welcome in some of the gardens, either. They were mentioned by 26 interviewees; 65% of them said these amphibians used the area as their habitat while 35% reported that the frogs only passed through. These animals were usually removed from the gardens or killed. Snakes were reported by five interviewees, four of whom mentioned that they used the gardens as a passage way, and one of them recounted a one-time episode when a snake fed on rodent pets (*Cavia porcellus*).

Bees and wasps were mentioned by 17 interviewees, and 64 and 23% of them related their presence to feeding and passing, respectively. Additionally, three of them also reported nesting activity, although the hives were always removed. Butterflies were cited by 31 respondents who believed they used the gardens for feeding (61%) and for passing through (39%). Beetles were seen by 19 interviewees, and they said these animals used the area for feeding (52%), passing through (30%), and nesting (17%).

3.5. The presence of birds

The interviewees cited 34 bird species occurring in their home gardens (Fig. 4). Species that were mentioned by only one interviewee are shown here as "others" and described in Appendix B.

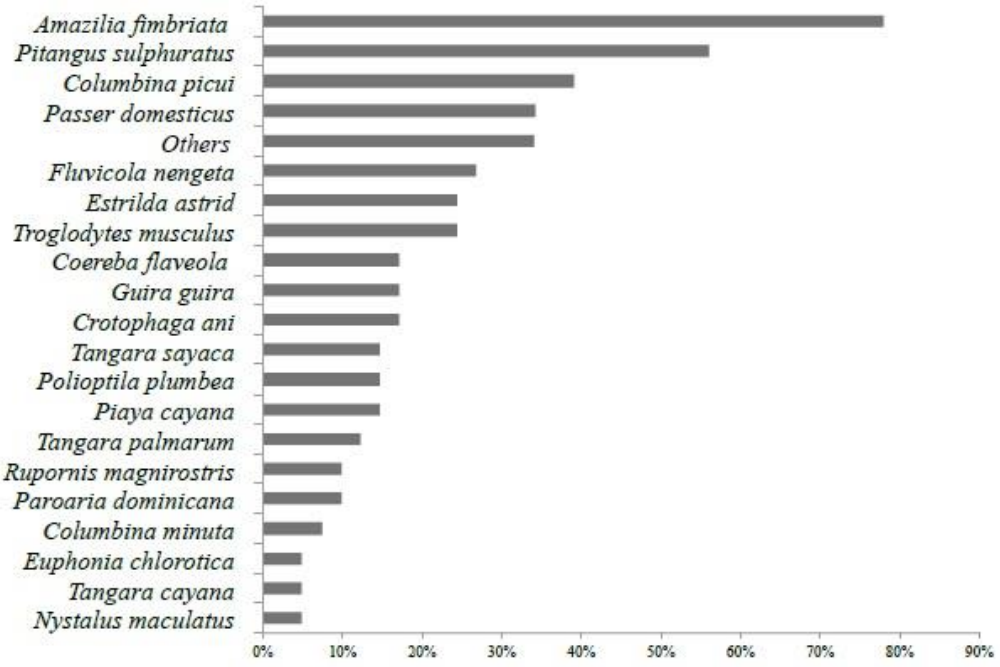

Fig. 4 – Percentage of citations of bird species occurring in home gardens, according to the interviewees (N=41). The sampled gardens are on the Brazilian NE coast.

The interviewees said that the gardens were important for the nesting of nine species (Appendix B). In over 70% of the citations, the birds were said to be feeding or only passing through the gardens (Appendix B).

4. Discussion

The growth of cities directly affects ecosystems by causing habitat fragmentation and changes in the population dynamics of plants and animals (Marzluff, 2001). Urban matrixes can make it difficult or impossible for some species to move between areas (Gascon et al., 1999), such as for some birds that disperse seeds (Medellin and Gaona, 1999). Such impacts and non-stop city growth bring to the forefront the need to reconcile

the promotion of ecosystem functions in urban environments and conservation measures that are not limited to protected areas. The results of this study showed that some types of urban gardens could favor the presence of animals and the maintenance of native plant species; it also revealed that there were some weak spots in their conservation potential, especially in relation to how garden owners deal with the visiting animals.

4.1. Native plants in the gardens

Even though many studies have shown how gardens can be efficient refuges for the cultivation of native species (Norfolk et al., 2013), including studies done in northeast Brazil (Albuquerque et al., 2005), where the use of native species from these gardens for food, medical, and religious purposes can represent up to 60% of a family's needs (Akinnifesi et al., 2010), the cultivation of exotic species prevailed at Pium. The local species were not common either in number of species or in abundance of individuals. The only commonly found native species was the cashew tree (*Anacardium occidentale*), whose fruits and nuts are used as food. However, two species found in this study (*C. echinata* and *Cattleya granulosa*) are included in the IUCN Red List list of endangered species for the Brazilian flora (IUCN, 2001). Nevertheless, the variation between gardens in the same region regarding the cultivation of local and exotic species suggests that multiple studies will be necessary to establish the real use and relevance of autochthones species as an ecosystem service (Kinupp and Barros, 2010), as well as their potential for conservation.

Many of the species present in the gardens analyzed here (e.g. *Psidium guajava* and *Annona squamosa*) have been naturalized in Brazil (Pyšek et al., 2004) and are also widely used in other countries, such as in Nicaragua and India (Kumar, 2011; Méndez et al., 2001). Still, other species of this study were native to Brazil but exotic to the local biome (e.g. *Thevetia peruviana*, *Philodendron bipinnatifidum*, and *Syngonium angustatum*). Depending on the dispersion and establishment potential of such exotic species, Brazilian

or otherwise, there can be a negative influence on the nearby protected areas, as these plants could become invasive (Gascon et al., 1999). Moreover, cultivated exotic species could represent an additional problem for conservation by representing a genetic threat to native forests, especially if these remnant forests carry rare species, such as when the individuals of different species hybridize between themselves (Allendorf et al., 2001).

4.2. Planned diversity and the associated fauna of the gardens

Gardens in the ornamental group (six in total) did not include one single native species. Gardens classified here as agroforestry groups were the ones that provided more food and medicinal diversity to the families; they also were the ones with the highest diversity of ornamental shrubs, herbs, and trees. These groups were similar to what has been described in the literature as an agroforestry garden, which represents ecosystems around homes with a high diversity of herbs, shrubs, and trees that have multiple uses (Kumar and Nair, 2004).

A higher diversity and the presence of multiple canopy layers have been shown to favor the presence of animals in different regions on the world, such as in Sri Lanka (Raheem et al., 2008) and Mexico (Huerta and van der Wal, 2012). In our study, it was also significantly important to have different canopy layers to provide environments, habitats, and resources for passing, nesting, and feeding of birds and marmosets. In fact, the logistical model clearly showed the importance of having a higher diversity of trees to attract marmosets, and the impact of a higher diversity of shrubs and herbs and secondarily, trees, on increasing the richness of birds present in a garden. Lizards, on the other hand, were attracted by the diversity of birds, which is probably due to the fact that these lizards prey upon bird eggs (Bovendorp et al., 2008). As birds depend on trees, the removal or decrease in tree diversity would also have a secondary effect on lizards.

As expected, agroforestry gardens (groups 2 and 3) were the most attractive ones for these two groups of species, although ornamental gardens (group 1) were also appealing to

birds. The agroforestry gardens did attract frogs, lizards, butterflies, bees, beetles, and bats, but these groups were only qualitatively evaluated. The size of a garden was correlated to the diversity of trees it contained. Hence, the loss of natural areas that occurs due to local development initiatives also implies the loss of environmental services, mostly biodiversity provisioning, through the loss of habitats and feeding resources for animals that depend on trees, like marmosets, and the opportunity to support conservation beyond the limits of parks.

The diversity of trees was the main factor that explained the presence of the marmosets *C. jacchus*, who came to the gardens mostly for feeding, because the trees present in the studied gardens were fruit trees appreciated by these monkeys, such as *Mangifera indica L., Musa sp., Eugenia uniflora L., Talisia esculenta,* and *Anacardium occidentale*. This last tree also provides exudates ingested by the marmosets (Pontes and Soares, 2005). Moreover, tree cover favors the presence of insects (Huerta and van der Wal, 2012), which are also an important component in the diet of *C. jacchus*.

Nevertheless, in some cases the interviewees said that they deliberately attracted marmosets to their gardens by offering them food. This habit can affect the natural foraging behavior of an animal, which could result even in unanticipated problems for the garden owners, such as the stealing of food (Sabbatini et al., 2006).

There were also cases in which the gardens provided easy access to food for some animals, even when the owners did not feed the animals, such as in the consumption of chicken eggs by white-eared opossum and lizards or of the predation of small pets by snakes. In such cases, the gardens did not provide a service to the owner or even to the animals, as in some instances these animals can obtain food rich in salt, fat, or sugar or that has been contaminated by house wastes (Sabbatini et al., 2006). Depending on the individual perception, social and economic conditions, and diversity of ecological processes, gardens can result in disservices to the families due to animal losses and the fear

of bee attacks (Escobedo et al., 2011). In such cases, the animals usually do not succeed in using the area, as was the case of bees and wasps whose hives and nests were actively removed from the gardens.

While the presence of some animals was not welcome by the household, other animals, such as birds and butterflies, resulted in inner satisfaction of the garden caretakers. These animals inspired some caretakers to plant more flowers to attract hummingbirds and butterflies or more fruit trees to attract birds. This positive interest could favor conservation in two ways. The first is the potential for establishing projects that aim to cultivate species that attract native birds. The second is the opportunity to put people in direct contact with animals and natural cycles, an experience otherwise lost in cities (Pyle, 2003). Such contact and associated knowledge could promote an awareness regarding the interrelation between species and the importance of the biodiversity maintenance, providing incentives for its conservation (McDaniel and Alley, 2005).

4.3. Bird presence

Native birds that commonly occur in Brazil visited the studied gardens. Most of these species have adapted to urban environments, although some, such as *Amazilia fimbriata* and *Rupornis magnirostris*, were observed only in neighborhoods with ample tree cover. South American species that have spread their distribution due to deforestation, such as *Guira guira* and *Columbina picui* (Sick, 1997), as well as two exotic species *Passer domesticus* and *Estrilda astrild*, were also identified.

This situation results from the urbanization process the region is experiencing, which increases the density of a few number of tolerant species to human altered environments and decreases the richness and community uniformity (Chace and Walsh, 2006). Changes in the vegetation structure can result in the absence of certain species that require specific ecological and landscape conditions to survive (Marzluff, 2001). Pressures derived from urban growth (vegetation removal and an increase in the isolation between areas), as

observed in this study, are likely factors that could explain the absence or low number of interviewee observations of species immediately more relevant for conservation, such as the threatened or rare ones.

This was a different finding than those of other studies conducted in urban areas, which have suggested that the diversity of plants in general and the presence of different levels of plant cover benefit both species that are tolerant to urban environments and those that are relevant for conservation (Smith et al., 2014; Toledo et al., 2012). Here, although the diversity of herbs, shrubs, and trees was shown to affect bird visitation, there was still missing evidence regarding the best vegetation structure to support birds that are more sensitive to human and urban impacts.

Nevertheless, the bird species mentioned to occur in the studied gardens play an important role in the garden's auto-regulation through pollination, seed dispersion, and the ingestion of insects and larvae. The trophic guild composition of the 34 bird species mentioned here was as follows: nine feed mostly on arthropods, eight are omnivores, six are grainivores, five are carnivores, four are nectarivorous, and two are necrophagous. Thus, these species encompass primary and secondary consumers, top predators, and negrophagous species that could control different populations occurring in gardens. The role played by birds in pollination and dispersion is clear and, depending on the species cultivated in the gardens, birds could be used in the restoration of nearby areas and the maintenance of protected parks (Zanini and Ganade, 2005).

5. Conclusions: Home gardens and biodiversity conservation

This study has shown that home gardens per se do not always have an important role in benefitting native species, although results can vary even within the same region. Here, the gardens were statistically grouped into three different types with different potentials to

affect the native and exotic fauna. Gardens with higher tree diversity contributed significantly more to attracting marmosets (specifically *C. jacchus*), while birds were benefited by a higher diversity of plants in general (trees, shrubs, and herbs). Higher-diversity gardens also attracted bird nesting more frequently than less diverse ones. Ornamental gardens, on the other hand, had a smaller effect on plant diversity and on animal attraction.

This study also showed that owners or caretakers of home gardens may have some limitations regarding the way they deal with animals, such as bees, wasps, snakes, and lizards. Both these limitations and the low representation of native species could be addressed by arborization projects that value native species, by studies that approach the nutrition, medicinal, and ornamental potential of such species, and by initiatives that teach garden caretakers how to deal with wild animals.

Here it is also highlighted the potential of studying how home gardens could improve the urban matrix and connect forest fragments (Perfecto and Vandermeer, 2008). For that, it would be necessary to understand which species would benefit the most and to identify their ecological requirements (Caryl et al., 2013). Additionally, it is worth investigating how home garden species could positively or negatively affect the composition of fragments as a repository of genetic diversity, population increase, seed and seedling banks, and also genetic contamination (Roberts et al., 2007). Such an approach entangles conservation in the daily routine of a community and could be used in city and house planning. In addition to expanding conservation beyond the limits of parks, such initiatives could reveal the potential of connecting fragments at a much cheaper cost (Raheem et al., 2008).

Therefore, once home gardens have shown their potential as a conservation strategy, the next investigations should approach the circumstances and features that allow home gardens to act as facilitators or limiters for the occurrence of certain species.

Understanding facilitation and limitation processes could help direct environmental education projects in order to create home gardens that serve as a positive interface between natural and human-made environments, acting as green islands in the urban landscape.

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Appendix A– List of the plant species found in the home gardens. Types of use (O – ornamental, M – medicinal, F – food and R – religious), canopy layers and their origin (local native, Brazilian exotic and exotic).

Botanical family	**Botanical name**	**Use**	**Canopy layer**	**Origen**
Acanthaceae Juss.	*Graptophyllum pictum* (L.) Griff.	O	Shrub	Exotic
Acanthaceae Juss.	*Peristrophe angustifolia* Nees	M	Herb	Exotic
Acanthaceae Juss.	*Megaskepasma erythrochlamys* Lindau	O	Shrub	Exotic
Acanthaceae Juss.	*Pseuderanthemum carruthersii* (Seem.) Guillaumin	O	Shrub	Exotic
Acanthaceae Juss.	*Justicia angustifolia* Pohl ex Nees	O	Herb	Local native
Adoxaceae E. Mey.	*Sambucus australis* Cham. & Schltdl.	M	Shrub	Brazilian exotic
Amaranthaceae Juss.	*Celosia cristata* L.	O	Herb	Exotic
Amaranthaceae Juss.	*Chenopodium ambrosioides* L.	M	Herb	Brazilian exotic
Amaranthaceae Juss.	*Pfaffia* sp.	M	Herb	Exotic
Amaryllidaceae J. St.-Hil.	*Allium sativum* L.	F	Herb	Exotic
Amaryllidaceae J. St.-Hil.	*Allium fistulosum* L.	F	Herb	Exotic
Amaryllidaceae J. St.-Hil.	*Hippeastrum puniceum* (Lam.) Kuntze	O	Herb	Local native
Amaryllidaceae J. St.-Hil.	*Griffinia* sp.	O	Herb	Brazilian exotic
Amaryllidaceae J. St.-Hil.	*Zephyranthes rosea* Lindl.	O	Herb	Brazilian exotic
Amaryllidaceae J. St.-Hil.	*Hymenocallis littoralis* (Jacq.) Salisb.	O	Herb	Brazilian exotic
Amaryllidaceae J. St.-Hil.	*Hippeastrum puniceum* (Lam.) Kuntze	O	Herb	Brazilian exotic
Amaryllidaceae J. St.-Hil.	*Crinum* sp.	O	Herb	Exotic
Anacardiaceae R. Br	*Mangifera indica* L.	F	Tree	Exotic
Anacardiaceae R. Br.	*Spondias tuberosa* Arruda	F	Tree	Local native
Anacardiaceae R. Br.	*Spondias cytherea* Sonn.	F	Tree	Exotic
Anacardiaceae R. Br.	*Anacardium occidentale* L.	F	Tree	Local native
Anacardiaceae R. Br.	*Spondias purpurea* L.	F	Tree	Exotic
Annonaceae Juss.	*Annona muricata* L.	F	Tree	Exotic
Annonaceae Juss.	*Annona squamosa* L.	F	Shrub	Exotic
Apiaceae Lindl.	*Coriandrum sativum* L.	F	Herb	Exotic
Apocynaceae Juss.	*Cryptostegia grandiflora* Roxb. ex R. Br.	O	Shrub	Exotic

Apocynaceae Juss.	*Thevetia peruviana* (Pers.) K.Schum.	O/R	Shrub	Brazilian exotic
Apocynaceae Juss.	*Catharanthus roseus* (L.) G.don	O	Herb	Exotic
Apocynaceae Juss.	*Plumeria rubra* L.	O	Shrub	Exotic
Apocynaceae Juss.	*Hancornia speciosa* Gomes	F	Tree	Local native
Apocynaceae Juss.	*Plumeria pudica* Jacq.	O	Shrub	Exotic
Apocynaceae Juss.	*Ervatamia coronaria* (Jacq.) Stapf	O	Shrub	Exotic
Araceae Juss.	*Alocasia cucullata* (Lour.) G. Don	O	Herb	Exotic
Araceae Juss.	*Aglaonema commutatum* Schott	O	Herb	Exotic
Araceae Juss.	*Alocasia macrorrhizos* (L.) G. Don	O/R	Herb	Exotic
Araceae Juss.	*Anthurium andraeanum* Linden	O	Herb	Exotic
Araceae Juss.	*Philodendron bipinnatifidum* Schott ex Endl.	O	Shrub	Brazilian exotic
Araceae Juss.	*Epipremnum pinnatum* (L.) Engl.	O	Herb	Exotic
Araceae Juss.	*Spathiphyllum wallisi* Regel	O	Herb	Exotic
Araceae Juss.	*Dieffenbachia* sp.	O	Herb	Exotic
Araceae Juss.	*Taccarum ulei* Engl. & K.Krause	O	Herb	Local native
Araceae Juss.	*Philodendron giganteum* Schott	O	Herb	Exotic
Araceae Juss.	*Syngonium angustatum* Schott	O	Herb	Brazilian exotic
Araceae Juss.	*Caladium bicolor* (Aiton) Vent.	O	Herb	Brazilian exotic
Araceae Juss.	*Caladium* sp.	O	Herb	Exotic
Araceae Juss.	*Zamioculcas zamiifolia* (Lodd.) Engl.	O	Herb	Exotic
Araceae Juss.	*Colocasia* sp.	O	Herb	Exotic
Araceae Juss.	*Philodendron acutatum Schott*	O	Herb	Local native
Araceae Juss.	*Monstera* sp.	O	Herb	Brazilian exotic
Araceae Juss.	*Anthurium affine* Schott	O	Herb	Local native
Araceae Juss.	*Syngonium auritum* (L.) Schott	O	Herb	Exotic
Araceae Juss.	*Philodendron pedatum* (Hook.) Kunth	O	Shrub	Brazilian exotic
Araliaceae Juss.	*Polyscias guilfoylei* (W. Bull) L.H. Bailey	O	Shrub	Exotic
Araliaceae Juss.	*Polyscias balfouriana* (André) L.H.Bailey	O/R	Shrub	Exotic
Araliaceae Juss.	*Schefflera arboricola* (Hayata) Merr.	O	Shrub	Exotic
Araliaceae Juss.	*Hydrocotyle bonariensis* Lam.	O	Herb	Brazilian exotic
Araucariaceae Henkel & W. Hochst.	*Araucaria* sp.	O	Tree	Brazilian exotic
Arecaceae Bercht. & J. Presl	*Roystonea oleracea* (Jacq.) O.F. Cook	O	Tree	Exotic

Arecaceae Bercht. & J. Presl	*Euterpe oleracea* Mart.	F	Shrub	Brazilian exotic
Arecaceae Bercht. & J. Presl	*Cocos nucifera* L.	F	Tree	Exotic
Arecaceae Bercht. & J. Presl	*Dypsis lutescens* (H.Wendl.) Beentje & J.Dransf.	O	Tree	Exotic
Arecaceae Bercht. & J. Presl	*Caryota urens* L.	O	Shrub	Exotic
Arecaceae Bercht. & J. Presl	*Syagrus cearensis* Noblick	O	Tree	Local native
Arecaceae Bercht. & J. Presl	*Rhapis excelsa* (Thunb.) A. Henry *ex* Rehder	O	Shrub	Exotic
Arecaceae Bercht. & J. Presl	*Phoenix roebelenii* O'Brien	O	Tree	Exotic
Arecaceae Bercht. & J. Presl	*Veitchia merrillii* (Becc.) H.E. Moore	O	Shrub	Exotic
Asparagaceae Juss.	*Dracaena fragrans* (L.) Ker Gawl.	O	Shrub	Exotic
Asparagaceae Juss.	*Dracaena marginata* Lam.	O	Shrub	Exotic
Asparagaceae Juss.	*Cordyline terminalis* (L.) Kunth	O	Shrub	Exotic
Asparagaceae Juss.	*Sansevieria trifasciata* Prain	O/R	Herb	Exotic
Asparagaceae Juss.	*Sansevieria cylindrica* Bojer	O	Herb	Exotic
Asparagaceae Juss.	*Dracaena sanderiana* Hort.	O	Shrub	Exotic
Asparagaceae Juss.	*Chlorophytum comosum* (Thunb.) Jacques	O	Herb	Exotic
Asparagaceae Juss.	*Cordyline fruticosa* (L.) A. Chev.	O	Shrub	Exotic
Asparagaceae Juss.	*Ornithogalum arabicum* L.	O	Herb	Exotic
Asparagaceae Juss.	*Dracaena surculosa* Lindl.	O	Shrub	Exotic
Asparagaceae Juss.	*Asparagus setaceus* (Kunth) Jessop	O	Herb	Exotic
Asparagaceae Juss.	*Asparagus densiflorus* (Kunth) Jessop	O	Herb	Exotic
Asteraceae Bercht. & J. Presl	*Bidens sulphurea* (Cav.) Sch. Bip.	O	Herb	Exotic
Asteraceae Bercht. & J. Presl	*Unxia kubitzkii* H. Rob.	O	Herb	Brazilian exotic
Asteraceae Bercht. & J. Presl	*Vernonia condensata* Baker	M	Herb	Exotic
Asteraceae Bercht. & J. Presl	*Acanthospermum hispidum* DC.	M	Herb	Local native
Asteraceae Bercht. & J. Presl	*Matricaria recutita* L.	M	Herb	Exotic
Balsaminaceae A. Rich.	*Impatiens balsamina* L.	O	Herb	Exotic
Begoniaceae C. Agardh	*Begonia*sp.	O	Herb	Exotic
Bignoniaceae Juss.	*Crescentia cujete* L.	U	Tree	Exotic
Bignoniaceae Juss.	*Tecoma stans* (L.) Juss. Ex Kunth	O	Shrub	Exotic
Bignoniaceae Juss.	*Fridericia chica* (Bonpl.) L.G.Lohmann	O	Tree	Local native
Bixaceae Kunth	*Bixa orellana* L.	O	Tree	Brazilian exotic
Boraginaceae Juss.	*Heliotropium indicum* L.	M	Herb	Exotic

Brassicaceae Burnett	*Brassica oleracea* var. *acephala* DC.	F	Herb	Exotic
Bromeliaceae Juss.	*Tillandsia usneoides* (L.) L.	O	Herb	Brazilian exotic
Bromeliaceae Juss.	*Ananas bracteatus* (Lindl.) Schult. & Schult. f.	O	Herb	Brazilian exotic
Bromeliaceae Juss.	*Ananas comosus* (L.) Merr.	F	Herb	Brazilian exotic
Burseraceae Kunth	*Commiphora leptophloeos* (Mart.) J.B. Gillett	O	Tree	Local native
Cactaceae Juss.	*Pereskia grandifolia* Haw.	F	Tree	Brazilian exotic
Cactaceae Juss.	*Pereskia grandiflora* Pfeiff.	F	Tree	Brazilian exotic
Campanulaceae Juss.	*Isotoma longiflora* (L.) C. Presl	O	Herb	Exotic
Cannaceae Juss.	*Canna x generalis* L.H. Bailey	O	Herb	Exotic
Caricaceae Dumort.	*Carica papaya* L.	F	Shrub	Exotic
Clusiaceae Lindl.	*Clusia fluminensis* Planc.& Triana	O	Shrub	Brazilian exotic
Commelinaceae Mirb.	*Tradescantia zebrina* Heynh. ex Bosse	O	Shrub	Exotic
Commelinaceae Mirb.	*Callisia warszewicziana* (Kunth & C.D.Bouché) D.R.Hunt	O	Shrub	Exotic
Convolvulaceae Juss.	*Ipomoea batatas* (L.) Lam.	F	Shrub	Exotic
Convolvulaceae Juss.	*Ipomoea carnea* Jacq.	O	Shrub	Local native
Convolvulaceae Juss.	*Ipomoea quamoclit* L.	O	Shrub	Brazilian exotic
Convolvulaceae Juss.	*Ipomoea horsfalliae* Hook.	M	Shrub	Local native
Costaceae	*Costus spiralis* (Jacq.) Roscoe	O	Shrub	Local native
Crassulaceae J. St.-Hil.	*Bryophyllum calycinum* Salisb.	M	Shrub	Exotic
Crassulaceae J. St.-Hil.	*Kalanchoe brasiliensis* Cambess.	M	Shrub	Brazilian exotic
Crassulaceae J. St.-Hil.	*Kalanchoe gastonis-bonnieri* Raym.-Hamet & H. Perrier	O	Shrub	Exotic
Cucurbitaceae Juss.	*Cucurbita pepo* L.	F	Shrub	Exotic
Cucurbitaceae Juss.	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	F	Shrub	Exotic
Cucurbitaceae Juss.	*Momordica charantia* L.	M	Shrub	Exotic
Cycadaceae Pers.	*Cycas circinalis* L.	O	Shrub	Exotic
Cycadaceae Pers.	*Cycas revoluta* Thunb.	O	Shrub	Exotic
Davalliaceae M.R. Schomb. ex A.B. Frank	*Nephrolepis exalta* (L.) Schott	O	Herb	Brazilian exotic
Dioscoreaceae R. Br.	*Dioscorea* sp.	F	Herb	Exotic
Dryopteridaceae Herter	*Rumohra adiantiformis* (G. Forst.) Ching	O	Shrub	Brazilian exotic
Dryopteridaceae Herter	*Codiaeum variegatum* (L.) A.Juss.	O	Shrub	Exotic

Ericaceae Juss.	*Rhododendron simsii* Planch.	O	Shrub	Exotic
Euphorbiaceae Juss.	*Euphorbia phosphorea* Mart.	O	Shrub	Local native
Euphorbiaceae Juss.	*Croton* sp1	O	Herb	Brazilian exotic
Euphorbiaceae Juss.	*Croton* sp2	O	Herb	Brazilian exotic
Euphorbiaceae Juss.	*Euphorbia splendens* Bojer ex Hook.	O	Shrub	Exotic
Euphorbiaceae Juss.	*Acalypha hispida* Burm.f.	O	Shrub	Exotic
Euphorbiaceae Juss.	*Manihot esculenta* Crantz	F	Shrub	Brazilian exotic
Euphorbiaceae Juss.	*Codiaeum variegatum* (L.) Rumph. ex A. Juss.	O	Shrub	Exotic
Euphorbiaceae Juss.	*Cnidoscolus urens* (L.) Arthur	M	Herb	Local native
Euphorbiaceae Juss.	*Euphorbia* sp.	O	Shrub	Exotic
Euphorbiaceae Juss.	*Ricinus communis* L.	O/M	Tree	Exotic
Euphorbiaceae Juss.	*Croton pedicellatus* Kunth	M	Shrub	Local native
Euphorbiaceae Juss.	*Jatropha gossypiifolia* L.	R	Shrub	Exotic
Fabaceae Lindl.	*Caesalpinia pulcherrima* (L.) Sw.	O	Shrub	Exotic
Fabaceae Lindl.	*Bauhinia forficata* Link	O/M	Tree	Brazilian exotic
Fabaceae Lindl.	*Caesalpinia echinata* Lam.	O	Tree	Local native
Fabaceae Lindl.	*Phaseolus vulgaris* L.	F	Herb	Exotic
Fabaceae Lindl.	*Clitoria ternatea* L.	O	At	Exotic
Fabaceae Lindl.	*Chamaecrista ensiformis* (Vell.) H.S. Irwin & Barneby	O	Shrub	Local native
Geraniaceae Juss.	*Pelargonium hortorum* L.H. Bailey	O	Shrub	Exotic
Gesneriaceae Rich. & Juss.	*Chrysothemis pulchella* (Donn *ex* Sims) Decne	O	Herb	Brazilian exotic
Gesneriaceae Rich. & Juss.	*Episcia cupreata* (Hook.) Hanst.	O	Herb	Brazilian exotic
Haemodoraceae	*Xiphidium* sp.	O	Herb	Exotic
Heliconiaceae Nakai	*Heliconia ortotricha* L. Andersson	O	Shrub	Exotic
Heliconiaceae Nakai	*Heliconia psittacorum* L. f.	O	Shrub	Local native
Hydrangeaceae Dumort.	*Hydrangea macrophylla*(Thunb.)Ser.	O	Shrub	Exotic
Iridaceae Juss.	*Trimezia fosteriana* Steyerm	O	Herb	Exotic
Lamiaceae Martinov	*Hyptis calida* Mart. ex Benth.	M/R	Shrub	Local native
Lamiaceae Martinov	*Tetradenia riparia* (Hochst.) Codd	O	Shrub	Exotic
Lamiaceae Martinov	*Solenostemon* sp.	O	Herb	Exotic
Lamiaceae Martinov	*Clerodendron* L.	O	Shrub	Exotic
Lamiaceae Martinov	*Mentha puligium* L.	M	Herb	Exotic
Lamiaceae Martinov	*Ocimum gratissimum* L.	F	Herb	Exotic

Lamiaceae Martinov	*Clerodendron speciosissimum* Van Geert	O	Shrub	Exotic
Lythraceae J. St.-Hil.	*Cuphea gracilis* Kunth	O	Herb	Brazilian exotic
Malpighiaceae Juss.	*Galphimia brasiliensis* (L.) A. Juss.	O	Shrub	Brazilian exotic
Marantaceae R. Br.	*Calathea ornata* (Lindl.) Körn.	O	Herb	Brazilian exotic
Moraceae Gaudich.	*Morus rubra* L.	F	Tree	Exotic
Moringaceae Martinov	*Moringa oleifera* Lam.	F	Tree	Exotic
Myrtaceae Juss.	*Campomanesia dichotoma* (O. Berg) Mattos	O	Tree	Local native
Myrtaceae Juss.	*Psidium guineense* Sw.		Tree	Brazilian exotic
Myrtaceae Juss.	*Psidium guajava* L.	F	Shrub	Exotic
Myrtaceae Juss.	*Eugenia azeda* Sobral	F	Tree	Local native
Myrtaceae Juss.	*Eugenia punicifolia* (Kunth) DC.	O	Tree	Local native
Myrtaceae Juss.	*Eugenia uniflora* L	F	Shrub	Brazilian exotic
Musaceae Juss.	*Musa* sp.	F	Herb	Exotic
Nyctaginaceae Juss.	*Tradescantia zebrina* Heynh. ex Bosse	O	Shrub	Local native
Orchidaceae Juss.	*Phalaeonopsis* sp.	O	Herb	Exotic
Orchidaceae Juss.	*Cattleya granulosa* Lindl.	O	Herb	Local native
Orchidaceae Juss.	*Oeceoclades maculata* (Lindl.) Lindl.	O	Herb	Brazilian exotic
Orchidaceae Juss.	*Arundina bambusifolia* Lindl.	O	Herb	Exotic
Orchidaceae Juss.	*Catasetum* sp.	O	Herb	Local native
Orchidaceae Juss.	*Cyrtopodium* sp.	O	Herb	Local native
Oxalidaceae R. Br.	*Averrhoa bilimbi* L.	F	Tree	Exotic
Oxalidaceae R. Br.	*Oxalis* sp.	O	Herb	Exotic
Phyllanthaceae Martinov	*Phyllanthus acidus* (L.) Skeels	F	Tree	Exotic
Piperaceae Giseke	*Peperomia scandens* Ruiz & Pav.	O	Herb	Brazilian exotic
Piperaceae Giseke	*Peperomia obtusifolia* (L.) A. Dietr.	O	Herb	Exotic
Polypodiaceae J. Presl & C. Presl	*Polypodium decumanum* Willd.	O	Shrub	Brazilian exotic
Rosaceae Juss.	*Rosa*sp.	O	Shrub	Exotic
Rosaceae Juss.	*Rosa wichuraiana* Crép.	O	Shrub	Exotic
Rutaceae Juss.	*Murraya paniculata* (L.) Jack	O	Shrub	Exotic
Sapindaceae Juss.	*Litchi chinensis* Sonn.	F	Tree	Exotic
Sapindaceae Juss.	*Cupania impressinervia* Acev.-Rodr.	O	Tree	Local native

Sapindaceae Juss.	*Talisia esculenta* (A. St.-Hil.) Radlk.	F	Tree	Brazilian exotic
Solanaceae Juss.	*Capsicum* sp.	F	Shrub	Exotic
Solanaceae Juss.	*Solanum paludosum* Moric.	O	Shrub	Exotic
Zingiberaceae Martinov	*Alpinia zerumbet* (Pers.)B.L. Burtt. & R.M.Sm.	O	Herb	Exotic
Zingiberaceae Martinov	*Curcuma longa* L.	F	Herb	Exotic

Appendix B – List of bird species mentioned to visit the home gardens and their activities, according to the interviewees: F – Feeding, N – Nesting and P – Passing.

Scientific name	**Local name**	**Activities in the home garden**
Piaya cayana	Alma-de-gato	P
Guira guira	Anu-branco	F
Crotophaga ani	Anu-preto	P
Hydropsalis torquata	Bacurau-tesoura	P
Polioptila plúmbea	Balança-rabo-de-chapéu-preto	P/N
Phaethornis pretrei	Beija flor-rabo-branco	P
Amazilia fimbriata	Beija-flor	F/N
Eupetomena macroura	Beija-flor-rabo-de-tesoura	P
Chrysolampis mosquitus	Beija-flor-vermelho	P
Pitangus sulphuratus	Bem-te-vi	F/N
Estrilda astrid	Bico-de-lacre	P/N
Coereba flaveola	Cambacica	F/N
Caracara plancus	Carcará	P
Athene cunicularia	Coruja-buraqueira	P
Megascops choliba	Corujinha-do-mato	P
Nystalus maculatus	Fura-barreira	P
Paroaria dominicana	Galo-de-campina	P
Rupornis magnirostris	Gavião-carijó	P/N
Sporophila albogularis	Golinha	P
Fluvicola nengeta	Lavandeira	F/N
Passer domesticus	Pardal	P
Veniliornis passerinus	Picapauzinho-anão	P
Tyto alba	Rasga-mortalha	P
Columbina minuta	Rolinha	F
Columbina picui	Rolinha	F/N
Troglodytes musculus	Rouxinol	P
Mimus gilvus	Sabiá-da-praia	P
Tangara cayana	Saíra-amarela	P
Tangara sayaca	Sanhaçu-cinzento	P
Tangara palmarum	Sanhaçu-de-coqueiro	P
Forpus xanthopterygius	Tuim	P
Coragyps atratus	Urubu-de-cabeça-preta	P
Cathartes aura	Urubu-de-cabeça-vermelha	P
Euphonia chlorotica	Vem-vem	F

Capítulo 2

FROM SHADE TO FRESH FRUIT: THE ROLE OF URBAN YARDS IN THE FOOD SECURITY AND WELL-BEING OF THEIR KEEPERS

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FROM SHADE TO FRESH FRUIT: THE ROLE OF URBAN YARDS IN THE FOOD SECURITY AND WELL-BEING OF THEIR KEEPERS

Abstract

Residential yards increase the well-being of the general population through socialization, contact with nature and local culture, and benefit the nutritional health of urban and rural families. However, specific characteristics of yards, such as diversity, can have distinct effects on food security and the well-being of those who maintain the yards and their families. This study aims to verify if well-being and food security are aspects particularly influenced by purely ornamental yards, agroforests yards or mixed ones. Yards in the Northeast of Brazil (n=41) were visited and their keepers were interviewed about the nutritional support provided by the yard, the use of external additives, and Gross Internal Happiness (GIH) indicators. The agroforest yards were found to contribute to the food security of the families, by providing them with food and medicinal herbs, for the most part without pesticides and chemical fertilizers. All types of yards are important components of the well-being of their keepers, in that, besides helping to transfer knowledge about agriculture, they favor socialization, contact with nature and provoke feelings of peace and harmony. In this way, the yards should be considered important spaces for projects and public policies as means to foment food security and well-being in communities that live in environments with few financial, social and environmental resources, even within urban areas.

Key words: green urban spaces, home gardens, well-being, urban agriculture.

Introduction

Food security and well-being are interlinked themes that affect people's development and freedom, by promoting positive changes in health, for example, in cases of poverty and malnutrition (SEN & MENDES, 2000).

Food security is a concept that is constantly developing. At the World Food Conference in 1974, food security was related to the production, storing and providing of food. However, it was shown that the increase of food did not guarantee the end of hunger (BELIK, 2003) and so other international discussions provoked the conceptual evolution of the theme – as at the World Conference on Human Rights in 1993. Between the decades of 1980 and 90, through the food and Agriculture Organization (FAO), and the World Health Organization (WHO), the concept of food security was made more complex, receiving a "nutritional" dimension, thereby including a concern for the access to safe foods (free of contamination), quality foods (nutritionally, sanitized and biologically) and produced in a sustainable way (BURITY, 2010). Promoting this right must have at its base the drive to encourage healthy food practices that respect cultural diversity and that are socially, economically and environmentally sustainable (LOSAN - nº 11.346/2006). Green urban spaces, such as community gardens and yards, can fulfill an important role in food security. The residential yards, especially, show a significant contribution in supplementing and improving family diets. This is due to the diversity of foods that can be produced in these spaces and the quality of these foods, in what is referred to as nutritional composition and the absence or lesser quantity of additives when compared with conventional agriculture (ALMEIDA, 2004; http://growing-gardens.org/)

Even without a precise definition, well-being is the norm when mentioning synonyms such as "happiness" and "quality of life" (McALLISTER, 2005). Objective aspects such as access to public services, housing, school and income, and subjective ones, such as self-evaluation of life satisfaction (PENNOCK & URA, 2011), are some of its components. For this reason, more complex indicators have been and continue to be developed. Of these, the Gross Internal Happiness (GIH) indicator was created by the current royal government of Bhutan, in light of the limitations of the Gross National Product (GNP) to measure the nation's progress (ALLISON, 2012). The GIH is made up of nine sub-indicators that consider subjective and objective spheres of well-being: psychological, health-wise, healthy time use, community vitality, education, diversity,

cultural and educational resilience, ecological diversity and resilience, good governance and lifestyle (PENNOCK e URA, 2011).

The yards have the potential to contribute to both the well-being and food security of their keepers. The family orchards can awaken feelings of peace, satisfaction in life, and opportunities for socialization (TZOULAS *et al*., 2007 & TSE, 2010); besides this, they represent a bridge between people and nature in an urban environment (KIESLING & MANNING, 2010; PYLE, 2003). In Brazil, there are few public policy measures on food production in city gardens (see EMBRAPA, 2014).

The Brazilian Northeast is the neediest region in the country (MONTEIRO, 2003), because of historical abuses and political abandonment, as well as its natural characteristics. This region is predominantly semiarid (70% of the territory is *caatinga* biome) (BUCHER,1982) with few enclaves of Atlantic Rainforest, dry coastland with little rainfall and poor, sandy soil that is not always good for conventional agriculture. The caatinga soil, as a result of the destruction of native vegetation, through the intensive use of firewood, clear cutting and slashing and burning practices, has been going through a salinization and desertification process, turning it even more inviable for agriculture (LEAL, 2005). As a result of this and other factors, in the region, there are elevated levels of malnutrition in the population (MONTEIRO, 2003). The future expectations for the region present an even darker picture, since the climatic changes expected should result in even less rainfall, increasing the social risk to an already vulnerable population (KROL & BRONSTERT, 2007).

Despite this, in some areas of this region of transition between caatinga and Atlantic Rainforest, urban yards can still be found – many of which are threatened by coastal overdevelopment and even changes in eating habits that devalue food produced locally. In this study, yards previously classified as ornamental, agroforests or food agroforests were analyzed in relation to their contribution to the well-being and food security of the families that maintain them. The expectation is that both kinds of agroforest yards provide greater food security to their keepers, by contributing to the diversity of food items, as well as the quality of these foods. On the other hand, it is not expected that there will be a difference in other aspects of well-being provided between the different types of yards, such as use of time, informal education, community vitality, self-evaluation of physical and psychological health, in light of the fact that all promote contact with nature.

In general, this study contributes to prior research and projects that make food security viable and the well-being of families in situations of social and environmental risk.

Methodology

Area studied

The data collection was carried out on the south coast of Rio Grande do Norte, in the northeast of Brazil, on an urban section, in the county of Pium, which is part of the city of Parnamirim. Pium is located 25km south of the State capital (Natal), (Figure 1).

The climate of the region is characterized, according to the Köpen classification, As (with a dry season in the summer) (ALVARES *et al.*, 2013), median rainfall and temperature of 1.44,8 mm and 27º C, respectively (MME, 2005). The vegetation is predominantly Atlantic Rainforest, despite suffering the influence of caatinga due to its proximity.

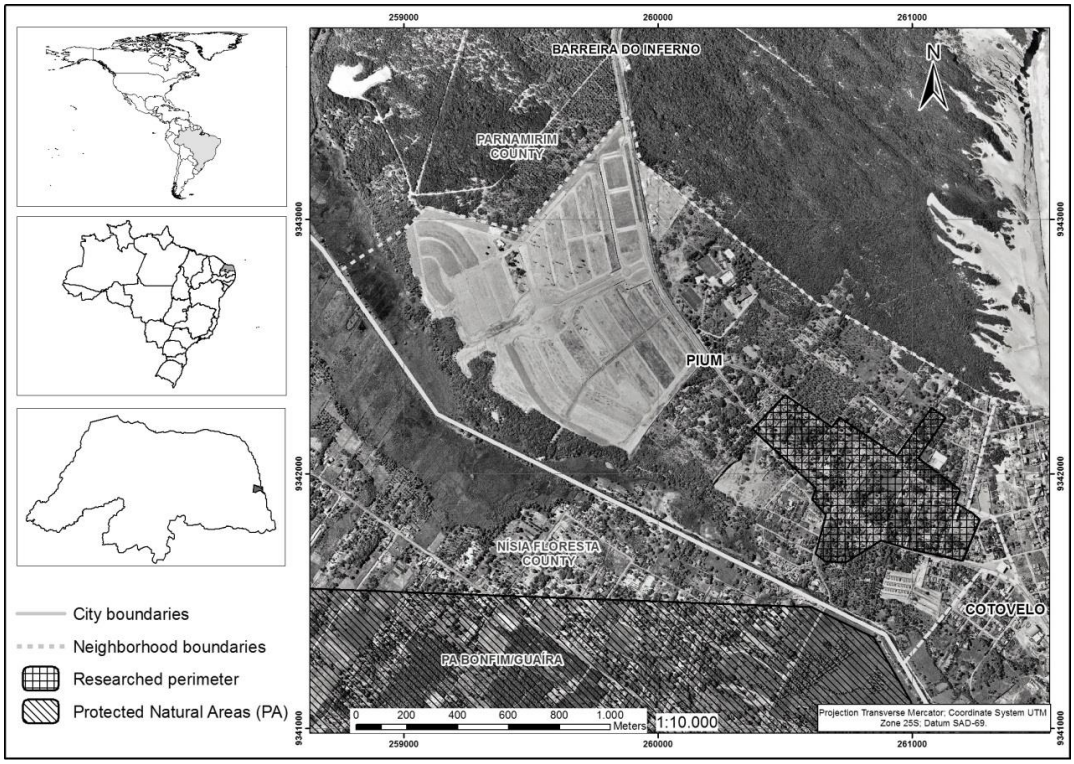


Figure 1 – Map of the study area. The sampled home gardens are in the area delimited by the black hachured line (Pium county, in the city of Parnamirim, RN).

Due to the proximity of these areas to the beaches and other natural environments, such as rivers, lakes and dunes, Pium has been undergoing a rapid process of population growth and urbanization – a process that is repeated all along the northeastern coast. The change in the use of space, brought on by urban growth, contributes to the extinction or reduction of land destined for cultivation yards, often being paved over to build commercial establishments to sell or rent. In this context, a series of changes occurs as well

in the local customs and traditional local knowledge linked to growing plants (personal observation).

Despite this, some yards still persist. Prior research (Bezerra et al., submit.) studied 41 yards in Pium and registered 187 species of plants for ornamental, food, medicinal, or religious use, which was the basis for the classification of ornamental and agroecological yards adopted in the present study.

Data collection

The field work was carried out from March to July, 2013. The greater part of the yards was identified through the observations in the streets of the neighborhood (not a random sample), even though indications also had been made by long-time residents and through interviews.

Despite the inexistence of concrete data about the population of the area studied, it is estimated that there are nearly 400 households, of which 56 present yards that have cultivation areas for medicines, food (fruit trees, orchards, flowers and edible herbs), religious and ornamental purposes. Of these, 41 were visited and their keepers were interviewed, since some of the residents were absent or did not want to participate in the study. Before being interviewed, the yard keepers received an explanation about the study being carried out and signed an authorization to participate in the research.

In the former study, previously mentioned (Bezerra et al., submit.), the calculation of the diversity of cultivated species (richness and equability) of use as food, medicines and ornamental was done. This research also provided a characterization of these spaces in three distinct groups, starting from a grouping analysis: 1) six ornamental – comprised of ornamental species, 2) 23 agroforests – which have the greatest diversity of plants in general and the most equitable distribution of types of use of these plants among the three groups, and 3) 12 food agroforests – which present the lowest number of plants of ornamental use and the greatest of food use, as well as the greatest arboreal diversity.

Among those interviewed, 28 were women and 13 men. The age of those interviewed varied from 26 to 81 years of age. In the majority of cases (80%) this time frame also corresponded to the age of the yard.

Evaluation of well-being

Each yard keeper responded to a semi-structured interview (Annex 1), containing 31 questions approaching the two thematic axes: well-being and food security. To analyze well-being, some of the dominions of the Gross Internal Happiness Indicator (‘time use’,

‘informal education’, ‘community vitality’ and ‘physical and psychological self-evaluation’) (PENNOCK & URA, 2011) were adapted to the present study and used as a base for the elaboration of interviews in the following way:

1. Time use – time dedicated to caring for the yard and the role of these spaces in the social activities;
2. Informal education – transmission of popular knowledge over generations, related to the cultivation of plants;
3. Community vitality – the custom of exchanging products with neighbors, friends and family;
4. Psychological and physical health – self-evaluation of physical health and stress levels and the relationship of these with the yards, and the meaning the yards have for their keepers.

Evaluation of Food Security

For the axis of food security two categories were designed: “hygiene and food security” and “ecological or organic”, which concern respectively the production of food free from substances that are harmful to human health and without risks of toxicity to the environment, such as pesticides or chemical fertilizers (ALMEIDA, *et al.*, 2006). For this, keepers were asked if the cultivation of food, as well as the growing of medicinal herbs were done free of chemical additives or any type of element that would be toxic to the gardeners, or anyone who might use products from the yards or the environment itself. Besides this, still within the food security axis, the nutritional support from the yard was considered. The interviewees were asked if they had eaten each of these items the week prior to the interview: teas, juices, fruits, vegetables, fresh leafy greens (including cooking herbs), meat and eggs. They were asked then if some of these items came from their yard and if so, if the quantities used corresponded to: 1) less than half of what they had consumed of this item, 2) half, 3) more than half, 4) all. The following evaluation regarded whether the participants whose yards were agroflorests and food agroforests consumed more diverse food items than those whose yards were comprised of primarily ornamental plants.

To verify if there was a quantitative difference in the contribution of the three types of yards for food security and for well-being, a point system was developed with the following classifications of dichotomy contributions (answers of 0/no or 1/yes):

1) Food security: the use of medicinal plants, destination of organic waste and dry leaves (if they were used for composting the soil or thrown in the trash) and use of chemical inputs.

2) Well-being: preferred place in the house (if it was in the yard or not); preferred place for religious practices (if it was in the yard or not); custom of giving or receiving donations of products from yards and the custom of teaching others about yard care and the use of medicinal plants.

Only these questions could be considered in the point system, as they are binary. Each positive response received one point. However, in the case of a positive response with relation to the use of chemical additives, a point was subtracted. The median point value was then analyzed with regard to the difference between the types of yards. For this the Kruskall-Wallis test was applied, after the Shapiro Wilk test detected the non-normality of the data.

Results

Yards and Well-being

Time Use – caring for the yards and social activities

The yards are for the most part (88%) visited daily by their keepers, while the others are visited weekly, for diverse periods, predominantly between 1 and 2 hrs/day (66%). Even so, more than half of those interviewed liked to spend time in the yards because the environment provoked various feelings of satisfaction, such as relaxation (73%), relaxation/production/socialization (15%), relaxation and production (12%), among others (Figure. 2a and 2b).

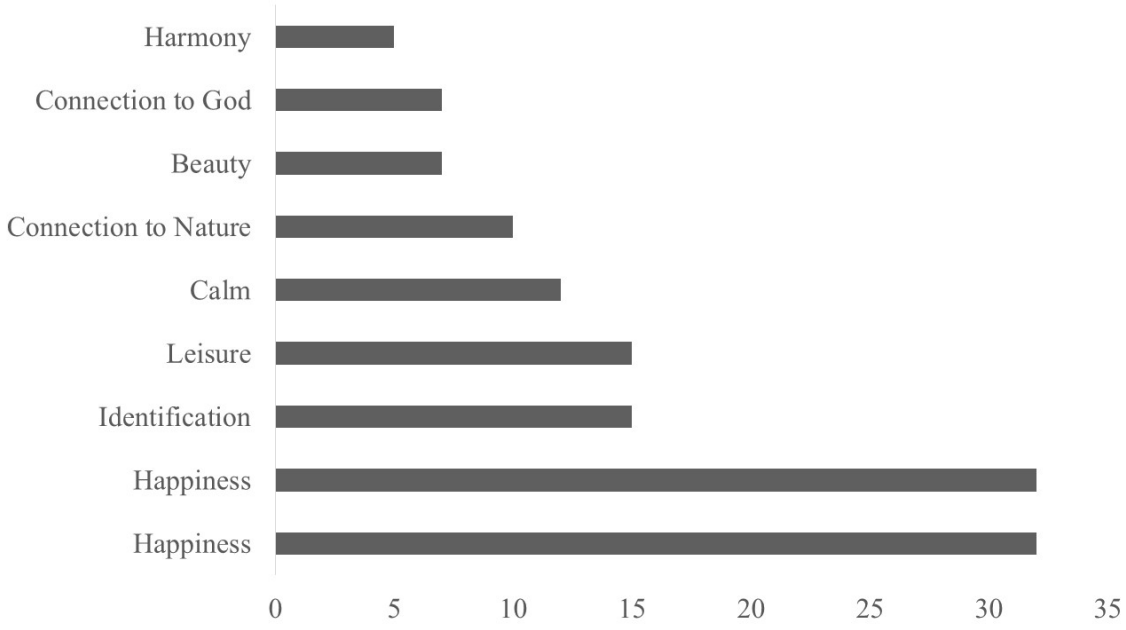
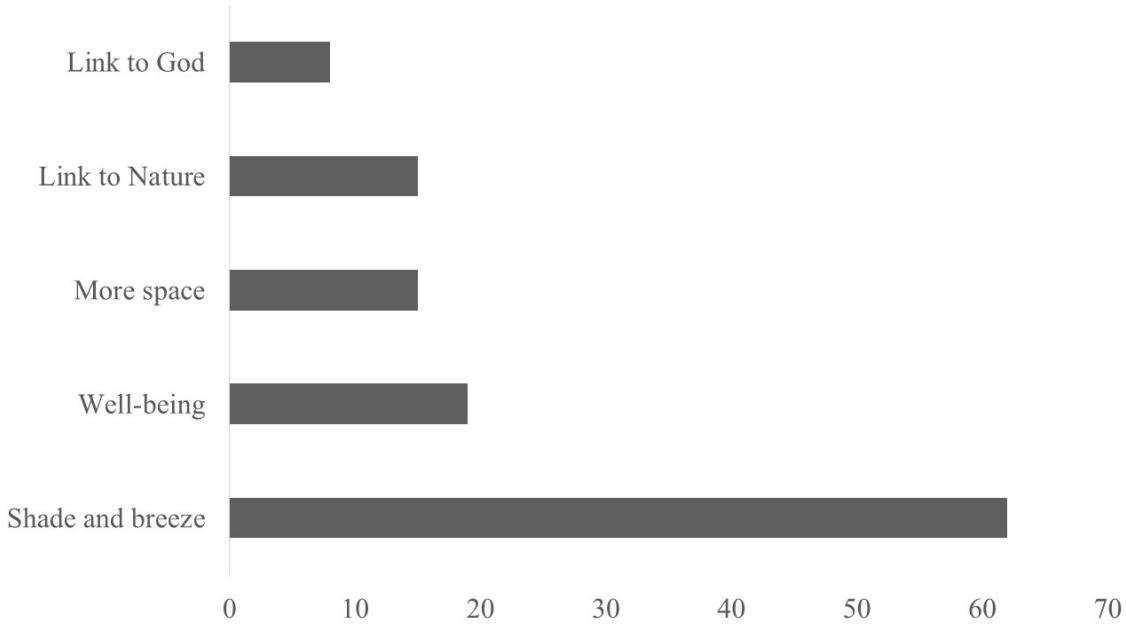


Figure 2. b) A) Percentage of feelings provoked by the yards according to the interviewees in %. N=41. B) Motives for which the yards are chosen for social activities %, n = 41



Relaxation was associated with the concentration on activities, forgetting problems while working or observing the yard, as well as the company of plants to listen to their problems and complaints. According to one of the men interviewed (29 years old), “it seems they (the plants) understand when we need to unload problems”.

The yards also provide an environment favorable for the interviewees to hold parties and gatherings of friends and family (63%) for the reasons expressed in Figure 2b.

Community Vitality – exchanges among neighbors, family and friends

The yard keepers exchange fruit, medicinal herbs, saplings and seeds (Figure 3). Besides material exchanges, the participants also reported exchanging knowledge about growing practices or the use of medicinal plants among neighbors.

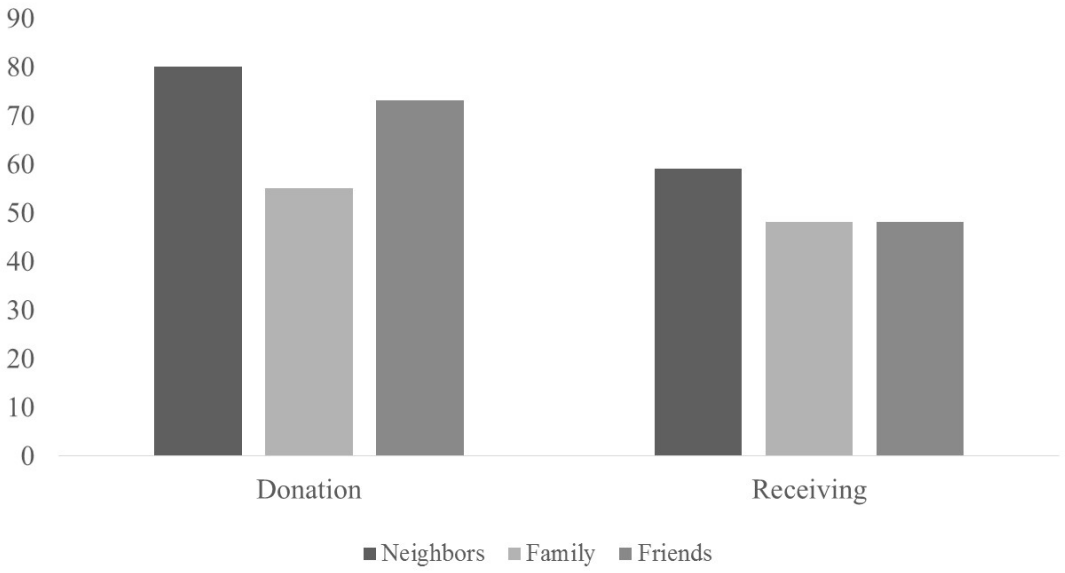


Figure 3: Frequency of positive responses about donating and receiving products from yards by neighbors, Family and friends of the owners of the yards, in %, n = 41.

Informal Education – teaching popular knowledge over generations

The yards represent an environment that favors the exchange of knowledge over generations (Figure 4). Those interviewed affirm that they teach their knowledge to neighbors (55%), family (58%), and friends (64%). However, many of them state that their children and grandchildren are not interested in this knowledge, suggesting that there can be a loss of this oral transmission.

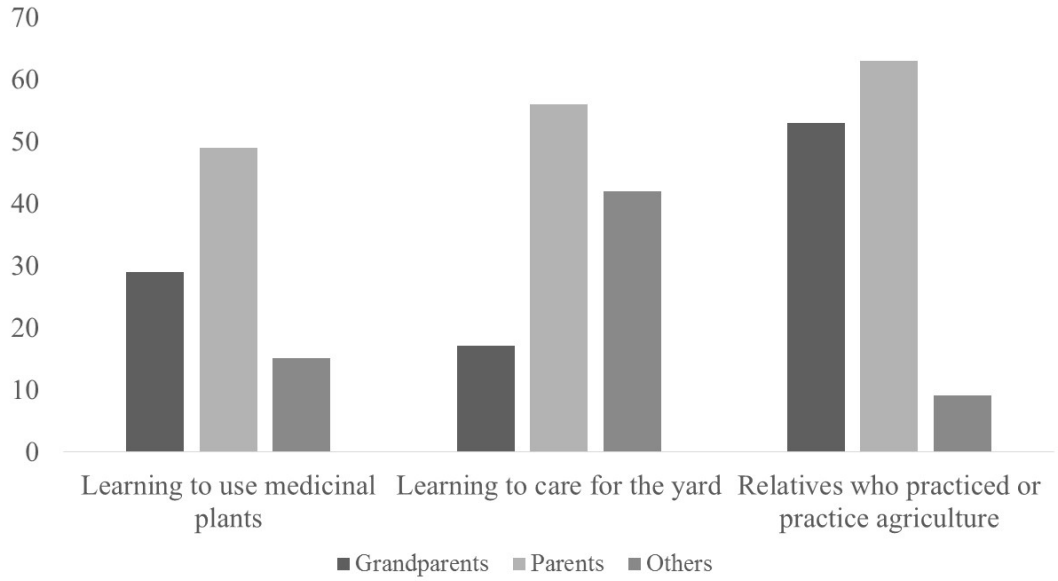


Figure 4 Percentage of answers that show with whom the interviewees learned about growing plants and using herbs. Percentage also of answers about relatives who practiced or practice agriculture, n = 41.

The keepers of the yards also affirm growing species that they know because someone in their family already grew it (59%). In this case, the majority of them (75%) inherited the custom from growing food crops, followed by ornamental (38%) and medicinal (29%).

Psychological and physical health – mental and physical health and their relationship to the yards

The answers referring to self-evaluation of stress levels and health were, low in frequency, related to the yards (Figure 5) .Of those who totally agreed that they felt healthy, 12% associated this response with their yard, whereas those who partially agreed and totally disagreed with the affirmation “I feel very stressed”, 5% to 10% respectively associated their responses to the yards. According to a man, 55 years old, “Sometimes I get stressed at work, but the next day I am renewed, because the yard helps”. On the other hand, two participants interviewed pointed to the yard as a source of stress, when it was found dirty or disorganized. Two mentioned that they felt limited and unable to take care of the plants the way they would like to because of health problems.

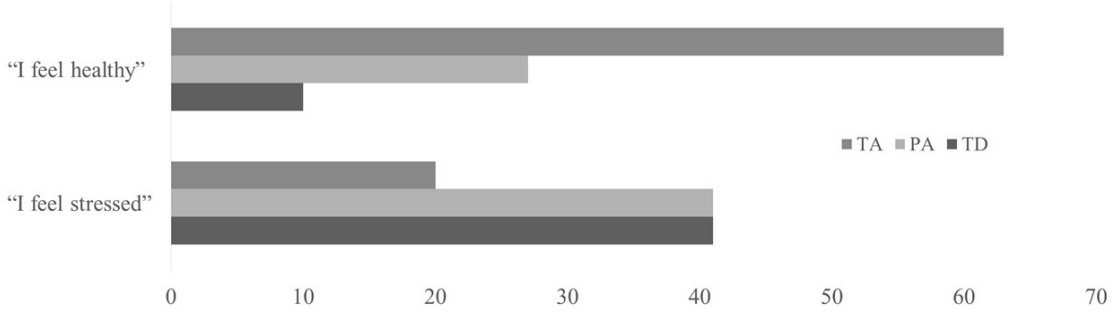


Figure 5: Self-evaluation of health and stress of 41 yard keepers, in regard to the statement "I feel healthy" and "I feel stressed", in %. CT = I totally agree, CP= I partially agree and DT = I totally disagree.

The places in the house that are considered preferred places by 49% of those interviewed for religious purposes and rest were their room (29% and 41% respectively) and the yard (20% and 32%), while the others did not report a favorite place for religious practices in the house or they were not accustomed to performing them.

Yards and human and environmental health

Food security – production of food and defensive uses

There was no difference in diet among the yard keepers of the three types of yards with relation to the consumption of items ingested during the week in question. Even so, the two types of agroforest yards were basically those that provided contributions of food items (fruit, juice, tea, spices, eggs and only in some cases, meat and chicken) (Figure. 6), since 78% of those interviewed mentioned that at least one of these types of foods was provided by the yard. Just one of these yards was not part of the agroforest yards.

There were three cases of generating surplus for commercialization, from which were sold: eggs, sweet coconut candy (cocada) from coconuts harvested in the yard, homemade medicinal syrups, made from medicinal herbs grown in the yard.

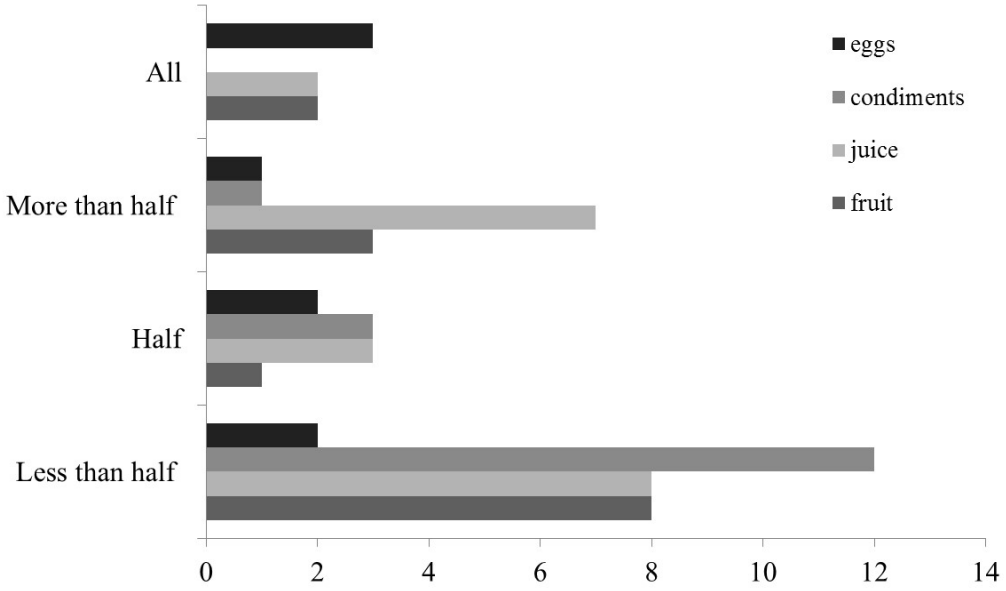


Figure 6 –Foods from the yards. Axis x: number of participants interviewed who stated they used food from their Yard. Axis y: quantity of food from the 35 agroforest yards, divided in categories: less than half (-50% of the total type of food ingested), half (50% of the total of they type of food ingested), more than half (between 51 and 75% of the total type of the food ingested) and all (100% of the total of the type of food ingested).

Use of pesticides

Of those interviewed, 39% reported that they apply industrialized products to their crops to kill weeds, which were not conventional agricultural additives, but actually domestic cleaning products like laundry soap, bleach and disinfectants. One part of these applications (four cases) was done on fruit trees. This shows that the production of food in the agroforest yards was not totally lacking toxic elements for the families and the environments. Even so, the food, for the most part, was not submitted to any kind of pesticides.

Only two cases reported the use of chemical fertilizer (NPK), and was used on ornamental species. The other 28 interviewed stated that they preferred to use cow manure for fertilizer (which was obtained locally), from chicken (in their own yards) or earthworms.

Use of medicinal plants

Findings showed that medicinal plants substituted pharmaceuticals in 78% of the cases, along with 60% of those interviewed also using plants found outside of the yard, such as in the supermarket, open markets, on the side of the road, in the woods or given by neighbors, and those familiar to them. Use is not weekly or daily: participants interviewed

reported using them only when they felt some symptom of illness. The majority of uses of the medicinal plants were related to the trust in the power of the herbs to cure and the lack of trust in the allopathic remedies. In just two cases participants reported that financial difficulties were the reason they opted to use the medicinal plants.

Benefits of the different types of yards

The yards studied did not differ among themselves in two categories of contributions analyzed, food security (H= 0,2678; gl=2; p= 0,8747) and well-being (H=1,0691; gl= 2; p= 0,5859), when considering the point value attributed to different items (Figure. 7).

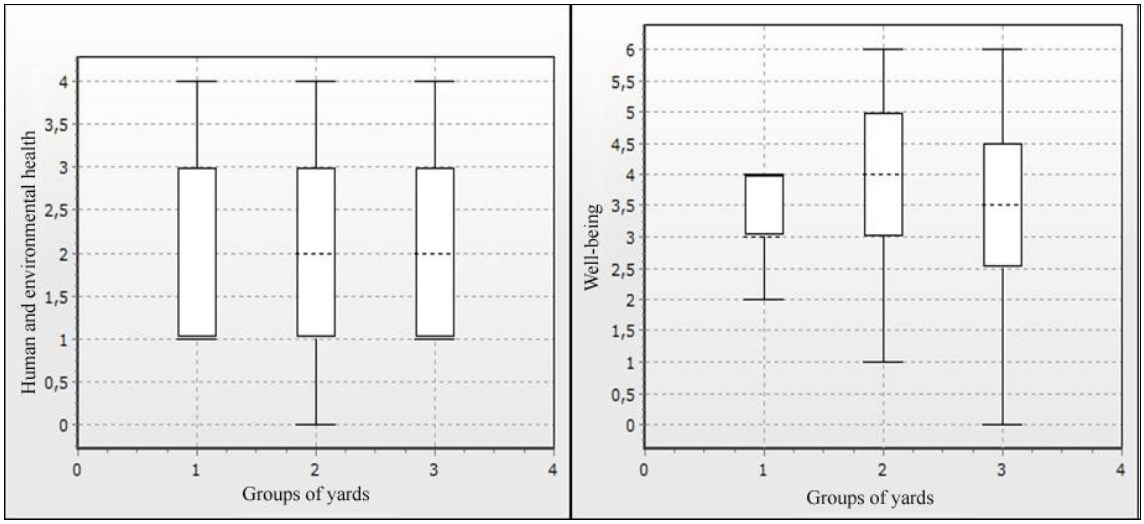


Figure 7 – Box-plot of the mean showing the y axis point value of the three groups of yards. On the x axis: 1 – ornamental yards, 2 – agroforest yards, 3- food agroforest yards.

Discussion

The yards and food security

The results of this study corroborate the importance of yards for food security (MÉNDEZ *et al*., 2001; CALVET- MIR *et al*., 2012). This is because these yards were related to the providing of food and supplementation of diet, to the low frequency of use of industrialized products in the crops, as well as the custom these environments favored in making exchanges of food and medicinal herbs among their owners.

Besides their transformative role, which they play in situations of food insecurity, the yards perform a positive function in lives of low income families (ALTIERI *et al*., 1999). The crops of the present study have implications on the probable reductions of food and medicinal expenses, of the yard owners, and in some cases, provided surplus to sell. For

similar reasons, urban agriculture initiatives, such as the yard, have been the target of community organization initiatives, social movements and public policies (SANTANDREU & LOVO, 2007; SANTIAGO, 2007).

The production in the agroforest yards visited is related to some of the fundamental values of food security policies, as hygiene and food security and the ecological or organic axis (ALMEIDA *et al*., 2006), by guaranteeing food free of element harmful to health and the environment, such as chemical fertilizers and agrotoxins. Even though chemical fertilizers were not used in food production, there were cases of the use of chemical products on species of fruit trees, suggesting that it would be important to train these yard keepers to deal with pests in their crops, using better practices, such as the ones provided by agroecology. This type of instruction for urban family farmers, together with the food education strategies, favor the understanding of the social actors about the context of production and consumption of food, and for this reason are basic instruments for the application of food security policies in the cities.

The exchange of food items and saplings from the yards among friends, relatives and especially neighbors can create the conditions for reciprocity among them, favoring the diversification of the diet in distinct periods (WINKLERPRINS & DE SOUZA, 2005). Growing practices and exchanging food can even act as element for building socioecological resilience (the capacity to deal with and absorb impacts on the social and environmental level), by providing food and medicinal herbs in moments of environmental, political or economic crisis (BUCHMANN, 2009). In this way, the practice of growing food crops in yards benefits life in the cities in a general way, but also especially with regard to the needs of populations that live with social and environmental problems, such as food insecurity and malnutrition, which plagues particular places in the Northeast of Brazil.

The application of policies that give value to and promote urban agriculture benefit society and the environment in many aspects, as the cities stop acting only as consumers of products from rural areas, and come to favor autonomy and food security of families with yards and perhaps their neighbors. This type of crop cultivation contributes directly to the reduction of negative environmental impacts in the chain of food production, such as pollution of hydric crops, the use of conventional agricultural additives, and the pollution caused by the transportation of foodstuffs, as well as indirectly, acting on for example the absorption of carbon in the atmosphere (SAHA *et al*., 2009) and in the microdrainage of rainfall. In this study the agroforest yards and also the ornamental yards contributed

equally in the destination of organic waste for the production of compost and in the reduction of using chemical additives.

The yards and well-being

Similar to the present study, a series of studies have focused on green infrastructure as an agent that promotes benefits, which weave through ecological and social systems (TZOULAS *et al*., 2007 & CALVET-MIR *et al*., 2012). The yards extend their benefits in multiple spheres: environmental, therapeutic, cultural and social, integrating human health and environmental health (TZOULAS *et al*., 2007).

The ornamental yards and the agroforest yards contribute equally in the indicators of well-being considered in the statistical analysis: preferred place in the house to rest and for religious practices. These environments provide individual leisure time, through the daily or weekly upkeep dedicated to them, as well as group leisure, since many types of social activities take place in them, such as parties, prayer groups and meals, with family, friends and neighbors. This reinforces the relevance of these environments in providing feelings of satisfaction with life, pleasure, happiness, relaxation, calm, as well as representing refuge in moments of stress and the need for quiet (CALVET-MIR *et al*., 2012; FREEMAN *et al*., 2012; TSE, 2010).

Informal education is one of the components of the GIH rate of well-being, which recognizes the value of transmitting traditional knowledge and skills about local culture, agriculture, the use of home remedies and ecology. This knowledge benefit people with the skills necessary to carry out their daily lives and in this way positively influence their quality of life. The yards in this study also show ways of enacting informal education, as the interviewees reported practicing traditional knowledge handed down from their relatives, about growing plants and the use of medicinal herbs, as well as passing this knowledge on to others.

These environments were shown to even enrich the community vitality, through exchanging items among neighbors, of herbal medicines, seeds and foods harvested in the yards, as well as sharing experiences, knowledge and tools (TSE, 2010; BARTHEL *et al*., 2010).

Some owners related their psychological and physical health to these spaces. Even so, here we also reinforce that in a few cases the yards can generate discomfort in people

who are going through moments of illness and physical limitations and cannot organize time or the dedication necessary or that they would like to care for the yards (FREEMAN *et al*., 2012). This circumstance calls attention to the need to develop strategies of accessibility in the yards, such as raised beds to facilitate maintenance and contact with the earth (http://growing-gardens.org/). These strategies can lessen the frustration caused by physical limitations and even aid in the process of recovery of the ill person (FREEMAN *et al*., 2012).

These and other researches reveal the important role and the multiple functions of the green urban areas (TZOULAS *et al*., 2007), which, despite this, are still rarely recognized in the application of policies aimed at well-being (MILLER, 2005). In the last decades, urban areas have increased in span and population, and are landscapes dominated by buildings and characterized by the absence or the devaluing of green spaces (MILLER, 2005). This accelerated process of urbanization tends to cause the so called "extinction of experience" – an urban phenomenon related to the alienation and loss of affect for nature, generated by the absence of human contact with the cycles of nature, flora, fauna and local cultural characteristics (PYLE, 2003). In this sense, the yards demonstrate their important role in the connection of people with the cycles of nature, since their owners maintain contact, in many cases daily, with all of the life that thrives in the yard.

Final Considerations

This work calls attention to the importance of the residential yards that act as true islands in the urban landscapes. The growth of cities brings the degradation or even the total extermination of expanses of areas of vegetation. The size and the shape of the spaces targeted for living are ever decreasing and shrinking green spaces. Going against the tide of this process, research and projects that show the value of the yards in diverse aspects of human life proliferate. Here it is shown that the yards studied improve the well-being of their owners, which permeates the use of time in leisure and social activities, the transmission of traditional and agricultural knowledge and the use of medicinal plants and community vitality. Also it can be concluded that the well-being promoted by the yards does not change depending on the type of plants grown in them.

The results of this study can serve as a basis for projects and public policies that aim to use green urban spaces as tools to increase well-being, and promote food security for citizens. One sector of the yards studied (the agroforests and food agroforests) stand out

among them for providing food and herbal medicines, as well as benefiting the economy of the residents. In this way, these spaces must be considered important means of providing food security for communities and families that live in environments of social, environmental and economic need, such as some rural and urban areas of the Brazilian northeast.

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Conclusões Gerais

Este trabalho chama a atenção para importância dos quintais residenciais, que atuam como verdadeiras ilhas nas paisagens urbanas. O crescimento das cidades leva à degradação ou total extermínio de extensas áreas vegetadas. O tamanho e a conformação dos espaços direcionados à moradia são cada vez menores e mais desprovidos de espaços verdes. No contra fluxo, pesquisas e projetos demonstram o valor dos quintais em diversos aspectos da vida humana. Este estudo trouxe contribuições para uma visão mais detalhada do papel dos quintais no contexto urbano. Os resultados demonstraram que os quintais por si só nem sempre são eficientes na manutenção de espécies nativas, embora isto possa variar até mesmo dentro da mesma região. Aqui, quintais foram estatisticamente agrupados em três diferentes grupos, com diferentes potencias de contribuição sobre a fauna. Quintais com elevada diversidade arbórea contribuíram significativamente mais para atrair saguis (aqui especificamente *C. jacchus*), enquanto aves são beneficiadas pela alta diversidade de plantas (arbustivas e herbáceas). Quintais ornamentais, por outro lado, têm pequenos efeitos na diversidade de plantas e na atração de animais.

Este estudo também mostrou que os mantenedores dos quintais e suas famílias podem ter algumas limitações em relação à maneira como lidam com animais que frequentam os quintais, como as abelhas, vespas, cobras e lagartos. Tais limitações e a baixa representatividade das espécies nativas podem ser trabalhadas em projetos de arborização que valorizem as espécies nativas, através de estudos que abordem nutrição, uso medicinal e potencial ornamental, bem como por iniciativas que ensinem como lidar com animais selvagens.

Quintais são relevantes tanto como espaços para promover a conservação, enriquecendo a matriz e permitindo o estabelecimento de espécies (HYLANDER & NEMOMISSA, 2008), quanto como uma maneira de aumentar a permeabilidade da matriz entre fragmentos, facilitando a migração de animais entre eles (PERFECTO & VANDERMEER, 2008).

O caso específico da área de estudo deste trabalho, por ser localizada entre duas áreas protegidas, poderia ser utilizado para responder como os quintais podem melhorar a matriz urbana e conectar fragmentos florestais. Para isso seria necessário compreender quais espécies se beneficiariam mais e quais são seus requerimentos ecológicos (CARYL et al., 2013). Além disso, vale investigar como as espécies dos quintais podem afetar positiva ou negativamente a composição de fragmentos como um repositório de diversidade genética,

aumento da população, bancos de sementes e mudas, e também por contaminação genética (ROBERTS et al., 2007).

Tal abordagem envolve a conservação na rotina diária de uma comunidade e pode ser usada em projetos de arborização, planejamento urbano e residencial. Dessa forma é possível, desenvolver estratégias de conservação que vão além das áreas protegidas e estabelecer conectividade entre fragmentos florestais a baixo custo (RAHEEM, 2008).

Portanto, uma vez que os quintais têm mostrado o seu potencial como uma estratégia de conservação, as próximas perguntas devem abordar as circunstâncias e características que permitem os quintais atuar como facilitadores ou limitadores para a ocorrência de determinadas espécies. Compreender os processos de facilitação e de limitação poderia ajudar a direcionar projetos de sensibilização ambiental, a fim que os os quintais possam representar uma interface positiva entre os ambientes naturais e antropizados.

Além das questões referentes à conservação da biodiversidade, esta pesquisa mostrou de que forma os quintais podem promover bem estar aos seus proprietários, o qual permeou o uso do tempo para atividades de lazer e socialização, a transmissão dos conhecimentos tradicionais de agricultura e uso medicinal de plantas e a vitalidade comunitária, e também mostrou que bem estar proporcionado não se diferencia pelos tipos de plantas cultivadas nos quintais. Nesse sentido os quintais favorecem as relações entre pessoas, entre culturas, assim como resgata a ligação enfraquecida do cidadão urbano com a natureza. Os quintais agroflorestais e agroflorestais alimentares se destacaram no fornecimento de alimentos e ervas medicinais, bem como por favorecer a economia nas residências. Dessa forma, políticas de apoio à agricultura urbana devem considerar os quintais como importantes meios de propiciar a segurança alimentar para comunidades e famílias que vivem em ambientes de carências econômicas, sociais e ambientais, como algumas áreas rurais e urbanas do Nordeste brasileiro.