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WinklerPrins, Antoinette; de Souza Oliveira, Perpetuo Socorro  
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**Urban agriculture in Santarém, Pará, Brazil:  
diversity and circulation of cultivated plants in urban homegardens**  
*Agricultura urbana em Santarém, Pará, Brasil:  
diversidade e circulação de plantas cultivadas em quintais urbanos*

Antoinette WinklerPrins<sup>I</sup>

Perpetuo Socorro de Souza Oliveira<sup>II</sup>

**Abstract:** Urban agriculture, including urban homegardens, is vital for urban survival of many people in various cities around the world, including those in the Amazon region of Brazil. These spaces, through daily praxis, become important for incidental agrodiversity conservation as food plants are cultivated and their plant material circulated. Utilizing data from a year-long intensive qualitative study of 25 rural-urban migrant households, this article considers the diversity of plant material in urban homegardens in the Amazonian city of Santarém, Pará, Brazil. The purpose of the study was to understand the social systems that maintain cultivated plant diversity in homegardens. Our objectives in this article are twofold: a) to demonstrate that plant agrodiversity in homegardens persists in a setting which is located 'at the market'; and b) to document the ways in which flows of plant material help maintain this agrodiversity.

**Keywords:** Homegardens. Agrodiversity. Santarém (PA). Amazon. Plant exchanges. Social networks.

**Resumo:** A agricultura urbana, incluindo quintais urbanos, é vital para a sobrevivência de muitas pessoas em várias cidades ao redor do mundo, incluindo as da Amazônia brasileira. Esses espaços, por meio da prática cotidiana, tornam-se importantes para a conservação incidental da diversidade agrícola, enquanto áreas para cultivo de plantas alimentícias e de circulação de plantas. Utilizando dados de um ano de estudo qualitativo intensivo de 25 residências de migrantes rurais-urbanos, o artigo aborda a diversidade de plantas nos quintais urbanos na cidade amazônica de Santarém, Pará, Brasil. O propósito do estudo foi compreender os sistemas sociais que mantêm a diversidade de plantas cultivadas nos quintais. Nosso objetivo neste artigo é duplo: a) demonstrar que a agrodiversidade de plantas nos quintais persiste em um cenário que se situa 'no mercado'; e b) documentar as maneiras pelas quais os fluxos de material vegetal ajudam a manter essa diversidade agrícola.

**Palavras-chave:** Quintais. Agrodiversidade. Santarém (PA). Amazônia. Intercâmbio de plantas. Redes sociais.

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<sup>I</sup> Michigan State University. East Lansing, Michigan, USA (antoinet@msu.edu).

<sup>II</sup> Independent Researcher. Santarém, Pará, Brasil (perpetuo10@yahoo.com.br).

## INTRODUCTION

Urban farming is one of the points where conservation interests and the interests of the cash-poor migrant begin to converge (Linares, 1996, p. 119).

Urban agriculture (UA) is critical for the survival of many people in urban areas around the world (Bakker *et al.*, 2000; Redwood, 2009; RUAF Foundation, 2010). According to the United Nations, the world is now an urban world, with over 50% of the global population living in urban places (UN DESA, 2010). In many cities, both large and small, the rate of urbanization exceeds the ability of local economies to absorb new migrants into the urban wage labor sector, and consequently the need to rely on subsistence livelihood strategies in the city remains (Linares, 1996; Sanyal, 1985; Brunn *et al.*, 2008; Armar-Klimesu and Maxwell, 2000; Browder and Godfrey, 2006; Foeken and Owuor, 2008).

UA has been studied for a long time from both an academic as well as a development perspective (Bakker *et al.*, 2000; Kimber, 2004). It is defined as “the growing of plants and the raising of animals within and around cities (...) [and] is integrated into the urban economic and ecological system” (RUAF Foundation, 2010). UA is practiced on private plots about a house or on more public spaces along road berms, on abandoned land, or in communally managed spaces. The private spaces where UA is practiced are known by a variety of names such as homegardens, house-lot gardens, dooryard gardens, and are defined as spaces around a house, a place of residence, which is cultivated with plants primarily for utilitarian, but also for aesthetic reasons (Landauer and Brazil, 1990; Kumar and Nair, 2004). Therefore urban agriculture includes the cultivation occurring in homegardens. Depending on the scale of the endeavor, the people cultivating in the city can be conceptualized as agriculturalists and/or as gardeners.

Homegardens have been acknowledged spaces for agrodiversity<sup>1</sup> and as sites for its ‘incidental’ conservation

(e.g. Lamont *et al.*, 1999; Brookfield, 2001; Trinh *et al.*, 2003; Ban and Coomes, 2004; Coomes and Ban, 2004; Amaral and Guarim Neto, 2008). A link between market proximity and homegarden agrodiversity has frequently been considered in homegarden research, with findings demonstrating both a decline in diversity with increased proximity to a market as well as maintenance of the diversity close to a market (Fernandes and Nair, 1986; Soemarwoto, 1987; Rico-Gray *et al.*, 1990; Lamont *et al.*, 1999; Wezel and Ohi, 2005; Kabir and Webb, 2009). These conflicting findings indicate the varying motivations that people have in maintaining homegardens and that simple economic explanations are not adequate (Slater, 2001).

This article presents findings from a year-long qualitative research project on the urban agriculture of rural-urban migrant households in the Brazilian Amazonian city of Santarém, State of Pará. The purpose of the study was to understand the social systems that maintain cultivated plant diversity in homegardens. Our objectives in this article are twofold: a) to demonstrate that plant agrodiversity in homegardens persists in a setting which is located ‘at the market’; and b) to document the ways in which flows of plant material help maintain this agrodiversity.

## STUDY AREA

Fieldwork was conducted with Amazonia’s historical peasantry, a mestizo people known as *caboclos* or *ribeirinhos*, in the urban portion of the Municipality of Santarém. This municipality is located in the western part of the State of Pará (Figure 1). While about the size of Belgium (24,154 km<sup>2</sup>), less than one percent of the entire municipality (40 km<sup>2</sup>) is defined as ‘urban’. Santarém is the fifth most populous municipality in the Amazon with 262,672 residents in 2000 (PMS, 2001). Of that total, 71% live in the official urban zone of Santarém, and the remainder in the rural area. These figures are the norm regionally as the Brazilian Amazon is now 70% urbanized (Browder and Godfrey, 2006, p. 20).

<sup>1</sup> The diversity of plants used in agriculture or other human-managed systems (Brookfield, 2001).

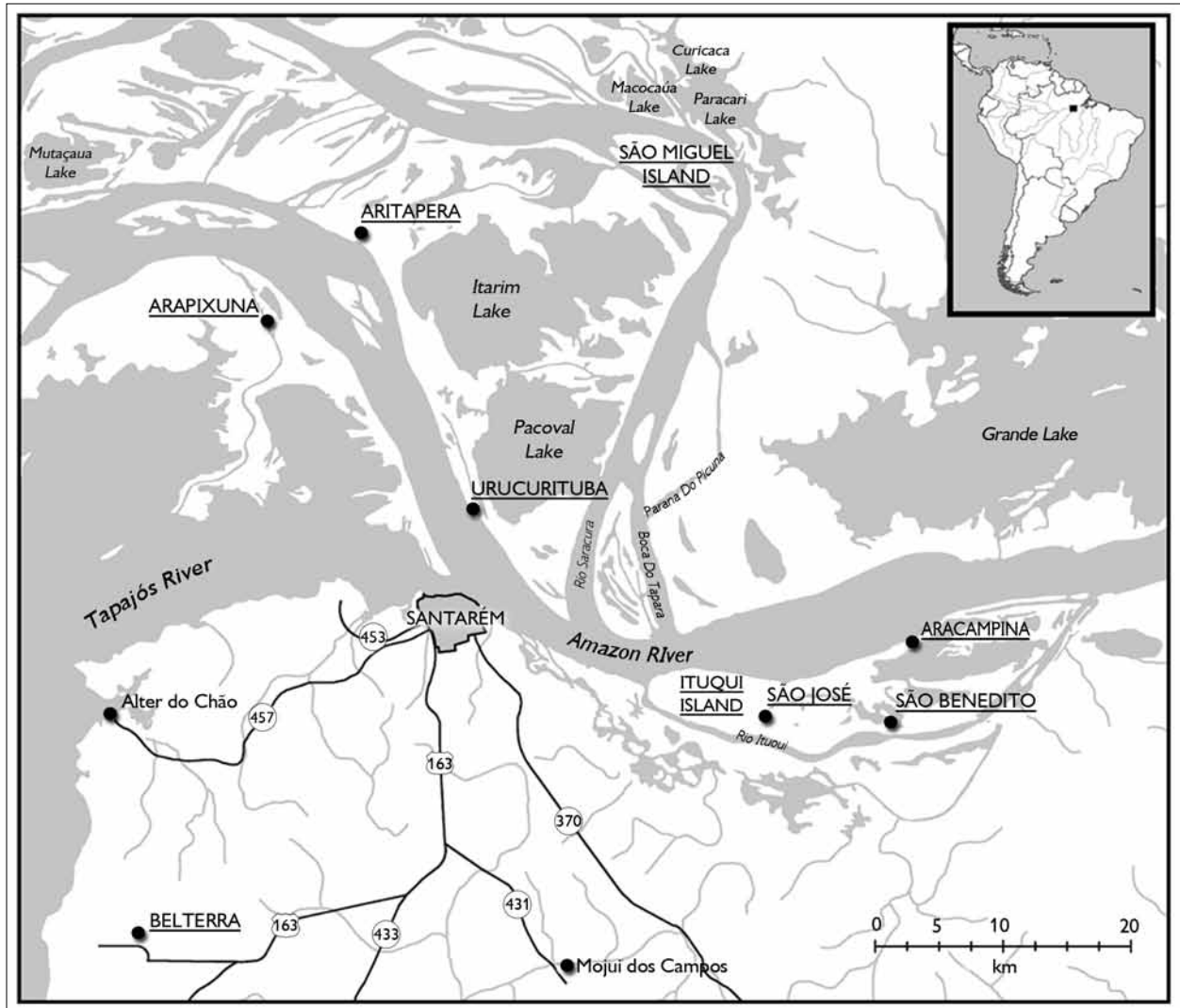


Figure 1. Location of study area. The label Santarém outlines the approximate limitation of the urban zone of the greater municipality. Source and destination communities are underlined. Prepared by Michigan State University's Remote Sensing and Geographic Information Systems Outreach Services and S. Aldrich.

Despite their official designation in the census as either urban or rural, most people in Santarém are in reality 'multi-local', having a residence in both the urban and at least one rural location and moving between the urban and rural homes with great fluidity and regularity (WinklerPrins, 2002a; Emperaire and Eloy, 2008).

Urban growth in the municipality is due, in part, to regional economic changes similar to those that contribute

to rural-to-urban migration elsewhere in the world (Brunn *et al.*, 2008). Changes in livelihood opportunities in rural zones, with accompanying changes in people's life expectations and attitudes, have resulted in rapid rural-to-urban migration. At the regional level, the collapse of jute (*Corchorus capsularis*) cultivation in the rural floodplain zone has contributed to the flow of migrants to the city (WinklerPrins, 1999, 2006; Madaleno, 2009). Jute provided

a livelihood for many locals, and permitted year-round occupancy of the floodplain. Since its collapse in 1990 floodplain dwellers have been finding alternative livelihoods including part-time occupancy of a house in the urban zone. Other structural changes in the region such as the expansion of soybean production along the main highway linking Santarém to the rest of Brazil (BR-163) from the south is also contributing to regional rural-urban migration (Fearnside, 2001; Torres, 2005).

Despite its size and role in the Amazonian urban system, Santarém is mostly a regional service town with limited permanent employment opportunities. There are some fish, chicken and timber processing jobs available, and several other minor industries offer some wage jobs, but most employment is anticipated and not real. The reality of much of the population that has migrated to the city is un- or under-employment. According to the most recent municipal census (PMS, 2001), 39% of the population has permanent employment (only 19% with a true work contract); 51% have wage employment only periodically; 11% are officially unemployed (PMS, 2001). It is estimated that 87% of residents make less than three monthly 'salaries': 43% make less than one such salary. In 2003 the monthly salary was R\$ 240 Brazilian Reais, equivalent then to about US\$ 84. In 2009 the monthly salary was R\$ 465 (about US\$ 227).

## METHODS

The methodological approach for this research was qualitative and participatory, with an emphasis on semi-structured ethnographic interviews and participatory observation (Limb and Dwyer, 2001). Extensive prior fieldwork in the rural zone, as reported in WinklerPrins (1999), permitted social access to urban homegardens. Sampling was purposive as our objective was to consider specifically how recent migrants to the city from rural

floodplain zones were subsisting in the city. We did, however, seek to include homegardens of different sizes and neighborhoods within the urban area (Figure 2). Because it is neither random nor highly quantitative, this type of targeted qualitative research is limited in its predictive capacity, however it permits a much deeper understanding of the social dimensions of people's relationship with the plants cultivated in their homegardens. Qualitative work can seek to clarify what might be noise or otherwise considered to be inconsistencies or random findings in survey-type research on homegardens that has become more popular in recent years (e.g. Perrault-Archambault and Coomes, 2008; Kabir and Webb, 2009).

We worked with 25 households over a period of one year, 2002-2003<sup>2</sup>. Initial interviews involved the completion of a semi-structured questionnaire recording basic household demographic data, a tour of the garden with the person who was primarily involved in maintaining it, and the completion of a list of all vernacular names of the plants in the garden. Subsequently each household was visited once per month by one of us, and the flows of plant material and food into and out of the household were documented in semi-structured questionnaires using participant recall. Human recall is often approximate and partial, and we fully realize that the numbers may not be totally accurate. However, given the repetitive nature of our research (a visit to each household each month for a year) our informants gained awareness over time and became attuned to the information they needed to be able to provide every month. We believe that our numbers at least offer an approximation of the in and out flow of plant material in homegardens. Data from the interviews were entered into an Access database and analyzed using structured queries. Open-ended responses were analyzed using thematic coding.

Plants samples (herbarium vouchers) were not collected for this research as the primary objective

<sup>2</sup> Permission was obtained from all participants in our sample following Michigan State University's Institutional Review Board (IRB) human subject research protocols.

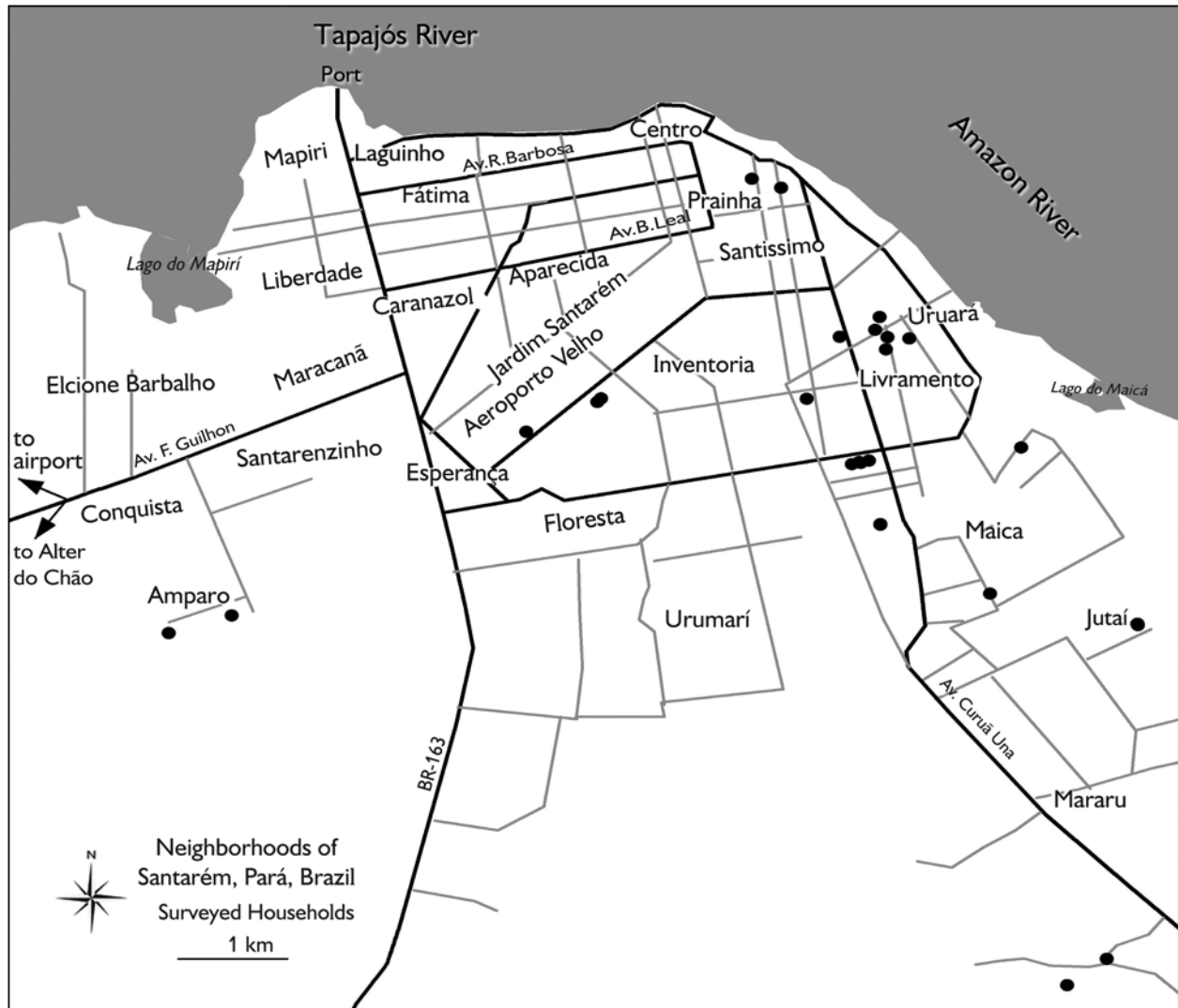


Figure 2. Map of neighborhoods and household locations in the urban zone of Santarém. Prepared by S. Aldrich.

of our study was to consider the social dimensions of homegardens, the social networks embedded in the products of the homegardens; hence the proper permission to collect plants was not obtained from the Brazilian authorities. Therefore plants were identified based on vernacular names, cross-checked with numerous botanical compendia and in consultation with Brazilian botanists regarding the proper botanical nomenclature. A similar strategy was used by Perrault-Archambault and Coomes (2008) in the Peruvian Amazon.

## HOMEgardENS AND THEIR MANAGERS

The homegardens we studied had a median size of 300 m<sup>2</sup> (the average was 2,083 m<sup>2</sup> but this measure is skewed by two gardens of over 10,000 m<sup>2</sup>). The average number of years living at location for our sample was 7.1 years, but with a large range, from a little over a year to 35 years. Here too the median of 4.5 years is a more representative figure. Average household size was 7.88, with a large range of 4-16 people. The relatively large range in household size is indicative that urban houses are the locus of part-time

residence for family members who may or may not be part of the core nuclear family occupying the household (Nugent, 1993). Family members may be in the urban house seasonally, for example when the floodplain is flooded, between jobs, or only on a monthly basis to collect social security or other government pensions or entitlements (WinklerPrins, 2002a, 2002b). This frequent movement between locations is significant for the flows of plant material. We found that average household size fell to an average of 4.76 if we included only those people who were resident for six months or more. Additionally, in our sample no household had a head with full-time employment; all were only sporadically employed if at all.

The homegardens we studied were managed primarily by women, though not exclusively. Of our sample, 78% of the homegardens listed as their primary manager a woman. We did see some variability, but women consistently dominated decisions about overall garden management, even when they were no longer primary managers. On a daily basis, maintenance may be performed by men, especially male children and young adults, and older men may become managers if their wives became ill or pass away. Gardens are often feminine spaces in the Amazon (Madaleno, 2000, 2002; Murrieta and WinklerPrins, 2003; Ban and Coomes, 2004; Coomes and Ban, 2004; Perrault-Archambault and Coomes, 2008), reflecting a regional trend in Latin America (Howard, 2006), although others have found homegardens to be more masculine (Pires Sablayrolles, 2005) or mixed management (Aguilar-Støen *et al.*, 2009). The gender of the dominant homegarden manager often has to do with the ends of the products from the homegardens; in small non-commercial endeavors such as those discussed in this article, gardens are feminine. Larger homegardens, when some of the production is destined for commercialization and/or the homegarden blends and merges with a proximate swidden system, its management may be more masculine and be more 'agricultural' than 'gardening'. The homegardens in our sample that were managed by men were the largest

and had at least some of their production destined for sale. This concurs with findings from a long-term study of homegardens in Brasília Legal, a community in the Tapajós River basin (Pires Sablayrolles, 2005) and elsewhere in Latin American (Howard, 2006).

Homegardens are primarily a source of food for household use, thereby providing some food security. Our research indicates that of the 67% of the fruit produced in homegardens is used for subsistence and 32% is given away into a kin network of gift exchange (*rede de doação*), itself a form of food security as it gives access to a greater range of food items (WinklerPrins and Souza, 2005). For vegetables the proportion for subsistence was much higher, 87% of vegetables were auto-consumed, with only 8% of vegetables produced being circulated in the gift network. What was clear from our research is that homegardens were used for subsistence purposes; the amount of homegarden produced plants that were sold was very low (2% of all fruit produced; 4% of all the vegetables produced).

## HOMEGARDEN AGRODIVERSITY

We documented 225 different plants of which 176 were identifiable as species in our sample of 25 homegardens (Table 1). Garden managers identify a number of locally acknowledged varieties of species, which is why the number of plants is higher than the number of species. On average each homegarden contained about 42 plants

Table 1. Homegarden agroddiversity based on vernacular names. The number of plants exceeds the number of species since some species have different varieties.

Plant type	Total number of plants	Total number of species
Fruit	70 (31.1%)	51 (29%)
Medicinal	53 (23.6%)	45 (26.6%)
Ornamental	53 (23.6%)	40 (22.7%)
Vegetable	36 (16%)	31 (17.6%)
Other	13 (5.8%)	9 (5.1%)
Total	225	176



– 16 fruit trees or shrubs, nine vegetables, eight medicinal plants, seven ornamentals, and two other plants such as rubber or timber. Table 2 lists the dominant 20 plants found in our sampled homegardens ( $n = 25$ ). Each plant listed was found in more than 50% of the homegardens we sampled. As can be seen in these two tables, the small urban homegardens of Santarém contain significant agrodiversity which is comparable, at a general level, with the findings elsewhere in the region.

Homegarden agrodiversity is well documented around the world, based primarily on rural gardens as urban gardens have been understudied (Soemarwoto, 1987; Kumar and Nair, 2004). In the Amazon, like other parts of the world, research has mostly focused on rural areas as well, although this is changing. Although studies differ in the specifics of their methodologies, rural homegardens in the Peruvian Amazon demonstrate significant numbers of species, for example, those in Santa Rosa contained 168 different species (in 21 homegardens) (Padoch and De Jong, 1991), those in Nuevo Triunfo, San Regis, and Sucre, had 82, 108, and 52 species respectively (in 24, 30, and 13 homegardens) (Ban and Coomes, 2004; Coomes and Ban, 2004), and those in villages along the Corrientes River contained 309 species (in 300 homegardens) (Perrault-Archambault and Coomes, 2008). Smith (1996) documented 77 different species in rural upland areas near Santarém (in 33 homegardens), Pará, whereas Lima and Saragoussi (2000) documented 262 species (in 16 number of homegardens) along the Amazon River floodplain near Manaus, Amazonas State, Brazil. In an urban setting in Peru, Works (1990) documented 120 species, excluding ornamentals (in 50 homegardens). Researchers count plants differently (species, varieties), and often leave out ornamental and/or medicinal plants, hence there is a difficulty with consistency, and comparing studies is problematic except for general trends. In our study we were inclusive, including all plants that homegarden managers identified as part of their homegarden, and we documented a

relatively high overall agrodiversity in the homegardens sampled for this study, numbers comparable to findings by others in the region.

A frequent focus of homegarden research is understanding the relationship between homegarden agrodiversity and proximity to the market. Some authors argue that with increased market access, i.e. the closer to a market homegardens are, the less diverse they become (Fernandes and Nair, 1986; Soemarwoto, 1987; Rico-Gray *et al.*, 1990; Lamont *et al.*, 1999). This argument is made mostly by authors who base their reasoning primarily in economic terms that proximity to the market is indicative of greater engagement in a market economy and access to wage incomes results in the use of money to purchase items that might otherwise have been grown in homegardens. Homegardens closer to markets may be more engaged in the commercialization of only a few species such as highly productive mangos (Major *et al.*, 2005). However, a commercial focus does not automatically result in a decline in overall homegarden diversity as their primary purpose often remains subsistence as has been demonstrated by Trinh *et al.* (2003) and Kabir and Webb (2009). Evidence in Amazonia about the relationship between distance to market and diversity of homegardens has been quite mixed and complex with Major *et al.* (2005) finding that diversity is higher further away from markets, while Heckler (2004) and especially Wezel and Ohl (2005) have found that agrodiversity is higher closer to the market.

The likely reasons for the conflicting findings have to do with the varied and mixed motivations for homegardening. Heckler (2004) argues that sociality – the social function of the garden – is critical while others point to factors such as maintenance of cultural values and gender identity as the main reasons for homegarden maintenance (Keys, 1999; Slater, 2001; Greenberg, 2003; Kimber, 2004; Christie, 2004; Howard, 2006). Our findings substantiate these claims. People maintain a homegarden because of the sheer joy and personal satisfaction of doing so, the



Table 2. Dominant plants in the sampled homegardens (n = 25). Scientific names are based on vernacular names.

Number of households with this plant	Percentage of households with this plant	Category	Common name (Portuguese)	Common name (English)	Family	Genus	Species	Origin
20	80%	Vegetable	Cebolinha	Green Onion	Alliaceae	<i>Allium</i>	<i>schoenoprasum</i>	Old World
19	76%	Fruit	Coco	Coconut	Arecaceae	<i>Cocos</i>	<i>nucifera</i>	Old World
19	76%	Vegetable	Xicória	Chicory	Asteraceae	<i>Cichorium</i>	<i>endivia</i>	Old World
18	72%	Fruit	Limão	Lime	Rutaceae	<i>Citrus</i>	<i>aurantiifolia</i>	Old World
18	72%	Fruit	Manga	Mango	Anacardiaceae	<i>Mangifera</i>	<i>indica</i>	Old World
18	72%	Vegetable	Pimenta	Hot Pepper	Solanaceae	<i>Capsicum</i>	<i>frutescens</i>	New World
17	68%	Fruit	Banana	Banana	Musaceae	<i>Musa</i>	spp.	Old World
16	64%	Fruit	Acerola	West Indian cherry	Malpighiaceae	<i>Malpighia</i>	<i>glabra</i>	New World
16	64%	Fruit	Ata/Pinha	Sweetsop	Annonaceae	<i>Annona</i>	<i>squamosa</i>	New World
16	64%	Vegetable	Cebola	Onion	Alliaceae	<i>Allium</i>	<i>cepa</i>	Old World
16	64%	Fruit	Jambo	Rose Apple	Myrtaceae	<i>Syzygium</i>	<i>malaccensis</i>	Old World
16	64%	Vegetable	Macaxeira	Sweet Manioc	Euphorbiaceae	<i>Manihot</i>	<i>esculenta</i>	New World
15	60%	Fruit	Goiaba	Guava	Myrtaceae	<i>Psidium</i>	<i>guajava</i>	New World
15	60%	Fruit	Laranja	Orange	Rutaceae	<i>Citrus</i>	<i>sinesis</i>	Old World
15	60%	Fruit	Mamão	Papaya	Caricaceae	<i>Carica</i>	<i>papaya</i>	New World
14	56%	Vegetable	Couve	Collard Greens	Brassicaceae	<i>Brassica</i>	<i>oleracea</i>	Old World
13	52%	Fruit	Cajú	Cashew	Anacardiaceae	<i>Anacardium</i>	<i>occidentale</i>	New World
13	52%	Fruit	Cupuaçu	Cupuassu	Malvaceae/ Sterculiaceae	<i>Theobroma</i>	<i>grandiflorum</i>	New World
13	52%	Fruit	Muruci	Nance	Malpighiaceae	<i>Byrsonima</i>	<i>crassifolia</i>	New World
13	52%	Ornamental	Não sabe o nome	Generic ornamental		spp.	spp.	unknown

social prestige of maintaining a well tended garden, and simply as an activity to be doing (Slater, 2001; Heckler, 2004; Howard, 2006). The later is particularly relevant for recently urbanized populations whose rural agricultural lifeways are expressed in urban homegardens.

Even from a more economic perspective, people do not quickly or immediately switch to being market-based when they urbanize, especially in a region such as the Brazilian Amazon where urbanization has taken on new and different forms and where it is very clearly disarticulated from

economic development and industrialization (Browder and Godfrey, 2006). Under these circumstances a population is only partially integrated into a wage-economy where a lack of wage opportunities in the cities perpetuates new migrants using 'rural' coping strategies in the urban setting. Given the economic conditions in Santarém, homegarden agrodiversity remains as the plants are resources for subsistence that are vital to urban survival as people circulate planting material and other necessary products in an 'economy of affection' (WinklerPrins and Souza, 2005). The market, though spatially

located coincident with place of the homegardens, remains out of reach for many due to a lack of monetary resources.

## FLOWS OF PLANT MATERIAL

In Santarém plant material is circulated by means of a system embedded within social networks that distribute plant material among and between homegardens in various regional locations. Homegarden plant material consists of seeds, seedlings, stems, cuttings, even the fruit itself, as it is sometimes given or received for its potential as a plant rather than its qualities as a food. There are two different categories of plant material sources and destinations – the personal and the locational (spatial) level. On the personal level, we documented several sources of plant material in our sampled homegardens. Gifting (*rede de doação*) was the major source with 53% of plant material gained in this manner. As part of the 'economy of affection' gifting is a major part of the informal economy of Santarém (WinklerPrins and Souza, 2005). Within gifting there are groups of people from whom material was received – neighbors, family, and others which include friends, colleagues, acquaintances, fellow church members, researchers etc. The food and plant exchanges often happen in small quantities and very informally when visiting with each other or seeing each other in church.

Another source of plant material was government sponsored horticultural programs (16%). These programs encouraged urban agriculture in a more formal way through the provisioning of plant material and technical assistance. Many of these programs were ephemeral and did not last long. Other sources were plants that were already in the homegardens (discussed below) (15%) and those obtained through purchase (8.5%). These numbers do not add up to 100%, indicating that we have not been able to account for all plant material sources. This is not surprising. Plant exchanges are part of everyday praxis and in using monthly recall as our source of information, not all exchanges were remembered. Also, we noted in interviews and participant observation that there was a

level of secrecy to specific sources of plant material that our participants did not want to disclose. The source of scarce, valuable, or plants with special meanings (whether symbolic or otherwise), may not be disclosed for fear that the source be depleted. Secrecy was also documented in the Peruvian Amazon (Coomes and Ban, 2004).

The spatial distribution of the sources and destinations of plant material include communities and households in the city (*cidade*) and those in rural areas (*interior*) whether on the *terra firme* uplands or the *várzea* floodplain. The dominant source location of plant material was a neighborhood in the city (30%). This is consistent with most plant material coming from people in neighborhoods – these people are located in neighborhoods and plant material is moved between neighborhoods as people interact socially is the gift exchange network. The next most important source location for plant material was the rural floodplain area with 23% of plant material coming from there. This is the region of antecedent communities of many who participated in this research, so this is not surprising. This region is relatively close to the urban zone of Santarém, reachable in about half a day by boat. As mentioned above, people come and go in urban homes as they utilize the resources and opportunities of multi-local living, and as they move between sites they move plant material, especially bringing food and plant material from the floodplain to the city. This movement of people between sites maintains a strong link between rural and urban areas – a phenomenon observed elsewhere as well (Linares, 1996; Ban and Coomes, 2004). Other important locational sources of plant material was the garden itself (discussed below) (19%), upland communities (3%), and stores for purchase (10%). Remaining sources were other or unknown (15%).

The existing homegarden as a source location for plant material plays an important role and is worth further discussion. New arrivals into urban Santarém often buy a home which already has a garden – whether planted or through spontaneous growth. We found that 60% of our sample moved into house-lots with an existing garden which is likely why so many gardens already had plants

in it as research elsewhere demonstrates that generally the older a homegarden is the more plants it has (Kumar and Nair, 2004). Homegardeners are also active garden managers, transplanting a favored plant from one part of the garden to another to increase overall yield of that crop. This may be done deliberately as a particular cultivar might be favored and is planted again in the garden or it may occur as a volunteer plant emerges spontaneously (perhaps from a discarded seed) and is then protected. Gardeners often talk about plants having been 'born' in the homegarden (*nasceu no quintal*) and the garden manager then decides to keep the plant where it is growing instead of culling it during the weeding process.

The purchase of plant material occurred very little. This is a reflection of the recent arrival of the rural-urban migrants in our study and that they are only partially integrated into the wage economy. They decide not to use the little cash they have to purchase seeds and other plant material when there is access to a gifting network to obtain these. Of the purchased seeds the majority was bought at the market, others were bought from friends, neighbors, a store, or a nursery.

Research elsewhere in the Amazon corroborates our findings of plant material sourcing. Building on work by Smith (1996), the research by Coomes and associates clearly indicates that most plant material is sourced through gift exchange networks with neighbors, family, and friends and that homegardens function as a reserve of cultivated plant diversity (Ban and Coomes, 2004; Coomes and Ban, 2004; Perrault-Archambault and Coomes, 2008). This pattern is a link to Amerindian exchange systems that continues amongst mestizo populations, such as those studied in this research. These same populations were/are also rapid adopters of introduced species, especially Old World species. Of the plants encountered in our homegardens, we estimate that 43% are Old World species, as are over 50% of the dominant 20 plants found in the homegardens, similar to the findings of others (Major *et al.*, 2005) (Table 2). Colonists and missionaries in the past were active agents in this process; today researchers,

travelers, even corporations, continue to bring in new crops and varieties (Ban and Coomes, 2004; Perrault-Archambault and Coomes, 2008). We noted a clear preference for non-native Amazonian species such as coconuts and mangos, due to their high fruit yields; this has also been documented in urban homegardens in Boa Vista, Roraima State, Brazil (Semedo and Barbosa, 2007). Because many native Amazonian fruit species are only incipient and semi-domesticates, their levels of productivity are lower than many of the Old World tropical fruit species such as mangos (Clement, 2001).

We documented fewer plants moving out of the surveyed homegardens than were moving in. The main destination for plants from the urban homegardens was to neighbors within the city, both within the immediate neighborhood (52%) as well as other neighborhoods in the city (23%). There was a small return of plants to the floodplain – mostly of scarce varieties or species (16%), and a very small stream, less than 1%, to upland rural locations. This demonstrates that there is a net gain of plant material in urban homegardens; they are, in a sense, 'sinks' for plant material whereas rural homegardens are primarily sources. This parallels the migration pattern of people as they move from rural to urban locations and reconstruct homegardens in their destination; not dissimilar to what other migrants have been documented to do in Mexico (Greenberg, 2003; Aguilar-Støen *et al.*, 2009). The reconstruction of a productive homegarden was talked about specifically by our informants as a deliberate objective. Parents make this effort when their children move to the city to continue their education, or when they move there themselves to access better medical care. Having access to similar plants and products in the urban homegarden provides comfort to the recent migrant.

The selling of plant material was minimal, only 8% of the outflow of the plants from the households. Commercialization and selling of homegarden production is a potential source of income in the future however, as the government sponsored horticultural programs to promote

urban agriculture are trying to demonstrate. Elsewhere in the Amazon, especially near large urban centers such as Belém and Iquitos, rural households make a living selling plant material (Hiraoka, 1995; Slinger, 2000; Coomes and Ban, 2004; Ban and Coomes, 2004).

### TYPES OF PLANTS THAT ARE CIRCULATED

In considering the types of plants that circulated, we found that the types of plants moving 'into' urban homegardens were different from the plants that moved 'out of' them. Table 3 shows that vegetables and fruits were the dominant plants that came into urban homegardens, whereas ornamentals and medicinals moved out of urban homegardens. The percentages in Table 3 are for the total numbers of each plant type that came into a household or left the household during the twelve-month study period, aggregated for the 25 households, and then converted to a percentage.

The pattern of the movement of vegetables and fruit into urban homegardens is related to the recentness of rural-urban migration in the region and the continued dependence on a kin network for household sustenance. Nugent (1993) calls this a rural 'subsidy' of the urban household. He documented that a continued flow of staples from rural parts of households to their urban home supporta life in the city. The food that flows as part of this subsidy includes plant material.

In terms of plants moving out of gardens, ornamentals were significant in their frequency. This reflects the aesthetic and pleasure dimensions of gardening that are often important aspects of homegardens, especially in the social

lives of women, and should not be separated from their economic or practical value (Slater, 2001; Heckler, 2004). Ornamental flowers decorate the front (entrance) of the houses, reflecting a joy in gardening and the importance of social prestige associated with having a 'pretty garden' for women (Howard, 2006). Many of the flowering plants were gifted as true presents (Murrieta and WinklerPrins, 2003); plant histories are often linked emotionally to the past. Women are very creative with these flowering plants, with great arrays of hybrids and new colors, and they often select for purely aesthetic reasons. Not surprisingly, a flowering plant with name unknown (*não sabe o nome*) was the dominant plant in the ornamental category (Table 2) with 52% of households having at least one such plant. In reality of course these are different plants. Further detailed botanical work is needed to understand the diversity of these flowering plants. Interestingly, Rico-Gray *et al.* (1990) found that urban homegardens in the Yucatan also tend to have higher numbers of ornamentals than their rural counterparts. Perhaps there is a greater desire or need for the aesthetic aspects of a garden in an urban area.

Medicinal plants were a significant outflow from urban homegardens as well. We noted several 'specialist' households from which very high numbers of medicinal plants were given away, and overall we documented that 33% of gifted plants were medicinal. These specialist gardeners often have a history of cultivating medicinal plants, are usually women with significant herbalist knowledge, and become neighborhood medicine cabinets. Although allopathic remedies can easily be purchased

Table 3. Type of homegarden plant material moving in and out of urban homegardens in Santarém.

	Vegetables	Fruit	Ornamentals	Medicinals	Other	Total
Percentage of plant type arriving 'into' urban homegarden	32%	31%	20%	15%	2%	100%
Percentage of plant type moving 'out' of urban homegardens	15%	22%	27%	33%	2%	100%

at corner pharmacies, they are expensive, use valuable cash, and traditional herbal medicines are turned to first if there is illness. These expert households hold substantial knowledge that is threatened with loss as the keepers of this knowledge are aging and newer generations are not as interested in becoming familiar with it (Voeks, 2007).

## CONCLUSIONS

Gardens (...) perhaps because they are geographically small (...) are ideal mirrors of the human condition (Doolittle, 2004, p. 402).

We have shown in this paper that new urban migrants circulate plants and plant material in social networks thereby maintaining high overall agrodiversity in their homegardens while being located 'at the market'. People practice urban agriculture in Santarém today because there is not much else to do in a weakly developed economy, and they remain at least partially dependent on self-provisioning and rural lifeways. There are no *maquiladoras* siphoning off labor here as they are in Central America and Mexico, nor is there any rapid increase in other industrial or service work. Cargill has recently built a port to service the soybean production of the Central-West of Brazil, but this port employs few. Similar other businesses exist, but they remain few in number (PMS, 2001). The expansion of soy itself, moving northward from Mato Grosso State along the 'soy highway', BR 163, may offer employment to a few, but as an industrial commodity it requires little labor (Nepstad *et al.*, 2006). This demonstrates that the foods and other materials such as medicines gained by the flow of plants supports life in a city where there are not enough wage opportunities for those seeking formal employment.

From the perspective of agrodiversity conservation, the systems of plant circulation that occur because of the continued importance of urban agriculture in Santarém, also supports the incidental conservation of agrodiversity through use. We echo the findings of Perrault-Archambault and Coomes (2008) that especially the 'expert' gardeners

and their homegardens could be considered 'hotspots' of agrodiversity. Further research should be conducted on the botanical dimension of the homegardens, especially on the medicinal plants and the knowledge that accompanies them, as well as on the diversity and hybridization of the ornamental plants. Likewise those interested in increasing local systems of crop production should not ignore these homegardens as they yield crops with potential wider-scale cultivation potential (Kumar and Nair, 2004; Nair, 2006). Therefore we urge researchers and policy makers who are interested in *in situ* conservation of agrodiversity not to overlook homegardens as sites of investigation (Steinberg, 1998; Zimmerer, 2006).

The maintenance of high homegarden agrodiversity in a place coincident with the market clearly demonstrates that the argument about diversity and distance from market is complex and nuanced, and general assumptions should not be made. Recent rural-urban migrants are recreating homegardens in the city as these gardens remain an important source for subsistence products and meaningful activity. Admittedly the maintenance of relatively high agrodiversity in urban homegardens may be a phenomenon of relatively new urban migrants. As has happened elsewhere, diversity may decline in subsequent generations as people become more fully engaged in a wage economy. In Moyabamba, Peru, the size of homegardens declined as house-lots became filled in with larger and other homes as the city developed economically (Works, 1990). Anecdotally we have observed a decline in the amount of space devoted to homegardens in house-lots in Santarém as households build more houses in their lots to accommodate more family member living in the urban home, or to generate income through rental of the second home. This needs further systematic investigation.

And so the homegardens of Santarém do in their own way "mirror the human condition" as Doolittle (2004, p. 407) has pointed out – the reality of life in this Amazonian city. They will change over time, as Santarém changes. But for now they are important spaces for the

newer residents of the city, places to be, places to socialize, and sources of food and gift, and thereby are also spaces where agrobiodiversity is conserved.

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