International Tree Crops Journal, 1996, Vol. 9, pp. 11-30
0143-5698 $10

HOME GARDENS AS A SPRINGBOARD FOR AGROFORESTRY DEVELOPMENT IN AMAZONIA

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SUMMARY

Home gardens are an often overlooked resource for agricultural development. In both upland and floodplain areas of the Brazilian Amazon, home gardens contain a wealth of promising material that could be planted on a wider scale for income generation and restoring degraded habitats. Over seventy perennial species are cultivated in dooryard gardens in Amazonia, and new domesticated plants are being constantly recruited for the surrounding forest; forest conservation and agroforestry development are thus linked.

INTRODUCTION

Economically-viable agroforestry systems are urgently needed in the Amazon to help arrest the wave of forest destruction in both upland and floodplain environments (Figure 1). Deforestation is being driven mainly by slash-and-burn farmers and cattle ranchers. One way to arrest this destructive trend is to offer attractive alternatives to cattle ranching and swidden farming with annual crops, such as agroforestry (Smith *et al.*, 1995). Home gardens are a form of agroforestry and are a largely untapped resource that could improve the viability of multiple-purpose tree planting in the Amazon.

The value of home gardens as sources of crops and varieties for agroforestry development is assessed by analyzing their species diversity, their multiple uses for rural people, and their role in plant domestication. Two distinct environments within the Brazilian Amazon are surveyed: uplands, and the floodplain of the middle Amazon river. Because home gardens are examined with particular attention to their role in promoting commercial agroforestry, only perennials with some market value were inventoried. The checklist of plants in the sampled home gardens would have been much higher if ornamental and medicinal plants as well as vegetables had been included.

Thirty-three home gardens were visited in upland areas of rural Pará, mostly along pioneer roads settled for approximately twenty years. Some home gardens were sampled in areas settled for at least forty years. Both migrants to Amazonia and long-time residents were included in the sample of small farmers. All home gardens surveyed belonged to small farmers with properties no greater than 100 hectares. The home gardens themselves were generally under one hectare in size.

Figure 1. Substantial tracts of floodplain forests are being cleared along the Amazon River, particularly in its middle section, to create pasture for cattle and water buffalo. Loss of floodplain forests will undercut future options for improving some existing tree crops and for domesticating new ones. Paraná do Ituqui, near Santarém, Pará. 15 March 1993.

Eighteen home gardens were inventoried on the Amazon floodplain in the vicinity of Manaus and between Juriti and Santarém. Home gardens of small farmers on the Amazon floodplain are surprisingly rich, in spite of the perception that annual floods render cultivation of perennials virtually impossible. Numerous trees and bushes are cultivated in backyards on the floodplain for a wide variety of purposes. Higher parts of the floodplain, where people tend to live, may only be flooded for short periods or as infrequently as once every two decades or so.

SPECIES DIVERSITY AND CROP ORIGINS

Home gardens of people born in the region are especially rich in species, but migrants to Amazonia, such as from the Northeast and Japan, are also quick to adopt diverse backyard gardens. A total of 77 species were found in 33 home gardens in upland areas, not including ornamental and medicinal plants (Table 1). The number of species in home gardens ranged from four in the case of a recent arrival from the northeastern state of Maranhão, to a high of 25 around the home of a long-time resident of Pará. The extraordinary richness of home gardens has been noted in other parts of the Amazon Basin; at Santa Rosa along the lower Ucayali, for example, two home gardens had 74 and 73 plant species respectively, with only 34 species in common (Padoch and de Jong 1991). A total of 168 species were encountered in 21 home gardens at Santa Rosa; the high number can be explained in part because herbaceous plants were included in the sample.

TABLE 1

Seventy-seven plant species found in 33 home garden in upland areas of rural Pará, Brazil, and their occurrence in fields (fld), second growth (sg), or forest

English name	Local name	Scientific name	No. Gardens	Fld	SG	Fst
Mango*	Manga	*Mangifera indica*	29	+		
Sweet orange*	Laranja	*Citrus sinensis*	27	+		
Cupuacu*	Cupuacu	*Theobroma grandiflorum*	21	+		+
Cashew*	Caju	*Anacardium occidentale*	20	+	+	
Guava*	Goiaba	*Psidium guajava*	19	+	+	
Coconut*	Coco	*Cocos nucifera*	17	+		
Avocado	Abacate	*Persea americana*	16			
Annatto*	Urucu	*Bixa orellana*	16	+		
Banana*	Banana	*Musa* sp.	16	+		
Jackfruit	Jaca	*Artocarpus heterophyllus*	15			

English name	Local name	Scientific name	No. Gardens	Fld	SG	Fst
Arabica coffee	Café	*Coffea arabica*	15			
Lime*	Limão	*Citrus aurantifolia*	14			
Tangerine*	Tangerina	*Citrus reticulata*	14			
Peach palm	Pupunha	*Bactris gasipaes*	14	+		
Pineapple	Abacaxi	*Ananas comosus*	11	+		
Açaí	Açaí	*Euterpe oleracea*	10			+
Cacao*	Cacao	*Theobroma cacao*	10	+		+
Papaya*	Mamão	*Carica papaya*	10	+	+	
Soursop*	Graviola	*Annona muricata*	10			
Muruci*	Murici	*Byrsonima crassifolia*	10			
Biribá	Biribá	*Rollinia deliciosa*	8	+		
Cotton*	Algodão	*Gossypium* sp.	7			
Malay apple*	Jambo	*Eugenia malaccensis*	7			
Black pepper	Pimento do reino	*Piper nigrum*	6	+		
Brazil nut	Castanheira	*Bertholletia excelsa*	6	+	+	+
Ingá*	Ingá	*Inga* sp.				
Yellow mombim*	Cajá, taperebá	*Spondias mombim*	6			
Manioc*	Mandioca, macaxeira	*Manihot esculenta*	6	+		
Bacaba*	Bacaba	*Oenocarpus distichus*	5	+	+	+
Calabash gourd*	Cuia	*Crescentia cujete*	5			
Capsicum pepper*	Pimenta	*Capsicum frutescens*				
Passionfruit*	Maracujá	*Passiflora edulis*	5	+		
Ameixa	Ameixa	*Eugenia cumini*	4			
Lima	Lima	*Citrus* sp.	4			
Sugarcane*	Cana	*Saccharum*	4	+		
Babaçu	Babaçu, côco	*Attalea speciosa*	3		+	+
Genipap*	Jenipapo	*Genipa americana*	3			
Rough lemon	Limão-cravo	*Citrus jambhiri*	3			
Azeitona	Azeitona	*Roucheria punctata*	2			
Barbados cherry	Acerola	*Malpighia glabra*	2	+		
Macacaúba	Macacaúba	*Platymiscium ulei*	2			+
Mucajá	Mucajá, macaúba	*Acrocomia sclerocarpa*	2		+	
Pitomba	Pitomba	*Talisia esculenta*	2			
Robusta coffee	Café	*Coffea canephora*	2	+		
Star fruit*	Carambola	*Averrhoa carambola*	2			
Rubber*	Seringa	*Hevea brasiliensis*	2	+		+
Cupuí	Cupuí, cacauú	*Theobroma speciosum*	2			+

English name	Local name	Scientific name	No. Gardens	Fld	SG	Fst
Sweetsop*	Ata	*Annona squamosa*	2			
Breadfruit*	Fruta-pão	*Artocarpus altilis*	1			
Buriti*	Buriti	*Mauritia flexuosa*	1			+
Caimito	Abiu	*Pouteria caimito*	1			
Canela	Canela	*Miconia* sp.?	1			
Crajiru	Crajiru	?	1			
Cedar	Cedro	*Cedrela odorata*	1	+		+
Common bean	Feijão	*Phaseolus vulgaris*	1	+		
Cumaru	Cumaru	*Dipteryx* sp.	1		+	+
Cunambi	Cunambi	*Ichthyothere cunabi*	1			
Embileira	Embileira	?	1		+	+
Giant granadilla	Maracujá-açu	*Passiflora quadrangularis*	1			
Inajá	Inajá	*Attalea maripa*	1			+
Ingá-açu	Ingá-açu	*Inga cinnamomea*	1			
Jangada	Jangada	?	1			
Juca*	Juca	*Caesalpinia ferrea*	1			
Lemon grass	Capim santo	*Cymbopogon* sp.	1			
Mamelo	Mamelo	*Aparisthmium cordeatum ?*	1			
Morototó	Morototó	*Didymopanax morototoni*	1		+	
Mountain soursop	Araticum	*Annona montana*	1			
Oiticica	Oiticica	*Licania tomentosa ?*	1			
Pajurá	Pajurá	*Couepia bracteosa*	1			+
Piquiá	Piquiá	*Caryocar villosum*	1	+		+
Pitanga	Pitanga, groseleira	*Eugenia uniflora*	1			
Sweet potato	Batata doce	*Ipomoea batatas*	1	+		
Tamarind*	Tamarindo	*Tamarindus indica*	1			
Tobacco	Fumo	*Nicotiana tabacum*	1	+		
Tropical alrnond	Castanhola	*Terminalia catappa*	1			
Tucumã*	Tucumã	*Astrocaryum vulgare*	1	+	+	+
Uxi	Uxi	*Endopleura uchi*	1			+

*Occurs in home gardens on uplands and the Amazon floodplain

Note: Home gardens were surveyed in 1992 and 1994 and ornamental, herbaceous medicinal, and vegetable plants were not included in the sample.

Locations Sampled: Home gardens were sampled in the following locations: 7 in Lastanica and São João Batista communities, Municipality of Itupiranga near

Marabá; 1 on a side-road of PA 150, 35 km southeast of Marabá; 1 in the Araras community, Transamazon Highway, km 35 Marabá-Estreito; 1 in agrovila Coco Chato, Transamazon Highway, km 42 Marabá-Altamira; 1 in Cuxiu 42 community, Municipality of São Domingos; 3 in Colonia del Rei, near Paragominas; 3 near Tomé-Açu; 1 on a side-road of PA 150 near Tailândia; 7 along the Santarém-Rurópolis highway or its associated side-roads; 2 near Belterra; 2 along margins of Curuá Una reservoir; 1 along Santarém-Curuá Una highway; 1 along side-road from Santarém-Alter do Chão; 1 at entrance to Lago do Veado, Arapiuns River, near Santarém; 1 in the small village of Arapixuna, near Santarém.

Home gardens typically contain a mixture of exotic and native species. Of the 77 species found in the 33 upland home gardens, approximately 46 percent are indigenous to Amazonia while some 27 percent are from the Old World. A precise breakdown is not possible, because the origins of some tropical crops are obscure, and the identity of some of the species is uncertain. Two of the most common perennials in home gardens are from the Asian tropics: mango (*Mangifera indica*) and sweet orange (*Citrus sinensis*).

The prominent role of exotics in home gardens underscores the continuity of the ancient process of crop exchange. When discussion turns to promoting the agricultural development of a tropical forest region, attention understandably focuses on the potential of indigenous species. But reliance on native species alone for "sustainable" development is unwarranted. In the case of the Brazilian Amazon, some of the most profitable crops are exotic, particularly black pepper (*Piper nigrum*) and sweet orange. Exotic crops tend to escape their associated pests and diseases, at least for a while. Local people are quite capable of sorting out the "right" mix of indigenous and imported crops that best fits their needs. Hence the value of exploring the experience of farmers when assessing research and development needs.

Home gardens on the Amazon floodplain are also rich in species. One home garden studied on Careiro Island along the Amazon River revealed only 13 plant species, contributing to the impression that dooryard gardens on floodplains are depauperate (Guillaumet *et al.* 1990). But a broader sample of home gardens on the Amazon floodplain reveals that they are surprisingly diverse, with 80 species encountered in the 18 gardens sampled along the central portion of the Amazon River (Table 2). The number of perennials found in home gardens on the Amazon floodplain varied from 6 to 27.

TABLE 2

Eighty plant species growing in 18 home gardens on the Amazon floodplain

English name	Local name	Scientific name	No. Gardens	Occurs Wild
Banana*	Banana	*Musa*	16	
Calabash gourd*	Cuia	*Crescentia cujete*	15	
Guava*	Goiaba	*Psidium guajava*	12	
Mango*	Manga	*Mangifera indica*	11	
Cashew*	Caju	*Anacardium occidentale*	10	
Coconut*	Côco	*Cocos nucifera*	10	
Uruazeiro	Uruazeiro	*Cordia* sp.	7	+
Annatto*	Urucu	*Bixa orellana*	6	
Sweet orange*	Laranja	*Citrus sinensis*	6	
Cupuaçu*	Cupuaçu	*Theobroma grandiflorum*	5	
Lime*	Limão	*Citrus aurantifolia*	5	
Soursop*	Graviola	*Annona muricata*	5	
Catauari	Catauari	*Crataeva benthami*	5	+
Genipap*	Jenipapo	*Genipa americana*	5	
Malay apple*	Jambo	*Eugenia malaccensis*	4	
Sugarcane*	Cana	*Saccharum*	4	
Yellow mombim*	Taperebá	*Spondias mombim*	4	+
Ingá-cipó, ingá-comprida	Ingá-cipó, ingá-comprida	*Inga edulis*	4	+
Munguba	Munguba	*Pseudobombax munguba*	4	+
Sapucaia	Sapucaia	*Lecythis pisonis*	4	+
Cannon ball tree	Castanha de macaco	*Couroupita guianensis*	4	+
Ingá*	Ingá	*Inga* sp.	3	
Bacaba*	Bacaba	*Oenocarpus bacaba*	3	
Bacuri	Bacuri	*Platonia insignis*	3	
Cotton*	Algodão	*Gossypium* sp.	3	
Mari sarro	Mari sarro	?	3	+
Pião branco	Pião branco	*Jatropha curcas*	3	
Capsicum pepper*	Pimenta	*Capsicum* sp.	2	
Ingá-grande*	Ingá-grande	*Inga* cf. *cinnamomea*	2	+
Manioc*	Mandioca	*Manihot esculenta*	2	
Mera-cuera	Mera-cuera	?	2	+
Papaya*	Mamão	*Carica papaya*	2	
Passionfiuit*	Maracujá	*Passiflora edulis*	2	

English name	Local name	Scientific name	No. Gardens	Occurs Wild
Pau mulato	Pau mulato	*Peltogyne paniculata*	2	+
Rubber*	Seringa	*Hevea brasiliensis*	2	
Socoró	Socoró	*Mouriria* cf. *ulei*	2	+
Ambarella	Cajarana	*Spondias dulcis*	2	
Araçá	Araçá	*Psidium* sp.	2	+
Cacao*	Cacao	*Theobroma cacao*	2	
Curumi	Curumi	*Muntingia calabura*	2	
Ingá-capuchinho, Ingá de macaco	Ingá-capuchinho, Ingá de macaco	*Inga fagifolia*	2	
Marizeiro, marimari	Manzeiro, marimari	*Cassia leiandra*	2	+
Pau de Angola	Pau de Angola	?	2	
Sweetsop*	Ata	*Annona squamosa*	2	
Tarumã	Tarumã	*Vitex cymosa*	2	+
Açaí*	Açaí	*Euterpe oleracea*	1	+
Avocado*	Abacate	*Persea americana*	1	
Jambolan	Ameixa	*Eugenia cumini*	1	
Andiráuchizeiro	Andiráuchizeiro	*Andira retusa*	1	+
Apé	Apé	*Urospatha caudata*	1	+
Apuizeiro	Apuizeiro	*Clusia* sp.	1	+
Aruanãzeiro	Aruanãzeiro	*Campnosperma* sp.	1	+
Aruazeiro	Aruazeiro	?	1	
Baineiro	Baineiro	?	1	+
Breadfruit*	Fruta-pão	*Artocarpus altilis*	1	
Buriti*	Buriti	*Mauritia flexuosa*	1	+
Caçeira	Caçeira	*Cassia* sp.	1	
Carnaúba	Carnaúba	*Copernicia cerifera*	1	
Caxingubeira	Caxingubeira	*Ficus anthelminthica*	1	+
Cecropia	Embaúba	*Cecropia* sp.	1	+
Canistel	Cutitiribá	*Pouteria macrophylla*	1	
Surinam cherry	Groseleira	*Eugenia uniflora*	1	
Ingá-xixi	Ingá-xixi	*Inga heterophylla*	1	
Juca*	Juca	*Caesalpinia ferrea*	2	
Mari-nemera	Mari-nemera	?	1	+
Murici*	Murici	*Byrsonima crassifolia*	1	
Paricá da várzea	Paricá da várzea	*Schizolobium* sp.	1	+
Patazana, pariri	Patazana	*Thalia geniculata*	1	+
Pião roxo	Pião roxo	*Jatropha gossypiifolia*	1	
Pineapple	Abacaxi	*Ananas comosus*	1	

English name	Local name	Scientific name	No. Gardens	Occurs Wild
Pojó	Pojó	*Guazuma ulmifolia*	1	+
Royal palm	Palmeira real	Roystonea oleracea	1	
Sapodilla	Sapotilha	*Manilkara achras*	1	
Sapupira	Sapupira	*Diplotropis* sp.	1	+
Star fruit*	Carambola	*Averrhoa carambola*	1	
Tamarind*	Tamarindo	*Tamarindus indica*	1	
Tangerine*	Tangerina	*Citrus reticulata*	1	
Tucumã palm*	Tucumã	*Astrocaryum vulgare*	1	+
Urucuri palm	Urucuri	*Attalea phalerata*	1	+
Vassoura	Vassoura	*Croton* sp.	1	

* Occurs in home gardens on uplands and the Amazon floodplain

Note: Home gardens were surveyed in 1993 and 1994 and ornamental, herbaceous, medicinal, and vegetable plants were not included in the sample.

Locations Sampled: Home gardens on the Amazon floodplain were sampled in the following locations. Five home gardens were sampled near Santarem (Urucurituba, Igarapé Jari, and Surubim-Açu); three along Paraná Cachoeri near Oriximinfi; three near Obidos; one near Juriti; one near Alenquer; and five on Careiro Island (Paraná do Careiro and Paraná do Cambixe) near Manaus.

Home gardens also contain a diverse mixture of cultivated and spontaneous species along the Upper Amazon and in the estuarine area. Over two dozen fruit species alone are cultivated in orchards surrounding homes on higher banks of the Upper Amazon (Hiraoka 1985). A single dooryard garden on Ilha das Onças near Belém at the mouth of the Amazon contained 68 useful perennial and herbaceous plants (Anderson *et al.* 1985).

Little significant difference is found in species diversity between home gardens on the uplands and the floodplain in the Brazilian Amazon: houseyards in both environments contain a wide assortment of perennials in varying associations and planting patterns. Exotics, especially banana and mango, are also among the more commonly planted trees.

Whereas some species are common to backyards on both the uplands and on the floodplain, such as mango, guava (*Psidium guajava*), and cashew (*Anacardium occidentale*), only a third of the species occurring in home gardens were found in both environments (Tables 2,3). The major ecological sieve between the two environments is flooding. Perennials that cannot tolerate poor drainage or periodic inundation, such as avocado (*Persea americana*) and coffee (*Coffea arabica* and *C. canephora*), are absent or rare in home gardens on the floodplain. On Careiro Island near Manaus, some farmers on high banks cultivate avocado in their backyards, even though they succumb to major floods, such as those in 1953, 1976, and 1989 (Bahri 1992:179).

One of the most distinctive nut trees of the floodplain, sapucaia *(Lecythis pisonis)*, also occurs in upland forest, thus exhibiting wide ecological adaptation. The form of sapucaia is different on the floodplain, where its numerous, low branches provide welcome respite from the midday heat, in contrast to the tall form in upland forests. Whereas this near relative of Brazil nut (*Bertholletia excelsa*), is relatively common in home gardens on the floodplain, it is rarely if ever found in backyards in upland areas.

AGROFORESTRY POTENTIAL OF FLOODPLAINS

The diversity of perennial plants in home gardens suggests a strong potential for agroforestry on the Amazon floodplain. The rich alluvial soils rejuvenated by annual floods and proximity to relatively inexpensive river transportation confer major advantages to growers on the floodplain compared to much of the uplands.

Outside of home gardens, three main agroforestry systems have evolved on the Amazon floodplain. Along the Upper Amazon in Peru, farmers cultivate small polycultural swidden plots on the higher parts of the floodplain, mainly to supply food at high water. Such plots, known locally as *chacras*, are geared towards domestic consumption, but are only kept in production for three to four years; they are thus a highly ephemeral type of agroforestry. A newly-prepared swidden field on the floodplain of the Upper Amazon typically contains 10 to 15 species, much less diverse than upland slash-and-burn fields (Hiraoka 1985). In some parts of the middle Amazon, such as on Careiro Island, riverine folk have enriched old rubber (*Hevea brasiliensis*) and cacao (*Theobroma cacao*) plantings with various fruit trees (Bahri, 1992). And tidal forests have been selectively enriched with açaí palm (*Euterpe oleracea*) in the estuarine zone near Belém (Andersan 1990; Anderson and Ioris 1992). The latter two agroforestry systems are decades or even centuries old.

While such systems can generate appreciable income in some cases, they occupy a relatively small part of the Amazon floodplain. New agroforestry systems are warranted for already cleared areas, such as abandoned jute fields and neglected cattle pasture.

Some of the species cultivated in home gardens, such as mango, sapucaia, and cashew, could be grown more extensively in polycultural fields away from home gardens. As in upland areas, farmers could make longer term investments by planting timber species adapted to the Amazon floodplain, such as ucuúba (*Virola surinamensis*), piranheira (*Piranhea trifoliota*), and pau mulato (*Calycophyllum spruceanum*). At the moment, many floodplain residents are forced to purchase upland timber species, such as itaúba (*Mezilaurus itauba*), for house and boat construction, because suitable floodplain species have been eliminated locally. As pressures on upland forests continue to mount, however, hardwood supplies will become more expensive and it will make increasing sense to plant timber trees on the Amazon floodplain.

Several obstacles impede a more wide-scale planting of perennial species on

the floodplain. Lack of credit for small farmers is due in part to the paucity of land titles along the Amazon floodplain. For the most part, no conflicts over land complicate development as in some other areas of the Amazon Basin; along the Amazon floodplain which has a long history of settlement land ownership is recognized even without official property titles. But tradition and "word-of- mouth" is not sufficient for banks. Flexible credit arrangements will be necessary so that small farmers can obtain financing for the planting of perennials without secure title to their land. Banks also need to be aware of the changing geomorphology of the Amazon floodplain so that perennial crops are placed in areas where they are not likely to be eroded away in the foreseeable future. Credit will also be needed in some cases so that sturdy fences can be erected to keep out cattle and buffalo until tree seedlings are large enough to sustain the presence of large livestock. Other impediments to an agroforestry "take-off" along the Amazon floodplain include inadequate supplies of high quality seedlings and the paucity of agroindustrial plants of various sizes to process fruits, nuts, and other products from perennial planting systems.

HOME GARDENS AS SUPPLY STORES AND SOCIAL CENTERS

Home gardens are resource islands that provide a wide variety of goods for domestic consumption, such as food, beverages, construction materials, firewood, and household supplies (Table 3). No single item found in home gardens may be economically significant, but when the contribution of all the plant products of home gardens are considered their value to households is considerable. Plants in home gardens are employed for dozens of purposes, thus helping families to avoid or reduce purchases.

TABLE 3

Some local uses of plants obtained from home gardens on the uplands and along the Amazon floodplain

Principal Local Use	Plants
Fruit	Açaí, ameixa, avocado, azeitona, bacaba, bàcuri, banana, biribá, breadfruit, cacao, caimito, canistel, cashew, cupuaçu, cupuí, genipap, grosela, guava, inga, ingá-açu, ingá-capuchinho, ingá-cipó, ingá-grande, jackfruit, Malay apple, mamelo, mango, mari sarro, marizeiro, mountain soursop, murici, pajurá, papaya, passionfruit, peach palm, pineapple, piquiá, pitanga, pitomba, sapodilla, socoró, soursop, sweet orange, sweetsop, tangerine, tarumã (particularly for children), tropical almond, tucumã, uxi, yellow mombim
Hot beverage	Arabica coffee, crajiru, cacao, capim santo

Principal Local Use	Plants
Juice	Açaí, bacaba, Barbados cherry, cacao, cashew, coconut, cupuaçu, guava, lime, papaya, passionfruit, pineapple, soursop, star fruit, sugarcane, sweetsop, tamarind, yellow mombim
Alcoholic drink	Genipap (fruit)
Nuts	Brazil nut, cashew, coconut, sapucaia
Food colorant	Annatto
Condiment/food flavor	Canela, capsicum pepper, lima, lime, sugarcane
Textile/twine	Cotton, embileira, apuizeiro (for stringing fish), munguba (for stringing fish)
Wick for kerosene lamps	Cotton
Caulking for canoes and boats	Cotton
Bowl	Calabash gourd
Staple food	Common bean, manioc, sweet potato
Cooking oil	Babaçu palm (nuts), mucajá palm (mesocarp)
Thatch for houses/nurseries	Babaçu palm (fronds), urucuri palm (fronds)
Wood for house construction	Pau mulato, pojó
Fence posts	Yellow mombim
Rootstock for grafting	Rough lemon
Essential oil	Cumaru (seeds)
Piscicide	Cunambi
Fish bait (fruit or seeds)	Baineiro, catauari[1], curumi[2], rubber, socoró, tarumã[5], uruazeiro[3]
Folk remedy	Jucá (tea made from fruit, leaves, bark, or roots, for diarrhea); mari sarro (pods boiled to make syrup for chest congestion); pião roxo (various remedies); taperebá (bark boiled to make tea for diarrhea and to wash wounds)
Skewers for roasting fish	Baineiro
Firewood	Cecropia, curumi, mari-nemera, mera-cuera, paricá da várzea, paricá da várzea, pau mulato, sapupira, tarumã
Shade	Aruanãzeiro, caxingubeira, mari-nemera, sapupira, uruazeiro
Mulch	Munguba (rotten trunks and branches)
Livestock feed	Apé (rhizome fed to ducks), cannon ball tree (nuts fed to pigs, chickens), patazana (seeds fed to chickens), sapucaia (chopped nuts fed to chickens), uruazeiro (fed to chickens), urucuri (fed to pigs),
Broom	Vassoura
Flour	Manioc
Soap	Pau de Angola
Wax	Carnaúba[4]

[1] Particularly useful for catching tambaqui (*Colossoma macropomum*)

[2] Particularly useful for catching pirapitinga (*Colossoma bidens*) and jatuarana (*Brycon* sp.)

[3] Particularly useful for catching aracu (various species of *Leporinus, Rhytiodus,* and *Schizodon*)

[4] Carnaúba palm was introduced to the Amazon by Northeastemers and is generally confined to backyards on the Amazon floodplain and in certain upland areas, such as Mosqueiro in Pará. In the vicinity of Monte Alegre, carnaúba has become spontaneous near planted specimens (A. Henderson, pers. comm., 11 April 1994).

[5] Particularly useful for catching pirapitinga (*Colossoma bidens*) and pacu (various genera).

Most trees in home gardens are grown primarily for their fruits. Over 45 species of perennials are grown for that purpose, and some 18 species are used to make juice. Barbados cherry (*Malpighia glabra*), cupuaçu (*Theobroma grandiflorum*), passionfruit (*Passiflora edulis*), star fruit (*Averrhoa carambola*), and tamarind (*Tamarindus indica*) are grown solely to make juice or their pulp is sold in urban markets to make ice cream. Cupuaçu pulp is also used to make preserves in towns and cities. The nutritional benefits (Cavalcante 1991; Pesce 1985) and psychological uplift derived from such treats are impressive. The richness of species planted in home gardens ensures a year-round supply of fresh fruits and juices.

A striking feature of home gardens on the Amazon floodplain is the number of forest trees used in fishing (Table 3). All of the trees are wild in the forest and are planted or spared from the ax around homes. For example, the fruits of catauan (*Crataeva benthami*) are particularly useful for catching tambaqui (*Colossoma macropomum*), while tarumã (*Vitex cymosa*) are reputedly relished by pirapitinga (*Colossoma bidens*) and jatuarana (*Brycon* sp.). The fruits of uruazeiro (*Cordia* sp.) are especially sought after by aracu (various species of *Leporinus, Rhytiodus,* and *Schizodon*). The seeds of the rubber tree are favored by tambaqui, one of the most prized fish of the Amazon. The inner bark of apuizeiro (*Clusia* sp.) and munguba (*Bombax munguba*), is used to string fish, while twigs of another wild tree, baineiro, are employed to skewer fish for roasting. In upland areas, cunambi (*Ichthyothere cunabi*) is sometimes planted in home gardens; the leaves of this evergreen shrub are mixed with manioc flour to attract and stupefy fish in streams.

A few farmers in upland areas cultivate timber species in their home gardens, such as macacaúba (*Platymiscium ulei*) and cedar (*Cedrela odorata*), as a long term investment. Timber trees are more commonly planted in polycultural fields, however.

Home gardens usually contain a stock of medicinal plants, spices, and vegetables, sometimes grown on small platforms or surrounded by a rudimentary stockade or netting, to keep out livestock (Anderson and Ioris 1992). One reason that munguba trees are often not cut down and burned around home gardens on the Amazon floodplain is that when branches fall off and rot, or the trees eventually die, they make excellent humus for plots of medicinal plants, spices, and vegetables. The spongy wood of decaying munguba helps retain moisture and suppresses weeds.

Not all plants are grown for "economic" purposes. Many a home in rural Amazonia is graced by a plethora of ornamental plants, some with spectacular flowers, others with striking foliage. Although many ornamental plants also have medicinal value, much care and attention is devoted to plants to lift the spirit, rather than satisfy hunger or generate income. The fronts of modest rural and

Figure 2. A grove of açaí palm (*Euterpe oleracea*) along an upland stream, km 3 Rurópolis-Santarém highway, Pará, 1 October 1992.

urban homes are often festooned with show plants spilling out of make-shift tin pots nailed to otherwise bare wooden planks. The generous shade of many home gardens provides welcome respite from the heat of the day for people and their livestock. Wooden benches are often set around the base of an old mango or avocado tree, and provide a refreshing setting for conversation and play.

HOME GARDENS AS CRUCIBLES FOR NEW CROPS

Home gardens serve as important launching pads for exotic crops. By planting a few individuals of an introduced plant in the backyard, a farmer makes a minimal investment while observing its performance and trying out its products. One of the "hottest" cash crops in Pará in the 1980s and 1990s, Barbados cherry, started out as a backyard bush for home consumption. Japanese-Brazilian farmers first introduced Barbados cherry to their backyards in the Bragantina zone east of Belém, after testing the market for its vitamin C-rich juice. Acerola, as the crop is known in Brazil, has since taken off as a commercial crop in fields. Barbados cherry is typically grown as a part of complex agroforestry systems in various parts of the Brazilian Amazon.

Home gardens also serve as "low cost" arenas for domesticating indigenous plants. Farmers sometimes leave native trees when clearing forest or old second growth for their homes if they are deemed useful. Several trees in upland forest or old second growth are deliberately left in home gardens when clearing a homestead. Forest trees sometimes left around homesites in upland areas include piquiá (*Caryocar villosum*) and uxi (*Endopleura uchi*), the latter noted in the backyard of a small farmer near Castanhal, Pará, in 1991. Most

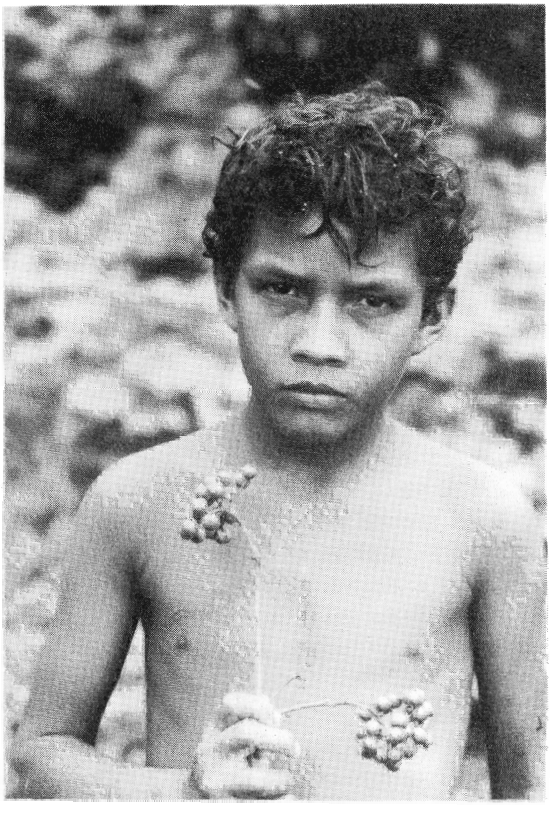

Figure 3. Fruits of uruazeiro (Cordia sp.) gathered in a home garden on the Amazon floodplain. Uruazeiro trees are sometimes planted in home gardens as a source of fish bait. Urucurituba, near Santarém, Pará, 20 March 1993.

of the piquiá and uxi fruits sold in markets are gathered in forests. Second growth trees sometimes spared when preparing a home-site include babaçu palm (*Attalea speciosa*) and fast-growing morototo (*Didymopanax morototoni*). Some wild trees protected in cleared areas are eventually fully domesticated. Furthermore, useful trees deliberately spared from cutting serve as seed sources for progeny to sprout spontaneously in home gardens.

Wild species enter the proto-domestication stage when seedlings sprout spontaneously in house yards and are carefully nurtured. The process of caring for perennials that arise spontaneously has been termed "arboriculture" (Harris 1978) and "incidental domestication" (Rindos 1984:152). Spontaneous seedlings of wild plants arise either as a result of natural dispersion from surrounding vegetation, from seeds discarded by family members, or from forest trees left standing around home sites. In upland areas, spontaneous seedlings of wild cacao, Brazil nut, and babaçu, and bacaba (*Oenocarpus distichus*) and inajá (*Attalea maripa*) palms are sometimes protected because of their fruits, nuts, or their generous fronds used in construction. In some cases, farmers collect seedlings from wild trees to enrich their gardens, such as açaí which sometimes occurs in dense groves along streams in upland areas (Figure 2) as well as in the estuarine area.

A similar process is underway on the Amazon floodplain, where a wide variety of useful tree seedlings are protected when they sprout spontaneously in backyards. Most of the protected trees are indigenous to floodplain forest, such as uruazeiro, munguba, apuizeiro, cannon ball tree (*Couroupita guianensis*), sapupira (*Diplotropis* sp.), socoró (*Mouriria* cf. *ulei*), and taruma. Some plants typical of disturbed habitats are also nurtured when they sprout in home gardens, including yellow mombim (*Spondias mombim*) and patazana (*Thalia geniculata*). The fruits of yellow mombim are mashed to prepare a refreshing drink, while the bark is boiled to treat wounds and diarrhea. Known as taperebá or cajá in the Brazilian Amazon, the rough-barked tree is an indicator species of old homesites along the Amazon and other parts of the humid tropics in Latin America, particularly when it occurs in dense stands (Smith *et al.* 1992).

Wild species are also deliberately planted both in upland areas and on the Amazon floodplain. In the newly-formed Lastancia Community near Itupiranga, Pará, for example, a farm family had recently planted towering buriti palm (*Mauritia flexuosa*) in their backyard. Buriti palms are normally found along rivers and on poorly-drained savannas. Buriti palms are widely appreciate for their numerous golf ball-sized fruits that are rich in vitamins A and C.

On the Amazon floodplain, seeds or seedlings of several forest trees are gathered for planting in home gardens, including catauari, pau mulato, sapucaia, socoró, uruazeiro (Figure 3), and tucumã palm (*Astrocaryum vulgare*). Seeds or seedlings of wild plants are also gathered from disturbed habitats for planting in home gardens, including yellow mombim and curumi.

The age-old process of plant domestication around homes in the tropics (Kimber 1978; Vermeer 1979), often cited as an important site for crop origins (Baker 1970; Hawkes 1970; Sauer 1947), clearly continues in Amazonia. The

Figure 4. The interface between a black pepper (*Piper nigrum*) field in foreground and a home garden with numerous intercropped perennials. Ramal Anauera, near Tomé-Açu, Pará, 1992.

origins of plants in home gardens and their associations have many practical implications for agricultural development in the region. Home gardens are propitious "hunting grounds" for promising new crops in Amazonia and could serve as important sources of germplasm for agroforestry and perennial cropping systems. The promotion of agroforestry in Amazonia would be facilitated by a better understanding of the relationships between home gardens and polycultural fields.

THE DYNAMIC BORDER BETWEEN HOME GARDENS AND FIELDS

Home gardens sometimes 'spill over' into adjacent fields. In some cases, home gardens and cleared fields form a continuum, whereas in other instances, the separation of door yard gardens and fields is abrupt (Figure 4). In order to promote agroforestry in Amazonia more effectively, it would be useful to know the reasons why intricate polycultural systems found in home gardens do not cover a larger proportion of the cleared space in tropical forest areas.

Three main factors constrain the spread of home gardens into surrounding cleared spaces. Much of the Brazilian Amazon has a pronounced dry season and the paucity of soil moisture is a major reason why farmers do not replicate the complexity of their home gardens in fields. In home gardens, young plants can be easily watered, but maintaining seedlings of perennial crops in a field is more cumbersome and they often perish before the regular rains return. Low cost irrigation systems would thus help home gardens radiate into second growth or fields with annual crops.

Another constraint to expanding the border of home gardens is market conditions. In some cases, farmers are too far from sizable urban centers where they can readily sell fruits and other agroforestry products. In other instances, transportation links to urban centers are precarious. The urban population in Amazonia is growing rapidly in relation to rural areas, however, so the market for agroforestry products will likely continue to improve. Two cities in Amazonia already have over a million inhabitants: Belém and Manaus.

A third impediment to the expansion of home gardens is the lack of suitable planting material. Both quality and quantity issues are involved. Quality in the sense of varieties in demand in the market place; quantity in that production of seedlings for home gardens is limited. Private or communally-operated nurseries are thus needed to produce disease-free seedlings of superior varieties for farmers. Some communities and municipal governments in the Brazilian Amazon are already attempting to fill this need. The Mayor of Machadinho in Rondônia, for example, has established a nursery to distribute seedlings of perennial crops that are better adapted to the generally poor oxisols in the area than annual crops.

FARMERS AS RESEARCH PARTICIPANTS

Home gardens clearly represent a fountain of possibilities for agroforestry development in Amazonia. A great deal of innovative experimentation is underway in backyards throughout the region, much of it conducted by women. The biological and cultural information in home gardens needs to be tapped more fully in order to realize the potential for agroforestry in the humid tropics (Jose and Shanmugaratnam 1993; Kimber 1966; MacDicken 1990; Pelzer 1945). Almost no work has been done on home gardens in urban areas, even though over half the region's population now lives in towns and cities. The potential of home gardens in urban centers for improving incomes and diets also warrants further study.

The inventorying and collection of germplasm in home gardens is only one step. More needs to be learned as to why people plant certain trees and bushes, how they are used, where they obtain planting material from, and what may be needed to foster the spread of home gardens and other agroforestry systems. Farmers need to be active partners in research, rather than passive informants (Chambers *et al.* 1990). In this manner, our knowledge base on home gardens will improve and the potential for adopting appropriate, new varieties and other technologies will increase. Science and folk knowledge can proceed hand in hand to promote sustainable development in Amazonia and other regions.

ACKNOWLEDGMENTS

I am grateful to Andrew Henderson and Jorge Uquillas for making helpful comments on an earlier draft of the manuscript. Field work was made possible by grants from the National Science Foundation and the United Nations University to the Critical Environmental Zones Project, Clark University. Information on home gardens was also gathered during field missions for CIAT (Centro Internacianal de Agricultura Tropical), based in Cali, Colombia, and LATEN, World Bank. The views and conclusions in the article are those of the author and do not necessarily reflect the positions or policy of any organization.

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