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## Flavors of the city: access to regional fruit and fruit consumption in the State of Acre, Brazil

### Sabores da cidade: acesso a frutas regionais e consumo de frutas no Acre, Brasil

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**Abstract:** In 2010 more than 70% of the population in the Brazilian Amazon was living in urban centers. This article looks at the effect of urbanization on market availability and consumption of regional fruits in the state of Acre. The east and west region were used as proxies for urbanization, and quantitative and qualitative methods were combined in interviews with regional fruit vendors and consumers. Open markets in large cities provided a greater variety of regional fruits for purchase, yet fruit consumption was more diverse in the less urbanized west, than in the east. This pattern reveals the importance of fruit tree diversity in home gardens and urban forested fragments, as well as of non-monetary exchanges of goods as promoters of variety in fruit consumption. Findings suggest that children may be benefiting the most from this consumption. Also, certain regional fruits have gained a 'cultural marker' status and are widely consumed regardless of the urbanization rates. Nevertheless, this article demonstrates how urbanization affects the diversity of fruit consumption in different social groups, and how this process is mediated by access, income level, and health concerns.

**Keywords:** Urbanization. Diet. Markets. Home-gardens.

**Resumo:** Em 2010, mais de 70% da população na Amazônia brasileira vivia em centros urbanos. Esse artigo analisa o efeito da urbanização sobre a disponibilidade de mercado e o consumo de frutas regionais no estado do Acre. O leste e oeste do estado foram usados comparativamente em termos de urbanização, e métodos quantitativos e qualitativos foram combinados em entrevistas com vendedores de frutas regionais e consumidores. Mercados abertos em grandes cidades ofereciam maior variedade de frutas regionais para a compra, no entanto, o consumo de frutas foi mais diversificado em cidades menores do oeste do estado. Esse padrão revela a importância da diversidade de árvores frutíferas nos quintais e em fragmentos florestais urbanos, assim como de trocas não monetárias de bens para a promoção da variedade no consumo de frutas. Os resultados sugerem que crianças podem ser as principais beneficiadas do consumo de frutas regionais. Certas frutas possuem *status* de 'marcador cultural' e são amplamente consumidas, independentemente das taxas de urbanização. Apesar disso, esse artigo demonstra como a urbanização influencia a diversidade do consumo de frutas em diferentes grupos sociais, e como esse processo é mediado por questões de acesso, renda e saúde.

**Palavras-chave:** Urbanização. Dieta. Mercados. Quintais.

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## INTRODUCTION

During the 1960s and 1970s the Brazilian Amazon experienced massive migration to urban centers concomitant with road construction (Belém-Brasília and Trans-Amazon Highway), which connected the north of the country with the more developed southern region. By 1980 more than half of the population in the Brazilian northern region was living in cities and this trend has continued, with the urban population reaching 73.5% in 2010 (IBGE, 2010a). In the 1970s, Wagley (1975) highlighted the dangers of rapid urbanization and of developing the Amazon under a purely extractive economy. Despite that, the issue remained largely unrecognized until the late 1990s when Browder and Godfrey (1997) explored the logic of “disarticulated urbanization”. They showed how urban areas could develop beyond internal limits and emphasized the destructive influences of outside pressures on the environment. On the other hand, Becker (1995) drew attention to the notion of “urban forests” in the Amazon context and the mobility of people among rural and urban settings. This mobility characterized urbanization in the Amazon as a unique and complex process, which was not inherently detrimental. The process involved several levels of urban clusters with different functions, acting as providers of jobs, education, and health services to residents of more isolated villages or to rural populations (Guedes *et al.*, 2009). Reverse trends of ‘ruralization’ of Amazonian cities are also found in the literature, such as ties to rural homes and the persistence of rural preferences, housing patterns, and food consumption (Padoch *et al.*, 2008).

The formation of Amazonian cities was heavily influenced by migrants, especially from rural origins. In the case of the state of Acre the majority of recent migrations is from other urban centers (Schmink and Cordeiro, 2008). The origin of migrants seems to play an important role in home garden species composition. In neighborhoods of Rio Branco, the capital of Acre, Delunardo (2010) found that the diversity of plant species, including fruit trees (15.5% of all species identified), was greater in residences with

migrants from rural areas. Gender is also an important factor, which was the only variable that predicted composition of species in home gardens in three sites in the state of Pará (Campos, 2006). In the Amazon estuary, a comprehensive study on açáí fruit production, market, and consumption show transformations from a formerly rural tradition to an important ‘fashion’ food in urban markets. Açáí, however, is still an indispensable staple for rural migrants and low income populations in the city (Brondizio, 2008). Researchers have highlighted changes in consumption by claiming there is a “nutritional transition” occurring around the world, defined by Johns and Eyzaguirre (2006, p. 182) as “the simplification of diets leading to a reduction in the consumption of diverse, nutritionally-rich and functionally-healthy plant foods”. Focusing on the research on such a transition in the Brazilian Amazon, recent studies have explored diet change in rural and traditional populations (Murrieta and Dufour, 2004; Piperata, 2007), but rarely in cities and towns. Nevertheless, with an increase in the degree of urbanization, supermarket based foods appear to be gradually increasing, at the same time traditional foods are decreasing in local diets (Nardoto *et al.*, 2011). This may be resulting in negative health consequences in the region.

This article focuses on the relationship between urbanization and diversity of regional fruit consumption in the western Brazilian Amazon, specifically in the state of Acre. The importance of fruits in Amazonian diets is generally related to the difficulty of cultivating vegetable crops under tropical conditions. Even though the nutritional content of fruits are highly variable, they represent the main source of vitamins, since many can be harvested year round and there is a great diversity of species in the region (Smith *et al.*, 2007). Vitamin A and iron are the principle nutritional deficiencies found in the Amazon (Alencar *et al.*, 2007; Cobayashi *et al.*, 2014), and both açáí and buriti, fruits frequently consumed, have significant amounts of these nutrients (IBGE, 2010b). The definition of regional fruits in this study includes species that have their centers of origin in the Amazon as well as

local varieties of more widely distributed tropical species (e.g. bananas and mangoes). Issues of crop domestication and centers of diversity in the Amazon are beyond the scope of this article. For an excellent review with new findings on this topic please refer to Clement *et al.* (2010).

The sources for regional fruit acquisition are also explored in this article, including markets, home gardens and exchange networks. Research has been sparse on the role of market change and urbanization reshaping food consumption (Phillips, 2006). Strong arguments detailing the negative impacts of supermarkets on local economies exist, especially in Latin America, where retailers dominate markets, potentially overpowering local economies (Reardon and Berdengué, 2002). In Acre there are few established supermarket chains and most are found in the capital of the state. These retailers commonly import fruits from more distant areas in the country, but also have initiatives to partner with local fruit and nut processing cooperatives. These new products are introduced as a competitive strategy.

Nevertheless, throughout the Amazon, food consumption goes beyond purchasing goods. WinklerPrins and Souza (2005) use the term “economy of affection” to demonstrate the crucial importance of home gardens in Santarém, Pará. Urban gardens were recognized as critical for urban survival, ensuring household subsistence and maintaining key social networks. In terms of circulation patterns, fruit species also contribute to the maintenance of agrobiodiversity in urban home gardens (WinklerPrins and Souza, 2010). Furthermore, Eloy and Emperaire (2011) looked at networks of plant exchanges in three rural settlements, emphasizing the importance of exchanges in social relations. They showed the fluidity between urban and rural spaces and the symbolism of agrobiodiversity in gardens as a remembrance of families’ life histories. The production space is intertwined with memory and identity; cultural memory is imprinted on different varieties, especially perennial fruit trees. The most prominent fruit of great cultural significance is açaí, with a stable regional and national market base (Brondizio, 2008). In some regions of

the Amazon, açaí has been identified as a ‘validator’ food, without which a normal dish is not recognized as a meal, and does not satiate hunger (Siqueira, 1997).

The aim of this article is to understand regional fruit consumption from the perspectives of market availability, access, identity, and health. Three main research questions are examined: 1. Do people in larger cities in the western Amazon consume a lower diversity of regional fruit species compared to people in smaller towns?; 2. Do markets in small towns offer a greater diversity of regional fruits for purchase compared to markets of larger cities?; and 3. What factors do people associate with fruit consumption, taking into account gender, age, and place of origin? These research questions are addressed by comparing interviews with consumers and with vendors in six urban areas in the state of Acre. Furthermore, I conducted qualitative interviews to investigate access to regional fruit consumption, looking at product availability – including home gardens, exchange and donations – as well as health concerns and income constraints.

## MATERIAL AND METHODS

### URBAN AREAS: EAST AND WEST OF ACRE

While definitions of urbanization vary immensely across the world, area size and population density are some core parameters present in most analyses (Vlahov and Galea, 2002). The Instituto Brasileiro de Geografia e Estatística (IBGE) uses a definition of hierarchy levels (six levels) varying with degree of influence of the urban center over other areas, presence of major decision-making organizations, and complexity of economy and services (IBGE, 2008). In this hierarchy system the capital city of Acre, Rio Branco, is classified as a regional capital (second level) with a large number of municipalities under its influence. Cruzeiro do Sul, the second largest city in the state, is considered a sub-regional center. In the east and west, all other urban areas are in the lowest category (local centers), where their influence does not exceed the limits of the municipality (Figure 1).

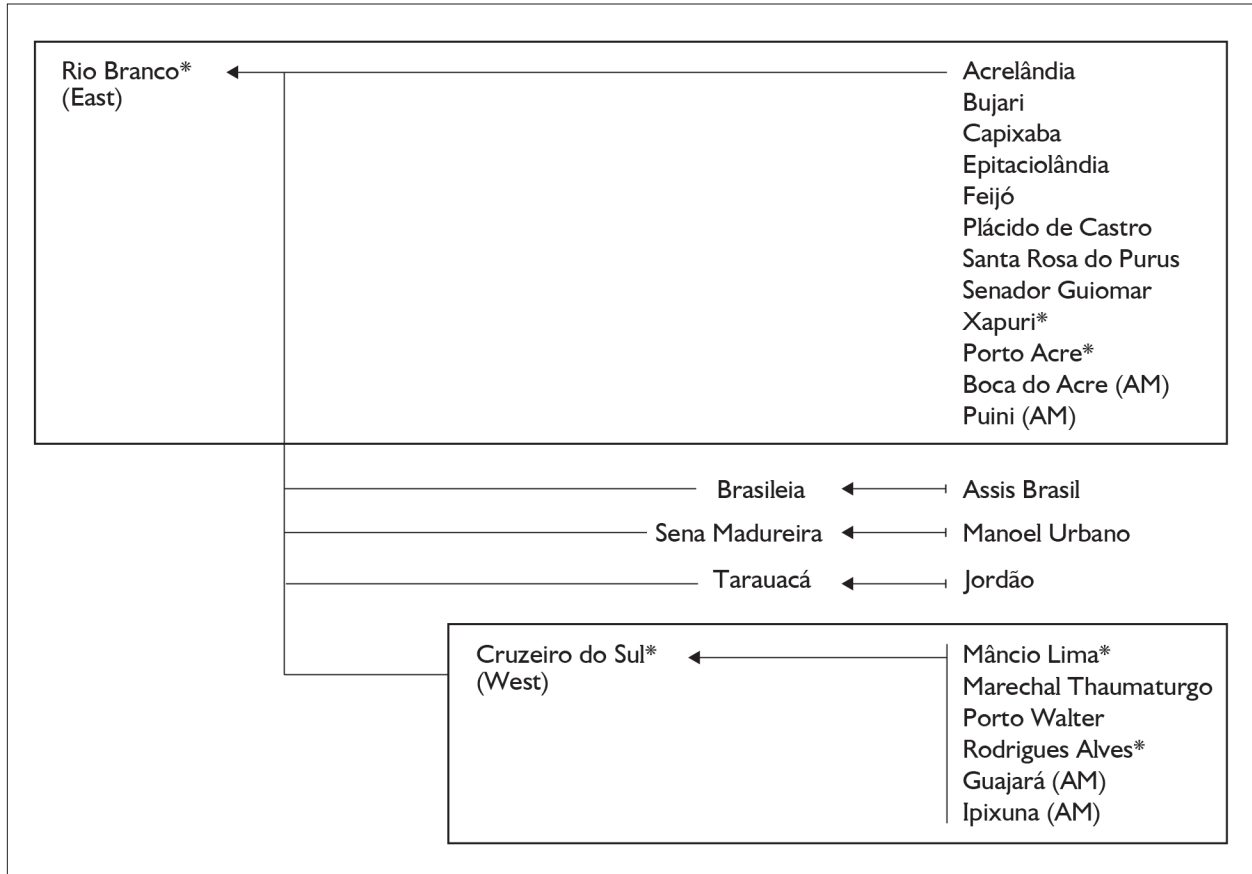


Figure 1. Urban centers of the state of Acre with east and west urban networks and hierarchy highlighted, including municipalities located in the state of Amazonas (AM). Legend: \* = Research sites. Adapted from IBGE (2008).

Using this classification for urban areas as a reference for the research design, sites east and west of Acre were used as proxies for the level of urbanization. The most populous urban areas are located in these two regions, here referred as east and west. The capital Rio Branco is located in the east, with 308,545 inhabitants and 38 inhabitants/km<sup>2</sup> in the municipality. The city of Cruzeiro do Sul is located in the west, with 55,326 inhabitants and nine inhabitants/km<sup>2</sup> in the municipality (IBGE, 2010a). The in-between region comprises an area larger than east and west together, but has only six urban sites, the most densely populated being Tarauacá (1.8 inhabitants/km<sup>2</sup>). The east and west are commonly identified as the main urban networks of the state, primarily based on the

sequence of cities along the valleys of Acre and Juruá rivers (IPEA *et al.*, 2001).

Despite being the two most urbanized regions of the state, east and west differ considerably. The east region is considered more urbanized than the west for several reasons: it has more than double the amount of urban areas, these are also more heavily populated, and there are several paved roads connecting the east to other parts of the country. The east is also where the capital is located, where more than 90% of residents of the municipality live, with service as the main economic sector. On the other hand, by 2010, the largest city in the west did not have permanently paved roads connecting it to the rest of the state.

## RESEARCH SITES

Acre is located between latitudes 07° 07' and 11° 08' S, and longitudes 66° 30' and 74° W (Figure 2). The state has international borders with Bolivia and Peru and national borders with Amazonas and Rondônia. The two regions compared in this study, east and west, which coincide with the valleys of Acre and Juruá rivers, share similar biophysical characteristics in their tropical forest cover, precipitation and seasonality (Acre, 2006).

For the study design, the valleys of Acre (east) and Juruá (west) rivers are used as proxies for urbanization differences. The eastern urban centers sampled were Rio Branco, Xapuri and Porto Acre, and the western ones were Cruzeiro do Sul, Mâncio Lima and Rodrigues Alves. These

urban centers were matched according to similar degree of urbanization in the municipality and relative size (large, medium, or small). The three urban areas in the east side have the following number of inhabitants and municipality urbanization rates: Rio Branco, 308,545 (91.8%); Xapuri, 10,330 (64.2%); and Porto Acre, 1,982 (13.3%). The numbers for the west side are: Cruzeiro do Sul, 55,326 (70.5%); Mâncio Lima, 8,750 (57.5%); and Rodrigues Alves, 4,315 (30%) (Acre, 2011).

## RESEARCH GOALS

The general goal of the research was to understand the effects of urbanization on the variety of regional fruits available in markets, and on the variety of fruits consumed by residents

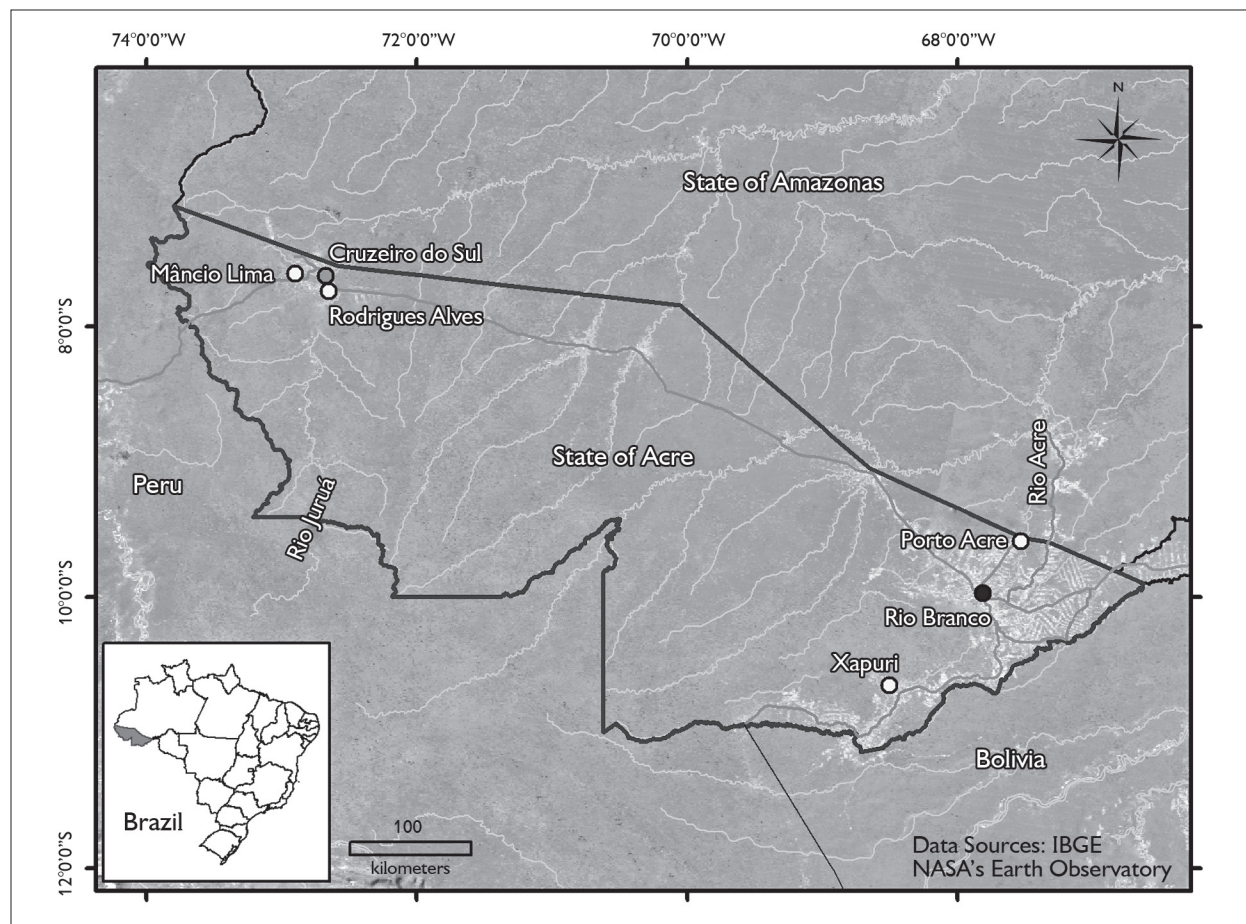


Figure 2. Map of Acre with research sites highlighted.



of these regions. Moreover, the objective was also to explore the main reasons for consumption, such as those related to the cultural significance of certain fruits, and for diet changes associated with age, place of birth (rural *versus* urban), possession of garden lots, income constraints and gender.

The specific research questions were: 1. Do open markets offer a greater diversity of regional fruits for purchase compared to supermarkets? Does that differ between more urbanized and less urbanized regions in the state? 2. Do open markets in smaller towns hold a greater diversity of regional fruits for sale compared to open markets in larger cities? Does that differ between more urbanized and less urbanized regions in the state? 3. Do people in more urbanized areas consume a lower diversity of regional fruits compared to less urbanized areas? 4. Are there associations between gender, income, place of birth, possession and number of fruit tree species in garden lots, with higher or lower consumption of regional fruits? What do people report as reasons for these associations?

## DATA COLLECTION AND ANALYSIS

Interviews were carried out with vendors and consumers in food stores of the six urban centers. Opportunistic sampling was used in all settings. Consumers were approached as they entered the store, and vendors in open markets were interviewed when available during or after market hours. In supermarkets, interviews were conducted either with a manager or with a designated knowledgeable worker. Food stores were classified by adapting the definitions used by Reardon and Berdengué (2002) in studies of markets in Latin America to two categories: 1. Open-markets (stores requiring personal assistance, and permanent or temporary open markets); and 2. Supermarkets (self-service stores requiring no personal assistance, with three or more cash registers). A cluster sample of establishments was randomly selected from a list of governmental and commercial establishments' union data. An additional subsample of low income neighborhoods was created, including areas where food stores were scarce.

Interviews were conducted from May through July 2010, a period characterized by a transition between rainy and dry season in Acre. When asked about fruits sold or consumed, vendors and consumers referred to the fruit species by their vernacular names. The scientific names listed here (Tables 1 and 2) were based on cataloging sources from Cavalcante (2010) and Smith *et al.* (2007). Information about fruit species available for purchase (including fruit pulps) was collected in 15 small neighborhood stores, 13 temporary street markets (several vendors were interviewed in street markets), seven permanent open markets (usually more than one vendor interviewed) and 12 supermarkets. In total, 82 vendors were interviewed in these places. They either recalled or had a formal record of the types of fruits sold in their establishments. The data on fruit availability were only compared qualitatively, because statistical comparisons were unsuited to the great variability in market types.

Consumers were asked about fruits consumed during the week (previous to the day of interview), as well as method for acquisition (purchased, harvested in garden lot, or received from a relative or friend), and recent diet changes. Data on age, gender, place of birth, and number of fruit species in home gardens were also collected. Home gardens were considered in the analysis only if fruit trees were present. In total, 276 consumers were interviewed in food stores. Statistical analysis of the data collected was performed using the Statistical Package for the Social Sciences (SPSS) software in two different ways. First, for comparisons of all fruit types consumed, between east and west, a count over segment variable grouped the number of different types of fruit mentioned. This variable was then used in a Poisson regression model as the dependent variable (index of dispersion equaled 1.06), and region (east or west), gender, age, place of birth and garden lot possession were included as independent variables. Second, for looking at consumption of individual fruit species, comparing east and west, chi-square tests were used (Table 1). Qualitative data collected with consumers were coded to find information on the main reasons for recent diet changes. The main

Table 1. Regional fruit species cited by consumers. Legends: \* =  $p < .01$ , \*\* =  $p < .001$ .

Common name	Scientific name	Family	Origin	% cited by consumers	
				East	West
Cajá	<i>Spondias mombin</i> L.	Anacardiaceae	Tropical America	1	-
Cajarana	<i>Spondias dulcis</i> Park	Anacardiaceae	Polynesia	-	4**
Cashew	<i>Anacardium occidentale</i> L.	Anacardiaceae	Brazil	-	1
Mango	<i>Mangifera indica</i> L.	Anacardiaceae	Tropical Asia	-	1
Biribá	<i>Rollinia mucosa</i> (Jacq.) Bail	Annonaceae	Amazon	-	1
Graviola	<i>Annona muricata</i> L.	Annonaceae	Amazon	6	9
Açaí	<i>Euterpe precatoria</i> Mart., <i>Euterpe oleracea</i> Mart.	Arecaceae	Amazon	49	37
Bacaba	<i>Oenocarpus bacaba</i> Mart.	Arecaceae	Amazon	1	-
Buriti	<i>Mauritia flexuosa</i> L.f.	Arecaceae	Amazon	3	42**
Coconut	<i>Cocos nucifera</i> L.	Arecaceae	Pacific and Indian Ocean	-	2
Urucuri	<i>Attalea phalerata</i> Mart.	Arecaceae	Amazon	2	-
Pataúá	<i>Oenocarpus bataua</i> Mart.	Arecaceae	Amazon	-	2
Pupunha	<i>Bactris gasipaes</i> Kunth	Arecaceae	Amazon	1	-
Pineapple	<i>Ananas comosus</i> (L.) Merrill	Bromeliaceae	Amazon	-	1
Papaya	<i>Carica papaya</i> L.	Caricaceae	Tropical America	2	19**
Watermelon	<i>Citrullus vulgaris</i> Schrad.	Cucurbitaceae	Africa	1	7*
Ingá	<i>Inga</i> sp.	Fabaceae	Tropical America	1	2
Avocado	<i>Persea americana</i> Mill.	Lauraceae	Central America	1	7*
Acerola	<i>Malpighia puniceifolia</i> L.	Malpighiaceae	Caribbean	1	-
Banana	<i>Musa</i> sp.	Musaceae	Tropical Asia	5	32**
Uvaia	<i>Eugenia stipitata</i> McVaugh	Myrtaceae	Amazon	-	1
Guava	<i>Psidium guajava</i> L.	Myrtaceae	Tropical America	-	3
Passion fruit	<i>Passiflora edulis</i> Sims f.	Passifloraceae	Southern Brazil	-	10**
Citrus	<i>Citrus</i> sp.	Rutaceae	Central to southeast Asia	9	15
Abiu	<i>Pouteria caimito</i> (Ruiz et Pavon) Radlk	Sapotaceae	Amazon	-	1
Cacao	<i>Theobroma cacao</i> L.	Sterculiaceae	Amazon	2	-
Cupuaçu	<i>Theobroma grandiflorum</i> (Willd ex. Spreng.) Schum.	Sterculiaceae	Eastern Amazon	32	25

themes revealed are illustrated with quotes in the results and discussion section. Interviewee names reported are fictitious.

## LIMITATIONS

A long-term study of fruit consumption with detailed data about diversity, quantity, and fruit processing/preparation

would provide a more precise understanding of diets. A longer timeframe would also be ideal for investigating consumption of regional fruits, given their seasonality. The data in this study are only representative of a specific transition period. Moreover, reported recall data on weekly consumption certainly does not represent actual



consumption. The fact that data for all interviewees were collected by the same interviewer, with a consistent question about a week's consumption, likely produces data with similar biases, allowing for comparison. However, specific conclusions about exact consumption should be taken with caution. Further studies could clarify the differences between the data reported on variety of fruits consumed in a week and actual consumption observed by the researcher.

## RESULTS AND DISCUSSION

### MARKETS AND FRUIT DIVERSITY

A total of 39 fruit species were either mentioned by vendors or observed in markets across all study sites, during the period of data collection. Vendors cited all the same fruits as consumers (Table 1), as well as additional species (Table 2).

Addressing the first research question, it was expected that open markets would hold a greater diversity of fresh fruits compared to supermarket stores. The data collected suggest that this assumption is correct for Rio Branco and Cruzeiro do Sul, the only study sites where

supermarkets were present. In Rio Branco (east) this difference was more apparent since supermarkets held no regional fruits, compared to eight types available in supermarkets in Cruzeiro do Sul (west). In Rio Branco's supermarkets, fresh fruits were all imported, predominantly from southern Brazil. Vendors in these establishments declared that regional fresh fruit producers did not meet the criteria for quality and supply regularity, which is a common difficulty in developing regions (Reardon and Berdengué, 2002).

The diversity of regional fruit pulps (frozen or refrigerated) did not follow the same pattern as fresh fruits. Approximately the same number of regional fruit pulps was present in open markets, and in supermarkets of large cities: 13 types in supermarkets *versus* 12 in open markets in Rio Branco, and 13 types *versus* ten in Cruzeiro do Sul. Yet, supermarkets also impose restrictions on suppliers, including regularity of supply and product registration in the Ministry of Agriculture. The difference in this case was that pulps in open markets were predominantly refrigerated or freshly squeezed, and were all homemade. On the other hand, all pulps in supermarkets were industrialized, refrigerated or frozen.

Table 2. Additional fruit species cited by vendors.

Common name	Scientific name	Family	Origin	Cited by vendors	
				East	West
Marajá	<i>Bactris maraja</i> Mart.	Arecaceae	Amazon	-	✓
Tucumã	<i>Astrocaryum aculeatum</i> G.F.W. Meyer	Arecaceae	Amazon	✓	-
Piquiá	<i>Caryocar villosum</i> (Aubl.) Pers.	Caryocaraceae	Amazon	✓	-
Bacuri	<i>Garcinia</i> sp. or <i>Platonia insignis</i> Mart.	Clusiaceae	Amazon	✓	✓
Breadfruit	<i>Artocarpus altilis</i> (Sol. ex Park.) Fosb.	Moraceae	Polynesia	✓	-
Jackfruit	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	India	✓	✓
Jambo	<i>Eugenia jambos</i> L.	Myrtaceae	Malaysia	✓	✓
Starfruit	<i>Averrhoa carambola</i> L.	Oxalidaceae	Tropical Asia	✓	✓
Maracujá da mata	<i>Passiflora nitida</i> HBK	Passifloraceae	Amazon	-	✓
Jenipapo	<i>Genipa americana</i> L.	Rubiaceae	Amazon	✓	✓
Cubiu	<i>Solanum sessiliflorum</i> Dunal	Solanaceae	Amazon	-	✓
Cacau do Peru	<i>Theobroma bicolor</i> Humb. & Bompl.	Sterculiaceae	Peruvian Amazon	✓	-

Many regional fruits are traditionally consumed as pulps and home extraction is somewhat labor intensive. This is the case for açai, buriti and cupuaçu. In Rio Branco the government funds small local industries' efforts, so that they can comply with supermarket requirements. This could be one explanation for similarities in the availability of fruit pulps in open markets and supermarkets. In addition, many consumers are concerned with the quality of pulp and the potential transmission of diseases, especially in larger urban centers, and may consider industrialized pulp safer.

Looking at the second research question, open markets in larger cities had a greater diversity of regional fruits for sale, compared to smaller towns. Therefore, previous research assumptions, that open markets in smaller towns would provide a greater variety of regional fruits for purchase, did not hold. In the east, the variety of fresh fruit and fruit pulps in open markets of Rio Branco was higher than the variety found in open markets of its smaller eastern counterparts, Xapuri and Porto Acre. Breadfruit, 'cacao do Peru' and tucumã were among the ten additional species present only in Rio Branco's open markets. This trend may be related to the process of urbanization, since the intense transfer of regional fruits collected or produced in smaller towns to large cities seems restricted to the east. This transfer of goods to Rio Branco is due to better infrastructure and services, along with a greater number of consumers willing and able to pay more for regional products. In the less urbanized west, there was no significant difference in the diversity of fruits and pulps available between the urban centers of differing size. Vendors mentioned three additional fresh fruits in Cruzeiro do Sul: cubiu, marajá and 'maracujá da mata'. Bacuri was only mentioned in Mâncio Lima, the medium sized city in the west.

## FRUIT DIVERSITY AND CONSUMPTION

Data gathered on the general profile of consumers reveal that the number of females interviewed was slightly higher than males (54% and 46% respectively), and, of all of

them, 45% were born and lived for at least ten years in the countryside, whereas 55% were either born in urban areas or migrated at very young age. The average age of interviewees was 41 years old, with the oldest being 68 and the youngest 18. The vast majority of them was born in the state of Acre, with only 8% from other states, mainly from the North or Northeast. Only three interviewees were from other regions, the states of Minas Gerais, Rio de Janeiro and Paraná.

In total, 27 fruit types were reported by consumers of all sites during the data collection period (Table 1). Of this total, four fruit species were mentioned by consumers across the six research sites: açai, cupuaçu, graviola and papaya. Açai was among the top three most widely consumed species (44% of all interviewees mentioned consumption during the previous week), confirming its cultural significance and overall consumption in the Amazon, widely recognized in the academic literature (Murrieta *et al.*, 1999; Padoch *et al.*, 2008; Brondizio, 2008). Açai was indeed a symbol of pride and identity, and many interviewees highlighted its positive properties. One example was given by Francisca, in Rio Branco: "Who wouldn't drink açai? How could someone not like it?".

Cupuaçu was also important in terms of consumption, representing more than 16% of the regional fruits consumed by all interviewees in the sample. Cupuaçu is not found wild in Acre (it is native to eastern Amazonia) and people recognized it less frequently as a regional symbol. It is a commonly planted crop and market incentives for its production started around the 1990s (Smith *et al.*, 1995). Moreover, in 2003, cupuaçu became a media protagonist for a few weeks, when a non-governmental organization from Acre started a campaign called "O cupuaçu é nosso" (Cupuaçu is ours) as a response to a Japanese patent of a product called *cupulate*, a dessert made of the seed of the fruit. The campaign had a national reach, framed as a defense against international exploitation and as a protection of Amazonian and Brazilian patrimony (Rezende and Ribeiro, 2009). These events may have increased sales

and consumption of this fruit. Consumption of papaya and graviola were reported considerably less, by 5.8% and 4.3% of interviewees respectively.

Addressing the third research question, a higher urbanization rate (east) was indeed associated with lower diversity of regional fruits consumption,  $\chi^2(1, N = 239) = 37.85$ ,  $p = .00$ , controlling for gender, age, place of birth and garden lot possession. Moreover, comparing the same data from an intra-regional point of view (within research sites of each region), this difference in consumption is seen only in the east, where in Rio Branco the diversity of fruits consumed is lower compared to smaller towns (Xapuri and Porto Acre). In the west, consumption among the three urban centers of varying sizes was similar. These results are in line with theories that predict a greater consumption of industrially processed foods in more urbanized areas in the Brazilian Amazon (Nardoto *et al.*, 2011), associated with a decrease in the consumption of regional fruits.

Individually, for the period considered, the following fruits were consumed significantly more in the less urbanized west than in urban centers in the east: buriti, banana, papaya, passion fruit, watermelon, avocado and cajarana (Table 1). Buriti was mentioned more than twice as much as açai in Mâncio Lima and Rodrigues Alves, and did not surpass but was similar in number to açai consumption in Cruzeiro do Sul. Buriti was referenced many times as a symbol of pride of the Juruá valley in the west. For instance, José, a migrant from the northeast of Brazil, affirmed: "It was love at first sight, with Cruzeiro do Sul and with buriti". Interestingly, according to Smith *et al.* (2007), the fruit is also highly appreciated in the Peruvian Amazon, west of the state border.

Regional fruit consumption reported by residents of Rio Branco was much lower than in any other urban centers studied. Of all fruit consumption reported by interviewees in the state capital, açai accounted for nearly 60% and cupuaçu for 30%; only six other species were cited, accounting for approximately 10% of consumption in that specific week. Many widely consumed fruits in all other research sites were either not mentioned or

insignificant in Rio Branco. For instance, banana and citrus were not mentioned, whereas the average consumption in the two smaller towns in the east was substantial: above 9% and 15% for that given week.

This difference in consumption of regional fruits comparing east to west can be addressed by looking at research question number four, concerning changes in consumption and individual characteristics. For instance, issues of income constraint and concerns with fruit pulp quality and health, were frequently reported by interviewees in open-ended questions.

While diversity of consumption did not differ upon mention of income constraint  $\chi^2(1, N = 239) = .26$ ,  $p = .61$ , people in the east mentioned income as a limitation for consumption significantly more than interviewees in the west  $\chi^2(1, N = 276) = 21.85$ ,  $p = .00$ . Considering only the state capital, 50.6% of interviewees mentioned income as a limiting factor for regional fruit consumption. Income concerns are illustrated in the following excerpt: "The salary I get does not even allow me to buy the fish here in Acre, much less the buriti, patoá or açai. Still, I buy a liter [of one of these fruit pulps] once at the end of every month, because it is when I get my money" (Gilberto, in Rio Branco).

Concerns with quality of purchased fruit pulp or nutritional benefits of fruits were also associated with fruit consumption, specifically in Rio Branco. These were mentioned by 32% of interviewees of the state capital and by less than 4% in all other sites. These concerns seem to be triggers for diet change, regarding either an increase or decrease in consumption, according to interviewees' perceptions. For instance, João, a resident of Rio Branco, talked about his concerns with pulp quality: "I love the taste of the fruits from the forest, but I don't trust people that I don't know extracting the pulp. I know there is a risk of contamination". At the time of data collection, state authorities were heavily regulating the sale of fresh fruit pulp in street markets, especially in Rio Branco, which was a result of concerns with food safety. Low hygiene standards in handling the fruit for pulp extraction were related not

only to cases of food poisoning, but also to cases of Chagas disease. Oral contamination may happen by ingestion of infected triatomine bugs and/or their feces (e.g. bugs crushed in fruit pulps), and also by ingestion of infected mother's milk, raw or undercooked meat from infected animals, and food contaminated by secretions from the anal glands of marsupials (Pereira *et al.*, 2010). Only recently have scientists begun to understand the oral transmission of the disease (foodborne) and how the pathogen can be killed if present in the pulp through pasteurization (Nóbrega *et al.*, 2009), which is a very uncommon practice in the region. Pereira *et al.* (2010) argue that focusing on hygiene during processing is so far the best control method, given the importance of consumption and marketing of regional fruits in the Amazon.

Statistically, diversity of consumption did not differ by gender,  $\chi^2 (1, N = 239) = 2.20, p = .14$ , or place of origin (urban *versus* rural),  $\chi^2 (1, N = 239) = .22, p = .642$ . However, in open ended questions, place of origin was often apparent as reason for changes in fruit consumption. For instance, a decrease in consumption of buriti was associated with migration from the west to east of the state, as mentioned by Maria Lucia, a resident of Rio Branco: "Here every time I see someone selling buriti I buy it. I am from Cruzeiro do Sul and every time I get back there the first thing I do is to lunge at it". In Acre, recent migration between urban centers may be affecting patterns of regional fruit availability in markets and consumption. Schmink and Cordeiro (2008) report that these trends were the most frequent in the state of Acre as opposed to rural-urban migration. A longitudinal study, looking at recent waves of migration and changes in consumption of regional fruits, will be important in this setting. Others have documented changes in consumption from rural areas mimicking the increase in consumption of açai in other states, for example in Pará (Padoch *et al.*, 2008).

In terms of access to fruits, interesting findings related to children's consumption were also revealed in the coding of open-ended questions, as well as in places where regional fruits are obtained. Although diversity of

regional fruit consumption did not differ by age,  $\chi^2 (1, N = 239) = .02, p = .88$ , children were mentioned as avid consumers of regional fruits (12% of all interviews in open ended questions), and they were occasionally given priority in consumption over adults: "I usually don't drink much, but I buy a liter [of açai pulp] every week for my daughter" (Antonia, in Rio Branco); and "I have to buy buriti all the time because my kids keep on asking for it" (Maria, in Cruzeiro do Sul). Moreover, some interviewees mentioned their children's 'bad habit' of excessive fruit consumption, rejecting 'real meals': "Children are the ones consuming the most fruits in our house because they don't want to eat real food" (Raimunda, in Mâncio Lima). Others stated that children had frequent access to home gardens: "Our children eat a lot more fruit than us; they want to eat all the time and what we have to offer is the fruits in our home garden" (Ana Lucia, in Cruzeiro do Sul). Although there is limited research on the role of fruits in the diets of children in the Brazilian Amazon, a recent article by Piperata *et al.* (2013) found evidence that in food-scarce environments, mothers were skipping meals or reducing portion sizes, in order to prioritize children's consumption.

The possession of garden lots and number of fruit species in them, as well as fruit exchanges between households and procurement in urban forested fragments, were reported as ways of attaining regional fruits. Home gardens represented important spaces for providing a diverse diet with regards to fruits, as a higher diversity of planted fruit trees correlated with greater variety in consumption,  $\chi^2 (1, N = 239) = 11.36, p = .00$ . In rural Nepal, Jones *et al.* (2005) noted that children's nutritional status correlated with diversity of plants in home gardens, and not size of the garden. In the Amazon, home gardens were common throughout the research sites. Among all interviewees 75% had home gardens in the east and 87% in the west. Diversity of fruit species in home gardens varied significantly: the average was four fruit trees per home garden, but the number ranged between one (usually

cupuaçu) and 22 fruit species. There is a vast literature on the importance of home gardens in the Amazon, for subsistence and generating income, and encompassing traditional social-cultural practices of great potential for sustainable agricultural development (Miller *et al.*, 2006).

Moreover, forested fragments outside house limits were mentioned as a source for native fruit acquisition in the west (17% of interviewees), differing significantly from the east  $\chi^2(1, N = 276) = 18.37, p = .00$ . Access to forested fragments was not statistically correlated with higher fruit consumption diversity,  $\chi^2(1, N = 239) = 2.37, p = .12$ , but qualitative data show the need for further investigation of this issue with regards to right of access, quantity and seasonal availability. One example of gathering from forested urban areas was given by Luzia in Cruzeiro do Sul: "I rarely buy açaí because, when we want it, my husband goes and gets it from lowlands near our place". It was unclear, however, if these areas were private or governmental properties. Interviewees also mentioned concern about the decline in availability of fruits over the years: "When I was younger I consumed a lot more buriti because we did not have to pay, we would just get it at the lowlands. Now it is harder to find them and people started collecting the fruit to sell" (Maria das Dores, in Mâncio Lima).

Qualitative data analysis also revealed that exchanges or donations of regional fruits from relatives and friends were common across research sites. The state capital and the medium sized town in the west (Mâncio Lima) had the highest number of interviewees (approximately 20%) mentioning this practice: "The majority of fruits I consume is from my mother's home garden. She usually brings cupuaçu, coconut, guava, ingá and papaya" (Sonia, in Mâncio Lima); and "I am always going to my parents place in the countryside and there I can eat all the fruits I like (...). I love bacuri and I have a friend living in the countryside that saves it for me when she has it" (Cláudia, in Xapuri). These results demonstrate that markets are not the only source for the acquisition of regional fruits. The exchange of foods between rural and urban areas (Padoch *et al.*,

2008), and within urban areas (WinklerPrins and Souza, 2010) has been documented in other parts of the Amazon. However the role of forested fragments in urban areas and fruit procurement has yet to be addressed. A report on the contribution of forests to sustainable diets published by FAO (2013) highlights that research on fruit consumption from forests is sparse, including in peri-urban and urban areas, and there is great potential for understanding the contribution to diets in certain geographical areas.

In sum, the results from quantitative and qualitative analysis show a connection between increased urbanization and a decrease in the diversity of regional fruit consumed. Lower diversity of regional fruit consumption was significant in all sites in the east, compared to the west, and a higher number of fruit species in home gardens led to an increase in the diversity of consumption. A notable disparity in regional fruit consumption is found in Rio Branco. However, certain regional fruits, such as açaí and cupuaçu, find their way onto the plates of people independent of income constraint, possibly because they convey a sense of identity. In addition, findings show that markets are not the only mechanisms for regional fruit access in the state of Acre, similar to patterns found in other regions of the Amazon (WinklerPrins and Souza, 2005). The role of home gardens, forested fragments (where they still exist) and networks of access among relatives and friends appear to be important for maintaining the diversity of fruits in the diets of urban populations, especially the poor. Furthermore, another dimension of the significance of diverse home gardens is the potential contribution to children's diets at the household level.

## CONCLUSIONS

The results of this research contribute to an understanding of particular aspects of a decrease in the diversity of regional fruit consumption, as regions in the western Brazilian Amazon become more urbanized. While markets in larger cities carry a greater diversity of regional fruits on their shelves, this study shows that this increased availability does not necessarily translate into diversity in consumption

across the entire population. Therefore, the value of home gardens and urban forest fragments in the acquisition of regional fruits should not be neglected, independent of an urban area's size or population density. In particular, the number of fruit species in urban gardens seems to correlate with greater diversity in fruit consumption. Moreover, this study shows evidence in line with an 'economy of affection', in which exchanges of food between family and friends are significant in urban centers of the Amazon. In the case of more diverse home gardens, children could be benefiting the most from the consumption of these fruits at home. Additionally, given their importance in the context of the Brazilian Amazon, forest cover status, composition, conservation, and right of access to forested fragments must be investigated further (FAO, 2013). Furthermore, incentives for urban gardening and policies advancing better nutritional education possibly will be adopted more easily in larger cities, where public health concerns are more visible. Such strategies may contribute to diversification in regional fruit consumption through their focus on the broad array of fruits found in the western Brazilian Amazon.

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