

LAND TENURE, ACCESS TO RESOURCES AND FOOD SECURITY IN THE AMAZON ESTUARY

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Through an economic perspective, security to land, usually taken as legal title -- privately or communal -- has been regarded as a key component for the success of rural development projects aiming to increase food production and food availability (Schweigert 1989). Title to land has also been pointed as a predictor of land use practices leading to environmental conservation (Feder 1987). Underlying these statements are the assumptions that farmers will have greater incentives to intensify food production and/or carry out sustainable activities if they can benefit from the gains these actions can bring to them (Schweigert 1989). Private ownership and in a lesser degree also common property, are considered one of the greatest incentives for rural producers to make improvements or investments in their lands in comparison to other forms of land tenure, such as sharecropping, fixed renting in kind or cash (ibid).

Without doubt, recognition of land security is a step ahead in many developmental programs. However, rather than take for granted that land title will lead to greater incentives to food production and/or conservation, this paper argues that this statement should be based on empirical data. One cannot underestimate either the role of other factors and process affecting farmers' incentives and decisions, such as credit policies, marketing, transportation, among others factors which are usually out of farmers' control, as well as biophysical attributes of their properties. Also important, and often underestimated on a more strict economic perspective, are the formal and informal customary rules regarding access and constraints for specific resources, which go far beyond land tenure (Ostrom 1990)

In this paper we look at how land tenure arrangements offer opportunities and constraints for different strategies of land use, food production, and thus food consumption and security among Caboclo populations in the Amazon Estuary. Caboclos-- the largest native, non-Indian populations of the Brazilian Amazon-- living in the floodplain have been historically the major contributors to the regional agricultural and forest economy. As a social group they have developed a diversified economy based on fishing, hunting, slash-and-burn, agroforestry, and the extraction and commercialization of forest products as well as trade and off-farm jobs. The focus of our study is three Caboclo populations differentiated by dominant land tenure arrangements (small owners, sharecroppers and cooperativists) and, by land use (diversified, agroforestry, cash crop, respectively). Patterns of land use affect food availability and consumption, but they are not necessarily tied to land security in our study area, for instance. Increased regional market for a specific agroforestry product -- açai (*Euterpe oleracea*)-- has been an incentive for agricultural intensification, regardless of land tenure arrangements. It also allowed a greater cash flow among Caboclo households, which in many cases was converted in greater amount of food consumption, but not necessarily to a greater food security. In this context, food security is discussed in terms of land tenure, technology and market, on short and long-term perspectives. This paper also calls attention to the importance of access to common pool resources, such as rivers and forests, as important sources of food across these three land tenure systems.

The discussion that follows is based on ethnographic and food production data collected during several fieldwork seasons carried out between 1989 and 1994. Food availability and consumption data were collected at two different seasons in 1991.

While presenting and discussing our data, we aim to contribute to the literature on development, access to resource and food security, and ultimately, to policies that embrace the well-being of these populations.

Caboclos as Social Category and Food Producers

The term "Caboclo" in the Brazilian Amazon context incorporates several distinctive meanings. As used by anthropologists and other social scientists, as well as in this paper, it incorporates the idea of a social category that originated from detribalization, depopulation, and miscegenation by Portuguese, Africans, and their descendents who inhabited the Amazon floodplain between the 16th and 18th centuries, and the later assimilations of northeastern Brazilian migrants to the region in the late 19th and early 20th centuries during the rubber boom economic period (Moran 1974, Parker 1985). In contrast, colloquial usage of the term is loaded with prejudice, since it refers to the rural lower class and it is synonymous of laziness, indolence, passiveness and suspiciousness. In this case, the term represents a stigma rather than a categorization (Wagley 1953, Ayres 1992, Nugent 1993).

Caboclo culture, settlement and economy reflect the history of Amazonian colonization. Over time, they developed a social and economic system that incorporated the Portuguese institutions and the adaptive strategies of Amerindian, which included activities of subsistence and management of the environmental resources, such as fishing, slash and burning agriculture, hunting, agroforestry, and extractivism of forest products (Parker 1985). But as a social category, Caboclos emerged as individuals subjugated to Portuguese elites and latter by Brazilian ones. They were perceived as labor force, not as producers and citizens. As rubber tappers or plantation workers, they usually worked under a tenure system based on outside ownership and a patron-client relationship. All along the historical occupation of the floodplain, including the present time, their access to land title is restricted.

Despite being one of the major contributors to regional agricultural and forest economy, Caboclo's use of floodplains for food production is still not well understood. Most studies have been focused on the role that economic extractivism has played in supposedly limiting the Caboclo's agricultural intensification. Attention has been concentrated on the role of Caboclos in the intensification of grain production, such as maize and rice, while less concern has been dedicated to intensification of local production systems, especially agroforestry¹ (Brondizio and Siqueira 1997). The management of economic of native economic species, and/or management of economic species already widely available in the vegetation that mimics gardening and native vegetation has long provided a diversified resource pool for Amazonians (Berkman 1979, Lathrap 1970, Roosevelt 1989). However, only recently that better understanding of native agroforestry system has come about. Since the 1980's, an increasing number of studies regarding Caboclo production systems, agroforestry and ethnoecology have

¹ As defined by ICRAF (1983:3), "Agroforestry is a collective name for all land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are incorporated on the same land unit as agricultural crops and/or animals, in some form of special arrangement or temporal sequence...An agroforestry system integrates both ecological and socioeconomic components.. an interface between forestry and agriculture."

helped to complement and broaden the analysis of Caboclo agricultural systems (Brondizio and Siqueira 1997). But still, developmental projects implemented in the region tend to emphasize changes in the productive systems of these populations, leading many times to intense process of land use and land cover changes and unsuccessful agricultural programs.

The Data Collection and Analysis

Methods

The data presented in this paper derives from several fieldwork seasons carried out between 1989-1994, which focused in understanding patterns of food production, distribution and consumption among rural populations of Marajó Island². The dietary data were collected during two seasons (rainy and dry) in 1991. Additional qualitative data on food consumption were collected in 1992 and 1994.

In 1991, sixteen households were selected among the three study populations. The was done according to their significance regarding household composition, subsistence and economic activities, socioeconomic status, as well as their willingness to take part in the diet survey. The methodology applied was the 24-hour recall method (Dufour and Teufel 1995) and the food weighting method, which allows the quantification of the food consumed (Brown 1984).

Diet recall were done through semi-structured interviews with the household individual(s) responsible for the preparation and distribution of the food, who was usually the female head of the household, in an attempt to recall the past 24-hour food consumption of the household members. The diet survey was applied during seven consecutive days in both seasons. Measurements of the food consumption were converted in their caloric and energy values according to a Brazilian food composition (Franco 1987). For each sampled household the weekly intake was summed and then compared to the recommended dietary allowance proposed by the World Health Organization (FAO/WHO 1985), according to age and sex. For children and adolescents we used their ideal weight to calculate their estimated requirements, while for adults we used their actual weight. In this paper the data is presented and discussed at the aggregated level of community, rather than for households and or individuals (Tables 1 and 2).

The Study Area

The study area is located in the estuarine region of the Amazon, in Marajó Island, in the municipality of Ponta de Pedras (Fig.1). It is a transitional region between two macro-environments, natural grassland and forest, most of which are flooded forest (Pires 1983). As other regional municipalities, the human population of Ponta de Pedras may be found in the small urban center or scattered along the river banks. Most of its 16,000 inhabitants live along the rivers and in the upland areas. Economic and subsistence activities presented in the area include slash-burn agriculture, extractivism, fishing, trading temporarily work, mechanized agriculture and pasture.

² Further information can be found in Brondizio 1996, Brondizio and Neves 1996, Brondizio and Siqueira 1997, Brondizio et al. 1994 a-b, Murrieta 1994, Murrieta, Dufour and Siqueira 1999, Murrieta et al. 1989, 1992, Neves 1992, Siqueira 1997, and Siqueira et al. 1993.

The Study Populations and their Land Tenure

The three study populations are located surrounding the town of Ponta de Pedras. Two of them are located along river beds, and one in the upland (see Fig. 1).

Paricatuba, hereafter Smallholder, is located along the river with the same name and adjoining upland. It has a settlement pattern characteristic of Amazonian riverine populations with households scattered from 20 to 300 meters apart. By the time of our research, it comprised 19 households, 26 families, and about 144 individuals. Most of these households were small owners. This population can be labeled as "traditional" due to the fact that it still presents a diversified strategy of resource uses. Unlike the other two study populations, no specific economic activity compromises other subsistence activities. Most of the households practice shifting agriculture, fishing and shrimping, hunting, cultivation of palm forest-- açai (*Euterpe oleracea*), and extraction of other forest products (fruits, timber, vines, resin, etc.)

Marajó-Açu, hereafter Sharecropper, is the settlement along the riverbanks of Marajó-Açu. The river flows into Marajó Bay, and it is about 16 km long. The settlement pattern is similar to Pari. It comprises 46 households, 71 families, and about 371 individuals. Most of the households are sharecroppers, and the most important economic activities undertaken by this population are the cultivation and trade (*marretagem*) of açai fruit and shrimping. Both activities are done for household consumption and commercialization. Slash and burning agriculture was virtually abandoned due to intensification of açai fruit management, lack of suitable area and due to constraints imposed by absentee landowners on agriculture activities.

Praia Grande, hereafter Coop, is located in an upland area along the shoreline of Marajó Bay. Unlike the other two populations, most of the households are dispersed along a dirt road that is parallel to the shoreline. In addition to the settlement pattern, this population distinguishes itself from the other two due to its social organization and economic structure. These features are legacies implanted by the local Catholic Church in the area about 30 years ago. Since then, this population has been involved in different development projects aiming to increase food production, such as mechanized agriculture, cattle ranching, coconut plantation among others. It comprises 19 households, 22 families, and about 111 individuals. All households own collectively the land through membership in a cooperative. Up to 1994, most of the agricultural activities were held collectively, but the açai groves.

Hence, in terms of legal rights to land, members of the study populations can be divided into three major categories: small owners, those who cultivate their own land and have them recognized as individual properties; sharecroppers, those who work the landlord's land and turn over a predetermined share or portion of the harvest to the landlord; and cooperative members, those who own land in a collective base. The first category is mostly found in Smallholder, the second in Sharecropper, and the third in Coop. Among Sharecropper households, açai is the main product shared with the landlords, who are usually large absentee owners. The totality of small owners in Smallholder got their land through inheritance. Members of Coop got their access to land through the Church. Unlike some areas of the Brazilian Amazon frontier, among the

study population is rare a case when a sharecropper becomes a landowner, mainly due to the inexistence of market for small parcels of land.

Economic and Food Production Strategies

With different degrees, the economic and subsistence activities of the study populations are diversified. They are affected by land tenure arrangements and also by availability of seasonal resources (see Fig.2).

Agriculture

Among the study populations, two distinct agricultural techniques are observed: slash-and-burn and mechanized methods. One can be labeled as "endemic" and the other "exogenous." Slash and burn techniques are similar to other regions of Amazon and to other tropical regions of the world. This strategy of management, which is also labeled swidden agriculture, converts forest to crop areas through the process of slash and burning, aiming to add energy and nutrients to the vegetation-soil complex (Conklin 1957). In our study area, the fallow period is about 5 years, depending on the quality of soil, availability of areas, and availability of labor to open new areas.

In Smallholder, there are mainly two types of swidden gardens: upland (*roça*) and floodplain (*roçado*). The distinction between them is related to flooding and crop types. In upland areas cultivation is mainly of manioc, which does not cope with constant flood, while in the floodplains rice, maize, banana, sugar cane and pineapple are the cultivars most often cultivated. The techniques used in both crops are similar, the difference being the time of planting and harvesting (Brondizio 1996). The crop area varies between 2,500 m² to 7,500 m², and usually is cultivated by household members, without presence of paid labors. Most of the production of both gardens is for household consumption.

An important product of manioc is manioc flour (*farinha*), which is a primarily staple food for the study populations. The process of converting manioc, a toxic tuber, into a flour, and hence an edible food is highly efficient indigenous technique (Dufour 1985). The process of making *farinha* observed among the study populations can be divided into ten steps: soaking the tubers, peeling, grating, sieving, crushing, squeezing, sieving, cooling and storing. After being soaked for days, the process of turning manioc into *farinha* usually involves all members of the household, and can take all day long, or even two days.

In Coop, mechanized agriculture was implanted in order to substitute slash and burning agriculture, considered by development planners as a "primitive" form of food production. As part of the development program, emphasis was given to cash crops rather than food crops. Maize, rice and beans crops, and in association with coconut plantation, have required use of chemical fertilizers, pesticides, and mechanized plows, drills, fertilizers, and harvesters. In this context, the intense use of mechanical instruments has caused compaction of soil. Soil degradation has been intensified due to the lack of fallow period, and thus, requiring an increased amount of fertilizers to produce a successful crop. Because most of the crops were located between the coconut trees, the use of tractors has affected the roots of the trees, impeding their growth and development, thus, their production. Most of crop fields were worked collectively.

Fishing

With different intensity, fishing and shrimping are continual activities among the study populations. For Smallholder and Sharecropper, shrimping is an important economic activity, since surplus is sold in the market. In Praia, few household fish at daily basis, and when they do it is mainly for consumption.

Matapi, a cylindrical basket about 70 cm long with opening in each end and made of fibers from two native palms, is the principal fishing gear used to catch shrimps. The matapis are placed along the rivers, streams, and near mangroves during the fluctuation of daily tides.

Fish has its "peak" during June and July. The techniques used vary depending on the size and habitat of the fish. *Cercos*, *paris*, *cacuris* are kinds of fences made from palm stalks or other trees that are placed at the mouth of small streams (*igarapés*) or along mangroves to trap fish. *Malhadeira*-- a nylon net, and fish-hooks are also used.

Fishing and shrimping are activities carried out mainly by males (adolescents, adults and children) with little or no participation by women. However, adult females and children of both sexes usually help wrap the shrimp baits (*poquecas*).

Agroforestry

The most important agroforestry product among the study population is *açaí* fruit, a multi-stemmed palm widely occurring in the Amazon estuarine floodplain forest. Commercialization of its fruit is the principal economic activity of Pari and Mara. Among Mara households, this is the most and only agriculture activity. In addition to its marketing value, the juice of the fruit is an important regional staple food.

Açaí agroforestry areas, which are locally labeled as *açaizais*, result from intense management by local inhabitants (Brondizio 1996). It often involves three phases: weeding to eliminate competitive species, pruning of offshoots and stems of the clump, and selection and planting of *açaí* seeds and seedlings to increase the palm density and expand the *açaí* grove. *Açaí* palm trees have been successfully managed by other populations of the Amazon estuarine region as well, and similar procedures have been reported by other scholars (Anderson 1990, 1992; Jardim and Anderson 1987).

Management of *açaí* involves, all year long, children, elderly, adolescents and adults of both sexes. The harvest season of *açaí* goes from about September to January, time when the commercialization of the product takes its peak.

The fruit of this palm looks like blueberry fruit in its appearance. However, the *açaí* fruit is hard since it is a round seed covered with a thin mesocarp. Its juice is an important staple food for riverine and urban populations alike. In rural households, it is processed daily usually by women. After being harvested, the fruits are soaked in warm water for a short period of time in order to soften the mesocarp and to remove any dirt or debris. Then they are repeatedly macerated by hand until the mesocarp is loose and removed from the seeds. After that, the seeds are smashed again in sieves and water is added, producing a thick liquid.

Gathering

Gathering activities occur all year long, according to the seasonality of resources. Floodplain and upland forest are the locus of the most frequent gathering activities due to the presence of valuable trees, palms and vines in these areas.

Palms species are the most recognizable and used resource, used by all three populations due to their fruits, and also fibers, trunks and foliages, which are widely used for household artifacts.

Gathering can be an opportunistic or a planned activity. Usually it is done for household consumptions and needs. All members of the households can undertake this activity.

Hunting

In most households, hunting is sporadic all year long, and takes place usually in floodplain and upland forests. Among our study population it is carry out more often by Smallholder household members, who still have access to upland forest. On the other hand, in Coop it rarely occurs due to the destruction of game habitat.

Hunting is a male activity, and game animals are usually for household consumption.

Domestic animals

Almost all households from all three populations raise small yard animals, such as chicken, ducks and pigs. Some households in Coop also raise goats. Excluding pigs, which are often traded, the other animals are usually raised for household consumption.

The care of these animals is mainly women and children's responsibility.

Cattle raising

Cattle raising occurs only in Coop, and in small scale. By 1994, the community had about 37 cattle heads. Cattle care and pasture maintenance is hold collectively, and usually is male activity.

Trading

Trading of açai is done by most of households in Smallholder and Sharecropper, but with less frequency among Coop households.

Having a motorboat allows some members of households to trade açai during different times of the year. During the summer (July-Dec), they usually trade fruits locally produced. In the winter (rainy season), they travel to other parts of the island in search of açai to sell in the regional market. During the winter, these trips can last for as long as 15 days, and usually undertaken by adult males.

Sporadically, household members can also sell timber, palm fruits, heart of palm and some domestic animals.

Results

Diet Intake: Energy and Protein Variations across Populations

In all three populations, despite their land tenure arrangements and security, availability of animal protein was abundant, while energy sources were usually scarce. With different intensities, all three populations produce and purchase their daily food items.

Comparison of combined household food intake by population with its estimated energy and protein requirements shows that at the population level, only Sharecropper

fully achieved its estimated requirements. Smallholder and Coop, while achieving well above their estimated protein needs, both did not achieve their estimated energy requirements. Aggregated data from both seasons (rainy and dry) show that Smallholder, achieved 81.18% and 193.4%, Sharecropper achieved 139.88% and 299.81%, while Coop, achieved 81.39% and 216.92% of their estimated energy and protein requirements, respectively (Fig. 3).

In all three populations, the variety of food items consumed during both seasons was small, 47, 51 and 63 in Smallholder, Sharecropper, and Coop, respectively. Daily energy availability and intake fluctuated more than protein intake during the survey periods. Manioc flour and açai were the main caloric sources for all households in the three study populations. In Smallholder, manioc flour represented 45.77% of the total energy intake, while in Sharecropper and Coop it accounted for about 41.46% and 33.19%, respectively (Fig. 4). Açai juice accounted for 14% of the total energy intake by Smallholder, 30% by Sharecropper, and 18.7 % by Coop (Fig. 4).

Sources of protein were more varied than sources of energy among all households in the three populations. Analyzing the two seasonal set of data together, among Smallholder, game fish, and pork were the main sources of animal protein intake. They represented 46.89% of the total protein consumed. Among Sharecropper, fish, beef, and shrimp were the main sources, representing 61.97 % of total protein intake. Among Coop, fish, beef and shrimp were the main animal protein items, comprising 52.77% of the total protein intake (Fig. 5).

Main Sources of Energy Intake

In all three populations, the açai consumed was home produced; that is, it was collected in the local *açaizais* and processed as juice in the domestic unit. Occasionally, the açai consumed was a gift from a relative and/or neighbor. On the other hand, the sources of manioc flour varied among the populations. Most manioc flour consumed in Smallholder was produced locally, where the small holders own their farm plots and practice slash-and-burn agriculture. They have access to upland areas with different stages of vegetation regrowth. On the other hand, in Sharecropper, all manioc flour consuming during the survey was purchased. During the diet intake survey periods, some households were consuming manioc bought in large amount (60 Kg sacks) and others bought it on a daily basis at the Ponta de Pedras market.³ In Sharecropper none of the household surveyed produced their own manioc flour, mainly due to the fact that the landowners do not allow them to cultivate the land. In Coop, about 30% of the manioc consumed was locally produced, and the remainder was purchased at a small stall owned by a local household and/or at the Ponta de Pedras. Among this population, land tenure is not a factor constraining manioc gardening, since land is owned by cooperative members. However, misunderstanding of the importance of manioc in the Caboclo diet, the development projects implemented by the Church in Praia have left almost no room for this crop, that is, areas of secondary vegetation, while promoting mechanized fields of

³ In our fieldwork in 1994 we observed that some sharecroppers received as part of their payment sacks of manioc flour, which was purchased in Belém, the state capital, by the landowner or the middlemen. The reason pointed out for this transaction was the fact that the prices of manioc flour in Belém were lower than at the Ponta de Pedras market. However, we also observed that some of the middlemen, despite paying a lower price for the manioc, had charged the sharecroppers the local market price.

rice and beans. While being a staple food in other areas of Brazil, local population of Amazon do not value them as staple foods, nor they do not take them as a substitute for manioc flour in daily meals. Nevertheless, in 1991 three households out of 21 had small crops of manioc. During our survey, only one of the sampled households had a manioc garden, and a couple of households were consuming manioc flour received as gift from a closed relative who had harvested and processed manioc flour days before our survey. Those receiving manioc flour had helped in its laborious processing.

Main Sources of Protein

Fish was the most important protein source of Mara and Praia (see Fig.5). In Smallholder it represented 13.32% of total protein intake, in Sharecropper 34.32% and in Coop 23.06%. Individuals of all three populations consumed a varied of fish species. In all three populations, about half the fish consumed was bought daily in Ponta de Pedras market, and the other half was caught by male household members. In general, fish was eaten broiled (*moqueado*), boiled, smoked, and occasionally fried. Shrimp represented 12.86%, 8.88% and 13.3% of the total protein intake among Smallholder, Sharecropper and Coop respectively. It was a daily food item. Among the surveyed households it was rarely purchased. It was caught daily according to the lunar calendar with the use of *matapi*. It was usually consumed dried, after being boiled in salt water, at the main meals (lunch and dinner) or as part of a snack. Both fish and shrimp were caught in areas of open access, that is, river, streams and mangroves. Placement of matapis, usually in the mangrove along the riverbeds, however, follows a "territorial" order, usually close by the front limits of the farm plot.

Pork and beef, two other important sources of protein among the study populations were usually privately owned. Pork represented 16.38%, 4.41% and 6.04% of the total protein intake in Smallholder, Sharecropper and Coop, respectively (Fig.5). On the days pigs were slaughtered, consumption of meat was high in the households they belonged as well as in the households nearby. Among Smallholder and Coop households an extensive network of pork distribution was observed. Usually, household members eat pork for two days at their main meals. It is mostly boiled, and little is smoked or salted for near future. Pig fat is saved to cook other food items.

Beef was important food item, especially in Sharecropper and Coop (Fig.5). In Smallholder, it only represented 5.51% of the total protein intake during our survey, but among Sharecropper households it represented 18.77%, and among Coop 16.41%. Mostly of it was purchased at Ponta de Pedras market and was highly appreciated as a food source. In fact, it was the most preferable meat people would consume if money were available.

Game meat represented 17.19 % of all protein consumed among Smallholder households, and only 2.56% and 0.51% in Sharecropper and Coop, respectively (Fig.5). The high consumption of game meat is directly related to one household, whose members are locally recognized for their hunting abilities. Moreover, Smallholder has large areas of different stages of vegetation regrowth that tend to attract game. Once caught, the prey is usually distributed among nearby relatives and neighbors. Like pork meat, little game meat is stored for future provision. In Sharecropper and Coop, hunting is an opportunistic activity. Consumption of game meat is constrained by lack of areas for hunting as well as restriction by landowners, such as in the case of the sharecroppers of Sharecropper.

The consumption of small domestic animals, such as chicken and ducks, is rare in all three populations. Chickens are, in general, kept for special occasions, such as the postpartum period, since they are considered mild food (*mansa*), that is, food appropriated for certain life cycles. They are also kept as savings, since they can be easily turned into cash. Market demand for duck increases in November, when a traditional regional religious party, *Círio de Nazaré*, is celebrated with a regional dish, *pato no tucupi* (cooked duck with manioc sauce). Moreover, these animals provide eggs. Consumption of chicken was not observed in the two survey periods in Smallholder, and its contribution to the total intake of Sharecropper was small (1.7%). In Coop, chicken was the fourth main source of animal protein, representing 6.5% of total consumed protein. Chicken and duck's eggs contributed to 1.6%, 1.36% and 0.27% of total protein intake in Smallholder, Sharecropper and Coop, respectively.

Milk *in natura* was rarely consumed. Only in one household in Coop was goat milk consumed, accounting for 0.61% of the total protein intake of Coop intake. Other sources of animal protein consumed include a kind of mussel (*caramujo*, unknown scientific name), consumed sporadically among all three populations. They were collected along the river shores and were consumed after being boiled in water. *Turu*, a kind of worm living in rotten wood trunks usually in floodplain and mangrove areas, is highly valued by most of the surveyed households. It can be eaten rotten or cooked. However, its consumption was not reported during the diet surveys.

In addition to açaí, which is widely consumed as juice, cultivated and semi-domesticated fruits provide a small but important contribution to local diet. Fruits are cultivated in and surrounding manioc gardens and surrounding the domestic units (*quintais*). In Smallholder, during the first stages of floodplain gardens (*roçado do várzea*), that is, those gardens that at the end of their cycles turn into *açaizais*, fruits such as banana and pineapple are harvested. In fact, in these gardens banana trees continue to produce fruits even after the dominance of açaí. In Coop, most of households have a domestic garden with a variety of valued fruits, such as papaya, avocado, orange, coconut, lemon, banana, passion fruit, among others. During the diet surveys, 10 types of fruits were mentioned in their intakes by households in Smallholder, 8 by Sharecropper, and 15 by Coop (see Tables 3, 4 and 5).⁴

Reported consumption of vegetables was small in all three populations, but they were frequent, especially in Coop⁵. Squash, *maxixe*, *caruru* were the items most consumed. Usually, they were consumed cooked. As spices, tomato, onion and pepper were used in addition to *urucu*, basil and chicory. All but tomatoes and onions are home produced.

⁴ Due to tide fluctuations, *quintais* are less present in the two riverine populations (Pari and Mara) than in Praia.

⁵ Community members in Praia emphasize vegetable intake as a healthy food habit. In Praia there is a community vegetable garden nearby the local school and is mostly cultivated by women, children and adolescents. Its harvest serves first the school snacks (in soups, for instance) and the rest is distributed among people who have worked on it. It is interesting to note that in Northern and Northeast regions of Brazil, vegetables are considered insect's food (*comida de lagarta ou grilo*) (Cascardo, 1968, cited in Shrimpton and Giugliano 1979). In general, vegetable consumption by rural and urban dwellers are rare, due to absence of food habit as well as their high prices, since they are usually imported from other regions of the country. However, Shrimpton and Giugliano (1979:134) note that several European explorers reported consumption of raw *caruru* and other green vegetables by Amazonian Indigenous populations, a habit that was lost.

Both populations consume few processed foods. However, among them vegetable oil and salt are the most important. They are essential ingredients in daily food preparation. Other reported consumed products consumed during the survey periods were canned meat (beef and sardine fish), beef sausage (*mortadela*), beef jerky, butter, margarine, cookies, noodles, canned guava candy, mixes for children's gruel, porridge, milk powder, chocolate powder, beer, soda, wheat flour and cornstarch (see Tables 3, 4 and 5)

Food Sources: Production, Purchase and Reciprocity

In all three populations food items were obtained through a variety of means, but especially through purchase, cultivation and fishing. Hunting, borrowing, domestic livestock, gathering, and food exchange played a secondary role in the means of obtaining food.

Smallholder produced most of its consumed manioc flour in addition to all the açai juice consumed in the daily meals. Most of its main animal protein sources, such as game meat, pork, and fish were obtained through hunting, and from subsistence and economic activities. Part of consumed fish was obtained through marketing transactions. Only beef, which represented 5.54% of total protein intake was solely obtained through purchase.

In contrast, Sharecropper was the one most dependent on purchased food during the diet survey periods. Manioc flour, their main energy source was purchased, while açai juice, their second most important energy source, was home produced. Their main sources of protein were obtained through purchase and fishing. Fish, the main protein source of this population, was partially caught and partially purchased at Ponta de Pedras market. Beef was always obtained in the market, but all reported intake of shrimp, which is a constant contribution to protein daily intake, was caught. In general, household food purchases was guaranteed with the income provided from the marketing of açai fruit, which is the most important economic activity among this population⁶.

In Coop agricultural activities mainly based on mechanized fields of rice and beans provided little of the staple food of this population. Most of the manioc flour consumed was purchased. Its main sources of animal protein were partially purchased and partially home produced. Fish was sometimes bought at the Ponta de Pedras market and other times caught. Beef was always purchased, and shrimp was usually caught or received as a gift.

Like Sharecropper, in Smallholder and Coop açai fruit marketing also provided most of household incomes⁷, allowing them obtain other food items that were not home produced. Exchange of food items among households was most frequently observed in Pari and Praia than in Mara. Food exchanged or received as gifts included cooked and raw items. In Praia, reciprocity might be understood as a result of the organizational work

⁶ In all three populations it was observed that another important household income contribution is the monthly governmental paycheck provided for retiree agricultural workers. In Brazil, only in 1989 did agricultural workers have the right to receive a full retiree pension (which is about 1 minimum wage salary). Before that, agricultural workers received only half a minimum wage salary, and women agricultural workers were not eligible to receive a monthly wage in case their husbands were already retired.

⁷ It is interesting to note that even among Praia households, açai represents 64% of total household income generated from agricultural activities, including rice, beans and coconut (POEMA 1994).

of the cooperative, as well as a response to the instability of food production (Murrieta 1994). In Mara, fewer food reciprocities can also be understood as an outcome of their land tenure arrangements as sharecroppers due to the greater rotation of households in the area, thus, contributing to weak network relationships.

Discussion

Land Tenure, Economic Activities and Nutrient Achievements

Energy and protein requirements of households were calculated based on sex, age, ideal weight (for children and adolescents) and actual weight (for adults), assuming a moderate level of activity for the maximum number of individuals composing the sampled domestic units. Aggregating household data by population and comparing the estimated requirements to the food intake data collected during the two seasonal periods, winter and summer, it was observed that only one population, the sharecropper population, fully achieved its estimated energy and protein requirements. The other two populations, Smallholder and Coop, fell short of achieving their estimated energy needs. Unexpectedly, the population with less security to land was the one who fully achieved their estimated food requirements, mainly due the economic importance of açai fruit in the regional market.

At the population level, the success of success of Sharecropper in achieving its estimated food requirements seems strongly related to the growing importance of açai agroforestry marketing. However, higher levels of food consumption are not synonymous of a stable production system nor of greater food security. Açai management, production and marketing have grown considerably in the past two decades, increasing the supply of the fruit to the market. Up to now, açai agroforestry has proved to be an important process of food intensification without deforestation. However, it is important to point out that in the medium and long run, the growing fruit production in the absence of an increased market demand or more appropriated technology for storage and that makes possible other uses for the fruit can cause substantial collapse of the fruit prices, affecting many households and estuarine town economies. Moreover, in Sharecropper, while having unlimited access to açai fruit for household consumption, households were fully dependent on market transactions to have access to the main staple food, manioc flour, since as sharecroppers they were not allowed to cultivate gardens.

Our data also hint at the fact that agricultural development projects implemented in Coop community did not ensure its population greater food security. Perhaps, the greatest error of these agricultural projects was to underestimate the vulnerability of external subsidies, environmental limitations and the importance of manioc flour as an energy source in daily meals. Cash crops and ranching activities implemented in the community left almost no room for manioc gardens, as well as for forest patches, which are important sources of food (fruits and game) and craft materials. These agricultural and cattle ranching activities demanded a constant flow of outside resources, such as seeds, chemical fertilizers, pesticides, tractors, fuel, and so on, which were subsidized by the church. However, economically these projects did not sustain themselves. That is, the output production of these systems did not match the investments made on them. Moreover, the harvested products were also little valued as staple foods. Nevertheless, besides not being the focus of this paper⁸, positive outcomes of these

⁸ For this discussion see Siqueira 1997, Brondizio 1996, Murrieta 1994 and Murrieta et al. 1993.

development programs are observed in Coop community, especially those related to social and political organization of its members.

Smallholder presents a broader array of subsistence and economic activities, much along the patterns observed by riverine Caboclo populations elsewhere in the Brazilian Amazon. Maintenance of multiple economic and subsistence activities seem strongly related to their land tenure situation, i.e., they are small holders rather than sharecroppers. Most of the households still practice slash and burn agriculture, which allows them certain autonomy in obtaining their main energy source, manioc flour. Moreover, these activities are suitable with forest cover in different stages of regrowth, being also important sites for fruit gathering and hunting. The location of this population along the riverbeds favors shrimp and fish activities. They are also greatly involved into marketing activities of açai fruit. Nevertheless, this diversity of economic and subsistence activities did not seem able to guarantee their energy needs.

Securing and Enriching Energy Sources

Affirming the importance of manioc in the Caboclo's diet does not preclude the necessity of motivating other grain crops that could contribute to the diversification of the household diet. Crops such as rice, beans and corn, should be encouraged in addition to manioc, but not as its substitute. They could serve for household consumption as well as for market. As pointed out by Brondizio (1996),

(To) date, manioc is the best adapt crop to the region's socioeconomic and upland land environment. Much work can be done to improve manioc's productivity and long term use of gardens, such as emphasizing agroforestry techniques that improve the value of fallow vegetation during shifting cultivation periods. Intensifying production of shifting cultivation areas through the integration of manioc gardens and fallow agroforestry can improve diet and household income without jeopardizing food security and without destruction of resource basis (p.111)

In addition to being an important food source, açai cultivation has been a process of food intensification without deforestation. This process contrasts sharply with other mainstream paradigms of development (see example of Praia), in which agricultural intensification is synonymous with deforestation, and mechanization. However, despite its importance, açai production suffers a series of constraints. It still has a relatively limited consumption (mainly in the Northern region of the country), is highly perishable, being basically unusable for consumption three days after harvesting. These two constraints supposedly limit its production to areas close to market centers, despite the fact that nowadays, several brokers are exporting the frozen juice to the Southeast region of Brazil, where there is a growing market especially among young urban dwellers who take the juice as vitamin supplement.

Researchers from the regional branch of EMBRAPA- Brazilian Agriculture Research Agency (*Empresa Brasileira de Pesquisa Agropecuária*) have worked on the development of technologies aiming to preserve the fruit, but no successful technique has been reached yet. Continuity of this kind of research should be encouraged and when reached, transferred to the control of those who are the producers, in order to allow them to benefit from the increased value of their product.

Securing Sources of Animal Protein

To the study populations, as well as other Amazonian Indigenous (Dufour 1992, Pereira 1974), rural and even urban populations (Costa 1965, Giugliano et al. 1978, Motta-Maués and Maués 1980), fish is an important source of protein. However, as reported by our informants, fish, which was a plentiful common resource, is becoming a scarce one. They blame the overexploitation due to commercial fishing in Marajó Bay, and the use of small mesh nylon nets, human population growth, as well as lack of law enforcement as the main causes for decreasing fish stocks in the region.

On the other hand, shrimp is still a common resource not considered scarce, although members of the three study populations recall that shrimp yields are decreasing in the estuary. They point the use of *matapi*, which catches all sizes of shrimp, including small ones, and the no-observance of spawning periods as the main causes of decrease. The reasons mentioned by most of interviewed fishermen are those similar to Hardin's (1968) reasoning about open access resource, that is, everyone tries to maximize his/her short-term gains. On the other hand, everyone affirms that s/he would stop fishing during the reproductive period if s/he would be sure everybody would do the same. To make things worse, locally there is no branch of the governmental agency (IBAMA- Brazilian National Environmental Agency) responsible for enforcing fishing protective laws. In addition, the leaders of the local branch of *Colônia de Pescadores* (Fishermen Union), which should fight for the rights and common interests of fishermen, are not considered genuine representative of the group, and hence, few fishermen are affiliated to it.

Game meat, hunted or purchased, provides a sporadic, but important source of animal protein. By Brazilian environmental laws, hunting is forbidden, and is a crime. Locally, the law is rarely enforced due to lack of personnel. However, the terms of the law should be reviewed. Based on scientific research, permission to hunt should be guaranteed for household consumption and for commercialization in cases of abundance of resources. Raising of wild animals should also be given incentives.

Beef (oxen or buffalo) and pork, despite not being native to the region, are highly appreciated due to their taste among all three populations. Beef is mainly obtained through market transactions. Despite the fact that cattle ranching are the most important activity in the central and eastern part of Marajó Island, its supply in the market is inconstant. Most of cattle production (meat, milk and cheese) supplies the regional demand (Belém), but not the local ones. A better distribution of these resources should be encouraged. On the other hand, pigs are locally produced. However, raising pigs depends on the availability of resources to feed them. They are economically viable source of protein only if they can forage for their food, otherwise, the cost of raising these animals is too high for most of the study populations. Having access to areas of forest and/or fallows is an important component to make these animals viable to household consumption.

In case of fish and shrimp, despite their ecological importance per se, protection of these two river resources is fundamental to the quality of the diet of many rural and urban populations. It is necessary to guarantee their plentiful availability as well as their price accessibility. Moreover, in the specific case of the study populations, shrimp is also an important source of household income.

Final Considerations

In general, these populations are farmers and fishermen/women. Figure 6 summarizes their characteristics. They depend on land and water resources. To guarantee food security and their well being, Caboclo has to have access to both resources, hold privately and communally.

In the context of our study, food availability was not directly an outcome of land tenure security. Nor it was positively affected by technology innovation (ex. Coop). Sharecroppers did not have security to land, but they had access to market, guaranteeing them food security for a short term. However, great dependence on a unique market product, and lack of autonomy to diversify their economic activities may put their food security on jeopardy on a long run. Only with land tenure security, autonomy of decision and a diversified portfolio may these rural producers guarantee their food needs on a long-term.

Moreover, by itself, however, land security does not guarantee agricultural intensification neither sustainable agricultural practices. Agricultural development programs should take into account local management practices, local food preferences and from there, propose techniques that increase and even diversify production. Attention should be given to market prices and opportunities and to process that add value to the farmers' products. In addition, attention should be given to water resources too, given the fact that they are important component of Caboclo daily life. In short, recognizing the diversity of subsistence and economic activities to the survival and well being of these rural populations is an important step in addressing their needs.

Figure 2.

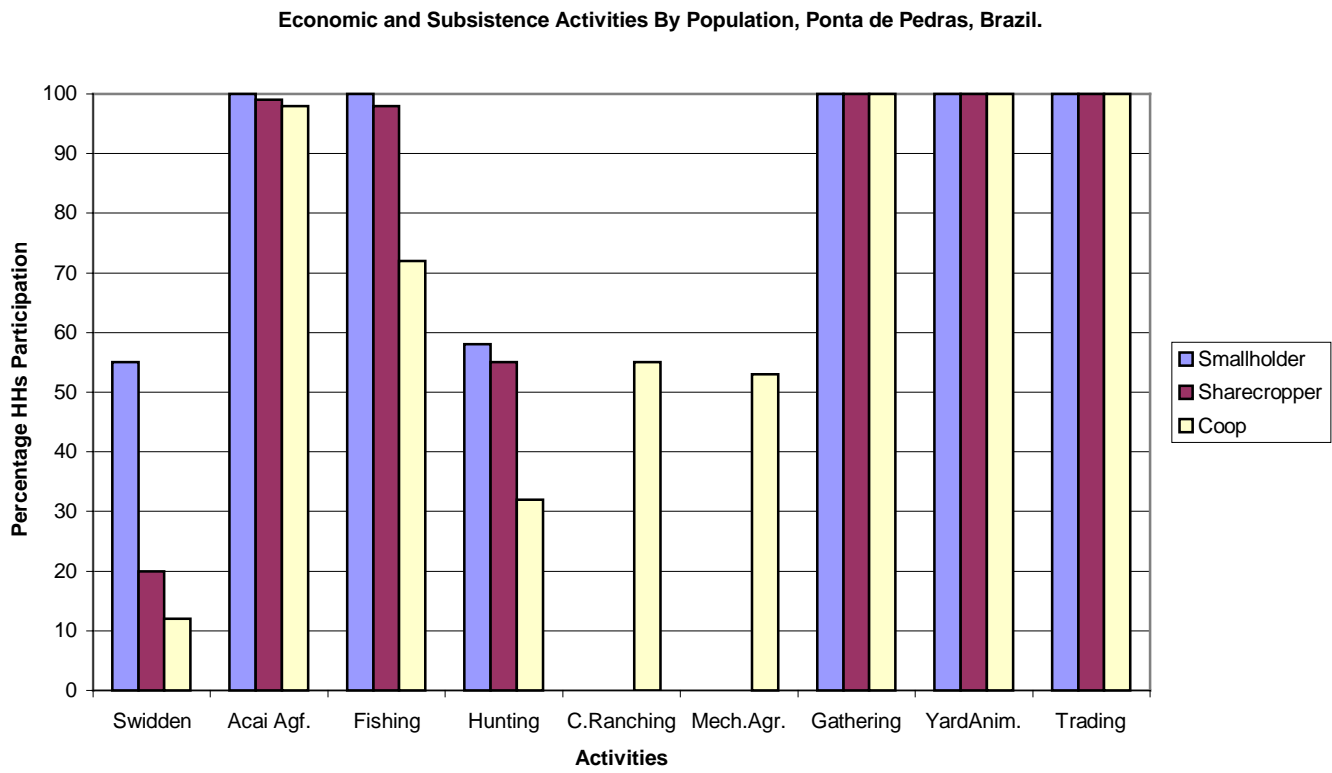


Figure 3.

Average Energy and Protein Intake (Rainy and Dry Seasons) in Relation to FAO/WHO/UNU Estimated Requirements, Ponta de Pedras, Brazil, 1991.

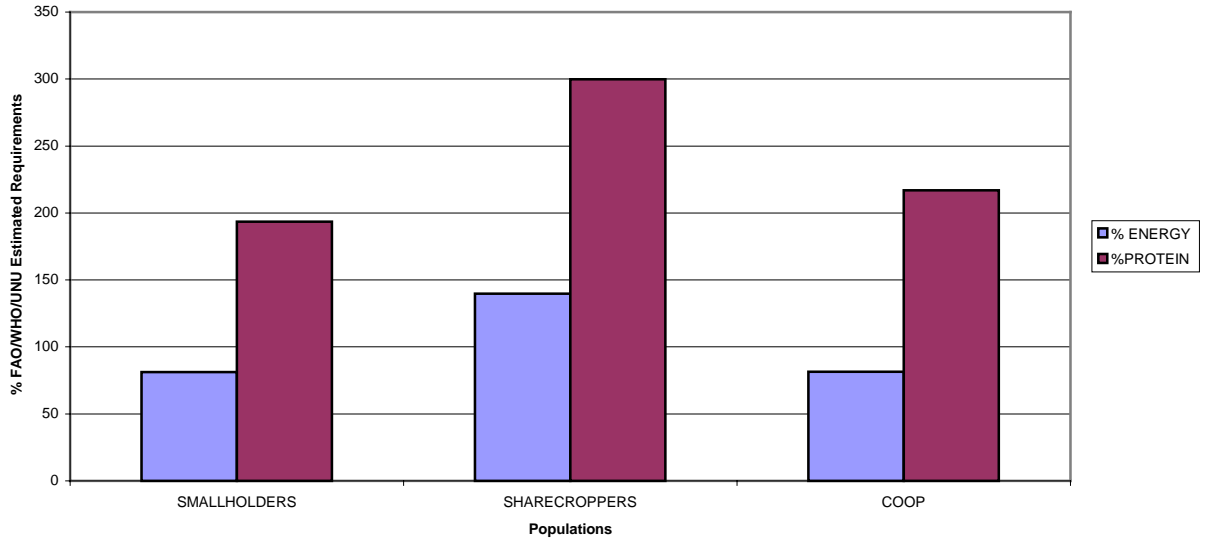


Figure 4.

Average Manioc and Acai Contribution to Total Energy Intake, Ponta de Pedras, Brazil, 1991.

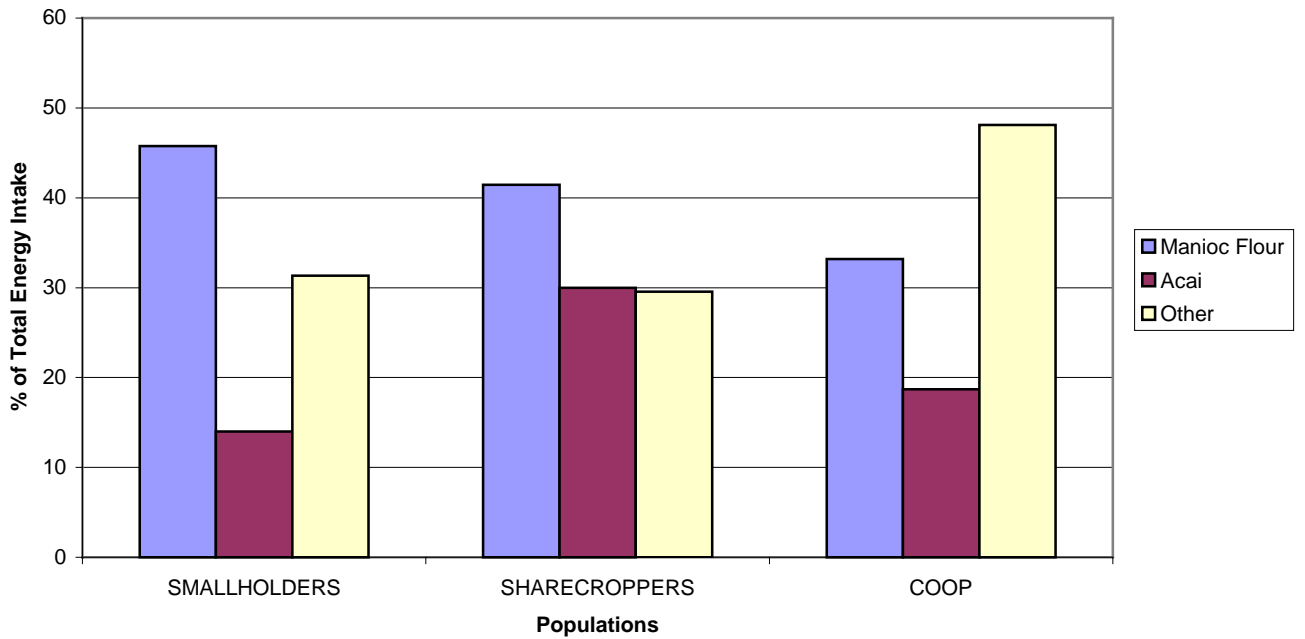


Figure 5



Figure 6.

	SMALLHOLDERS	SHARECROPPERS	COOP
ECONOMY	Diversified + market	Market oriented (specialized)	Cash Crop + subsidies
FOOD ACQUISITION	Production, Reciprocity, Purchase	Purchase, Production, Reciprocity	Purchase Reciprocity Production
RESOURCES	Private (açai+garden) Common (river+forest)	Private (açai) Common (river)	Private (açai) Common (agric. Fields, river)
FOOD INTAKE	Protein- high Energy- low	Protein- high Energy- high	Protein- high Energy- low
FOOD SECURITY	Short term- good Long term- vulnerable	Short Term- good Long Term-good	Short Term- vulnerable Long Term- good

Table 1.
 Sampled Household Age Group Composition Per Population, Ponta de Pedras, Brazil, 1991.

	Number of Sampled HHs	Children (0-9.9 yrs)	Adolescents (10-17.9 yrs)	Adults (+18 yrs)	TOTAL
SMALLHOLDERS	4	12	9	11	32
SHARECROPPERS	6	18	8	17	43
COOP	6	15	7	15	37
TOTAL	16	45	24	43	112

Table 2.
Estimated Weekly Energy and Protein Requirements*, Ponta de Pedras, Brazil, 1991.

	ENERGY	PROTEIN
SMALLHOLDERS	508270	6986.14
SHARECROPPERS	653450	9422
COOP	379190	5207

*Requirements based on FAO/WHO/UNU (1985) recommendations considering sex and age. We used *actual* body weights for adults (+18 yrs), and *ideal* weight for children (0-9.9 yrs) and adolescents (10-17.9 yrs) and physical activity (moderate) for the maximum number of permanent individuals of the sampled households.

Table 3.

Food Items Consumed in Smallholder and their Main Sources, Ponta de Pedras, Brazil, 1991.
(Both Seasons Combined)

FRUITS	ANIMAL PROTEIN	OTHERS
Açaí (AÇAIZAL)	Armadillo**(FOREST/GARDEN)	School Snacks***
Bacaba (FOREST/AÇAIZAL)	Beef (MARKET)	Beans (MARKET)
Banana(GARDEN)	Jerky Beef (MARKET)	<i>Beiju</i> (GARDEN)
Cocoa (FOREST/QUINTAL)	Lizard** (SAVANNA)	Coffee (MARKET)
<i>Fruta Pão</i> (QUINTAL)	Cow Tripe (MARKET)	Cookies (MARKET)
Guava (QUINTAL/GARDEN)	Egg (QUINTAL)	Crackers (MARKET)
<i>Inga</i> (FOREST)	Fish (RIVERS)	Noodles (MARKET)
Papaya (GARDEN/QUINTAL)	<i>Jaracuru</i> ** (FOREST)	Manioc Flour(GARDEN)
Pinneapple (GARDEN)	Opossum**(FOREST)	Porridge mix (MARKET)
Peach Palm (FOREST)	<i>Paca</i> ** (FOREST/GARDEN)	Cocoa Powder (MARKET)
	Pork (QUINTAL)	Milk Powder (MARKET)
	<i>Saracura</i> ** (FOREST)	Rice (MARKET)
	Shrimp (RIVER)	Salt (MARKET)
	Venison**(FOREST/SAVANA)	Sugar (MARKET)
	Toucan**(FOREST)	Sweet Manioc (GARDEN)
		<i>Tapioca</i> (GARDEN)
		Vegetable Oil (MARKET)
		Wheat Flour (MARKET)
		Wheat Bread (MARKET)
		Wheat Cookie (MARKET)

* game meat

** rice flour, powder milk, soil bean milk, etc.

Table 4.

Food Items Consumed in Sharecropper and their Main Sources, Ponta de Pedras, Brazil, 1991.
(Both Seasons Combined)

FRUITS	ANIMAL PROTEIN	OTHERS
<i>Açaí</i> (AÇAIZAL)	Alligator* (MARKET/RIVER)	Beans (MARKET)
Avocado (<i>QUINTAL</i>)	Beef (MARKET)	Beer (MARKET)
<i>Bacaba</i> (FOREST)	Chicken (<i>QUINTAL</i>)	<i>Beiju</i> (MARKET)
Coconut (<i>QUINTAL</i>)	Cow Stomach (MARKET)	Coffee (MARKET)
<i>Coco do Marajá</i> (FOREST)	Cow Tripes (MARKET)	Cornstarch (MARKET)
<i>Cupuaçu</i> (FOREST)	Crab (RIVER)	Crackers (MARKET)
Guava (<i>QUINTAL</i>)	Egg (<i>QUINTAL</i>)	Dumplings(fried)(MARKET)
<i>Jambo</i> (<i>QUINTAL</i>)	Fish (RIVER/MARKET)	Manioc Flour (MARKET)
	Jerky Beef (MARKET)	Margarine (MARKET)
	Opossum** (FOREST)	Milk (MARKET)
	Pork (<i>QUINTAL</i>)	Noodles (MARKET)
	Shrimp (RIVER)	Onions (MARKET)
	Sloth** (FOREST)	Palm Hearts (AÇAIZAL)
	Snail (RIVER)	Pastries (MARKET)
		Periwinkle (MARKET)
		Porridge Mix (MARKET)
		Milk Powder (MARKET)
		School Meals**
		Rice (MARKET)
		Rice Gruel (MARKET)
		Soda (MARKET)
		Salt (MARKET)
		Sugar (MARKET)
		<i>Tapioca</i> (MARKET)
		Tomato (MARKET)
		Vegetable Oil (MARKET)
		Wheat Bread (MARKET)
		Wheat Flour (MARKET)

* game meat

** rice flour, powder milk, soil bean milk, etc.

Table 5.

Food Items Consumed in Coop and their Main Sources, Ponta de Pedras, Brazil, 1991.*(Both Seasons Combined)*

FRUITS	ANIMAL PROTEIN	OTHERS
<i>Açaí (AÇAIZAL)</i>	Alligator (MARKET)	Beans (MARKET/FIELDS)
<i>Bacaba (FOREST)</i>	Armadillo*(FOREST)	Bear (MARKET)
Banana (<i>QUINTAL</i>)	Beef (MARKET)	Beiju (GARDEN/MARKET)
<i>Biriba (QUINTAL)</i>	Jerky Beef (MARKET)	<i>Caruru (QUINTAL)</i>
<i>Buriti (QUINTAL)</i>	Chicken (<i>QUINTAL</i>)	Coffee (MARKET)
<i>Cashew (QUINTAL)</i>	Cow Tripe (MARKET)	Cookies (MARKET)
<i>Cupuaçu (QUINTAL)</i>	Cow Liver (MARKET)	Crackers (MARKET)
<i>Fruta Pão(QUINTAL)</i>	Liver (<i>QUINTAL</i>)	Manioc Flour (GARDEN/MARKET)
Guava (<i>QUINTAL</i>)	Fish (MARKET, RIVER)	Guava Candy (MARKET)
Papaya (<i>QUINTAL</i>)	Pork (<i>QUINTAL</i> , MARKET)	Maize (FIELDS)
Passion Fruit (<i>QUINTAL</i>)	Sardines (canned)(MARKET)	Margarine (MARKET)
Orange (<i>QUINTAL</i>)	Shrimp (MARKET, RIVER)	<i>Maxixe</i> (GARDEN)
Piquia (<i>QUINTAL</i>)		Milk (goat) (HOME PRODUCTION)
Palm Peach (<i>QUINTAL</i>)		Noodles (MARKET)
Sweet Lime (<i>QUINTAL</i>)		Okra (<i>QUINTAL</i>)
<i>Tucumã (QUINTAL)</i>		Onion (MARKET)
Watermellon (<i>QUINTAL</i>)		Palm Heart (AÇAIZAL)
		Periwinkle (MARKET)
		Chocolate Powder (MARKET)
		Milk Powder (MARKET)
		Rice (FIELDS/MARKET)
		School Meals**
		Soda (MARKET)
		Soup Mix (MARKET)
		Squash (<i>QUINTAL</i>)
		Salt (MARKET)
		Sugar (MARKET)
		<i>Taioba (QUINTAL)</i>
		<i>Tapioca</i> (GARDEN/MARKET)
		Toast (MARKET)
		Vegetable Oil (MARKET)
		Wheat Bread (MARKET)
		Wheat Germ (MARKET)

* game meat

** rice flour, powder milk, soil bean milk, etc.

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