The technical transformation of an agricultural system in the Colombian Amazon

Luisa Fernanda Herrera, Inés Cavelier, Camilo Rodríguez and Santiago Mora

Introduction

Archaeological data obtained in the Amazon region up to the present indicate that there was an increase in population density throughout the whole area at the beginning of the Christian era. In fact, a greater proportion of settlements is indicated for this period (Meggers 1987). This change, which has been registered by some archaeologists through ceramic horizon studies, has been generally associated with sedentary farmers who controlled riparian areas (Lathrap 1970; Meggers and Evans 1961).

Important transformations in the structure and composition of the soils in some areas were brought about during this period; anthropic soils originated due to intense agricultural activity (Smith 1980; Andrade 1986).

On the contrary, the first Amazonian farmers are associated probably with scattered settlements, with a low population density and a slash and burn exploitation of small plots within the forest. These are similar to the techniques used today by indigenous communities in the lowlands (Plate 1) (Mora et al. 1991). Polyculture is the most common form of agriculture; the oldest registered cultivated plants in the Amazon are maize and manioc. The former has been found in Ecuador, dating 6000 BP (Bush et al. 1989; Mora et al. 1991) and towards 4700 BP in Araracuara, where, according to the palynological analysis, it preceded manioc.

The detailed and systematic study of those societies which brought about the agricultural intensification in the Amazonian region is still in its early stages (Cavelier et al. 1990; Herrera et al. 1988; Roosevelt 1991; Mora et al. 1991). However, a connection between the continuous occupation of various sites and their strategic location within the Amazon landforms has been revealed.

In the tropical lowlands of Colombia archaeological sites with anthropic soils of considerable extent have been found, which show high concentrations of human activity. The main sites located so far are at the Guayabero rapids (López and Botero 1990); in La Pedrera and Córdoba within the lower Caquetá river region (Reichel 1987; Reichel and Hildebrand 1982–3); and by the Araracuara rapids on the middle Caquetá river (Fig. 1). These sites share features such as physiographical location in areas of high stability; easy access to a waterway where navigation is partially or totally interrupted, due to natural causes; association with rock art; and the formation of dark-coloured anthropic soils over

Plate 1 Cultivated plot *chagra* in Araracuara.

40cm deep, on sandy strata. It should be added that in the vicinity of these sites, smaller ones were found that have shallower anthropic soils.

Araracuara: settlements located mid-course Caquetá river

The area under study is located 250m above sea level, in the middle course of the Caquetá river, in the Colombian Amazon. Its central coordinates are 72°24′W – 0°3′S. According to Köppen's classification, the climate is 'very damp, equatorial', with an average temperature of 26°C, and an annual rainfall of 3,000mm.

The most outstanding geographical feature in the region is the plateau of Araracuara, a Paleozoic sandstone formation, with an area of approximately 16 square km. It rises to a height of 200m and dominates all the surrounding area. Such plateaus are rare in the Amazon landscape and help to create areas of specific resources that are scarcer

Figure 1 Location of Araracuara, Guayabero, Pedrera and Cordoba in the tropical lowlands of Colombia.

elsewhere. It is also possible to distinguish other physiographic regions such as the denudative area, low terraces and alluvial plains and islands, which are periodically flooded.

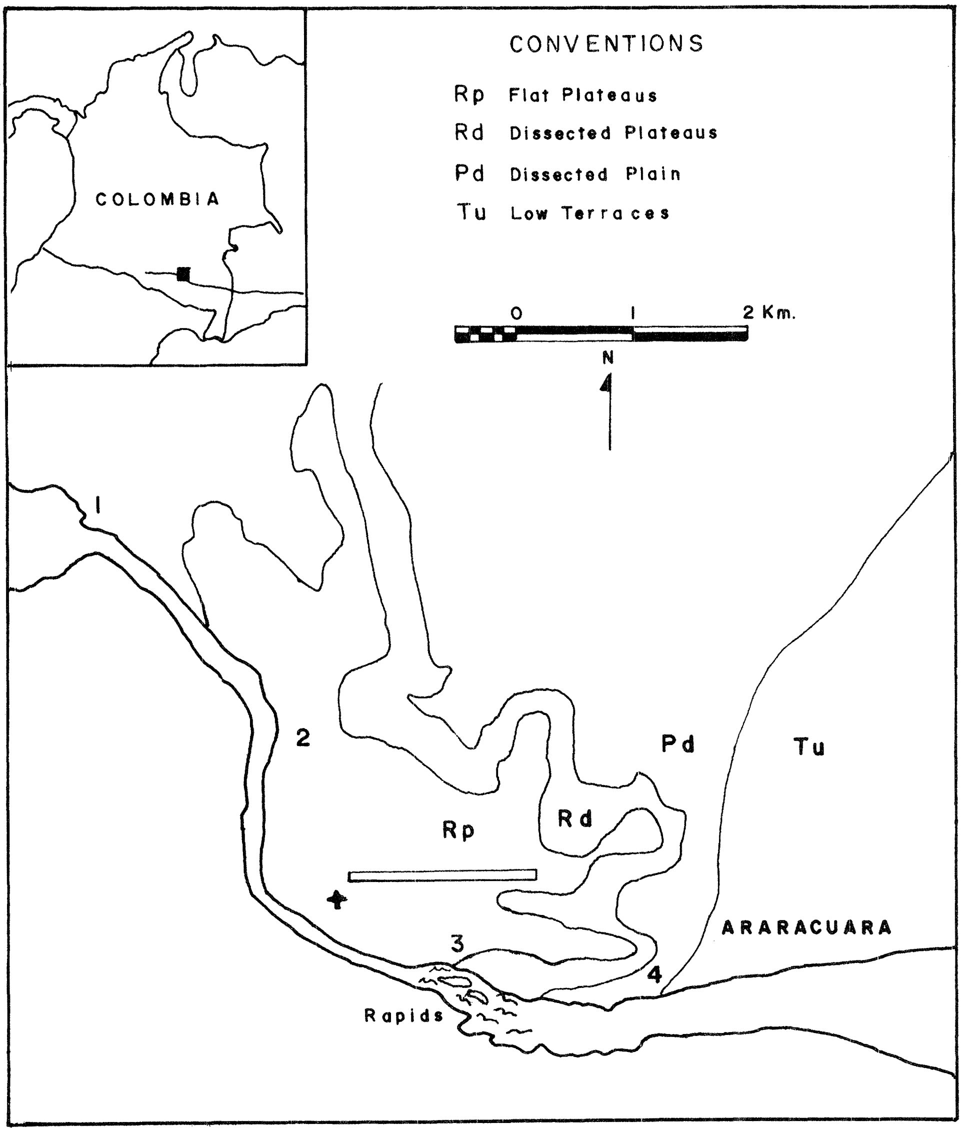


Figure 2 Location of archaeological sites in the Araracuara region.

In this article four particular settlements within the Araracuara region are taken into consideration (Fig. 2), three of which have anthropic soils (2, 3, and 4). Site 2 consists of 6ha of brown loamy-sand soils with an average depth of 22cm. On the other hand, site 3 has an area of 14.5ha of sandy-loam soils with an average depth of 40cm (León 1983). Site 4 is located at the base of the structural plateau, at the exit of the Araracuara rapids, covering approximately 9ha. It also has sandy-loam soils. Site 1 found at the entrance to the rapids only consists of 1ha of clayey soils, without any substantial modifications observed.

Although other sites have been examined in this area (Fig. 3), we consider that the ones mentioned above are representative of the changes in the agricultural techniques which probably covered a wider territory.

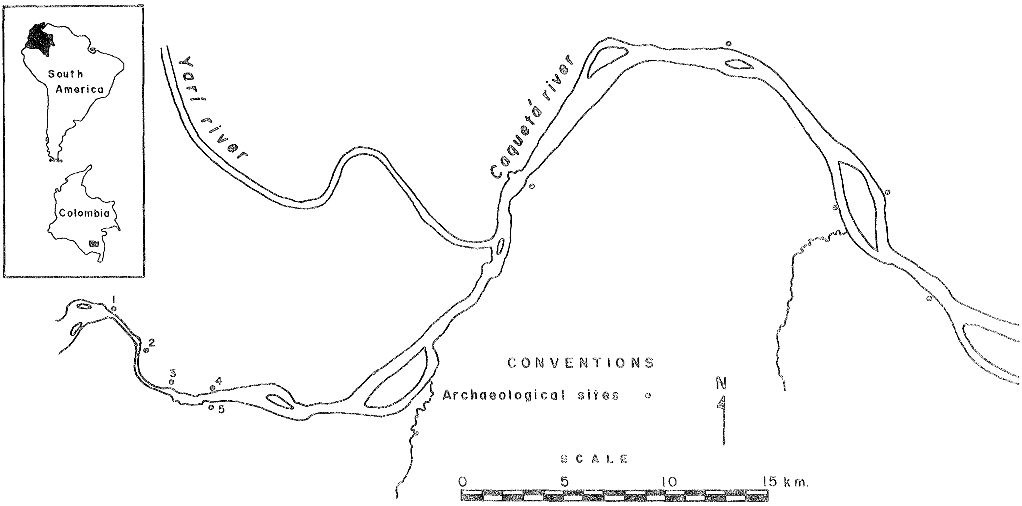


Figure 3 Archaeological sites – Middle Caquetá river.

The anthropic soils studied on the plateau (Fig. 4) have been separated into two categories: black and brown. Four different basic components are found in them: colour of the stratum, percentage of organic material, amount of phosphorous, and depth of the horizons. According to Andrade (1986) and Eden et al. (1984), this data allows us to estimate the amount of human intervention and the use of these soils: the brown soils being the result of cultivated plots, and the black ones from dwelling places. Nevertheless, archaeological studies of the Araracuara plateau demonstrate that many of these activities were inter-related and alternated, as shown in the following pages.

Sites 2 and 3 have a very complete palynological, edaphic and chronological record. The dates for the anthropic soils in site 2 span from 1565 ± 35 BP (Grn 16970) to 775 ± 25 BP (Grn 16968), in site 3 from the first century until AD 1800 (relative dates calculated through pollen analysis from the C14 date 1160 ± 50 (Beta 6950); in site 1 from 1640 ± 70 BP (Beta 21894) to 740 ± 35 BP (Grn 14998), and in sites 4 and 5, from 1815 ± 105 BP (Beta 1503) to 340 ± 50 BP (Beta 1510) (Table 1).

Studying the data obtained at site 3, we see that the anthropic soil was initially formed by the addition of organic wastes. Palynological analysis indicate that there was a substantial change in this method towards the year AD 790. This consisted of the addition of alluvial silt into the soil, inferred by the appearance of humidity indicators (algae) belonging to permanently swamped areas (Fig. 5). These plants come from a zone at the base of the structural hill, where the Caquetá river flows.

Along with the change in the soil improvement techniques in site 3, a diversification of cultivated plants is seen, suggesting a process of intensive use. These include: *Ipomoea batatas* (sweet potato), two types of *Manihot esculenta* Crantz (manioc), two types of *Zea mays* (maize), *Anacardium occidentale* (cashew-nut fruit tree) (Fig. 6).

A distribution of cultural materials also appears along with different-coloured patches in the soil which indicate a rotation of dwelling places within a restricted locality. Its use as a living area is suggested by the exceptionally high phosphorus and organic material

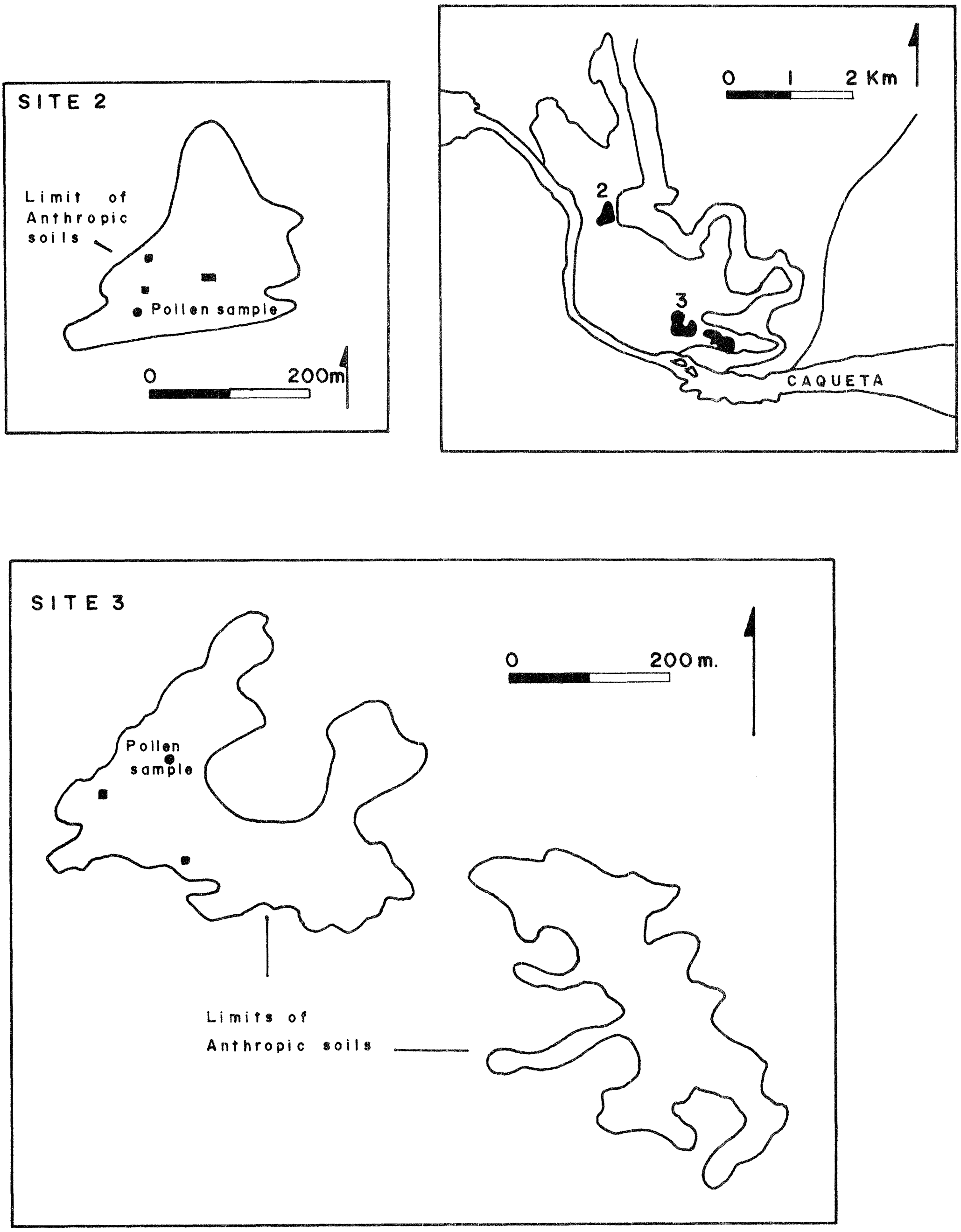
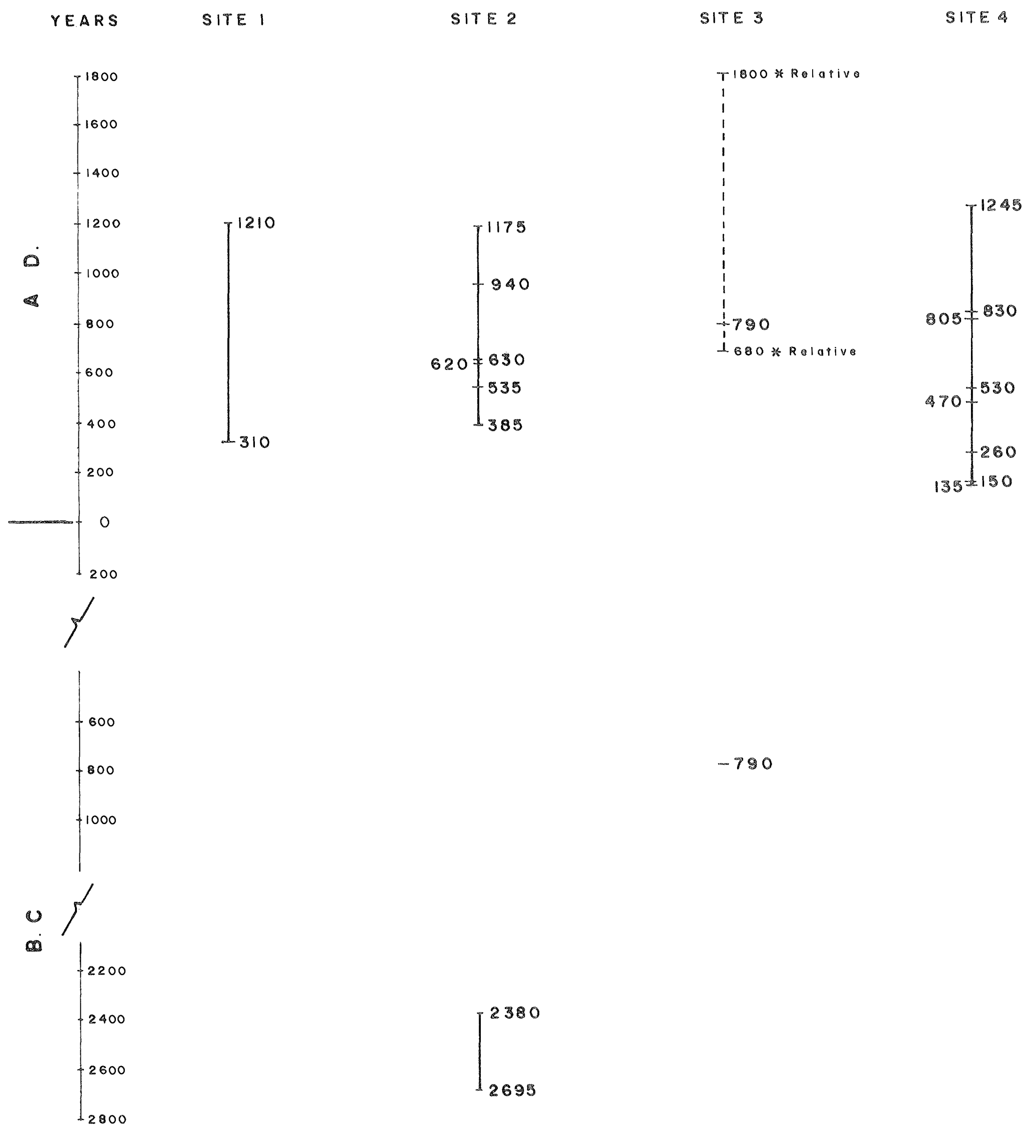


Figure 4 Excavations and pollen samples in sites 2 and 3.

concentrations (up to 1000ppm and 2.61 percentage respectively). Additionally, the excavation of a fireplace inside a dwelling showed that a stratum of soils, darker and deeper than the surrounding ones, was formed there.

Table 1 Dates from Araracuara



Soil studies also show the multiple use of space at site 3. They reveal that there was no change in the adjoining forest, which is implied by the organic material content, aluminium, interchangeable bases, phosphorus and the amount of clay, as well as an acid pH (Table 2). These observations have been confirmed through palynological analysis where a high forest component is observed.

Site 2 enables us to document another kind of agricultural management. It should be noted that there were two separate periods of occupation in this place, having distinctive characteristics: a first one, dated at 4645 ± 40 BP (Grn 14987), without an anthropic soil and with an early record of maize cultivation. Throughout the latter period, dating from

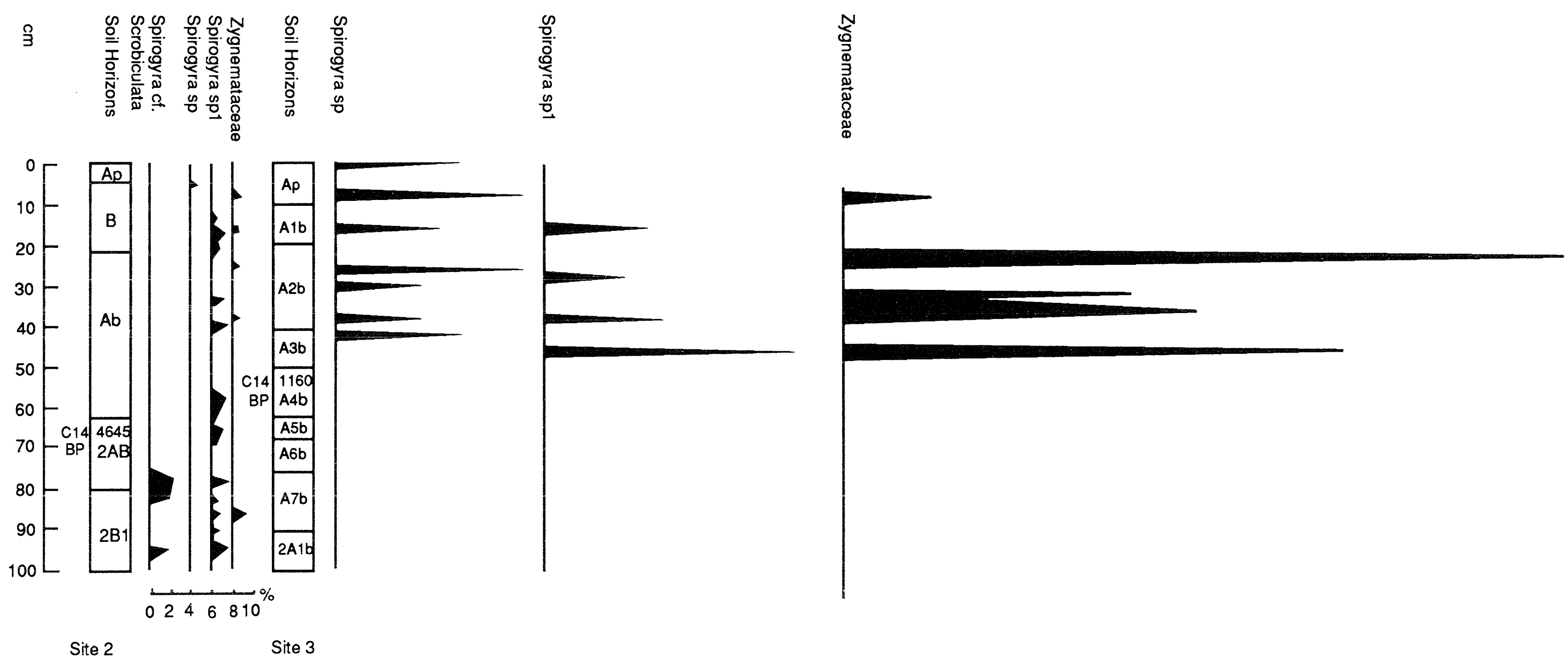


Figure 5 Pollen diagram from sites 2 and 3. Humidity indicators.

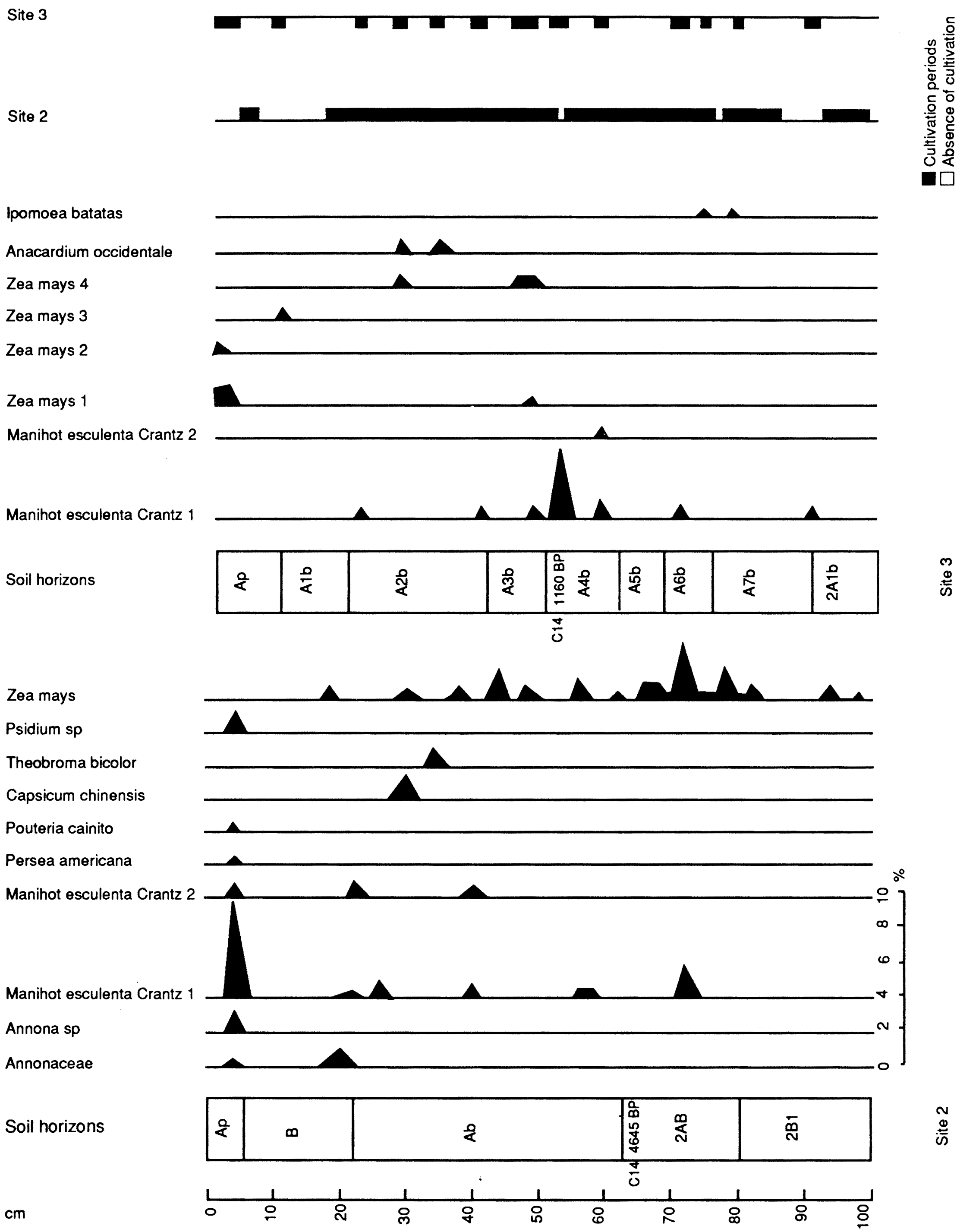


Figure 6 Pollen diagram from sites 2 and 3. Cultivated plants.

Table 2

	SITE 2		SITE 3	
	MIN.	MAX.	MIN.	MAX.
ORGANIC MATTER	0.5	1.33	0.93	2.61
ALUMINIUM	0.5	2.2	1.0	1.8
INTERCHANGEABLE BASES	4.1	31.4	6.8	12.5
PHOSPHORUS	3	28	360	480
pH	4.0	4.7	4.0	4.6
AMOUNT OF CLAY	6	8	2	4

1565 ± 35 BP to 775 ± 25 BP, soils were artificially modified, and there is a predominance of open vegetation. This was observed through edaphic data such as lower acidity, greater quantity of clay and aluminium and less interchangeable bases, as well as low percentages of organic material (Table 2). This interpretation is palynologically backed up by the large quantity of gramineae found throughout the occupation (Fig. 7).

Dwellings and crops were maintained in the same place, showing a preference of house concentration towards the centre of the settlement, while crops were located more to the outskirts. This was proved from the excavations carried out in this sector, as well as the 120 bore-holes which defined the occupied site. Agriculture was maintained for 800 years with a lower proportion of added wastes than at site 3. This is reflected in the phosphorus and organic material amounts (up to 53ppm and 1.33 per cent respectively), and also in the uninterrupted record of cultivated plants visible in the pollen diagram (Fig. 6). These cultivars are: *Zea mays* (maize); 2 types of *Manihot esculenta* Crantz (manioc); *Capsicum chinensis* (chili pepper), and *Theobroma bicolor* (maraca), a fruit the size of a water melon of which both the flesh and seeds are consumed.

It should also be mentioned that palm trees were identified on these two sites (2 and 3). Their percentages could show their use and management (Fig. 8). The local indigenous tribes show the many-fold utility of these plants: *Oenocarpus* sp. does not only have its fruit consumed, but once felled, its trunk becomes a breeding ground for coleoptera larvae, which are also eaten. Fiber is extracted from the leaves as well. The *Lepidocaryum tenue* palm is especially important for the use of fronds in thatching. The nut from *Attalea* sp. is either consumed or processed to extract oil. The fruit from *Mauritia* sp. is used for human consumption, the leaves for fiber, and the trunk to breed larvae. *Syagrus* sp. is sporadically used for roofs, and its nut is edible. *Astrocaryum sciophilum* has a nutritious seed. The trunk of *Euterpe* sp. is used in constructions and its fruit made into a drink. By splitting the trunk of *Iriartea* sp. lengthwise, it is adapted for the divisions and floors of dwellings. The *Chamaedorea* sp. flowers are used because of their strong pleasant scent (Galeano 1991). *Geonoma* sp. which is characteristic of the understory, does not appear during the occupation. It is important to mention that these plants show different management at each site. For site 2, where agricultural practice was almost continuous,

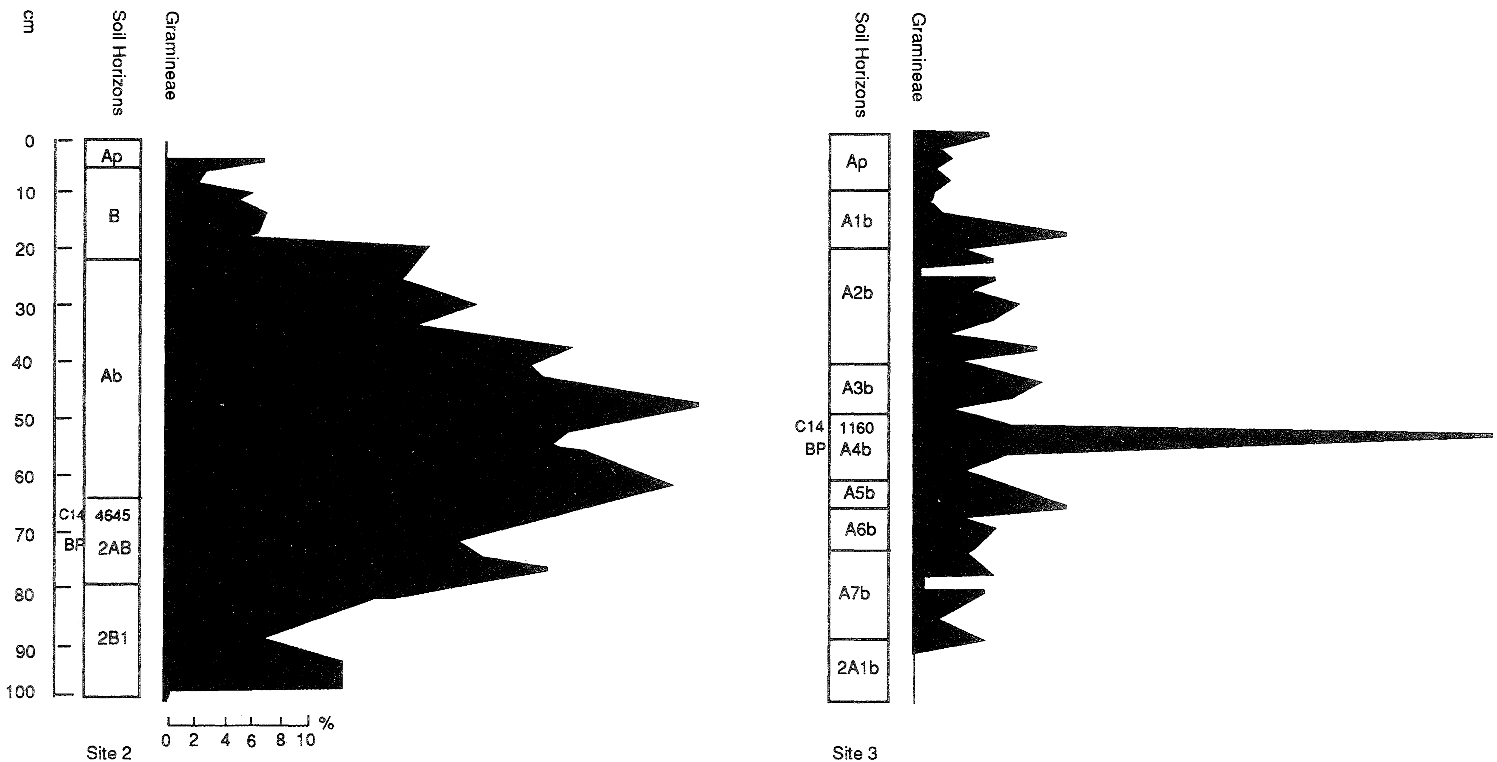


Figure 7 Pollen diagram from sites 2 and 3. Gramineae.

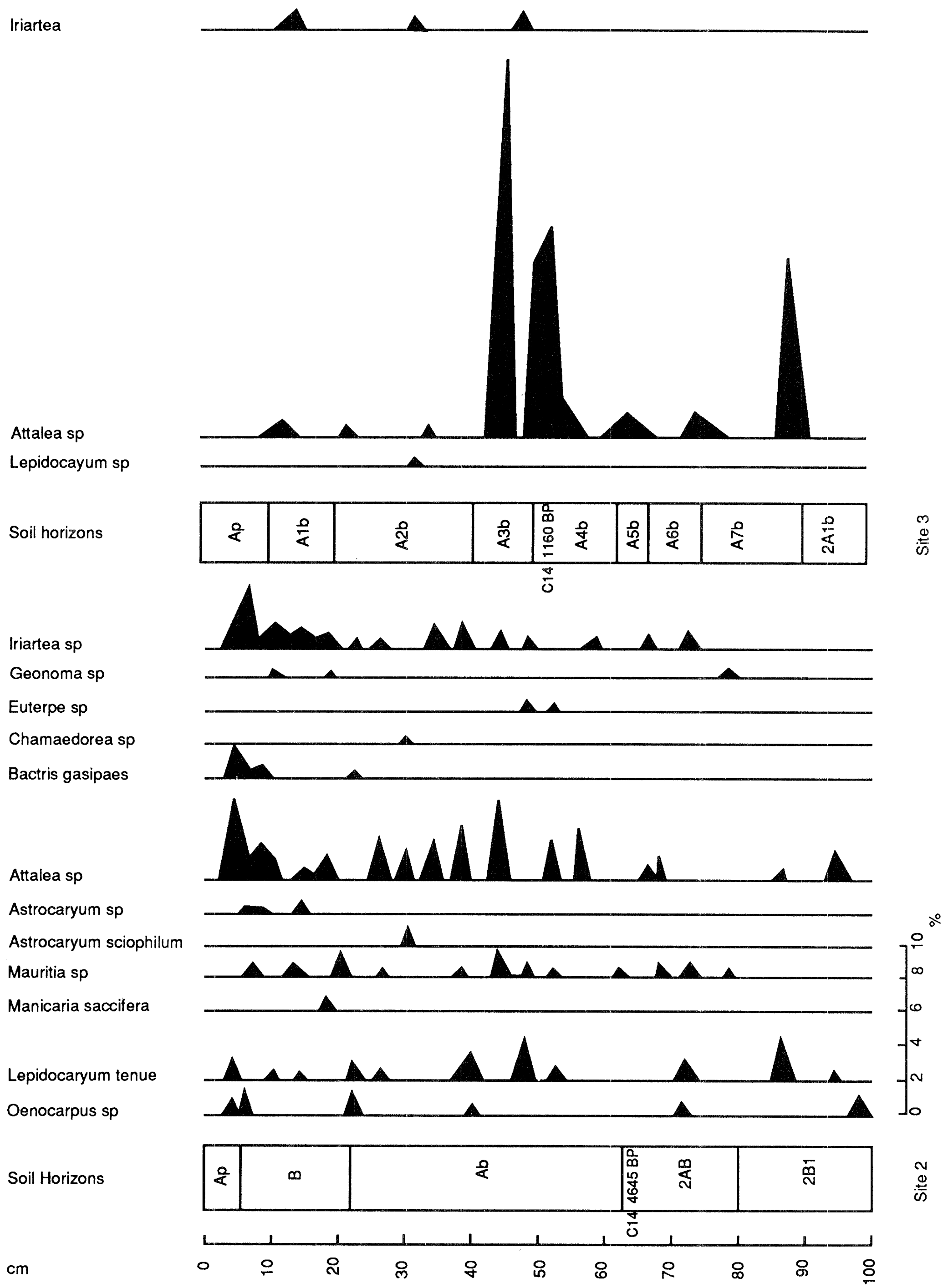


Figure 8 Pollen diagram from sites 2 and 3. Palms.

the maximum percentages of palms coincides with those of cultivated plants. On the other hand, this was observed only for the *Lepidocaryum tenue* palm in site 3 (Fig. 8).

Sites 1 and 4 situated at the extremities of the Araracuara canyon, at the base of the hill, lack such precise information. Notwithstanding, it is possible to see some of their most important characteristics, such as the duration of the occupation and the character of soil modification. Site 4 contains black soils used continuously from the first century AD. Site 1, on the other hand, was abandoned after 900 years. From its size and location one can assume that it could have been used to control the obligatory land travel due to the rapids.

The archaeological record enables us to establish relations between all the above mentioned sites, as well as emphasize their different activities. It is necessary to realize that the distances separating them are not greater than 3km. Long overlapping periods are shown in their chronologies, although the northern settlements were abandoned around the year AD 1200.

There is a noticeable continuity in the shape of ceramic materials and a gradual transformation in decorative style. The ceramic decoration of the late period (AD 800–1000) is modeled, and incised with red and white paint. It must be added that there are indications that vessel size also increased. It is also necessary to point out that there is a predominance of simple pots in site 2, while elaborate ones are abundant in sites 3 and 4.

There are also important differences in lithic materials. On the south side of the hill, towards the river margin (site 4), important concentrations of discarded axe blanks and flakes of diabase are found. The sources of raw material are located in this area. On the top of the hill, and within short distance from site 3, there is a stream whose rocky bed shows scores of hollows used to finish the polished axes. Sites 1 and 2 lack remains that could show local manufacture of these lithic instruments.

All of the above leads us to infer that the permanence of the sites located on the southern part of the hill (sites 3 and 4) is related to the occupation and abandonment of sites 1 and 2. It could be suggested that there was a process of fission and fusion, where site 2 might be the result of a group splitting from one of the oldest settlements (3 or 4). This is inferred by the way the space was occupied: the forest was cleared in order to establish dwellings and cultivated plots in the entire 6ha; a fairly homogeneous layer of modified soil was formed from the beginning of the occupation. The formation of such soil ceased by the year AD 1200; the pollen record shows that some cultivars remained, probably serving as a germplasm bank for storing cultivated plants. The site was probably used as a hunting ground; similar examples are documented in ethnographic and archaeological literature (Hildebrand 1975; Linares 1976). It is difficult to determine the place where the population from site 2 moved to after AD 1200; probably, they re-located in one of the settlements which remained until the seventeenth century. We have mentioned the process of agricultural intensification in site 3 which could imply a greater population or an increased production for exchange purposes.

Site 1, which only has a few dwellings, located over a matrix of clayey soils at the riverside, shows a chronological sequence, similar to site 2; its disappearance also coincides with site 2. If it was an observation or control post, as we have suggested, what new circumstances arose that made it unnecessary? The abandonment could indicate that the inhabitants of the Araracuara plateau consolidated their power on the regional level, extending their borders westwards along the river.

The anthropic soils

We must consider the effort required for the formation of anthropic soils, by the addition of alluvial silts. Let us look at the experiment undertaken by Páez (1990) in Araracuara. Productivity related to the addition of alluvial silt or litter was examined. The results showed the need to incorporate 245 tons of sediments per hectare to create a one centimeter thickness of soil which gave a good crop. After the second harvest it was seen that this process had to be repeated annually in order to maintain the fertility of the soils. If the calculations done by Páez are correct, it is possible to estimate the amount of labor force required to form these soils. To do this, the characteristics of the place (site 3) where the archaeological record shows the addition of silt has to be taken into consideration. These are location, extension, depth, formation time and the source of these silts. Beforehand, we gave the coordinates of the site (figure 3); however, it is necessary to note that from the river banks to the plateau there is a 60° slope 500 meters long, which then levels off over the next 400 meters to the nearest limit of the anthropic soils, which extend for another kilometer. In the 14.5ha of anthropic soil, the depth varies between 20 and 125 cm. The average depth calculated from 50 bore-holes is 40cm. The AD 800 date was obtained at 50cm and corresponds to the time the silt was first added. Further on, and making allowance for the charcoal, lithic and ceramic materials, whose contributions never exceed an estimated 4cm, we estimate the quantity of added sediments to be 36cm. It is possible that the alluvial silt was taken from the banks of the Caquetá river, making full use of the yearly flooded sections. This can only be done from December to February when the river is at its lowest.

Adaptationist theories have characterized the settlements in the Amazonian region by their instability, attributed to the depletion of resources after a few years of human intervention. On the contrary, as many researchers now believe, man is not a predator, but a producer of resources. Archaeological data show that a stable occupation existed in the Araracuara zone. This was possible due to a continuous agricultural process.

The data presented so far, support recent ideas posited by researchers working in Amazonia, which present man conserving and managing resources, instead of just exploiting them. Archaeological information from Araracuara shows a continued agricultural production, along with the control of communication routes and the access to abundant and/or rare resources, as a basis for a stable occupation there.

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Fundacion Eligaie,
Apartado Aéro 89657,
Bogota, Colombia.

References

Andrade, A. 1986. *Investigación Arqueológica de los Antrosoles de Araracuara*. Bogotá: Fundación de Investigaciones Arqueológicas Nacionales, Banco de la República.

Bush, M. B., Piperno, D. R. and Colinvaux, P. A. 1989. A 6,000 year history of Amazonian maize cultivation. *Nature* 340: 303–5.

Cavelier, I., Mora, S. and Herrera, L. F. 1990. Estabilidad y dinámica agrícola: Las transformaciones de una sociedad amazónica. In *Ingenierías Prehispánicas* (ed. S. Mora). Bogotá: Fondo FEN, Instituto Colombiano de Antropología, pp. 73–109.

Eden, M., Bray, W., Herrera, L. and McEwan, C. 1984. Terra preta soils and their archaeological context in the Caquetá basin of southeast Colombia. *American Antiquity*, 49(1): 125–40.

Galeano, G. 1991. *Palmas de la Región de Araracuara*. Bogotá: Estudios en la Amazonia Colombiana, 1, Tropenbos Colombia.

Herrera, Luisa Fernanda, Mora, S. and Cavelier, I. 1988. Araracuara: selección y tecnología en el primer milenio A.D. Bogotá. *Colombia Amazónica*, 3(1): 75–87.

Hildebrand, von Elizabeth R. 1975. Levantamiento de los petroglifos del río Caquetá entre La Pedrera y Araracuara. Bogotá. *Revista Colombiana de Antropología*, XIX: 303–70.

Lathrap, Donald. 1970. *The Upper Amazon*. London: Thames & Hudson.

Linares, Olga. 1976. Cacería el huertas en los trópicos americanos. *Human Ecology*, 4(4): 331–47.

León, Tomás and Vega, A. 1983. Estudio detallado de suelos de las áreas de Terra Preta de Araracuara. Informe del Centro de Investigaciones Científicas de la Universidad Jorge Tadeo Lozano (unpublished).

López, E. and Botero, P. J. 1990. Prospección arqueológica-fisiográfica en la llanura aluvial del río Guayabero (Colombia). Ponencia presentada al il Congreso Mundial de Arqueología Barquisimeto, Venezuela (unpublished).

Meggers, B. 1987. The early history of man in Amazonia. In *Biogeography and Quaternary History in Tropical America* (eds T. C. Whitmore and G. T. Prance). Oxford: Oxford Science Publications, pp. 151–74.

Meggers, B. and Evans, C. 1961. An experimental formulation of horizon styles in the tropical forest area of South America. In *Essays in Precolumbian Art and Archaeology* (ed. S. Lothrop). Cambridge: Harvard University Press, pp. 372–88.

Mora, S., Herrera, L. F., Cavelier, I. and Rodríguez, C. 1991. *Cultivars, Anthropic Soils and Stability. A preliminary report of archaeological research in Araracuara, Colombian Amazonia*. University of Pittsburgh: Latin American Archaeology Reports (2).

Páez, R. 1990. Efecto del litter (capa de hojarasca) y fangos aluviales en el nivel de fertilidad de un suelo disturbado de la Amazonia Colombiana. Bogotá: Universidad de Bogotá Jorge Tadeo Lozano (unpublished).

Reichel, Elizabeth. 1987. Asentamientos prehispánicos en la Amazonia Colombiana. In *Colombia Amazónica*. Bogotá: Universidad Nacional de Colombia, FEN Colombia, pp. 127–56.

Reichel, Elizabeth and Von Hildebrand, M. 1982–1983. Reconocimiento arqueológico del área del bajo río Caquetá y Apaporis, Amazonas. Bogotá: *Noticias Antropológicas*, 76–7: 6–7.

Roosevelt, A. C. 1991. *Moundbuilders of the Amazon. Geophysical Archaeology on Marajo Island, Brazil*. New York: Academic Press.

Smith, N. 1980. Anthrosol and human carrying capacity in Amazonia. *Annals of the Association of American Geographers*, 70(4): 553–66.

Abstract

Herrera, L. F., Cavelier, I., Rodríguez, C. and Mora, S.

The technical transformation of an agricultural system in the Colombian Amazon

The development of new agricultural techniques made possible the intensive use of reduced areas, at the same time maintaining a dynamic equilibrium between environmental degradation and the needs of the inhabitants. This process has been documented for an 800-year period at Araracuara, in the tropical rain forest of the Colombian Amazon. The stability of occupation is examined through the most important changes in anthropic soil formation and cultivated plants.