RANGELANDS AND SMALL RUMINANT PRODUCTION IN CEARÁ STATE, NORTHEASTERN BRAZIL*

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Introduction

Rangelands have been receiving increased attention as a resource for improving world food supplies. Ironically, nowhere does this food production potential need to be exploited more than in developing countries or regions without established principales of range management.

One such region is the tropical semi-arid northeast of Brazil. Comprising about 20% (1,600,00 km^2 or 1,072,000 sq. miles) of the land area of Brazil, nine states make-up the geopolitical region of the northeast. Northeast Brazil's geographical position lies in a transition zone influenced by both northern and southern hemispheric weather patterns, thus contributing greatly to unstable precipitation from year to year (Howell, 1981). Ceará state is one of the nine states which falls within a distinct geoclimatic macroregion termed the "drought polygon" because of the frequency and severity of droughts (Figure 1).

The semi-arid inland region of the northeast is called the sertão, and extends for 1 million km^2 (670,000 sq. miles). Climatically the sertão is characterized by mean annual temperatures from 22 to 28º C (72 to 82 F), with annual minimum and maximum temperatures ranging from 8 to 40 º C (46 to 104 F), respectively (Fundação Instituto Brasileiro de Geografia Estatística,1972). Annual precipitation is highly variable, ranging from 300 to 1000 mm (12 to 39 in.). A four to six month rainy season (December through May) is followed by a six to eight month dry period .

Periodic droughts may extend the dry season to 11 or 12 months (Eiten and Goodland, 1979).

The drought phenomenon in the sertão exerts a tremendous influence on man and vegetation. Severe and frequent droughts are responsible for famine, unemployement, and outward migration of the human population (Aldaz, 1972).

Livestock are economically important in the agriculturally based society of the northeast. There are about 6 million each of goats and sheep. Ninety-two percent of Brazil's goat population is found in the northeast, compared to 30% for sheep. Generally, the sheep and goats are nondescript of mixed breeding. Native hair (woolless) sheep are of Crioula ancestry (Mason,1980), and have a pelage varying from a slick hair coat to a coarse , short-woolled coat. The native SRD (Sem Raça Definida) goats generally exhibit a short hair coat.

The predominate vegetation type of the sertão is the caatinga, which is an indian word meaning "white forest". Native caatinga rangelands are largely deciduous and during the dry season take on a distinctive "bleached bones" coloration. The vegetation is a complex mix of small trees and shrubs with an annual herbaceous understory.

Besides the climatic stress imposed on the caatinga by drought, man's activities over the past two centuries have apparently shaped the present-day caatinga. Over-grazing by livestock in conjunction with slash and burn agricultural practices have caused immense problems in range degradation and soil erosion .

Low livestock production levels and poor condition ranges are generally found throughout the notheast region.

Because of the high degree of variation in climate and physiognomy of the caatinga rangelands, we have generally limited our discussion to the rangelands of northern Ceará state.

Small Ruminant Production

Small ruminants have many desirable characteristics that favor their production in less-developed regions. Economically they can be produced with a low investment in land and labor. Holders of small land areas (i.e.,"poorest of the poor") can own one or more of these animals, which in turn integrate well with cropping or other agricultural enterprises. Because individually each animal is a small animal unit, the risk involved if an animal sickens, dies or is stolen is greatly reduced. Also small ruminants have proven to be especially well adapted to the often poor range conditions in semi-arid or arid climates.

Small ruminant products are used in a variety of ways in the Brazilian northeast. Perhaps the most important is meat production, which augments the protein level of human diets. Many goats and sheep are consumed on the ranches where they are raised. In hot tropical climates where rural refrigeration is often wanting, the small carcasses can be quickly used before spoilage begins. Goats and sheep are typically slaughtered at about 25 kg (55 lbs) liveweight. Native Crioula sheep and SRD goats reach this weight at about 18 months of age under native range conditions. Dressing percentages for native sheep and goats are 40 to 45% of liveweight. In the local marketplace in Ceará, animals sell for about US$1.25 /kg (US$ 0.57/lb.) liveweight. In over-the-counter transactions, undifferentiated cuts of meat sell for about US$2.50/kg (US$1.14 /lb.).

Since hair sheep and goats are overwhelmingly predominate in the northeast, wool production is virtually nonexistent (Brazil, 1981). As far as we know, no figures are available on hair production.

Sheep and goat hides are commercially very important to the northeastern region. In 1976, Brazil exported 11.5 million dollars worth of hides of goats and sheep (CEPA, 1978). Europe (especially Spain and W. Germany) is the principal market for Brazilians hides. In the local marketplace after the animals are slaughtered, the dry, green hides are worth from 20 to 30% of the liveweight price of the animal.

Although milk from sheep and goats is of little commercial importance in the region, Nestor Gutierrez, in a recent economics survey for Winrock International, found that about 20% of the goat producers surveyed in Ceará had at least one milk goat, and that about 1% of the respondents milked sheep (Gutierrez, 1981).

In Ceará over 90% of the livestock owners have cattle, sheep and goats in a mixed cropping system (Gutierrez, 1981). Ranchers generally reserve the best grazing land for cattle. Sheep and cattle graze dry crop resîdues as supplemental feed during the long dry season. Many producers (approximatelly 40% in Gutierrez's survey) prefer to run sheep but not goats. There are two principal reasons: first, there is the need for tighter, more expensive fencing for goats, especially in areas adjacent to cropland. Gutierrez (1981) reported that the producers considered fences the limiting aspect to expanding goat production. Secondly, there

is a greater acceptance by sheep of crop residues and cultivated grass as supplemental feed in the dry months. This preference for running sheep persists in spite of the need to supplement, or at least save for sheep an ungrazed forage reserve for use in the dry season, while goats are often forced to survive the dry seasons with few special management provisions. Goats are looked upon as a form of drought insurance because of their survivability. However, on heavily stocked ranges, even hardy native goats will at times die of starvation before the end of the dry season, if not given additional feed.

Sheep and goat management practices vary greatly in Ceará. Small producers with few animals generally practice little management. Such basic practices as castration and worming are often neglected. High mortality rates (20-35% up to 1 year of age) and low animal offtake (10-25%) are common on ranches of less than 250 hectares (600 acres) (EMBRAPA, 1980).

On ranches of greater than 250 ha, such as characterized by Gutierrez's (1981) survey, improved management practices are followed. Gutierrez (1981) found that collection of the animals at night to avoid predators (human or animal) is common. Even though the type of structure is variable, some form of housing is available to animals on these better managed ranches. Most of the ranchers castrate and deworm animals at least yearly. A majority of ranchers have cultivated pastures as supplemental feed. Some ranches raise spineless cactus (Opuntia fiscus-indica) as supplemental feed. This fodder cactus is reputed to be of high

nutritive value (Braga, 1960), and animal acceptance is generally favorable. Two undesirable management characteristics are prevalent in the sertão region regardless of ranch size. First is a year-long breeding season, and second is a lack of culling from ranch herds.

Water plays an important role in the production systems in this region. Most ranches depend heavily on small, earthen-dam reservoirs, called açudes, to provide stockwater throughout the year. These açudes fill up during the rainy season, then are slowly depleted during the dry season. Usually before the rains begin anew, the water in most açudes resembles a large, dirty mud puddle, and is highly contaminated, yet livestock, and even humans, often have no other alternative drinking water. The potential for transmitting diseases is probably staggering, but is undocumented.

Land Distribution

Two striking characteristics of the agricultural sector in the northeast are the distribution of land, and the ownership of livestock by a landless group of people. Seventy percent of the landholders in the northeast have indivudual holdings of 10 hectares (22 acres) or less, while 1.1% of the landholders have 500 ha (1100 acres) or more. However, those holders of more than 500 ha ocupy over 40% of the agricultural land in the region, while those landholders with less than 10 ha occupy about 5% of the land (Reboucas, et al., 1979).

Reboucas et al.(1979), indicate that the percent of landholders with less than 10 ha has increased from 62% in 1960 to the 1975 level of 70%. One partial explanation is that existing landholdings are divided among surviving children when the "dono da terra" dies, thus family holdings tend to shrink with each passing generation.

In a range management context, one might speculate that holders of small parcels of land are not very important because they probably own few animals and even collectively control only a small part of the range.

However, the skewed distribution of land resources undoubtedly affects decision making about animal and range management, especially at the small holder level. The size of landholding would certainly influence many basic ranch characteristics such as numbers of livestock, proportions of cattle, sheep and goats, availability of capital for range improvements, capacity to withstand extended drought, ability to respond to new research

and technology, etc.

A second important characteristic of the agricultural sector is the ownership of livestock by a landless group of sharecroppers termed moradores. Preliminary results indicate that about 19% of the sheep and goats in Ceará are owned by moradores (Gutierrez, 1981). These sharecroppers are an important labor source on many ranches and share in crop production, while using the owner's rangeland for pasture. In some cases a yearly contract is a signed; in other instances the sole security of the morador rests with the word of the landowner.

It is possible that those people with animals but no deeded land are not significant in a range management sense because most of these herds appear to be very small (i.e. 5 to 10 animals), and are scattered amongst larger flocks (Johnson, 1971). Because of the dispersed nature of the herds, it seems unlikely that these flocks will have much impact in future range management schemes.

Vegetation

Caatinga vegetation has been subjected to numerous manipulations by man since the 17 th century, including slash and burn agriculture, selective wood removal, clearing followed by burning and simply clearing. All of these treatments are superimposed upon grazing by cattle, sheep, goats and ubiquitous grey burros. Clearing and planting by hand-held tools has produced highly localized plant seral communities, which are extremely variable in physiognomy. Despite this variability, the term "caatinga" , as used in the international literature, erroneously conveys the idea of homogeneity, even though caatinga embraces a wide spectrum of different vegetation sub-types which occur in the northeast (Ferri, 1980).

The bulk of the herbaceous strata in the area surveyed is composed of annual forbs. Some of the non-leguminous genera encountered are Hyptis spp., Bainvillea spp., Melanthera spp., Ipomoea spp., Bidens spp., Oxalis spp., Evolvulus spp., Iris spp., Alternanthera spp., and Wissadula spp.. The legumes are well represented by annual and perennial Centrosema spp., Macroptylium spp., Canavalia spp., Arachis spp., Cassia spp., and Phaseolus spp.. The grasses are also primarily annuals and the genera Brachiaria spp., Digitaria spp., Sporobolus spp., Paspalum spp., Panicum spp., Eragrostis spp., Antephora spp., Chloris spp., Echinochloa spp., Setaria spp., Aristida spp., and Dactyloctenium spp. predominate. The ephemeral nature of the herbaceous strata

and a lack of botanical information preclude a more detailed discussion of the herbaceous species.

Although several other woody species occur in the area surveyed, fourteen are considered due to their ubiquity and/or potential economic importance. In approximate order of prevalence these are: Pau branco (Auxema oncocalyx Taub.), Marmeleiro (Croton hemiargereus Muell. Clrg.), Jurema preta (Mimosa acutistipula Hub.), Mofumbo (Combretum leprosum Mart.), Sabiá (Mimosa caesalpinifolia Benth.), Catingueira (Caesalpinia pyramidalis Benth.), Carnaúba (Capernicia cerifera (Arr. Cam.) Mart.), Imburana (Torresea cearensis Fr. All.), Pereiro (Aspidosperma pyrifolium Mert.), Juazeiro (Ziziphus joazeiro Mart.), Jucazeiro (Caesalpinia ferrea Mart.), Canafistula (Cassia excelsa Schrad.), Aroeira (Astronium urundeuva Engl.) and Oiticica (Licania rigida Benth.).

Different combinations and structural arrangements of these species yield the major plant communities found in northern Ceará. These plant assemblages may be associated with topo-edaphic conditions, and, if viewed in broad terms, these plant communities appear to be successionally related. For discussion purposes, the sites in the area studied may be classified as well-drained, poorly-drained, and deep alluvium.

Broadly speaking, the well-drained sites may be subdivided into medium and fine textured soils with relatively high water holding capacity and fertility, and coarse textured soils with low water holding capacity and fertility. These soils range in depth from 130 cm (50 in) to 45 cm (18 in) with 70 cm (28 in)

being a commonly encountered depth. Although significant, depth considerations will be ignored in this paper due to our attempt at generalization, plus the fact that the bulk of the roots from most species are concentrated in the top 50 cm (20 in.) of the profile. It is worth noting that coarse textured soils in this discussion may host a "claypan" below 40 cm (16 in.), and owe their drainage to the local relief. Ph values from 4.5 to 6.5 are found over a broad range of soil textures.

On well-drained sites with medium to fine textured soils, the most stable (i. e. oldest) community is a deciduous forest with a closed canopy between 6 to 8 m (20 to 26 ft.) high, composed primarily of Pau branco (75%) in association with Catingueira and Sabiá. Marmeleiro patches (clones) may occur, and if so, are usually associated with some disturbance. Following clearing and burning, Jurema preta and Mofumbo are primary invaders of the site. The tenacity of this invasion is extremely variable, and depends mainly on the percent kill of the individuals composing the former community, and site characteristics such as soil depth. Usually, enough Pau Branco individuals resprout, and with the aid of fast growing seedlings, reclaim the site within 20 to 40 years. Under this pressure, Jurema preta fails to reproduce and succumbs within 50 years. Often the sequence between the burning and clearing and the reclaiming of the site by Pau branco includes Marmeleiro and Sabiá as intermediate components of the plant community. The high palatability of Sabiá appears to be an important factor controlling its distribution. Rarely is secondary succession

allowed to proceed to the total reclaiming of the site by Pau branco. Usually, within 20 years, the seral community is reclea-red, resulting in the complete domination of the site by Jurema preta. Often a Marmeleiro dominated community replaces Jurema preta within the following 20 years.

On the sites with coarse textured soils, the most stable community found is a deciduous forest with a closed canopy between five and seven meters (16 to 23 ft.) high. Pau branco, although prevalent, shares dominance roles with Sabiá, Catingueira and Imburana. These latter three species often account for more than half of the total plant cover.

Clearing and burning of this community results in a notably higher percent kill of the dominant species than on more fertile sites. Following the abandonment of the field, Jurema preta invades, but its proliferation is limited, allowing Marmeleiro to dominate the site within several years. Repeated clearing and burning of this site leads to severe deterioration, resulting in areas devoid of woody vegetation.

Poorly drained sites result from a claypan or rock within 50 cm (20 in.) of the soil surface, and have low local relief. The bulk of these poorly drained soils have a loamy sand/sandy loam surface texture, with or without cobbles. Poor drainage characteristics yield a highly aggregated plant distribution, which is closely associated with micro-relief. Total plant cover ranges from 10 to 50% due to variable sized plant clumps. The composition of the clumps is highly variable and depends upon

disturbance factors. When relatively undisturbed, these clumps are composed primarily of Pau branco, Sabiá and Catingueira. Following clearing, Marmeleiro becomes the dominant species within the clumps. Mofumbo and Pereiro, although present in significant numbers, usually are not responsible for the overall make-up of the community.

The Carnaúba palms together with large Oiticica trees characterize the alluvium sites. Of limited areal extent, these sites are economically very important, not only due to the plant products (Carnauba wax and Oiticica lubricant oil), but also because of the production potential that exists for irrigated agriculture, where salinity is not a problem.

Caatinga-special aspects

There appears to be no lack of available forage to grazing animals in the native caatinga during the wet season. Preliminary studies indicate that dry weights of 2500 kg/ha (2225 lbs./acre) are typical of herbaceous biomass during the wet season (EPACE, 1978). This super-abundance of forage usually lasts for one or two months after the rains cease, then forage as we typically think of it (i.e., herbaceous growth) begins to decline during May and June. By June most herbaceous growth is dry, and adds little to the total biomass of forage available, yet dry herbaceous standing dead contributes substantially to animal diets in June and July (unpublished data).

Although not usually considered as forage in traditional range measurements, leaf litter from the deciduous forest is a very important diet component of grazing sheep and goats in the dry season. Our preliminary results show that the green foliage of the tree species, measured up to the browsing limit for goats of 1.6 m (5.25 ft.), contributes 300 kg/ha (270 lbs./acre) of forage in May and June. The amount of green foliage available to animals on the trees begins to decline in July as the deciduous trees lose their leaves. An important forage species, Sabiá , begins to lose leaves heavily as the dry season commences, usually in June, while other deciduous trees extend their leaf drop into July and August.

Our measurements indicate that in June, leaf litter makes

up less than 25% of the forage available. However, from July on through the remainer of the dry season (usually until January or February), the leaf litter component of available forage is predominate. We found that in July and August over 1000 kg/ha (890 lbs./acre) of forage available is leaf litter. The palatable leaf litter is gradually consumed as a natural hay by grazing animals. Under heavy stocking with goats and sheep, grazing pressure (and some decomposition, weathering and trampling) reduces the leaf litter in November to about 500 kg/ha (445 lbs./acre). By December and January, relatively small quantities of poor quality forage remain.

Although some caatinga species such as Jucazeiro and Juazeiro are evergreen, much evergreen foliage is rendered unavailable to animals during to dry season because it is out of reach even to browsing goats. During droughts, farmers will lop off the branches to feed to animals. Green tree foliage is at times renewed during the dry season on several tree species with as little as 25 mm (1 in.) of hard rain. Marmeleiro and Catingueira appear to be especially opportunistic in using this moisture; both species displayed a sudden production of new leaves within a week of such a rainstorm. In fact, Catingueira reputedly can leaf out in response to sudden increases in relative humidity (Gomez, 1977). Browsing goats are very adept at using this green foliage while it lasts. One such shower can have a residual affect for several months as the animals benefit from the green foliage, and then from the newly available leaf litter when the leaves are dropped.

Late dry season (November to January) is a tense period of time for livestock producers as they anxiously await the preliminary, erratic rains which signal the approaching wet season. Without supplementation, moderate weight losses (15 to 25% of bodyweight) are normal on native caatinga range during these months. If ephemeral rains do not occur in November or December, severe late season weight losses of 30 to 35% can occur.

Extensive clearing of native caatinga rangeland is widely practiced in Ceará. The primary purpose of clearing is for cultivation, with corn, beans and perennial (5-year) cotton being the principle crops planted. Often clearing is accompanied by burning of the wood slash piled around the stumps. Wood harvested from cleared lands is viewed as a secondary by-product by ranchers. Wood is sold for fence building, and as fuel (wood or charcoal) to local industries such as bakeries, brick factories, and for construction purposes.

Local ranchers have traditionally viewed clearing, with or without burning, as a means to increase livestock carrying capacity of the caatinga. They reason that clearing the tree overstory promotes the growth of the herbaceous understory in the wet season, and therefore provides more animal feed per hectare during the dry season. It is also believed that clearing will result in increased forage quality, as well as quantity. These questions have yet to be critically evaluated.

Presently, clearing native caatinga and planting bufflegrass (Cenchrus ciliaris) is a promoted range improvement practice in

Ceará. Although high yields of plant biomass are produced, the nutritional value or acceptability of bufflegrass to goats in unknown. Our experience leads us to believe that such monocultures will not blend well with the highly selective feeding habits of goats. Such pastures are probably better suited for sheep and cattle grazing.

As range scientists we see several problems with the current axe-wielding philosophy. Clearing native caatinga undoubtedly results in increased short-term forage production. However the annuals and herbaceous perennials contributing to these high yields may fail entirely during consecutive drought years, or those plants with less drought-tolerance may disappear, resulting in a forage decline.

On cleared caatinga nutritional benefits to undernourished goats from ephemeral rains would be greatly reduced. We have noted that, on uncleared native range after a sudden shower, goats elect to browse heavily on fresh, green tree leaves even though the herbaceous understory will germinate within 24 to 36 hours after such a rain. Sheep, on the other hand, select mainly from amongst the herbaceous plants, but also browse some tree leaves, especially Pau branco regrowth, Sabiá and Catingueira (when within reach), and Marmeleiro. Although the quantity of arboreal forage that becomes available after ephemeral rains may be relatively low, such forage often becomes available at critical times in the dry season. In addition, highly nutritious fruits and flowers would not be available at key periods on cleared caatinga. Our

observations indicate that the flowers of Jurema preta, Feijão bravo, and an unknown species of Cipó (_____ _____) are avidly sought after by goats and sheep during different periods in the dry season. The fruits of Juazeiro are also highly palatable to animals in the late dry season (and are sold for human consumption in the local marketplace).

Although native trees and shrubs may offer less total year-round forage than many herbaceous species, complete clearing and burning may favor short-term site productivity at the expense of long-term stability. The importance of leaf and wood decomposition in nutrient recycling in caatinga forests, though not documented, must be of primary importance to ecosystem stability. Since the woody plant material acts as a huge nutrient sink, continual removal of the trees may produce a decline in long-term productivity as these nutrients are drained off without replacement.

Another interrelated and serious problem we see is soil erosion on cleared and burned caatinga. When such pastures are grazed (and even when deferred from grazing), the ground cover during the dry season is sparce. We suspect that on cleared lands, the reduced ground cover will increase soil losses due to wind and rain erosion. Extremely intense rainstorms are very common at the beginning of the rainy season when cleared caatinga has very little protective ground cover. The uncleared caatinga forest canopy appears to offer protection and soil-building potential due to accumulated leaf litter, and subsequent nutrient redistribution after leaf decomposition.

Research towards solutions

Small ruminants such as sheep and goats play an especially critical role in the food production in developing areas such as northeast Brazil.

The value of goats and sheep as a renewable food resource is generally recognized; however, research efforts aimed at maximizing productivity among low-income producers have been limited (Devendra, 1974; 1981). While the broad constraints on sheep and goat production systems in many developing areas are known, specific solutions will come only from years of research. Recognizing this research need, the U.S. Congress in 1975 created the Small Ruminant Collaborative Research Support Program (SR-CRSP), under the auspices of Title XII, the International Development and Food Assistance Act. The SR-CRSP has a general mandate to conduct research and training overseas. The SR-CRSP program in Brazil is a multidisciplinary effort directed towards production of sheep and goats by small landholders.

Objectives of the range research presently being conducted in Brazil are fourfold: 1) on a seasonal basis determine the botanical and chemical composition, and intake, of grazing animals diets, 2) determine the annual forage supply and decomposition cycle 3) relate plant-soil parameters that define different range sites, and 4) determine effective brush control and manipulation strategies.

Range research in the northeast is coordinated with EMBRAPA,

the Brazilian federal research agency. SR-CRSP activities are centered at the National Sheep and Goat Research Center, in Sobral, Ceará. Range researchers realize that a number of years will be required to fulfill the program objectives. It is expected that a transfer of research results to the producer level will be carried out by extension services and public education. In the long-run, acceptance and use of future range management recommendations by livestock producers and other users of rangelands will be the major measure of the success of present range research efforts in northeast Brazil.

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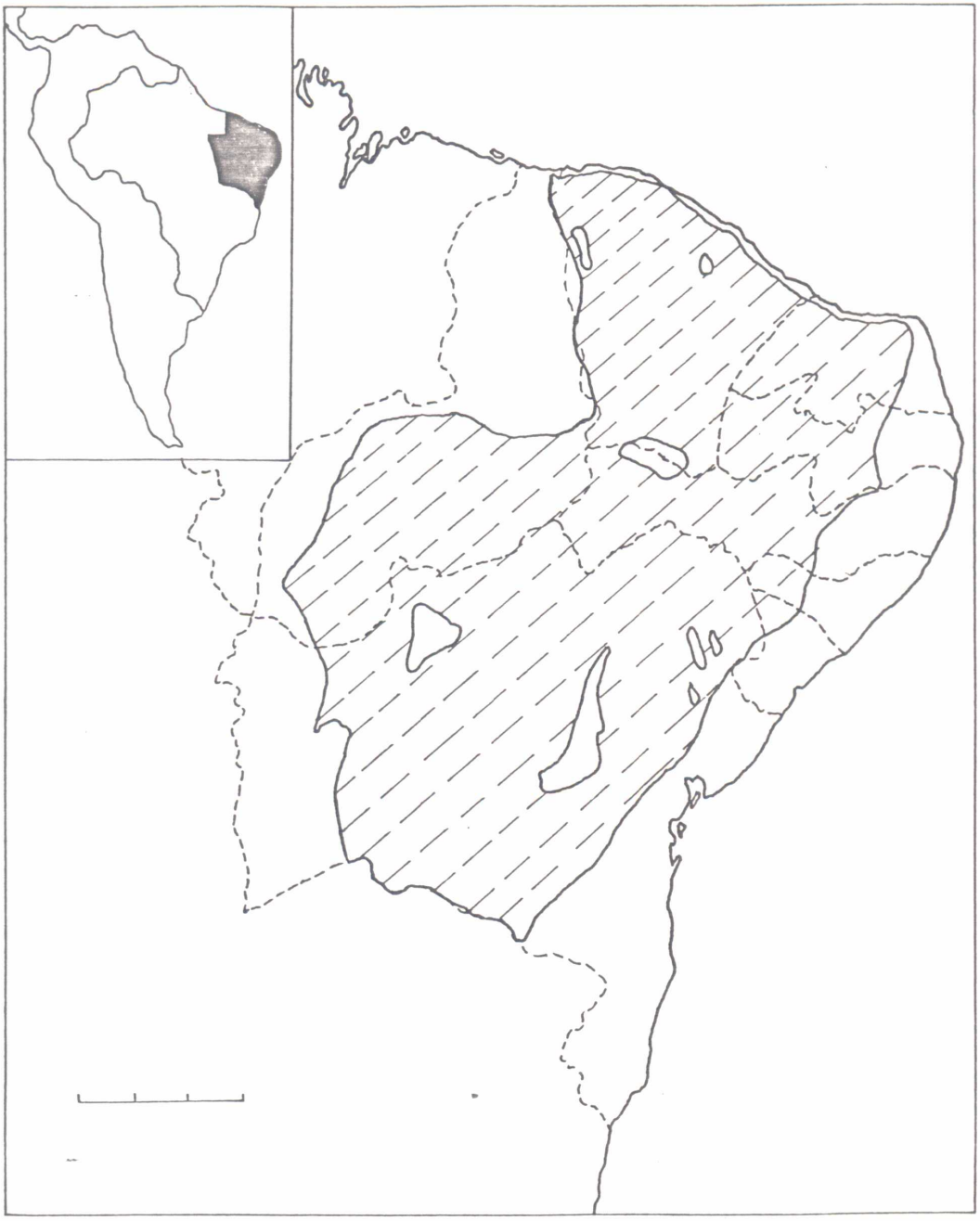

fig 1 Caatinga vegetation in NE Brazil

Errata

Gutierrez, N., 1981. should be et.al.

Rebouças et al., 1979. should be Rebouças (1979)

Note:

Aldaz, 1972. João took this book with him so need to get the exact reference from him.

Mason, 1980. I don't have this complete reference.

Roxane is preparing a map but it isn't ready yet(will be figure 1).