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Use and knowledge of fuelwood in an area of Caatinga vegetation in NE Brazil

Marcelo Alves Ramos[a], Patrícia Muniz de Medeiros[a], Alyson Luiz Santos de Almeida[a], Ana Lícia Patriota Feliciano[b], Ulysses Paulino de Albuquerque[a,*]

[a]Laboratório de Etnobotânica Aplicada, Departamento de Biologia, Área de Botânica, Universidade Federal Rural de Pernambuco, Av. Dom Manoel de Medeiros s/n, Dois Irmãos, CEP: 52171-900, Recife, Pernambuco, Brazil
[b]Departamento de Ciência Florestal, Área de Silvicultura, Universidade Federal Rural de Pernambuco, Av. Dom Manoel de Medeiros s/n, Dois Irmãos, CEP: 52171-900, Recife, Pernambuco, Brazil

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ABSTRACT

Caatinga (dryland) plants used as fuel by rural communities were examined to verify the criteria that determined the preference and use of each species, as well as the techniques and patterns involved in their harvesting. Fieldwork was carried out utilizing various methodologies for collecting and analyzing data, including semi-structured interviews, guided-tours, and direct observation. Differences in knowledge concerning the use of fuelwood species were examined in terms of informant sex and age, and local availability of these resources. A total of 67 plants were cited as energy sources, of which only 27 were actually used as domestic fuel, and 10 for charcoal production. The species most well known were the most collected, independent of their availability, in spite of the fact that other highly preferred species were more available. As only a small group of plants were heavily used, it will be important to quantify the harvesting of these resources in the region in order to estimate the impact of this use on the local vegetation.

1. Introduction

Fuelwood is used as an energy source by most of the world's population on a daily basis, especially in rural areas in developing countries [1,2]. It is estimated that two out of every six people use wood as their principal energy source, making this one of the world's most important resources [1,3]. While there is an overwhelming necessity to harvest firewood, these often scarce plant resources are being subjected to levels of demand above their replacement rate, with the result that fuel gathering is one of the principal activities contributing to the decline of forest cover on a global basis [1,3].

In addition to the environmental implications of fuelwood harvesting, the high demand for biofuels as sources of energy (as wood or charcoal) has direct social implications. These biofuels are not only vital resources for cooking in rural communities throughout the world but also similarly support other activities and processes such as drying, fermentation, and energy production [1,4,5]. The Food and Agriculture Organization (FAO) of the United Nations is very aware of the social consequences generated by the scarcity of fuelwood in some severely affected countries, forcing those populations to scavenge for kilometers in order to collect the minimum of fuel necessary for their subsistence needs.

Ethnobotanical studies undertaken in many parts of the world have made important contributions to addressing these problems, gathering and discussing information about the use of biofuels by local and traditional populations [6,7]. These reports have demonstrated that people use a wide

*Corresponding author. Tel.: +55 81 3320 6350; fax: +55 81 3320 6360.
E-mail address: upa@db.ufrpe.br (U.P. Albuquerque).
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spectrum of species for fuel purposes, but that some plant groups suffer greater harvesting pressure than others [8,9].

In light of the lack of research concerning the use of native Brazilian plants as energy sources (especially in the *caatinga* biome), the present study sought to investigate the knowledge, use, and preferences for woody species used as fuel by rural communities, and to examine the local strategies for the selection, collection, and management of these species. A number of specific questions were addressed in this study: are there differences among community members in their use, knowledge, and preference for specific plant energy sources? Does the person's age or sex influence their relationship with these resources? What are the local criteria that determine the use of each species? Does availability affect the use of woody plants for fuel?

2. Materials and methods

2.1. Study area

The municipality of Caruaru, located in the Pernambuco State, northeastern Brazil, at the approximate geographic coordinates 8°14′19″S and 35°55′17″W [10], covers an area of approximately 926.1 km^2 and has a population of 253,634 [11]. The regional vegetation is known as *caatinga*, which takes on a dry forest physiognomy in the study area, with a hot semi-arid climate, altitude of approximately 550 m, and an average annual temperature of 24 °C. The average annual rainfall is 609 mm, but can vary greatly from year to year.

Approximately 36,227 inhabitants of the municipality live in rural areas, composing of 13 districts. The Riachão de Malhada de Pedra community (belonging to the District of Gonçalves Ferreira), located approximately 12 km from the major city of Caruaru, was chosen as the study site. The community has about 123 residences and a total of 493 inhabitants [12], is located near a fragment of hypoxerophytic arboreal *caatinga*. The principal local economic activity is subsistence agriculture, with some families raising cattle, goats, or pigs to supplement their income [13]. Other ethnobotanical studies have been undertaken in the area and can be referred to for more detailed information concerning the physical and cultural aspects of the study locality [14–16].

2.2. Ethnobotanical inventory

Visits were made to all of the inhabited residences whose owners consented to participate in the research (102 residences). Information was obtained using semi-structured interviews during the period between 10–2005 and 5–2006 [17]. Interviews were made with the household-head who was present at the time of the visit, regardless of their sex or age, where 50 were women between the ages of 20 and 85, and 52 were men between the ages of 21 and 82. Fieldwork was divided into two phases: in the first, all of the informants (102) were presented with questions of a socio-economic nature (age, number of people living in the household, occupation). They were also asked questions at this time related to their knowledge of the regional plants used for fuelwood and charcoal, the types of fuel used in the residence, the best species that could be used as fuelwood and their qualities, and the preferred time of the year for collecting these species. We distinguished the plants cited as known of those cited as actively used as fuel.

The second phase was initiated using 33 residences selected on the basis of the observed use of fuelwood in those households. Additional questions were presented, such as: what species are used as firewood, where are the collections made and who does the collecting, which plant parts are collected, and which species are preferred and why? The firewood stocks present in the residences surveyed in the second phase were also noted.

The technique of "guided tours" [17] was used, consisting of field visits in the company of an informant in order to examine the species cited in the interviews. This technique also aided in the collection of botanical material for later identification. The species cited by the informants were collected and later stored in the Professor Vasconcelos Sobrinho Herbarium (PEUFR) of the Federal Rural University of Pernambuco.

2.3. Data analysis

The Kruskal–Wallis test [18] was used to determine if significant differences existed between the men and women interviewed in terms of their knowledge and use of fuelwood. Differences between the number of species known and used were analyzed using the Wilcoxon Test [18]. The Spearman Correlation [18] was employed to determine: if the preferred species were also the most used; the relationship between the ages of the informants and the numbers of species known and used by them; if the most preferred species were assigned more quality attributes, and; if the informants who knew more plants also used a wider variety. The Spearman Correlation was employed to examine whether availability (measured as absolute density) was related with the use or preference of the species. The density of the species encountered in the *caatinga* vegetation fragment adjacent to the community as based in data from Lucena et al. [13].

In order to calculate the frequencies of plants cited as known, used, or preferred within the categories of fuelwood and charcoal, the total number of informants that knew–used–preferred a given species was divided by the total number of informants interviewed.

3. Results

3.1. Origin of the fuels used in the community

Half (50%) of the residents interviewed cooked only with liquid petroleum gas (LPG), having adopted it earlier in place of forest-derived fuels (at the time of the interview). The other half used biofuels extracted from forests to supply their energy needs for cooking (firewood or charcoal). Only 5% of these fuelwood-using residents fully depended on these fuels as their only combustion source while the other 45% also used LPG.

Approximately 33% of the homes visited were using firewood for cooking purposes while the interviews were taking place. The use of firewood is very often associated with the use of other fuels, principally charcoal and LPG, constituting a system of alternating uses of energy sources.

It was found that 37% of the residences depended on charcoal for cooking purposes, whether associated with another fuel source or not. Importantly, 75% of the charcoal used in these residences was purchased from outside sources. Only eight people interviewed actually produced their own charcoal. There are two shops in the community that sell charcoal to supply local demands. This material is normally acquired from other localities in Pernambuco, or from Paraíba State, and apparently does not generate any impact on the local vegetation.

3.2. *Knowledge of the plants used as fuelwood*

A total of 67 plants were cited by their common names as being known to be used as fuelwood (of which 57 species were identified—Table 1), these being distributed among 48 genera and 21 families. The most species-rich families were Mimosaceae (12 species), Euphorbiaceae (10), Anacardiaceae (6) and Caesalpiniaceae (5). The genera with the greatest number of species were *Acacia* (4 species) and *Croton* (4).

Of the 67 plants cited as fuelwoods, only six were frequently cited: *Anadenanthera colubrina* (Vell.) Brenan. var. *cebil* (Griseb.) Reis (cited by 92.78% of those interviewed), *Acacia piauhiensis* Benth. (76.29%), *Croton blanchetianus* Baill. (73.2%), *Caesalpinia pyramidalis* Tul. (71.13%), *Piptadenia stipulacea* (Benth.) Ducke (68.04%), and *Schinopsis brasiliensis* Engl. (68.04%) (Table 1). All of these species are native to the region. The fact that 79% of the plants used as fuelwood were cited by only a few informants demonstrates that knowledge about most of these species is restricted to a very small group within the community.

The informants identified a total of 40 plants that could be used for producing charcoal (Table 1). Only three species were well known: *A. colubrina* (92.39% of those interviewed), *S. brasiliensis* (76.09%), and *C. pyramidalis* (60.87%); these same plants were also frequently cited in the firewood category.

3.3. *Use of plants as fuelwoods in the community*

Only 27 species were cited as being used as fuelwoods in the community, although 67 were known. Of this total, only six appeared to play important roles as biofuels, being cited by a majority of the interviewees: *A. piauhiensis* (69.70% of those interviewed), *A. colubrina* (57.58%), *P. stipulacea* (54.55%), *C. blanchetianus* (51.52%), *C. pyramidalis* (42.42%), and *Croton rhamnifolius* (42.42%) (Table 1). A majority of the species used are native to the region, principally those with the highest use-frequencies. The exotic species that demonstrated the greatest level of use in the area was *Prosopis juliflora* (12%).

Ten species were cited as being used to produce charcoal (Table 1), of a total of 40 known plants. The species cited with the greatest frequency were: *A. colubrina* (88.89% of those interviewed), *S. brasiliensis* (66.67%), *Ziziphus joazeiro* (44.44%), and *C. pyramidalis* (33.33%). Of the plants known to be used for producing charcoal, only *P. juliflora* (11.11%) was not native to the region.

There were significant differences in the frequencies of plants known to the informants and those actually used by them as fuelwood ($Z = -4.71$; $p < 0.0001$), indicating that they knew of more plants than they actually used. On the other hand, there was no relationship found between the number of species known by an informant and the number of species that he/she used ($rs = 0.27$; $p > 0.05$), indicating that knowledge about a greater number of plants does not result in the use of a greater diversity of species.

3.4. *Knowledge and use in relation to sex and age*

Men possessed a greater knowledge of the plants cited for use as fuelwood ($H = 23.28$; $p < 0.0001$) and charcoal ($H = 12.64$; $p < 0.001$) than did women. However, this relationship did not extend to effective use ($H = 2.65$; $p > 0.05$). Family structure may help explain this result, as the men know these plants from collecting, while women would be familiar with them because they are used with great frequency in the kitchen. There was a significant statistical relationship between the age of the informant and the number of species known as firewood ($rs = 0.58$; $p < 0.0001$) and charcoal ($rs = 0.57$; $p < 0.0001$), in the sense that older people tended to know a greater number of species. However, this same relationship was not observed when considering the species actually used ($rs = 0.22$; $p > 0.05$).

3.5. *Preferences for fuelwood*

Fourteen species were mentioned as preferred for fuelwood and 11 for production of charcoal (Table 1). *A. colubrina*, *C. pyramidalis*, and *S. brasiliensis* stood out in both categories, while *C. blanchetianus* was only mentioned as being preferred as firewood (Table 1). The informants explained their preferences for these species as being based on their combustion properties, as these plants were described as forming hot, strong coals and lasting flames.

The preference for any plant was highly related with the number of attributes assigned to it by the informants ($rs = 0.87$; $p < 0.0001$). If we can measure the preference for a species as a function of the number of attributes assigned to them, could we expect that these same criteria would be used to select the plants actually used? Analyses revealed that there was, in fact, a high correlation between the number of times a species was cited as preferred and the frequency with which it was used ($rs = 0.7361$; $p < 0.0001$). It thus appears that, in the community studied, the use of a plant is related to its perceived qualities.

Reinforcing this result, the relationship between the availability of a species in the forest fragment near the community and its number of use-citations was not found to be significant ($p > 0.05$), indicating that the species that have the greatest density in the forest are not the most used. Thus, in spite of being presented with highly available options, it is the preference of the harvester that acts as the selection criterion for the plants effectively used as biofuels.

Table 1 – Ethnobotanical survey of the plants used as fuelwoods by the Riachão de Malhada de Pedra community, Caruaru, Pernambuco State, Brazil

Family	Frequencies					
Scientific name, local name	Knowledge		Use		Preference	
	F	C	F	C	F	C
Anacardiaceae						
Anacardium ocidentale L., Caju	29.9	6.52	18.18	–	–	–
Mangifera indica L., Mangueira	4.12	1.09	–	–	–	–
Myracrodruon urundeuva Allemão, Aroeira	21.65	20.65	9.09	11.11	4.60	4.65
Schinopsis brasiliensis Engl., Baraúna	68.04	76.09	21.21	66.67	14.94	31.40
Spondias mombin L., Cajá	1.03	–	–	–	–	–
Spondias tuberosa Arr. Cam., Umbu	2.06	–	–	–	–	–
Annonaceae						
Annona squamosa L., Pinha	1.03	–	–	–	–	–
Apocynaceae						
Aspidosperma pyrifolium Mart., Pereiro	2.06	1.09	–	–	–	–
Bignoniaceae						
Tabebuia aurea (Silva Manso) Benth. and Hook. f. ex S. Moore, Pau d'arco	3.09	5.43	–	–	–	–
Boraginaceae						
Cordia alliodora Cham., Frei-Jorge	4.12	1.09	3.03	–	–	–
Cordia globosa (Jacq.) Humb., Bompl. and Kunth, Maria-Preta	5.15	2.17	–	–	–	–
Burseraceae						
Commiphora leptophloeos (Mart.) J. B. Gillet, Imburana	4.12	4.35	3.03	–	–	–
Cactaceae						
Pilosocereus pachycladus F. Ritter, Facheiro	2.06	–	–	–	–	–
Caesalpiniaceae						
Bauhinia cheilantha (Bong.) Steud., Mororó	15.46	14.13	3.03	–	2.30	2.33
Caesalpinia ferrea Mart. ex Tul., Jucá	2.06	3.26	–	11.11	–	
Caesalpinia pyramidalis Tul., Catingueira	71.13	60.87	42.42	33.33	52.87	34.88
Hymenaea courbaril L., Jatobá	1.03	1.09	–	–	–	–
Senna martiana (Benth.) H.S. Irwin, Canafístula	2.06	1.09	–	–	–	–
Capparaceae						
Capparis hastata L., Feijão-de-boi	1.03	1.09	–	–	–	–
Crataeva tapia L., Trapiá	3.09	1.09	–	–	–	–
Cecropiaceae						
Cecropia sp., Embaúba	1.03	–	–	–	–	–
Euphorbiaceae						
Croton argirophylloides Muell Arg., Sacatinga	5.15	1.09	–	–	–	–
Croton argyroglossum Baill., Velame-branco	5.15	–	–	–	–	–
Croton blanchetianus Baill., Marmeleiro	73.2	22.83	51.52	11.11	21.84	2.33
Croton rhamnifolius Kunth., Velame	28.87	3.26	42.42	–	1.15	–
Euphorbia tirucalli L., Avelós	15.46	1.09	6.06	–	–	–
Jatropha mollissima (Pohl) Baill., Pinhão	2.06	1.09	3.03	–	–	–
Manihot cf. dichotoma Ule., Maniçoba	4.12	–	3.03	–	–	–
Ricinus communis L., Carrapateira	1.03	–	–	–	–	–
Sapium lanceolatum (Müll. Arg.) Huber, Burra-leiteira	1.03	–	–	–	–	–
Sebastiana jacobinensis (Mull. Arg.) Mull. Arg., Leiteiro	1.03	1.09	–	–	–	–
Fabaceae						
Amburana cearensis (Fr. Allemão) A. C. Smith, Imburana-de-cheiro	1.03	–	–	–	–	–
Erythrina velutina Willd., Mulungu	5.15	1.09	–	–	–	–
Lonchocarpus sp., Rabo-de-cavalo	1.03	2.17	–	–	–	–
Malphigiaceae						
Malphigiaceae 1, Rama-branca	2.06	–	–	–	–	–
Byrsonima sericea DC., Murici	1.03	–	–	–	1.15	–

Table 1 (*continued*)

Family Scientific name, local name	Frequencies					
	Knowledge		Use		Preference	
	F	C	F	C	F	C
Mimosaceae						
Acacia farnesiana (L.) Willd., Jurema-branca	10.31	8.70	3.03	–	–	–
Acacia paniculata Willd., Unha-de-gato	8.25	3.26	–	–	–	–
Acacia piauhiensis Benth., Calumbi-branco	76.29	14.13	69.70	–	13.79	–
Acacia sp., Rapadura	2.06	2.17	–	–	–	–
Albizia polycephala (Benth) Kilip, Comundongo	4.12	2.17	–	–	–	–
Anadenanthera colubrina (Vell.) Brenan. var. *cebil* (Griseb.) Reis, Angico	92.78	92.39	57.58	88.89	47.13	61.63
Leucaena leucocephala (Lam.) De Wit., Lucena	1.03	–	–	–	–	–
Mimosa tenuiflora (Willd.) Poir, Jurema-preta	19.59	19.57	9.09	22.22	2.15	8.14
Parapiptadenia sp., Miguel Correia	4.12	4.35	3.03	–	–	
Piptadenia stipulacea (Benth.) Ducke, Camumbi-preto	68.04	9.78	54.55	–	10.34	
Prosopis juliflora (SW.) DC., Algaroba	23.71	26.09	12.12	11.11	4.60	8.14
Mimosaceae 1, Tambor	1.03	–	3.03	–	1.15	–
Moraceae						
Ficus sp., Benjamin	1.03	–	–	–	–	–
Myrtaceae						
Eucalyptus sp., Eucalipto	4.12	2.17	3.03	–	–	–
Myrciaria sp., Jaboticabeira	4.12	2.17	–	–	–	–
Nyctaginaceae						
Bougainvillea spectabilis Willd., Arvoredo	1.03	–	3.03	–	–	–
Guapira laxa (Netto) Furlan, Piranha	2.06	1.09	–	–	–	–
Rhamnaceae						
Ziziphus joazeiro Mart., Juá	12.37	22.83	–	44.44	1.15	3.49
Sapindaceae						
Talisia esculenta (St. Hill.) Radlk, Pitomba	6.19	4.35	3.03	–	–	1.16
Solanaceae						
Capsicum parvifolium Sendtm., Pimentinha	5.15	2.17	–	–	–	–
Solanum paniculatum L., Jurubeba	1.03	–	3.03	–	–	–
Verbenaceae						
Lantana camara L., Chumbinho	1.03	–	–	–	–	–
Lippia sp., Camarazinha	3.09	–	3.03	–	–	–

F = firewood, C = charcoal.

3.6. *Patterns of collection and consumption*

A majority of the informants indicated that fuelwood is preferentially harvested in the summer (95%), indicating that there is a period during the year when the extraction of fuelwood is more intense. The principal motive for this seasonal pattern, according to the informants, is that it is easier to enter and move about the forest during the dry season.

Approximately 63% of the informants indicated that they collected biofuels only in anthropogenic zones (agricultural fields, their own properties or those of neighbors, home-gardens) while 14% indicated that they collected only in the forest fragment adjacent to the community. There were also those who indicated that they collected both in the forest and in the anthropogenic zones (11%), and those who used these two sources but also took old fence posts (12%).

Collecting fuelwood for residential use is one of the principal responsibilities of the male head of the household in Riachão de Malhada de Pedra. In terms of the plant parts harvested, there appeared to be lack of preference for dry branches as opposed to trunks, these having 27 and 28 citations, respectively. Only slightly less preference was shown for collecting green wood: those who harvest fuel-woods in this manner cut the branches (16 citations) or the trunks of living trees (17). The type of wood (dry or green) harvested is related to the type of stove used in the residences: there are certain types of homemade stoves that use only dry wood, while others (known locally as "green-wood stoves") function efficiently with still humid wood.

4. Discussion

4.1. *Origin of the fuels used in the community*

Rural communities in many parts of the world commonly use associations of biofuels with non-forest energy sources [5,19].

The criteria determining the use of one energy source are strongly linked to the economic status of the families. The high costs of commercial non-forest energy often oblige poor populations to resort to biofuels of forest origin (such as firewood or charcoal) as these can be acquired through their own labor, or at least at more accessible prices [6,20]. Other decisive factors in this choice are related to regional cultural questions, the climate and the availability of any other energy sources [5]. However, it is certainly the economic situation of the families that appears to have the greatest influence on the use of fuelwood in households throughout the world [21,22]. The ample use of LPG, followed by forest sources such as charcoal and fuelwood, was observed by in rural areas of Pernambuco State located near urban centers [20], just as in the community at Riachão de Malhada de Pedra.

4.2. *Knowledge, use, and preference of fuelwoods*

The diversity of plants known to be used as biofuels in the region of Riachão de Malhada de Pedra was very high (67 species). While studying the same community, Lucena et al. [13] recorded only 28 species. Other published surveys undertaken in other regions of Brazil have noted substantially lower diversity of biofuel species than were encountered here [23–26]. However, a majority of these studies focused on the knowledge of the informants in relation to a relatively large number of use-categories, and did not concentrate on specific uses.

The community examined used only a small fraction fuelwood species. Tacher et al. [27] proposed that the use of a large number of species implies a better ecological use of those resources, functioning as a conservation strategy and reducing risks to specific plant groups. However, the use-citations of the Riachão de Malhada de Pedra community did not accompany the known diversity of species there.

The species with the highest use-citation frequency were also the most known, in agreement with the observations of Abbot and Lowore [28] who reported that a majority of the most popularly plants were also the most used. Although the most important species (*A. colubrina*, *A. piauhiensis*, *C. blanchetianus*, *C. pyramidalis*, *P. stipulacea*, and *S. brasiliensis*) were found to be abundant in the forest fragment near the community [13] they must still be viewed as the most vulnerable, for they are the principal targets for systematic exploitation, as biofuels and for other wood uses [13,14,16,23,24].

In their study of knowledge and use of plants in a humid forest in the Amazon region of Bolivia, Reyes-Garcia et al. [29] observed that the knowledge of a large number of plants by the informants in one of the villages studied was related to the large diversity of species used in their homes. However, this type of relationship is not always observed, as in the Riachão de Malhada de Pedra community examined here where knowledge of fuelwood species was not equivalent to the diversity of species actually used. The factors that influence the actual selection of a species are usually related to quality, availability, and access [8]. Abbot and Lowore [28], for example, have reported the tendency of informants to use the most high-quality species, although Samant et al. [8] observed that in Kumaun, India, the diversity of uses of a species was strongly influenced by its local availability.

The criteria that seem to explain the selection of the plants used in the community examined here were not related to the availability of the plants, but rather to preferences related principally to the qualitative attributes attributed to them. In some regions of Kenya, the domestic use of forest species is also related to preferences, with other species being harvested only in the absence of those more preferred [30]. Communities that demonstrate this type of behavior usually tend to drive the favored groups of plants to local exhaustion [28,31].

Men generally have a more extensive knowledge of fuelwood plants than women, probably due to the fact that the men normally perform the harvesting in the forest. Matavele and Habib [32] observed that it is also common for men to have a greater knowledge of the plants used to furnish other wood products. Women are generally found to have a greater knowledge of the use of medicinal plants [33].

It has been seen in this study that personal, cultural, and socio-economic factors exercise a significant influence on people's knowledge of natural resources, especially in terms of the sex and the age of the informants [32,34,35]. However, the fact that older people know of more plants (which is to be expected) does not necessarily mean that this knowledge is being passed on to other generations. This chain of knowledge can be interrupted by many factors, such as the cultural oscillations caused by access to other more modern means of communication, or the increase in the degree of urbanization and/or modernization [36,37]. Interestingly, the age of the informants was not related to the number of species used, reinforcing the idea that use is strongly concentrated on the most preferred species.

4.3. *Patterns of collecting and use*

Fuelwood collecting is principally undertaken during the dry months of the year in the region studied. McCrary et al. [38] demonstrated that communities in Nicaragua, like Riachão de Malhada de Pedra, preferred to collect firewood in the summer due to the greater ease of access to that resource. The reason for this preference is quite obvious in the *caatinga*, for the plants there loose practically all of their leaves in the dry season, greatly facilitating vision and movement in the forest interior [39].

Forest areas are the principal sites throughout the world for collecting plants for fuelwood and charcoal use [1]. In Cambodia, forests supply more than 50% of the local needs for fuelwood, non-forest areas are only the most important biofuel collection sites in regions with few forest areas [2]. Similar behavior was observed in Pakistan, where the Ayubia National Park was cited as the principal source of fuelwood [40].

The apparent widespread harvesting in anthropogenic zones near Riachão de Malhada de Pedra may actually be the result of the reluctance of these collectors to reveal the true source of their fuelwoods. Florentino et al. [14] examined the homegardens of this community and determined that only 52% of the species utilized were actually available in these private lots, and then only at low frequencies; and the most abundant species were less frequently used as biofuels. This author makes reference to three species cultivated in homegardens purely for fuelwood (*Acacia paniculata, A. piauhiensis* and *P. stipulacea*), but only the latter two were indicated as being used in the present survey. As such, it can be seen that the homegardens, even when considered together with the anthropogenic zones, cannot be the principal collection areas needed to fulfill the biofuel requirements of this community.

Fuelwood collection in Riachão de Malhada de Pedra is quite different from the harvesting encountered in other parts of the world, especially in Africa, where it is principally a women's chore [7,28,40]. Muneer and Mohamed [41] have stated that this difference is related to a sharp division of labor and responsibilities in these regions, leaving women responsible for almost all the domestic activities, which include collecting fuelwood for cooking.

Although the number of people who indicated that they collected green fuelwood was high, dry wood is much more preferred, and this seems to be a common preference in the entire semi-arid region. In some areas this preference is related to the fact that dry wood is lighter and easier to transport, and may also have to do with the quality of the resource, as dry wood can be more efficiently burned [40,42]. In the semi-arid regions of India, Nagothu [43] observed that 74% of the residents collected dry wood, while only 26% harvested green wood, and there was also a marked preference for collecting dry wood in Malawi, Africa [28].

5. Conclusions

The use of fuelwood in the Riachão de Malhada de Pedra community was quite heterogeneous, and it appears that economic limitations constituted the principal factor determining the use of biofuels derived from forest areas. In spite of the wide use of liquid petroleum gas, a significant portion (50%) of the population depends on biofuels such as charcoal and fuelwood, harvesting almost exclusively native species.

Independent of an informant's age, sex, or knowledge of biofuel resources in the area, the principal criterion for selecting any given wood for fuel use is the collector's personal preference for that plant.

It will be necessary to quantify the extraction of fuelwood from the study area in order to determine if this activity is exerting heavy use-pressure on the local vegetation, especially those species most sought after both for fuel and other wood uses.

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