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Can wood quality justify local preferences for firewood in an area of caatinga (dryland) vegetation?

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, Brasil*

[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, Brasil*

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A B S T R A C T

Studies have been undertaken in many parts of the world to evaluate the qualities of fuelwood, but rarely is this information associated with an examination of the preferences of the local populations. As such, the present study sought to address the question of whether local preferences for fuelwoods can be explained by the physical characteristics of the wood itself. To that end, the residents of 102 domiciles in a rural community in NE Brazil were interviewed and a list was compiled of all the plants used and preferred for domestic use. These woods were subsequently analyzed to determine their density, water content, and Fuel Value Index (FVI). Although a total of 67 species were identified by the residents, only 14 were described as being preferred—due to their great number of desirable attributes for cooking. The density, humidity, and FVI of 38 species used and/or preferred were determined. A significant relationship ($p<0.05$) was noted between plants with the highest FVIs and the most preferred fuelwood plants in the region, indicating that local preference could be explained by the physical properties that were examined.

1. Introduction

Biofuels are still the principal energy source for a large proportion of the world's population, especially in rural areas of developing countries [1,2]. Socioeconomic factors are mainly responsible for this dependence on these natural resources as biofuels are available at low (or even zero) cost; commercial fuels, on the other hand, are often well beyond the acquisitive power of these people [3]. Wood has traditionally been the most important biomass source, being used in the form of either charcoal or firewood by approximately 70% of the population in underdeveloped countries, with an average per capita use estimated at 700 kg per year [4]. In Brazil, fuelwood is still largely used by the poorest members of that society [5]. As native forests are the principal sources of those biofuels, fuelwood harvesting has added to the problems of deforestation in that country [6].

As more authors have sought to evaluate the quality of fuelwood, the Fuel Value Index (FVI) has emerged as an important tool for classifying species according to the physical properties of their woods. The principal parameters used to construct this index include the caloric value of the wood, wood density, production of ashes, and the water content of the branches or trunk wood of each species [7]. Abbot and Lowore [2] indicated that ash production and the caloric values of different woods vary very little and therefore

*Corresponding author. Tel.: +55 81 3320 6350; fax: +55 81 3320 6360.
E-mail address: upa@db.ufrpe.br (U. Albuquerque).

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do not greatly influence the final FVI, such that the index becomes heavily weighted towards the relationship between density ($kg\,m^{-3}$) and water content (%).

Most of the research that has evaluated the physical properties of fuelwood species was undertaken in India and Africa [3,7–9]. However, it is still rare to find publications that associate the physical properties of the fuelwoods with the preferences of the local populations using them [2,9], in spite of the fact that domestic firewood use is known to be intimately linked to the preferences of the people who collect them [10,11].

In light of the paucity of information related to the use of fuelwoods in Brazil (in contrast to the extensive consumption of these resources within the country), we sought to identify the fuelwood species preferred by and used by a rural community located in the northeastern region of that country and to quantify the principal physical factors that influence the quality of that firewood. As such, the principal question that directed this research was: can the physical qualities of the different fuelwoods explain local preferences for them?

2. Materials and methods

2.1. Study area

Research was undertaken in the community of Riachão de Malhada de Pedra, located within the municipality of Caruaru, in the Pernambuco State, Brazil (Northeastern), at the approximate geographic coordinates 8°14′19″S × 35°55′17″W. The regional vegetation is known as *caatinga*, and it takes on a dry forest physiognomy in the study area (altitude approximately 550 m). The climate is hot and semi-arid, with an average annual temperature of 24 °C. Rainfall in the region is usually concentrated within the months of June and July, and the average annual precipitation is 609 mm [12]. The population of the municipality of Caruaru is 253,634, and 36,227 people live in rural areas [13]. In 2003 approximately 1800 m^3 of fuelwood were produced in the municipality, generating approximately US$7000 in revenues [14].

The Riachão de Malhada de Pedra community has approximately 123 households [15], and the principal local economic activity is subsistence agriculture [16]. The community studied is located near a fragment of hypoxerophytic arboreal caatinga covering an area of approximately 20 hectares that is owned and protected by the Empresa Pernambucana de Pesquisa Agropecuária (IPA). The major arboreal components of the forest include the families Mimosaceae, Euphorbiaceae, Cactaceae, Caesalpiniaceae, Capparaceae, and Rubiaceae [17].

2.2. Species selection for analysis

An ethnobotanical survey of the community was undertaken in order to identify the species reported as known for fuelwood, the plants used in the homes, and the plants preferred as firewood (independent of their being used at the time of the interview). It is important to note that the plants selected as the focus of this report are those cited as being preferred.

A complete survey of the plants used in this community was first undertaken in order to select the fuelwood species to be evaluated for their physical properties (see below). The preferred species were identified by direct interviews with each of the household heads. Additionally, the species were classified in regard to the ease with which they can be gathered, being considered either "restricted" or "non-restricted" in their distribution as follows: "restricted" species occurred only in the caatinga forest fragment and were difficult to find there (few individuals); "non-restricted" species occurred in other locations in addition to the forest fragment, and were easy to find in those places. The validity of this classification was based on interviews with informants and confirmed during field excursions in the company of a principal informant.

The first phase of the research was carried out between October 2005 and April 2006, when all of the occupied residences in the community were visited. A total of 102 household heads consented to participate in the interviews (52 men and 50 women). Semi-structured interviews were carried out [18] using standardized socioeconomic questionnaires that also solicited information concerning the types of fuels used in the house and the species of fuelwood known, used, and preferred by them. At a later moment, a second round of interviews was undertaken exclusively with household that actively used fuelwood ($n = 33$). Visits were made in order to evaluate the fuelwood stocks and to check for the presence of woody species that had not been cited in the interviews. Data were supplemented using other investigative ethnobotanical techniques, such as direct observation and walk-in-the-woods [18]. This latter technique entails undertaking field excursions with key informants in order to collect botanical material of the species cited in the interviews or encountered among the fuelwood stocks. The collected material was identified, mounted, and stored in the Professor Vasconcelos Sobrinho Herbarium (PEUFR) of the Federal Rural University of Pernambuco.

The plant species selected for physical analysis were chosen from the list of plants preferred and used as firewood. Within this criterion we had a final list based on the technical necessity of having species with trunk or branch diameters between 1.5 and 3.5 cm for the analysis of the physical properties of the wood.

2.3. Wood analysis

A total of 38 species were selected for analysis of their wood density and water content. The techniques used in the analysis were adapted from Bhatt and Tomar [3]. Initially, 40 cm lengths of wood were selected from four randomly chosen individuals of each species, and sub-divided into four 10 cm long sub-samples (totaling 16 sub-samples per species) that were marked in the field and weighed. The only exception was with *Eugenia* sp., as only one individual of this species was encountered.

In order to determine the water content of the wood samples, their fresh weight was noted and the samples were then placed in a drying oven at 100±5 °C for 48 h before weighing them again. This process was repeated until the sample weights stabilized [19].

Wood density was measured using a technique described by Barbosa and Ferreira [20]. Samples were first immersed in water for 5 days to achieve total saturation, allowed to drain for 5 min, and their diameters were then measured using a vernier caliper. The volume of the wood was then calculated using the formula:

$$\text{volume} = \frac{\pi \times D^2 \times C}{4},$$

where D is the average diameter and C the length of the sample.

The samples were subsequently dried at 100 °C until attaining a constant weight. The basic density of each sample was then calculated according to Amaral et al. [21], using the formula:

$$\text{density} = \frac{\text{DW}}{\text{SV}},$$

where DW is the dry weight (kg) and SV the sample volume (m^3).

Using this information, FVI was calculated according to the formula developed by Abbot and Lowore [2], in which the FVI is equal to the ratio between the density of the wood ($kg\,m^{-3}$) and the water content of the sample (%).

2.4. Data analysis

The frequency of use-preference citations for a species was calculated by dividing the number of informants who preferred that species by the total number of informants interviewed.

The Spearman correlation coefficient [22] was used to test if there was any relationship between the preferences for species and their FVIs, and to evaluate if the preference expressed for a given species was related to the number of attributes assigned to it. Statistical analyses were preformed using the BioEstat 3.0 software program [23].

3. Results and discussion

3.1. Preferred fuelwood species

A total of 67 plant species were cited as being known as fuelwoods by residents of the Riachão de Malhada de Pedra community, but only 14 of these were indicated as being preferred. The preferred species were distributed among 12 genera and 6 families (Table 1): Mimosaceae (6 species), Anacardiaceae (2), Caesalpiniaceae (2), Euphorbiaceae (2), Malpighiaceae (1), and Rhamnaceae (1). Most of the

Table 1 – Species preferred and desirable qualities of fuelwoods, as cited by informants in Riachão de Malhada de Pedra, municipality of Caruaru, Pernambuco State (NE Brazil)

Family / Species	Preference frequency (%)	Growth habit	Attributes								Total
			A	B	C	D	E	F	G	H	
Anacardiaceae											
Myracrodruon urundeuva Allemão	4.60	Tree	x	x		x		x			4
Schinopsis brasiliensis Engl.	14.94	Tree	x	x				x			3
Caesalpiniaceae											
Bauhinia cheilantha (Bong.) Steud.	2.30	Tree		x	x						2
Caesalpinia pyramidalis Tul.	52.87	Tree	x	x	x		x				4
Euphorbiaceae											
Croton blanchetianus Baill.	21.84	Shrub	x	x	x	x	x		x	x	7
Croton rhamnifolius Kunth.	1.15	Subshrub			x						1
Malpighiaceae											
Byrsonima sericea DC.	1.15	Tree		x							1
Mimosaceae											
Acacia piauhiensis Benth.	13.79	Tree	x		x	x					3
Anadenanthera colubrina (Vell.) Brenan. var. *cebil* (Griseb.) Reis	47.13	Tree	x	x		x	x				4
Mimosa tenuiflora (Willd.) Poir	2.15	Tree		x			x				2
not identified	10.34	Tree	x								1
Piptadenia stipulacea (Benth.) Ducke	4.60	Tree	x		x	x					3
Prosopis juliflora (SW.) DC.	1.15	Tree	x	x	x						3
Rhamnaceae											
Ziziphus joazeiro Mart.	1.15	Tree	x	x							2
Total frequency of the attributes			10	10	7	5	4	2	1	1	

A = high caloric value, B = long duration, C = ease of ignition, D = ease of collecting, E = produces little smoke, F = produces little ash, H = produces few sparks, H = produces an agreeable odor when burning.

informants cited a preference for at least one of the following three fuelwood species: *Caesalpinia pyramidalis* Tul., *Anadenanthera colubrina* (Vell.) Brenan. var. *cebil* (Griseb.) Reis, and *Croton blanchetianus* Baill. (Table 1). Some of the genera cited as preferred in the present study were similarly cited in other surveys, such as *Acacia* [2,24] and *Bauhinia* [2]. The species *Schinopsis brasiliensis* Engl. was seen to be reasonably preferred for fuelwood use (14.94%), and had in addition regional importance in terms of other wood uses (due to its durability) [16].

Even though a wide variety of fuelwood species were locally known, the inhabitants in the study area restricted their collecting to a relatively small group of plants. This observation is of some concern from an environmental perspective, for, when preference is the principal factor that drives harvesting [2], "desirable" plants may be driven to local scarcity through intensive use. In some instances, the most highly preferred group of plants may not be used, however, as harvesting can be influenced by external factors such as accessibility or availability, as was observed by Samant et al. [25] in the Himalayas.

The preferred characteristics of a firewood, as expressed by the residents of Riachão de Malhada de Pedra, are listed in Table 1. These users give special emphasis to long-burning woods with high caloric output. These two characteristics are closely associated in the woods examined, and represent firewood with strong coals that burn for prolonged periods of time at high temperatures. Additionally, the ease with which these woods ignite, the ease of harvesting, and the amount of smoke that they produce are all perceived as relevant attributes of a good firewood. The fuel characteristics preferred by the residents of Riachão de Malhada de Pedra are very similar to those reported in studies undertaken in Africa [10,24,26]. Other characteristics, such as the production of few sparks and agreeable odors while burning, are limited only to a single species: *C. blanchetianus*. This species occupied the third position in the use-preference ranking, and was indicated as having the largest number of desirable characteristics (see Table 1).

A significant relationship was observed between the number of attributes assigned by the informants to a given plant and the number of times it was indicated as being preferred ($rs = 0.88$; $p < 0.05$), stressing that the preference for a given species is intimately related to the number of positive characteristics attributed to it.

A direct relationship was observed between the physical properties of the fuelwoods and their locally perceived qualities. For example, wood density is related to both durability [24] and high caloric potential [27], while the water content is an important characteristic in defining the ease of combustion of a fuelwood, the amount of smoke it produces, and its caloric energy [19]. These observations reinforce the importance of associating laboratory analyses with local knowledge.

3.2. Physical properties of the woods

3.2.1. Basic density

The density values obtained for the fuelwood species examined are listed in Table 2. These values are occasionally lower than those previously reported [28,29], but these differences may be attributable to inaccuracies resulting from our use of wood samples with reduced dimensions.

The species with the highest densities were *Lonchocarpus* sp. (806.4 $kg\,m^{-3}$), *Eugenia* sp. (796 $kg\,m^{-3}$), and *Allophylus quercifolius* Radlk. (792.1 $kg\,m^{-3}$) (Table 2). None of these plants were cited as most preferred by the informants, which may be attributable to their limited distribution in the forest fragment adjacent to the community, which would make access to these resources considerably more difficult. Species demonstrating restricted distributions within the forest fragment are listed in Table 2, and none of these plants were cited as being used for fuelwood (with the single exception of *Acacia farnesiana*). These species were, however, encountered among the fuelwood stocks in one or two households, indicating that they are used as firewood by the local residents but are actually little known.

Another related fact is that none of the species with restricted distribution in the forest fragment were cited as preferred by the local inhabitants; and when these plants are excluded from the statistical analysis, all of the 11 plants with the highest wood densities were seen to be included in the group of preferred species.

Some species, such as *Mimosa tenuiflora*, *C. pyramidalis*, *S. brasiliensis*, and *A. colubrina*, were found to have high wood densities in the present study but had been assigned lower density values in earlier works [28–30]. These same three species are widely and frequently used as fuelwoods in northeastern Brazil [28,29,31].

Manihot cf. *dichotoma* (320.9 $kg\,m^{-3}$), *Commiphora leptophloeos* (355.2 $kg\,m^{-3}$), and *Erythrina velutina* (356.3 $kg\,m^{-3}$) demonstrated the lowest wood densities among the species examined (Table 2). Plants with low wood densities do not possess good combustion properties, and are mainly employed in handicrafts [29].

3.2.2. Water content

The water content of the fuelwoods examined varied between 22.7% (*C. blanchetianus*) and 63.5% (*E. velutina*) (Table 2). The three species most highly preferred as fuelwoods (*C. pyramidalis, A. colubrina*, and *C. blanchetianus*) were among the five plants with the lowest water content.

The family Euphorbiaceae gave contrasting results in terms of water content, for *C. blanchetianus* had the lowest water content of all the plants examined, while five other species of this family were among the 10 plants with the highest water content. Other studies have reported similar results, and support the observation that this family generally comprises species with very high water contents [3,24].

3.2.3. Fuel Value Index

The average FVI of the species examined was 17.3 ($\pm$7.2). *C. blanchetianus* (30.9), *A. quercifolius* (29.7), *C. pyramidalis* (26.6), and *A. colubrina* (26) demonstrated the highest FVIs (Table 2), indicating them as the best firewood from a technical point of view. All of these species (with the exception of *A. quercifolius*) were attributed the highest number of positive fuelwood attributes and were therefore considered to be the best firewood species (Table 1) and the most preferred for collecting. Although numerous studies have calculated the

Table 2 – Physical properties and citations of preferences for 38 species used as fuelwood in Riachão de Malhada de Pedra, municipality of Caruaru, Pernambuco State (NE Brazil)

Species	Common name	Family	Category	Density ($kg\,m^{-3}$)	Water content (%)	FVI	FVI rank	Preference rank
Croton blanchetianus Baill.	Marmeleiro	Euphorbiaceae	CP, CU, PS	700.1±41.8	22.7±1.2	30.9±3.2	1°	3°
Allophylus quercifolius Radlk. A[a]	Estralador	Sapindaceae	PS	792.1±50.6	26.8±0.8	29.7±2.7	2°	–
Caesalpinia pyramidalis Tul.	Catingueira	Caesalpiniaceae	CP, CU, PS	726.2±50.0	27.5±2.2	26.6±3.3	3°	1°
Anadenanthera colubrina (Vell.) Brenan var. *cebil* (Griseb.) Reis	Angico	Mimosaceae	CP, CU, PS	723.4±51.3	27.9±0.9	26±2.4	4°	2°
Piptadenia stipulacea (Benth.) Ducke	Calumbi-preto	Mimosaceae	CP, CU, PS	656.1±83.4	25.8±0.7	25.5±3.7	5°	6°
Prosopis juliflora (SW.) DC.	Algaroba	Mimosaceae	CP, PS	762.5±29.5	30.1±1.3	25.4±1.9	6°	7°
Acacia paniculata Willd.	Unha-de-gato	Mimosaceae	PS	652.4±102.0	29.3±3.6	22.9±7.0	7°	–
Bauhinia cheilantha (Bong.) Steud.	Mororó	Caesalpiniaceae	CP, CU, PS	704.3±44.6	30.9±1.8	22.8±1.4	8°	8°
Talisia esculenta (St. Hill.) Radlk	Pitomba	Sapindaceae	CU	603.3±33.9	28.7±9.6	22.8±7.4	9°	–
Eugenia sp.[a]	Batinga	Myrtaceae	PS	796	35	22.8	10°	–
Lonchocarpus sp.[a]	Rabo de cavalo	Fabaceae	PS	806.4±71	35.7±0.8	22.6±2.4	11°	–
Mimosa tenuiflora (Willd.) Poir	Jurema-preta	Mimosaceae	CP, CU, PS	783.7±76.3	36.4±9.6	22.6±6.0	12°	9°
Acacia farnesiana (L.) Willd.[a]	Jurema-branca	Mimosaceae	CU	687.5±39.1	30.7±0.8	22.4±1.6	13°	–
Parapiptadenia sp.[a]	Miguel Correia	Mimosaceae	CU, PS	694.6±50.3	31.2±2.0	22.3±1.9	14°	–
Eugenia uvalha Cambess.[a]	Ubaia	Myrtaceae	PS	705.4±25.8	32.7±1.9	21.6±1.1	15°	–
Schinopsis brasiliensis Engl.	Baraúna	Anacardiaceae	CP, CU, PS	723.9±52.6	34.4±1.1	21.1±2.2	16°	4°
Croton rhamnifolius Kunth.	Velame	Euphorbiaceae	CP, CU, PS	702.3±102.4	34.4±4.2	20.9±5.0	17°	10°
Acacia piauhiensis Benth.	Calumbi-branco	Mimosaceae	CP, CU, PS	624.6±71.2	32.2±4.0	19.8±4.5	18°	5°
Zizyphus joazeiro Mart.	Juá	Rhamnaceae	CP	710.2±93.6	36.8±5.2	19.7±4.3	19°	10°
Myracrodruon urundeuva Allemão	Aroeira	Anacardiaceae	CP, CU, PS	680.3±35.3	39.4±4.7	17.5±2.6	20°	7°
Capparis hastata L.[a]	Feijão-de-boi	Capparaceae	PS	645.6±44.8	38.8±0.9	16.7±1.5	21°	–
Cordia globosa (Jacq.) Humb. Bompl. and Kunth	Maria-preta	Boraginaceae	PS	619.2±31.6	40.4±4.7	15.5±2.3	22°	–
Cordia alliodora Cham.[a]	Frei-Jorge	Boraginaceae	CU, PS	562.6±15.2	39.7±1.7	14.2±0.9	23°	–
Lantana camara L.	Chumbinho	Verbenaceae	PS	527.5±35.7	40.3±3.5	13.2±2.0	24°	–
Solanum paniculatum L.	Jurubeba	Solanaceae	CU	449.9±69.1	36.9±8.2	12.8±4.3	25°	–
Crataeva tapia L.	Trapiá	Capparaceae	PS	545.9±26.4	43.2±3.8	12.7±1.3	26°	–
Eucalyptus sp.	Eucalipto	Myrtaceae	CU	547±56.8	44.6±3.5	12.4±2.1	27°	–
Albizia polycephala (Benth) Kilip[a]	Comondongo	Mimosaceae	PS	500.8±79.6	42.4±3.7	11.8±1.3	28°	–
Cedrela odorata L.[a]	Cedro	Meliaceae	PS	530.8±49.3	48.6±8.0	11.3±2.7	29v	–
Guapira laxa (Netto) Furlan	Piranha	Nyctaginaceae	PS	520±45.6	47.6±3.0	10.9±1.2	30v	–
Anacardium ocidentale L.	Caju	Anacardiaceae	CU, PS	536.3±15.2	53.7±2.2	10±0.2	31°	–
Sapium lanceolatum (Müll. Arg.) Huber	Burra leiteira	Euphorbiaceae	PS	383.4±59.2	52.9±20.3	9.3±5.2	32°	–
Jatropha mollissima (Pohl) Baill.	Pinhão	Euphorbiaceae	CU	509.2±38.7	56.6±2.3	9±1.0	33°	–
Euphorbia tirucalli L.	Avelós	Euphorbiaceae	CU, PS	452.9±79.1	57.8±5.7	8±2.0	34°	–
Euphorbia cotinifolia L.	Crote	Euphorbiaceae	PS	373.4±73.6	61.3±4.7	6.2±1.6	35°	–
Commiphora leptophloeos (Mart.) J. B. Gillet	Emburana	Burseraceae	CU	355.2±60.2	60.3±3.8	6±1.4	36°	–
Erythrina velutina Willd.	Mulungu	Fabaceae	PS	356.3±50.6	63.5±5.7	5.7±1.2	37°	–
Manihot cf. dichotoma Ule.	Maniçoba	Euphorbiaceae	CU	320.9±15.6	59±4.8	5.5±0.6	38°	–

FVI = Fuel Value Index, CP = plants cited as preferred, CU = plants used (cited by the informants), PS = other plants used (present in fuelwood stocks).
[a] Species with distribution restricted to the forest fragment adjacent to the community.

FVI of fuelwood species, few surveys have associated these results with local preferences. Among the few studies that employed this methodology, only Abbot and Lowore [2] likewise determined that the preferred species were also among those with the greatest FVI.

The FVIs of the species in the present study were consistently greater than the indices reported by Abbot and Lowore [2] in their study in a community in Malawi, but lower than those reported by Tabuti et al. [24], who calculated the FVIs of species used in Bulamogi, Uganda. Both of these surveys employed the parameters of density and water content.

Of the 20 species with the largest FVIs in the present study, 12 were considered by the informants to be the best firewoods (Table 2). There was a significant relationship observed between preference citations and the FVIs of the species ($rs = 0.57$; $p<0.05$), where the species with the largest number of citations also demonstrated the highest FVIs. This relationship became even more significant ($rs = 0.77$; $p<0.05$) when the species with the most limited distributions in the forest fragment were removed from consideration (Fig. 1). As such, the physical properties analyzed explain local preferences for fuelwoods in the Riachão de Malhada de Pedra community.

Other plants that demonstrated high FVIs were encountered in fuelwood stocks in some households but were not cited by any informants as being preferred species. Although these species are of high quality, they are only found in very restricted areas in the forest fragment and few people know about them or know where to look for them. Examples of species that have this profile are *A. quercifolius* Radlk., *Eugenia* sp., and *Lonchocarpus* sp.

Of the species analyzed, 30 were native to the caatinga, while eight were exotic. The native species stand out in terms of their high combustion values, and they comprise the group of plants most preferred by and most used by the local community. The exotic species with the highest FVIs ranked in sixth and ninth place (*Prosopis juliflora* and *Talisia esculenta*, respectively) (Table 2). The use of exotic plants is principally related to their easy access, as they are usually found growing in homegardens and are therefore more easily accessible. The quality of the native fuelwood species is normally quite high as they are adapted to the physical and ecological conditions of their natural environment [8].

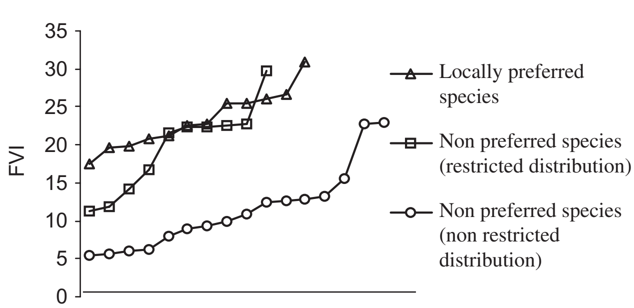

Fig. 1 – Combustion Value Index of species preferred and/or used in a rural community located in the municipality of Caruaru, Pernambuco State (NE Brazil).

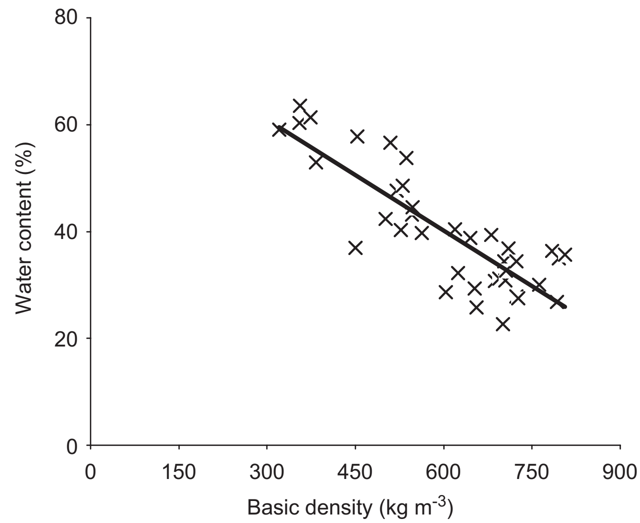

Fig. 2 – Relationship between the physical properties of the wood of species used and/or preferred as fuelwood in a rural community located in the municipality of Caruaru, Pernambuco State (NE Brazil).

M. cf. *dichotoma, E. velutina*, and *C. leptophloeos* stand out as having the lowest FVIs, and their use is probably related only to their easy acquisition, especially in anthropogenic areas near the residences.

When taken together, the physical properties of the plants analyzed here show a significant inverse proportional relationship between high density and low water content ($rs = -0.77$; $p<0.05$) (Fig. 2). When similar analyses are performed using data from other surveys, the results were either not significant [2,9,19], or significant but with correlation coefficients lower than 0.50 [3,5]. This analysis reinforces the observation that caatinga woody species are generally high quality firewoods.

In spite of the fact that density and water content were identified as the most important attributes of good firewoods, local preferences are in part determined by secondary properties not considered in the FVI. According to Abbot and Lowore [2], the sum of these physical properties, as valued by the society itself, determine the fuelwood qualities that are most acceptable to a given community.

4. Conclusions

The Fuel Value Index represents a simple and practical instrument for identifying the highest quality biofuel species. This index contributed to confirming the initial hypothesis presented—that the local preference for fuelwood species in the community can be explained by the physical properties of their wood.

C. blanchetianus, *C. pyramidalis*, and *A. colubrina* var. *cebil* had the highest quality fuelwood and the greatest local preference, and thus were the principal targets for harvesting in the region. As such, political and social initiatives should focus special attention on these species, stimulating the cultivation of these trees in fuelwood plantations and in the homegardens within the community.

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