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The use of firewood for home consumption and the fabrication of hand-crafted ceramics in a semi-arid region of Northeast Brazil

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ABSTRACT

This study aimed to identify, analyze and compare different uses of firewood for home consumption and for handicraft work in rural communities in Altinho, Pernambuco, Brazil. Semi-structured and free-listing interviews were performed to catalog the plants that were better known by locals and that were mostly used as firewood for home consumption and handicraft work. Two *in situ* inventories were performed at the homes of the study location in order document the plants that were actually used. A total of 39 species of woody plants belonging to 16 botanical families were registered. The most widely-known species for both uses were also the species that were most used and preferably-used-as-wood by the population. The plants most preferably-used-as-wood by the participants, which were selected as samples, were also those that the participants identified as having superior quality. Thus, there is a small group of plants that is used for both activities, and thus more vulnerable to extractivism, and which ought to be conserved. Alternative management strategies are needed that secure the availability of these species in the future to meet the needs of the local population and to conserve biodiversity.

Keywords: Caatinga, dry forest, ethnobotany, ethnobiology, ethnoecology, local ecological knowledge

Introduction

In forest ecosystems, woody plants are the most exploited natural resources by human populations (Tabuti *et al*. 2003; Ogunkunle & Odale 2004). Wood is among the many resources that can be extracted from these plants, and it is harvested by individuals with low income and who live in rural areas of developing countries (Francelino *et al*. 2003; Tabuti 2007).

Out of the many materials that can be obtained from wood, firewood and vegetable charcoal are the main. reasons for the extractivism practiced by local populations (Ramos *et al*. 2014). Because such usages require a constant harvest in order to refill stocks (Ramos *et al*. 2015), wood harvesting is considered one of the main causes of environmental impacts and of the decrease in rainforest diversity (Pote *et al*. 2006; Ramos *et al*. 2008a). According to FAO (2011), between 1988 and 2009 the use of wood as energy supply was responsible for over 50 % of the world's total rough production of wood, and Brazil is among the five countries that use it the most for producing fuel (FAO 2011).

Due to the large demand for these resources, discussions about their conservation crop up quite frequently. One of these discussions concern the inclusion of local populations in the decision-making process regarding the management of natural resources, once these people have relevant information about useful plants and about the dynamics of local vegetation (Albuquerque 2006).

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Therefore, knowing the main tendencies of selection and harvesting of wood resources in forests by different human populations is a crucial step towards the implementation of these resources' conservation strategies. A practical example of this is the identification of the most valued and used groups of species by the populations, since these species are potentially the most threatened group (Tabuti *et al*. 2011). Analyzing the relation between preference and availability in firewood selection by local people helps us understand how wood is harvested in natural environments. Such analysis may provide tools to identify the consequences of the extraction of these resources in the forests (Samant *et al*. 2000; Cavalcanti *et al*. 2015).

With that in mind, this study sought to characterize some aspects regarding knowledge, usage and local preferences for woody plants, in a rural context where this resource is used as fuel for two distinct purposes: (1) home consumption: the use of firewood for cooking food, done in ovens that are usually inside people's houses. This activity is considered essential in rural areas, once it plays a crucial role in these populations' nutrition (Ramos *et al*. 2008a); (2) handicraft use: the use of firewood for baking ceramics in ovens outside peoples' houses. Pottery making is considered one of humankind's oldest activities, and it is an important component of the cultural identity of certain rural populations (Arnold 1989).

Pottery making is well spread among rural populations in many countries (Arnold 1989), although some aspects of this practice may differ from one place to the other, depending on the resources available in each region (Cabral *et al*. 2015). Local potters in Altinho produce their clay vessels without using wheels or molds (Cabral *et al*. 2015). Pieces are shaped with the use of a modeling technique, which they may have inherited from Amerindian groups (Alves 2004). According to Arnold (1989), the main resources that are normally used for the production of artisanal pottery are clay, water, and fuel. Out of these materials, the most important one for this study is firewood, which is used to fire the pieces.

That being so, this research sought to characterize the consumption and the practice of harvesting wood for home consumption and for handicraft use, analyzing if there are similar patterns in the selection and harvest of the species. The study was performed so as to answer the following questions: which are the general tendencies of usage and harvesting of wood for home consumption and for handicraft making? How many woody plants do participants know, use the most and preferably use as fuel for home consumption and for handicraft making, and what are the relations between these plant groups? According to the participants, what are the adopted criteria for choosing which species are preferred and to select the ones that will be harvested for actual use? Are there any similarities among the criteria chosen by local participants to elect some species as the preferred ones, in the context of both uses under study? Are there any similarities among the criteria chosen by local participants to select some species to be harvested for effective use, in the context of both uses under study?

Materials and methods

Study area

The municipality of Altinho is located in the state of Pernambuco, Northeast Brazil, at 8°35'13.5"S 36°05'34.6"W. It has a territorial area of 452.523 km^2 and presents a total population of 22.353 inhabitants, with 11.589 residing in the rural zone (IBGE 2010). The region is located in a *caatinga* hypoxerophytic vegetation area with the presence of fragments of native vegetation. The hot semi-arid climate has an average temperature of 26 ºC. Also, it has an annual precipitation ranging between 550 and 800 mm (CPRM 2005). The rainy season is between May and August, while the dry season is normally from September to April.

For the purposes of this study, four contiguous locations (known by locals as "sítios") were chosen: Poços Pretos, Gameleiro, Espinho Branco and Jenipapo.These rural localities are approximately 5 km away from the city's urban center. They were selected due to the presence of people who use firewood for home consumption and of craftspeople who use firewood for making handcrafted pottery. Once they were selected, the 109 homes that are located in the region were visited. Out of these homes, the families that claimed to use firewood for home consumption and/or for pottery making were selected. All the participants who used firewood to cook food also had the habit of using that same resource to fire pottery. But the contrary was not true, since most participants used firewood solely to cook food. The main source of income of the inhabitants of this region is subsistence farming, and beans and corn are the most cultivated species. In the rural localities under study, Catholicism is predominant. When it comes to education levels, most participants have completed up to the fourth grade.

Data collection

All the 109 homes were visited so that the aims of the research were explained to the population and the heads of the families were invited to take part in the study. Out of the 109 households, 46 (42.2 %) were selected, once tenants claimed they used firewood for home consumption. Out of all the four studied locations, 13 families used to manufacture handmade ceramics, but only five of them had ovens to bake the pieces. Out of the sample, six people who were directly in charge of firing the ceramics were interviewed.

In order to collect and register the data, semi-structured interviews (Albuquerque *et al*. 2014) were done between March and September, 2013 so as to interview the people

who were directly responsible for cooking the foods and baking the pottery, regardless their age or sex. The interviews covered socio-economic matters (age, level of schooling, occupation, civil status, time at current address and number of people living in the household), as well as issues concerning the plants that are known and preferably-used-as-wood at home. The aim was to document the variety of plants, the criteria for preference and selection of the species that are used, and also to identify, among the people who live in each home, who are the ones in charge of harvesting, and how many times per month did the interviewees harvested firewood. The interviewees were also questioned why they used firewood both to cook food and to fire ceramics.

The interviews were done using the free-listing method (Albuquerque *et al*. 2014), so each interviewee was asked to list the plants he or she was familiar with and, later, the ones that he or she prefers to use for cooking. At this moment, the interviewees informed the reason why they preferred the species that were mentioned in the free list. In order to enrich the free lists, the technique of "new reading" (Albuquerque *et al*. 2014) was also used.

In the homes where pottery is made, a second semi-structured interview was done, which included questions concerning the known and preferred plants for this activity, as well as the criteria used in the selection of the species and the people responsible for doing the harvesting. In this case, the questions were asked to the people who were directly in charge of baking the vases. Immediately after the interview, the free-listing technique was applied, as was done regarding home consumption.

In this study, we have considered three different degrees of knowledge: a) known plants: the framework of species that make up the participants' background knowledge of plants that can be transformed into fuel; b) preferred plants: the group of species with unique features, according to the participants; c) used plants: the species kept in the homes' stocks of firewood. The last group of plants was obtained through an inventory technique *in situ* (Ramos *et al*. 2014). This technique was applied in two moments, one during the rainy season (in June) and the other in the dry season (in October), in order to obtain a more reliable list of the collected species, this way decreasing the seasonal effects onto the variety of collected species (see Ramos & Albuquerque 2012). During the inventory *in situ*, the participants were asked to show their stocks of firewood for home consumption and, when there was any, for pottery making. From then on a list was made with all the plants' names, the reasons for using them, how many times is the resource harvested per month, places where to harvest them and their availability. The availability was accessed through the aspects previously mentioned by the participants, related to the abundance of the resources within the environment and their accessibility at the moment of the extraction.

In order to do the taxonomic identification of the plants mentioned in the interviews and registered in the *in situ* report, three guided tours (Albuquerque *et al*. 2014) were done with the key-participants of each studied location, who were chosen because they had the wider knowledge about the plants used as firewood. All the botanical material was collected, identified, herborized and deposited in Herbarium Sérgio Tavares, at the Federal Rural University of Pernambuco (UFRPE).

Data analysis

The frequency with which the species were known, used and preferably-used-as-wood was calculated with a ratio between the respective numbers of how many times they were said to be known, the number of times they were seen being used (in the available stocks) and how many times they were mentioned as preferred species by the whole of participants of each sample.

Spearman's (Sokal & Rholf 1995) rank-correlation test was used so as to verify if there is a significant relation between the frequency of knowledge, use and preference for the home and handicraft uses. This analysis was done using BioEstat 5.0 (Ayres *et al*. 2007).

The Kruskal-Wallis test (Sokal & Rholf 1995) was applied in order to investigate the existence of significant differences between the number of known, used and preferred species by the participants, regarding handicraft and home consumption.

Results

General tendencies of use and harvest of firewood for home consumption and handicraft use

Home consumption

Out of all the interviewees that use firewood as a fuel supply at home in the studied regions, 13.04 % claimed to rely exclusively on it for acquiring energy to cook food, whereas 86.96 % informed that they also use liquefied petroleum gas (LPG).

Regarding the reasons that lead the participants to use firewood for home consumption, the majority (76.09 %) claimed that it is due to financial reasons; others have said that they do it in order to maintain a local tradition (17.39 %); and a few (6.52 %) allege it is due to personal preference, for, according to them, the food cooked with this fuel tastes much better. As far as the ways of obtaining wood go, most of the participants (86.96 %) asserted that they acquire the resource by harvesting, while 13.05 % said that they buy firewood from middlemen (people who mediate the trade of goods or resources in the region). All the participants who said they buy firewood are elderly and therefore are not able to go into the woods to harvest the

plants. For those who actually harvest the firewood, this activity is done by the head(s) of the family (man and/or woman), with an eventual help from their children and closer relatives.

When questioned about the place from which they extract wood, 77.5 % of the participants claimed to do it in the remains of forest that are in private properties near their homes. Others (22.5 %) say they collect wood in anthropogenic areas that belong to areas of common use in the community, such as roadsides.

With respect to the frequency with which wood is harvested, most interviewees (86.95 %) affirmed that they do it during the entire year, although they said they prefer harvesting during the "summer" (dry season), so in the "winter" (rainy season) the frequency of trips into the forest is reduced. When questioned about the reasons why they preferred harvesting during the dry season, 60.87 % affirmed that it is easier to go into the woods during this period, 32.61 % consider that it is easier to transport wood to the respective homes, and 26.09 % say that it is because the wood is "drier" during the summer.

Handicraft use

Only one of the six potters that were interviewed informed that he exclusively uses firewood for making ceramics, while others claim they mix wood with ox manure. Regarding the influence of seasonality in pottery making, five out of six craftspeople affirmed that, during the dry season, they bake the ceramics at least three times per month. The production decreases to only once per month during the rainy season.

All potters affirmed that they collect wood for pottery making from the fragments of forests within the region, and that the harvesting is always done by the person who is directly in charge of baking the ceramics. When it comes to the frequency of harvesting wood for this type of use, five out of the six potters said that they extract the wood right before baking the pieces, so they don't keep permanent stocks. That way, the frequency of this activity is directly related to the seasons of the year.

Richness of known, used and preferably-used-as-wood plants

Out of all the 43 plants mentioned in the interviews, 39 species of woody plants were identified, considering both the use for home consumption and that for handicraft making (Tab. 1), distributed in 35 genders and 16 botanical families. The most representative families, regarding the number of species, were Fabaceae (nine), Euphorbiaceae (six) and Anacardiaceae (six).

Table 1. List of known, preferred and used-as-firewood species for domestic and handicraft use in the communities of Poços Pretos, Espinho Branco, Gameleiro e Jenipapo, belonged to the rural zone of the city of Altinho, Pernambuco. (FK = Frequency of knowledge, FU = Frequency of use, FP = Frequency of preference).

Family / Scientific name	Local name	Domestic use			Handcraft use		
		FK	FU	FP	FK	FU	FP
Anacardiaceae							
Anacardium occidentale L.	Cajueiro	6.52	2.17	0.00	16.67	0.00	0.00
Mangifera indica L.	Mangueira	10.87	8.70	2.17	16.67	0.00	0.00
Myracrodruon urundeuva Allemão	Aroeira	8.70	4.35	0.00	16.67	0.00	0.00
Schinopsis brasiliensis Engl.	Baraúna	65.22	34.78	15.22	16.67	0.00	0.00
Spondias mombin L.	Cajá	4.35	2.17	0.00	16.67	0.00	0.00
Spondias tuberosa Arruda	Umbuzeiro	2.17	0.00	0.00	16.67	0.00	0.00
Boraginaceae							
Varronia globosa Jacq.	Moleque Duro	4.35	4.35	0.00	16.67	0.00	0.00
Burseraceae							
Commiphora leptophloeos (Mart.) J. B. Gillet	Imburana	13.04	8.70	0.00	83.33	83.33	33.33
Cactaceae							
Cereus jamacaru DC.	Mandacaru	-	-	-	33.33	33.33	0.00
Capparaceae							
Capparis hastata (Jacq.) J.Presl.	Feijão de Boi	4.35	2.17	0.00	16.67	0.00	0.00
Crateva tapia L.	Trapiá	8.70	8.70	0.00	50.00	33.33	0.00
Neocalyptrocalyx longifolium (Mart.) Cornejo & Iltis	Icó	4.35	0.00	0.00	-	-	-
Euphorbiaceae							
Croton blanchetianus Baill.	Marmeleiro	84.78	67.39	43.48	100.00	100.00	16.67
Croton sp.	Rama Branca	4.35	4.35	0.00	-	-	-
Croton heliotropiifolius Kunth	Velame	32.61	19.57	8.70	100.00	100.00	100.00
Euphorbia tirucalli L.	Avelos	67.39	52.17	6.52	100.00	100.00	66.67
Jatropha mollissima (Pohl) Baill.	Pinhão	-	-	-	33.33	33.33	0.00
Ricinus communis L.	Mamona	2.17	2.17	0.00	-	-	-

Table 1. Cont.

Family / Scientific name	Local name	Domestic use			Handcraft use		
		FK	FU	FP	FK	FU	FP
Sapium glandulosum (L.) Morong	Burra Leiteira	4.35	4.35	0.00	-	-	-
Fabaceae							
Mimosa arenosa (Willd.) Poir.	Unha de Gato	10.87	10.87	0.00	-	-	-
Bauhinia subclavata Benth.	Mororó	6.52	4.35	2.17	-	-	-
Erythrina velutina Willd.	Mulungu	6.52	6.52	2.17	100.00	100.00	66.67
Indigofera suffruticosa Mill.	Anil	-	-	-	50.00	50.00	0.00
Libidibia ferrea (Mart. Ex Tul.) L. P. Queiroz	Jucá	23.91	10.87	4.35	-	-	-
Mimosa tenuiflora (Willd.) Poir	Jurema Preta	93.48	89.13	52.17	50.00	33.33	0.00
Piptadenia viridiflora (Kunth) Benth.	Espinheiro	84.78	58.70	26.09	50.00	33.33	0.00
Poincianella gardneriana (Benth.) L.P.Queiroz	Catingueira	73.91	43.48	21.74	50.00	50.00	0.00
Prosopis juliflora (Sw.) DC.	Algaroba	60.87	45.65	19.57	50.00	33.33	16.67
Malvaceae							
Gossypium hirsutum L.	Algodão	-	-	-	16.67	16.67	0.00
Sidastrum paniculatum (L.) Fryxell	Carrega Luvrai	-	-	-	33.33	33.33	0.00
Mimosaceae							
Piptadenia Stipulacea (Benth) Ducke	Jurema Branca	2.17	2.17	0.00	16.67	0.00	0.00
Moraceae							
Artocarpus heterophyllus Lam.	Jaca	2.17	0.00	0.00	-	-	-
Myrtaceae							
Myrciaria cauliflora Mart.	Jabuticabeira	2.17	0.00	0.00	-	-	-
Nyctaginaceae							
Guapira sp.	Piranha	4.35	4.35	0.00	50.00	33.33	0.00
Rhamnaceae							
Ziziphus joazeiro Mart.	Juá	93.48	73.91	41.30	33.33	33.33	0.00
Rubiaceae							
Tocoyena sp.	Jenipapo	2.17	0.00	0.00	16.67	0.00	0.00
Rutaceae							
Citrus sp.	Laranja	2.17	0.00	0.00	-	-	-
Zanthoxylum monogynum A.St.-Hil.	Limãozinho	4.35	2.17	0.00	-	-	-
Solanaceae							
Solanum paniculathum L.	Jurubeba	6.52	2.17	0.00	16.67	0.00	0.00
Indeterminate	Chumbinho	4.35	0.00	0.00	16.67	0.00	0.00
Indeterminate	Pau Santo	2.17	0.00	0.00	-	-	-
Indeterminate	Pitomba	4.35	4.35	0.00	-	-	-
Indeterminate	Rabo de Cavalo	4.35	4.35	0.00	16.67	16.67	0.00

Home consumption

When considering only home consumption, 38 species of woody plants pertaining to 14 botanical families were mentioned. The most representative families, concerning the number of species, were Fabaceae (eight), Anacardiaceae (six) and Euphorbiaceae (six) (Tab. 1).

The taxons that have the most mentions as being known by locals are *Ziziphus joazeiro* and *Mimosa tenuiflora*, both cited by 93.47 % of participants, followed by *Piptadenia viridiflora* (84.78 %), *Croton blanchetianus* (84.78 %), *Poincianella gardneriana* (73.41 %), *Euphorbia tirucalli* (67.39 %), *Schinopsis brasiliensis* (65.21 %) and *Prosopis juliflora* (60.86 %) (Tab. 1). The frequent mentions of these species show that they are widely known in the region. 71.42 % of the known plants were cited by a small number of interviewees.

The inventory *in situ* allowed us to observe that, out of the total of known species used for cooking food, 29 (76.31 %) were actually used. Nevertheless, only seven (18.42 %) played important roles, for they were found in the majority of the participants' home stocks. They are the following: *M. tenuiflora* (89.13 %), *Z. joazeiro* (73.91 %), *C. blanchetianus* (67.39 %), *P. viridiflora* (58.69 %), *E. tirucalli* (52.17 %) *P. juliflora* (45.65 %) and *P. gardneriana* (43.47 %) (Tab. 1). A positive and significant relation between the frequency of knowledge and the frequency of use of species as energy supply for cooking foods was observed ($rs = 0.93$; $p < 0.0001$). Therefore, the most widely cited species, that is, the most popular group of plants that the participants are familiar with, tend to be the ones that are more frequent in the home stocks of firewood.

Out of the 38 species known by the interviewees for cooking foods, only 11 (28.95 %) were considered preferably-

used-as-wood (Tab. 1). As far as this criterion goes, the species that should be pointed out are *M. tenuiflora* (52.17 %), *C. blanchetianus* (43.47 %), *Z. joazeiro* (41.30 %), *P. viridiflora* (26.08 %) and *P. gardneriana* (21.73 %). The frequency of preference has also shown to be strongly related to the frequency of knowledge (rs = 0.82; p < 0.0001) and to the number of records of the species in stocks (rs = 0.83; p < 0.0001). These results show that the species identified as preferably-used-as-wood tend to be the more known and also the more widely used by the participants of the studied regions.

Handicraft use

Considering exclusively the handicraft use, 30 woody species that belong to 13 botanical families were documented. The richest families are Anacardiaceae (six), Fabaceae (six) and Euphorbiaceae (four) (Tab. 1). The more widely known species were *E. tirucalli* (100 %), *C. blanchetianus* (100 %), *Erythrina velutina* (100 %), *Croton heliotropiifolius* (100 %) and *Commiphora leptophloeos* (83.33 %). These same species are the most popularly used (Tab. 1), although the analysis of the stocks showed that the use is limited to 18 species. There is a highly positive and significant relation between the better known plants and the ones more widely used by participants (rs = 0.93; p < 0.0001). Hence, as in home consumption, the most popularly known species in handicraft making are also the most present in the firewood stocks.

Out of the 30 known species, only six (20 %) were preferred for handicraft use (Tab. 1): *C. heliotropiifolius* (100 %), *E. tirucalli* (66.66 %), *E. velutina* (83.33 %), *C. leptophloeos* (66.66 %), *P. juliflora* (16.66 %) and *C. blanchetianus* (16.6 %). It was observed that the preference frequency was significantly related to the knowledge frequency (rs = 0.82; p < 0.0001), and with the use of plants (rs = 0.83; p < 0.0001). That is, both in home consumption and in handicraft use, the preferred plants tend to be better known and more widely used by the interviewees.

The overall richness of species mentioned as known, registered in the *in situ* inventory and indicated as favorites by the participants have been greater for the domestic use. However, on an individual average basis, the participants mentioned a significantly greater number of species known, used and preferred for the handicraft use (respectively, H = 5.08 e p = 0.024); H = 8.49 e p = 0.003 e H = 5.98 e p = 0.014). Therefore, the participants which were responsible for the handicraft ovens were able to demonstrate knowledge of a greater average number of species when compared to the other participants, which practiced only the domestic use.

Adopted criteria for the selection of the preferred species and of those that were actually used

Home consumption

When questioned about the reasons for preferring certain species, 88.15 % of the participants indicated the quality of the resource as the main factor, whereas only 11.85 % indicated that the availability of the resource is a determining factor in the selection of the preferred plants. A similar result was achieved when the criteria used by participants at the very moment of harvesting were taken into consideration, for 84.78 % of the observations also indicate that the choice of a species is based on the quality of the resource, while others consider availability.

Handicraft use

According to the answers of the six potters that were interviewed, we concluded that the quality of the resource was the main criteria used to classify a species as preferred for pottery production, and also for choosing the species that will actually be harvested for firing pottery. This indicates that, as it was registered in home consumption, the participants seek to collect and use the species that are recognized locally as the ones with superior qualities as fuel, and they don't consider the availability of the resource as a main criterion.

Discussion

General tendencies of use and harvesting of firewood for home consumption and handicraft use

As was observed in this study, the combination of different sources of fuel for cooking foods is quite common among human populations that live in rural areas (Brouwer & Falcão 2004; Ventura-Aquino *et al*. 2008; Ramos *et al*. 2008a; Ramos & Albuquerque 2012). This may be due to the economic aspects of the given social group, since many individuals can't afford the costs of acquiring petroleum-based fuels, which is why they keep using fuel supplies found in the woods, eventually combined with petroleum-based fuels (Ramos *et al*. 2008a).

In pottery making, firewood is also combined with another type of fuel. But in this case, contrary to what was observed in home consumption, it is associated with a fuel source that has inferior quality (ox manure) if compared to oil derivatives. The studied regions present the scenario known in literature as "the energy ladder", in which different populations, influenced especially by economic issues, may "climb up" the ladder, once they use fuels that are more efficient than wood, such as oil derivatives, or they may "climb down" when they need to adopt fuels of inferior quality, such as agriculture waste materials or animal manure (see Brouwer & Falcão 2004; Marufu *et al*. 1997; Mahapatra & Mitchell 1999). The scarcity of firewood in the studied region may explain these different scenarios. In home consumption, the local population can still compensate for the effects of the lack of wood by alternating it with liquefied petroleum gas (LPG). In pottery making, on the other hand, using LPG would not be financially possible,

so people use ox manure as an alternative that is more in terms with the local reality.

As was found in other studies (Samant *et al*. 2000; Ramos *et al*. 2008a; Ramos & Albuquerque 2012), the main source of wood as energy supply are the fragments of forests that exist near the participants' homes. In Altinho, it was possible to notice that both the harvesting and the use of firewood were more intense during the dry season. Similarly, Ramos & Albuquerque (2012) did a monthly assessment of the stocks of firewood during the dry and the rainy seasons, and observed that, in two rural areas of Paraíba, seasonality has contributed to a variation in the harvest strategies. This variation may occur due to the resource's availability, since, during the summer, it is easier to get around the fragments of forests (McCrary *et al*. 2005; Ramos *et al*. 2008a; Silva *et al*. 2009; Ramos & Albuquerque 2012). Moreover, Silva *et al*. (2009) have pointed out that, during the dry season, there is a greater availability of dry wood, which is the most appropriate state for firing.

Corroborating this view, a study done in India has verified that, during the rainy season, the harvest and the use of firewood as fuel have decreased considerably (Bhatt & Sachan 2004). Similarly, Brouwer & Falcão (2004) have discovered, in research done in Moçambique, that, during the rainy season, firewood was less available due to various problems, among which are the difficulty to reach the resource and the decrease of available workmanship, since during this period the population is more dedicated to farming.

As for handicraft use, this study also observed a sexually equal division of labor when it comes to harvesting wood, so both men and women were responsible for obtaining vegetable biofuels as well as for baking the pottery. It was observed that the participants believe that the people in charge of pottery baking should personally go into the woods, for they are the ones who know how to properly choose the type of wood that will be used (Arnold 1989).

Richness of the plants that are chosen, used and preferably-used-as-fuel

Both in home consumption and in handicraft, an inferior variety of used species was noticed when compared to the richness of known species by the studied population, which shows that harvesting isn't distributed equally among the different known plants. This result is similar to that found by other studies that examine the use of plants as fuel for cooking foods in Northeast Brazil (Ramos *et al*. 2008a; Silva *et al*. 2009) and for small rural industries, as those that use firewood in the production of pequi (*Caryocar coriaceum*) oil (Cavalcanti *et al*. 2015).

The group of plants that were classified as preferably-used-as-fuel by participants, both for home consumption and for handicraft use, has shown to be quite similar to the group of species that are actually used. These data show that there is a close relation between mental aspects (knowledge and preferences claimed by participants) and behavioral aspects (the actual use of the plants, verified by two external observers in the inventory *in situ*), which corroborates other ethnoecology studies done in Latin America (Barrera-Bassols & Toledo 2005). Contrary to the tendency described here, of strong correlations between the knowledge about and the effective use of the plants in Altinho, there are studies, such as that by Albuquerque (2006), that show weak correlations between the knowledge and the medicinal use of plant resources in areas of caatinga. This comparison is limited, however, since Albuquerque (2006) studied medicinal plants, not firewood. Anyway, there is a continuing need to examine and analyze, in each case, the ways by which the relations between knowledge and practice take place, within the context of ethnobiology and ethnoecology research (Albuquerque 2006; Reyes-García *et al*. 2006). The most preferably-used-as-fuel species made the plant group even more restricted, which is natural, since the interviewees have lived in the region for a long time, making it possible for them to develop and share specific knowledge during the day-to-day relations with wood supplies. This was also observed in many studies done in the Northeast of Brazil (Ramos *et al*. 2008a; Silva *et al*. 2009; Cavalcanti *et al*. 2015). In Altinho, the most widely used plants are also the most preferred, which is alarming, once the human populations that adopt this type of foraging may, with time, according to Abbot & Lowore (1999), cause a decrease in the most popular or most used plants' population. Medeiros *et al*. (2011) followed a similar line of thought when they mentioned that using a group of preferred plants may present obstacles to the conservation of biodiversity on a local level. Hence, when the harvest of certain plant groups is guided based on local preferences, a stronger pressure for extraction is possibly directed to this restricted group (Cavalcanti *et al*. 2015).

On the other hand, broader social and economic aspects (such as variations in the family income and in the prices of fossil fuels) may also have an influence in this, although it is difficult to measure and relate them in a single study. In order to restrain the high exploitation of these species, due to a constant use and a strong preference and other likely factors, it is recommended that conservation plans are designed for the studied location. It is also important to develop study models that encompass, simultaneously, specific cultural aspects (preference being one of them) and other data, be they ecologic (such as the determination of the availability of supplies through phytosociological studies) and/or socioeconomic. In this context, educational strategies might also be useful to value the local knowledge as a key element to generate culturally appropriate solutions.

Since those participants that managed handicraft ovens cited a greater average number of species, we can see them as local specialists. They seem to be more knowledgeable than those who managed firewood only for cooking

domestic food. Studies such as this, in which more than one local way of using firewood is considered, seem to be a promising approach to find these outstanding local knowledge bearers.

Adopted criteria for the selection of species of preferably-used-as-fuel and actually used plants

Many factors may explain the people's preference and the criteria used by them when selecting the resources that will be collected. Plants that are widely available in the environment, for instance, may be more used than plants that are rare or not so available (Phillips & Gentry 1993). Moreover, personal preferences may also exist, such as the choice for the most popular species within the community, which are easier to manage and harvest, or even the identification of certain species as providing wood of superior quality (Samant *et al*. 2000; Ramos *et al*. 2008b; Silva *et al*. 2009).

Even though there is a variety of factors that influence the selection of the species group that are more widely used within a community, in Altinho the participants have indicated that the reasons for choosing a certain vegetable as a fuel supply and for choosing to harvest it (actual use) is associated with how effective they consider the plant. In other words, people select the species that are identified as those with superior quality as fuel supplies. This reveals an important scenario, since research has often been focused on explaining the selection of resources based exclusively on their availability (Phillips & Gentry 1993). In Altinho, the resource's efficiency has proven to be the main factor, but it is worth noting that, since an ecological study has not been done in the region, we cannot discard completely the role of availability, once the plants that are preferably used as wood and those which are used the most may also be the most available in the environment.

This tendency adds relevance to our findings, once it shows that if there is a local preference for specific wood resources, it raises the probability of pressure on these resources. Thus, if this tendency is confirmed, the efforts for conservation must be focused - at least in part - on the protection of these resources.

Final considerations

As for cooking foods, it was possible to examine that a large part of the participants use vegetable biofuels combined with petroleum derivatives, whereas in pottery making, craftspeople combine vegetable biofuels with ox manure. It is suggested that these combinations occur especially due to the population's financial restraints and to the scarcity of wood supplies in the region, which justify the adoption of different strategies to meet the local demand for energy without compromising the families' economic situation.

Both for cooking foods and for baking pottery, the participants of all four rural regions in Altinho recognize that there is a restricted group of preferably-used-as-wood plants, identified as species of higher quality, which is why they are the most sought after species. This type of foraging is one that causes worries, for it reinforces the existence of a limited group of plants that suffer the strongest pressure by local extractivism. Phytosociological studies in the region are required so as to analyze the status of the targeted species, in order to support strategies of local management that do not compromise the conservation of biodiversity.

We should, however, relativize our findings, specially in relation to the use of wood for baking ceramics, given the small number of people who carry on this practice in the region of Altinho. On the other hand, the very fact that only a small number of people keep up this ancestral practice reinforces the need for studies such as this one, so that the richness associated to this tradition isn't lost.

Still regarding availability, future research could also investigate to what extent ecological factors (related to the availability of resources in the environment) and the perception of availability of the same species may be interrelated in the studied scenario. It would be worth, in those cases, to evaluate which factor (environmental availability and perceived availability) will have a greater influence on the selection of the resources.

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