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ETHNOARCHAEOLOGY IN THE MOROCCAN JEBALA (WESTERN RIF): WOOD AND DUNG AS FUEL

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Abstract: We deal with the use of wood and dung as fuel among the tribe Gzaua, in Jebala (Rif, Morocco). There are different activities that require the use of fire: 1) cooking and water heating (domestic hearths); 2) bread making (bread ovens), and 3) pottery firing (open bonfires). Women do not express clear preferences in the fuel they use for domestic hearths. However, the use of tree fodder for domestic animals might lead to intensive selection. The subproduct of this activity ends up as fuel in hearths and bread ovens. Industrial activities show that fuel is subject to an intensive process of selection that is clearly linked to technical requirements. The firing of pottery in open bonfires is carried out in Jebala with a combination of wood and dung cakes. The discarding of residues from the different firing structures (domestic hearths, bread ovens, pottery bonfires) is an important question for archaeologists since it is related to the mode of arrival and deposition of the wood charcoal. The work in the Rif points to the fact that charcoal can be re-used, stored and transported from one structure to another.

Key words: fuel, dung, ethnoarchaeology, Rif, Morocco,

1. INTRODUCTION

In order to understand human behaviour in the past from the material remains it has left, it is necessary to have some keys to assist the process of interpretation. Modern analogues are always used for this purpose, sometimes unconsciously. The researcher's own experience is usually the point from where interpretation starts. In archaeobotany, experimental practices and ethnography have proved to be the most effective approaches adopted for studying past human activities dealing with plants. Ethnobotanical research specifically intended to help archaeological interpretation has a long tradition (among others HILLMAN 1981, 1984 and 1985; JONES 1984 and 1996). In our case our field work has focused on the Iberian Peninsula (PEÑA-CHOCARRO 1994 and 1999; PEÑA-CHOCARRO & ZAPATA 1997, 1998 and 1999) and in the Moroccan Rif (PEÑA-CHOCARRO et al. 2000).

However, humans show an almost infinite capacity for diversity and historical processes cannot be ignored, so for years there has been much debate about how far analogies can be used. The fact that some material remains are the result of an action does

not preclude the possibility that other actions may generate similar remains, so direct analogies are not desirable (PETREQUIN & PETREQUIN 1992; STOCZKOWSKI 1992). One way of limiting this problem is to have exhaustive knowledge of the ethnographical data, so alternative explanations can be put forward. Also, the validation of the hypothesis has to be done taking into account different aspects of the archaeological evidence (KEELEY 1992).

In this paper our research is driven by very basic questions that arise when trying to interpret archaeobotanical remains: do people select the wood they use for fuel? Do they avoid specific trees? Is archaeological charcoal a good environmental indicator? What factors are involved when using dung for fuel? Can context-related variation be distinguished without major problems from anthracological data? We will try to throw some light on the way in which fuelwood and dung are used in the Jebala region (Rif, Morocco), how they are selected and collected, how farmers value the different species and how the residues are disposed. The area was particularly interesting for us because we could watch the use of different types of fuels not only for domestic purposes but also for pottery firing.

We think that ethnographic observations will at least improve our working hypothesis and make us ask new and better questions of our archaeological samples. Hopefully, in the end, more than bridging a gap between past and present by drawing analogies, the knowledge of contemporary societies will provide sets of ideas for thinking through archaeological evidence, as a medium of thought, rather than as a simple model to be tested against the data (TILLEY 1996: 2).

In this paper we will deal with the Jebala region, located at the westernmost part of the Rif chain, in the north of Morocco. As far as climate and vegetation are concerned, this mountain area is Mediterranean, modelled by the alpine orogeny and with abrupt orography with altitudes above 2000 m. Precipitations vary with the topography and across the highest areas exceed 2000 mm per year. There are several vegetation zones but the landscape is dominated by woodlands of lentisk (*Pistacia lentiscus*), oaks (*Quercus suber*, *Q. ilex*, *Q. coccifera/rotundifolia*) and strawberry tree (*Arbutus unedo*). *Q. suber* forests have been altered by human activity and grazing developing into open managed woodlands. *Juniperus oxycedrus* and *Crataegus monogyna* are common. The shrub community consists mostly of *Ericaceae* and *Cistus*. *Nerium oleander* and *Arundo donax* are common elements near the watercourses.

Agriculture and animal husbandry are the economic basis of the area under research. Arable crops include einkorn, free-threshing wheats, barley, maize and sorghum which, together with vegetables and legumes grown in back-gardens, are the main components of the farmer's vegetal diet. Domestic animals include cattle, sheep, goats, donkeys, mules and hens. The pre-industrial conditions of the area have allowed the survival of primitive agropastoral practices and crafts which have already disappeared from other nearby areas. This paper is part of an ongoing ethnoarchaeological project[1] which focuses on agrarian and herding systems and on some crafts such as ceramic and leather technology. Some preliminary results have already been published (GONZÁLEZ URQUIJO et al. in press; IBÁÑEZ et al. 2000 and 2001; PEÑA-CHOCARRO et al. 2000).

The observations we are going to discuss come from different *duar* (small villages) from Jebala, particularly Ain Kob, Kalaah, Dahar, Briet, Agbalou and Homar. Fieldwork has been carried out during the years 1997, 98, 99 and 2000 for a total period of more than five months during the summer and the autumn. The processes that are described are based on direct and participant observations and also on open-ended and semi-structured interviews with farmers and potters based around a checklist of topics which we wanted to

[1] The project is called *Las primeras comunidades campesinas en la Región Cantábrica. El aporte de la etnoarqueología en Marruecos*. It is funded by the Fundación Marcelino Botín and is based at the University of Cantabria (Santander, Spain). The authors can be consulted for details about the project.

cover. This approach reveals a range and depth of information which is difficult to elicit using more formal methods and also facilitates the development of informal relationships between local and external participants (COTTON 1996).

2. WOOD AS FUEL

Charcoal very often constitutes the most frequent type of archaeobotanical remains on archaeological sites. The information it provides is twofold: 1) environmental, showing at least the presence of different taxa in the vicinity of a site, and 2) ethnobotanical, about patterns of wood provision and preferences of human groups when collecting trees and shrubs for fuel. The interpretation of the anthracological data is often controversial: some perspectives will assume that archaeological charcoal is –at least in some cases- a function of past vegetation (CHABAL 1997) while others will claim that the gathering of fuel involves a selection of specific species depending on human preferences and activities (PIQUÉ 1999a). Taphonomic and post-depositional questions are also problematic issues involved in the significance of the quantification of the fragments we identify (PIQUÉ 1999b).

2.1. Domestic hearths

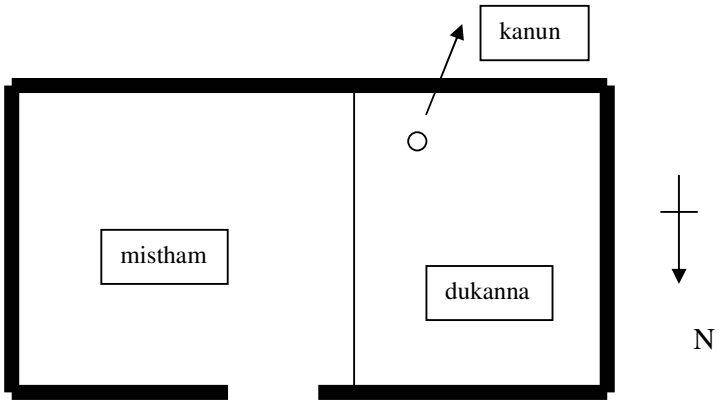
Among the tribe Gzaua, in the Jebala, there are different activities that require the use of fire. The main ones are related to: 1) cooking and water heating (domestic hearths); 2) bread making (bread ovens), and 3) pottery firing (open bonfires).

Wood is the most widely used fuel for domestic purposes. This is probably due to the fact that forests are still important in the area and wood can be easily collected. Dung is only used as fuel for firing pottery.

The houses in the area traditionally used to have two hearths (*kanun*), one indoors, for the winter, and another one outdoors, for the summer. The summer hearth is usually located by the main entrance of the house at the patio. In some villages it can be surrounded by a semicircular 40-50 cm high clay wall which protects the fire from the wind. The wall is open at the front to allow the introduction of the fuel and pots (Figure 1). The winter hearth is generally located in the stall (*bit*), a room for the animals apart from the main building (Figures 2 and 3). Depending on the particular situations of the households it can also be located in other places. At Kalaah for instance, the hearth is located in a small space, adjacent to the main building, created underneath the roof eaves. Fires are not usually made in the main building. Oil lamps are kept in niches on the walls, but only to provide illumination.

INSERT FIGURE 1, 2, 3

(a)



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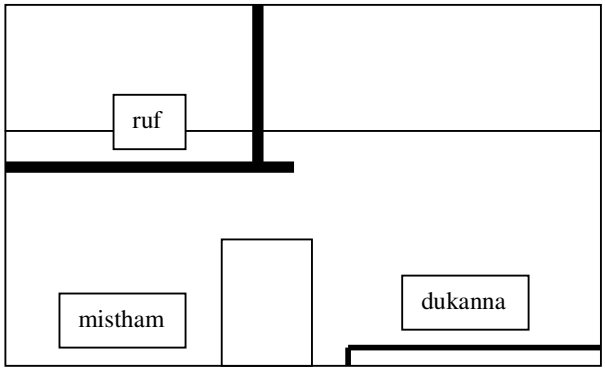

Figure 2: Plan (a) and section (b) of a *bit*, or room for the animals. The *bit* is divided into two halves: 1) *Mistham*, or area for the animals, usually goats; 2) *Dukanna*, or adobe platform, where people used to sleep in winter, warmed by the heat from the animals. The hearth (*kanun*) was located on this platform opposite the door. The *ruf* is a false ceiling for storing tools.

In all cases the hearths are built in the same way: a hole of approximately 20 cm depth and 20 cm diameter is dug and, in most cases, a broken hemispheric ceramic is introduced inside and the walls are plastered with clay. The fuel is burnt inside and three stones are placed outside (more recently a tripod) to hold the cooking pot (*gedra*) (Figure 4). In the past, rectangular prisms of unfired clay, made exclusively by women, were used for this purpose. The prisms had a central hole so they could be taken out of the fire with a stick. Very similar artefacts, also made by women, existed in Serbia with the same function (FILIPOVIC, 1951). When the fire was finished, the embers were covered with ashes and kept alive, so that the next day the fire could be lit again with them. Cooking could be done on the fire. However, there are also "mobile hearths", ceramic braziers (*mishmar*) with three small platforms on the top to support the cooking pot (Figure 5). The braziers can be transported to the kitchen where they are used for cooking or heating water or they can be

transported to the rooms to heat them during the winter. Both hearth and brazier are cleaned every day.

INSERT FIGURE 4, 5, 6

Moreover, every household has its own baking oven outdoors for daily bread production (Figure 6). In the past many houses did not have these ovens. They used to make bread inside ceramic plates (*makla*) located on the hearth.

The fuelwood needed for these activities is collected by women. The frequency seems to be variable. Most households prefer to collect enough wood for the whole year during spring and summer. It is left to dry in the open air and, afterwards, it is stored. Those who have animals intensify the collection of tree fodder during the winter. In this case they usually go out every day or every two days. Kindling from this activity is stored in rows that make divisions of properties, create small animal enclosures or protect small gardens from the animals.

At ceramic centres the need for fuel is much greater during the summer when potters light the bonfires for firing the ceramic. Obviously, they prefer to collect the wood from areas close to the *duar*. However, in places which are highly deforested, they need to walk long distances that may take between 40 minutes and 3 hours on a round trip. Whenever possible, they prefer to collect dead wood but this is not abundant. Women carry the fuel on their backs. The collection of wood seems to be an important time for social relationships among women. They tend to go out in groups during the afternoon/evening.

2.2. Uses of common woody species

These are some of the opinions and beliefs about the uses and properties of the most common woody species in the areas surrounding Chefchaouen, Morocco (scientific and Arab names provided) (Table 1):

	Good fuel	Tree fodder	Other uses and comments
Arbutus unedo (sesnu)	✓	✓	Edible fruits, although they are believed to produce drunkenness. Used for building purposes (traverses). Not everybody agrees it is a good fuel.
Arundo donax (ksab)			Used for basketwork, thatching and building purposes (fences, enclosures, divisions...). Poor fuel.
Ceratonia siliqua (jarob)			The fruit used to be given to the animals in the past and it is sold. The pods without the seeds are also sold. Wood is used for making ards. Poor fuel.
Chamaerops humilis (azef)			Leaves are braided to produce baskets and protectors for the hands when threshing. Not used for fuel.
Cistus ladanifer (oukir)	✓		Flour is produced from the seeds. Widely used as kindling for bread ovens in combination with *Quercus*.
Erica spp. *(jelenge)*	✓	✓	It is used for making brooms.
Ficus carica (karmoasse)	✓	✓	When green it is a very poor fuel but after drying it is very good. Dead wood is used at the base of the bonfires for firing pottery.
Fraxinus angustifolia (derdar)	✓	✓	It is used for building and making the wooden structure when thatching with *Triticum monococcum* straw. The wood is used for making ards and hafts.
Juniperus oxycedrus (taqqa)	✓		Sometimes it is used for hedges. Good as kindling.
Myrtus communis (rajan)			Fruits are collected and eaten by people and animals. Not commonly used for fuel.

Nerium oleander (defla)			Used for making enclosures and divisions and hafts. Very bad fuel, it produces smoke. A poison is produced with the stem
Olea europaea (berri / zaitoun)	✓		Olive wood is considered the best for hafts. It is used for the central piece of the rotary querns and also for building purposes (traverses). Only dead wood is used for fuel. Some consider it a good fuel that lasts little and burns well when green. Others consider it very strong and only use it in ceramic ovens.
Pistacia lentiscus (dro)	✓	✓	Very good fuel, this is the main use of the plant. It is also used for building purposes (branches in timber framework of floors) and for enclosures. Leaves and fruits are used as fodder. A medicinal oil is produced from the grain. Ashes from the leaves are used in circumcision and for making dried grapes.
Populus alba (sefsaf)			Poor fuel.
Prunus domestica (barkok)	✓		
Quercus rotundifolia / coccifera (bellut hlou, djerba, tasaft, kerrush, bellut hara, asai, corrish)	✓	✓	Very good fuel.
Quercus suber (dlem)	✓	✓	Wood charcoal is produced with it. Cork is used for different purposes such as making beehives. Sometimes it is used for making wooden pieces of rotary querns.
Sambucus nigra (bu ruabez)			The flowers are collected for medicinal purposes. Very bad fuelwood.
Vitis vinifera (dolya)	✓	✓	Its wood is used in bread ovens as fuel

Table 1. Farmers' opinions about the uses of common woody species

In the area under research, the most widely used species for domestic hearths are: *Q. rotundifolia/coccifera (djerba), Pistacia lentiscus (dro), Arbutus unedo (sesnu), Fraxinus angustifolia (dardar), Prunus domestica (barkok), Olea europaea (zaitun/berri).* In all cases big branches are selected, whereas for the bread oven they use smaller ones.

2.3. Tree fodder: a source of fuelwood

Tree fodder comes from leaves and twigs of trees and shrubs. In modern farming societies, people tend to use it as winter fodder regularly or occasionally when other foods are scarce (if there have been droughts or snow…). The collection of tree fodder for domestic animals is a twofold resource: it provides food for the animals but, as a subproduct, remnant small branches are used as kindling. The use of trees for animal food has been well described ethnographically (GREIG 1984; AUSTAD 1988; RASMUSSEN 1990; BEHRE & JACOMET 1991; HALSTEAD & TIERNEY 1998) and has been recognised in Europe from the Neolithic (REYNOLDS 1987; RASMUSSEN 1993; AKERET & JACOMET 1997; HAAS et al. 1998; KARG, 1998; BADAL 1999). The preference of particular types of species as fodder is one of the factors that might explain the importance of particular taxa in archaeological samples

In the Jebala, animals are fed with different types of tree fodder. *Fraxinus* seems to be highly valued. However, it is not very abundant so the most widely used taxa are: *Arbutus, Quercus, Pistacia, Olea* and *Acacia*. The fodder is fresh when they give it to the animals. When the soft part has been eaten, the small branches are left drying outside the houses and afterwards are used for fuel, in hearths and bread ovens. *Quercus*, *Ficus* and *Vitis* leaves are also collected as leafy hay, sometimes after beating the trees with sticks, and can be stored for months.

3. DUNG, AN IMPORTANT SECONDARY PRODUCT

3.1. Dung for manure, tempering and container making

Among traditional farming societies dung is a very valuable product which is never discarded. Farms supply a regular and predictable production of dung which can be used in a great variety of ways. The most known is the use of dung for manure, an activity difficult to recognise archaeologically. However, in N Morocco ethnographic observations show other uses with a low archaeological visibility, such as the tempering of floors and walls and container making.

Fresh cow dung mixed with water is used for tempering the floor of the houses and adjacent areas. Mixed with clay it is used for tempering the walls of the mudbrick houses. These activities are carried out yearly during the summer. Threshing floors are also tempered during the summer with a mixture of dung and water, something that we have also recorded in Atlantic Spain and in some areas of Italy. The mixture is made in big containers and is spread with *Pistacia* brooms. This process is usually repeated every time a different product is going to be threshed.

In the Jebala, dung has also been used for making containers which are used for the storage of dried foods (cereals, legumes, flour, dried figs, salt, etc.), feeding the animals and transporting grain to the quern (IBÁÑEZ et al. 2001). There are other references in other parts of the world about the use of this material for this purpose (MAKAL 1954; HILLMAN 1984; ERTUG-YARAS 1997). In this area, the containers (*tabtoba* and *tonna*) can be made 1) only with dung, 2) with unfired clay and 3) with a mixture of both, dung and clay. The choice of one material depends upon availability and on the characteristics of the raw material. In spring, for example, dung can be too soft and its consistency improves when mixed with clay. The technique for container making, by hand-forming, is the same for all these unfired materials. The activity is carried out during the summer in order to improve drying. Also, this is the time when the volume of the harvest is known and, consequently, the amount and size of the containers that are going to be needed. Sometimes dung containers are complementary to other types of containers.

Women make sufficient numbers of containers in order to have enough for the cold season. They use techniques which have been widely described for pottery making (RICE 1987; GIBSON & WOODS 1990; ORTON et al. 1993): a series of short coils are joined and smoothed together. A mould can be used in order to shape the base; in this case a very characteristic angle can be observed.

3.2. Dung as fuel for firing pottery

The Jebala pottery belongs to the Berber ceramic tradition in the north of the Magreb (BALFET 1965; VOSSEN & EBERT 1986; CAMPS 1987; VOSSEN 1990; FAYOLLE 1992; PICÓN 1993; BURILLO 1994; SCHÜTZ 1994). In this area pottery is made by women following archaic techniques: it is hand-made, fired in open fires and commercialised in a very restricted geographical area. The study of the techniques and the social context related to this production is an important part of our project. Here we will describe the ceramic technology in the western Rif, close to the village of Mokrisset, to the south of Chefchaouen, in the land of the tribe Gzaua. A few kilometres to the north of Mokrisset the neighbourhoods (*duar*) of Ain Kob, Dahar and Briet are located. Here women make two main types of ceramics: 1) Painted decorated vases, used for liquids (oil, water and milk), and 2) containers related to the processing and cooking of foods. Technical (procurement and processing of the clay, container making, decoration firing) and social aspects have been described elsewhere (GONZÁLEZ URQUIJO et al. in press), so here we will only focus on the activity that requires the use of fuel: the firing of the ceramic.

The most simple technique for firing pottery is using domestic hearths. The hearth is used when there are only one or a few pots to fire. Production is small-scale and intended for domestic use or for exchange with neighbours from the same *duar*, usually not to be sold in the market. The pots are located over the hearth on stones or unfired clay pieces. Small branches are used as fuel and the pottery is covered with cork (*Quercus suber*). No selection of wood is carried out for the hearth, the only requirement is that the branches are small (Figure 7).

INSERT FIGURE 7

However, the most common type of firing takes place on open bonfires (Figure 8). In the *duar* of Ain Kob, they combine two types of fuel: wood and dung. Wood is brought from a nearby forest. In this neighbourhood they do not show a preference for any type of wood. They use whatever is available (*Pistacia, Quercus, Fraxinus...*). Women cut the wood with an axe, sometimes with a stone wedge in order to get longitudinal pieces.

INSERT FIGURE 8

The bonfire is located 30 m away from the house where they live and make the containers. It is always located in the same place, a small hollow 20 cm deep. A circular area is made with wood splinters and ceramic containers are located on it, surrounded by a wood belt supported by a circle of stones. The containers' mouths are covered with ceramic fragments so that embers do not get inside. The ceramics are covered first with a layer of dry dung cakes. On the top they put another layer of fresh dung for the fire not to be very strong and for the heat to be distributed regularly. The bonfire is lit introducing small branches in the fire through three different points that have been left open at the base of the structure. When the fire is lit these points are closed with dry dung cakes. During the firing more, mostly fresh, dung is added to cover any open area with flames, particularly in the centre of the fire because that is the area where they locate the containers made with a type of clay that demands a higher temperature. The fire continues for several hours and is left overnight to cool down. Next day, the ceramics are collected and taken to the market.

This type of bonfire leaves very few remains and its archaeological visibility would be very low. Once the ceramics are fired, in Ain Kob the charcoal is collected and stored. The circle of stones that supported the structure and fragments of ceramics that have been broken during the process are left *in situ*. When the area is going to be used again for another firing it is cleaned and any leftovers are thrown away onto a slope close by. Once cleaned the only evidence of the activity is the fired soil and the circle of stones that show signs of having been in contact with fire. Continuous use creates a regular, hard burnt surface at the base of the oven.

In the neighbourhood of Briet, the bonfires are also always located in the same place, 50 m away from the houses, in a small hollow made by a ravine. Before firing begins, the residues of previous firing can be seen: charcoal, ashes and some stones at the borders. In the winter, due to the torrents of water affecting the area, all remains disappear. In this *duar* the wood used in this activity was subject to an intensive selection process. The ceramists traditionally covered the bottom of the hollow with a layer of *Ficus* wood. According to the women from the *duar* this wood produces a slow fire, particularly good for firing pottery. Both pruned and dead wood from fig trees was used, and it was the women who would search for it, sometimes covering great distances. Recently, they have started to use pine cones from a nearby plantation because they are very easy to collect. The pottery is put on the bottom layer of wood/pine cones and it is covered with dried dung cakes. After the firing the residues are cleaned away (usually before another firing

episode): the residues are thrown onto the slope, a few metres away. Sometimes the charcoal can be used for manuring the gardens, garlic patches in particular.

In the *duar* of Dahar the bonfire is also located in a natural hollow on a slope. Sometimes they modify a ravine making it wider. A circular base made of wood fragments is laid out. No selection is made of the type of wood used for fuel. They put the pottery on top of it and cover it with more wood, like a pyre. The structure is set on fire and after 40 minutes, when the strong flames are gone, it is covered with dry dung cakes.

As we can see, the process in the area is similar, although there is some variation. It requires the combination of wood and dung for fuel. The wood is always used at the base of the structure. Sometimes it is also placed as a lateral belt or covering the whole structure. The dung is used on the top, sometimes combining dry cakes with fresh material, in other cases only using dry cakes.

The firing of the pottery is a key moment, the control of the temperature is important and different factors (wind, rain...) may ruin the production. The type of clay that has been used may require different firing conditions. The containers for liquids, which are made with white clay, demand more time and higher temperatures than the cooking vases, made with a different mixture of clays. Thus, the former are usually located at the centre of the bonfire, where temperatures are higher; also more fuel can be added to the area where they are located.

Ficus wood is selected in Briet for pottery firing. Ceramists say it is needed because of the type of clay they use. *Ficus* wood produces less heat –too much may fracture the pots-. There is at least one other place, Ain Barda (Taunat), where, once again, only *Ficus* wood is used for pottery firing. In this *duar* the ceramic production has to wait until the fruit is collected and the trees are pruned. However, such a strong selection does not seem to exist in other places. *Quercus ilex* and *Pistacia lentiscus* are highly valued fuels but other taxa such as *Olea europaea* and *Rosaceae* are also used. *Fraxinus* and *Pinus* are avoided because the surface of the pottery turns matt whenever used. Taxa with a high calorific value might also fracture the production. Different technical reasons lie behind this selection/avoidance: at Ued Lau, by the coast, hand-made pottery is produced. Here, because of the type of clay used, higher temperatures are needed for the closed kilns (Figure 9). So they use pine roots as fuel, even digging out roots from living trees.

INSERT FIGURE 9

The use of dung as fuel is usually linked to situations of deforestation (BOTTEMA 1984; MILLER 1984; ANDERSON & ERTUG-YARAS 1998), in areas where wood is not available. However, dung has other significant possible uses: in traditional societies it is the main source of fertiliser, so it is most commonly used to this end.

In the Jebala, woodland areas are still abundant so wood has traditionally been the main source of fuel for domestic purposes. The use of dung for fuel is related to industrial activities and can be justified for: 1) technical reasons: the material is highly suitable for covering open fires because it achieves a higher concentration of heat and avoids quick cooling; combustion is more slow and regular than with wood; it probably works by depositing an insulating layer over the vessels that helps retard convective heat loss (RICE 1987: 157); and 2) limited consumption: only a partial amount of the household production of dung is used as fuel. The rest of the production can be used for other purposes (manure, container making, plastering…). Dung cakes are prepared when the summer pottery season is approaching, several weeks ahead. The cakes may have a combination of cow and goat excrement. When fresh dung is going to be used, cow dung is preferred –in exceptional cases, donkey dung too. Where not enough dung is available, it is supplied from neighbouring farms; some of the pottery will be given back as compensation.

4. DISCARDING OF FUELS: THE ARCHAEOLOGICAL IMPLICATIONS

The discarding of residues from domestic hearths, bread ovens and pottery bonfires is an important issue for archaeologists since it is related to the mode of arrival and deposition of the wood charcoal. The work in the Rif illustrates the fact that charcoal from different firing structures can be re-used, stored and transported from one structure to another (Figure 10):

- Charcoal from domestic hearths: domestic hearths are usually cleaned, after having been used or before using them again. If residues are left, sometimes they are thrown away but on other occasions they are stored to be used for cooking, or to be used as manure in the vegetable gardens, sometimes mixed with animal dung. Very often, residues do not accumulate in the area around the fire.
- Charcoal from bread ovens: bread making always produces charcoal that can be collected and stored for re-use. Hot embers can be used straight away for cooking or heating water. At the *duar* of Agbalou embers from the bread oven are stored in a ceramic container which is covered and put aside. When needed, charcoal is sieved to get rid of the ashes which can be used to manure home gardens and, particularly, garlic patches and deposited in the brazier (*mishmar*), ready to be used. To light the brazier, the use of einkorn (*Triticum monococcum*) straw was common. At Briet, the embers were stored in a container covered with clay, and they were used on busy days when there was no time to light a fire to do the cooking.
- Charcoal from pottery firing: in the *duar* of Ain Kob, the charcoal left after firing the pottery on the open bonfires is also collected, stored and re-used for cooking. Every firing of pottery produces a residue of 6-7 litres of charcoal. Hot charcoal from the different structures is stored in a ceramic container covered with ashes. When cold, it is sieved and stored in sacks.

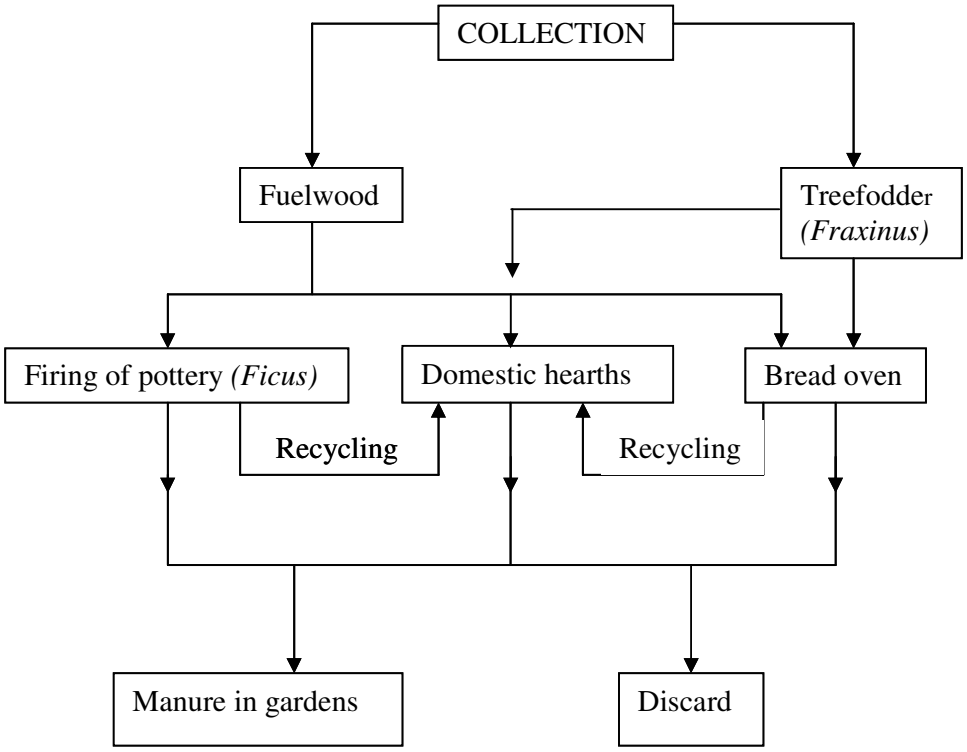

Figure 10. Fuelwood at Jebala may have been collected *per se* or be a by-product of tree fodder for domestic animals. It is used in different areas: pottery bonfires, bread ovens and domestic hearths. The charcoal produced as a subproduct of the different firing structures can be re-used in domestic hearths. Some of it (e.g. *Ficus, Fraxinus*...) may have been carefully chosen.

5. CONCLUSIONS

There are different factors that can be involved in one fuel being more used than another and thus, potentially, being better represented archaeologically. Among these, availability and physical properties are crucial. As we have seen, the Jebala is particularly interesting as a research area because there are different activities, domestic and industrial, that require the use of fuels. Also, wood and dung are used, sometimes in combination.

As far as we have seen, women in this area do not express clear preferences in the fuel they use for domestic hearths, intended basically for cooking and heating. Some of the most common trees in the vicinity are also the most widely collected for fuel (*Quercus, Pistacia, Arbutus, Fraxinus, Olea*...). A few species such as *Arundo donax*, *Nerium oleander*, *Populus alba* and *Sambucus nigra* are rejected for different reasons (poor fuels, production of smoke...). However, the use of tree fodder for domestic animals is an important activity that might lead to intensive selection in the input of wood to the household since the subproduct of this activity ends up as fuel in hearths and bread ovens. *Fraxinus* is highly valued as animal food but farmers tend to use other more common taxa such as *Pistacia*, *Olea* and *Arbutus*. Further quantitative studies will be carried out in the future in order to determine how far the use of tree fodder conditions the use of particular fuelwood in a household.

Industrial activities show that fuel is subject to an intensive process of selection that is clearly linked to technical requirements. The firing of pottery in open bonfires is carried out in Jebala with a combination of wood and dung cakes. The type of clay and firing demand different temperatures and conditions. In Ued Lau, with closed kilns and a different type of clay, *Pinus* is selected because resins in conifers produce higher temperatures (RICE 1987; CHABAL 1997). In the case of the Berber ceramic tradition area, with open bonfires, lower temperatures are needed and therefore *Pinus* is avoided. Some *duar* exclusively use *Ficus* wood for the firing because it is considered a slow burning fuel. In other neighbourhoods, however, no such clear selection has been observed: *Pistacia lentiscus* and *Quercus ilex* are highly valued but different woods can be used. Even in an industrial activity, human decisions and believes may be important in the response different individuals give to particular needs of fuel. As in the case of at least some of the woods, the use of dung cakes to cover the bonfires responds to technical properties: potters regard dung as slow burning material which enhances the heat-enclosing kiln-like effect.

The treatment of residues in different households is variable. Charcoal produced in the different burning areas can be: 1) thrown away, 2) used as manure in home gardens, or 3) re-used for cooking in domestic hearths. This not only involves the collection and storage of the charcoal, but also its being moved from one structure to another. This means that charcoal from different sources –some of it chosen with great care- may turn up in the areas used for cooking. If we take this into account, context-related variation in archaeological samples might not be such an easy question to approach.

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Figures

1. Summer hearth with a low clay wall. It is located by the entrance of the house at the patio (Dahar, Jebala).
2. Plan and section of a *bit* or room for the animals. The *bit* is divided in two halves: 1) *Mistham* or area for the animals, usually goats; 2) *Dukanna* or adobe platform where persons used to sleep in winter, by the heat from the animals. The hearth (*kanun*) was located on this platform opposite to the door. The *ruf* is a false ceiling for storing tools.
3. Interior of a *bit*. The hearth (*kanun*) can be seen on the right (Agbalou, Jebala).
4. Winter hearth or *kanun* (Tefraouen, Jebala)
5. Two ceramic braziers (*mishmar*) with three platforms on the top to support the cooking pot. Braziers can be transported for cooking or for heating rooms.
6. Bread oven.
7. Firing for a single vase can be done on the hearth or anywhere at the patio.
8. Firing is usually carried out in open bonfires at small hollows.
9. Kilns for firing pottery at Ued Lau.
10. Fuelwood at Jebala may have been collected *per se* or be a by-product of tree fodder for domestic animals. It is used at different areas: pottery bonfires, bread ovens and domestic hearths. The charcoal produced as a subproduct of the different firing structures can be reused at domestic hearths. The selection of some of it (e.g. *Ficus, Fraxinus*...) may have been particularly favoured.

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