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Vegetation Context and Wood Exploitation in the Southern Neolithic: Preliminary Evidence from Wood Charcoals

Introduction

The main purpose of this paper is to present the preliminary results of the analysis of wood charcoals from South Indian Neolithic sites[1]. The aim of such analysis is to provide a major source of data that could be used for the reconstruction of the vegetation environment, and, broadly speaking, the palaeoecology of Neolithic habitation in South India. More specifically, this reconstruction aims to clarify:

1. The environmental context of the Southern Neolithic. Was environmental change one of the factors instigating the beginnings of food production and agriculture in this part of the world?
2. What was the impact of permanent settlement and agricultural activities on the vegetation environment and the landscape(s) inhabited by the Neolithic communities?

Any attempt towards understanding the environmental and socio-economic context of the onset of agriculture in South India, relies on the elucidation of the relationship of human societies with the natural environment. What were the environmental conditions faced by the human populations at that time? How were they shaped by local geography and climate change, and how the environment came to be increasingly affected by human action through fuel collection, pastoralism, burning, vegetation clearance and cultivation? For this purpose, our research into the early agriculture of South India has at its heart the investigation of vegetation change and its exploitation by prehistoric communities. Human impact on past vegetation can be assessed at different scales and levels of analysis. For example, changes in the frequencies and types of charcoal taxa recovered from stratified archaeological deposits may help in identifying woodland clearance and corresponding shifts in the dominant tree and shrub vegetation, which could in turn be attributed to the effects of human activities like fuel collection, grazing and browsing by herds of domestic animals (cf. Asouti 2003; Asouti, in press; Asouti/Hather 2001). From a more anthropological perspective, such patterns in the composition of archaeobotanical assemblages can also provide information on the precise content of human choices. By considering the appropriate ethnographic data and anthropological theory, the archaeologist can in turn interpret such choices as signifiers of settlement economy and the socio-economic structures conditioning resource perception and use by prehistoric communities (Asouti/Austin, in press). Ultimately, such a study of past vegetation, alongside the analyses of crop and pastoral production (the objects of seed archaeobotany and archaeozoology respectively) may allow for a meaningful understanding of both the origins and the development of agricultural production and sedentism in South India.

The archaeobotanical context of the present study

Earlier stages of our project had focused on the systematic collection and analysis of archaeobotanical remains of seed crops (see Fuller et al. 2001a and references therein) This research has indicated the widespread importance of indigenous crops such as small millets and pulses in the agricultural systems of the Southern Neolithic. Definitive evidence for these crops dates from least 2200 BC (i. e. Phase II in the traditional chronology of the Southern Neolithic). Verified crop species include browntop millet *(Brachiaria ramosa)*, bristley foxtail *(Setaria verticillata)*, mung bean *(Vigna radiata)* and horsegram *(Macrotyloma uniflorum)*.

Alongside these crops there has been evidence for the use, at a smaller scale and possibly by selected communities, of introduced non-monsoonal crops such as wheat and barley, and the

[1] Allchin 1963; Allchin/Allchin 1982; for a recent general review see Korisettar et al. 2001a.

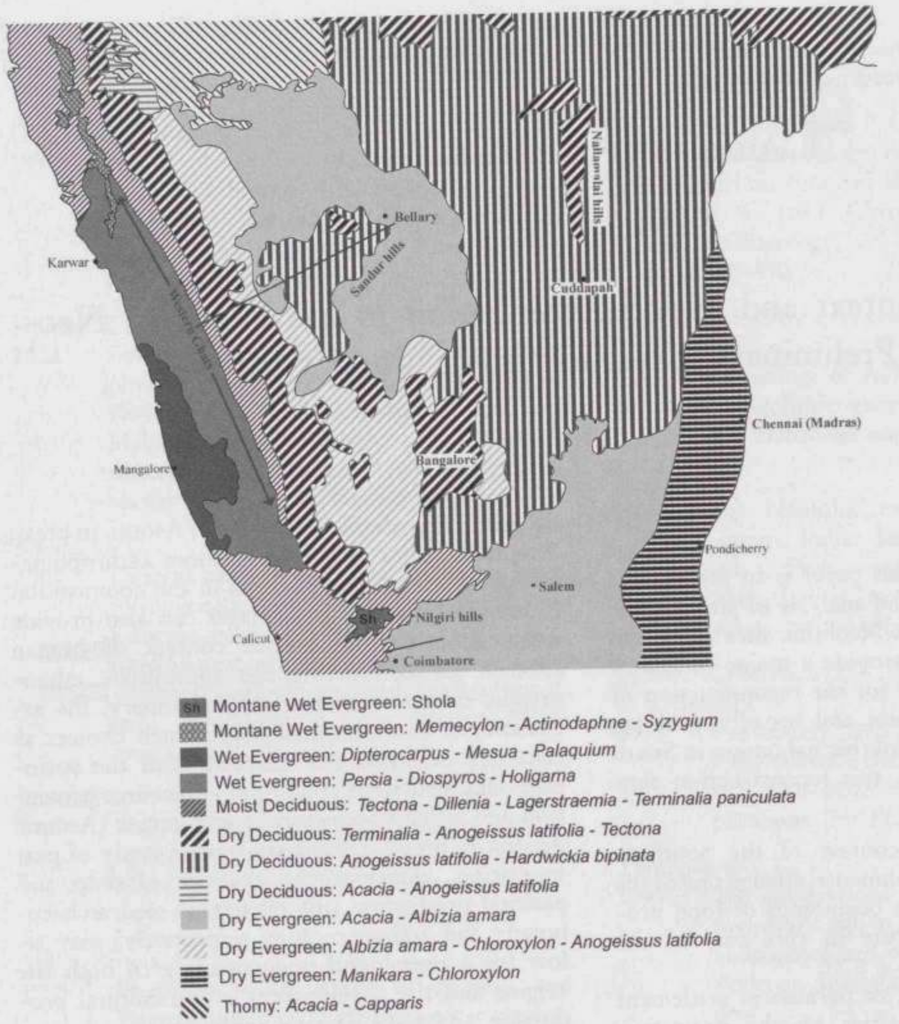

Fig. 1. Vegetation zones of South India and transects of those sampled for modern wood specimens.

adoption of hyacinth bean. However, the evidence for African millets, including pearl millet and finger millet has been extremely limited, and their precise dating remains problematic (cf. Fuller 2003).

Archaeobotanical sampling has included sites in the core region of the Ashmound Tradition in the Bellary district and adjacent parts of Andhra Pradesh. Recent archaeobotanical study of material from the site of Watgal undertaken by Professor Mukund Kajale confirms essentially the same range of crops for the Raichur region of the Ashmound Tradition (M. Kajale, pers. comm.). In addition, further sampling has indicated the same range of crops in the adjacent, and broadly contemporary cultural traditions of the Kunderu River Catchment, and the Hallur area on the upper Tungabhadra River (Fuller et al. 2001b). Further research will hopefully clarify the timing of introduction and how widespread African millets were, the full range of wild fruit species exploited by the Neolithic communities, and also cultivation practices, through the detailed analysis of the field weed floras that accompanied the main crop species (cf. Fuller et al. 2001a).

Modelling the distribution of forest and woodland vegetation zones

On the basis of published information about vegetation zones in the region and past climate change, we have suggested that the dry deciduous forest and woodland (and their transition into the wet deciduous vegetation of the Western Ghats), were probably the areas where the wild progenitors of native crops flourished in prehistoric times. In terms of species ecology, it is woodland openings (natural and anthropogenic) and forest edges within these vegetation zones where pulses in particular would have found suitable growing habitats. For the millets, streamside habitats and the lower hill slopes are the most likely environments.

Based on modern field data (Puri 1960; Puri et al. 1983), it is possible to model the distribution of these vegetation zones by way of a "potential natural vegetation" map (see fig. 1). This map can subsequently be modified in the light of the results of charcoal analysis and independent evidence on past climate change.

Of particular importance is the postulated mid-Holocene (5th to 4th millennium cal. BC) wet phase, which would have favoured forest expansion and thus the spread of wet deciduous woodland outside its present geographic limits on and around the Western Ghats. With the end of this wet phase (in the period from the mid-4th through the later 3rd millennium BC) it is also likely that the availability of the wild progenitors was severely reduced. Such a reduction in gathered wild plant food sources, together with other pressures on the subsistence base (such as likely changes in preferred animal habitats and hence the distribution of hunted species) could in turn have encouraged some groups practising hunting and gathering to take up cultivation, in a process comparable (at least in the ecological sense) to that proposed by currently available models on the beginnings of cultivation in Southwest Asia during the Younger Dryas cold episode at the very end of the Pleistocene (e. g. Hillman et al. 2001). This model of vegetation change may also have important implications regarding the geography of the origins of the Southern Neolithic. Essentially, it predicts that the beginnings of agriculture took place in those environmental zones that would have been most affected by a reduction in the availability of edible wild plant species (that is the Western Ghats and adjacent areas), and not in the arid central Deccan, the heartland of the Ashmound Tradition. This would imply that agriculture in the Ashmound Tradition was introduced at a later stage, either through the movement of groups from further west, or via the gradual adoption of crop species by pastoralist and hunter-gatherer groups.

At present, a data-informed evaluation and testing of this model of vegetation change and agricultural origins in South India is impeded by a lack of direct evidence. Seed remains have largely derived from likely sedentary sites, such as hilltop sites, which have generally better preservation of charred plant remains. Until now, almost all sites from which samples have been obtained date to Phase II of the Southern Neolithic. By that time, however, plant cultivation together with cattle, sheep and goat pastoralism had already been established. Therefore, earlier periods during which the transition took place (Phase I) remain to be elucidated. Increasingly it appears that during Phase I of the Allchins' chronology, settlement pattern was probably more mobile (being focused on cattle pastoralism), hence archaeologically less visible. While pastoralism during this period is indicated by the very occurrence of ashmound sites and the few studied bone assemblages with evidence for the presence of domestic cattle, the extent to which plant cultivation was an integral part of their economy remains unclear. It is theoretically possible that cattle were domesticated locally, but there is no evidence from bone remains to support this (cf. Korisettar et al. 2001b). It is indeed very likely that cattle were introduced in this region, which is also the case with domestic sheep and goat. The period at which the importation of animal domesticates must have taken place raises the possibility that domestic livestock and (more importantly perhaps) the knowledge of breeding techniques, spread among indigenous hunter-gatherers. Therefore it is likely that a herder-forager phase had preceded the beginnings of plant cultivation in Central Deccan. This hypothesis, although in need of conclusive empirical demonstration, makes the most sense of the incomplete archaeological and archaeobotanical record currently available.

The charcoal analysis project: reference collection and preliminary results

Charcoal analysis consists of the microscopic examination and identification of wood charcoal fuel macro-remains retrieved from stratified archaeological deposits (see e. g. papers in Thiébault 2002). Its main advantage compared to pollen analysis is that, at the site level, it can offer (when appropriate sampling and analytical procedures are followed) a very detailed record of local, small to medium-scale changes in past vegetation. Such changes are in turn very rarely picked up by more traditional methods of palaeobotanical research such as pollen analysis. Pollen analysis requires for this purpose the presence of a dense network of suitable coring sites (such as lake sediments), a condition that is almost universally absent outside the Northwest European and North American temperate zones. Furthermore, in arid and tropical environments poor preservation of organic materials in sediments means that high resolution, well dated pollen sequences may be equally rare. By contrast, stratified charcoal macro-remains can offer a vegetation record which is contemporary to the period of prehistoric habitation and thus, by definition, most relevant to the scales of analysis required by archaeological research.

Previous analyses of charcoals from southern Neolithic sites are rather limited. The most recently published is a compilation of data by Vishnu-Mittre and Savithri Ravi (1990) from the sites of Tekkalakota, Sanganakallu and Hallur. Examined specimens were handpicked from charred remains that were visible during excavation, without the systematic application of water flotation. Such results have therefore little quantitative value and can serve at best as indicators for the presence or absence of individual plant taxa in past woodland vegetation, with no information being available (for example) on the relative proportions of fuel types used in the past. Charcoals are reported to derive from a number of tree taxa such as *Soymida febrifuga, Acacia, Albizia, Anogeissus, Holarrhena* and *Polyalthia* (Vishnu-Mittre/Savithri Ravi 1990). There is, however, no objective way to verify or

SGK & HGD	Hallur
Acacia	*Anogeissus*
Albizia	*Acacia*
	Dalbergia
Mangifera? (SGK)	*Terminalia*
	Tectona
	Ziziphus
	Euphorbiaceae (cf. *Securinega*)
	Bauhinia type
	Mangifera?
	Cassia type

Fig. 2. Major plant taxa found in charcoal samples from Sanganakallu (SGK), Hiregudda (HGD) and Hallur (analysis by E. Asouti).

evaluate these identifications, because neither the precise microscopic anatomical criteria used for charcoal identification nor the micro-photographs or detailed descriptions of the taxa in question have been included in this and earlier publications.

In order to establish some objective criteria for the microscopic identification of ancient charcoals, it was necessary to build a comparative collection of wood from modern trees and shrubs. For this purpose the first author undertook a field survey of different vegetation zones in the region, aiming primarily at the collection of wood specimens. The main part of this survey covered a transect through the core area of the Southern Neolithic in the Bellary District, and extended into the wetter areas of the Western Ghats. In total, 151 wood specimens were collected, of which 68, corresponding to 31 families of native trees and shrubs, were selected for laboratory treatment (thin sectioning, staining and mounting on glass slides) and description of their microscopic anatomy. The results of this analysis will be published by the first author separately and will become available for use by other researchers in future analytical investigations.

Following the construction of the reference collection, the first author undertook a pilot assessment of samples from three sites that are located in contrasting environmental zones: Hiregudda and Sanganakallu (in the *Albizia-Acacia* thorn scrubland zone), and Hallur (in the wet deciduous forest zone). Figure 2 shows the taxa present in these sites (see also fig. 3).

Conclusions and future research

1. The distribution of vegetation zones during the Neolithic

According to these very early results, our model for the distribution of the vegetation zones would seem to be verifiable. The sites associated with ashmounds in the drier Bellary District have given evidence for the thorn vegetation characteristic of the area to this day. The contrast with Hallur in the deciduous forest zone could not be more obvious. Of course much more analysis is required, in order to obtain reliable quantitative results from more sites and, furthermore, a coherent picture of woodland composition and its temporal and spatial variations.

2. Human impact on past vegetation

Our model for past vegetation change recognizes the Bellary area as part of the dry savanna zone of the Southern Neolithic. Yet, the exclusive presence so far in the charcoal record of only the two major thorn species *(Acacia* and *Albizia)*, strongly suggests that the natural vegetation had already been for many generations under the pressure of intensive human activities, especially the grazing and browsing by domestic animal herds which had all but eliminated more palatable species. Examination of charcoal from earlier phases of these and other sites in the same area will hopefully demonstrate the validity of this hypothesis, with evidence for the gradual impoverishment of woodland vegetation and its domination by thorn species that were unpalatable to domestic animals. This in turn would have major implications for the consideration of savanna scrubland as an anthropogenic instead of a natural (i. e. climatically controlled) vegetation type.

3. Possible evidence for arboriculture

Thus far our best evidence comes from Hallur and Sanganakallu with the presence of what appears to be remains of mango *(Mangifera indica)*. For Hallur such occurrence may be little surprising, since this vegetation zone is frequently home to abundant and dense stands of mango trees (first author's personal observation). For Sanganakallu it is, however, more difficult to interpret. It may indicate the occurrence of this species exceptionally in woodland stands growing around natural springs (since the area would have been otherwise too dry for this species). The cultivation of mango trees (not necessarily systematic or at a large scale) is another possibility. Finds of mango fruit remains (likely to be present among the fruit remains) offer additional credence to this alternative. If the presence of mango is verified beyond reasonable doubt by further finds of wood and fruits in the Sanganakallu samples, its implications are very important: It would suggest the removal of this species from its natural habitat and its cultivation under conditions of irrigation in the Bellary area, from as early as the Neolithic.

Clearly the application of the methodology of charcoal analysis has exciting potential for the investigation of the environmental and cultural setting of the Southern Neolithic. Although more definitive statements are still far off in terms of achieved results, we hope that our paper has

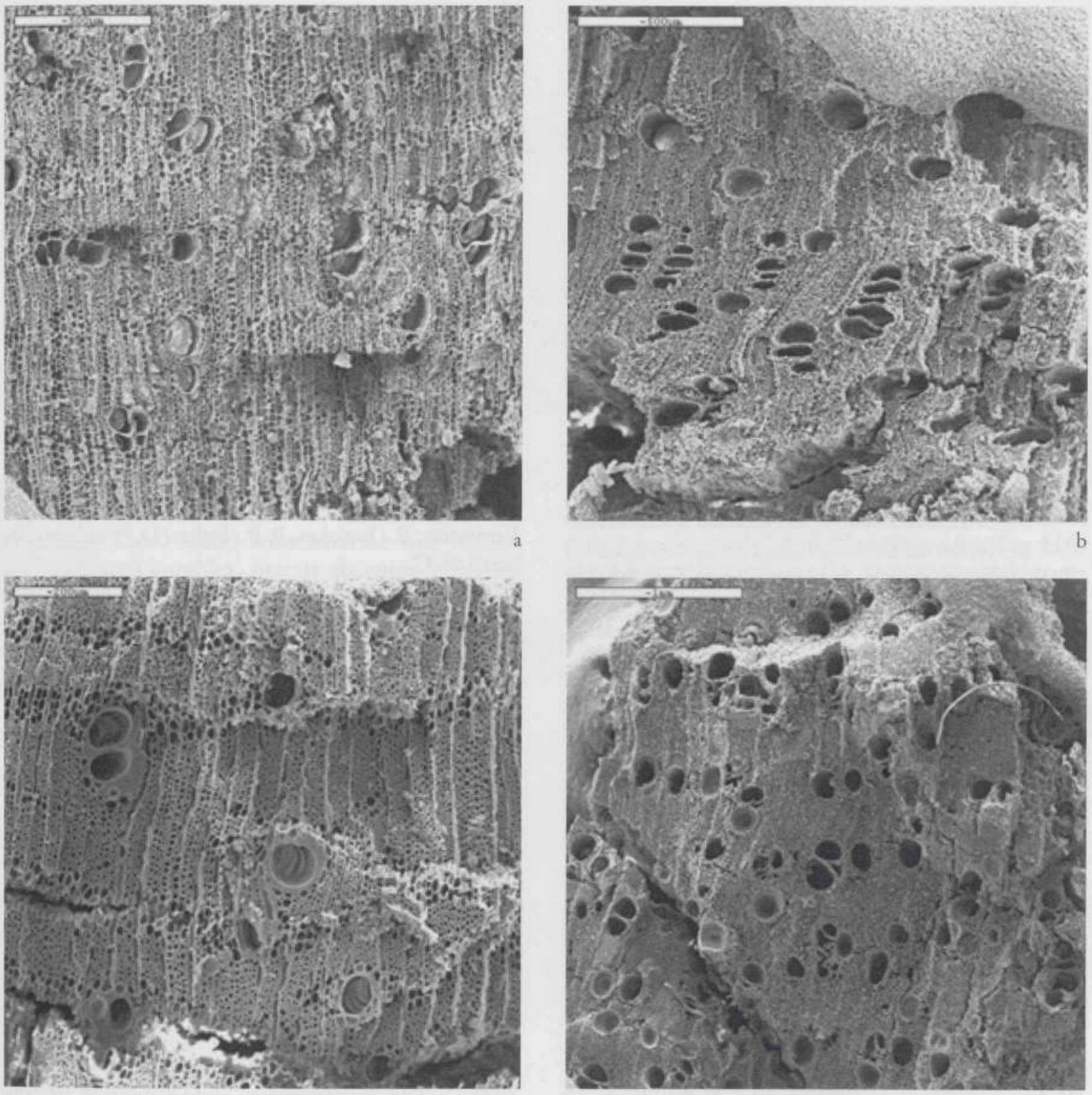

Fig. 3. Examples of charred specimens from the site of Hallur: a. Anacardiaceae (cf. *Mangifera*), b. Leguminosae-Caesalpinioideae (cf. *Bauhinia*), c. *Dalbergia* sp., d. *Tectona grandis.* SEM microphotographs by E. Asouti.

demonstrated the relevance of an approach based on the principles of environmental and (broadly speaking) landscape archaeology, for achieving a more in-depth understanding of the Southern Neolithic. This is the case not simply because we can learn what prehistoric communities used as food, fuel and fodder or what was the environmental setting of their habitation sites, but (more importantly perhaps) because environmental archaeology provides us with the appropriate research questions as to how such activities and choices came about in these particular socio-economic and ecological contexts, and with the methodological tools to address them.

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