10. Subsistence system models and plant food production in prehistoric East Timor: a conclusion

This final chapter revisits the data previously discussed and argues their importance to understanding subsistence systems used in East Timor during the late Pleistocene and the Holocene. It also discusses and puts into perspective the new plant information regarding the local and wider regional models of subsistence during this period. The human occupation of the BCUM site is analysed using archaeobotanical evidence, the phytolith record, and the remaining archaeological lines of evidence. Finally, based on this combined evidence it is argued that the subsistence system strategy used by human groups in East Timor throughout the Holocene until recent times was founded on the exploitation of a variety of resources that have long been in use.

10.1 Matters of food plant use: the new archaeobotanical data in context

The archaeobotanical data presented in chapter 8 and discussed in detail in chapter 9 suggest that a number of fruit and nut trees as well as tuber crops with important economic uses, have long played a role in the subsistence system strategies used by prehistoric populations in East Timor. With the exception of cf. *Colocasia esculenta* and members of the Fabaceae family, only present in pottery-bearing layers of the sites analysed, all other economic plant remains identified were present and presumably targeted by human groups in East Timor since the early- to mid-Holocene and possibly the late Pleistocene. It is possible that *C. esculenta*, the remains of which preserve poorly and so are difficult to detect, could have been present in Timor from an earlier period but at this stage it is not possible to confirm it. At Jerimalai, in the eastern end of East Timor, member(s) of the cf. Arecaceae family were identified in layers older than 40 ky, suggesting that one or more species within this family (which in the area investigated includes *Areca catechu*, *Arenga pinnata*, *Borassus flabellifer, Cocos nucifera, Corypha utan* and *Metroxylon sagu*) were targeted by the first human populations for which there is a record in East Timor.

The importance of these finds for an understanding of issues of subsistence and cultural practice in East Timor during the late Pleistocene and the Holocene should not be underestimated. The new archaeobotanical data suggest a continuum of food plant exploitation during several millennia with no major changes registered across the pottery-transition boundary around 3800 – 3600 cal BP. If we except the identification of *C. esculenta*, for which, however, there is much older evidence further east in New Guinea (cf. for example Denham 2003 and Denham *et al*. 2003) and the Fabaceae remains only present at Telupunu within the last ca. 1200 years, the emergent picture in terms of plants with the potential for food production in East Timor is one where the major changes only occurred within the last ca. 500 years after the first European contacts.

As noted in the introduction to this study, *Zea mays* and *Ipomoea batatas* are amongst some of the most important crops in East Timor today and these are of New World origins. Contrary to what is likely to have happened in Polynesia, where the presence of sweet potato in pre-European archaeological contexts suggests some degree of cultural contact between South America and that region in pre-Columbian times (see, for example, Yen 1974; Hather and Kirch 1991; Hather 1992), there is little in the archaeobotanical record of East Timor to suggest that this may have been the case here.

Use of caves and rock shelters to corral domestic animals is common practice in the Baucau region and other parts of East Timor today. The caves are walled, and animals are penned overnight. The resulting manure-rich floor cover is then removed and used to fertilise nearby gardens. Both these cultural practices would militate against the survival of the most recent cultural deposits and account for the paucity of occupation evidence spanning the last few thousand years. Activities relating to food processing and use may thus not be well represented for the last millennia, making it additionally difficult to detect the timing of arrival of crops introduced during this time.

As outlined, most plant identifications in this study were obtained using SEM. When the identified remains are compared with the totality of charred plant material recovered for each site (or even with the quantity of plant material ascribed to each non-woody category analysed), it is apparent that only a very small fraction of specimens was analysed using this technique. For this reason, quantification of specimens attributed to each identified species is not possible at this stage. The only exceptions are those cases where identification – even if at a lower level of confidence – is possible using low-powered bifocal or stereoscope microscopy only (e.g. morphologically distinctive seeds, when intact). At this stage, therefore, the

interpretation of the assemblages previously discussed can hardly go beyond signaling the presence *versus* absence of plant families, genera and species at each of the investigated sites.

Despite allowing addressing the utilisation of plants themselves, the presence *versus* absence criterion is limiting for various reasons. First, it is difficult to claim the importance of certain plant species in the past based on the presence of one or a few specimens only. As noted elsewhere, preservation of macrobotanical remains in archaeological sites is dependent upon the plant part itself. Different plant parts preserve differentially, with some types of hard nutshell fragments, seeds and wood charcoal being more commonly preserved in archaeological contexts, and parenchyma and fragile fruit/seed remains being more easily affected by post-depositional factors and thus rare. Even when post-depositional conditions are conducive to the preservation of charred plant materials, as they were at BCUM and Telupunu, very few remains of the non-woody types preserved. If the agricultural signal we are looking for is one based on a diverse range of tree and tuber crops rather than the presence of a single dominant crop, it will be more difficult to recover good sample sizes of plant material.

The agricultural practices observed during fieldwork in 2005 around BCUM confirmed the use of a diverse range of food plants as had been previously noted by Metzner (1977). In an unpredictable environment where prolonged dry weather and an irregular wet season are the norm, diversity of resource exploitation seems to be the preferred subsistence strategy to avoid potentially catastrophic food shortages. The archaeobotanical record from East Timor appears to reflect this type of strategy in the sense that diversity of plant species in small numbers rather than significant amounts of one single plant resource were recorded.

On the other hand, the presence or absence of some type of food plants in archaeological sites will also reflect site function and the types of activities pursued there. For example, whether these are habitation sites and if so, whether they were temporarily or permanently occupied, will impact on the nature of the food type consumed, i.e. some plants are directly gathered or harvested and consumed, while others such as rice and the starch-rich pith of some trees go through different stages of processing before storage and much of the plant may be discarded away from the habitation site. Glover suggested that although the nature of the subsistence strategies may have changed through time in East Timor, the cave sites he investigated had not seen any major change in the nature of their use. According to Glover, this had to do with the fact that caves are used mainly as temporary shelters by hunting parties or by family groups while working in gardens distantly located from their homes (Glover 1986:206). Although Glover invoked the lack of significant ethnographic data documenting the use of

caves as permanent habitation sites, in Timor and elsewhere, to support his hypothesis, a recent paper by Pannell and O'Connor (2005) provides significant new anthropological and ethnographical information on contemporary cave use, suggesting that caves in Timor have always been central places with a diversity of uses including habitation. The study documented one cave in Baucau being used as a permanent occupation site and described the life of the occupant as a "picture of near self-sufficiency" (Pannell and O'Connor 2005:200). Corn, beans and yams were grown in gardens below the site and corn and beans were dried and stored in the cave. Tobacco was grown in the rich soil at the cave mouth and papaya, mango and breadfruit were grown along the drip line at the entrance, utilizing the natural water seepage. According to Pannell and O'Connor, the importance of caves and rock shelters to past communities should probably not be measured just in terms of how much material culture we find in them, but as central places connecting "people to the wider physical and ideological landscape" (Pannell and O'Connor 2005:2004).

Glover's hypothesis, of course, was intimately related with the fact that he had not found much evidence of prehistoric open sites (still largely missing in the East Timorese archaeological record of the last ca. 4000 years), and that direct evidence for the introduction of cereal agriculture, which he believed had been introduced to Timor with the first pottery and animal domesticates, was also virtually absent in all sites he analysed. Despite the lack of evidence Glover hypothesised that fully agricultural practices were suggested by the presence of indirect proxies, such as pottery and animal domesticates. This type of reasoning has long been present in the archaeological literature and is recurrently used to explain processes of expected change in subsistence system strategies related to exploitation of plant resources, when evidence for some degree of cultural change is present (cf. for example Spriggs *et al*. 2003:49, where abandonment of pre-pottery shell middens as "vestiges of a pre-agricultural mobile settlement pattern" was explained by the "arrival of agricultural lifestyles on Timor").

Regarding the nature of food types consumed in archaeological sites and their archaeobotanical expression, the better that plant management practices are ethnographically documented the more we can learn about how food plants are processed and may preserve archaeologically. As Paz noted, there seems to be a correlation between the different ways in which *Colocasia* and *Dioscorea* are prepared and consumed and the way they preserve archaeobotanically, with the first more exposed to accidental charring and thus more commonly found in archaeological sites (Paz 2001:269). During fieldwork in the Baucau area it was observed that despite the common availability of other seasonal plant resources, the starch-rich trunk of the *Metroxylon sagu* palm was regularly being cut and transported to be

processed and stored as a famine food (plates 10.1 and 10.2). Considering how prominent remains of Arecaceae were at BCUM (and at most other sites analysed), it would not be surprising that some of these archaeological plant remains could indeed represent exploitation of one of the sago-producing palm trees existing in East Timor today. In that sense, the future analysis of the charred wood remains from these sites may help elucidate this question.

Plate 10.1: Starch-rich trunk of *Corypha utan* palm.

Plate 10.2: Transporting the trunk of *Corypha utan* palm near Osso Ua/Uaisa village.

Another limitation derived from the presence *versus* absence criterion that we have been discussing has to do with achieving identifications of plant remains from archaeological sites with higher degrees of confidence. When gross morphological features are not helpful, this can only be achieved with the use of SEM. When comparing the results obtained in the course of this study with published data from elsewhere, one has to assume that identifications proposed by most authors are correct as most of these are still not supported by SEM images or indeed measures of confidence.[1] The problem here, as this study clearly shows, is that there are diagnostic features for the identification of plants to species, genera and family levels that can only be determined using SEM. As some species within the same family (and even from different families, as seems to be the case with *Terminalia* and *Inocarpus*) show close resemblances. They are difficult to distinguish if the specimen is not large enough to preserve enough diagnostic traits, and so erroneous identifications based on gross morphology only can be expected. The issue of using SEM and reporting the resulting images may have implications in the acceptance of some published literature. In the study conducted by Lepofsky *et al.* (1998) the interpretation of results of metric analysis was not supported by anatomical identification criteria and SEM work. This suggests that their discussion on evolution through

[1] The most outstanding exception to this is Paz's doctoral work and some later published papers of his.

time of size and shape of some fruits from Near Oceania may have actually been based on research which instead incorporated specimens from more than one species (Jean Kennedy pers. comm.).

The identification of suites of plants at most sites analysed within this study has provided one additional line of evidence to understand the subsistence strategies used by human populations in East Timor during the late-Pleistocene and the Holocene. The use of plants as food resources in Timor is certainly as ancient as humans themselves there, and the importance of these to understand models of subsistence and cultural exchange in the region is briefly discussed below. Before that, however, a note must be added on whether we should view these identified archaeological plant remains as the result of gathered, cultivated or domesticated resources. As Fairbairn notes, from an archaeobotanical perspective it is very difficult to distinguish between domesticated and non-domesticated populations of many plant species, and especially tree crops (Fairbairn 2005:5; see also Yen 1985). This has mainly to do with the fact that there is little control over reproduction and dispersal of trees, which accounts for the difficulty in distinguishing genotypic and phenotypic traits in populations of wild and domesticated plants. This distinction, however, may not always be significant as domestication itself is "not a prerequisite for use of a plant in tropical cultivation systems" (Fairbairn 2005:5).

Metzner reported that many useful trees and bushes that were planted in gardens and around houses elsewhere in the Indonesian region were wild in the area he investigated in East Timor. Despite noting that most land had usufruct rights and that some important trees were personally owned, Metzner (citing a Food and Agriculture Organization report from 1960) observed that the list of cultivated plants in East Timor was considerably smaller than in neighbouring eastern Indonesian islands and suggested that this was due to the long duration of the dry season there and the fact that Timorese farmers relied heavily on wild plant resources (Metzner 1977:138-139). Amongst the plants that Metzner listed as wild in East Timor were *Tamarindus indica*, *Psidium guajava*, *Metroxylon sagu*, *Cordyline fruticosa*, *Bauhinia tomentosa*, *Leucaena leucocephala*, *Zizyphus mauritiana* and *Arenga pinnata*. With the exceptions of *L. leucocephala* and *B. tomentosa*, of probable New World origins, all the rest may have been in Timor for many millennia and, as we have seen, none is strictly speaking "wild". In the vicinity of BCUM along a stream that runs 2 kilometres west of the Osso Ua/Uaisa village, there is a large plantation of Arecaceae that includes *Arenga pinnata* (an important sugar palm), *Corypha utan* (from the trunk of which sago is extracted and the sap is used in producing the alcoholic beverage locally known as *tuak*), and *Cocos nucifera*. Besides

food produce, all these trees also provide important building materials and wood. This plantation and other small groves of the same trees elsewhere on the Baucau Plateau are extremely important in the Kaisido area of which Osso Ua/Uaisa is one of the villages. The trees are owned by one of the two dominant social groups in the area and are subject to strict usufruct rules. To an external observer, however, they may just look like wild or unattended trees growing alongside a water source.

These examples recommend that we re-centre the discussion in the plants rather than in any *a priori* models that attempt to explain their presence or absence in the archaeological record through other –usually indirect – lines of evidence. As Kennedy rightly points out, the theoretical and technical problems surrounding its definition suggest that "it is less appropriate to regard domestication as a qualitative state at one end of a continuum than as a continuing process" (Kennedy 2004:12). So it is advocated here – as Fairbairn does – that we should set about "ditching the baggage of domestication and focusing on what people do with plants" (Fairbairn 2005:491). From an archaeological perspective, that essentially means giving priority to analyses of plant assemblages recovered from archaeological sites (Fairbairn 2005:491). At the same time, we need to look at plant foods as part of a more inclusive subsistence system, one that looks at resource management as a whole. As Brookfield (2001:55) suggested, "the farm does not end where the field meets the wood", and so too our understanding of plant-human interactions will improve if we consider these resources as part of a more holistic system of managing subsistence economy assets. The following section therefore looks at the forest rather than the tree, putting plant resources into perspective and integrating the results of the archaeobotanical study with the overall archaeological findings from East Timor.

10.2 Matters of subsistence: the archaeobotanical and the archaeological records in East Timor

The previous section discussed matters of variable preservation of charred plant materials in archaeological sites and the implications of this in understanding subsistence strategies In East Timor based on the exploitation of plant resources. The following section discusses the plant resources and puts them into perspective and into a wider frame, one that includes other types of food resources. These include maritime or freshwater (mostly fish and shellfish) and

animal (wild or domesticated) resources. Other expressions of material culture that may help elucidate issues of subsistence and cultural contact are also briefly discussed.

As noted in chapter 8, the remaining lines of archaeological evidence recovered from excavations at BCUM have not yet been analysed in detail and only numbers and weights have been provided. Within these, marine shellfish clearly stand out as the most conspicuous material evidence, suggesting that gathering of this coastal resource has played an important role in the subsistence economy of the populations that occupied BCUM and the other sites analysed during the Holocene and the late Pleistocene. The abundance of marine shellfish remains in coastal or near-coastal archaeological sites in East Timor was initially reported by Glover (1986, especially at Lie Siri) and seems also confirmed within Holocene and Pleistocene layers at other sites excavated in East Timor (O'Connor and Spriggs pers. comm., quantification of shellfish remains from these sites has yet to be published). The absolute importance of this type of resource, when compared with the plant assemblages discussed, is hard to determine at this stage as shell is not affected by post-depositional factors in the same way as macrobotanical remains. Its abundance throughout the caves' periods of occupation as human shelters, however, suggests a relative high importance whenever this type of resource is available[2].

Sea urchin, crab and small quantities of fish remains were also present at all sites (although in much smaller numbers relatively to marine shellfish) and analysis of these is pending (O'Connor and Spriggs pers. comm.). The presence of two shell fishhooks in square F at Lene Hara, one directly dated to 10,782 – 10,476 cal BP and the other to 7501 – 7294 cal BP (O'Connor and Veth 2005:252; see also appendix 3 in this study), in association with remains of pelagic fish species clearly suggest that fishing in the open sea was part of the economy of the occupants of that site from very early on. Interestingly, in Horizon five at BCU (50 metres from the BCUM site investigated in 2005) Glover found another shell fishhook. This Horizon has recently been re-dated to 10,591 – 10,247 cal BP (Selimiotis 2006:367), a date that overlaps with the one obtained for the older fish hook from Lene Hara. Direct AMS dating of the BCU fishhook, as long as it is not formed from fossil shell, would reinforce the suggestion that these

[2] During fieldwork in 2005, significant scatters of marine shellfish remains were noted covering the ground around the village of Osso Ua/Uaisa. Following an initial suggestion that these could still be gathered from the nearby coastal zone, an attempt was made to collect some modern shellfish. However, this proved unsuccessful and it seems that this type of resource has since become unavailable.

types of fishing practices are ancient and clearly pre-date the introduction of Austronesian influences within East Timor (O'Connor and Veth 2005:255).

As to terrestrial resources, they have also not yet been quantified at BCUM or at any of the other sites investigated. As initially reported by Glover (1986:196-197), the only native mammals present in pre-pottery layers at the sites he excavated were large rodents and bats. Glover noted that cuscus (*Phalanger orientalis*) from the east entered the archaeological sequence more or less at the same time as pottery and other animal domesticates coming, in contrast, from presumably Asian sources (pig, civet cat and macaque, all present at Uai Bobo 1 and 2). Evidence for the presence of this phalangerid marsupial in Timor, however, now dates back to about 10,000 to 8000 BP (O'Connor 2006:83). The cuscus remains represent a significant find, suggesting some level of contact between populations in East Timor and New Guinea or the Moluccan Islands, from where this species must have been translocated at this early period in time (Heinsohn 2005). As an individual line of evidence, it thus gives credence to the hypothesis that some level of interaction between human populations in these regions must have occurred long before the introduction of pottery, and that we could also expect to see plant translocations from the east reflected in the archaeobotanical record analysed.

The confirmation by the ETAP team, and later by O'Connor and Aplin (2007), that an impoverished faunal suite marks the archaeological record of East Timor before the introduction of pottery (present only from ca. 3800 – 3600 cal BP), and domestic animals, reinforce the idea that faunal resources were not abundant before this period and would not have played a significant role in the subsistence system until then. As previously noted, Glover also reported the presence of other animal domesticates within pottery layers such as sheep/goat, pig and bovid but none of these remains were directly dated, and the age Glover suggested for the introduction of these species (i.e. with pottery) would be better seen as tentative for now. Of these species the pig is more certainly an early introduction, given dates for its introduction to northern Maluku and the western Pacific before 3300 BP (Bellwood 1997).

Also significant and reinforcing the suggestion made above of early eastern contacts is the presence of earth oven features in East Timor from early- to mid-Holocene contexts (at Macha Kuru 2 and BCUM, respectively). Regarded as representing the "quintessentially Melanesian form of cooking" (Spriggs 1997:60), the presence of earth ovens in Timor now seems to pre-date the oldest known evidence for similar type of structures in New Guinea where they presumably originated. It is possible that the presence of this distinctive cooking technique in

both regions also signals cultural interaction and exchange in subsistence technology at an early date (O'Connor 2006). It is perhaps no coincidence that earth ovens are a preferred cooking technique for tubers and tree pith in the Pacific where they are still widely used today.

Another expression of material culture that could potentially be associated and inform on the introduction of new food resources into Timor is metals. Evidence for metal in archaeological sites in East Timor, however, remains elusive. Glover reported one single copper ornament, interpreted as an earring, from Uai Bobo 1, in association with a radiocarbon date of 2344 – 2000 cal BP (ANU 237). As noted elsewhere in this study, Glover did not believe that this object alone should be used to support a date for the introduction of metals into Island Southeast Asia (Glover 1986:153). Despite the fact that this date seems to be in good agreement with dates for metal and glass bead introduction elsewhere in Island Southeast Asia (Spriggs 1998:59; and cf. Spriggs 1989), the fact remains that almost no other evidence of metal has been reported from East Timor archaeological contexts. The few iron fragments recovered from the topmost spits at BCUM have been described earlier and do not seem to add much to the issue of dating metal introduction in East Timor. Dating the introduction of metal together with the investigation of its possible place of origin are important and could potentially help clarify the antiquity of some plant crops and animal domesticates of South and Southeast Asian derivation. As previously seen in chapter 6, some of the vegetable pulses documented in the area investigated have presumably come from South Asia and could have been introduced to East Timor through cultural exchange at a similar date as metal and glass beads.

10.3 Concluding remarks: plants in the past, plants in the present, plants for the future

As discussed in previous chapters, the investigation of prehistoric subsistence system strategies in East Timor suggests that these strategies have always been markedly diversified. Within this diversity, sophisticated plant management practices have presumably played an important role and may have remained significantly unchanged until very recently. As a shift in use in most sites investigated in East Timor occurred within the last ca. 2000 years, the only major change in these subsistence systems that it is possible to detect (from a plant management perspective) is provided by post-European historical accounts. The archaeobotanical record obtained through both the macrobotanical analysis and the phytolith data suggests a continuum of strategies punctuated by some introductions and adaptation, rather than substantial changes or discontinuity motivated by replacement.

In practical terms, what these conclusions point to is the need to investigate matters of past plant management practices primarily through direct lines of evidence, such as macrobotanical remains and phytoliths, as indirect ones such as the presence of pottery or animal domesticates can be misleading. As we have seen too, even when these direct lines of evidence are used the interpretation of data specifically collected to investigate directly subsistence practices based on the use of plant resources has its own problems. Despite such impediments, however, systematic recovery, analysis and identification of charred plant materials from archaeological sites have proved to be vital tools in gaining insight into the history of plant management practices in East Timor.

The archaeobotanical investigation of food production in this part of the world has seen significant progress in the last few years, with important work showing evidence for early use of edible tubers (Paz 2001) and fruits and nuts (Fairbairn 2005). Large-scale multidisciplinary projects such as the one conducted at the Kuk site, in Papua New Guinea (Denham 2003) may not always be feasible, but sound individual lines of evidence clearly produce a more accurate record than general theories with little or no archaeobotanical evidence to support claims for particular plant-use strategies.

In the first part of this study, five main research goals were outlined and these guided the investigation to produce the results discussed so far. Let us return to those research goals and briefly cross-check them. The principle objectives that this research set up to investigate were:

1. Determining the range of plants used as food resources in the sites investigated;

2. Investigating changes in food plant use across the pottery-introduction boundary;

3. Investigating the antiquity of cereal-based agriculture in East Timor;

4. Obtaining a local palaeoenvironmental record from around BCUM through phytolith analysis; and

5. Contributing to the development of state-of-the-art archaeobotanical practice in the region.

Regarding the first two goals, they have been discussed in the previous sections. Despite the fact that certain plant taxa were identified only to lower degrees of confidence, there is enough evidence to suggest diversity and continuity in the plant subsistence systems practiced by communities living in East Timor during the time frames investigated. The approach chosen to identify charred plant remains that in many cases did not contain enough diagnostic

features, against a collection of reference material that was limited to a certain number of plants noted by one researcher only in the 1970s, had necessarily to be a conservative one. For that reason, some identifications were kept to the lowest species' level of confidence and sometimes only to genus or family. Nevertheless, a significant number of plants with economic uses and edible properties were identified at all sites analysed. At sites with evidence of occupation during the Holocene, the suite of plants identified (both through macrobotanical analysis and the phytolith record) showed a continuous trend, with most species identified from early to mid-Holocene layers and across the pottery-introduction boundary. The overall picture provided for sites with a Pleistocene occupation is not as clear, essentially due to the lack of good preservation of the archaeobotanical remains. The identification at Jerimalai of member(s) of the cf. Arecaceae family in layers older than 40 ky, however, suggests that one or more species within this family were being targeted for their economic uses and possibly as a food resource.

As to the age of cereal-based agricultural systems in East Timor the issue remains, archaeobotanically speaking, elusive. With the possible exception of *Coix lachryma-jobi*, neither the macrobotanical evidence nor the phytolith record show clear signs of the introduction of cereals before the first European contacts. It is still the case that the best available information remains that provided by historical records: *Zea mays*, one of the most important cereal staples in East Timor today, was most probably introduced by the Portuguese shortly after their arrival in East Timor. Regarding the remaining cereals with current economic importance, the picture is also unclear. *Oryza sativa*, despite being reported in early historical accounts (Pigafetta 1969, originally published in 1525), is not present in any of the archaeobotanical assemblages analysed. As to *Coix lachryma-jobi*, besides the only available macrobotanical record reported by Glover in layers at Uai Bobo 2 dated to 17,385 – 14,206 cal BP, the phytolith evidence also suggests its presence at BCUM in layers dating to 7274 – 7000 cal BP. It is known that this cereal is edible and the possibility remains that it may have been more widely used in the past than it is today. Nevertheless, its presence in Timor from such an early stage suggests that it was either locally available or had been brought into cultivation in East Timor long before other cereals putatively associated with the Austronesian dispersal. On the other hand, the half-seed case from the same site tentatively identified as *Setaria Italica*, was not directly dated and was located within a layer above the topmost radiocarbon date obtained at Uai Bobo 2. The implications of this have been pointed out earlier in this study, and it was suggested that this specimen needs to be directly radiocarbon dated before it is

accepted as evidence for the presence of cereal agriculture within the time frame accepted for the introduction of pottery in East Timor.

On the other hand, and as discussed in the previous chapter, the palaeoenvironmental record provided by the phytolith samples recovered from BCUM is consistent with the analysis obtained through the macrobotanical remains. This record indicates clearance of vegetation by fire around BCUM from the early to mid-Holocene and a shift from a treed landscape to grassland within the latest period of the cave's history. Despite the suggestion by Lentfer that this shift may be associated with more intense landscape management practices possibly associated with the introduction of cereal agriculture, evidence for this in the form of phytoliths is absent. As the timing for that shift is only bracketed by the two topmost radiocarbon dates, i.e. 1890 – 1700 cal BP in layer 6 and 141 – 24 cal BP in layer 2, it is possible that cereal agriculture could only have been introduced at a much later stage, possibly with the first European contacts in the 16th century. Otherwise, there is nothing in the phytolith record suggesting that agricultural practices during the Holocene impacted significantly on the vegetation around BCUM, with shade-intolerant grasses and regrowth forest elements present throughout most of the sequence and suggesting a more open forest vegetation throughout the period.

Finally, this study clearly demonstrates that the use of a comprehensive archaeobotanical approach to archaeological investigation produces useful data in investigating directly past plant management practices. The complexity surrounding archaeobotanical studies and the general assumption that macrobotanical remains do not always preserve well in tropical and semi-tropical environments have often resulted in the use of indirect lines of evidence to explain human-plant interactions in the past. As clearly shown in chapter 3 of this study, the amount of archaeobotanical information available in this part of the world, mostly produced within the last 40 years or so, is not particularly comprehensive. With the exception of Paz's systematic approach in the last decade and a few other isolated examples in Island Southeast Asia and Near Oceania, it still remains the case that archaeobotany is not well integrated into most archaeological investigations carried out in the region. As demonstrated by the results shown here, plant remains not only preserve in semi-tropical archaeological sites, they also provide a unique perspective into plant management practices through time.

The archaeobotanical record of the sites analysed in East Timor, together with the archaeological data from these and other sites previously investigated in East Timor, suggest a subsistence system which has seen very few changes since the early- to mid-Holocene until the

16th century. The general pattern observed suggests diversity of resource exploitation, with the use of trees and tuber, a significant component of marine resources (especially shellfish in near-coastal sites), and exploitation of the impoverished wild fauna that for most of the Holocene has inhabited the Timorese environment (bats, rats and cuscus). At about 3800 – 3600 cal BP, pottery (or the knowledge that allowed making it) was introduced to Timor, and a number of domesticated mammals including dog, pig and goat/sheep start to appear in the archaeological record from then onwards.

This scenario largely suggests a continuity of resource exploitation in East Timor, starting around 40,000 ky ago with the first evidence for a human presence in the island (cf. O'Connor 2007). These first populations probably brought with them the knowledge that allowed the exploitation of existing tree resources, and it is possible that some of these trees were translocated from elsewhere. The suggestion made by Latinis (2000) that agricultural practices in this part of the world may have had their roots in the Pleistocene seems to be strongly confirmed in East Timor. This scenario of continuity in plant resource exploitation and the absence of marked changes in the archaeobotanical record of East Timor across the pottery-introduction boundary also suggest that plants, pots and other expressions of culture do not necessarily travel together and that greater caution should be observed when ascribing to past populations the knowledge of certain agricultural practices without direct evidence for them. On the other hand, this continuity and clear lack of an archaeobotanical signal for the introduction of cereal crops in East Timor at the time of other introductions – especially pottery and animal domesticates usually seen as the result of dispersion of populations of an Austronesian origin – also gives credence to the view that this dispersal was not fuelled by agriculture (Bulbeck in press). The overall view, as the archaeological record of some parts of China summarized in chapter 3 clearly indicates, is that we may find pottery and domesticated animals in sites throughout the region without any clear signs for cereal agricultural practices being present.

It should be noted that despite the differences in terminology in much of the literature dealing with agricultural origins and plant management practices in the past, the view taken here largely follows that expressed by Kennedy and Clarke, following Purseglove (1974) and Brookfield (2001), in suggesting that the distinction between horticulture and agriculture should be disregarded (Kennedy and Clarke 2004:5). When considering the archaeobotanical record of East Timor and that of other parts of South, Southeast Asia and Near Oceania, a pattern of plant resource exploitation emerges, one that has been overlooked in much of the archaeological and archaeobotanical literature. That pattern has to do with the presence of a

range of tree crops, usually considered as wild resources and not credited with their rightful value. The debate around the search for the origins of cereal agriculture may be pointed out as the main culprit in this situation, as much of the published plant evidence from China and Thailand (just to mention two examples, although cf. Yen 1977 for a different view) seems to suggest. As the recent debate between Fuller *et al*. (2007, 2008) and Liu *et al*. (2007) appears to indicate, it is probably time to revise our view of the importance of much of the plant evidence published earlier and consider the possibility that cereal agriculture in South and Southeast Asia, and elsewhere, is just a later addition to a continuum of previously in-place and much older plant management practices (cf. Fuller *et al*. 2007).

It is pointed out elsewhere in this study that the possibilities opened up through the use of archaeobotany to investigate past plant-human interactions are manifold, despite limitations inherent in preservation of plant remains, in the distinction between domesticated and non-domesticated species, and in the degrees of confidence to which specimens from archaeological sites can be identified. As already outlined by other authors (cf. Paz 2001:287, Fairbairn 2005) and as also clearly suggested by the outcomes of this research, an archaeobotanical approach and a direct integration of its methods at the onset of archaeological projects are highly recommended and should be pursued. A “focus on a contextual understanding of plant use practice", as Fairbairn (2005:16) defines it, and systematic flotation and wet-sieving techniques as ways of recovering evidence of food plants from archaeological sites, are amongst some of the necessary means if we are to understand the uses people made of plants in the past. Together with more ethnographic information on current use of plants and modern plant genetic studies to help understand their origins and trajectories, these approaches and methodologies will prove fundamental in providing the evidence with which archaeological models may be built to interpret archaeobotanical assemblages (cf. Fairbairn 2005).

Finally, the understanding of plant management practices long in use in East Timor is also fundamental as a way to address present and future economic opportunities in the country. It was noted at the beginning of this study that approximately 80% of East Timor’s population today survives on agricultural practices that could be broadly defined as being of a subsistence type. Besides possessing a number of domesticated animals, seen chiefly as an asset and exchange good and mostly consumed during ritual occasions, a considerable part of the East Timorese economy relies on a diversified array of agricultural crops that include some of the trees, nuts and tubers present in the archaeobotanical record of the last several thousand years. With the exception of those plant resources that were only introduced after the 16th

century and cash-crops of increasing importance such as coffee, the agricultural practices in which most of the population of East Timor are engaged represent the cultural expression of a unique *modus vivendi* that is possibly, as Kennedy and Clarke (2007:87) define it, “an anachronism in today’s world”. With a population of little more than a million and a fragile economy (despite rich but non-renewable fossil fuel resources), East Timor needs to look to the future without disregarding an agricultural knowledge that is an intrinsic part of its culture. That ancient agricultural knowledge, together with the use of caves and rock shelters, has in the last 30 years regained a central place in East Timor with many such places being used as shelters by the Timorese Resistance, who also fed from the many resources existing in the forest. In this sense, caves and rock shelters are seen today as "monumental landmarks in the nation's history", as Pannell and O’Connor (2005:204) rightly stressed, and the evidence recorded in them and discussed here should take a central place in the country’s narratives, both as past cultural expressions and as relevant knowledge for future generations.