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ECONOMY AND SETTLEMENT IN THE NEAR EAST:
Analyses of Ancient Sites and Materials

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Fig. 1:
Map of Near East showing sites mentioned in text.
CLEARING LAND FOR FARMLAND AND FUEL:
ARCHAEOBOTANICAL STUDIES OF THE ANCIENT NEAR EAST

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In a wooded region, clearing land of trees is probably the simplest way to expand farmland and provide fuel for a growing population. As long as there is sufficient wooded land people will be able to collect fuel. As land clearance proceeds, it will take more effort to collect fuel. Vegetation loss may lead to a permanent drop in the water table, increased runoff and wind erosion, and loss of seed sources for vegetation renewal. Such processes ultimately transform the landscape. Continued disturbance may eventually necessitate changes in settlement, agricultural production, and fuel procurement. These forces are clearly at work in today's world, but dramatic changes in the landscape are by no means restricted to modern times. For example, a recent study of environmental change in the southwestern United States showed that periodic abandonment of Anasazi villages resulted from the depletion of fuel resources near settlements, and that local changes induced by tree cutting, along with population growth, may eventually have led to agricultural intensification (Kohler and Matthews 1988). Land clearance can have a variety of effects, many of which leave traces in the archaeological record.

In the Near East, people have been actively modifying the vegetation for millennia (Köhler-Rollefson 1988; Miller 1991). The pace of change probably quickened during times of population expansion in areas of intensive settlement, and the third millennium B.C. was such a time. Although it is difficult to date episodes of land clearance, we use several lines of evidence to trace landscape change, including texts (Rowton 1967; Hansman 1976) and sedimnetology (Diester-Haass 1973; Nietzsche 1976). Although Diester-Haass attributes increased sedimentation in the Gulf to climate changes, one can easily imagine that deforestation in the Tigris-Euphrates drainage caused increased runoff and erosion. Archaeological and pollen evidence discussed below yields further evidence of deforestation. Wood was cut primarily to create agricultural fields and to provide fuel for domestic and industrial purposes. As trees were cut down near settlements, the composition of the woodlands changed, and alternative fuel sources were used more frequently. Detailed paleoethnobotanical analysis at Malayan, an urban center in the highlands of southern Iran, illustrates the environmental implications of an increased demand for fuel. Preliminary paleoethnobotanical results from Kurban Höyük, a small town in southeastern Turkey, suggest a similar pattern of tree cutting (Fig. 1). Since fuel remains from archaeological sites reflect local vegetation and plant use, one can assess the degree of environmental disturbance caused by people. In conjunction with the evidence of craft production, the magnitude of land clearance inferred from the archaeobotanical record allows one to monitor and interpret aspects of economic and social change.

Plaster and metal production

The people of the ancient Near East developed a number of fire-using technologies: lime and gypsum plaster production, ceramic manufacture, and copper metallurgy (cf. Wertime 1983). Floors, bowls, statues, and other artifacts made of lime plaster have been documented from the Epipaleolithic on (Kingerly et al. 1988). Metal use first appeared in Anatolia during the Aceramic Neolithic (Muhtly et al. 1987). Small quantities of pure native copper appear first, and early smiths may also have experimented with the more plentiful, colorful copper-bearing minerals, such as malachite (Kingerly et al. 1988; Rostoker et al. 1988).

Although many ceramics can be produced with relatively low quality fuels, the manufacture of both lime plaster and metals requires high temperatures and large amounts of fuel. For each ton of lime plaster produced, about two tons of limestone must be burned with two tons of fuel wood. Oxidic and sulfidic ores may be smelted down to copper with relatively simple techniques that use wood fuel (Rostoker et al. 1988); however, to smelt complex, weathered copper-iron sulfide ores it is critical that
the ore come into contact with charcoal for the chemical reduction to pure copper to take place (Rostoker et al. 1988). Wood, dung, and straw are not adequate for this process. The use of charcoal for fuel is relatively inefficient, as much of the heat value is expended by burning during its manufacture (Horne 1982). But even if the simpler technology employing only wood fuel was practiced, it would have taken more fuel to produce metal tools and vessels than comparable items made of clay, basketry, wood, or stone.

Local population increase in parts of the Near East during the third millennium can account for some forest clearance, since more people require more land to farm and more wood for cooking and heating. In many regions, per capita rates of fuel use probably also increased due to continuing use of plaster and pottery and the introduction of new metal technologies.

Malyan

One such area is the Kur river basin, located on one of the main land routes between Mesopotamia and the Iranian plateau. Malyan was a major highland center at the northwest end of the valley. The extant vegetation suggests that the site lies at the southeastern limit of the Zagrosian oak park forest zone, near the pistachio-almond steppe forest of southern Iran (Fig. 2). The region is semi-arid. Rainfall agriculture is possible, but irrigation considerably reduces the risk of crop failure.

Sedentary population in the valley seems to have declined drastically between the beginning and end of the third millennium. Malyan itself was virtually abandoned (Sumner 1989). The valley was resettled in the late third millennium (Kaftari period), and social complexity seems to have increased at that time as well. Population distribution and size changed, as suggested by an increase in the number of levels in the settlement hierarchy from two to four, and a dramatic increase in the total area covered by settlements (Fig. 3). At the beginning of the third millennium B.C. (Banesh period) Malyan was about 40 ha. At the beginning of the second millennium (Kaftari period), it was much larger, 130 ha. Population estimates based on archaeological survey data for the settled population of the Kur basin are about 9600 during the Banesh period and 45,000 in Kaftari times (Sumner 1986, 1989). It is likely that relatively high population in the valley and at Malyan itself led to forest clearance for both fuel and agricultural land.

Paleoethnobotanical work at the site established the

Fig. 2:
Oak forest at northwest end of Kur river basin.
Fig. 3:
Maps of Kur river basin: Banesh (above), and Kafkari (below) settlement systems. Population estimates of 110-210 people per ha of settlement are based on ethnographic analogy. Malayan is estimated to have housed about 6400 people, or two thirds of the valley's population at the beginning of the third millennium, and 19,800, or nearly half of the valley's population at the beginning of the second millennium (see Sumner 1986, 1989).
basic character of the ancient environment and subsistence (Miller 1982). Ancient forest composition is inferred from modern distribution studies and analysis of archaeological charcoal. The charcoal is not a direct reflection of the ancient vegetation, but rather a reflection of fuel choice. Juniper, almond, pistachio and poplar were most often chosen for fuel, probably because they grew near the site (Miller 1985). A decrease in juniper and poplar, wood types thought to have grown on the valley floor, and an increase in oak charcoal suggest that the distance travelled to procure fuel was greater in Kafah than in Banesh sites. The charred seed assemblage provides further support for forest clearance.

Kurban Höyük

Malayan is one of few third millennium sites for which an extensive paleoethnobotanical record exists. Contemporary levels at Kurban Höyük in southeastern Turkey are presently under investigation (see Algaze et al. 1986). Kurban Höyük is located on the Euphrates river in the northern reaches of the Mesopotamian steppe, a more arid region than Malayan.

Like Malayan, the early third millennium occupation was relatively small at first, and there is a stratigraphic break between the deposits of the first and second half of the third millennium. The settlement seems to have prospered and grown during the latter half of this period (mid/late Early Bronze Age). Although the site is only 6 ha, compared to Malayan’s 130 ha, it is thought to have functioned as a small local center. Not only is it the largest site within its immediate catchment (radius 5 km), but intra-site differences in faunal remains that could reflect status-based dietary differences suggest the site was more than just a simple farming community (Wattenmaker 1987). The total area of contemporary sites in the catchment reaches a peak not surpassed until Roman/Early Byzantine times (Wilkinson 1990). Kurban Höyük may have been involved in regional exchange as a result of its location along major overland trade routes between lower Mesopotamia and Anatolia (Algaze et al. 1986).

One result of population expansion and economic development is intensified agriculture and increased demand for fuel. Attendant stress on the vegetation can lead to more permanent disturbance. Wilkinson (1990) suggests that population may have approached the maximum possible before intensive manuring and annual cropping would have become necessary. Furthermore, he found evidence for a major erosional episode near Kurban Höyük (Wilkinson 1990:23). Based on sherds found at the interface between the underlying red soil and the eroded limestone debris, he has dated the onset of erosion to the late third millennium. The botanical analysis is not yet complete, but evidence for deforestation is consistent with this dating, and comparisons can also be made with the Malayan assemblage.

The natural vegetation around Kurban Höyük would be an open canopy oak woodland (Zohary 1973). Today, there are only two relict oak trees and some hawthorn and a few other types on the bluffs (Fig. 4). The major trees along the river are willow, tamarisk, and fig. Most charcoal from Kurban Höyük is too fragmentary to identify, but there are a number of identifiable seeds. Many of the weed seeds are the same types occurring at Malayan (e.g., Loliurn, Astragalus, Medicago, Galium; Fig. 5). As mentioned earlier, seed to charcoal ratios shed some light on fuel use. The proportion of seeds relative to charcoal is substantially higher at Kurban Höyük, presumably due to greater reliance on dung fuel in this arid area (Fig. 6). As was the case at Malayan, the relative quantities of weed seeds increase...
Fig. 4:
Oak tree on bluff of Euphrates river near Kurban Höyük.

Fig. 5:
Scanning electron micrograph of weed seeds from Kurban Höyük: a. (left) Lolium, b. (right) Galium.
dramatically between the early and later half of the third millennium, supporting the proposition that the number of trees declined.

How widespread was land clearance?

The paleoethnobotanical evidence from both of these widely separated sites suggests land clearance was an important factor in human-land relationships in the third millennium Near East. Other studies have had similar results. For example, to the south of Kurban Höyük, van Zeist and Woldring (1980) noted a decline in tree pollen in the third millennium in northwestern Syria. In the Kebar region, upriver from Kurban Höyük, Willcox (1974) found evidence for deforestation sometime between the end of the Early Bronze Age and Hellenistic times. Unfortunately, he did not have a continuous sequence of charcoal samples, so more precise dating of forest decline in that region is not possible.

The extent of land clearance in this period cannot be deduced from a few archaeological or palynological studies. Despite the examples just presented, there is no reason a priori to suppose that uniform processes of population growth, agricultural expansion, and metallurgical advances operated throughout the Near East. Certainly in historic times, the severity of environmental disturbance fluctuated. In the Kur basin, for example, travelers' accounts from the seventeenth to nineteenth centuries show that the degree of environmental degradation and human influence on the landscape is a function of political control, and even severely abused woodlands are able to regenerate to some extent if left alone for long enough (Kortum 1976). As for more distant times, the first evidence for human disturbance in the pollen record of Lake Zeribar in the central Zagros oak forest does not occur until a little over two thousand years ago (van Zeist and Bottema 1977). At Lake Van, in eastern Turkey, human activity first shows up only five hundred years ago (van Zeist and Woldring 1978). These areas, where population densities and technological advancement were not great enough to make as visible an impact on the vegetation, were remote from the mainstream of trade and contact with the urban civilizations of Mesopotamia.

Conclusions

Local, site-specific studies of fuel use provide important information about the intensity of land use in a region and the ability of the human population to maintain its lifestyle at a given level of technology. Both Malian and Kurban Höyük were on major trade routes in antiquity. They saw population growth during the third millennium, and were occupied at a time when bronze metallurgy became more important. And both settlements witnessed land clearance in their vicinity. Social and technological developments do not occur uniformly, however, and paleoethnobotany provides one way to assess the impact of human activities on the landscape.

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Note

1. Forest decline was probably not continuous, for in the middle of the third millennium the valley was either depopulated or only seasonally occupied by nomads.

References


Fig. 6:
Number of weed seeds per gram of charcoal in flotation samples: a. (above) Kurban Höyük, b. (right) Malyan.
Note: The ratios in Fig. 6a and b are not directly comparable because the size of the charcoal fragments weighed is not the same for Malyan (>0.84 mm) and Kurban Höyük (>1.00 mm).


Nickerson, J.A. 1983. Intrasite Variability During the Kaftari Period at Tal-e Malyan (Anshar), Iran. Ph.D. dissertation, Ohio State University, Columbus.


