exploitation and cultivation in North Gujarat is, however, difficult because of the challenging archaeological deposits. Indeed, the lack of clear stratigraphy and significant pre- and postdepositional taphonomic processes in most Anarta sites create a scant macrobotanical assemblage. Similar processes of combined small millets and pulses domestication occurred in southern India (Fuller et al. 2004). Horsegram has been cultivated in southern India since ca. 2500 BC (Fuller and Harvey 2006) and small millets from ca. 2000 BC (Fuller 2011), therefore later than the mid third millennium BC Anarta remains from Loteshwar.

The seeds of domestic sesame from Anarta Loteshwar are among the earliest recovered in South Asia (for a review, see Fuller 2003). The presence of wild sesame seeds at Vaharvo Timbo suggests that the plant was already exploited by hunter-gatherer groups during the early-middle Holocene and possibly became locally domesticated during the mid-Holocene. However, further evidence and a more robust chronology are needed to establish North Gujarat as the center of sesame domestication.

Conclusions

The archaeobotanical data from Loteshwar and Vaharvo Timbo, in the wider context of North Gujarat, are an illustrative example of human adaptation to climatic and environmental changes in semiarid regions. The end of the hunter-gatherer occupation at these sites roughly coincides with the weakening of the precipitations (ca. 7,000 BP) and the retreat of the interdune marshland environments. This evidence suggests that food production emerged in North Gujarat as a response to weakening rains (monsoon) to ensure resource predictability, as it seems to have been the case in other semiarid areas of the world, such as the African Sahel (Marshall and Hildebrand 2002). In our area, human populations adopted a strategy that involved seminomadic pastoralism, the cultivation of fast-maturing crops, and the gathering of wild plants. We consider that our data support a local origin of plant domestication and that North Gujarat can be seen as a primary center of origin, regardless of a local development of animal domestication (Patel 2009) or through adoption from neighboring areas such as the southern Indus Valley (Fuller 2006).

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Comments

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Even though it is now recognized that there are at least 19 independent centers of agricultural origins worldwide (Larson et al. 2014), hard data in the form of archaeological plant remains have been slow in forthcoming for many, particularly in Africa and South Asia. Consequently, our ability to formulate and refine regional models of crop origins and subsistence transitions needed for global comparison has been seriously hindered. North Gujarat is one of three regions of South Asia proposed as one such locus of domestication (Fuller 2006, 2011), yet it is entirely lacking in archaeobotanical evidence for the period spanning the move from food gathering to food production (Murphy and Fuller 2014). García-Granero et al.'s study of early plant use by Mesolithic hunter-gatherers and Chalcolithic pastoralists at two mid-Holocene sites in North Gujarat therefore provides a much needed, archaeobotanically informed view of these processes.

Although the question of whether Gujarat is a center of plant domestication is ultimately left open in their paper, García-Granero et al. build a compelling case for the mid-Holocene transition to cultivation at the site of Loteshwar. This argument is based primarily on the presence of seeds from arable weeds (*Trianthema* and *Chenopodium*; the former a common millet weed in Harappan and later sites; Fuller et al. 2014) alongside the remains of small millets (e.g., *Panicum sumatrense*, *Brachiara ramosa*, and *Setaria* spp.), tropical pulses (*Macrotyloma uniflorum*), and the important oil crop, sesame (*Sesamum indicum*), among others. These findings are congruent with the local distribution of the wild progenitors of these crops as well as archaeobotanical evidence presented elsewhere showing that they were established as key domesticates in Gujarat by the Harappan period (see Fuller and Murphy 2014). The study thus represents a significant breakthrough in the search for agricultural origins in South Asia.

It is now widely accepted that the pathway to agriculture was not necessarily uniform or linear but a dynamic process that followed diverse regional trajectories as hunter-gatherers actively responded to new environmental opportunities and challenges at different times and places. For North Gujarat, García-Granero et al. present a model that situates the earliest phases of cultivation in the context of a weakening Indian summer monsoon system, where hunter-gatherers were compelled to begin cultivating wild plants to ensure a predictable and reliable food supply. As shown by previous zooarchaeological studies, this was broadly concurrent with a shift toward seminomadic pastoralism, with livestock as well as crops such as wheat (*Triticum* sp.) likely acquired through contact with Harappan cultures. This model of agropastoral land use neatly encapsulates the available archaeological and paleoenvironmental data and presents another case globally where local environmental and cultural circumstances lent themselves to the development of cultivation before permanent sedentism.

Undoubtedly crucial to the success of this study was the adoption of an integrated archaeobotanical strategy that employed multiple lines of macro- and microbotanical evidence. This approach has long been used in tropical regions, such as the Americas and Oceania, where early subsistence regimes focused on underground storage organs (roots and tubers) as well as seeds and fruits. However, archaeobotanists working in regions where seed crops dominate—such as the Near East, Africa, East Asia, and South Asia—have been comparatively slow to adopt multiproxy toolkits (though studies are increasing). Yet it is this strategy that gives García-Granero et al.'s approach strength, enabling them not only to offset the preservational biases of different types of plant remains against one another but also to combine multiple data sets to build stronger cases for the presence of particular plants or plant groups at each site.

While an integrated multiproxy methodology enabled the authors to overcome certain biases, a number of other archaeobotanical challenges were also encountered. The stratigraphic mixing of deposits at Loteshwar—which caused Anarta phase macrobotanical remains to intrude into the lower Mesolithic layers—proved particularly problematic for chronological reconstruction. As a result, chronological inferences relating to the Mesolithic phase rely on dates obtained during previous excavations at the site (forming the basis, for example, for the suggested antiquity of pulse exploitation dating to the seventh millennium BC). Yet the stratigraphic relationship between the recovered archaeobotanical assemblages and these previous dates has not been made clear. Given that García-Granero et al.'s radiocarbon dates also suggest a shorter chronology for their Anarta layers compared with the previous excavations, this issue warrants further discussion. The absence of dates from deposit 1 at Mesolithic Vaharvo Timbo—which was the only layer from that site to produce macroremains—also presents chronological limitations. Although the authors acknowledge the need for a "more robust chronology," it seems an oversight to not directly accelerator mass spectrometry date the seed macroremains from these sites, especially as recent advances in radiocarbon pretreatment methods now allow for the improved dating of very small millet-sized seeds (e.g., Motuzaite-Matuzeviciute et al. 2013).

Other taphonomic factors discussed as having possible effects on the archaeobotanical assemblages include the abrasion of microremains during grinding (which, in the case of starches, can also make granules more susceptible to enzymatic decay) and the chemical dissolution of phytoliths. To this list, I would also add the differential preservation of starch granules in sediments versus grindstones, where entrapment in surficial pits may help protect starch from soil-borne starch-degrading enzymes (Barton and Matthews 2006; Haslam 2004). This factor may explain the observed pattern of starch granule abundance in grindstones and scarcity in sediment samples.

Perhaps most striking, however, was the impact of modern starch contamination on their study, which, once realized, prompted the authors to disregard all starch data from Vaharvo Timbo. It appears near impossible at this stage to determine which, if any, of the recovered granules might be genuine ancient starches, particularly as the expected ancient morphotypes overlap with the modern contaminants. The extent of the problem is perhaps signaled by the almost two orders of magnitude greater number of starches recovered from grindstones at Vaharvo Timbo compared with Loteshwar (on average, about 72 times more starches per artefact, on the basis of concentration), with the overwhelming majority of those at Vaharvo Timbo (82%) being the same Panicoideae types as detected on the nonpowdered gloves worn during extraction. These results serve as a warning to analysts of the risks that modern laboratory contaminants can potentially pose in skewing ancient starch data (see also Crowther et al. 2014).

These matters aside, I certainly look forward to seeing the results of future research by this team at these and related sites in North Gujarat. In this regard, there are many avenues that the authors might explore to build on their multiproxy method. For example, the analysis of characteristic use-wear patterns that can develop on grindstones during plant processing would serve as the perfect complement to the starch and phytolith residue studies already undertaken (e.g., Fullagar et al. 2015). Likewise, lipid studies may determine whether the grindstones were used to extract oil from sesame seeds, potentially providing a direct link between the recovered macrobotanical remains and crop processing methods. In any case, the ongoing integration of these and other archaeological science techniques will no doubt forge new understandings of the timing, complexity, and regional variability of the transition to food production in what is clearly a key region of the world.

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The paper by García-Granero et al. breaks new ground and endeavors to identify the Anarta region of modern Gujarat as one of several independent centers of the origins of agriculture in the Indian subcontinent. At the outset, I would like to