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TRACING THE ROOTS OF AGRICULTURE: THE FOUNDATION OF EARLY HUMAN SURVIVAL

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Abstract

A pivotal issue in world prehistory is determining whether population migration or cultural diffusion played a more crucial role in the dissemination of agriculture across various regions. An often neglected yet significant aspect of this debate is the examination of preserved crops and weeds from early agricultural societies. Research utilizing archaeobotanical data from diverse sites has revealed distinctive vegetation patterns linked to specific regions occupied by early populations. The findings suggest that a broad range of plant species at early agricultural sites were likely utilized for food, and there is no evidence of a reduction in plant food diversity as agriculture expanded. These observations provide valuable insights into the process of crop domestication, indicating a symbiotic relationship between humans and plants may have been instrumental in the advancement of agriculture. This review article underscores the presence of early agricultural sites across distinct domestication centre across Asia including Ohalo II, Jiahu, and Xinglonggou showing that early plant cultivation developed in varied ecological settings, often predating or extending beyond the conventional Neolithic timeline. The evidences provided are derived from existing excavation reports, and there remains the possibility that upcoming findings could extend these dates even more.

Keywords: Archaeobotanical, Neolithic, Jiahu, Ohalo II, Xinglonggou

INTRODUCTION

The origins and evolution of agriculture involve analysing shifts in human food procurement behaviours and the adaptive responses of plant populations. The transition to food production marked a profound behavioural change in humans, encompassing activities such as soil manipulation (including clearance and tillage) and selective cultivation of specific plant species. By studying contemporary plant populations, we can trace the closest wild relatives of modern crops, their natural habitats, and the differences between these domesticated plants and their wild ancestors. The evolution from ancient wild forms to modern cultivated varieties was a complex process characterized by distinct stages, shaped by various selective pressures and human interventions, occurring at differing rates (Fuller 2007; Zhao 2017; Stalker et al. 2021).

Archaeobotany, the study of plant remains from ancient human sites provides essential insights into this process of crop evolution, linking it directly to the archaeological record of human behaviour through its stratigraphic context (Fuller 2007; de Vareilles et al. 2021). Ancient agriculture is typically understood to comprise two main components: crop farming and animal husbandry, with the latter often reliant on crops or farming by-products for animal feed (Zhao 2011). Consequently, plant remains, especially those of crops, are vital for studying the origins of agriculture. However, these remains are often poorly preserved, small, and challenging to identify during fieldwork. Without meticulous recovery efforts, they can be easily overlooked in archaeological excavations. Charred plant remains are frequently better preserved in archaeological contexts because the carbonization process makes them chemically stable, resistant to microbial deterioration, and less prone to soil and water erosion. Due to their lower specific gravity compared to soil particles and water, charred plant remains can be efficiently separated from the soil matrix using flotation method, a widely employed and effective technique for extracting plant remains from soil samples (Miksicek 1987).

Archaeobotanical evidence indicates that plant cultivation and domestication arose independently in multiple regions during the early Neolithic or possibly even the Late Palaeolithic, as exemplified by findings at Ohalo II in Israel (Whitlam et al. 2018; Snir et al. 2015). Pre-domestication cultivation, involving the cultivation of wild crop progenitors, has also been observed at various archaeological sites. This type of cultivation is just one of several pre-agricultural plant management strategies (Zohary and Hopf 1988). The plants that were domesticated and became part of the 'Neolithic crop package' represent only a small fraction of the wild plants that people were gathering, consuming, and potentially managing during this period (Harlan et al. 1973). The domestication process can be identified through morphological markers, such as tough rachis or seed size, and by recognizing arable weed floras that indicate the cultivation of wild crops (Nesbitt 2002). However, other plant management strategies may have involved significantly different forms of crop husbandry and wild plant food production, including practices with no direct modern equivalents. Evidence supporting these diverse practices has been observed globally (Fuller 2007; Willcox 2013). This review article focuses on archaeobotanical data from across Asia, including the Near East, which are acknowledged as having some of the earliest and best-documented plant domestication centres. The selected sites indicate major chronological milestones and methodological approaches within these regions, but are not intended to represent all worldwide agricultural origins.

Archaeobotanical Evidences of Cultivation

Interpreting wild plant foods at ancient sites demands careful consideration, as the mere presence of plant remains in an archaeobotanical assemblage does not necessarily reflect their consumption. This inference becomes more credible when a particular plant taxon appears in substantial quantities and when alternative sources of plant material, such as dung burning, crafts, or construction, have been excluded. Subsequent to excavations, archaeologists have proposed that various food crops and grasses were cultivated to meet human needs, either as part of sustenance or fodder (Whitlam et al. 2018).

There are many significant sites that give a glimpse of role of agriculture in ancient times. One of them being Ohalo II, situated on the southwestern edge of the Sea of Galilee in Israel, that offers early evidence of wild cereal utilization, dating back roughly 23,000 BP. Nearly 19,000 of the 90,000 plant remains from 142 taxa that were found at the site were grass grains, and the majority of them were excellently preserved. In addition to offering proof of broad-spectrum plant collection, the plant remains from Ohalo II also gives evidence for grass collection which predate hitherto (Weiss et al. 2004).

The site of Abu Hureyra gives a distinctive comprehensive documentation of shift from foraging to agriculture. It also provides evidence of the factors that appeared to push hunter-gatherers to embark on the demanding task of cultivation. The main catalyst seems to have been the significantly diminished availability of essential wild plant staples during the arid Younger Dryas climatic period. This early start of cultivation set the stage for the emergence and rapid proliferation of integrated agro-pastoral systems in the early Holocene period. Although the rise of agriculture is commonly celebrated as a significant achievement in 'establishing the foundations of civilization', the subsequent social, demographic, nutritional, and ecological repercussions of this chain reaction have largely been detrimental, affecting nearly every facet of contemporary life (Hillman et al. 2001; Colledge and Conolly 2010).

The Neolithic site of Çatalhöyük located 50 kilometers southeast of Konya in the central-southern region of Anatolia showed intricate patterns of plant resource utilization and exploitation in the Konya plain during the early Holocene. The location of the settlement was not determined by closeness to fertile arable land or easy access to forestry resources such as firewood, timber, and fruit-bearing plants. Archaeobotanical findings indicate the cultivation of domesticated wheat, emmer, barley, lentils, and peas. The existence of threshing floors, storage facilities, and food preparation zones demonstrates a structured agricultural system (Fairbairn et al. 2002; Zeder 2025).

In Mesoamerica, three primary crops were first cultivated: maize (*Zea mays*), common bean (*Phaseolus vulgaris*), and squash (*Cucurbita pepo*). The oldest examples of cultivated plants discovered in Mesoamerica include squash and bottle gourd (*Lagenaria siceraria*), which have been found at two locations in the highlands namely Guilá Naquitz cave in the Valley of Oaxaca and Coxcatlán cave in the Tehuacán Valley. The specimens recovered from Guilá Naquitz have been accurately dated to roughly 9900 cal. BP, while those from Tehuacán are dated to about 7900 cal BP (Zeder 2025; Pickersgill 2016).

The Mehrgarh site, a Neolithic location in Pakistan is significant for being one of the earliest records of agriculture in the region. This site reveals evidence of early cultivation practices by semi-nomadic communities, including crops such as six-row barley, wheat, emmer (*Triticum dicoccum*), and dates. Additionally, in subsequent phases, there are evidences of jujubes (*Ziziphus mauritiana*) and grapes (*Vitis* sp.). Pollination analysis results indicate that from approximately 8000 years ago to 6000 years ago, vegetation such as *Salix, Tamarix*, and *Ulmus* was present in the area (Yang et al. 2020). In this section of the article, we will explore the cultivation of diverse crops in antiquity across different global sites.

Ancient Rice Cultivation Evidences

The domestication of rice was primarily an evolutionary process influenced by human activities, aimed not at deliberately modifying the genetic or biological traits of the plant, but at improving the yield of wild rice. The Jiahu site in China, located in the upper Huai River region, represents the earliest well-documented instance of rice agriculture. Dated between 9000 and 7800 cal BP, based on 19 radiocarbon dates, this site spans 50,000 square meters and features a well-organized layout including residential areas, manufacturing zones, and cemeteries, indicative of a settled village. Excavations conducted in the 1980s revealed numerous charred grains identified as domesticated rice. Over 4,100 seeds from 16 different taxa were identified, encompassing both edible plants and weedy grasses from the region. Edible plants included tubers (e.g., lotus roots), nuts (e.g., acorn), and grains (e.g., rice and wild soybean), while weedy grasses included species such as *Digitaria* and *Echinochloa*. The flotation samples contained more than 400 charred rice grains. Analyzing the shape, size, and morphological traits of these grains, in conjunction with the site's distance from known wild rice distribution areas, indicates that the rice found at Jiahu was likely domesticated (Zhao 2017; 2014).

The Sorori rice field located in Cheongwon County, Chungbuk Province, Korea, is significant due to the finding of ancient rice and quasi-rice within a middle peat layer that is positioned between 32 and 30.5 meters above mean sea level. Peat samples extracted from this layer have been radiocarbon dated to an age range of 12,780 to 14,800 years BP, while the peat below it falls between 16,300 and 17,300 years BP. Recent analyses via radiocarbon dating of both the rice and peat samples have verified that Sorori rice is the most ancient radiocarbon-dated rice discovered in Asia, with dates of 12,520 ± 150 and 12,552 ± 90 years BP, respectively. This data supports previous discoveries of quasi-rice grains at Seoul National University (SNU), reinforcing the idea that both ancient rice and quasi-rice existed during the same time period and that rice farming originated more than 10,000 years ago (Kim et al. 2013; Cho et al. 2024).

Ancient Barley Cultivation Evidences

The plant assemblage from the Upper Palaeolithic site of Ohalo II in Israel includes a significant quantity of charred Gramineae (*Poaceae*) grains. Evidence suggests that *Hordeum spontaneum* was a major dietary staple for the site's human inhabitants. Ohalo II, a submerged Late Upper Palaeolithic site, has been radiocarbon dated to approximately 23,000 cal BP. Situated on the southwestern shore of the Sea of Galilee (Lake Kinneret) in Israel's Rift Valley, Ohalo II is remarkable for its well-preserved features, including huts, hearths, a grave, and an extensive array of artifacts. These artifacts include flint and ground stone tools, a diverse faunal collection (mammals, birds, rodents, fish, mollusks), and a rich plant assemblage. Notably, species such as *Hordeum* *glaucum*, *H. marinum*, *H. hystrix*, *H. spontaneum*, and others were also cultivated in this region (Wright 1980; Miller 2011; Whitlam et al. 2018).

Starch residues found on a large flat stone at the hunter-fisher-gatherer site of Ohalo II represent the earliest known instance of Upper Palaeolithic grass grinding. The site's submersion for millennia has allowed for exceptional preservation of a broad range of material remains in situ. Analysis of a sample from the surface of the grinding stone recovered 150 starch grains, 127 of which were identified as grasses. Among these, 78 exhibited the size and morphological characteristics associated with *Hordeum* species. This evidence indicates that most of the identifiable grass starch from the stone likely originated from *Hordeum* sp., suggesting that the processing of selecting wild grasses predates their domestication in Southwest Asia. Further examination of the grinding stone revealed 13 additional starch grains on its central bottom area: one likely from *Hordeum*, eight bell-shaped grains, and three compound grains from grasses (Weiss et al. 2004; Nadel et al. 2012).

Ancient Wheat Cultivation Evidences

At the site of Ohalo II, over one-third of the abundant plant assemblage of seeds and fruits belongs to the grass family (*Poaceae*), including wild emmer wheat, wild barley, and wild oat (*Triticum dicoccoides*). Two key pieces of evidence demonstrate that these grains were processed for consumption: (i) a grinding slab found on the floor of Brush Hut 1, from which starch granules from wild cereals were extracted, and (ii) the distinctive distribution pattern of these grains around the grinding slab. These findings suggest the potential for small-scale experimental cultivation at Ohalo II, a 23,000-year-old sedentary hunter-gatherer site on the shore of the Sea of Galilee in Israel. Domesticated cereals, specifically wheat (*Triticum aestivum*), were harvested when the stems were dry and the grains fully mature. The presence of harvesting tools further supports the notion that wheat cultivation occurred at Ohalo II 23,000 years ago (Savard et al. 2006; Groman-Yaroslavski et al. 2016; Snir et al. 2015).

West Asia, China, northern Africa, and Mesoamerica/South America are four key regions where agriculture first developed around the globe. The Fertile Crescent, located in West Asia, includes countries such as Israel, Palestine, Lebanon, Jordan, Syria, northeastern Iraq, and southeastern Turkey, and is acknowledged for its significance in wheat cultivation and domestication. The two primarily domesticated wheat varieties are *Triticum monococcum* and *T. turgidum* (Zhao 2017). Wheat farming expanded beyond this core area into Mesopotamia, where early urbanization and irrigation advances helped its growth (Weiss and Zohary 2011). By the sixth millennium BP, wheat was grown in northern Africa, especially in Egypt, where it became a staple of Nile Valley agriculture (Bard 2015). On the other hand, Mesoamerica and South America were not primary centres for wheat indigenous crops such as maize, beans, and quinoa dominated early agriculture. Although East Asia was not a centre of wheat domestication, wheat was introduced in China around 4000 BP and later was became staple food (M. Lu et al. 2019; Pickersgill 2016).

Ancient Millet Cultivation Evidences

Rice and millet were likely introduced to Korea from China around the same period, appearing simultaneously. In China, two primary species of millet are cultivated: *Panicum miliaceum* (common or broomcorn millet) and *Setaria italica* subsp. *italica* (foxtail millet). Both species are native to northern China, where their cultivation is thought to have originated. Although the precise timing of domestication and the routes of dispersal are not fully resolved, the earliest contested evidence comes from the Cishan site in northern China, where husk phytoliths and hydrocarbons from common millet were found in grain storage pits. Charcoal samples from these pits date to approximately 10,300 to 8,700 cal BP, though these dates do not directly pertain to millet. Foxtail millet appears in the archaeological record following this period, with sites in Gansu and Liaoning dating to around 7,500 to 8,000 cal BP. Additional, more precise dates from various sites are necessary to accurately establish the chronology and origin of millet domestication. The Xinglonggou site is recognized as a significant early millet farming location in China, marking a shift from hunter-gathering to agriculture. The resilience of common millet to poor soils and drought likely facilitated its adoption during the early Holocene period. Millet is believed to have been introduced to Korea around 8,000 cal BP, coinciding with the Middle Jeulmun pottery period (Dodson and Dong 2016).

The savannahs of West Africa are a significant region for independent plant domestication, giving rise to pearl millet, African rice, various legumes, and vegetable crops. One of the earliest evidences of pearl millet (*Pennisetum glaucum*) from the site of Tilemsi Valley, Mali, dated to be around 2500 and 2000 BC (Manning et al. 2011; Finucane et al. 2008).

Archaeological Evidence and Interpretations of Early Plant Domestication

A pivotal development in the evolution of modern societies was the domestication of plants and animals, which enabled the shift from nomadic hunter-gatherer groups to permanent settlements. Unlike hunter-gatherers, who lived in small, mobile bands with limited capacity for accumulating material wealth, settled communities were able to cultivate crops and manage livestock. This transition led to more stable and reliable food sources and the establishment of land ownership. The shorter breeding cycles of domesticated species facilitated faster population growth and allowed for a more specialized division of labour. This increased complexity fostered advancements in cultural, religious, and political systems, and accelerated technological progress. Indeed, the emergence of many contemporary societies is deeply rooted in the development of domestication and agricultural practices around the world (Dodson and Dong 2016; Bar-Yosef 2012).

The following table presents archaeobotanical evidence of early plant use organized chronologically, starting with Ohalo II (~23,000 BP), one of the earliest known locations with preserved plant remnants. Early East Asian plant utilization is reflected in Sorori in Korea (~12,780–12,520 BP) and Jomon Pottery in Japan (~12,000–2,300 BP).

The Fertile Crescent's transition to farming is reflected in sites like Abu Hureyra (~13,500–7,500 BP), Jerf el Ahmar (~11,500–10,000 BP) and Netiv Hagdud (~10,500–10,000 BP). A chronological sequence of plant domestication throughout Asia and the Near East is depicted by later examples such as Cishan (~10,300–8,700 BP), Jiahu (~9,000–7,800 BP), Çatalhöyük (~9,000–8,000 BP), Mehrgarh (~9,000–7,000 BP), and Xinglonggou (~8,000–7,500 BP).

Table 1 Archaeobotanical Evidence of Early Plant Use and Analytical Techniques Employed

Site	Location	Approx. Date (cal BP)	Archaeological Methods Employed	Key Plants Identified	Significance	References
Ohalo II	Israel	~23,000	starch grain analysis, charred remains analysis	wild barley, wild wheat, wild oat	earliest evidence of grain processing	Nadel et al. 2012
Sorori	Korea	~12,780–12,520	radiocarbon dating	ancient rice and quasi-rice	oldest radiocarbon-dated rice in Asia	Cho et al. 2024, Kim et al. 2013
Jomon Pottery	Japan	~12,000–2,300	impression analysis	nuts, acorns, grasses (via impressions)	identifies plant parts from impressions in pottery, culture spans over a long time	Obata et al. 2020, Crawford 1992
Abu Hureyra	Syria	~13,500–7,500	flotation, AMS radiocarbon dating	barley, rye	comprehensive documentation of shift from foraging to agriculture	Colledge and Conolly 2010, Hillman et al. 2001, Moore 2023
Jerf el Ahmar	Syria	~11,500–10,000	macrobotanical analysis	barley, wheat, rye	early cultivation at a forager-to-farmer transition site	Fuller 2007
Netiv Hagdud	Israel	~10,500–10,000	flotation	barley	one of the earliest farming communities in Southwest Asia	Bar-Yosef et al. 1991
Cishan	Northern China	~10,300–8,700	phytolith analysis	common millet	early evidence of millet use	H. Lu et al. 2009
Jiahu	China	~9,000–7,800	flotation, radiocarbon dating	rice, tubers nuts wild soybean	early evidence of rice domestication	Zhao 2014, 2011
Çatalhöyük	Turkey	~9,000–8,000	phytolith analysis, stable isotope analysis	emmer wheat, barley, pulses	neolithic settlement with systematic farming practices	Zeder 2025; Fairbairn et al. 2002
Mehrgarh	Pakistan	~9,000–7,000	pollen analysis	barley, wheat	earliest evidence of introduced cereals in South Asia	Yang et al. 2020
Xinglonggou	Northern China	~8,000–7,500	flotation	broomcorn and foxtail millet	early pre-domestication cultivation stage	Zhao 2011

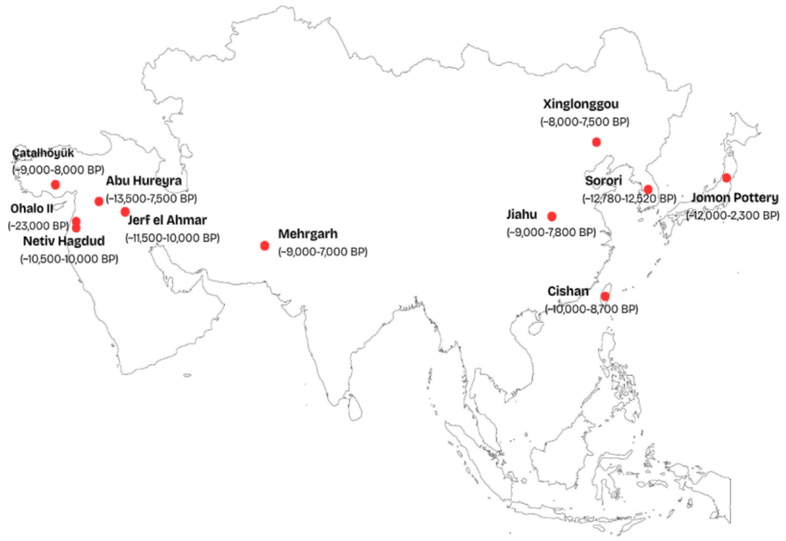

Figure 1. Geographic Distribution of Archaeobotanical Evidence of Early Plant Domestication

Domestication appears to have originated in several distinct regions, with the Levant and Eastern Asia among the earliest centres. The reasons for the relatively late onset of this process in human history are still not fully understood. However, it is plausible that the onset of milder and more stable climates during the Holocene, which began just over 10,000 years ago, played a significant role. Such stable climates may have made the ranges of exploitable species and living conditions more predictable over generations. Initial domestication efforts were based on local species and thus varied by region. Some widely distributed animal species, such as pigs may have been independently domesticated in multiple centres. As trade and technological exchanges expanded, valuable domesticated species and innovations spread to new areas (Nesbitt 2002; Mannion 1999; Li 1983).

The beginnings of domestication are now recognized as a complex interplay of local processes rather than a singular ground breaking event. This perspective stands in stark contrast to previous views, like Childe's concept of the "Neolithic Revolution", which depicted agriculture as a rapid and transformative shift. Current studies portray domestication as a mutually beneficial co-evolutionary relationship between those who domesticate and the species being domesticated, differing from resource management and agricultural practices. It is also considered as a non-linear journey, where human actions and environmental factors influenced biological characteristics over thousands of years (Zeder 2015). There are also models in evolutionary ecology indicating that the development of agriculture can be seen as a strategic reaction to diminishing foraging yields and rising demographic pressures (Shennan 2009).

The Ohalo II site, dating back 23,000 years, offers information about the initial stages of plant domestication, occurring even before the well-known Neolithic Revolution. Evidences indicates that there was early experimentation with the cultivation of cereals and other plants long before agriculture became widespread (Snir et al. 2015; Nadel et al. 2012).

In the Fertile Crescent, crops such as wheat and barley were domesticated approximately 10,500 to 9,000 years ago, in conditions that were dry and seasonal, promoting early storage practices and the establishment of settled communities. The wild progenitors of these crops were plentiful and had genetic traits that made them ready for domestication (Fuller 2007). The Yangtze River Basin experienced rice domestication roughly before 6300 BC in wetland ecosystems. Archaeobotanical evidences indicate a lengthy process of experimenting with grains leading to its eventual integration into subsistence (Zhuang and Fuller 2024; Deng et al. 2015). The Old World (Afro-Eurasia) and Mesoamerica exhibit a comparable disparity. It took several thousand years for maize to be domesticated from its wild parent, teosinte, in Mesoamerica. The original cultivars needed considerable morphological modification because they were low-yielding and unsuitable for intensive farming. On the other hand, because of innately advantageous characteristics, grains in the Old World experienced quick morphological modifications (Piperno et al. 2009).

Recent studies question the conventional belief that evolutionary shifts in plants due to human use were always advantageous or culturally superior. This represents a significant departure from essentialist views that link the beginnings of agriculture to certain geographic "cradles" or favoured cultural groups. This new perspective has important consequences: the variety of primitive crops necessitates a reassessment of their flexibility and resilience, especially as we consider incorporating agricultural weeds into food production systems. Such models permit the exploration of wider ecological processes, including human-driven gene flow across different landscapes, and highlight the significance of early cultural connections in influencing domestication trends (Allaby et al. 2022).

According to research, the interplay of ecological environments and societal traditions, each defined by the distinct landscapes and communities in which they evolved, had a significant impact on the paths to domestication. Climate variability, soil fertility, hydrology, and seasonal resource availability all had an impact on which plant species were appropriate for cultivation and how they were managed (Fuller and Lucas 2017). For example, Abu Hureyra late Pleistocene climate shifts created favourable conditions for the cultivation of rye, demonstrating how environmental pressures could catalyse agricultural innovation. Cultural values, subsistence preferences, and symbolic links influenced human selection, preservation, and exchange of plant species. Social traditions and culinary habits may promote the choice for specific crops over others, even when environmental conditions allow for a greater range of options (Moore 2023; Colledge and Conolly 2010; Hillman et al. 2001). Cultural values, subsistence preferences, and symbolic connotations all had a profound influence on plant species selection, preservation, and interchange. In northern China, for example, millet held strong cultural significance, maintaining its supremacy in farming systems long after wheat was introduced. These insights emphasize that domestication was not a uniform or linear process, but rather a mosaic of adaptive strategies shaped by the interplay of environmental opportunities and cultural choices, eventually giving rise to the rich diversity of agricultural traditions (Fuller et al. 2011; Harris 2016; M. Lu et al. 2019; Zhao 2014).

Future research are becoming more interdisciplinary, focusing on how weeds are integrated into farming systems and examining the impact of gene flow across landscapes managed by humans. These methods recognize the dynamic nature of early cultural networks and their effects on biological diversity. Analysing material culture provides additional depth. For example, investigating in situ phytoliths from Çatalhöyük as part of material culture reveals the utilization of various plants for different purposes, such as wild *panicoid* grasses used in the making of coiled baskets. The botanical analysis of foliage found on headdresses from the third millennium BC burial site at Ur has been examined in conjunction with the current range of *Dalbergia sissoo* to assess the tree's importance in Mesopotamian society through archaeobotanical evidence. Although the evidence for plants being utilized as material culture is often constrained by preservation challenges, leveraging a broader spectrum of evidence and comparisons could facilitate an exploration of the relationship between the physicality of plants and their roles as tangible objects (Lodwick 2019). A significant advancement is the use of ancient DNA (aDNA) to investigate gene flow between wild and cultivated species, especially in cereals such as wheat (Iob et al. 2024).

CONCLUSION

The process of domesticating plants and animals was not a straightforward or uniform evolution but instead a lengthy, regionally specific, and culturally ingrained journey. Rather than a swift or universally linear transition, the shift from foraging to agriculture manifested through intricate interactions among ecological limitations, symbolic practices, and sociopolitical frameworks. Comparative research reveals that varying species, environmental factors, and cultural ideologies resulted in different pathways of domestication, each anchored in local circumstances and adaptive methods. Recent research across various fields has greatly transformed our comprehension of plant domestication. Discoveries from areas such as the Horn of Africa and East Africa indicate that initial farming methods were varied and tailored to local conditions, contradicting the conventional perspective of a singular "Neolithic Revolution". New evidence in archaeobotany, genetics, and isotopic studies pushes the timeline of plant cultivation back over 20,000 years, undermining long-held beliefs regarding the timing and characteristics of the "Neolithic Revolution". Early plant cultivation may not have solely been driven by material needs; rather, it could have equally been focused on fostering social unity, symbolic rituals, and intentional experimentation alongside efficient caloric production. This shift in perspective necessitates a revaluation of what is understood as domestication and opens the door for more diverse, inclusive models that recognize the creativity and agency of early human societies. The integration of multidisciplinary data also reveals the cultural significance of plants as tools, symbols, and catalysts for innovation while challenging the clear-cut boundaries between the wild and cultivated varieties. The existence of agricultural weeds, wild relatives, and ritual plants in ancient collections highlights the fluidity of ecological and cultural divisions in ancient agricultural systems.

Conclusively, domestication ought to be perceived not merely as a singular milestone in human progress but as a continual conversation between humans and the natural world, one that keeps evolving. This broadened perspective not only alters our comprehension of the distant past but also holds significant implications for tackling present-day issues in food security, crop resilience, and sustainable land management. By acknowledging the complexity, variability, and adaptability; characterizing early domestication processes, scholars are better positioned to conceive future agricultural systems that are just as diverse, resilient, and culturally relevant. The current data provided is based on known excavation reports, and it is possible that agricultural techniques date back even further, awaiting confirmation through future finds.

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