



Agricultural adaptation to highland climate in Iron Age Anatolia



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ABSTRACT

As polities grow and expand into environments distinct from their homeland, settlers moving to new landscapes may need to adapt familiar agricultural strategies to a new climate. This article explores one such case through the site of Kerkenes, a fortified, mountaintop urban center of Iron Age Central Anatolia evidently founded by Phrygian settlers from further west. New archaeobotanical data from Kerkenes indicate a set of agricultural practices broadly similar to that of other contemporary sites in Anatolia. Farmers at Kerkenes, however, appear to have prioritized bread wheat cultivation over that of barley, in stark contrast to agricultural strategies at Gordion, capital of the Phrygian kingdom. Placing Kerkenes in its environmental and economic landscape suggests that farmers took advantage of favorable rainfall patterns to emphasize a preferred cereal crop, deploying new strategies to minimize local subsistence risk. These results highlight the potential of regional syntheses of agricultural practices within large territorial states to illuminate the environmental footprints and agricultural signatures of individual polities.

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1. Introduction

The study of how large, complex polities grow and expand has been a central concern of archaeologists since the beginnings of the discipline, and for good reason—such cases offer unique insights into social and economic forces leading to complex hierarchies and regional economic networks (Alcock et al., 2009; Algaze, 2005; Sinopoli, 1994; Smith and Montiel, 2001). The economic basis of many early polities, however, was agricultural production, and all polities must find ways to feed their populations. To gain deeper insight into the processes of regional expansion that create large territorial states, we first need to understand how farmers moving into new environments, potentially with dramatically different climatic conditions from their homeland, adapt familiar agricultural systems to new climate regimes. The success of agricultural adaptations to new climates contributes to the long-term success or failure of both settlements and polities, as highlighted by case studies from areas as diverse as the desert US Southwest (Redman et al., 2009), the Maya lowlands (Dunning et al., 2012; Iannone et al., 2014), and highland southwestern China (d'Alpoim Guedes et al., 2015; d'Alpoim Guedes et al., 2014).

We can best investigate agricultural adaptation to climatic diversity through a multiproxy archaeological and paleoenvironmental approach that combines datasets from multiple contemporary sites within a

polity that lie in distinct climatic zones. Such a regional and holistic perspective permits us to ask how each population adapted to their unique, local climatic and landscape conditions, and to assess whether those adaptations were successful over the long term or just short-term experiments that were quickly abandoned (Marston, 2015; Miller, 2010, p. 69; Redman and Kinzig, 2003). A regional, synchronic approach to agricultural adaptation to climate variation also offers valuable data with which to assess potential strategies to cope with diachronic climate change, such as that of the Late Bronze Age in the Eastern Mediterranean, to which social collapse and reorganization are often at least partially attributed (e.g., Kaniewski et al., 2010; Weiss, 1982).

This article explores agricultural systems of the Phrygian kingdom, which controlled Central Anatolia (modern Turkey) between the ninth and mid-sixth centuries BCE (Roller, 2011). We present new archaeobotanical data from the short-lived highland urban site at Kerkenes Dağı (Fig. 1) and identify how Phrygian settlers, who founded the site in the later seventh century (Branting et al., in press; Summers, 2013; Summers and Summers, 2013), structured regional agricultural and land-use practices. By comparing data from Kerkenes with a contemporary archaeobotanical dataset from Gordion, the lowland Phrygian capital, we ask how farmers at Kerkenes adapted to highland climatic conditions and assess the success and sustainability of their agricultural practices. These findings reflect on the ability of the Phrygian state to expand into new areas and maintain long-term settlements in strategic areas with challenging climatic conditions, such as the Anatolian highlands.

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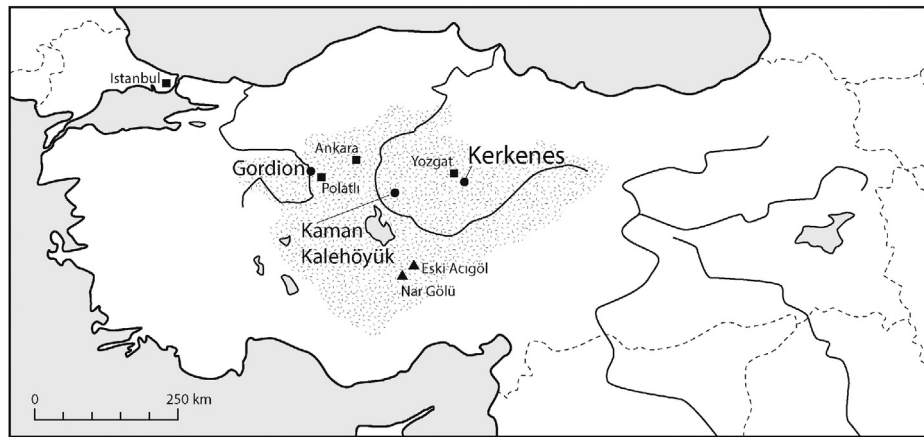


Fig. 1. Map of Turkey depicting Central Anatolia (hatched), sites with data mentioned in text (dots), pollen core sites (triangles), and modern cities (squares).

2. Agricultural adaptation to climate variation

Studies of agricultural adaptation to climate change have become increasingly critical in recent years as the effects of anthropogenic global change become more evident (Foley et al., 2005; Porter et al., 2014). Archaeologists and environmental scientists point to the past as offering multiple avenues to explore adaptation to diachronic climate and environmental change. A broad suite of methods have been employed to reconstruct agricultural systems, ranging from the direct morphological analysis of archaeological plant (Marston et al., 2014; Pearsall, 2015) and animal remains (Arbuckle et al., 2009; Zeder, 1991) to recent advances in stable isotope analyses of plants (Fiorentino et al., 2015) and animal, as well as human, skeletons (Bentley, 2006; Warinner, 2014). When combined with paleoenvironmental reconstruction, it becomes possible to explore long-term diachronic change in agricultural systems as a response to environmental and climatic change (e.g., Miller, 2013; Riehl, 2009, 2014) and to identify the impacts of agriculture on local landscapes (e.g., Butzer, 2005; Casana, 2008; Marsh and Kealhofer, 2014).

Agricultural expansion into new climatic zones offers an alternative pathway to study adaptation to climatic change. One advantage to studying spatial variation in agricultural systems across different climatic regimes is that agricultural adaptation can be explored within the context of contemporary political and economic systems, which change over time. An excellent example of such adaptation is how farmers adapt when moving into highland environments, characterized by cooler temperatures and reduced growing seasons, as well as precipitation regimes that often differ substantially from adjacent lowlands. Recent research in southwest China has shed new light onto how highland agricultural strategies were enabled by the introduction of new crops amid ongoing Holocene climate change (Chen et al., 2015; d'Alpoim Guedes, 2015; d'Alpoim Guedes and Butler, 2014; d'Alpoim Guedes et al., 2013; d'Alpoim Guedes et al., 2015).

While highland regions of Anatolia do not reach the elevations of the Tibetan Plateau, distinct agricultural strategies were still needed for farming in the colder and wetter climatic regime of highland Central Anatolia. New archaeobotanical data from the highland Iron Age site of Kerkenes indicate a significantly different set of agricultural practices than practiced at the contemporary lowland site of Gordion, the capital of the Phrygian kingdom 270 km to the west (Fig. 1).

3. History and paleoclimate of Kerkenes

The site of Kerkenes is an Iron Age city encompassing some 271 ha of planned urban blocks within a massive 7 km circuit wall, situated atop a mountain ridge at 1250–1490 m elevation in the highlands of eastern Central Anatolia (Figs. 1, 2). The city was likely founded in the later

seventh century BCE and was destroyed in the 540s BCE during the conquest of Anatolia by Cyrus the Great, founder of the Achaemenid Persian Empire (Summers and Summers, 2013). There has been considerable debate regarding the settlement date of the site, which cannot be reliably determined using radiocarbon dating due the plateau on the radiocarbon calibration curve spanning the late 8th to late 5th centuries BCE (Reimer et al., 2013, p. 1881). This has led to speculation about the identity of the site and the polity that constructed the city, which is clearly an imperial foundation given its size and location. Evidence for a clear Phrygian cultural connection comes from epigraphic evidence, architecture, ritual installations, sculpture, and ceramics (Branting et al., in press; Summers, 2006, 2013; Summers and Summers, 2013). Many scholars now accept Kerkenes as the eastern-most expansion of the Phrygian state (Kealhofer and Grave, 2011; Roller, 2011), while others suggest that it could have been an independent polity founded by Phrygian settlers from the west (Summers, 2013).

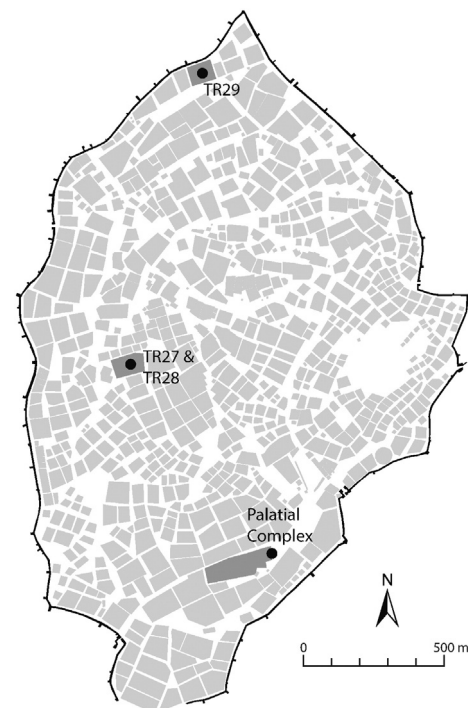


Fig. 2. City plan of Kerkenes, with areas of archaeobotanical sampling marked in dark grey; trenches TR27, TR28, and TR29 provide the new data presented in this article, while palatial complex finds are reported in Smith and Branting, 2014.

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