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Managing Predictable Unpredictability: Agricultural Sustainability at Gordion, Turkey

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SUSTAINABLE LIFEWAYS

Cultural Persistence in an Ever-changing Environment

EDITED BY

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Managing Predictable Unpredictability: Agricultural Sustainability at Gordion, Turkey

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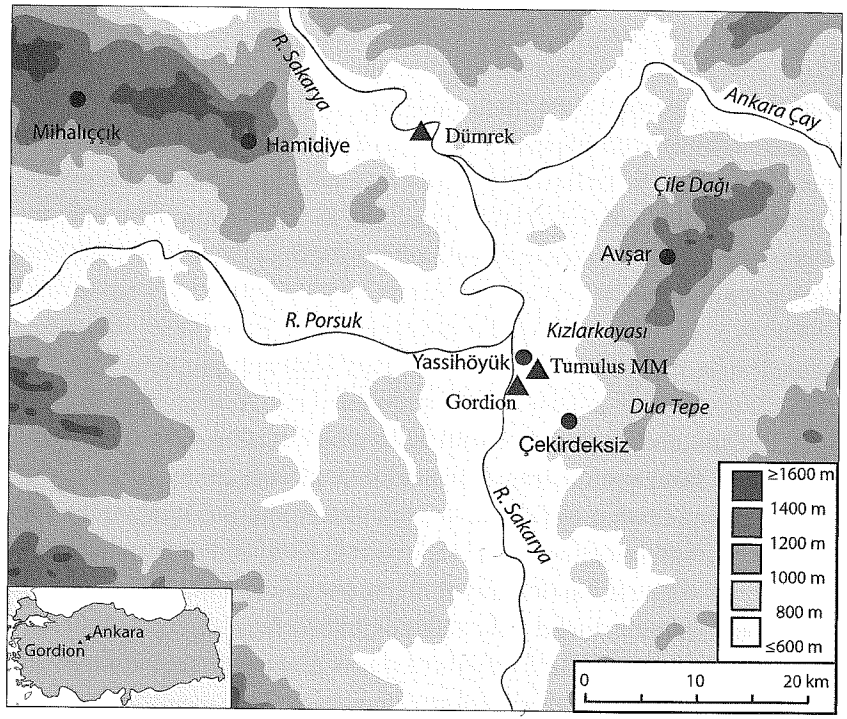
Farming is a notoriously risky occupation, and is particularly so when climate conditions are very variable. The agropastoral economy that developed in west Asia about 10,000 years ago was one solution. It integrated a subsistence base of domesticated plants and animals: wheat, barley, pulses, sheep, goat, cattle, and pig. Depending on local conditions, this flexible system tolerated varying degrees of sedentism or mobility by allowing people to combine multiple strategies in exploiting a diverse group of taxa. By the time of the early civilizations (3rd millennium BC, the Early Bronze Age), technological advances, such as irrigation, and social developments, like the specialization of labor (including full-time nomadic pastoralism; see Beck, this volume), added even more options.

The archaeological site of Gordion, near the present-day village of Yassihöyük, is located at the upper edge of the central Anatolian steppe where dryfarming and herding have been practiced for over 6000 years (Kealhofer 2005). Famous as the home of King Midas and early waystation on Alexander the Great's conquest of Asia, Gordion was occupied long before and well after those two lifetimes. Located in the Sakarya river valley, about 90 km southwest of Ankara, the ancient settlement remains date as early as the 3rd millennium BC and extend through the Roman period; there is some Medieval occupation, and faint surface traces of military trenches date to the

Turkish War of Independence in 1921 (Fig. 11.1). The 1st millennium-BC occupation extends for over a kilometer on both sides of the river. Based on small mounds and sherd scatters, regional survey has securely documented settlement in the valley and surrounding uplands by the Early Bronze Age (Kealhofer 2005). The most visible remains of the region, however, are well over one hundred burial mounds, most of which seem to date to the Middle Phrygian period (Liebhart et al. n.d.). The largest of these, at a height of 53 m, is Tumulus MM, which dominates the landscape (Fig. 11.2).

Excavation (1950–present) has centered on the 13-ha Citadel Mound. The first phase of work, directed by Rodney Young, exposed several hectares of the early Phrygian "Destruction Level" (Sams 2005). In 1988, Mary Voigt directed smaller-scale excavations with the goal of refining the stratigraphic sequence (Table 11.1; DeVries et al. 2003; Voigt 2005) and obtaining archaeobotanical, zooarchaeological, and other samples for scientific analyses.



11.1 Map of Gordion region. (Miller 2010: fig. 2.1)

Table 11.1. Yassıhöyük Stratigraphic Sequence, Approximate Dates (source: Voigt 2005:27)

	PHASE	DATE
YHSS 1	Medieval	13–14th century AD
YHSS 2	Roman [not in these samples]	early 1st–5th century AD
YHSS 3	Hellenistic	330–mid-2nd century BC
YHSS 4	Late Phrygian	540–330 BC
YHSS 5	Middle Phrygian	800–540 BC
YHSS 6	Early Phrygian, ending in "Destruction Level"	950–800 BC
YHSS 7	Early Iron Age	12th century–950 BC
YHSS 8–9	Late Bronze Age	1500–12th century BC
YHSS 10	Middle Bronze Age	2000–1500 BC
—	Early Bronze Age [not in these samples]	2500–2000 BC

Plant macroremains and animal bones from the 1988/1989 deep sounding at Gordion allow us to characterize ancient environment and land use within an ever-changing landscape (Miller 2010; Miller, Zeder, and Arter 2009; Zeder and Arter 1994). The remains discussed here date from Late Bronze Age to Hellenistic and also Medieval times (see Table 11.1 for the "Yassıhöyük Stratigraphic Sequence," YHSS 8/9 to YHSS 3 and YHSS 1; Voigt 1994). From the beginning, plant and animal husbandry focused on wheat, barley, sheep, goat, cattle, and pig. Variability within this broadly defined agropastoral system was a response to prevailing natural and social conditions. The archaeobiological evidence suggests that a strategy that flexibly incorporates dry-farming cereals, small-scale garden irrigation, and a strong pastoral component is the one that provides the most secure living in this environment.

CLIMATE AND NATURAL VEGETATION

In central Anatolia, precipitation declines with elevation. Annual precipitation at the nearest meteorological station in Polatlı (about 15 km to the southeast, elev. 885 m) averages about 350 mm/yr and interannual variability is high.[1] Average annual precipitation at Gordion is somewhat lower; at just under 700 m, the site lies at the upper edge of the steppe zone. It sometimes rains during our field seasons (June to August). Even more commonly, we see rain falling from storm clouds all around us, but not in the center of the valley. Although total grain crop loss from drought is rare, the conditions of dry-farming are marginal enough that relatively small shifts in

11.2 View across the excavated center of the Citadel Mound toward Tumulus MM (left) and other tumuli.

annual precipitation might have had strong effects on agricultural production. Our sequence is recent enough that major climate change is not an issue, but there are some hints of a moist phase dating to the mid-9th century across Eurasia (Morris 2004:730; van Geel et al. 2004). As Neil Roberts (this volume) points out, shorter-term fluctuations can affect the success of different agropastoral strategies; this Iron Age climate amelioration may help explain some of the changes we see in the archaeobiological record.

The present-day distribution of vegetation is the product of millennia of grazing, agriculture, and deforestation interacting with the geological substrate and climatic conditions. Healthy steppe vegetation includes dense growth of perennial grasses such as feathergrasses (*Stipa arabica, S. holosericea, S. lessingiana*), sheep's fescue (*Festuca ovina*), perennial brome grasses (*Bromus cappadocicus, B. tomentellus*), and many other plants. With overgrazing, sagebrush (*Artemisia* sp.) and wild thyme (*Thymus* spp.) become prominent. Today, the area within a kilometer of Gordion is covered with this degraded steppe vegetation, irrigated fields of wheat, barley, sugarbeet, onions, melon, and sunflower, and some poorly drained low-lying areas. A limited number of woody plant taxa grow along the Sakarya river (willow,

tamarix), in watered gardens, and there are a few isolated elm trees allowed to grow in the midst of fields.

With elevation, open woodland of scrubby juniper (*Juniperus oxycedrus, J. excelsa*) and oak (*Quercus pubescens*) are established within 20 km of the site, at about 900 m, near Avşar. They may have grown closer to the settlement in antiquity; under moister conditions, all can grow to be full-sized trees. Closed-canopy pine forest (*Pinus nigra*) grows as close as 40 km northwest of Gordion at about 1100 m, near Hamidiye. A variety of other trees grows as part of these associations.

Analysis of the charred wood remains from Late Bronze Age to Medieval times provides a broad picture of changes in vegetation cover (Miller 1999a, 2010). Over time, juniper growing on the nearby rock outcrops declined. Oak increased, as did minor woods of riparian habitats and secondary forest. These general results suggest an overall decline in woody vegetation, but trees were readily available for fuel throughout the sequence. This conclusion is consistent with Ben Marsh's (2005) geomorphological work, which suggests the massive erosion we see today is a relatively recent phenomenon.

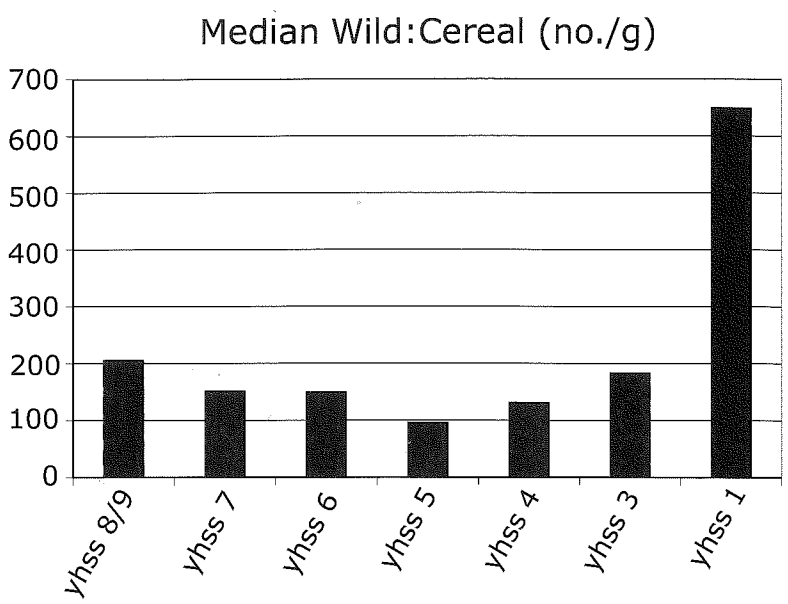
THE AGROPASTORAL CONTINUUM

The traditional mixed farming economy of west Asia is particularly adapted to unpredictable environments. People can respond to changing climatic or sociopolitical conditions by adjusting their reliance on the pastoral and agricultural elements of the subsistence economy, a fact well-recognized by the present-day inhabitants of Yassıhöyük (Gürsan-Salzmann 2005:176). The charred seed remains recovered in flotation samples provide insight into those choices made by the ancient inhabitants (Miller 2010).

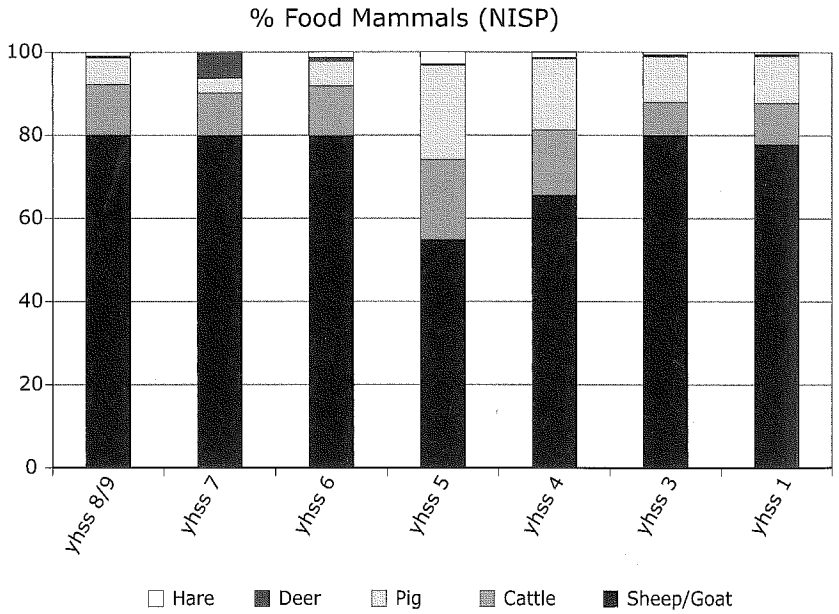
Based on concentrations of seeds in burned buildings as well as remains scattered in other samples, the primary crop plants at Gordion were two- and six-row barley, bread wheat, lentil, and bitter vetch. Minor crops include flax and millet (*Setaria*); rice and cotton first appear in Medieval times. Seeds of wild plants, especially *Trigonella* (a clover-like legume), abound in the flotation samples from occupation debris.

Many seeds found in occupation debris from west Asian archaeological sites originated in animal dung used as fuel (Miller 1984), so seed remains are key to integrating plants and animals in the archaeological record. An earlier archaeobotanical study of Bronze Age sites along the Euphrates river pointed to the potential value of the ratio of wild seeds to cereal grains for monitoring shifts in the emphasis on herding and farming (Miller 1997). In particular, the dung of animals pastured on the steppe will have a higher proportion of the seeds of wild steppe plants relative to cultivated grain, and if that dung is burned for fuel, the resulting wild:cereal ratio will be relatively high. Insofar as the seeds of wild plants originated in dung from steppe grazers, and cereals were consumed by crop-fed or stubble-grazing animals, changes in the wild:cereal ratio serve as a proxy for changes in dependence on farming and herding. Not surprisingly, in areas with higher rainfall the economy relied more heavily on cultivation, with lower wild:cereal ratios and high proportions of cattle and pig bone. Cattle and pig both need ready access to water, and so in the context of west Asia, are penned closer to settlements than sheep and goat. Areas with lower rainfall show higher wild:cereal ratios and higher proportions of sheep and goat bone. Holding climate constant, the wild:cereal ratio can reflect change over time in the sociopolitical factors of herding strategies. At one of the Euphrates sites, Kurban Höyük, occupation phases characterized by higher wild:cereal ratios indicating steppe pasture were associated with higher proportions of sheep and goat (relative to cattle and pig).

Gordion shows even stronger associations in these measures (Figs. 11.3, 11.4). Zeder's faunal analysis (Miller, Zeder and Arter 2009; Zeder and Arter 1994) shows that sheep and goat were the most important food animals throughout the sequence, but in the Middle Phrygian period (YHSS 5), cattle and pig are of maximum significance (see Table 11.2 for absolute quantities on which figures are based). Consistent with this evidence for limited pastoralism compared to farming, the low point in the wild:cereal ratio also occurs in Middle Phrygian times. Two other plant indicators of agriculture and land use support the view that the Middle Phrygian period is anomalous in its high dependence on farming: the distributions of *Trigonella* and of indicators of irrigation. *Trigonella*, the most numerous wild seed, is a plant of healthy steppe that would be preferentially grazed; to this day, at least six species have been seen growing on or near the site. Its proportions in the seed assemblage generally follow the wild:cereal ratio, except at the end of the sequence by which time its numbers presumably had been reduced by overgrazing (Fig. 11.5). The proportion of indicators of irrigation generally follows the wild:cereal ratio, except during the Middle Phrygian



11.3 Median Wild:Cereal ratio (number/weight in grams). (Miller 2010: fig. 5.19b)



11.4 Percent food mammals: sheep/goat, cattle, pig, deer, hare (NISP: number of identified specimens). (Miller 2010: fig. 6.1)

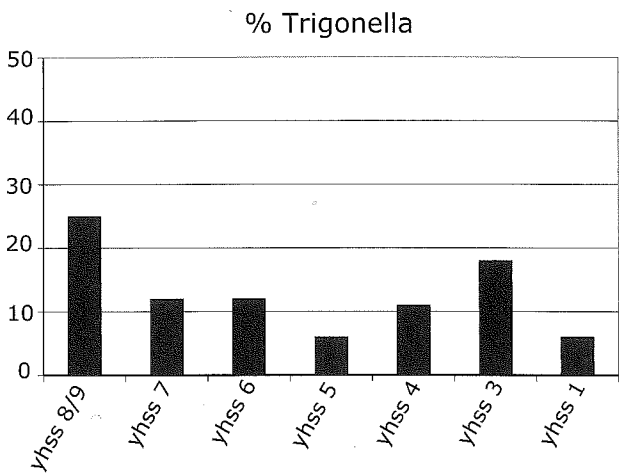
period, when it has a high value (Fig. 11.6). The distribution of the ruderals, or herbaceous indicators of disturbance (mostly *Galium*, but also *Alhagi*, *Peganum harmala*, *Hordeum* cf. *murinum*, and others), is harder to explain, but may relate to small numbers recovered. They do, however, tend to increase over time, until the Medieval period (YHSS 1) (Fig. 11.7). The cumulative effects of disturbance to the native vegetation can also be seen in the results of the wood charcoal analysis; an overall decline in woods of primary forest (juniper, oak, and pine) corresponds to a gradual increase in riparian and secondary succession species (elm, pear/hawthorn, poplar/willow) (Miller 1999a; 2010:Fig. 4.1).

Table 11.2. Quantities on which Graphs Are Based (source: Miller 2010)

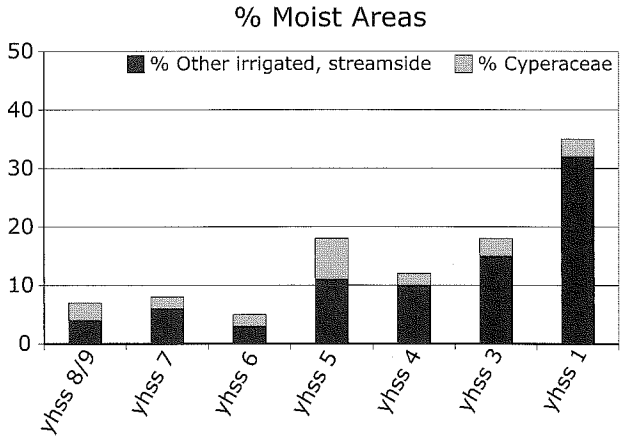
YHSS PHASE	8–9	7	6	5	4	3	1
No. samples	32	66	8	15	53	36	15
Wild & weedy (total no. per phase)	5060	7710	58	368	8765	6573	2557
Median Wild:Cereal (no./g)	206	152	150	97	132	184	650
NISP food mammals*	2269	3303	1628	1827	2169	1322	881
Italian millet (*Setaria italica*) (no.)	0	9	0	3	161	77	91
Naked wheat (*Triticum aestivum/durum*) (weight, g)	5.36	18.86	0.08	0.66	9.07	4.07	0.54
Two-row barley (*Hordeum vulgare* var. *distichum*) (weight, g)	7.90	12.41	0.13	1.53	18.33	6.27	0.68

*sheep/goat, cattle, pig, deer, hare

The Medieval period (YHSS 1) saw a qualitative change in the agropastoral economy, one that employed a new strategy: summer irrigation. The change may have been at least partly a response to the heavy deposition of sediments from eroded hillsides, which would have led to a more flood-prone, meandering river in the valley bottom (Marsh 2005:168). That new regime is closest to what became the traditional (i.e., 20th-century) base of the Yassıhöyük village economy (Gürsan-Salzmann 2005): sheep and goat herding and the cultivation of winter crops (wheat and barley) and summer-irrigated cash crops (onions, sugarbeet, melon, and, until the 1950s, rice). As in most of the archaeological sequence, relatively high

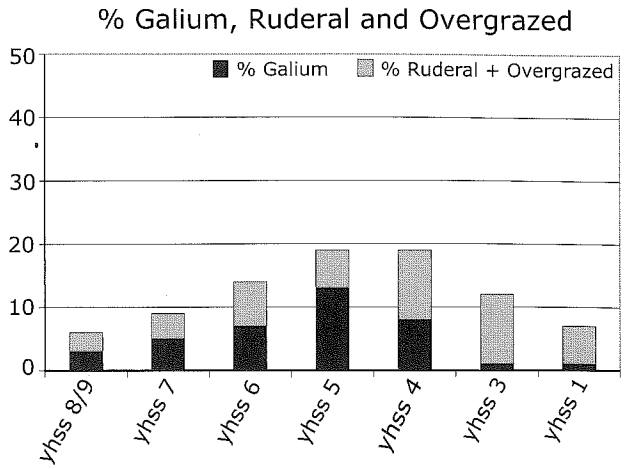


11.5 Percent *Trigonella*. (Miller 2010: fig. 5.20a)

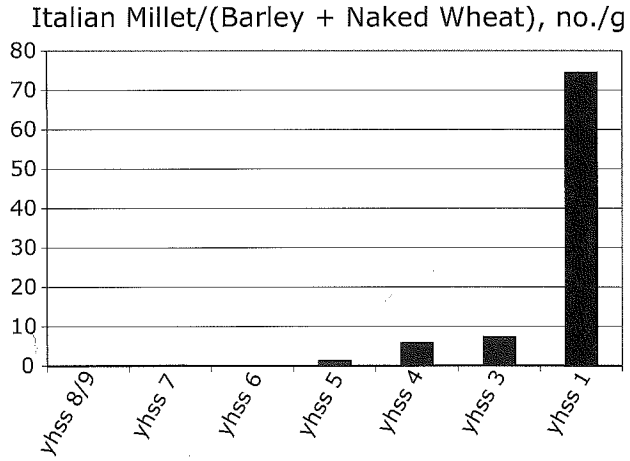


11.6 Percent indicators of irrigation and streamsides. (Miller 2010: fig. 5.26)

proportions of sheep and goat characterized the pastoral economy. Fall-sown wheat and barley were the primary cereals. But relative to those traditional grains, the proportion of millet, a summer-irrigated crop that had occurred in low but increasing amounts over the course of the Gordion occupation, reaches its maximum in the Medieval samples, which also contain the first evidence for summer-irrigated rice and cotton (Figs. 11.6, 11.8; see also Fig. 11.4).



11.7 Percent ruderals: indicators of disturbance. (Miller 2010: fig. 5.23)



11.8 Italian millet (*Setaria italica*) relative to wheat and barley (number/weight in grams). (Miller 2010: fig. 5.8)

The results of the integrated archaeobiological analysis (Miller, Zeder, and Arter 2009) are fully consistent with the conclusions reached by other project members (Kealhofer 2005; Voigt 2005, 2007, 2009), and strongly suggest that people adjusted their agricultural strategies according to physical and social conditions. Sheep and goat herding expands the territory that can be turned to productive use (i.e., pasture), and irrigation, with its heavy use of human labor, expands the time put toward production. Both strategies

can reduce year-to-year fluctuations in the food supply, and are discernible in the archaeobiological record.

A mid-9th century BC climate amelioration may have set the stage for the period of prosperity that culminated in the territorial state associated with King Midas during the 8th century BC (i.e., the Middle Phrygian period). During the 9th century the site was fortified and formal stone buildings were constructed (the Early Phrygian period, YHSS 6). By the time of a catastrophic fire dated to 800 BC, a massive building project involving the laying of clay fills as a foundation for new buildings in the palace quarter and a reorientation of the stone fortications had already begun. After the fire, workers covered the central area (the archaeological "Destruction Level") with several meters of clayey sediment, built up a second high mound adjacent to it, and laid fills in an adjacent Lower Town (Voigt 2007). As Marsh (2005) suggests, the spoil from canal digging may have provided the material that raised the level of the city. Irrigation of staple crops would have greatly enhanced food security as well as overall quantity; large, predictable surpluses would have allowed trade and craft production to flourish. The site of Gordion reached its greatest extent during Middle Phrygian times (Voigt and Young 1999), the regional settled population was at its greatest, and the maximum area of land was devoted to agriculture (Kealhofer 2005).

Gordion remained an economic center, but lost political autonomy in the Late Phrygian period (YHSS 4) (Voigt 1994:278; Voigt and Young 1999). Regional population seems to have declined (Kealhofer 2005). The rapid reversion toward pastoralism suggests the Middle Phrygian economy was not sustainable in the long run without serious input of labor; climate aridification would have intensified this shift in subsistence strategy.

Regional settled population in the Medieval period appears to have been relatively small (Kealhofer 2005), and sheep and goat herding reached levels not seen since the Early Iron Age (YHSS 7). Perhaps the human population was more transhumant than in earlier times. For those who remained in the settlement, the increased emphasis on summer irrigation represents a new strategy, though both irrigation and millet were known as early as the Iron Age at Gordion and elsewhere (Nesbitt and Summers 1988). The seeds of summer-irrigated crops represent a tiny proportion of the assemblage, but rice and cotton may have been grown as commodities (see Karaman 2009; Samuel 2001:428). Despite the overall decline in settlement in the valley, cultivation of these crops shows that medieval farmers worked harder during the summer months. Where Middle Phrygian summer irrigation of millet was almost certainly a strategy that would have increased the food supply or crop security, that strategy seems less likely in the more sparsely populated valley of medieval times. Whether to satisfy tax obligations or just supplement their income, this year-round system suggests that medieval farmers were participating in a supraregional economy.

LESSONS FOR TODAY

Over the past twenty years of my observation, the agricultural landscape continues to evolve. As Ayşe Gürsan-Salzmann (2005) has documented, the largely pastoral economy of the 19th century gave way to a mixed agricultural economy in the 20th. Today, the village of Yassıhöyük houses fewer farmers year round, as many residents seek economic opportunities for themselves or schooling for their children in Polatlı and beyond. Increasingly, migrant agricultural workers from southeastern Turkey camp on the outskirts of the village. Anecdotally, we (the archaeologists) have seen fluctuations in the proportions of sheep, goats, and cows. In the mid-1990s, the national government began an irrigation project that allows farmers to irrigate virtually all their fields. Farmers have told Gürsan-Salzmann (pers. comm.) that they keep growing onions and other cash crops even though they deplete the soil; any cash income is welcome, and the cost of the water is subsidized. As irrigation increased, we noticed a dramatic decline in sheep grazing on the landscape. As the zooarchaeological model would have predicted, we initially saw an increase in the number of cows. Pigs did not have a corresponding increase, now that the local population is Muslim. In the summer of 2006, herds of cattle predominated over flocks of sheep. The cows were a Dutch breed that produces a lot of milk and whose purchase was subsidized by the government (Gürsan-Salzmann, pers. comm.). Thus, recent history seemed to reflect many aspects of the past: the labor, cattle, and irrigation complex apparently was replacing the lower-intensity traditional agropastoral economy. And then, in the severe drought year of 2007, cows virtually disappeared from the village. Two villagers, Zekeriya Utgu and Remzi Yılmaz, told me that the drought had made it too expensive to hire cowherds (shepherds' wages are lower), so the only cows kept in the village were ones individual families could care for by themselves. Flocks of sheep and goat were again numerous.

The Gordion archaeological project has played an important role in the economy of the Yassıhöyük for over sixty years. In the early years, the project intensified dependence on the cash economy through the wages paid to local workmen. Tourism has had a smaller impact than might be expected, given Gordion's place in myth and history. Since the mid 1990s, I have been developing ways of using plants for conserving the archaeological monuments, with an eye on using archaeological and environmental preservation to enhance the touristic value of the region and to provide the village with another source of income (Miller 1999b, n.d.). In recent years, the Gordion project's goals have greatly expanded and now include this kind of work, too (Gürsan-Salzmann and Erder 2010).

The history of agricultural land use in the Sakarya valley near Gordion suggests alternative pathways for making a living in this precarious environment. For several thousand years, an agricultural economy based on sheep and goat herding and dryfarmed cereals was the norm. In different ways and for different reasons, the Middle Phrygian and Medieval periods represent novel variations on this theme. Agropastoralism is a very flexible system that allows people to respond quite quickly to rapidly changing conditions. No analogy is perfect, and natural and social environments are not static. Even if climate returns to some prior state after a long- or short-term shift, the land itself may change; it would not be possible, for example, to reestablish forest on eroded, soil-less slopes. It is even more obvious that social conditions do not revert to some prior state. To an even greater extent than was the case in Middle Phrygian times, present-day Yassıhöyük is embedded in a national and international economy that demands both agricultural productivity and monetary income. Finally, each succeeding generation has inherited the landscape of its predecessors, and the historical landscape itself is a resource that has survived over 2500 years, longer than any irrigation regime. If over-irrigation is allowed to change the water table and soil chemistry, the land may be permanently harmed. It is, however, still possible to create a sustainable economy that incorporates plant and animal husbandry along with ecotourism and archaeological tourism.

NOTE

1. I am grateful to Mr. Hüseyin Erdoğan of the Polatlı Meteoroloji Istasyonu for these data: 355.4 mm (41-year average).

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