CHAPTER TWENTY-FIVE

Agriculture in Roman Egypt

Brendan Haug

Introduction: Preparing the Soil

Sometime in late March or early April of CE 278, Ulpius Aurelius, Egypt's *dioikêtês* (chief of finances) composed a circular for distribution to the *stratêgoi* (governors) of the Arsinoite nome (administrative district) and the several nomes of the Heptanomia – in total a 600 km stretch of the Nile Valley from the apex of the Delta to the city of Thebes in the south. Among the original recipients of the document was one Aurelius Harpocration, *stratêgos* of the Oxyrhynchite nome, whose capital city of Oxyrhynchus lay to the west of the Nile some 280 km south of Alexandria. On the 6th of Pharmouthi (1 April) having appended his own introductory remarks, Harpocration forwarded copies of the letter to his subordinates, the *dekaprôtoi*, a group of ten men selected from the Oxyrhynchus' city council and tasked with local administration and tax collection in the nome. It was they who would carry out the *dioikêtês*' instructions.

The subject of this official communiqué, published as *P.Oxy.* 12.1409, was irrigation. Although the country was still in the depths of the dry season – the Nile at low ebb and the first appearance of the annual flood at least two months distant – the *dioikêtês* writes that a critical period of the year had been reached, a time of preparation for the coming inundation:

> Ulpius Aurelius to the *stratêgoi* and *dekaprôtoi* of the Heptanomia and the Arsinoite nome, greetings. Since the time for the building up of the dykes and the cleansing of the canals is at hand, I thought it necessary to announce to you by means of this letter that all the farmers and […] should at this time build them up with all zeal on the [lands?] belonging to them, both for the public benefit of all and the personal benefit of each. For I am convinced that everyone is aware of the benefit that comes from these tasks (ll. 7–12).

Nome officials were commanded both to encourage all to begin the yearly labors and to select overseers from local magistrates or private persons. These overseers would, in turn, compel everyone to perform their appointed tasks personally. Overseers were not permitted

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to accept cash payouts in place of physical labor for only sweat and toil would ensure that critical works were completed.

> So that the dykes are raised to the established height and width and the breaches are blocked up, in order that they may be able to withstand the blessedly impending flood of the most sacred Nile, and so that the canals are cleansed up to the so-called standards and the accustomed dimensions, in order that they may easily bear the coming onrush of water for the irrigation of the fields, this being for the common good (ll. 12–19).

The letter ends with a warning to any persons who attempt to exact bribes or shirk their responsibilities (ll. 20–22): both their life and property are at stake for "endangering measures intended for the safety of all of Egypt."

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A traditional reading of this papyrus would begin with the assertion that Roman Egypt's governing institutions were designed solely to maximize and extract agricultural surplus (Monson 2012, p. 275). The country was, after all, the granary of Rome – more natural resource than proper province – and the lives of tens of thousands of grain-dole recipients in the city depended upon a constant supply of Egyptian cereals. Behind Ulpius Aurelius' rhetorical invocations of the "safety" of Egypt and the "common good" lay his true goal of filling Roman bellies through the oppressive taxation of the Egyptian peasantry. To this end his local agents would disperse throughout the countryside to enforce a hated dyke- and canal-repair *corvée*, subjecting Egyptian bodies to the lash in order to ensure proper irrigation, a bountiful harvest, and a substantial surplus destined for hungry Romans in the imperial capital (Rostovtzeff 1929).

A more optimistic appraisal informed by later comparative evidence (Mikhail 2010; *id.* 2011) views the state–society relationship in this papyrus from the ground up and emphasizes the agency of the Egyptians themselves. Indeed, despite its authoritative tone and dire concluding threat, Ulpius Aurelius' own words betray that Alexandria had no direct hand in managing the flow of water through the canals and basins of Egypt's countryside. Lacking an irrigation and agricultural bureaucracy capable of governing water resources centrally, the *dioikêtês* instead relied upon the spontaneous initiative of an Egyptian peasantry whose own prosperity was dependent upon the communal self-regulation of local irrigation works. The state nonetheless retained a significant financial stake in Egyptian agriculture and accordingly empowered its local representatives to encourage, coordinate, and materially support the traditional irrigation practices of rural communities. Ulpius Aurelius may speak of compulsion (*anangkasontas*), but on balance his representatives were more likely to serve as *de facto* "community organizers" than agents of authoritarian oppression (Haug 2012).

The truth – an Egyptian agriculture neither enslaved nor largely indifferent to Roman governance – lies somewhere between these two extremes. It has become clear, for instance, that levels of taxation during the Roman period were low to moderate and that Egypt's centrality to the *annona* (Rome's grain supply) has been overstated (Rathbone 2007a, p. 717). Further, Rome's agricultural administration is now understood to have relied less upon despotism than upon the coordination of traditional irrigation practices at the local level. As a result, the classic depiction of the province as exceptional – as the emperor's private property, wrung for maximum gain via ossified and dirigiste Ptolemaic institutions – has been discredited. The richness of the documentary record nonetheless continues to complicate the picture by

revealing considerable regional and temporal diversity. Attempts to summarize the characteristics of a distinctly Roman Egyptian agriculture are thus often frustrated by the appearance of contrary evidence from other places and times.

Although the wealth of the papyrological evidence precludes discussion of every topic debated in contemporary scholarship, this chapter introduces a selection of critical issues: the environment, the strengths and weaknesses of our evidence, population and the size of the cultivated area, land tenure and taxation, crops and diet, the management of Egypt's natural resources, and changes to Egyptian agriculture toward the end of the period covered here. Although the debate on several of these subjects is far from settled, this chapter will guide readers toward the most essential contributions.

Environment and Landscape

Environmentally, Egypt is the most "un-Mediterranean" of the Mediterranean countries. As in the rest of North Africa, a Mediterranean climate with sporadic and unpredictable winter rains (c. 20–100 mm/yr) prevails along its coastline. But while these narrow coastal strips quickly give way to desert in neighboring Libya, Tunisia, and Algeria, the River Nile provides Egypt with an ample water supply in the otherwise hyperarid Sahara. Although it empties into the Mediterranean, the Nile is in fact a tropical river, and its flow owes little or nothing to Mediterranean climate patterns. It is instead governed by the southerly climate systems of the Indian Ocean and East Africa and is strongly affected by cycles of the El Niño-Southern Oscillation (Abtew, Melesse, and Dessalegne 2009).

In antiquity, the Nile's yearly cycle of flood, recession, and low ebb structured the Egyptian agricultural calendar. From February to May, the river is at its lowest level, ancient Egypt's dry harvest season. During this period, the White Nile, the Nile's longest tributary, contributes the majority of the river's scanty flow from sources in central Africa as far south as the Nyungwe Forest in Rwanda, some 2700 km from Egypt's southern border (Dumont 2009, p. 2). In flood, however (c. June to September, the irrigation season), close to 95% of the Nile's waters are delivered by a secondary tributary, the Blue Nile, and derive from monsoon rains in the highlands of Ethiopia (Wohl 2011, p. 78). This monsoon runoff also carries with it the silt that fertilized Egypt's fields each year.

Following the convergence of the Blue and White Niles at Khartoum in the Sudan, the flood travels north through the main stem of the Nile for c. 1400 km, arriving at Aswan on Egypt's southern frontier in early June. Today the flood terminates in the Lake Nasser reservoir behind the Aswan High Dam, the cornerstone of contemporary Egypt's perennial irrigation system since its completion in 1970 (Collins 2002, pp. 177–194). Prior to the construction of the High Dam and its predecessor the Low Dam in 1902, the inundation traversed Aswan unimpeded and reached the Delta some 800 km to the north by July, transforming the floodplain into a vast lake dotted by cities and villages built on high rocky outcroppings (Hdt. *Hist.* 2.97). From October to January, the flood receded, and Egyptians sowed their crops on fields that had been cleansed, irrigated, and fertilized by the Nile's bounty.

Since this annual inundation was the primary source of water for agricultural irrigation in the Nile Valley, its height was a harbinger of surplus or scarcity. Weak floods or those that arrived later than usual resulted in food shortages due to insufficient irrigation or a truncated growing season. High floods similarly reduced the annual harvest by leaving much of the countryside waterlogged and uncultivable until late in the year (cf. Plin. *HN* 5.10.57–58). The latter were also far more dangerous than low floods since the fearsome onrush of a

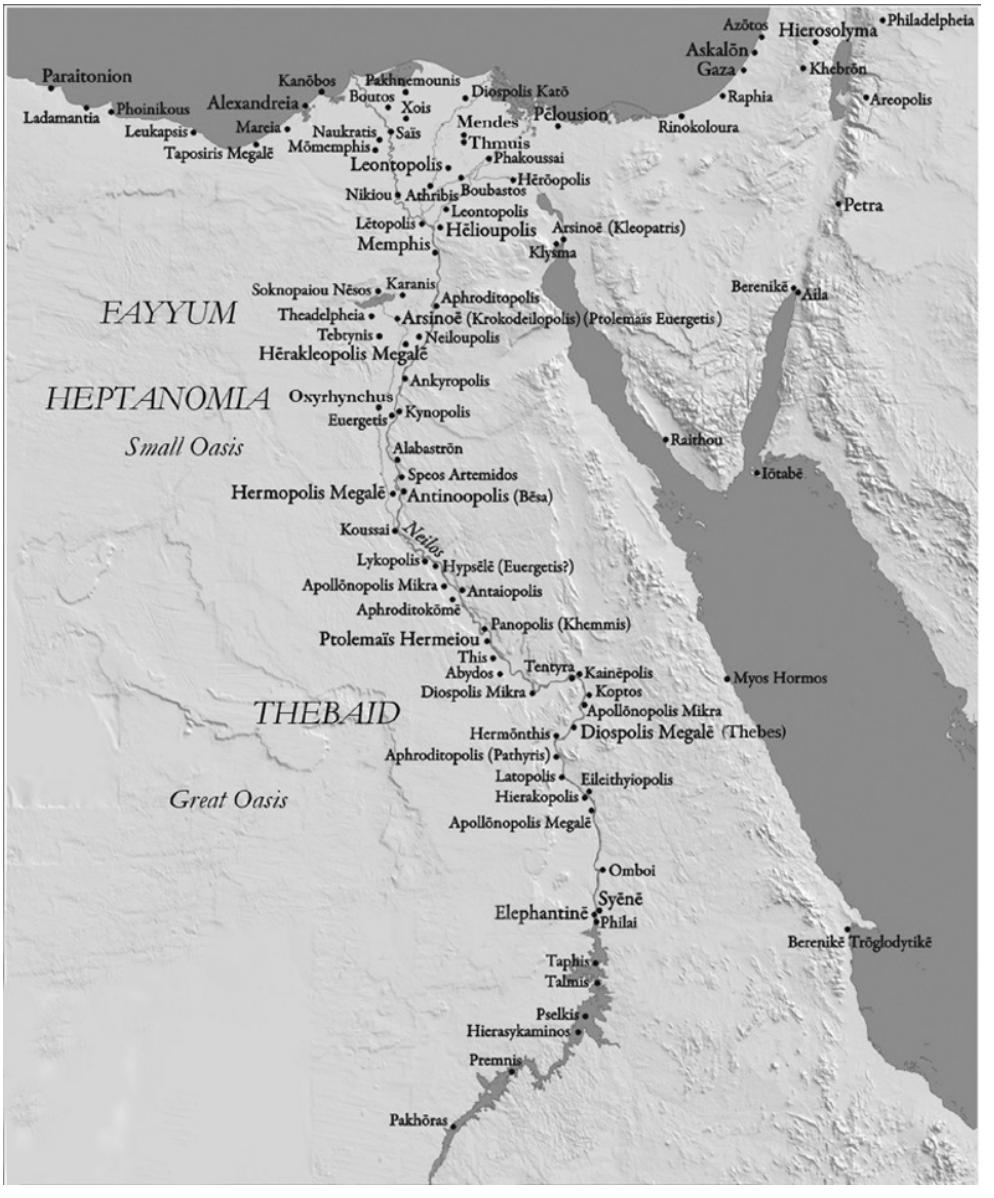

Figure 25.1 Egypt in the Roman Period. Source: Courtesy of Dr. Ian Mladjov.

high Nile drowned humans and animals alike, destroyed irrigation infrastructure, and spoiled stored foodstuffs (Willcocks 1889, pp. 300–301; Wilkinson 2014, p. 8).

These risks aside, the flood was adequate more often than not. While no long-term sequence of recorded flood levels has survived from the Ptolemaic, Roman, or Byzantine periods, records from the seventh to fourteenth centuries CE suggest that the waters arrived on time and in sufficient strength to irrigate the majority of the countryside in roughly three out of every four years (Said 1993, pp. 96–97). Although this method of irrigation permitted only one annual crop, bountiful harvests in good years and an arid climate conducive to food storage enabled the population to endure short-term deprivation during the occasional bad

year, albeit with hardship. Longer series of unfavorable floods were more destabilizing and may have contributed to political turmoil throughout Egyptian history (Hassan 2007; Chaney 2013).

The landscape watered by the inundation had also changed in the centuries since the end of native pharaonic rule. At a macro-level, the Nile's channel has shifted to the east over the millennia (Schumm 2005, p. 185). This is observed most dramatically near the apex of the Delta, where the river has abandoned the ancient capital of Memphis and the royal burial complexes at Giza and migrated toward what is now the massive conurbation of modern Cairo (Lutley and Bunbury 2008). More important from the perspective of this chapter, however, is a single anthropogenic alteration to Egypt's landscape dated to the Hellenistic period. During the third century BCE, political pressures in the nascent Ptolemaic state resulted in a massive expansion of agricultural settlement into an area known today as the Fayyum, a geological depression west of the Nile in Egypt's Libyan Desert that had been minimally developed in the early part of the second millennium BCE but was otherwise still largely uninhabited (Manning 2003, p. 100). Seeking to increase their hold over the countryside through the settlement of Graeco-Macedonian veterans but unable to find sufficient lands elsewhere in Egypt, the first two Ptolemies reclaimed the entirety of the Fayyum by diverting a portion of the annual flow of the Bahr Yusuf, a seasonal side channel of the Nile that emptied into the depression during the flood and refreshed the shallow, marshy lake in its center, Lake Moeris. Massive canals were then excavated, which channeled irrigation water to dozens of newly founded villages, an irrigation system unlike any other in Egypt.

This project gradually reduced the size of Lake Moeris and opened up between 1200 and 1600 km^2 of new agricultural land, increasing Egypt's total cultivable area by 5 to 7% (Manning 2003, pp. 103–108; *id.* 2010, pp. 139–140). Officially dubbed the Arsinoite nome, the Fayyum reached its greatest extent during the early Roman period, its administrative area comprising nearly 1700 km^2. Boggy conditions in parts of the depression, a feature of its unusual hydrology, nonetheless prohibited intensive cultivation throughout the entirety of this massive area (St. John 1845, p. 182; Bonneau 1982; Haug 2015; *id.* 2017).

Yet the distinctiveness of the Fayyum does not imply an otherwise homogeneous Egyptian landscape. Rather, variations in topography throughout the Nile Valley created a diverse countryside with unique experiences of the inundation. Hard-pressed on either side by the rocky hills of the desert, the floodplains of Middle and Upper Egypt concentrated the Nile's annual water and silt deposits within a slender ribbon of fertile farmland scarcely more than a kilometer wide at its narrowest points in the far south. These tight quarters consistently boasted the country's most fertile soils and highest population densities. By contrast, the broad, flat expanses of the Delta and the Fayyum contained high amounts of marginal land, particularly the marshes of the northern Delta and the saline soils in the Fayyum (on which see Monson 2013). The lower productivity of both of these areas was long correlated with lower population densities prior to the advent of modern irrigation and drainage technologies, and the introduction of artificial fertilizers (Monson 2012, pp. 43–54).

Evidence

The archaeology of the post-pharaonic Nile Valley suffers by comparison to the earlier period. Dug out by farmers in search of fertile archaeological soil (*sebakh*), ransacked by antiquities- and papyrus-hunters, or plowed through in the search for pharaonic treasures, many Graeco-Roman sites in the Valley and the Fayyum were decimated before proper excavations could be conducted (Cuvigny 2009; Davoli 2015). The agricultural town of Karanis in the

northeastern Fayyum is a notable exception thanks to extensive excavation by the University of Michigan from 1925 to 1935. Sadly, this pioneering project was never fully published, and its findings have been presented only in summaries and in articles on particular aspects of the site (summaries in Husselman 1979 and Gazda 2004). Work at Karanis recommenced in 2003, and its results are eagerly anticipated (Cook 2011; Cappers et al. 2013). Excellent work continues at the important Fayyum sites of Soknopaiou Nesos and Tebtunis as well, but little to nothing in their findings concerns agriculture (see in general Davoli 1998).

In contrast to the relative paucity of archaeological evidence concerning agriculture in the Valley and Fayyum (apart from the substantial finds at Karanis), excavations in the Dakhla and Kharga Oases in the Western Desert have provided considerable insights into agricultural life in a region of Egypt that has long been less familiar to scholars accustomed to working primarily with papyri (Kharga: Bousquet 1996; Dakhla: Bagnall 1997 and Bagnall et al. 2016). Due to considerations of space, however, the oases will be excluded from general consideration here.

As for the papyri, settlements on Egypt's best agricultural lands have preserved next to nothing thanks to their continuous inhabitation. Only abandoned and desiccated sites along the borders of the agricultural landscape have produced large caches of documents (Bagnall 1995, pp. 9–11). Multiple near-desert regions of Roman Egypt are thus known in great detail, while the majority of the country remains undocumented.

Biases are inevitable under such circumstances. Of great significance is the fact that rural documents survived in large numbers only in the Fayyum. Here, thousands of papyri were recovered from a ring of abandoned villages along the depression's outer rim. Thanks to these texts, the agricultural societies of these border settlements are relatively well known, while villages elsewhere in Egypt remain invisible. Even the Fayyum's continuously inhabited interior is obscured by a lack of documentation until the Middle Ages (Haug 2017). We must therefore be cautious about regarding liminal Fayyum settlements as microcosms of the rest of Egyptian agricultural society. Located at the tail-ends of the region's unique canal system, their backs to the encroaching desert, these villages were atypical.

Our view of urban Egypt during the Roman period is similarly dominated by documents from a single locale, Oxyrhynchus (see in general Parsons 2007). The city was sited at some remove from the Nile, lying instead on the western banks of the Bahr Yusuf on the outskirts of the floodplain. The slow eastward shift of the river and possible alterations to the course of the smaller Bahr Yusuf (Cooper 2014, pp. 101–102) may have prompted its abandonment sometime after the Arab conquest. Whatever the case, its rubbish heaps preserved the largest cache of metropolitan papyri from Roman Egypt. Thanks to their urban provenance, the Oxyrhynchus papyri primarily record the interests of the state – taxation, law and order – as well as the economic interests of urban landowners with holdings in the nome's countryside (Rowlandson 2007, pp. 211–212). The voices of the nome's country villages are correspondingly underrepresented.

An important supplement to the Fayyum and Oxyrhynchus finds are the carbonized papyri from the city of Thmuis, the Roman-era capital of the Mendesian nome in the northeastern Nile Delta. Although it contains two-thirds of Egypt's agricultural land, the soggy Delta cannot preserve papyrus in its natural state, and the carbonized rolls from Thmuis are thus a rare and precious find (Blouin 2014). Needless to say, this corpus has its own limitations. Produced in the municipal archives of a nome capital, these rolls contain cadasters, accounts of tax in arrears, and other fiscal documents. They are, in other words, schematic representations of the nome's landscape designed to facilitate the assessment and extraction of revenue. Further, the archive is dated to the end of the second to the beginning of the third centuries CE, a period during which Egypt was affected both by the Antonine Plague and an uprising led by

residents of the Delta's liminal regions, the so-called Revolt of the *Boukoloi* ("herdsmen"). Documenting a society in some degree of disarray, the evidence of these texts is surely not representative of conditions in the northeastern Delta in all periods.

These qualifications, though essential, are far from a counsel of despair. Papyri have indeed been recovered from other parts of Egypt, albeit in smaller quantities than the bountiful Fayyum and Oxyrhynchus finds. Furthermore, papyrologists have exploited the parochial nature of much of the surviving documentary papyri to write compelling local histories (e.g. Rathbone 1991; Rowlandson 1996; Schubert 2007; Monson 2008; *id.* 2013; Blouin 2014). Scholars also increasingly subject their evidence to rigorous cross-comparison in the attempt to illuminate local and regional peculiarities, an approach that has resulted in significant increases in our understanding of Roman Egypt's variegated agricultural landscape.

Population and the Cultivated Area

Since population levels and the extent of the cultivated area are tied to aggregate production, consumption, and taxable surplus, estimates of these variables have a direct bearing on our overall impressions of the agricultural wealth of Egypt under Roman rule. Several caveats are once again in order. First, neither variable remained static over time. Modern estimates thus attempt to establish theoretical maxima: the highest numbers sustainable under ancient conditions. Second, no uncontested ancient evidence for either figure has survived. The debate has consequently been vigorous and consensus elusive, particularly since different scholars privilege different datasets and apply different standards of historical plausibility (this contribution is no exception). Our often impressionistic conclusions accordingly remain subject to revision in the light of new evidence and/or improved methodologies (for surveys, see Scheidel 2001b; Bowman 2011; Monson 2012, pp. 33–49; Tacoma 2012).

The two surviving attestations of Egypt's population in the Roman period are at wide variance. On the low end, Diodorus Siculus (1.31.6–9) claims a population of not less than 3 million persons in the first century BCE. In the first century AD, Josephus puts the figure much higher: 7.5 million, excluding Alexandria (Josephus *BJ* 2.385). While the latter figure, high even by comparison to Egypt in the 1880s, was once widely accepted, the most popular contemporary estimate is a more circumspect 5 million. This figure is reached by combining an urban population of 1.75 million – a rough guess at the populations of Alexandria and the c. fifty nome capitals – with a rural population of some 3 million. The rural figure is extrapolated from the average population densities of several Fayyum villages: 120 persons/km^2 (Rathbone 1990; Bagnall and Frier 1994, pp. 53–56).

Several objections to this conclusion have been raised. First, population densities along the Fayyum's margins were lower than those on better lands in the Nile Valley. Scattered ancient evidence suggests as much while data from the beginning of the nineteenth century show substantial variation throughout the country, including low density in the Fayyum (Monson 2012, pp. 41–46). A further objection (Lo Cascio 1999) asserts that although its many metropolitan nome capitals made Egypt one of the most urbanized regions of the Roman world, the roughly 35% urbanization rate that results from a population of 5 million is far too high. Moreover, accounting for the non-farming population of craftspeople and other service providers in Egypt's villages raises the non-agrarian share of this population still higher to c. 40%, far beyond the pale for the premodern world. Diodorus' population estimate of no less than 3 million is thus argued to refer only to adult male payers of the poll tax (*laographia*), i.e. males between 14 and 62 years of age, who ought to amount to 32.6% of the population under prevailing age and sex ratios (Bagnall and Frier 1994, pp. 91–102). This reduces the

urban share of the population to acceptable levels but pushes the total population to nearly 9 million, beyond even Josephus' count.

The higher estimate nonetheless remains the more implausible of the two; indeed, nine million persons is an impossible figure under a premodern agricultural and technological regime in Egypt. Egypt's population only reached and sustained this level by the end of the nineteenth century following decades of agricultural modernization and increased productivity, sanitation improvements in the major cities, the expansion of health services, and subsequently rapid population growth. Yet 5 million may also be an undercount. Privileging comparative data once again, we see that Egypt's population hovered in the vicinity of 5 million in the early nineteenth century following a period of internal unrest, poor floods, invasion, and disease at the last decades of the 1700s (Crecelius 1998; Cuno 1992, pp. 30–32). That early Roman Egypt – technologically comparable, peaceful, prosperous, and plague-free – supported a similar population to this troubled era is questionable at the very least (Monson 2012, p. 48). A range between 6 to 7 million persons is an acceptable compromise between these two estimates: high enough both to account for denser inhabitation outside marginal areas like the Fayyum and to reduce the urbanized percentage to more reasonable levels yet still low enough to reflect an Egyptian population at peak premodern levels (much here depends upon Scheidel 2001a, pp. 201–208).

We gain perspective on this issue by linking demography to estimates of the size of the cultivated area. Here we dispose of only a single ancient figure. An inscription in the Ptolemaic temple of Edfu claims that Egypt farmed 9 million arouras, i.e. 24 804 km^2 (1 aroura = 2756 m^2), a figure widely cited in the scholarly literature as 25 000 km^2. Like Josephus' population count, the Edfu inscription is considerably in excess of later comparative evidence. Napoleon's *savants* estimated only some 13 000 km^2 at the end of the troubled eighteenth century, while a report to the British government of 1840 puts the figure at 14 700 km^2, surely indicating progressive recovery from its historic low at the end of the previous century (Bowring 1840, p. 13). Even the return of economic prosperity under Muhammad Ali and his successors, driven in large part by a massive and coercive expansion of cotton (Beckert 2014, pp. 131–132), produced a cultivated area of still less than 20 000 km^2 by the mid-nineteenth century, far short of the Edfu figure (O'Brien 1968, p. 172).

In fact, cultivation on 25 000 km^2 was never reached during the nineteenth century despite population growth, technological improvements, and constant agricultural expansion. Completed in 1861 and perfected in the 1890s, the Delta Barrage provided perennial irrigation to Lower Egypt, while the Ibrahimiyya canal in the south (1873) increasingly permitted perennial irrigation in Middle Egypt and the Fayyum. Yet even by 1889, with perennial irrigation reaching into the depths of the countryside, massive estates under cotton, and a population close to 9 million, only 23 269 km^2 were *potentially* cultivable with just 18 969 km^2 actually cultivated and paying taxes (Willcocks 1889, pp. 16–17). Egypt reached and sustained the 25 000 km^2 benchmark only in the 1950s, decades after the introduction of artificial fertilizers in 1902, the inauguration of the Low Dam at Aswan, and with a population in excess of 26 million persons (Scheidel 2001a, pp. 220–223; population figure in Robinson and El-Zanaty 2006, p. 24).

A cultivated area of 25 000 km^2 in the Roman period is therefore unlikely. If we accept the low population estimate of 5 million, we are compelled to believe that some 3 million Roman Egyptians performed agricultural labor equivalent to that of well more than 20 million twentieth-century farmers equipped with modern agricultural technologies. Even at the high estimate of 9 million persons, sustained cultivation on 25 000 km^2 by c. 6.75 million peasants still seems improbable for the same reasons. A maximum of 20 000 km^2 of cultivable land during the early Roman period is thus a safer bet. If between 80% and 90% were cropped in

a given year, the taxable area would amount to 16 000–18 000 km², a plausible figure in comparative perspective.

This is an undeniably conservative estimate by the standards of contemporary scholarship, and readers should pursue the contrary arguments in detail (particularly Rathbone 1990). At the same time, these conclusions should not be regarded as pessimistic since it will be argued below that the average productivity of Egyptian fields has, by contrast, been underestimated. As a result, the smaller Egypt imagined here was as or more productive than the larger Egypt depicted by other authors.

Land Tenure and Taxation

Although significant complexity must be elided here, a general division between private (*idiotikê*) and public (*dêmosia*) agricultural land obtained in Roman Egypt, analogous to the distinction between *ager privatus* and *ager publicus* in Roman law. Public land owned by the Roman state derived in large part from the royal land of the Ptolemies (*basilikê gê*), but it also included temple lands (*hiera gê*) that had been transferred to the state administration during the Augustan period (Capponi 2005, pp. 98–99). Estates (*ousiai*) acquired by the emperor or members of the imperial family during the Julio-Claudian period and occasionally gifted to favored individuals were also transformed under the Flavians into a subspecies of public land (*ousiakê gê*) and administered like other public domains (on the *ousiai*, see Tacoma 2015).

The evolution of private land is more complex. Until recently it was believed that fully alienable private land did not exist under Ptolemaic rule save for small garden plots and orchards. On this view, some of the private lands attested during the Roman period originated in the conversion of a spectrum of Ptolemaic land categories into *idiotikê gê*. For instance, holders of plots of temple land on hereditary lease, already *de facto* owners by the late Ptolemaic period, became landowners *de jure* with full rights under Roman administration (e.g. *P.Mich.* 5.254; 260). The majority of private land, however, was thought to derive from the allotments (*klêroi*) possessed by Ptolemaic kleruchs (*klêrouchoi*) and cavalry settlers (*katoikoi hippeis*), military men holding plots of state-owned land in exchange for their service to the crown in times of need. Originally, *klêroi* were held for the duration of a kleruch's life and reverted to the state upon death. Lacking full ownership, kleruchs could not alienate their plots though they could cede them to fellow kleruchs. Over time, kleruchs gained more control: first, the ability to transmit their *klêroi* to their sons and later the right of alienation (Bingen 2007, p. 108; Fischer-Bovet 2014, pp. 225–237). Rome's conversion of kleruchic and katoikic land into fully alienable private land simply completed an evolutionary process already well under way at the end of the Ptolemaic period.

It has recently been demonstrated that this narrative, based almost exclusively upon the papyri of the Fayyum, overlooks the amount of private land that existed elsewhere in Egypt during the later Ptolemaic period. A rare glimpse of southern Egypt is illustrative: in 119/118 BCE, 72% of the cultivable land in the Apollonopolite nome (Edfu) was already private (*idioktêtos*), compared to only 2% held by kleruchs. This stands in stark contrast to the pattern of land tenure observed in the southwestern Fayyum village of Kerkeosiris during the same year. Data from the archive of Menches, *kômogrammateus* (village scribe) of Kerkeosiris, shows that 34% of the village's land was held by kleruchs, while a full 52% was in state hands (*basilikê*). Smaller percentages are given over to pasture, temple land, and derelict land, but no private land is attested. Earlier data from the eastern Fayyum village of Tanis dating to 240/239 BCE shows much the same pattern: 40% kleruchic and 45% public (Monson 2012, pp. 80–92).

Patterns of land tenure during the Roman period thus reflect distinctive regional histories. Though its kleruchies were indeed converted into private land, public land continued to make up more than 50% of the total in the Roman Fayyum, a legacy of its origin as a state project of the Ptolemies. But in nomes farther south where the footprint of the Ptolemaic state had always been lighter, percentages of Roman *dêmosia gê* descended from Ptolemaic *basilikê gê* were significantly lower: between 15% and 26% in areas from which evidence has survived (figures in Rathbone 2007a, p. 701). In such regions, Roman *idiotikê gê* also derived in large part not from kleruchies but from Ptolemaic *idioktêtos gê*, private land already in existence before the Roman annexation.

In their exploitation of private land, owners were free to work it themselves or to lease their plots out to tenant farmers in exchange for a rent in kind. Moderately prosperous urban landowners, the societal upper crust of Egypt's nome capitals, preferred leasing (*misthôsis*) as a low-investment, low-risk strategy for securing a modest and stable return (Rowlandson 1996). Owners of large estates, however, had the capital necessary to employ permanent and occasional labor forces for intensive, direct exploitation (Rathbone 1991, pp. 88–174).

Public land, on the other hand – at least in the Fayyum, where it was most abundant – was leased to groups of villagers known corporately as "public farmers" (*dêmosioi geôrgoi*). Represented by a body of elders (*presbyteroi*), the Fayyum's public farmers worked their plots on informal, customary terms rather than through written contracts (Rowlandson 1999, p. 148). Because these lands contained numerous marginal plots, allotments were periodically redistributed through a "communal leasing-out" (*koinê diamisthôsis*), in order to ensure that the better and worse parcels were shuffled among members of the group (Rowlandson 2005; Monson 2008).

Whatever the nature of their tenure, all cultivators owed a portion of their annual profits to the state. Orchards, vineyards, and market-garden plots tended to be taxed in cash since their produce was not sufficiently durable to permit in-kind payments. Although taxes on land under cereals could also be collected in cash (e.g. Rathbone 1993, p. 84; Blouin 2014, pp. 174–175), payments in kind were the norm. Public farmers paid between 3 and 5 artabas of wheat per aroura (1 artaba = 38.78 dry liters), while private plots were tariffed at an average rate of only 1 art./ar. (Bowman 2013, p. 247).

Compared to the high return on seed that could be expected on fertile and well-flooded land (see the next section below), tax rates on cereal lands were low. Yet even low rates would pinch in the case of a weak flood and a poor harvest, while a series of inadequate floods could drive farmers deep into arrears from which they could not hope to recover. In response, a process developed during the second century CE whereby holders of both public and private parcels could declare their land to be un-flooded (*abrochos*). These written declarations (e.g. *P.Mich.* 6.368) then occasioned an official inspection (*episkepsis*) and a subsequent alleviation of tax burden (Habermann 1997). Still, the periodic need for emperors and prefects to decry the inflexibility of the tax system and to offer amnesty or extended payment-plans to absconders in *anachôrêsis* (tax flight) indicates that the Roman fisc was not always nimble enough to respond appropriately to conditions on the ground (Rowlandson 1996, pp. 76–78; on *anachôrêsis*, see Jördens 2009, pp. 313–315).

Yet periodic interruptions to the revenue stream were not necessarily disastrous for the grain supply to the imperial capital. Verifiable data is, as ever, impossible to come by. The fourth-century *Epitome de Caesaribus* (1.6) claims that 20 million *modii* (4.4. million artabas) of grain were imported to Augustan-era Rome each year (1 artaba = 4.5 *modii Italici*). An edict of Justinian (13.8) later claims that Egypt's total annual dues – i.e. not just wheat for the capital – stood at 8 million unspecified units. The latter figure is generally thought to

be measured in Egyptian artabas, a conclusion accepted here, but not all are convinced (artabas: Bagnall 1985, p. 304; uncertainty: Erdkamp 2005, p. 229).

Estimating the total annual needs of the city of Rome lends perspective on these figures. At a population of 1 million, Rome would have consumed some 30 to 40 million *modii* (6.6–8.8 million artabas) per year (Temin 2013, p. 31). According to Josephus (*BJ* 2.383–6), Egypt contributed one-third of Rome's needs, while North Africa supplied the remainder. This is surely simplistic, since wheat strains from Sicily, Sardinia, Gaul, the Chersonese, and Spain are also attested (Plin. *HN* 18.66). Still, if we include only North Africa and Egypt in our speculations, Egypt's contribution to Rome's 30–40 million *modii* subsistence may have amounted to some 10–13.3 million *modii* (2.2–2.9 million artabas).

Obviously, this falls short of the figure attested in the *Epitome*. Yet Rome surely imported more than pure need would dictate, both to provide surplus for storage and to account for losses through spoilage, contamination, and shipwreck. Moreover, some percentage of Egypt's total revenues would have been distributed within the country itself – e.g. to the army or to Alexandria – and, on occasion, used to provision cities in the eastern Mediterranean. The scale and the schedule (if any) of all such expenditures are again unknown (Wörrle 1971; cf. Rathbone 1989, pp. 173–174; Erdkamp 2005, pp. 232–235).

Justinian's 8 million artabas are as good a guess as any at the scale of Egypt's total revenue in a normal year: an amount well in excess of what was necessary to provision the imperial capital, leaving a sizable remainder for storage and for distribution within and outside of Egypt. If the figures for Egyptian cereal productivity proposed in the following section are on the right order of magnitude, such a levy would have weighed rather lightly on the backs of Egypt's peasantry in years of adequate flood, albeit only by expanding wheat cultivation to the detriment of agricultural diversity.

Crops and Diet

Sadly there are no Roman-period equivalents to the village-level crop surveys contained in the late Ptolemaic archive of Menches, *kômogrammateus* of Kerkeosiris (Verhoogt 1998). Nevertheless, the picture that emerges from Menches' archive is broadly representative of cropping patterns in the Roman period: a predominance of cereals (wheat followed by barley), leguminous vegetables (lentils, beans, vetch) in second place, and small amounts of the remaining land devoted to oil crops and fodder (Thompson 1999, p. 130; cf. Crawford [Thompson] 1971, pp. 112–118). To this should be added the produce of small parcels of orchard – including vineyard – and garden land, a minor but profitable agricultural sector (Sharp 1999).

Durum wheat was Roman Egypt's largest crop by far. Yet it was also a relative newcomer to the Egyptian countryside. In the millennia prior to the Ptolemaic period, emmer wheat (*olyra*) had been the staple of the Egyptian diet. Greek immigration soon marginalized emmer in favor of durum wheat (*pyros*), a product that could also be exported to the rest of the Greek world. Emmer rapidly declined into near-total obsolescence, and by 235 BCE it already accounted for only 1.7% of the crop in the Fayyum (an admittedly heavily Hellenized region). Wheat, by comparison, made up 74.6% of the cropped area and barley 14.5% (figures in Thompson 1999; for wheat exports, see Buraselis 2013).

Barley (*krithê*) was cultivated as a secondary grain both for animal fodder and bread making. Although its fiscal value was roughly half that of wheat, as much as one-fifth of grain land might have been given over to barley (Bagnall 1993, p. 25). In part, this owes to barley's hardiness; it tolerates levels of soil salinity that retard the growth of wheat, thereby making it

an ideal alternative crop on land that had been over- or under-inundated and thus insufficiently cleansed of deleterious minerals. Barley is also the primary ingredient in beer, Egypt's alcoholic beverage of choice since the pharaonic period. Beer drinking was nonetheless on a long-term downward trajectory, and it virtually disappears in favor of wine in the later Roman period (Van Minnen 2001).

These two cereal crops occupied the overwhelming majority of Egypt's cultivable land. In the second-century Mendesian nome, 95.5% of all productive land in at least one toparchy (district) was under grain, while the minute remaining percentage was devoted to vineyards, gardens, beans, and reeds. Marshy areas of the nome's border zone (*limnai*) were also progressively converted to grain fields, thereby desiccating parts of the landscape, altering local flows of the river, and possibly causing social disruption due to the encroachment of grain cultivation into the lands of peoples living on the Delta's fringes (Blouin 2014, pp. 173–207, figure at pp. 190–191).

In addition to dominating the cultivated area, cereal productivity was exceedingly high by Mediterranean standards. Fields were sown at a rate of one artaba per aroura, and average yields have been calculated at 10:1 (Rathbone 1991, p. 243). To put this figure into perspective, estimates for the most fertile, well-manured estate lands in Roman Italy range from only 8:1 to 10:1, while peasant farms probably saw returns of 5:1 or 6:1. Roman Palestine was still less fertile, with average yields between 4:1 and 7:1 (Erdkamp 2005, pp. 34–53). A more pessimistic estimate puts average dry-farmed yields at between 3:1 and 4:1 in the premodern Mediterranean (Wickham 2009, pp. 362–363).

As impressive as a 10:1 yield is by comparison, the estimate should be revised upward. Our best ancient evidence derives from Theadelphia, a village on the western edges of the Fayyum. During the third century AD, estate production in Theadelphia ranged from 7 to 16.6 artabas per aroura for an average return of 13:1 (Rathbone 2007a, pp. 703–704). Yet the fertility of this marginal settlement surely did not compare to that of better lands elsewhere. In support of this supposition, comparative evidence from the Napoleonic *Description de l'Égypte* reveals considerable regional variability. Eighteenth-century harvests equivalent to 24 artabas per aroura are attested on the fertile fields of Upper Egypt, while the less fertile Delta and Fayyum saw returns equivalent to between 10 and 18 artabas per aroura. The nationwide average return on seed is set at 15:1 (Monson 2013, p. 132). Upper Egyptian yields in the 1830s are again impressively high, corresponding to some 18 to 25 artabas per aroura in Asyut and never less than 16.8 in Farshut farther south, while the national average amounts to 13.5 artabas per aroura (Bowring 1840, p. 16, 18).

These data once again remind us that our perspective has been skewed by a dependence upon Fayyum papyri. For the sake of argument, then, we may regard an average return of 13:1 and 15:1 as within the realm of plausibility. At this level, a cultivated area of 16 000 to 18 000 km^2, 95% under cereals, could have produced anywhere between 71 and 93 million artabas per year (cf. the figures in Rathbone 2007a, p. 704). This strongly suggests that aggregate cereal production in a good year far outstripped basic need, thereby making a sizable surplus available for taxation, trade, sale, and storage (1 artaba of wheat-equivalent per month provides sufficient energy for a very active adult male, Bowman 2013, p. 248).

In contrast to the prevalence of cereals, the other two pillars of the Mediterranean Triad, olives and grapes, were cultivated to a more limited extent due to environmental constraints. Only Egypt's slender coastal strip has a climate conducive to the growth of these two diagnostically Mediterranean crops (Hughes 2005, p. xxii). Indeed, viticulture flourished along the northern coastline, particularly in the area of Lake Mareotis near Alexandria, which long boasted a wine industry (Dzierzbicka 2010). Farther south, however, extreme heat and aridity, the annual flood, and Egypt's dense, silty, and poorly drained soils presented considerable

environmental challenges to vine growers. Vineyard cultivation was nonetheless still possible on high-lying, un-flooded, and well-drained parcels that could be irrigated artificially. Still, the expense entailed in purchasing and maintaining irrigation machinery as well as providing the continuous human and/or animal power it required necessarily limited grape cultivation to wealthier segments of the population. Although modestly sized vineyards are attested in the papyri (e.g. 1.5 arouras in *P.Mich.* 5.266), owners of large estates were the most prolific viticulturists since they possessed the necessary capital for investment in land, artificial irrigation, and specialized vineyard laborers on a large scale (see Eyre 1994 for the pharaonic period and agro-environmental issues; Rathbone 1991; Hickey 2012 for late antiquity).

Olives, too, could be cultivated under artificial irrigation though they appear to have been much rarer than grapes. Attestations are few during the Ptolemaic period, and by the Roman period intensive cultivation seems to have been restricted to the Fayyum, where irrigation by canal was possible (Strabo 17.1.35; Thompson 1999; Blouin 2014, pp. 184–185). A potential exception is the Dakhla Oasis, where olives may have been cultivated more extensively and their oil transported by land across the desert for sale in the settlements of the Nile Valley (Bagnall 2005, p. 197).

With olive oil in limited supply, Egyptians were largely reliant upon other plants to supply lipids to the diet. In the Ptolemaic period, sesame, castor, safflower, linseed, and colocynth (bitter melon, *Citrullus colocynthis*) oil are all mentioned in the Revenue Laws of Ptolemy II. All are edible save for castor, which was more often burned in lamps. Unfortunately, references to these crops by name are few or nonexistent in Roman papyri. The most common oil crop is instead *lachanospermon*, "vegetable seed." The identity of "vegetable seed" was long mysterious – some variety of lettuce seed oil was once suggested – although a Greek-Coptic vocabulary list now makes clear that the term refers to sesame (Bagnall 1993, pp. 29–30; *id.* 2000).

For protein, Egyptians largely depended upon legumes. Because of their nitrogen-fixing properties, legumes were often grown in rotation on wheat fields to refresh the soil (Rowlandson 1996, p. 238). Numerous species are attested including lentils, chickpeas, and fava beans (Bagnall 1993, p. 26). The latter, cooked with vegetables and oil as *fūl* or mashed, spiced and fried as *ta'ameyya* – a variant of *falafel* – remains an Egyptian staple to this day. Served with flatbread and sesame (*tahina*) for dipping, this combination of cereal, vegetable protein, and vegetable fat is a modern descendent of the ancient diet.

The importance of this dietary triad was due in large part to the ease with which each crop could be stored. Oils such as sesame can be stored for months at a time without modern refrigerants. With a shelf life of many years, unprepared legumes are still more durable. Whole grain is the most stable and can be stored for decades if kept dry and pest-free. Shorter-lived food products, however – assorted greens, onions, garlic, and other flavorful additions to the diet – were often grown in household garden plots and quickly consumed. Fruits like dates and even olives could also be cultivated on smaller plots and their produce either eaten fresh or dried (Sharp 1999, p. 184; see *SB* 12.11113 for a date and olive grove near Karanis). Sadly, private home gardening is all but invisible in the documents, making it difficult to know to which fresh foods in what quantities the average peasant had access on a regular basis.

Consumption of animal protein is also difficult to quantify. Thanks to the Nile, Egyptian peasants, particularly those dwelling along the coastal lakes and lagoons, may have had greater access to fish than peoples elsewhere in the Mediterranean (Blouin 2014, pp. 228–230). Since fish rapidly spoils, salted fish (*tarichos*) are more often attested than fresh; an entire street was dedicated to the sale of salt-fish in the Fayyum's capital city Arsinoe (Marzano 2013, p. 93). Outside the commercial realm, household production of salt-preserved fish was, again, probably quite common. In a letter of the second or third century CE, an Oxyrhynchite writes on

a personal matter to a man he dubs "brother," casually adding at the end of the letter, "if you are making little salt-fish (*tarichia*) for yourself, send me a jar as well" (*P.Oxy.* 6.928). For additional animal protein, Egyptians could also turn to fowling and the hunting of other small game in marshy regions of the countryside, particularly after the flood began to recede. Like home gardening, intermittent hunting and fishing also largely escapes documentation. The state nonetheless maintained control over larger bodies of water and leased out the right to hunt and fish within them (e.g. *P.Ryl.* 2.98; Blouin 2014, pp. 224–225).

Consumption of larger domesticated animals like beef, lamb, and mutton, or poultry was rarer still. Poultry was more useful as a source of eggs, while cattle were better utilized as sources of power for large agricultural tasks. Animals such as sheep and goats, sheared for their wool, were also valuable as producers of milk and cheese, the latter of which could be traded and stored (Rathbone 1991, pp. 202–206). Lacking more than scattered evidence, it is impossible to say what proportion of the average commoner's diet was composed of animal products. On balance, it is likely that plant products contributed the overwhelming majority of daily caloric intake.

In sum, the papyri reveal an array of edible plant and animal products that would have enlivened an otherwise banal diet founded upon cereals, legumes, and vegetable oils. Yet even in the absence of any fresh and flavorful supplemental fare, the average Egyptian did not face serious food shortages on a regular basis. The high productivity of the country in good years, the relative rarity of exceedingly poor floods, and the durability of staple crops surely went a long way toward alleviating the specter of poverty and starvation in the countryside (cf. Rathbone 2006).

But humans were not the only hungry animals in Egypt; animals, too, needed constant sustenance, and fodder crops (*chlôra*, *chortos*) were widely cultivated (Rowlandson 1996, pp. 236–239). Like legumes, fodder could be grown in rotation on cereal lands. Rather than harvesting the crop, cultivators might simply lease out grazing rights to nearby shepherds whose animals' manure further replenished the soils of fields exhausted by constant cereal production. Unsurprisingly, errant beasts occasionally wandered into fields growing crops for human consumption, trampling and devouring them. This routine fact of life caused constant friction between settled agriculturalists and the herders who plied the outskirts of the cultivated land (*P.Ryl.* 2.126, 131, 132; Rowlandson 1996, pp. 21–23).

But Egyptian agriculture was not entirely concerned with food, and a few brief words on non-alimentary crops are in order. First, documentary habits both in Egypt and abroad required the cultivation of papyrus (*Cyperus papyrus*) on a large scale. Marshy areas left waterlogged after the flood (*drymoi*) provided the perfect habitat for this aquatic sedge, especially if they could be supplied with artificial irrigation for intensive, continuous cultivation of this and other reed and brushwood crops (*P.Tebt.* 2.308; *P.Wisc.*1.31, 34, 35; Bonneau 1982; *ead.* 1983). Though the oil from its seeds is also edible, flax was also grown for linen textile production. Like papyrus, flax requires marshy lands ill-suited to cereals and was widely cultivated in the Delta (Blouin 2012; *ead.* 2014, pp. 223–239). Oxyrhynchus in Middle Egypt was also a significant clothing producer in antiquity. The area was famed for its linen and other textiles in the Middle Ages, a tradition that it may have inherited from the Roman past (Van Minnen 1986; Hickey 2012, p. 34).

Managing Nature

We return now to the issue raised at the outset of this chapter: the management of Egypt's natural resources. It was long asserted that the governance of Egypt's water and soil was a matter of state coercion organized through forced labor, a perspective that has tended to

deny the agency of Egypt's peasantry (e.g. Rostovtzeff 1926, p. 259). Debates within Egyptology have dismantled this paradigm of despotic water control (Manning 2010, p. 37), and it is now fully accepted that no premodern Egyptian state possessed the administrative capacity to regulate irrigation centrally. Water control thus remained a local matter until the nineteenth century (pharaonic period: Butzer 1976; Willems 2013; Ottoman period: Mikhail 2010; *id.* 2011).

Yet the needs of the state (revenue) and the needs of the populace (sustenance) were consistently entwined, and Egyptian governments were in all periods eager to encourage and support local efforts (Michel 2005; Mikhail 2011). From his seat in Alexandria, a *dioikêtês* like Ulpius Aurelius exhorted his subordinates to round up local worthies who would oversee and direct the otherwise spontaneous process of canal cleaning, dyke maintenance, and irrigation. Accordingly, a dizzying array of local liturgical officials concerned with water and other agricultural matters is attested in the papyri (Bonneau 1993). Their precise duties are nonetheless imperfectly understood, and their official Greek titles may often conceal traditional rather than statist origins (cf. the informal "engineers" in the medieval Fayyum: Rapoport and Shahar 2012).

But these local coordinators could also be laden by the state with important tasks that villagers could not accomplish themselves. Hence, a petition from the Fayyum village of Kerkesoucha near Karanis in the northeast of the region (*SB* 4.7361). In 210/211 CE, all the farmers of the village, both landowners (*geouchoi*) and public farmers, collectively complain to a regional governor (*epistratêgos*) that local officials known as the supervisors of sowing (*katasporeis*) had failed to supply "the wood and brush they provide each year for the building up of the wattlework dyke called 'Log' by the village, nor did they provide any maintenance" (Youtie 1974; on the *katasporeus,* see Bonneau 1993, pp. 168–173).

Still, the most important task of local overseers was the coordination of human labor. In the Fayyum, this took the form of an institutionalized *corvée*, the *penthêmeros*, compulsory labor of five or more days on the nome's dykes and canals for which each participant received a written receipt. The receipts attest that most villagers were required to work on the canals of their own community (Sijpesteijn 1964, p. 79), something that most would have done anyway thanks to social pressure from their neighbors (cf. Crawford 1988; Trawick 2001a; *id.* 2001b; Lloris 2006; Mikhail 2011, p. 175). At the same time, however, there are attestations in the surviving receipts of villagers compelled to travel as far as 40 kilometers to work on the Bahr Yusuf itself as well as the "six-gated sluice" (*hexathyros*) at the village of Ptolemais Hormou, a structure at the entrance to the Fayyum that was the lynchpin of the entire irrigation system (Haug 2012, p. 138, pp. 216–217). Although such work was undeniably critical to the health of the Fayyum's canal network, we should not discount the potential hardship involved in drawing able-bodied men away from their home communities during this critical period of the year, something that must have occasioned intermittent avoidance or resistance (Figure 25.2).

Outright opposition to state coordination is best illustrated in an Oxyrhynchus petition of 245/246 CE (*P.Oxy.* 38.2853). Two overseers (*epimelêtai*) of a canal called "Thousand Arouras" (*Chiliarourai*) complain that they had approached two brothers and asked them to perform work on their share of the canal. The brothers allegedly refused and attacked the local officials with blows. More than this cannot be said with certainty about these events. Still, the name of the canal – Thousand Arouras – perhaps indicates a large public conduit on which two free riders hoped to avoid working while still reaping its benefits, a common problem in canal-irrigation communities (Ostrom and Gardner 1993).

Figure 25.2 Canal-cleaning at Karanis during the Michigan excavations, 1924. Source: KM Negative 0658 "Scenes at the canal when the South Bank broke. Repair work." @ Kelsey Museum of Archaeology.

At one and the same time, then, the management of Egypt's natural resources partook of both coordination and coercion. From the perspective of a Fayyum farmer required to clean and repair the canals and dykes of his home village, the *penthêmeros* was simply the institutionalization of routine and self-interested behavior; for the farmer dragged far from home, it was something else altogether. The incident recorded in the Oxyrhynchus papyrus further reminds us of the limitations of the system: the unwilling could always opt out, violently if necessary.

Conclusion: Looking Ahead

By the third century CE, a unit (*phrontis*) of the estate of a wealthy Alexandrian, by the name of Aurelius Appianus, had come to dominate the formerly bustling village of Theadelphia in the western Fayyum (Rathbone 1991; Sharp 1999). On the opposite side of the nome, estates similarly swallowed up much of the village of Philadelphia (Schubert 2007). The causes of this phenomenon are much debated. Although the widespread mortality and land abandonment accompanying the Antonine Plague of 165–180 CE are often cited as the primary cause of these developments, it has become clear that the plague was simply one of many factors influencing the evolution of Egyptian society and economy during this period (Schubert 2007, p. 156; Andorlini 2012; Harris 2012).

Whatever their origins, these large estates dramatically altered the agricultural landscape, at least in the Fayyum: small, scattered plots of public and private land once dedicated to grain

were consolidated under a single owner and converted into massive vineyards producing wine for sale on the market. The irrigation requirements of these intensive viticultural operations further encouraged the spread of irrigation technology throughout the countryside, particularly the animal-powered waterwheel (Arabic *sâqiya;* Greek *mêchanê*: Rathbone 2007b).

By the middle of the fourth century, however, even the estates were gone. Theadelphia, reclaimed from the desert under the Ptolemies some six centuries prior, had once again been covered by sand and would not again be revealed until the later nineteenth century (Boak 1926). The abandonment of this and of other villages of the marginal Fayyum has often been regarded as a microcosm of Egyptian agriculture as a whole in late antiquity, a tale of decline and fall on the fringes of the empire (Bell 1917). Yet this process was slower than previously suspected and better characterized as a progressive contraction toward the more fertile and sustainable center of a uniquely fragile region rather than as a sudden and precipitous collapse (Keenan 2003; Haug 2015; *id*. 2017). More importantly, however, this chapter has continually stressed the danger inherent in writing Egyptian agricultural history from the evidence of one region and period. Indeed, as the Fayyum declines and fades from view, other areas come more clearly into focus, such as Hermopolis (Ashmunein) in southern Egypt (Van Minnen 2009). Formerly regarded as a period of collapsing state power and the rise of proto-feudal medieval estates based on viticulture, late antique Egypt is now understood as a period of relative stability and cooperation between the great estates of the countryside and the central state in Constantinople (Hickey 2012).

Much still remains to be done. Paleoclimatology is the most recent and exciting addition to the toolkit of the history of Graeco-Roman Egypt, one not yet fully exploited but already ripe with promise (McCormick et al. 2012). This integration of modern scientific methodologies with traditional papyrology, a marriage of macroscopic global perspectives with microscopic analyses of local socioeconomic conditions, will soon begin to reveal in greater depth the various ways in which natural systems and human decisions combined to shape the Egyptian agricultural landscape over the *longue durée*.

FURTHER READING

Although focused on a single large estate in the village of Theadelphia, Dominic Rathbone's (1991) *Economic Rationalism and Rural Society in Third-Century AD Egypt* remains the most thorough English-language study of agriculture in the Roman Fayyum. It should be paired with Paul Schubert's (2007) *Philadelphie. Un village égyptien en mutation entre le IIe et le IIIe siècle ap. J.-C.*, an equally penetrating study of another important Fayyum village. Jane Rowlandson's (1996) study of Oxyrhynchus is another comprehensive regional analysis focused on the economics and social relations of Egyptian agriculture from the perspective of urban landlords. Katherine Blouin's (2014) *Triangular Landscapes* offers the first substantial history of the Nile Delta in the Roman period and integrates contemporary environmental-historical perspectives and methodologies with a traditional papyrologist's keen eye for textual detail. Andrew Monson's (2012) *From the Ptolemies to the Romans* is perhaps the most important and challenging study of the institutional history of Egypt to emerge in a generation. Monson's reinterpretation of the transition from Ptolemaic to Roman rule is a path-breaking, if controversial, blend of Stanford-school social science methodologies and rigorous textual analysis. Lastly, the value of comparative perspectives is now broadly admitted. Alan Mikhail's (2011) *Nature and Empire in Ottoman Egypt* is essential reading for historians of Egypt in any period. Drawn from thousands of petitions preserved in the Ottoman archives of Cairo and Istanbul, Mikhail's work illuminates the ways in which an imperial state exploited the agricultural wealth of Egypt without the capacities afforded by modern technologies. Although comparative evidence should be treated with care, the book offers papyrologists an in-depth look at rural Egypt in the final moments before the onset of

industrial modernity. Finally, Nicolas Michel (2005) has made direct and fruitful comparison between the Graeco-Roman and Ottoman periods in a seminal study of dyke maintenance, which highlights both continuities and ruptures in irrigation practices across the centuries.

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