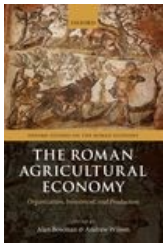

The Roman Agricultural Economy: Organisation, Investment, and Production

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CHAPTER

7 7 Agricultural Production in Egypt

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Abstract

This chapter analyses various strands of quantifiable evidence for nome sizes and landuse regimes: calculations of grain yields and tax income for the Arsinoite nome (AD 184/5); distribution of land among landowners (from tax registers and legal declarations from nome capitals); and rather different patterns of distribution of landownership in village communities. At the village level, case studies are possible for intensive wine production at Philadelphia in the third century BC; the crop regime and rent returns at Kerkeosiris in the second century BC; land use at Theadelphia in the second century AD; and the sale and leasing of land at Tebtunis in the second century AD. Data from several regions indicate severe decline in agricultural production and tax revenues between the second and fourth centuries AD. The chapter allows us to grasp the scale of the agrarian economy and to illuminate some of its structural features at different levels.

Keywords: Roman economy, agriculture, Egypt, land ownership, leases, wine production

Subject: Ancient Roman History, Greek and Roman Archaeology

Introduction

Compared to other parts of the Mediterranean world, there is a massive amount of detailed evidence for the agricultural economy of Egypt between c.100 BC and AD 350. Our approach to dealing with this in a way that we think is fruitful for our larger context has already been outlined.[1] A move from this to a more detailed analysis presents its own problems of scale and perspective. There is far too much detailed evidence for proper presentation and analysis in the space available here. Even a summary account of modern syntheses would be likely to exceed it, would probably require more than a single monograph, and would not yield a convincing consensus. There is, furthermore, a real methodological difficulty in extrapolating from a series of microcosmic scenarios to a general synthesis or a model that is plausible, an observation that can be exemplified in recent scholarship.[2] The more generalized the calculations or models become, the less contact they seem to have with any reality, as the number of assumptions or speculations increases to fill the gaps in the evidence. On the other hand, the reader may well feel frustrated at being offered a series of methodologies and recommendations as to how the material might be analysed without finding that any of them have actually been implemented. Our aim here is, or should be, to attempt to maintain some contact with the reality of the surviving bodies of evidence, as the building blocks of our economic analysis. The present attempt therefore inevitably has to steer a course between Scylla and Charybdis and aims to offer some plausible speculations within reasonable parameters, along with a number of ↳ more detailed,
p. 220 illustrative scenarios (in which it is important not to conflate or confuse 'validity' and 'typicality').[3]

A further constraint on what can be done here is imposed by our having adopted an approach to quantifying the documentary evidence for the Egyptian economy that is essentially cumulative. Understanding population and settlement patterns, as far as is possible, is an essential prerequisite for analysing the agrarian regime in a quantified manner, and we have attempted that in an earlier volume.[4] But there are still many major issues on which certainty and consensus have not been achieved. Despite that, quantifiable data for various aspects of agricultural activity can now usefully be assembled and analysed. A fuller understanding of the economics of Egyptian agriculture can be obtained only in the context of governmental fiscal mechanisms and institutions (for example, taxation and coinage), the operation of transport networks, trade, markets, and so on, and this remains to be done.[5] Nevertheless, if we build on what we analysed in looking at land and settlement, it is possible to approach a quantified analysis of agricultural activity in Egypt by considering detailed evidence for some key systemic features of the agrarian sector and for a series of individual, smaller scenarios, which offer plenty of quantifiable data. All these elements are capable of expansion into longer individual studies (which some have already received), and there is room and evidence for still more.[6] A central and recurring question will, of course, be how far these smaller scenarios will help us to understand general trends in the bigger picture. The problem in using these as evidence for the macroeconomic picture over time lies, as ever, in reconciling data that are diverse and specific to different regions, periods, and units of production and represent different facets of the agrarian economy or activities in it. The judgement as to which bodies of data may plausibly be generalized from one scenario is bound to be to some extent intuitive and subjective, but it is inevitable and (it is hoped) transparent.

The basics are undisputed. Egypt was exceptionally productive and yielded significant surpluses throughout the period we are considering.[7] At no time in the Ptolemaic or Roman periods, as far as we can see, did overall internal demand come close to matching or exceeding supply, however we analyse the possible
p. 221 fluctuations of population and any theoretical Malthusian constraints ↳ (even if some areas suffered significant downturns in productivity).[8] There was significant expansion of the agricultural economy from the early Ptolemaic period onwards, at least into the middle of the second century AD; the effects of and recovery from the Antonine plague are still in debate, with some claiming that there is no useful proxy evidence at all—and closer study of the evidence from the Mendesian Nome in the Delta might suggest that

depopulation had begun to set in *before* the plague struck.[9] In the sixth century Egypt was still sending large quantities of tax in kind to Constantinople (though in the fourth century the latter required very much less for a smaller population than Rome had needed in the earlier empire).[10] The detailed documentary evidence, and some potentially useable archaeological evidence, for the agricultural economy is not evenly spread in time and space. There are also serious doubts about some of the major features we need to know about (for example, population size and fluctuation), macro-estimates of which might be generally accepted (or not).

It will be obvious that any attempt to provide a balanced picture of the agricultural economy needs to take account of quantifiable evidence for production and consumption. Given the amount of quantifiable documentary evidence offered by the papyri, it is hardly possible to do that in the space available here. This chapter therefore considers only one side of the supply-and-demand chain in detail, offering some analysis of the shape of agricultural production (mainly arable) in Egypt with attention to diachronic changes and the relationship between metropoleis and villages in the larger contexts of their administrative districts (nomes). Full discussion of the demand side would require at least as much space again and is therefore postponed for future study, the possible direction of which is indicated briefly at the end of the chapter.

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The Nomes

In the Ptolemaic and Roman periods the number of nomes fluctuated between thirty and forty (Fig. 7.1). There is nothing like a complete picture for any one region, but there is good, detailed evidence for several features of individual nomes, principally the Arsinoite (Fayum), the Oxyrhynchite, and the Hermopolite in Middle Egypt and the Mendesian Nome in the Delta. Estimates of the sizes of these and other nomes in

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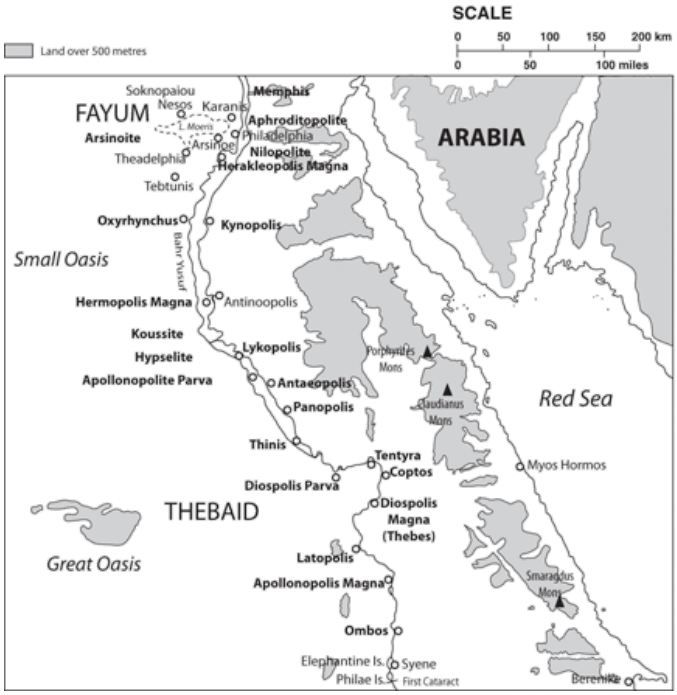
Middle and Upper Egypt may be seen in ↳ Table 7.1 (for the Delta there are at present no useful data except perhaps for the Mendesian Nome[11]). For several of these nomes the numbers and relative sizes of the towns and villages can be deduced, albeit somewhat hypothetically, and we have already made the case for considerable population growth from the Ptolemaic period into the 'high' empire (mid-second century, before the onset of the Antonine plague).[12]

Fig. 7.1



The Nomes of Middle Egypt

Note: The precise locations of nome boundaries are uncertain. The individual nomes are indicated either by the name of the capital (metropolis) where known, or by the name of the nome. Both forms of toponym are in boldface. This version follows the information recorded on the maps in the Barrington Atlas, except that it omits another 'Aphroditopolite Nome' marked in Barrington on the West Bank between Panopolis and Antaeopolis. The names of the main Fayum villages, discussed below, are also marked. (A. Kotarba-Morley)

Table 7.1. Estimates of land use in nomes of Middle Egypt

Nome	A Surface area	B* Inhabited/cultivated area = 90% of A		C† Grain land in = 80% of B		D‡ Garden and vineyard = 12% of B		E§ Other = 8% of B	
	(ha)	ha	=ar.	ha	=ar.	ha	=ar	ha	=ar.
Ombite	7,200	6,480	23,563	5,184	18,850	777	2,827	518	1,885
Apollonopolite	13,700	12,330	44,757	9,863	35,806	1,479	5,380	986	3,586
Latopolite	22,500	20,250	73,507	16,199	58,806	4,920	17,893	1,620	5,890
Diospolite	28,400	25,560	92,782	28,448	74,226	3,067	11,153	2,044	7,435
Koptite	33,100	29,790	108,137	23,832	86,510	3,574	12,999	2,383	8,666
Tentyrite	30,000	27,000	98,010	21,600	78,408	3,240	11,781	2,160	7,854
Diospolite Parva	30,600	27,540	99,970	22,032	79,976	3,304	12,017	2,203	8,011
Thinite	61,300	55,170	200,267	44,136	160,214	6,620	24,074	4,413	16,049
Panopolite	57,500	51,750	187,852	41,400	150,282	6,210	22,581	4,140	15,054
Antaiopolite	53,100	47,790	173,477	38,232	138,782	5,734	20,853	3,823	13,902
Hypselite	12,500	11,250	40,837	9,000	32,670	1,350	4,909	900	3,272
Apollonopolite Parva	20,600	18,540	67,300	14,832	53,840	2,224	8,090	2,749	9,999
Lykopolite	25,000	22,500	81,675	18,000	65,340	3,000	10,909	1,800	6,545
Koussite	27,200	24,480	88,862	19,583	71,090	3,264	11,869	1,958	7,121
Hermopolite	114,000	102,600	372,438	82,080	297,950	12,312	44,770	8,208	29,847
Kynopolite	11,000	9,900	35,937	7,920	28,750	1,188	4,320	792	7,880
Oxyrhynchite	78,000	70,200	254,826	56,160	203,861	8,424	30,632	5,616	20,421
Herakleopolite	64,300	57,870	210,068	48,706	168,054	6,944	25,252	4,629	16,834

Arsinoite	150,000	135,000	490,909	108,000	392,707	16,200	58,909	10,800	39,272
Nilopolite	13,300	11,970	43,511	9,575	34,809	1,436	5,223	957	3,482
Aphroditopolite	20,000	18,000	65,340	14,400	52,272	2,160	7,854	1,440	5,236
Memphite	28,100	25,290	91,802	20,232	73,442	3,034	11,035	2,023	7,357

Note: ar. = arouras; ha = hectares.

* Column B: this calculation is very much a compromising though not arbitrary approximation, representing roughly 28,000 of 32,000 km^2. It is within the range of the recent macro-estimates, for a summary of which see Bowman (2011: table 11.1). The sites of the towns and villages will constitute a small percentage of the inhabited area and are envisaged as subsumed in E ('Other'). 'Cultivated area' should be taken to indicate the extent of cultivation rather than the area actually sown in any particular year or season. The model as a whole relies heavily on extrapolation from the Oxyrhynchite evidence (Bagnall and Worp 1980), which alone gives us a firm figure for the amount of grain land in the fourth century (202,534 arouras, comparing with my approximation of 203,861 arouras).

† Column C: the areas available for grain or other high-value crops, rather than the areas actually sown with cereals or rotated.

‡ Column D: this figure is somewhat arbitrary but at the upper end of the range of 8–12% that is attested (see below, pp. 238–9).

§ Column E: This figure is simply the remainder and will include, for example, town and village sites, temples, necropoleis, military sites, grazing land, and land used for other economically productive activities.

Sources: Surface areas (Column A): Butzer (1976); basis for calculating land under cultivation after Bagnall (1993).

Villages were certainly numerous in all nomes for which we have sufficient information,[13] and for the **Oxyrhynchite Nome** we can hypothesize a schematic distribution of amounts of territory attached to villages based on tax registers, which has no implication as to the status of ownership of the land in that territory (see Table 7.3).

Table 7.3. Relative sizes of Oxyrhynchite villages based on tax payments

Village*	A† Payment figure applied (dr.)	B Payment A as % of total payment (%)	C‡ Area of grainland represented by % payment in B (ar.)	D Total cultivated land assuming grainland in C = 80% of the whole (ar.)	E§ Toparchy
Nesmimis	1,024	3.54	4,816.40	6,020.50	U
Chysis	828	2.87	3,894.51	4,868.14	U
Sinkepha	568	1.97	2,671.60	3,339.49	U
Athychis	712	2.46	3,348.90	4,186.13	U
Enteiis	300	1.04	1,411.05	1,763.82	U
Thosbis	70	0.24	329.25	411.56	U
Mermertha	1,068	3.70	5,023.35	6,279.19	U
Monimou	872	3.02	4,101.46	5,126.83	U
Kerkemounis	360	1.25	1,693.26	2,116.58	U
Episemou	846	2.93	3,979.17	4,973.96	U
Nigrou	80	0.28	376.28	470.35	U
Iseion Panga	371	1.28	1,745.00	2,181.25	U
Sadalou	236	0.82	1,110.03	1,387.54	U
Xenarchou	72	0.25	338.65	423.32	U
Nesla	64	0.22	301.02	376.28	U
Senyris	116	0.40	545.61	682.01	U
Archibiou	72	0.25	338.65	423.32	U
Kerkethyris	441	1.53	2,074.25	2,592.81	W
Senekeleu	236	0.82	1,110.03	1,387.54	W

Senokomis	1,296	4.49	6,095.75	7,619.69	W
Syron	560	1.94	2,633.97	3,292.46	W
Senao	100	0.35	470.35	587.94	W
Pela	1,018	3.52	4,788.18	5,985.22	W
Paeimis	100	0.35	470.35	587.94	W
Seryphis	1,940	6.71	9,124.81	11,406.02	W
Herakleidou ep.	108	0.37	507.98	634.97	W
Paneuei	516	1.79	2,427.01	3,033.77	W
Lenon	72	0.25	338.65	423.32	W
Mouchinaxap	45	0.16	211.66	264.57	W
Leukiou	324	1.12	1,523.94	1,904.92	W
Petemounis	108	0.37	507.98	634.97	W
—	63	0.22	296.32	370.40	E
Psobthis	356	1.23	1,674.45	2,093.06	E
Taampemou	630	2.18	2,963.21	3,704.02	E
Ophis	500	1.73	2,351.76	2,939.70	E
Satyrou	68	0.24	319.84	399.80	E
Posompous	72	0.25	338.65	423.32	E
Adaiou	200	0.69	940.70	1,175.88	E
Terythis	223	0.77	1048.88	1,311.10	E
Pakerke	342	1.18	1608.60	2,010.75	E

Phoboou	900	3.11	4233.16	5,291.45	E
[Lile]	88	0.30	413.91	517.39	E
[Sarapionos Chaeremonos]	176	0.61	827.82	1,034.77	E
[Th…]	272	0.94	1,279.36	1,599.19	E
Sento	108	0.37	507.98	634.97	M
Tanais	438	1.52	2,060.14	2,575.17	M
Ieme	100	0.35	470.35	587.94	M
Istrou ep.	380	1.32	1,787.33	2,234.17	M
Senepta	100	0.35	470.35	587.94	M
Nomou ep.	622	2.15	2925.58	3,656.98	M
Taampitei	540	1.87	2,539.90	3,174.87	M
Herakleion	265	0.92	1,246.43	1,558.04	M
Takolkeilis	156	0.54	733.75	917.18	M
[Pou.eo]	48	0.17	225.77	282.21	M
[Koba or Koma]	68	0.24	319.84	399.80	M
[Petne]	300	1.04	1,411.05	1,763.82	M
[Artapatou]	54	0.19	253.99	317.49	M
[Plelo]	48	0.17	225.77	282.21	M
[Nemera]	242	0.84	1,138.25	1,422.81	M
[Mastingophorou]	78	0.27	366.87	458.59	M
[Psobthis]	98	0.34	460.94	576.18	M

[Kerkeuros]is	145	0.50	682.01	852.51	M
[Texei]	36	0.12	169.33	211.66	M
[Petenouris]	29	0.10	136.40	170.50	M
Teis	1,308	4.53	6,152.19	7,690.24	T
Paomis	496	1.72	2,332.94	2,916.18	T
Palosis	208	0.72	978.33	1,222.91	T
Tholthis	72	0.25	338.65	423.32	T
Kesmouchis	117	0.40	550.31	687.89	T
Sepho	72	0.25	338.65	423.32	T
Iseion Tryph.	213	0.74	1,001.85	1,252.31	L
Sinary	340	1.18	1,599.19	1,998.99	L
Souis	160	0.55	752.56	940.70	L
Talao	379	1.31	1,782.63	2,228.29	L
Tholthis	225	0.78	1,058.29	1,322.86	L
Sesphtha	796	2.75	3,744.00	4,680.00	L
Takona	632	2.19	2,972.62	3,715.78	L
Tychinphagon	300	1.04	1,411.05	1,763.82	L
[Iseion Kato]	20	0.07	94.07	117.59	L
[*c.*6]aur.[. (Psobthis?)	300	1.04	1,411.05	1,763.82	L
[Kosmou]	101	0.35	475.05	593.82	L
[Mouchinar]yo	188	0.65	884.26	1,105.33	L

[Dositheou]	700	2.42	3,292.46	4,115.57	L
[Total]	28,895		135,908.00	169,885.00	

Note: ar. = arouras; dr. = drachmas.

* The villages are listed in the order in which they appear in *P. Oxy.*X. 1285. The hypothesis is that the total number of villages recorded with payments preserved (n = 83) is about two-thirds of the total number of villages in the Oxyrhynchite (see Rathbone 1990). There are some significant omissions of well-known larger villages (notably Sko).

† The payment figures, some of which might be modified by re-reading, basically follow those used by Rowlandson (1996: 288–90). I here assume that this has not caused significant statistical distortion. The total (28,895 drachmas) is the cumulative total of the preserved payments and not the total of the subtotals given for each toparchy in the text.

‡ The total amount of grain land is two-thirds of the figure in Table 7.1, on the assumption that the total number of villages with preserved payments represents approximately two-thirds of the total number of villages in the Oxyrhynchite (see *).

§ Abbreviations of the names of toparchies (subregions): U = Upper, W = Western, E = Eastern, M = Middle, T = Thmoisepho, L = Lower.

Sources: *P. Oxy.* X. 1285, with Rathbone (1990) and Rowlandson (1996) used as a basis for calculating amounts of land attached to the villages.

The distribution is based on the estimate of 203,861 arouras of grain land (Table 7.1), which in turn is very close to the precisely attested figure (202,534 arouras) for the amount of grain land under cultivation in (probably) the first half of the fourth century.[14] This has also to be used as a basis for estimated calculations of the distribution of land in the neighbouring Hermopolite Nome, where similar conditions may be presumed.[15] The more detailed evidence for landholding in the Oxyrhynchite, which has been subjected to exhaustive analysis, reveals much about the nature and the mechanisms of landownership and tenancy (of both public and private land) and the ways in which these patterns changed over time, as the quantities of royal and public land diminished with the Roman annexation and were further reduced, effectively to zero, over the course of the Roman period.[16] Evidence is unfortunately lacking for the Ptolemaic period, but it has been estimated that around two-thirds or more of the land in these areas might have been in private ownership in the Early Roman period.[17] Both public and private landholdings were predominantly exploited through tenancy, which by and large guaranteed a better return to the owner. Private leases for relatively short terms and multiple, small parcels of land are evident throughout the period, even in the cases of wealthy landowners such as Claudia Isidora and Calpurnia Heraklia, whose families clearly actively acquired and disposed of land over ↳

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centuries.[18] As for public land, a distinction must be made between the *katoikoi*, descendants of privileged military allotment-holders of the Ptolemaic period, who were effectively transformed into a class of private landowners, with alienation of land effected in technical terms of cession rather than sale, and the tenants of public land (called *demosioi georgoi* in the Arsinoite Nome), who are on the whole smaller fry.[19] Over the period, the evidence shows enhancement of the status of the private landowner and diminution of that of the tenant, and this is further intensified in the Later Roman period, as public land is transferred (by various mechanisms including imperial initiative to sell, absorption of smallholdings by the wealthy, and reclassification) into private ownership—the term being retained in the fourth century only to designate a higher rate of taxation.[20] Finally, two points to emphasize. First, that there is no sign of the leases specifying an increase in rents in kind in the later third century (when the currency is supposed to have collapsed) and second that, as we move into the fourth century, when private ownership is virtually universal, the lease is replaced by the rent-roll, as a symptom of the 'fiscalization' of estates.[21]

In the neighbouring **Hermopolite Nome** at the same period we are able to calculate the distribution of land among urban landowners resident in Hermopolis and Antinoopolis on the west bank (although the picture is skewed by the absence of the register of landholdings in the district closest to the metropolis) and to move from that to a speculative comparative estimate for the distribution of land among village landholders, which shows a lesser degree of inequality than among their urban counterparts. (In this respect there are interesting comparisons to be made with the fourth-century census records from Asia Minor analysed by Thonemann).[22] Once again the number of small to medium-sized holdings is striking, as are the fragmentation of the landholdings and the continuation of traditional patterns of leasing by large owners. Of particular value is the fact that the two contemporary Hermopolite registers allow us to quantify the amount of land changing hands, presumably by sale, which indicates a market that was still active and open. A synopsis of the key points of Bagnall's speculative model[23] for the Hermopolite Nome as a whole is as follows:

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- ↳ Total area: 1,140 km^2 = 413,820 arouras.
- Grain land: 298,000 arouras (reduced by 10 per cent, which was detached in the fourth century to form the Antinoopolite Nome) = 270,000 arouras,[24] of which:
- 95,000 arouras are owned by urban residents, 175,000 by village residents.
- A model population consists of 7,400 rural landholders with an average of 24.3 arouras each and 1,208 urban landholders, broken down as 952 Hermopolites with an average of 89.3 arouras and 256 Antinoites with an average of 39.0 arouras each. Men own 86 per cent and women 14 per cent of the total land.[25]

Evidence for conditions of this type in the other nomes of Middle Egypt is much more sporadic and for Upper Egypt virtually non-existent.[26] Bagnall's speculative attempt to quantify the holdings of vineland in the **Panopolite Nome** is broadly within the parameters of what can be deduced elsewhere.[27] More informative and from the mid-first century AD is a detailed though incomplete register of 163 holders of various categories of land, royal (*basilike*), private (*idiotike*), and sacred ('¾ artab land'), around the village of Krokodilopolis in the **Pathyrite Nome**, close to Thebes, which is important simply because there is so little evidence of this kind for this area.[28] The equality of distribution within this category is more or less what one might expect in a village context, but it is striking that only 10 per cent of the 124 holders of royal land possessed more than 20 arouras (the largest being 46 arouras), whereas 45 per cent of the owners of private land have more than 20 arouras (the largest being 127 arouras). Thirty-five per cent of the holders of sacred land have more than 20 arouras (the largest 80+ arouras), which may reflect the traditional strength of the temples in landholding in this region.

In the **Arsinoite** (Fayum), conditions appear to have been rather different (as they surely were, in other ways, in the Delta too[29]). Unlike the other areas discussed, the Arsinoite is exceptionally well represented in
p. 227 our Ptolemaic evidence and several individual villages are also very well attested in the ↳ Roman period and down to the fourth century AD (see below).[30] The overall picture has to be understood in the context of consistent expansion and intensification of the agrarian economy and heavy settlement by the Greek immigrant population both in the metropolis (Krokodilopolis, later named Ptolemais Euergetis) and the villages. The latter have traditionally been regarded as large by Egyptian standards, but it is no longer so clear that this was true except in a very few cases. It is likely that the proportion of public land in various categories was greater in the Arsinoite than in other nomes, perhaps approaching 50 per cent.[31] Here, as elsewhere, there is some evidence for increasing concentration of landownership in private hands in the third century, particularly those of the descendants of veteran settlers of the Roman period.[32] As has already been noted, decline in some of the Fayum villages from the early fourth century is starkly evident, and it may be that the high proportion of public land contributed to this by failing to attract private investment as

the government withdrew from direct ownership and leasing of land to public or royal tenants. Another important factor will have been the need to maintain the artificial irrigation system, which must have been a greater burden than in those areas that were directly inundated. In its heyday in the Roman period, the Arsinoite was vastly productive, as is suggested by the quantity of tax in kind assessed on one of the three divisions of the Arsinoite, 814,862 artabas for the year AD 184/5, when (it may be supposed) the effects of the Antonine plague have still to be taken into account.[33]

How can we use use such a figure?[34] There are various ways in which we can extrapolate from this evidence as an exercise in estimating orders of magnitude, none of them completely robust and all with some degree of approximation, but it is perhaps not too misleading to offer a simple calculation of its implications on the understanding that it might represent an expectation in 'normal times'.[35]

p. 228 The Herakleides division, which includes the metropolis, represents about 40 per cent of the population in the Arsinoite Nome (which may, but need not, imply 40 per cent of the cultivated land).[36]

Average tax rates across the various categories of land in wheat equivalent are 4.6 artabas/aroura.[37]

The amount of grain land represented by the tax assessment is approximately 177,143 arouras (814,862/4.6), *c.*45 per cent of the total estimated Arsinoite grain land (Table 7.1).

Total tax on grain land for the whole Arsinoite Nome is 1,806,452 artabas (392,707 arouras × 4.6).

Total grain yield is 4,712,484 artabas (392,707 arouras × 12).

Deduct 4.6 artabas/aroura for tax + 1 artaba/aroura for seed (2,199,159 artabas).

Remainder: 2,513,325 artabas, which would provide the basic wheat requirement for 76,161 families of 5.0—that is, close to 0.38 million people—at 33 artabas per family (wheat constituting 70 per cent of total caloric intake); on a total inhabited area of 1,350 km^2, this yields a population density of 282/km^2.

It should be obvious that this is merely an exercise in probabilistic estimation but not, I suggest, totally without value. The figures can be adjusted within plausible parameters and will then naturally afford different results. Of the quantified assumptions in the calculation, the most fragile or improbable will probably be the figures for population and density (particularly the latter),[38] but a main impact of the calculation is the demonstration that under 'normal' conditions the government might expect a level of grain production that could support close to 0.4 million people after taxes and seedcorn were deducted.[39] If
p. 229 this probably exceeds the likely actual population even at its height (which was ↳ presumably **not** the situation in AD 184/5) by some margin, it will thus be affording a significant 'surplus' (before deduction of transaction costs and so on). Whether such a level of production could be sustained with a lower population as a result of the impact of the plague is, of course, a different matter, and such evidence as there is certainly suggests that the population decline in the second century entailed an increase in unproductive land in the Mendesian Nome and presumably elsewhere too.[40] The corollary of this will be that, **if** the figure for AD 184/5 is a real one, the corresponding figure and its extrapolation thirty years earlier will be even larger.

Discussion of the actual cash value of this Arsinoite surplus may be postponed for the time being. On the one hand, it will, of course, be reduced by the need to take into account labour and transaction costs. On the other, the grain is only a part of the (in principle) quantifiable surplus: the foodstuffs that constitute the other 30 per cent of the human diet and caloric intake may also have yielded significant surpluses. This was certainly the case with wine, according to a recent calculation that predicts an annual production of around 0.25 million hectolitres per annum in the Ptolemaic period, a figure that is likely to have increased significantly in the Roman period as wine gained in popularity against the traditional Egyptian beer.[41] This will have produced a significant cash return, as was surely the case in the third-century AD Appianus estate.[42] Detailed evidence for individual communities, which is further considered below, is consistent with

the general inference that in the Arsinoite (as elsewhere) the proportion of land under arable cultivation was between 70 per cent and 80 per cent and certainly not normally less than about 70 per cent. This is the picture that emerges from a text of the later third century BC giving us the crop schedule for an area of 180,000 arouras: 74.6 per cent wheat, 14.5 per cent barley, the remainder fodder and legumes.[43]

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The Metropoleis

As regards the **nome capitals or metropoleis**, we naturally have less detail about the fundamental operations of the agricultural economy and we again rely on information from a very few (and the same) places: Oxyrhynchus, Hermopolis, Arsinoe (Ptolemais Euergetis), and a limited amount from Panopolis. We are mainly confined to evidence for urban landownership and for consumption of agricultural products, but this should not mislead us into clichés that emphasize the dominance of absentee urban landlords or the character of urban centres as parasitic and simply draining the wealth from the agrarian sector. The relationships are more complex and reciprocal. On the one hand, the urban centres supply a great deal of the technological and commercial infrastructure, which enables the agricultural product to be turned into tangible wealth. In addition, some significant proportion of the urban population is directly involved in the agricultural economy, sometimes as tenants, sometimes directly involved in the details of estate management, as is evident from many personal letters.[44] On the other, a significant number of the larger villages are socially stratified and provide facilities and administrative services characteristic of complex population centres.[45]

The patterns and configuration of landownership and land exploitation have been exhaustively dealt with from various points of view in recent publications, and much of the detail need not be repeated here.[46] The metropoleis naturally contained a concentration of wealthier landowners, and this must have intensified as the amount of land in private ownership increased, as the metropoleis grew in size and effectively became (under Roman rule) more status-based and stratified, with the emergence of a 'Hellenic' local elite. The exact relationship between the owners and the metropoleis is somewhat complicated (as it also is in the case of some of the Fayum villages) by the ownership of land by Alexandrians:[47] these may be either Alexandrians by *origo* who have acquired land in the *chora*, or metropolites by *origo* who have acquired Alexandrian citizenship, which was an integral part of upward mobility in Roman Egypt. The extensive fourth-century Hermopolite landlists also register landowners resident in Antinoopolis whose holdings lie in the Hermopolite Nome but unfortunately do not include landholdings in the district closest to Hermopolis itself.[48] Though there are some distinctions between these groups, from the present perspective
p. 231 it is clear ↳ that, as one would expect, wealthy landowners are concentrated in the urban centres and that the inequality of distribution within the urban landholding population is very great and likely to be increasing in the later Roman period.[49] Data from the earlier periods and from the later Roman period suggest that the degree of inequality of distribution was much less marked in the village landowning community.[50]

From the perspective of quantification and strategies of production, the fourth-century evidence from Hermopolis seems to support two relevant and related conclusions. First, that, although the concentration of land in the hands of fewer wealthier owners is evident, as it is elsewhere,[51] it is difficult to discern any movement towards geographical concentration and consolidation of 'large estates'—wealthy owners tended to own multiple plots in diverse locations. Second, that there is still a significant amount of market movement of land at this period by sale.[52] Other evidence indicates that, although there are significant changes in the modes of documentation, tenancy still remained the dominant feature of the exploitation of land.[53] Whether this concentration of landownership led to greater productivity (in terms of reduction of overheads, if not increased yields) is an interesting question that deserves further investigation.

The structural role of the urban communities in the agrarian economy is clearly a complex one. A very great deal of the business, commercial, and artisanal activity located in the metropoleis was integrally connected to the agrarian sector in one way or another. Despite the fact that many of the large villages had administrative institutions and offices, the metropoleis were the main centres of administration, documentation, and management for the land, as the large volume of relevant papyrological material found in or deriving from the major towns shows. This was true not only for the governmental administrative institutions but also for private estate management. The scattered *phrontides* of the Appianus estate in the Arsinoite Nome each had a manager (*phrontistes*), but the headquarters of the whole operation was in the nome capital Arsinoe, where the senior administrators presumably lived.[54]

p. 232 It has been estimated that, in Hermopolis, between 10 per cent and 15 per cent of the residents could feed themselves from the produce of their land,[55] leaving (presumably) a large number of urban residents for whom land was not their only or main source of livelihood and who needed to purchase much or all of what they consumed. Although the total of such landholdings was not inconsiderable and the average holdings in Bagnall's model (above) were certainly many times more than subsistence level,[56] there were a very few whose land yielded an extremely handsome surplus and remained in their family's possession for many generations. Examples from all three areas here under discussion are easy to identify but present diverse obstacles to precise quantification: Claudia Isidora, the Ti. Julii Theones, Calpurnia Heraklia (Oxyrhynchus);[57] Hyperechios, Aurelia Charite (Hermopolis);[58] the Appianus estate (Arsinoite).[59] It is again worth emphasizing, however, that such holdings of individual landlords were typically widely spread and often comprised land in different categories in the earlier periods when terminological distinctions between the categories were substantive. In almost all cases we cannot be sure that the data we have for individual landowners are complete, but the orders of magnitude revealed nevertheless have illustrative value. I cite examples of larger landowners (three from the above list) that cannot be generalized but, on the other hand, are not likely to be wholly exceptional either:

1. A declaration of only part of the property of Calpurnia Heraklia in AD 245/6 shows land in five separate villages in the eastern part of the Oxyrhynchite Nome totalling around 1,683 arouras and comprised of individual parcels ranging in size from a few arouras to several hundred (Table 7.2). All of the land is leased out, and the pattern of acquisition by purchase is particularly notable: the earliest is in the reign of Tiberius, then there is a gap before further increases under Commodus, the Severi, and Gordian III.[60]

Table 7.2. The assets of Calpurnia Heraklia

Village	Land area* (ar.)	Land value† (tal.)	Grain stock (art.)	Grain value (1)‡ (dr.)	Grain value (2)‡ dr.)
Thmoenacom(…)	219				
Thmoenopsobthis	909		460	7,360	11,040
Schoebis	256				
Osoronnophrios	69				
Tychinnecotis	230				
Suis			3,020	48,320	72,552
Dositheou			245	3,920	5,880
Iseum Tryphonis			220	3,520	5,280
Lile			280	4,480	6,160
Satyrou§			820 (533)	13,120 (8,528)	19,680 (12,792)
Total	1,683	28.5	5,045	80,720 (72,192)	120,592 (113,704)

Note: ar. = arouras; art. = artabas; dr. = drachmas; tal. = talents (1 talent = 6,000 dr.).

* Much of the declared land was uninundated, presumably because of a poor flood or a series thereof. This should not affect the capital value of the land over time, and one would assume that a wealthy landholder would not normally need to sell land when prices were depressed.

† The figure calculated for the capital value of the land is purely theoretical. It assumes that 1 aroura of saleable grain land at this period was worth around 1,000 drachmas (see Rowlandson 1996: 320–1, table 11). But prices vary considerably according to location and quality. Not all of the land declared was private and straightforwardly saleable, but the value is assessed as if it were.

‡ The 'normal' value (value (1)) of 16 drachmas per artaba is derived from the figures given by the editor of *P.Oxy*. XLII. 3047–8 and Rathbone (1997: 193–4) for the mid-third century. The compulsory purchase price of 24 drachmas per artaba (value (2)) is very high and clearly indicates severe shortage. The amounts of grain stocks available for purchase need to be reduced by unquantified deductions for rations of employees and wage labourers on the estates.

§ For Satyrou, the figures in parentheses account for the amount of 287 artabas already pledged to individuals in the city.

Sources: *P.Oxy*. XLII. 3047–8, AD 245/6; Rathbone (1997).

2. The will of the Oxyrhynchite *bouleutes* Aurelius Hermogenes-Eudaemon, dated AD 276, bequeaths grain land in six villages of the nome, vineyards in three villages, a house with appurtenances, and slaves in the metropolis.[61]

3. About a century later, the two more or less contemporary Hermopolite landlists show property
p. 233 belonging to Aurelia Charite in four or five ↳ separate districts (*pagi*) as 61 and 60¾ arouras of 'public' land and 193 and 314 arouras of 'private' land. We do not know which of the lists is the earlier, but it is evident that there was significant movement of her 'private' holdings by purchase or sale. An archive of her documents contains leases of parts of her holdings (the sizes of the parcels leased are unfortunately not preserved).[62]

4. The Hermopolite lists also show the diverse holdings of the family of the descendants of Hyperechios, amounting to at least *c.*4,000 arouras, more probably a minimum of 5,509 and possibly as much as 6,760.[63] As may be seen from Table 7.3, this is well in excess of the estimated total land in the territory of
p. 234 most villages in the Oxyrhynchite Nome. ↳

p. 234 ↳

The Villages

It is both legitimate and revealing to extend some of these methods and calculations to the **village communities**, where the patterns of distribution of landownership among individuals are different and somewhat less unequal.[64] But the evidence for the relative size of villages and their territories in the Oxyrhynchite based on tax assessments (Table 7.3) again shows a marked inequality in territorial size, with few large and many small villages with no implication here as to who actually owned the land in these territories—in many cases presumably urban residents such as Calpurnia Heraklia.

In the present context, which will not permit exhaustive analysis, there is much to be gained from a handful of case studies that throw light on different aspects of the agricultural economy in a quantitative perspective. It needs to be borne in mind, however, that almost all this evidence comes from villages in the Fayum, which have been analysed in detail in some excellent recent studies and cannot simply be mapped onto other regions. Nevertheless, such spots of evidence as we do have from elsewhere suggest that the agricultural regime in villages of Middle, Upper Egypt, and the Delta was not totally different in kind. The presentation follows a more or less chronological order as far as evidence permits.

I offer first of all a table (Table 7.4) with some orders of magnitude for population, site size, and land at various periods. Many of these are quite sizeable villages with some administrative facilities of their own. Idiosyncrasies, which are probably attributable to unreliable evidence and should therefore be set aside, include some *huge* figures (for example, for the population of Narmouthis and the territory of Bacchias). A general picture emerges of significant growth from the first two centuries of Ptolemaic rule to the mid-second century AD, and significant decline in the period after AD 300.[65] Some of the villages listed in the table provide illustrative or diagnostic evidence for particular features of the agricultural regime, which can be analysed in more detail.

Table 7.4. Population, site size, and land in Fayum villages

Village	A Population	B Site area (ha)	C Land Area ha. = ar.	Date of evidence for area in C	Source
Karanis	3,600 (I/II AD)	80	3,176 = 11,549	*c.* AD 170	Davoli (1998: 74)
	2,300 (II/III AD)		1,160 = 4,219	AD 308	Bagnall (2003)
	400 (IV AD)				Bagnall (1992)
Bacchias		34			Davoli (1998: 117)
Euhemeria		65			Bagnall (1993)
Hiera Nesos			1,117= 4,062	AD 167	Rathbone (1990)
Kerkeosiris	1,200 (II BC)		1,297= 4,716	118 BC	Rathbone (1990)
Philadelphia	3,300 (I/II AD)	50	2,750+= 10,000	AD 167	Rathbone (1990) Hanson (2007)
Soknopaiou Nesos	1,100 (I/II AD) 760⟩ 420⟩0 (II/III AD)	22			Rathbone (1990) Davoli (2005) Messeri Savorelli (1989)
Theadelphia	2,300 (I/II AD) 80 (IV AD)	25	*c.*1,874 = 6,814	*c.* AD 150	Rathbone (1990); Davoli (1998); Sharp (1999) ; Bagnall (2003)
Narmouthis	(6,500) (I/II AD)	60			Rathbone (1990) Davoli (1998: 223)
Tebtunis	4/5,000 (I/II AD)	57			Davoli (1998: 179) Rowlandson (1999)
Dionysias	1,150 (III BC)	40		Rathbone (1990); Davoli (1998: 301)	
Philoteris	1,100 (III BC)	10.7			Römer (2004)
Oxyrhyncha	*c.*1,000 (?) (II BC)		*c.*2,180 = 6,000 (min.)	2nd c. BC	Clarysse (2008)

Note: ar. = arouras; ha = hectares.

* France (1999: 309) has a higher estimate of *c.*9,400 arouras for the second century AD.

Although the agricultural regime in the Ptolemaic period certainly differed in important respects, it is nevertheless worth a prefatory look at some quantifiable evidence for that period, for comparative purposes. **Kerkeosiris** appears to have been in a less than wholly healthy economic condition in the late second century BC. We have a good idea of the territory and population size and can now compare them with data from elsewhere in the Ptolemaic Fayum. Careful analysis of the crop regime and rent returns by Dorothy Crawford (Thompson), augmented by evidence subsequently published, shows that the data for cleruchic
p. 235 land (that is, that allotted to the more ↳

p. 236 ↳

p. 237 ↳
privileged landholders)[66] include a much higher proportion of unproductive or derelict land and suggest that the relatively more privileged cleruchs were actually in a worse situation than the crown tenants at this time. For land held by the latter, the statistics emphasize the relative stability of the crop regime and the tax yield. The high-value crops (wheat, barley, lentils) predominate, occupying an average of 76.6 per cent of
p. 238 the land under cultivation, and this ↳ may be compared with data from *P. Petrie* III 75 of 235 BC (cited above). The average tax yield across all land and crops hovers around 4 artabas/aroura and a further deduction of 1 artaba/aroura should be made for seed in calculating surpluses. Unfortunately, we do not know for certain what proportion of the average total yield 5 artabas/aroura will have represented, but it is very unlikely to have been as high as 50 per cent and was probably quite significantly lower.

Evidence from **Philadelphia** for the third century BC shows wine production on a significant scale, a Ptolemaic innovation that is not part of the picture in the preserved records from Kerkeosiris. The calculations of wine production at Philadelphia by Vandorpe and Clarysse[67] imply a production of 5,760 hectolitres on 234 arouras at 25 hectolitres/ha, to which they compare a yield at Bubastos of 1,920 hectolitres on *c.*77 ha. This they extrapolate to a yearly production for the Arsinoite of 220,000 hectolitres on 8,800 ha = 32,000 arouras, calculating a market value for the total Arsinoite wine production of 1.34 million drachmas per annum. This is evidently speculative and seems to me suspiciously optimistic, not least because the amount of vineyard land obviously must vary from place to place.[68] For comparison, the Appianus estate of the mid-third century AD, based at Theadelphia, shows twenty attested vineyards but nothing on size or productivity. Rathbone's estimate is calculated on the basis of 7,000/7,500 mon. p.a. = 500 hectolitres at 100 monochora/aroura = *c.*25 hectolitresl/ha—that is, *c.*72 arouras.[69] These orders of magnitude, perhaps a little reduced, can be measured against the broad picture suggested in Table 7.1 above, which posits perhaps *c.*60,000 arouras (16,200 ha) of productive non-arable land in the Arsinoite. The other period for which we have good quantifiable evidence, the third century AD, shows that in AD 215/16 there were 3,826 arouras of privately owned grain land and 757 arouras of garden land (vineyards and orchards), 83.5 per cent and 16.5 per cent respectively. Detailed analysis of the level of equality of distribution reveals a Gini coefficient of 0.532, greater (more unequal) than Ptolemaic Kerkeosiris, less than fourth-century Hermopolis. This is part of the picture adumbrated by Schubert, analysing the build-up of larger estates, a process in which the descendants of veteran families played a prominent role.[70]

Here it is perhaps convenient to compare other evidence for **Theadelphia**, which has been analysed in great detail by Sharp.[71] His estimate of *c.*6,800 arouras (= 1,874 ha.), is argued to have included about 7–8 per cent
p. 239 of vineyard and garden land. Of the arable land, the pattern of cultivation ↳ (with some double cropping and rotation) in the mid-second century AD shows:

> **Wheat:** under 40 per cent
> **Lentils:** 22 per cent

Barley: unknown (some hundreds of arouras)
Fodder: 10 per cent

Here the wheat proportion is strikingly low (and perhaps untypically so even for this village) but from an economic point of view compensated to some extent by lentils, which are a high-value crop (1:1 with wheat). If the unknown figure for barley were 10 per cent (within the known ranges from other places), the high-value crops would comprise over 70 per cent, consistent with patterns elsewhere. It is noteworthy that by AD 216 the amount of land under cultivation was comparable but the proportion of vineyard and orchard land seems to have risen to almost one-third (3,600 arouras of arable, 1,500 arouras of garden and orchard), and the proportion of vineyard to garden land may also have increased. Again, this may reflect a tendency to concentration of land in the hand of wealthier owners, and it has also been suggested that the production and consumption of wine tend to increase in the course of the Roman period. It is well known that by the early fourth century Theadelphia had suffered drastic depopulation and decline, apparently to a greater extent than Karanis (see below).[72]

There are good quantifiable data from **Tebtunis** for the Ptolemaic and the Roman periods, and Rowlandson provides an excellent sketch of the latter with emphasis on the social relations of the agrarian economy in which the balance of crop distribution was probably much the same as that elsewhere: predominantly arable, with some alternation of fodder crops, and a small percentage of vineyard and garden land.[73] Unfortunately, there is no hard evidence for population or size of territory, but, if Rowlandson's guesses are close to the mark, it will have been significantly larger than any of the other villages listed in Table 7.4. In the present perspective, some of the best material is derived from the Grapheion Archive of the reign of Claudius, which has been subjected to some analysis, though perhaps not exploited as fully as is possible. The full range of documents associated with Tebtunis and the grapheion runs from AD 8 to AD 56, and it provides the most detailed evidence we have for the ways in which the management of property (domestic as well as agricultural) was documented, including sales, leases, and subleases of land, which may partly be viewed as strategies or mechanisms for the division or redistribution of agricultural resources, in the form
p. 240 of both private and state land. In fact, this body of material offers an excellent opportunity to quantify ↳ 'transaction costs' in the definition cited by Lo Cascio—the costs associated with defining, protecting, and exchanging property rights.[74] Leasing was clearly the predominant mode of exploitation. The documents summarized in Tables 7.5a and 7.5b show a high level of activity in moving control of small amounts of land (*c.*23 per cent of all contracts), many with metropolitan landlords leasing to villagers.[75] It is worth quoting Rowlandson's conclusion that at Tebtunis we find leases of land made for every tenurial category and every type of crop (with fodder particularly prominent for reasons that she attempts to explain), with all sections of the population involved, whether as landlords, tenants, or (significantly) both.[76] It is in this body of evidence that we find very high wheat rents, which imply yields that may be as much as twentyfold. There is no reason to suppose that Tebtunis was wholly exceptional in these respects, but the evidence from family archives of the second century AD, subjected to careful analysis by Rowlandson, suggests some different nuances: combination of leasing and direct paid labour (the 'Laches archive'); metropolitan landowners with holdings in several villages including Tebtunis (*P. Fam. Teb.*), a pattern well attested at Oxyrhynchus; an independent village family acting as both lessors and lessees and partly financing their operations by loans (Kronion archive).[77]

Table 7.5 Movement of land at Tebtunis
(a) Individual documents

Transaction type	Transaction (n)	Date range	Size range (ar.)	Average size (ar.)
Sale/cession	18	AD 25/6–48	0.5–10	3.66
Lease/sublease	12	AD 8–46/9	2.5–26	11 (rounded)

(b) Registers

Transaction type	Transaction (n)	Date range	Size range (ar.)	Average size (ar.)
Sale/cession	20	AD 42–45/7	0.5–10	4.3
Lease	144	AD 42–45/7	0.5–24	5.8

Note: ar. = arouras.

Source: Material from the Leuven database (http://www/trismegistos.org/) accessed and compiled in 2006/7 by Dr Myrto Malouta.

There is no reason to assume that things were substantially different at **Karanis** in the north-east Fayum, at least in the period up to *c.* AD 150. This is undoubtedly the best-attested village over the first four centuries
p. 241 of the Roman period, with both documentary evidence and a significant, even if partial, ↳ archaeological record.[78] These in conjunction indicate that, as elsewhere, there was a significant sector of the population engaged in non-agricultural activities and also give us some hints of the scale of land in the surrounding territory (the villages in the *horiodeiktia* of Karanis). The evidence for orders of magnitude in production and consumption in the period before the Antonine plague of the mid-second century and in the early fourth century afford a striking contrast that is certainly paralleled in some other villages (Table 7.6).[79] Following
p. 242 Bagnall, my calculations are based on an estimated pre-Antonine ↳ population for Karanis of *c.*3,600 people, which I reckon as *c.*700 families, *c.*2,300 (*c.*450 families) in the 170s, showing the effects of the Antonine plague, and an early fourth-century population of 420 (*c.*80 families). The population of the villages in the *horiodeiktia* (of which at least three were substantial) is unknown. The evident drastic reduction in population, land, and tax yield is very striking, but detailed discussion of what the latter, in particular, means must be postponed. The obvious question is whether the levels of government revenue from this area really did decline so drastically, from an overall average rate of *c.*4.5 artabas per aroura to 1.55 artabas per aroura, or whether the reduction in this mode of taxation was compensated by other modes of revenue extraction, and, if so, whether this also applied elsewhere in Egypt. For the earlier period, it should be noted that the overall figures for tax yield are of the same order of magnitude as those derived for crown land at Kerkeosiris in the second century BC, an apparent stability (if that is the case) that is maintained through a period of significant demographic expansion.[80]

Table 7.6. Land and taxes at Karanis and neighbouring villages, mid-second to early fourth century AD
(a) Mid-second century

Area/payment	Karanis	Horiodeiktia	Total
Land area (ar.)	11,549	14,986	26,535
Tax paid (art. of wheat)	54,457	67,690	122,147
Tax rate (art./ar.)	4.7	4.5	4.6

(b) Mid-second century, dependent villages

Area/payment	Ptolemais Nea	Hiera Nesos
Land area (ar.)	3,924	4,061
Tax paid (art. of wheat)	16,891	15,797
Tax rate (art./ar.)	4.3	3.9

(c) Early fourth century

Area/payment	Karanis	Horiodeiktia	Total
Land area (ar.)	1,198	3,020	4,218
Tax paid (art. of wheat)	2,092	4,447	6,539
Tax rate (art./ar.)	1.74	1.47	1.55

Note: ar. = arouras; art. = artabas.

Source: after Bagnall (1985 = 2003).

From the point of view of estimating production, consumption, and subsistence, it is interesting to compare the second-century and the fourth-century data with an emphasis that is slightly different from that of Bagnall, who correctly points out a huge quantitative decline both at **Karanis** and at **Theadelphia** (Table 7.7).[81]

Table 7.7. Production and consumption
(a) Mid-second century AD

Land/product	Karanis	Theadelphia
Land (ar.)	11,549	6,814
Yield (art.)*	137,508	81,768
Tax (art.)†	54,457	31,344
Seed (art.)‡	11,549	6,814
Balance (art.)	71,592	43,610
Total subsistence (art.)§	32,900	21,150
Actual wheat consumption (art.)	23,100	14,850
'Surplus' (art.)	38,692 (= 28%)	22,460 (= 27.5%)

(b) Early fourth century AD

Land/product	Karanis	Theadelphia
Land (ar.)	1,198	[235]
Yield (art.)*	14,376	2,820
Tax (art.)†	2,092	363
Seed (art.)‡	1,198	[235]
Balance (art.)	11,086	2,222
Subsistence (art.)§	3,760	940
Actual wheat consumption (art.)	2,640	660
'Surplus' (art.)	7,326 (= 51%)	1,880 (= 66%)

Note: ar. = arouras; art. = artabas.

* The rate of yield applied is 12 art./ar.

† The rate of tax applied in wheat equivalent is 4.6 (mid-second cent.) and 1.6 (early fourth cent.) art./ar.

‡ The sowing rate is standardly 1 art. of seed per ar.

§ The subsistence requirement is calculated in wheat equivalent.

These figures are again in some cases highly hypothetical or speculative,[82] but, if we assume (and it *is* a big assumption, given the severe reduction in population that might affect ability to sustain intensity of production) a consistent twelvefold yield, we can see that the percentage 'surplus' is considerable in both periods, even in that of 'decline'. Self-evidently, adopting the estimate of a total area of 11,549 arouras of grain land for the 170s, when the population is presumed to have declined to *c.*2,300, would yield a more favourable outcome, if the levels of cultivation and of production were maintained at pre-plague levels, but this seems inherently unlikely.[83] In any event, the 'surplus' is not a real surplus in the sense of profit, merely a figure after deduction of tax, seed, and subsistence requirement in wheat equivalent and would need to be reduced by further considerations:

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- ↳ effect of crop rotation;
- transaction costs;
- labour costs.

Such a scenario ideally needs more precision, however, and by analogy it would in principle be better to consider Karanis and its *horiodeiktia* together, since Karanites may well have owned or held land in the district. Unfortunately, we are hampered by the absence of any grounds for an estimate of the population of its *horiodeiktia* that would enable us to estimate subsistence requirements and surpluses. Even with all these

caveats, however, it seems possible to conclude that the inhabitants of the 'declining' villages of the early fourth-century Fayum were not in fact individually impoverished to the point of non-viability.

Conclusions

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The selection of data presented here in this compressed form is by no means exhaustive, but it is hoped that it gives some sense, albeit patchy and selective, of the scale and shape of various features of the agrarian economy in Egypt. Although I have claimed some level of general validity, even if crude and speculative, for some of the data, I have not attempted large-scale agglomeration or extrapolation to a pan-Egyptian picture. It would not be difficult to do that on the basis of transparent methods of calculation and data, some of which at least are robust. But, as stated at the outset, it is difficult to avoid the feeling that greater generalization leads us further away from any testable reality and I suspect that such conclusions would at this stage merely complement our pre-existing ideas of context and scale. At a later stage, where we do have some evidence on which to base large-scale calculations,[84] we can attempt to see how the balances of individual elements might have changed or fluctuations in the level of production might have occurred within the agrarian sector in a way that is consistent with (let us say) the levels of revenue known under Augustus and under Justinian.[85] That might be a next step in the chain.

As indicated earlier, a complete picture with a proper estimate of generation of surplus wealth needs to consider the balance between supply and demand or production and consumption and it has not been possible to deal with the latter in any detail here. If arable production supplies an estimated 70 per cent of subsistence requirements, we need to add consideration of viticulture and oleoculture, livestock, and other agricultural products, balanced against the costs of labour, animal power, fodder, transport, and so on. Thus far, we can offer only a crude and unrefined illustration of orders of magnitude for the metropoleis. They were concentrated centres of consumption that offer some quantifiable evidence, part of which has already been addressed.[86] We here proceed on the basis that the total populations of Arsinoe, Oxyrhynchus, and Hermopolis in the period up to *c.* AD 150 consisted of up to 9,000, 6,000, and 7,000 families respectively, with a family average of five individuals.[87] It is a simple matter to estimate basic subsistence requirements for these population levels, but this will leave us no wiser than we were with the knowledge that the product of these regions far outstripped the basic subsistence needs. For Oxyrhynchus in the later third century (*c.* AD 270), we also have the evidence for the 'corn-dole', the output of which can be quantified at a maximum
p. 245 of around 48,000 artabas per annum (though it remains unclear exactly where ↳ the expense of this benefit fell).[88] It is not clear whether this allowance was calculated in the form of milled or unmilled wheat (more probably the latter), but we do know that thirty loaves could be made from an artaba of (milled) wheat and how many the bakeries could produce per day.[89] On this basis, as a very rough approximation, we could calculate the annual subsistence requirements in wheat equivalent for a metropolitan population of 6,000 families at *c.*242,000 artabas and the actual wheat consumption, assuming it constitutes 70 per cent of diet, at *c.*198,000 artabas. Any estimate for the nome is bound to be purely speculative, since we lack the means to estimate population. If 30,000 families were taken as a maximum and a twelvefold yield applied to a rounded 203,000 arouras of grain land (Tables 7.1 and 7.8), the results would be large 'surpluses', which would need to be reduced by calculation of overhead costs and other factors mentioned above in order to achieve a more realistic picture of the excess value of supply over consumption.[90]

Table 7.8. Oxyrhynchite cereal production

Wheat usage	II AD	IV AD
Yield*	2,436,000	2,436,000
Tax†	609,000	324,800
Seed‡	203,000	203,000
Wheat consumption§	990,000	990,000
'Surplus'	634,000 (26%)	918,200 (37.7%)

* The rate of yield applied is 12 artabas/aroura.

† The average figures used for tax on all categories of grain land are 3 artabas/aroura for the second century and 1.6 artabas/aroura for the fourth (Bagnall 1992). For further discussion of the earlier figure and the discrepancy, see Appendix, n. 6.

‡ The sowing rate is standardly 1 artaba of seed per aroura.

§ The calculation is based on a purely illustrative estimate of 30,000 families in the Oxyrhynchite Nome (of which 6,000–7,000 are in the metropolis) at a consumption rate 33 artabas of wheat per family per annum (see Appendix).

The belief implicit in the approach adopted here is that the individual scenarios of regions, towns, and
p. 246 villages analysed do have something to tell ↳ us about the structural features and the overall scale of the agrarian economy, even if they each have their own idiosyncratic elements. We might also have added individual estates, except that the present scale would allow only the briefest summary of syntheses already available that have undermined the idea of a primitive and small-scale subsistence economy in the agrarian sector.[91] But, if this approach seems valid for the sets of Egyptian data, I believe it is also legitimate to hypothesize along the same lines when trying to set Egypt (or any other province) in the broader context of the Hellenistic world or the Roman empire. That is not the same as a claim of 'typicality' for Egypt. Apart from the obvious geographical and ecological differences that profoundly condition the agrarian regime and set it apart from other regions, idiosyncratic features such as the very low level of slave labour also need to be taken into account. It may, however, be suggested that one could allow for these differences without ignoring the significance of the modes in which agrarian behaviour fits into the social and economic patterns of the Hellenistic and Roman states.

This chapter has compiled evidence that suggests some such changes over the period under consideration, some possibly contingent and temporary (the effects of plague), others more fundamental and longer term (the effective privatization of land). There is evidence for exploitation though direct labour, but tenancy is predominant. The indebtedness of tenants seems more prevalent later, entailing a need for greater security of tenancy, a widening of the gap between the status of the tenant and landlord as rent rolls replace leases on private or fiscal estates (which may be seen as the Egyptian form of what is usually called the late Roman colonate). All this points to a greater equality of distribution in the Ptolemaic and early Roman periods (except for imperial estates) and growing inequality into the later Roman period. It is relevant for all periods that slave labour on the land plays little or no role except as an occasional substitute for 'wage labour'. This suggests, overall, an agrarian economy that is flexible, entrepreneurial, and deeply monetized, even at the village level, as the significant number of cash payments for rents and purchases shows.

We can enrich the picture by looking at the Egyptian agrarian economy in a broader political and institutional context, considering how, for example, the average tax rates on land can be increased or decreased by the state by manipulating the balance of other modes of taxation and raising revenues that have to be paid in cash and at least partly, in effect, by commutation of the agricultural 'surplus'. Although it remains to be tested in detail, this is the most obvious explanation for the dramatically lower rates of grain tax after AD 300. We can also consider the relationship between our quantifiable data and the
p. 247 possibility of constructing some sort of a generic model that would take ↳ account of amount and use of land, average yields, various deductions for tax, seed, labour, transport costs, subsistence requirements, and so on. This type of analysis has already been fruitfully applied to some bodies of evidence and suggests an approach in which the model can be successfully created only if it is driven by a clear sense of the questions that the existing evidence can address and an iterative process that allows the incorporation of new evidence to modify it.[92]

Appendix

The basic figures used for my calculations are as follows:

1. Aroura, unit of land measurement: 0.68 acre, 0.275 ha (1 feddan = 1.524 arouras = 0.42 ha).
2. Artaba, dry measure: 38.78 litres = 4.5 *modii Italici* = 30.2 kg of milled wheat.
3. *Modius Italicus*: 8.62 litres = 6.7 kg wheat.
4. Cereal yields: twelvefold average yield over time. This is a critical issue on which is it very difficult to achieve certainty. In Egypt yields varied greatly according to the level of the Nile flood and the consequent quality of the harvest. An average tenfold yield has often been assumed, but my estimate is rather higher, following the evidence analysed by Rowlandson (1996: 247–9) (for the Oxyrhynchite Nome, normal yields of 10 artabas per aroura and more). For comparative estimates for Italy (much lower), see Spurr (1986: 82–8).
5. Seed: 1 artaba per aroura is standard sowing rate.
6. Taxation rates in kind (wheat or wheat equivalent). The figures applied are crude but likely to be of the right order of magnitude. For the period before Diocletian rates of tax on private land are 1 artaba/aroura or a bit more, on the various categories of public land 5 or 6 artabas/aroura. For the Fayum (Arsinoite), where there is assumed to be significantly more public land, than elsewhere (perhaps 50/50), following the calculations of Bagnall, as corrected in n. 79 above), I apply an overall average rate of 4.6 artabas/aroura. For Middle Egypt and the Oxyrhynchite, where the ratio of private to public land was perhaps more like 2:1 (Rowlandson 1996), I apply an overall average rate of 3 artabas/aroura. For the post-Diocletianic period, when all land was effectively in private ownership, I apply an overall average of 1.55 artabas/aroura (fuller discussion of the significance of this difference in rates must be postponed).
7. Subsistence and consumption needs in wheat equivalent, established by Foxhall and Forbes (1982):

i. Average for wheat: 3,340 calories/kg.

ii. Average for barley (60/70 per cent extraction of meal from hulled barley): 3,320 calories/kg.

p. 248 iii. ↳ Male requirements per diem: 3,822 (exceptionally active), 3,337 (very active), 2,852 (moderately active). So 1 artaba wheat per month = subsistence for a 'very active' male.

These are the basis for calculating household requirements per diem: 15,494 calories for six-person household unit (Foxhall and Forbes 1982), scaled down to a maximum of *c.*13,000 for Egyptian household of 5.0 persons = approx 3.9 kg = *c.*0.58 modius = 0.129 artabas = **47 artabas per annum in wheat equivalent**; **33 artabas wheat per family per annum in actual consumption**, assuming that 70 per cent of calorie requirements are provided by wheat in the diet.

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Notes

1 Bowman (2009); Bagnall (2009). I am grateful to Dominic Rathbone for his comments on an earlier draft of this chapter.

2 For examples in the form of models that can accommodate a number of not wholly consistent datasets, or are based on arbitrary premises, or are capable of explaining any evidence at all, or are not tested against data, see Bagnall (2002a: 115; 2007: 641).

3 The metrics on which these calculations are based are set out in the Appendix to this chapter.
4 Bowman (2011).
5 This will be the subject of Bowman (forthcoming).
6 For a recent survey, see Bagnall (2005), and, for a new database for the Fayum, Winkler (2008) ⟨http://www.agre.uni-tuebingen.de⟩ (accessed 12 Aug. 2009).
7 For recent summaries, see Rathbone (2006, 2007); and cf. Rathbone (1989).
8 By 'internal demand' I mean the needs of the population of the kingdom/province and of the administrative and military personnel who managed it, and the phrase 'at no time' should, of course, be understood as referring to averages smoothed over the period: the variability of the flood levels did create shortages in particular years (see Bonneau 1964). For decline in the Fayum villages, see Bowman (2011) and below. It should be noted that, even if the whole of the productive land in the Fayum were lost after *c.* AD 300, that would still account for only about 5% of the total area under cultivation in Egypt, though we should allow for the probability that levels of yield and production were more intensive than elsewhere. The demands of managing the irrigation system in the Fayum presumably meant that land could more easily become unproductive than elsewhere. An overall decline in population levels from the late third through to the fifth century and beyond is certainly not to be assumed, perhaps the reverse (or at least steady state); see Bowman (2011). Rathbone (1990: 137) summarizes the evidence for severe depopulation in the late second century in the Delta (see also Blouin 2005), but that does not preclude the possibility of some recovery in the course of the next 100 years or so.
9 Rathbone (1990: 118); Greenberg (2003).
10 Rathbone (1989); Bowman (2011).
11 See Rathbone (1990: 134–7); Blouin (2010; Chapter 8, this volume).
12 This is the level at which Bagnall (2009) suggests we can find the best opportunity to extrapolate a useful model. I have here used some of the data to which he refers, and some other material, though space does not permit exhaustive analysis. There is scope for much further work.
13 Bowman (2011: 333–40).
14 Bagnall and Worp (1980).
15 See Bagnall (1992).
16 Rowlandson (1996, 2006).
17 Rowlandson (1996: 63–9), but with considerable variation from region to region and even within regions. The proportion of public land is generally thought to be higher in the Fayum. What follows is essentially a summary of her main conclusions. For a different perspective, which cannot be discussed in detail here, see Monson (2008).
18 For Calpurnia Heraklia, see Table 7.2.
19 It is, however, important not to see them simply as subsistence-level peasants, and many landholders held amounts of both public and private land; see the analysis of landholdings at Krokodilopolis (below). and Rowlandson (1996: 93–6).
20 Bowman (1985); Rowlandson (1996: 101); Schubert (2007).
21 Rowlandson (1996: 276–8).
22 Bowman (1985); Bagnall (1992); Thonemann (2007).
23 Bagnall (1992: 137–9). Cf. my estimate (Table 7.1) of 297,950 arouras of grain land, essentially identical. His figure for village residents is a rounded 180,000 arouras.
24 As an approximation, this figure is derived as: cultivated/inhabited land = 90% of total area, grain land = 80% of cultivated land/inhabited land, minus 10% for Antinoopolite (Bagnall 1992: 137).
25 See the model of Tacoma (2006: 92–114) and cf. Bagnall (2007).
26 There is important evidence for the Apollonopolite Nome in the late Ptolemaic period in a papyrus analysed in the unpublished thesis of Christensen (2002), showing a high proportion of privately owned land.
27 Bagnall (2002b).
28 *P.Lond*. III 604A (pp. 71 ff.), with discussion by Sharp (1998: 37), augmented by my own calculations. See also Monson (2008).
29 There is no good evidence for the Delta except in the case of the Mendesian Nome (second century AD), discussed by Rathbone (1990), Rowlandson (2006), and Blouin (2005, 2007, 2008, 2010, and Chapter 8, this volume).
30 For a gazetteer of Fayum villages, see ⟨http://www.trismegistos.org/fayum⟩ (accessed 12 Aug. 2009).
31 Bagnall (1979/82 = 2003; 1992).
32 Schubert (2007).
33 *P.Oxy*. LXVI. 4527; see Schubert (2007: 149). Not that they are obvious: on the relationship of the figures to the effects of the plague, see Bagnall (2000); Van Minnen (2001).
34 Against Bagnall's minimizing view of the effects of the plague, Van Minnen argues for a restoration of line 15 of the text, which would show that the amount actually collected up to the end of the year was only 223,581 artabas and therefore the area was in deep economic trouble. Self-evidently, the restoration (which suits the lacuna) cannot be verified or falsified,

and we can make use of this evidence only by treating the larger figure as representing the official assessment and expectation, regardless of its realization. If the gap between the two were as striking as Van Minnen's argument implies, the government would have had plenty of time to adjust the assessment to a realistic level based on the amount of land still in production.

35 This is the method I have used for the calculations on the Oxyrhynchite and the Fayum villages (below), applying the figures explained in the Appendix. They are evidently fairly crude, and there must be margins of error. If they can have no claim to accuracy, it is my intention that they should be transparent enough to make it clear what the consequences would be of adjusting any of the basic metrics (e.g. population size, yield, or tax rate).

36 For population in the Ptolemaic period, see Clarysse and Thompson (2006: 102–13 and n. 111; table 4.7) showing 43% of attested Arsinoite villages in Herakleides; for a schematic map, see ⟨www.trismegistos.org/fayum⟩ (accessed 12 Aug. 2009). I assume that the proportion was maintained through population growth into the Roman period, when the population of the metropolis was perhaps 40,000+ (Bowman 2011). Note that the distribution of vineland between the 3 *merides* in the Roman period shows 50% in Herakleides (Ruffing 1999: 438).

37 For the tax rates, see Bagnall (1979/82 = 2003) and below (pp. 240–2) on Karanis. It is generally agreed that the proportion of public land (and hence the tax yield) was higher in the Fayum than elsewhere, see above, n. 17.

38 The figure is within the parameters of 200–300 proposed by Scheidel, but estimates for regions vary widely from over 400 to under 100; see the summary by Monson (2008).

39 It is important to emphasize that the grain tax was not the only form in which taxes were raised, so this constitutes only a part of the state's revenue from this area. This subject will be analysed in more detail in Bowman (forthcoming).

40 Rathbone (1990).

41 Vandorpe and Clarysse (1997), and, for more detail below, Rathbone (1991: 247); cf. Ruffing (1999). The rate of yield in both calculations is 25 hectolitres/ha, which means that the annual production requires 10,000 ha under cultivation. This can be accommodated within the estimate in Table 7.1 of 16,200 ha of garden land and vineyard and is consistent with the ratio of 2:1 for vineyard and garden land at Theadelphia suggested by Sharp (1998: 61). For comparative orders of magnitude note the estimate of 1.5 million hectolitres p.a., the produce of over 50,000 ha, for the city of Rome in the first century AD, see Tchernia (1986: 21–7).

42 Rathbone (1991) and, for comparison with the Byzantine period, Banaji (2002: 18–19). Ruffing (1999: 405) offers a calculation of the profits in Arsinoite wine production for the first three centuries AD.

43 *P. Petrie* III .75, 235 BC, cf. *P. Lille* I. 30–33 (Ghoran): cereals 75%, the remainder almost all *arakos*, a fodder crop. It is, of course, necessary to allow for local specialization of the kind identified by Crawford (1973).

44 Some evidence cited by Rowlandson (1996: 265) and Parsons (2007: chs 6 and 7).

45 See Rowlandson (2007).

46 Bowman (1985); Rathbone (1991); Rowlandson (1996); Bagnall (1992, 2002a, 2002b, 2007); Tacoma (2006: esp. 76–113).

47 Cf. Tacoma (2006: 95).

48 Bowman (1985).

49 Tacoma (2006: 94) concludes that the majority of urban inhabitants in Hermopolis did not own land.

50 Bagnall (1992).

51 Cf. Schubert (2007), on Philadelphia.

52 Bowman (1985).

53 Rowlandson (1996).

54 Rathbone (1991: 24–5). In this case, much of the production was achieved by wage labour, but there is no reason to assume a different pattern for large fragmented estates, which were mainly tenanted.

55 Sharp (1998: 45).

56 As is also true for village landholders.

57 All discussed by Rowlandson (1996: see index *svv*).

58 Lewuillon-Blume (1988); Harrauer (2008: *P. Charite*).

59 Rathbone (1991).

60 *P. Oxy*. XLII.3047–8.

61 *P. Oxy.* VI.907; cf. Tacoma (2006: 69–70).

62 Lewuillon-Blume (1988: *P. Charite*).

63 Bowman (1985: 144 n. 45); Lewuillon-Blume (1988); Harrauer (2008).

64 Bagnall (1992).

65 More detail, particularly bibliographical, is available in the database entries in ⟨http://www.trismegistos.org/fayum⟩ (accessed 12 Aug. 2009).

66 Crawford (1971: 53–85).

67 Vandorpe and Clarysse (1997).

68 For detailed analysis of data for the Roman period, see Ruffing (1999).
69 Rathbone (1991: 247).
70 Schubert (2007).
71 Sharp (1998, 1999). Also for the location of major parts of the Appianus estate, see Rathbone (1991). See also France (1999); Van Minnen (2000: 214–15).
72 Bagnall (1979/82 = 2003).
73 Toepel (1973); Rowlandson (1999); Lippert and Schentuleit (2005).
74 Lo Cascio (2006: 218–19).
75 Based on material compiled by Dr Myrto Malouta from the text database in ⟨www.trismegistos.org⟩ (accessed May 2006).
76 Rowlandson (1999: 155).
77 Rowlandson (1999: 152–4).
78 There is a large bibliography that cannot be cited here. For the archaeological evidence, see Davoli (1998: 73–116). Geremek (1969) provides a synthesis of the documentary evidence, which has much increased in the past four decades.
79 The data in Table 7.6 (a–c) are derived from original calculations by Bagnall (1985 = 2003), but with correction of one significant statistical error. The figure given at Bagnall (1985: 293) for the total land at Karanis should be 11,549 arouras rather than 7,855 (cf. Rathbone 1990: 134); Bagnall has failed to add the further estimate (1985: 292) of 3,694 arouras for the *ousiai* (the total of 12,204 for the *horiodeiktia* **does** include the *ousiai*). The effect of this correction is to reduce the overall average taxation rate from about 5 artabas/aroura to 4.6 artabas/aroura. The figures tabulated for the *horiodeiktia* on the basis of *P. Bour*. 42 by Rowlandson (2006: 177) are somewhat smaller, because of choices made as to how to estimate (or not) missing figures. For Karanis, see Rathbone (1990: 132).
80 Bowman (forthcoming).
81 A very crude sighting shot for subsistence may be derived from the statement that five arouras will provide subsistence for a family in the Ptolemaic period (*P. Teb*. I. 5).
82 In particular it should be noted that the fourth-century figures for Theadelphia are calculated from the known figures of taxes collected in AD 312 of *c.*363 artabas (*P. Sakaon* 5), on the basis of a rate of 1.55 artabas/aroura; applying the figure of 451 artabas for AD 336 (Bagnall 1985 = 2003: 295) would increase the results proportionately.
83 Cf. Rathbone (1990: 134–6) (Mendesian Nome); Bagnall (2002a).
84 e.g. Bagnall (1979/82 = 2003); Rathbone (1989).
85 Rathbone (1989).
86 Bowman (2011).
87 In this calculation, 'family' = 'household', including all consumers (e.g. slaves).
88 12 artabas p.a. for a maximum of 4,000 adult males; see *P. Oxy*. XL.
89 *P. Oxy*. VI.908, XII.1454, cf. Sharp (1998: 153, 156). The figure suggests a direct relationship between the artaba, the number of loaves, and the grain dole, in that the individual allowance of one artaba per month is equivalent to one loaf per day. See also Bagnall (2001).
90 This is, of course, an oversimplification, and several of the figures are subject to margins of error. Some may think a twelvefold yield too high (see Appendix), and it is applied across the total of grain land without taking account of crop rotation. This is clearly a crucial element, and the estimate used here is derived from Rowlandson's calculation (1996: 215) of yields derived from rent levels in leases. For the pre-AD 300 average tax rate of 3 artabas/aroura assuming a ratio of 2:1 private to public land, see Appendix, note 6)). The surplus cannot be pure profit, since it does not take account of labour and transaction costs. Nevertheless, it is still substantial, even allowing for rotation and for extra costs, and represents, of course, only a proportion of the agricultural surplus. It hardly needs to be pointed out that, if the population were higher, the 'surplus' would be correspondingly lower.
91 Świderek (1960); Rathbone (1991).
92 See Van Minnen (2000); Winkler (2008), describing the database at http://www.agre.uni-tuebingen.de⟩.