

Productivity in arable farming in the sixteenth century: evidence from the Eastern Mediterranean*

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Abstract

This paper focuses on a perennial subject in agricultural history: land and labour productivity and how they evolve during periods of demographic growth. It provides per capita, per worker, and per hectare output estimates from a region in the pre-industrial Eastern Mediterranean and investigates whether the demographic growth of the sixteenth century brought about a subsistence crisis in Ottoman Anatolia, as many historians have argued. As observed in this study, the evolution of output per worker and per sown area in the Western Anatolian district of Manisa in the early- and late-sixteenth century lends support to the Boserupian view by revealing a negative association between land and labour productivity. Arable acreage remained largely stable in Manisa over the sixteenth century, but agricultural output nevertheless expanded considerably. While labour productivity declined as population grew, land productivity increased, facilitating output levels that could sustain a relatively high population density in the region.

Ample empirical evidence shows us that in many regions of Europe in the pre-industrial period where arable land could not be further expanded, population increases stabilized and then decreased the productivity of agricultural labour, as per the law of diminishing returns. Conversely, labour became more productive in periods of demographic contraction resulting from exogenous shocks, such as epidemics and wars.¹ Scholars have proposed this as the main mechanism behind the periodic fluctuations in agricultural incomes and stagnant, if not declining, levels of agricultural income in the long run.

It was only the agricultural economies of the North Sea area, particularly England and the Netherlands, which succeeded in escaping from this trap. The move towards modern capitalist agriculture in this area was indicated by a rise in labour productivity. In contrast to the general

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¹ E. Thoen and T. Soens, 'Contextualizing 1500 years of agricultural productivity and land use in the North Sea area. Regionally divergent paths towards the world top', in Thoen and Soens (eds), *Struggling with the environment: Land use and productivity* (2015), pp. 455–99.

tendency to increase labour input per unit of land to sustain the rising population, English and Dutch agriculture took a more capital-intensive path and benefited from economies of scale, which enabled higher levels of production of agricultural output while also enhancing labour productivity.²

While there is a wide consensus among economic historians regarding the falling productivity of agricultural labour in the face of demographic expansion prior to the nineteenth century, the question of how the productivity of land evolved in response to the rising demand for food remains a controversial issue. The interpretation of classical economics suggests that population growth should have resulted in the extension of cultivation to marginal lands and soil exhaustion. Thus, in the absence of capital intensification and technological change, output per worker and per surface area should have declined, eventually leading to a subsistence crisis.³ In contrast, the Boserupian view claims that an increase in output per unit area, which became possible through intensification (increased labour input per unit area and land-saving agricultural techniques), partly compensated for the declining output per worker. Thus, the agricultural output levels resulting from a series of 'innovations', could sustain considerable levels of rural and urban population without culminating in a Malthusian crisis. According to this more optimistic line, the opposite movement of land and labour productivity in response to demographic growth – an increase in physical productivity at the expense of declining labour productivity – appears as a typical feature of intensive smallholding economies.⁴

The sixteenth-century Eastern Mediterranean under the Ottoman rule is a fertile ground to test these arguments. According to the traditional historiography, which is largely influenced by neo-Malthusian interpretations, the mid-sixteenth century marks the beginning of a decline in the Ottoman rural economy, following two centuries of expansion.⁵ The introduction of the Ottoman land regime in regions that fell under Ottoman control from the fourteenth century onwards resulted in the replacement of the pre-conquest landlords with a new landlord class, as well as the reorganization of agricultural production within a new institutional environment, although traces of the previous institutional setting were not completely eradicated. As in the Balkans, Syria, and Palestine, peace and better protections for peasants under this new regime in Anatolia fostered substantial increases in cultivated arable land, population, and urban development.⁶ In the mid-sixteenth century, it is argued, the Ottoman rural economy reached its limits. As a result of rapid population growth during that century, peasant landholdings became increasingly fragmented and the number of landless peasants rapidly climbed, while per capita grain production dropped, leading to a 'subsistence crisis' in the Malthusian sense that affected different regions to different extents.⁷

² Ibid. For a critique of this view, see G. Clark, *A farewell to alms: A brief economic history of the world* (2007).

³ B. Chiarini, P. Malanima, and G. Piga, *From Malthus' stagnation to sustained growth: Social, demographic and economic factors* (2012).

⁴ E. Boserup, *The conditions of agricultural growth: The economics of agrarian change under population*

pressure (1965).

⁵ M. Akdağ, *Celâli isyanları [Celali Rebellions] (1550–1603)* (1963).

⁶ H. İnalcık, 'State, land, and peasant', in İnalcık and D. Quataert (eds), *Economic and social history of the Ottoman Empire* (1994), pp. 103–78.

⁷ M. A. Cook, *Population pressure in rural Anatolia, 1450–1600* (1972).

In fact, the argument of a 'subsistence crisis' in the Ottoman countryside in the late sixteenth century largely relies on Ottomanists' interpretation of the era of social unrest that followed, rather than on empirical evidence. Several historians cite a late-sixteenth century economic crisis, which occurred as a result of 'population pressure', as the reason for the early seventeenth century attacks, invasions, and plundering by bandits, mercenaries, and landless peasants that led to large-scale depopulation in Anatolian villages. But there is no direct evidence suggesting that there were chronic food shortages in urban or rural areas in the Ottoman realm in the later part of the sixteenth century.⁸ Moreover, the account of a rural economy in decline throughout the century is quite inconsistent with several other economic indicators: the well-documented spurt in urban growth, the wave of migration to towns, the emergence of an advanced elite culture, commercial expansion, and market development. Although crude estimates of per capita grain production from fiscal surveys suggest a fall, all these developments point to agricultural output levels that were high enough to sustain large non-agricultural populations and considerable volumes of marketed agricultural surplus.

İslamoğlu-İnan was the first to suggest that Ottoman peasants responded to the increased demographic pressure on natural resources with Boserupian innovations, meaning intensification was underway in sixteenth-century Ottoman Anatolia.⁹ She was critical of Cook¹⁰, who claimed, '[Ottoman] peasants were reaching the limits of cultivation as defined by their physical environment', based on his findings suggesting that the expansion of arable acreage trailed population growth from the late fifteenth century onwards.¹¹ Within Ottoman historiography İslamoğlu is perhaps the scholar who defended most explicitly and convincingly the idea that the limits to peasant production in pre-industrial societies were not physical or technological but institutional. Still, the quantitative basis for this line of thought in Ottoman rural historiography remains weak despite the unique opportunity provided by the Ottoman fiscal surveys of the fifteenth and sixteenth centuries. These sources report on both the productive resources – land and labour – and tithes, from which agricultural output levels can be estimated, on a village-by-village basis. As such, they enable us to observe how *both* output per surface area and per worker evolved at a particular location in response to demographic trends.

While quite limited in number, there have been attempts to estimate land and labour productivity and output per capita in the Ottoman countryside based on these sources.¹²

⁸ Ibid.

⁹ H. İslamoğlu-İnan, *State and peasant in the Ottoman Empire, agrarian power relations and regional economic development in Ottoman Anatolia during the sixteenth century* (1994), pp. 149–55.

¹⁰ Cook, *Population*.

¹¹ Ibid., pp. 21–2.

¹² The tedious work such endeavours required, particularly in the absence of contemporary data management tools, is more than impressive. See M. Öz, '16. Yüzyılda Anadolu'da tarımda verimlilik problemi [The problem of productivity in agriculture in sixteenth century Anatolia]', in *XIII. Türk tarih kongresi, Ankara 4–8 Ekim 1999, kongreye sunulan bildiriler II*.

cilt [Thirteenth Turkish history congress, Ankara October 4–8, 1999, proceedings presented at the congress vol. 2] (2002), pp. 1643–51; E. Ş. Batmaz, 'XV–XVI. yüzyıl kanunnamelerine göre Osmanlı Devleti'nde tahıl üretimi [Grain production in the Ottoman State according to the fifteenth and sixteenth century law codes]', *Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Tarih Bölümü Tarih Araştırmaları Dergisi* 23 (2004), pp. 35–41; N. Beldiceanu and I. Beldiceanu-Steinherr, 'Recherches sur la province de Qaraman au XVIe siècle. Étude et actes', *J. Economic and Social Hist. of the Orient* 11 (1968), 1–129; R. Murphey, 'Population movements and labor mobility in Balkan contexts: A glance at post-1600 Ottoman social realities',

However, most of these attempts arrive at somewhat pessimistic conclusions regarding the robustness of the results and the potential for Ottoman fiscal registers to assist quantitative research, mainly because of the unrealistically high figures resulting from their calculations. After pointing out numerous limitations and problems associated with using fiscal surveys to estimate land and labour productivity, Orbay argues in a methodological paper that these sources are insufficient and unreliable and that it is not possible to quantitatively demonstrate the levels and trends in agricultural productivity in the Ottoman realm.¹³

This paper, however, argues that, despite several shortcomings and problems highlighted in the relevant literature, data from fifteenth- and sixteenth-century Ottoman fiscal surveys are no less reliable than most other sources that scholars have used to examine agricultural productivity in Europe. Indeed, it is possible to accurately detect changes in output per unit area and per worker by employing data from fiscal registers if we follow an astute sampling strategy, take into account possible scenarios, and rely on our knowledge of other pre-industrial agrarian settings.

Building upon the methodologies of the existing studies – while making some corrections in the process – this paper looks at how both the output per unit area and output per worker moved in Western Anatolia in the sixteenth century, not only in response to the rapid population growth, but also in relation to each other. In doing so, it aims to address questions that are directly linked to current debates in the field of rural history: How did land and labour productivity respond to the population increase in a pre-industrial rural context in which land reclamations were no longer possible or remunerative? Did Ottoman Anatolia experience a subsistence crisis in the late sixteenth century as a result of Malthusian mechanisms?

This study concentrates on the Ottoman district of Manisa (Magnesia). In the sixteenth century, Manisa was the centre of the Ottoman province of Saruhan in Western Anatolia. The administrative district covered an area of around 250,000 hectares, and comprised around 150 villages. Boasting fertile valleys and rich river basins, Aegean Anatolia has been a prosperous and densely populated region since ancient times. Rich agricultural production, as well as a geographical position that facilitated close trade relations with other parts of the Mediterranean, shaped the region's economy over many centuries. After the Ottoman conquest, the region supplied the imperial capital with grain and other foodstuffs, while also exporting significant quantities of wheat, cotton, raisins, figs, alum, carpets, wool and hides to European markets.

As observed in this study, the evolution of output per worker and per sown area in early and late sixteenth century Ottoman Manisa lends support to the Boserupian view by revealing a negative association between physical yields and labour productivity. Arable acreage remained largely stable in Manisa over the sixteenth century, but agricultural output nevertheless expanded considerably. While labour productivity declined as population grew, land productivity increased, facilitating output levels that could sustain a relatively high population density

Note 12 continued

in *Studies on Ottoman society and culture, 16th–18th Centuries* (2007), pp. 275–98.

¹³ K. Orbay, 'Osmanlı İmparatorluğu'nda tarımsal

üretkenlik üzerine tetkikat ve notlar [Investigation and notes on agricultural productivity]', *Belleken* 81 (2007), pp. 51–120.



MAP 1. The Ottoman Empire in 1580, showing the location of Anatolia

in the region. The findings, thus, do not suggest any Malthusian crisis in Manisa in the late sixteenth century.

The first section explains the methodology adopted in estimating land and labour inputs and agricultural output from Ottoman fiscal surveys. Section II meanwhile, presents and discusses the results. Section III provides a comparative perspective on the level of physical yields and tries to understand where sixteenth-century Manisa fits into the Mediterranean region in terms of output per unit area and how it compared to north-western Europe.

I

Periodic fiscal surveys and registers (*tahrir defters*), through which the Ottoman government obtained information on the empire's sources of revenue, were essential to the functioning of the land regime. These documents included detailed information on taxpaying subjects and taxable resources on a village-by-village basis.¹⁴ The *tahrir defters* were used for a variety of purposes; they served as official registers to establish legal claims to land, assess the empire's expected tax revenues, and to allocate the revenues among military and administrative officials.¹⁵

Employing data from two sets of registers dated 1531 and 1575, this study calculates *gross agricultural output per worker (as male adult equivalent) and per sown hectare and disposable*

¹⁴ M. Coşgel, 'The economics of Ottoman taxation' (University of Connecticut Department of Economics Working Paper Series, 2004).

¹⁵ İnalçık, 'State, land, and peasant'.

agricultural output per capita (net of seed, taxes, and loss in milling) for the early and late sixteenth century.¹⁶ Here, the data available in Ottoman fiscal surveys is deemed largely reliable, since agricultural tax revenue constituted the most essential source of income for the Ottoman state and collecting accurate information was of vital importance for state finances. That said, problems and limitations associated with using Ottoman fiscal surveys to estimate land and labour productivity, which Orbay summarized in an article in which he declared these sources useless for this purpose, should not be dismissed altogether.¹⁷ These include difficulties in converting the *çift*, an Ottoman surface measurement controlled for soil quality, and other local units of volume and weight to standard units; the lack of some information required for estimations, such as tax rates, household size, seed productivity, and amounts lost in milling; the use of official prices in calculations in fiscal surveys, which are different than current market prices and price fluctuations; fluctuations in output; and more. In what follows, I address most of these issues and propose some possible solutions.

First, however, I will underline more general points regarding how data from fiscal surveys can reliably shed light on productivity in arable farming in the Ottoman Empire. Almost all the limitations highlighted by Orbay and others concern difficulties that are associated with estimating absolute levels, rather than trends. Thus, for instance, even in the absence of accurate information concerning household size, rough estimates can help construct output per worker indices to examine change over time at a particular location or differences across regions, so long as no major changes over time or regional differences are expected in household size. Another way to deal with these problems is to make upper and lower estimates that take into account alternative scenarios. Ultimately, closer engagement with these primary sources suggests that sampling is necessary. To my knowledge, no existing research on Ottoman fiscal surveys has employed sampling as a strategy to cope with the problems presented by these sources. Datasets include all the village entries belonging to a district or province. However, some of these village entries are not usable for a number of reasons, and these should be excluded from the sample. For instance, some entries contain obvious miscalculations, others include uninhabited hamlets – whose tax revenues (tithes and land taxes) are given together as lump-sum amounts – and many others report the existence of private holdings, the extent of which are unclear. In some villages, tithes imply the existence of agricultural production, even though the records indicate no inhabitants or land tax. In most of these instances, what is missing in the registers is the information on the extent of the land under cultivation, while relevant output levels are generally reported and thus, included in the calculations. As might be understood from this brief note, if we do not exclude such cases underestimating the extent of the arable land becomes inevitable – something that typically clouds such attempts in the existing literature.

In light of these considerations, the present study constructs a two-period sample (1531 and 1575) that uses the same 67 tax units in both periods, and presents lower and upper estimates

¹⁶ *Mufasssal tahrir defteri* [detailed tax register], TD165, (h. 937/1531), Ottoman Prime Ministry Archives [hereafter OPMA], pp. 1–91; *Evkaf defteri* [waqf register], TD398, (h. 934/1527–8), OPMA, pp. 1–60; *Mufasssal tahrir defteri*, TD115, (h. 983/1575), Land Registry Archives

[hereafter LRA], 3b–81a; *Evkaf ve emlak defteri* [waqf and private property register], TD544, (h. 986/1575–6), OPMA, 2a–29a.

¹⁷ Orbay, ‘Osmanlı İmparatorluğu’nda tarımsal üretkenlik’.

of the output per unit of sown area and per worker. Considering the wide gap between lower and upper estimates for the output per worker, these are not reported as absolute levels, but rather as index numbers. As will be seen below, in terms of index numbers, these two estimates produced almost identical results.

Agricultural output is traced back from output and input taxes reported in the fiscal registers at the village level, following a procedure commonly used by previous studies.¹⁸ To compute the total output for output-taxed products, I multiplied the nominal tithe values¹⁹ given for different agricultural products by the inverse of the relevant taxation rate²⁰ and then added them together to obtain the amount of annual gross agricultural product in nominal terms. Estimating the total output of input-taxed products (grapes, fruit from trees, nuts, olives, animal products, and output from orchards and gardens etc.) posed some difficulty because of the absence of direct information that would enable us to match the tax amounts to the total output of these products.²¹ For output from vineyards, orchards, and gardens, I used Coşgel's estimate of eight (which he arrived at by combining the fiscal data with more recent information about the productivities and production processes of some of the items listed in the registers). I then added the gross nominal total figures for input and output-taxed products and converted this amount to metric units, obtaining *gross agricultural output as wheat equivalent in tons* for 1531 and 1575.²²

To calculate the *disposable agricultural output*, I subtracted the amount of seed (for input taxed products only); agricultural taxes; and loss in milling (for grains) from the total gross output. Agricultural taxes amounted to 12 per cent of the gross agricultural product. Loss in milling

¹⁸ B. W. McGowan, 'Food supply and taxation on the Middle Danube (1568–1579)', *Archivum Ottomanicum* 1 (1969), pp. 139–96; Coşgel, 'Taxes, efficiency, and redistribution: Discriminatory taxation of villages in Ottoman Palestine, Southern Syria, and Transjordan in the Sixteenth Century', *Explorations in Economic Hist.* 43 (2006), pp. 332–56.

¹⁹ Among alternative ways to aggregate output of different crops, this study preferred conversion to wheat equivalent by using historical price weights. An important cause of overestimation of agricultural output in most past studies is the use of the twentieth-century price weight of 0.70 in the conversion of legumes and non-wheat grains to wheat equivalent. Indeed, the aggregate ratio (0.58) based on the prices reported in the registers is considerably lower than this figure. Although tithes were collected in kind, the monetary values were also recorded separately for each crop aside from the quantities. In these calculations, a single average price for each crop was used for all villages in the district, rather than regionally variant market prices. Because these official prices are used here for the purpose of aggregation, what matters is the robustness of relative prices (price of other products relative to wheat) rather than the absolute value. It is assumed

that the relative official prices reflected relative market prices, and there is no reason to believe otherwise. That said, using relative prices to aggregate the output of different crops might distort the results when looking at the trends if relative prices show sharp fluctuations over time. No such change is observed in sixteenth-century Manisa, as the relative prices of crops remained largely constant.

²⁰ While the fiscal survey themselves do not indicate the rates at which agricultural output were taxed, this information is included in the provincial agricultural codes, most of which were compiled in Ö. L. Barkan, *XV ve XVI. asırlarda Osmanlı İmparatorluğu'nda zirai ekonominin hukukî ve malî esasları, I: Kanunlar* [Legal and fiscal foundations of the agricultural economy in the Ottoman Empire in the fifteenth and sixteenth centuries], 1943. The agricultural code of the province of Saruhan is among the few codes missing. Yet, the conventional view – also confirmed by alternative sources such as court registers – is that the tax rates in Saruhan were the same as those indicated in the agricultural codes in practice in the neighbouring province of Aydın.

²¹ Coşgel, 'Taxes, Efficiency, and Redistribution'.

²² 1 kile of Manisa (1 Manisa kilesi = 3 Istanbul kilesi = 76.98 kg).

amounted to 10 per cent for grains, although some historians have deemed this figure too high. A seed to yield ratio of 1:4.5 for wheat and 1:5 for overall grains and legumes is assumed.

The lower estimate of 1:3 raised by some historians might be valid for drier, inner parts of Anatolia in the sixteenth century but does not appear possible for one of the most fertile areas of the Ottoman realm (See Table 1 for alternative seed productivity estimates). Murphey, Öz, Şafakçı, and Pamuk mention higher figures of 1:4, 1:5, and 1:6 for the fifteenth and sixteenth centuries.²³ Given the lack of reliable information for this period, this study adopts data from the early and mid-nineteenth century for Manisa here, recognizing that the introduction of revolutionary agricultural techniques to boost seed productivity is unlikely to have occurred in Ottoman Anatolia before the second half of the nineteenth century. Based on documents dating 1824 and 1856, Nagata mentions a seed productivity of 1:4.5 and 1:4 for wheat and 1:10 for cotton in this region.²⁴ In calculating the net output, I relied on an assumption of productivity of 1:4.5 for wheat, and 1:5 for output taxed products overall, considering that grains other than wheat and cotton had a much higher seed to yield ratio.

The study computed and separately reported animal products net of taxes. I computed the number of sheep (ovine-breeding rather than cattle-breeding was the dominant form of livestock husbandry in Manisa) owned by regular peasants from the relevant tax (1 *akçe* per 2 sheep) and subsequently estimated the amount of meat and milk from the sheep herds in their possession as a wheat equivalent, following McGowan.²⁵

For estimating the *population*, the number of regular peasant and semi-nomadic households in villages are multiplied by a hypothetical household size and then the number of bachelors is added to this figure. The *labour force* is then computed by taking into account differences in effective labour between adult males, females and children, as well as the participation of women, children, semi-nomadic groups and landless peasants to the agricultural workforce. Considering the fragility of the assumptions, upper and lower estimates were provided for the population and agricultural workforce.

Two alternative figures – 5 and 4.17, respectively – proposed by Barkan and Göyünç, are employed as upper and lower estimates for the household size.²⁶ Following Coşgel, an average of one member of the family is assumed to have been ineligible to work because of age or other restrictions, leaving us with a multiplier of 4 and 3.17.²⁷ In estimating the household labour supply as adult male equivalent, for the upper estimate, adult male and female labour supply are considered to be equal, while child labour totalled about half the adult labour. For the lower estimate, both the female and child labour supply were assumed to be around half the adult male labour supply.

²³ Murphey, 'Population movements', pp. 95–6; Öz, '16. Yüzyılda Anadolu'da tarımda verimlilik', p.1644; H. Şafakçı, '16. Yüzyılda Siristad [Siristad in the sixteenth century]', in *Uluslararası sempozyum: Geçmişten günümüze Bozkır [International symposium: Bozkır from past to today]* (Konya, 2016); Ş. Pamuk, *Osmanlı-Türkiye İktisadî Tarihi 1500–1914* (2007), p. 38.

²⁴ Nagata, *Tarihte Âyânlar: Karosmanoğulları Üzerine Bir İnceleme [Notables in history: an inquiry*

into Karosmanoğlu family] (1997), p. 123.

²⁵ McGowan, 'Food supply and taxation'.

²⁶ Ö. L. Barkan, 'Tarihi demografi araştırmaları ve Osmanlı tarihi [Studies on historical demography and Ottoman history]', *Türkiyat mecmuası* 10 (1953), pp. 1–26; N. Göyünç, '"Hane" deyimi hakkında [On the concept of household]', *Tarih dergisi* 32 (1979), pp. 331–48.

²⁷ Coşgel, 'Taxes, Efficiency, and Redistribution'.

TABLE 1. Seed productivity, sowing seed and output per sown hectare (gross of seed) estimates

Region	Date	Sowing seed kg/ha	Seed-to-yields ratio	Output per sown hectare (gross) kg/ha	Source
Anatolia	Before 1800	75–115	1:3 (grain)	350	a
Anatolia	Before 1800	95–115			b
Karaman (Central Anatolia)	Mid-sixteenth century			420	c
Anatolia	Fifteenth– sixteenth century		1:3 (grain)		d
Anatolia	Before 1800	110–160	1:2 on poor-quality soil; 1:3; 1:4 on medium-quality soil; 1:6 or 1:7 on high-quality soil (grains)		e
Anatolia	Before 1800		1:5 or 1:6	800	f
Anatolia	Before 1800	140–175	1:4	630	g
Anatolia			1:3		h
Siristad (South-West Anatolia)	Sixteenth century	175	1:5	870	i
South Morea	1715		1:5 (wheat); 1:6 (barley); 1:6.25 (oat); 1:11 (maize)		j
Anavarin (South-West Morea)	1716	60–160	1:4 to 1:7 (wheat); 1:10, 1:15 (maize)		k

Sources:

- a. E. Ş. Batmaz, 'XV–XVI. yüzyıl kanunnamelerine göre Osmanlı Devleti'nde tahıl üretimi [Grain production in the Ottoman State according to the fifteenth and sixteenth century law codes], *Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Tarih Bölümü Tarih Araştırmaları Dergisi* 23 (2004), pp. 35–41, at p. 41.
- b. Y. Koç, 'Zirai tarih araştırmalarında ölçü-tartı birimleri sorunu: Bursa Müdü örneği [The problem of measurement units in historical agrarian research: the example of Müdü of Bursa]' in *Uluslararası Kuruluşunun 700. Yıldönümünde Bütün Yönleriyle Osmanlı Devleti Kongresi [International congress on Ottoman Empire with all aspects on 700th anniversary of its establishment]* (2000), pp. 541–47, at p. 544.
- c. N. Beldiceanu and I. Beldiceanu-Steinherr, 'Recherches sur la province de Qaraman au XVIe siècle. Étude et actes [Research on the province of Qaraman in the sixteenth century]', *J. Economic and Social Hist. of the Orient* 11 (1968), pp. 1–129, at p. 22.
- d. M. A. Cook, *Population pressure in rural Anatolia, 1450–1600* (1972), p. 15.
- e. M. Öz, '16. Yüzyılda Anadolu'da tarımda verimlilik problemi [The problem of productivity in agriculture in sixteenth century Anatolia]', in *XIII. Türk tarih kongresi, Ankara 4–8 Ekim 1999, kongreye sunulan bildiriler II. cilt* [Thirteenth Turkish history congress, Ankara October 4–8, 1999, proceedings presented at the congress vol. 2] (2002), pp. 1643–51, at p. 1644.
- f. Ş. Pamuk, *Osmanlı-Türkiye İktisadî Tarihi 1500–1914* (2007), p. 38.
- g. R. Murphy, 'Population movements and labor mobility in Balkan contexts: A glance at post-1600 Ottoman social realities', in *Studies on Ottoman society and culture, 16th–18th Centuries* (2007), pp. 95–6.
- h. H. İslamoğlu-İnan, *State and peasant in the Ottoman Empire, agrarian power relations and regional economic development in Ottoman Anatolia during the Sixteenth Century* (1994), p. 40.
- i. H. Şafakçı, '16. Yüzyılda Siristad [Siristad in the sixteenth century]', in *Uluslararası sempozyum: Geçmişten günümüze Bozkır [International symposium: Bozkır from past to today]* (Konya, 2016), at p. 249.
- j. S. Parveva, 'Agrarian Land and Harvest in South-West Peloponnese in the Early 18th Century', in *Village, Town and People in the Ottoman Balkans 16th–mid-19th Century* (2009), pp. 61–110, at p. 88.
- k. F. Zarinebaf, J. Bennet, and J. L. Davis, *A historical and economic geography of Ottoman Greece: The Southwestern Morea in the eighteenth Century* (2005), p. 195.

Landed regular peasants were not the only rural producers, and in the context of Manisa, semi-nomadic or settled groups with clan status, as well as landless peasants, comprised an important part of the agricultural workforce. There is no direct evidence of how these landless peasants and their families lived. It is generally assumed that at least most landless peasants and semi-nomadic or settled populations with clan status made a living by cultivating the land in neighbouring uninhabited villages (which were numerous in Manisa both in the early and late sixteenth centuries) under the status of outsider peasant.²⁸ It is possible to assess the considerable share of the land cultivated by these groups in Manisa through the huge amounts of land taxes levied on such land. It is also highly likely that these groups engaged in labour-intensive agricultural production activities – such as cotton cultivation or viniculture – as wage-labourers and sharecroppers. The lower estimate assumes a participation in the agricultural workforce by one-third of these groups; the upper estimate assumes a participation of three-quarters.²⁹

The land was cultivated under a number of different landholding contracts, the most important being the *tapu*, which granted peasants hereditary usufruct rights over a plot. The land under each legal category is computed in a different way, using a variety of information from the registers and then summed up.³⁰

After calculating the total *arable area* in metric units, we need to estimate the share of fallow within arable land to compute the *sown area*. This, however, is a challenging task due to the lack of evidence. Some studies assume a share as high as 1:2 for fallow land. However, this does not seem to be a reasonable figure, at least for sixteenth-century Manisa, given that the share of fallow land in medieval Europe was around one-third and declined considerably during the early modern era thanks to innovations in agricultural techniques. In fact, a fallow-to-sown land ratio of 1:2 would not enable the agricultural output levels achieved in the sixteenth-century Ottoman realm given the limited output per unit of sown area in pre-industrial societies. Alternatively, Öz's estimates of land productivity relies on the assumption that at any one time, five-eighths of the regular peasant holdings were allocated for staple food production, while the remainder was allocated as fallow land and garden, orchard, and vineyards (which corresponds to a ratio of approximately one-third for fallow land).³¹ This study retains Öz's assumption that one-third of the arable land was fallow.

In a further step, this study calculated *wheat crop area* as a percentage of the *sown area*. Wheat comprised around half of the total agricultural output in value. Ottoman agricultural surveys from the early twentieth century suggest that the share of the area allocated to wheat production equalled, or slightly surpassed, its relative importance within agricultural production. Based on this fact, this study made lower and upper estimations based on assumptions that 50 per cent and 60 per cent of sown area was allocated to wheat production, respectively.

When measuring land productivity, there are different ways of relating agricultural output to land input, depending on the alternative forms of variables used.³² For the purpose

²⁸ O. Özel, *The collapse of rural order in Ottoman Anatolia: Amasya 1576–1643* (2016), p. 16.

²⁹ Ibid.

³⁰ The appendix explains in detail the procedures followed in the estimation of these figures.

³¹ Öz, '16. yüzyılda Anadolu'da tarımda verimlilik'.

³² For a formulation, see M. Overton, *Agricultural revolution in England: The transformation of the agrarian economy 1500–1850* (1996), pp. 70–4.

of comparison with other pre-industrial settings, this study adopts the most commonly used measure of *gross output per unit of sown area* and provides estimations of both total agricultural output and wheat output per sown hectare. For this, I divided output – the gross of seed and expressed as wheat equivalent – by the total area sown (which is obtained by subtracting fallow from the total arable area). As stressed by Overton and others, comparisons merely based on this indicator suffer from significant shortcomings and risk hiding the real across-space differences in the productivity of arable land if differences in field systems and in the share of fallow are ignored. First, ‘a farm with a relatively large fallow area might have higher yields per sown cereal acre but much lower yields per unit of arable [land] than a comparable farm with a lower fallow proportion’.³³ Second, this approach ignores the differences in seed yields, which exhibited a high geographical variability and represented a significant source of differences in returns to land. Furthermore, areas of high seed yields were also areas of limited use of fallow, thus, these two biases are highly likely to act in the same direction, widening the impact of a possible distortion.

Similarly, the indicator used here for labour productivity, i.e., output per worker as adult male equivalent, has its own limitations. Estimating the agricultural labour input is much more complicated than estimating total output and the extent of arable land. It requires a number of assumptions concerning household size; agricultural labour input by households (including the participation of women and children in the workforce and the number of days and hours that workers laboured); and participation in the agricultural workforce by groups with clan status, as well as landless peasants. For the sixteenth-century Ottoman Empire, there is no empirical data available on these variables other than some estimations of household size.

Because of the dearth of information about the annual number of hours and days that workers laboured in the agricultural sector, this study examines *gross output per worker* (gross total agricultural output expressed as wheat equivalent divided by the number of workers as adult male equivalent), like many other studies on the subject. One significant problem is that this variable is only a rough proxy for the productivity of agricultural labour, and, as Thoen and Soens state, reveals nothing more than a relationship between population level and output.³⁴ One of the arguments I would like to test is whether, during periods of demographic expansion, peasant households increased labour input per unit area by adopting more labour-intensive agricultural practices in order to increase agricultural output in the face of land shortages and rising demand for food. However, the absence of data regarding effective labour input by peasant households and, in particular, how labour input in agricultural activities at the household level was accommodated over time to respond to changing relative scarcities, hides exactly what we are interested in when studying productivity: the decline in the productivity of labour due to the shift towards more labour-intensive cultivation. Still, this seems to be the best indicator that we can construct based on the available data.

Finally, I look at *disposable agricultural output per capita*; that is, total agricultural output, net of seed, taxes, and loss in mill, divided by the producer population in the villages under

³³ Ibid., p. 73.

³⁴ Thoen and Soens, ‘Contextualizing’.

study. My main motivation here is to assess the changes in the living standards of the rural producer class throughout the sixteenth century, and whether the latter faced a subsistence crisis as a result of population growth.

II

An exceptionally fertile region throughout its history, Manisa is located in the area known as the 'Lower Gediz Basin' and its topography comprises lowlands along the Gediz river and its tributaries (Kumçayı and Nif); and mountainous areas with hills of 1000–1500m altitude: Spil in the south west, Yundağı in the north west, and Çaldağı in the east³⁵. Manisa is endowed with fertile soil (alluvial deposits in the river basins carried by streams and floods; calcareous brown soil; and non-calcareous brown forest soil), and ample assets of water with the main river Gediz, its tributaries, and several streams feeding these. A distinctive hydrogeological feature, the shallow aquifer system accessible by water wells only a few meters deep, that Kuru draws attention to, should also be mentioned.³⁶ The area is in general under the influence of the Mediterranean climate, with hot and dry summers, and mild and wet winters and a highly fluctuating precipitation regime. The higher altitudes exhibited features of the drier continental climate.

With 12.1 inhabitants per square kilometre in 1531 and 16.8 in 1575, sixteenth-century Manisa had a population density that was considerable by pre-industrial standards.³⁷ And, like other regions in Anatolia and the Balkans, the district witnessed a rapid population growth throughout the sixteenth century. The rural population (regular peasants, semi-nomadic groups with clan status, and landlords living in villages) in the 67 tax units in the sample increased by about one-third from around 10,500–12,500 in 1531 to 14,000–16,000 in 1575, with an annual growth rate of 0.55 per cent. Table 2 presents the estimates of arable land, population, and agricultural output in Manisa.

Despite the considerable demographic expansion, the extent of arable land remained almost constant (15,700 hectares in 1531 and 16,100 hectares in 1575), with only a marginal (3 per cent) increase. When compared with Cook's results regarding the provinces of Aydın and Hamid, located in Western and South-Western Anatolia, for about the same time period, this is rather a striking finding.³⁸ For these provinces, Cook suggests an increase in the extent of arable land of one-third and one-quarter, respectively. The most reasonable explanation seems to reside in the intensity of land use in Manisa. In the sixteenth century,

³⁵ Aşiloğlu and Çay's study on the central district of Manisa today, suggests that about eight tenths of the area covered by fields had an altitude of 18–500 m, one tenth, 500–750 m, and the rest was above 750 m. See F. Aşiloğlu and R. D. Çay, 'Reclaiming idle agricultural areas on periphery of cities: Case study of Manisa', in *IV International Conference 'Ecology of Urban Areas' Proceedings* (Zrenjanin, 2014), pp. 401–14.

³⁶ M. Kuru, 'A magnificent climate: Demography, land and labour in sixteenth century Anatolia', in

O. İnal and Y. Köse (eds), *Seeds of power: Explorations in Ottoman environmental history* (2019), pp. 35–57.

³⁷ These figures are slightly below the European average, which was 13.6 inhabitants per square kilometre in 1500 and 18.3 inhabitants per square kilometre in 1600, and higher than Spain, Portugal, Poland, and the Balkans. See S. Capasso and P. Malanima, 'Economy and Population in Italy (1300–1913)', *Popolazione e Storia* 8 (2012), pp. 15–40.

³⁸ Cook, *Population*, p. 86.

TABLE 2. Land, labour and output estimates from 1531 and 1575 fiscal surveys

	Tax units	Total agricultural output as wheat equivalent	Wheat output	Arable land	Population of producers		Workforce (Adult male equivalent)	
		(Tons)	(Tons)	(ha)	(Lower)	(Upper)	(Lower)	(Upper)
1531	67	11,499	5,045	15,676	10,250	12,164	3,852	6,816
1575	67	12,844	5,908	16,082	13,525	15,805	5,039	9,086

Source: Manisa fiscal registers. Number semi-nomadic households and bachelors in villages is taken from F. M. Emecen, *XVI. asırda Manisa kazası* [Administrative district of Manisa in the sixteenth century] (1989), pp. 158–221.

arable acreage accounted for slightly less than one-tenth of the total surface area. Given that as late as the first decade of the twentieth century, arable land made up around 11 per cent of the surface area in the Western Anatolian provinces,³⁹ and that most of the mountainous areas in the north of the district were completely unsuitable for arable farming, Manisa's agricultural economy in the sixteenth century seems to have been characterized by a significantly intense land-use pattern, particularly on the plains in river basins. Thus, the most likely explanation for the lack of expansion in arable acreage during a period of rapid population growth is that the agricultural economy in this region, which has been densely settled since ancient times, had reached its limits imposed by the physical environment and pre-industrial technology by the early sixteenth century and that reclamations were no longer possible or remunerative.

Evidence from surveys also points to efforts throughout the sixteenth century to limit grazing in favour of arable land, such as the spread of barley, maize, and legumes, all of which were sometimes used as fodder crops to reduce the need for pastureland.⁴⁰ Furthermore, the decrease in the number of sheep per capita indicates an overall decline in husbandry amid the population increase. Such findings support Huang, who argues that 'high population density on a given amount of land will eventually drive out animal husbandry in favour of a crops-only economy' because, 'at a given level of technology, a unit of land under crops can support more people than one under livestock (to support people through meat, milk, cheese)'.⁴¹ Still, the impact of such efforts seems to have been very limited and might have only ensured a marginal increase in arable acreage.

Rice cultivation in riverbeds is another indicator of high intensity in land use in sixteenth-century Manisa. Alfani suggests that in the context of early modern Italy, 'the importance of rice does not lie mainly in its yield per hectare, but in the fact that it contributed to the elimination of fallow and limited the excess of irrigated meadows that had developed during

³⁹ T. Güran, 'Osmanlı tarım ekonomisi, 1840–1910 [Ottoman agricultural economy, 1840–1910]', in *19. yüzyılda Osmanlı ekonomisi üzerine araştırmalar* [Studies on Ottoman economy in the nineteenth century] (1989), pp. 63–131.

⁴⁰ İslamoğlu-İnan, *State and peasant*.

⁴¹ P. C. C. Huang, 'Development or involution in eighteenth-century Britain and China? A review of Kenneth Pomeranz's "The greater divergence: China, Europe, and the making of the modern world economy"', *J. Asian Studies* 61 (2002), p. 506.

TABLE 3. Index of agricultural output based on figures reported by Emecen

	1531	1575
Grains and legumes	1.00	1.28
Cash crops	1.00	1.03
Output from vineyards, orchards, gardens	1.00	0.72
TOTAL	1.00	1.20

Source: as for Table 2, pp. 239–65.

the fifteenth and sixteenth centuries'.⁴² In sixteenth-century Manisa as well, rice cultivation was widespread – in 70 of around 150 villages – and occurred largely in riverbeds unsuitable for other arable farming. Thus, rice cultivation helped put land that would have otherwise remained unproductive under cultivation.

Since we know that the extent of land under cultivation remained largely constant while the population grew, we can now ask how agricultural output evolved. Estimates based on the sample suggest an increase of 12 per cent in total output as wheat equivalent, whereas for the whole district involving around 120 tax units, the figure is somewhat higher (20 per cent). The breakdown of the total agricultural output into categories presented in Table 3 reveals a visible expansion in staple food production (25 per cent in wheat, 30 per cent in barley, and 28 per cent in grains and legumes overall), as well as a stagnation in cash crops. The output of cotton, the most important cash crop in the district, decreased by 8 per cent in volume, but, in terms of its nominal value as wheat equivalent, an increase in the relative price compensated for this decline. However, viniculture and fruit and vegetable cultivation, which featured prominently in overall output early in the century, particularly in areas around the urban centre of Manisa, experienced a considerable drop (28 per cent) (mainly due to the transformation of vineyards and orchards into grain-producing land in parallel to rising food demand).

Table 5 presents indices of output per hectare and output per worker. Overall, sixteenth-century Ottoman Manisa seems to have shared the destiny of many pre-industrial European areas in which it was not possible to expand arable land further, by first stabilizing and then decreasing agricultural labour productivity. In both datasets, output per worker declined by about 15 per cent. That notwithstanding, as discussed above, increased labour input by households (in the form of increased participation of children and women in the agricultural workforce and increased hours of agricultural work per worker) would imply that output per worker figures presented here underestimate the real extent of the decline in the productivity of labour (measured in terms of an hour of adult work).

With regards to physical yields, the findings lend support to the Boserupian view by revealing the increase in land productivity and the negative association between output per hectare and output per worker. The expansion of the agricultural output against stagnant

⁴² G. Alfani, 'Population dynamics, Malthusian crises and Boserupian innovation in pre-industrial societies: The case study of Northern Italy (ca. 1450–1800) in the

light of Lee's "dynamic synthesis", in Chiarini and Malanima (eds), *From Malthus' stagnation to sustained growth* (2012), p. 42.

arable acreage implies that the increase in agricultural production was achieved through an increase in land productivity thanks to intensification. The aggregated agricultural output per hectare increased by about one-tenth from 1531 to 1575, partly compensating for the decline in the output per worker.

At this juncture, I must address a puzzle pointed out by Kuru: the relatively slower increase in agricultural output in coastal regions, which have been the most productive parts of Anatolia throughout history, in contrast to the spectacular growth rates in semi-arid inner Anatolia.⁴³ With an increase of one-fifth in total output and a rise of one-third in grain and legume output over half a century, Manisa – which is located not far from the Aegean coast – seems to confirm this pattern given that in almost all the districts studied by İslamoğlu-İnan in North-Central Anatolia, the output growth was much greater than in Manisa, reaching rates of 200 per cent over the same period.⁴⁴

According to Kuru, the extraordinary climatic conditions of the sixteenth century – namely, very high precipitation that turned semi-arid inner Anatolia into a well-watered area and Mediterranean coasts into almost a sub-tropical zone – accounts for this pattern. While climatic conditions should have contributed to slower growth rates in the coastal areas, as Kuru proposes, it seems more likely that regional differences in growth rates reflected to a greater extent, differing levels of population density and intensity of land use in the initial period. Here, it is suggested that the coastal regions had already reached the limits of their physical environment at the turn of the sixteenth century due to their historically high population density. Therefore, the output growth rates observed in coastal areas during this period mostly resulted from increased land productivity, rather than from the expansion of arable land. In inner parts of Anatolia, by contrast, there was still space to expand arable acreage in the early sixteenth century, and a considerable amount of land was duly brought under cultivation throughout this period. Thus, the high increases in agricultural output in such areas mainly reflected the extensification process, although intensified cultivation was not completely absent in inland regions as well. A comparison of sixteenth-century figures with statistics from the early twentieth century provides us a picture of regional differences in the intensity of land use between coastal and inland Anatolia. Among others, İnalçık states that Anatolia witnessed a general expansion of arable land and settlement in the marginal lands of the highlands and lowlands in the period 1470–1570. Still, evidence from fiscal surveys suggests that this view requires nuance.⁴⁵

Fiscal surveys do not allow us to directly observe the changing agricultural practices – that is, the practices of intensification through added labour input or land-saving techniques – which enabled this increase in output per hectare. Unfortunately, no data is available on most crop management practices (seeding rate, crop rotation and fallowing practices, alteration of soil conditions through manuring, irrigation, drainage, and the like). Yet, some information from the surveys – such as data on crop composition or notes about floods making arable land along the rivers uncultivable – give us important clues as to how the agricultural economy sustained a high population and how it responded to further demographic growth throughout the sixteenth century.

⁴³ Kuru, 'A magnificent climate'.

⁴⁴ İslamoğlu-İnan, *State and peasant*, p. 180.

⁴⁵ İnalçık, 'State, land, and peasant', p. 159.

It is clear that the physical environment in this part of Western Anatolia required a large labour input to ensure the continuity of arable farming. The region's rivers and rivulets, especially the Gediz, tended to overflow their banks every year, particularly in autumn and spring when precipitation was at its highest, flooding nearby agricultural lands. Sixteenth-century tax surveys recorded several instances in which peasants could no longer cultivate the land because of floods, meaning they had to abandon their settlements and could not pay their taxes. As a result, only a portion of the large fertile lands along the riverbanks in this area was available for cultivation at a particular moment. In such areas, the availability of agricultural lands depended on the constant efforts of peasants to reclaim flooded lands. Furthermore, although there is no reference in the fiscal surveys to irrigation facilities and techniques, the considerable importance in the agricultural economy of the region, of truck gardening,⁴⁶ viniculture, fruit growing, and cotton production – all of which require irrigation – suggests the existence of improved irrigation facilities, as in the case of North-Central Anatolia.⁴⁷ Thus, large amounts of capital, as well as human and perhaps animal labour, should have been used to construct canals, dams, ditches, etc.

Moreover, the crop composition in the region, particularly in the densely populated south, reveals a choice in favour of labour-intensive crops such as grapes, rice, and, especially, cotton. Manisa was one of the most important cotton-producing regions in Ottoman Anatolia,⁴⁸ and cotton was very prominent in the agricultural output of the district. Cotton cultivation necessitated female and child labour, particularly during harvest time, as skills were required to pick the bolls from cotton plants. Apart from the work of the women and children in picking, cotton required about twice, and rice about one-and-a-half times the number of labour-days per hectare as wheat.⁴⁹ Owen's estimates of the cost of production, value and the profit of various Egyptian crops per unit area c.1800, show that although production costs were much higher than for wheat and barley, cotton and rice cultivation was more productive and, accordingly, profitable per unit area compared to staple food.⁵⁰ Although I cannot estimate output per unit area for rice and cotton due to the lack of data on how much arable land was allocated for the cultivation of these crops, the same was likely true for sixteenth-century Manisa, and the net agricultural value created per unit area was greater than for grains.

Not much is known regarding fallowing practices and crop rotation systems and possible attempts to intensify land use in Western Anatolia. The conventional view is that prior to

⁴⁶ Fruit and vegetable production for urban markets, often in gardens and orchards in proximity of the towns, was a common agriculture activity in the Ottoman Anatolia. Unlike arable land allocated for grain production, these gardens and orchards were subject to private property. Registers suggest that in the sixteenth century the area around the town centre of Manisa was intensively engaged in truck gardening and fruit growing.

⁴⁷ İslamoglu-İnan, *State and peasant*, p. 154.

⁴⁸ Some 68 per cent of cotton production in Manisa occurred on imperial domains and relied on sharecropper labour, meaning it was generally associated with

higher levels of exploitation (Y. Nagata, '16. Yüzyılda Manisa köyleri. 1531 tarihli Saruhan sancağına ait bir tahrir defterini inceleme denemesi [Villages of Manisa in the sixteenth century. An attempt to examine a tax survey of the province of Saruhan dating 1531]', *Tarih Dergisi*, 32 (1979), p. 753). Unlike sharecropping practices elsewhere in Anatolia, the landlord did not provide the seeds, so he only received one-third of the output. Nagata argues that state policies encouraged nomads to settle on these lands and produce for the market.

⁴⁹ Huang, 'Development or involution'.

⁵⁰ R. Owen, *The Middle East in the world economy 1800–1914* (2009), p. 31.

the nineteenth century, fertilizers were rarely used in Anatolia because animal manure was especially needed for fuel in areas that lack forests, such as interior regions. This made it necessary to maintain the fertility of the soil by leaving fields fallow for two years out of three or through a two-field system, with only one half of the land under cultivation in any one year. Whereas substantially higher ratios of fallow-to-sown-land were a general pattern in large parts of semi-arid inland Anatolia, farm workers in the coastal Mediterranean region and other areas, which enjoyed favourable hydrogeological features or high-quality soil, could well have implemented shorter fallow periods or a three-part rotation system. For instance, a report submitted by Domenico Gritti provides evidence for the existence of a three-part rotation system in late seventeenth-century Morea, with chief grains (wheat, barley, oats, rye, and flax), lesser grains (millet, maize, and cotton), and fallow land.⁵¹

The Gediz Valley, and especially Manisa, which is endowed with many rivers and rivulets, alluvial soil in its river basins, and groundwater close to the surface, was probably one of the regions where shorter fallow periods or a three-crop rotation system occurred. In the Middle Eastern pattern, grains were generally planted in late autumn and harvested in spring or early summer; in contrast, cotton was a summer crop that was planted in spring and picked in autumn. Thus, a three-crop system of wheat-cotton-fallow as described by Gritti is possible. Considering the importance of husbandry in the region, it is also likely that manure was used as fertilizer and became more widespread throughout the sixteenth century. Similarly, in response to population growth in the sixteenth century, the favourable features of the physical environment could have enabled intensified land use through a decrease in the share of the land left fallow.

The only evidence in the surveys in this regard is the substantial increase of 62 per cent in the production of legumes (chickpeas, lentils, broad beans, and dolichos) and the tripling of maize during this period. As Boserup indicates, peasants cultivated legumes as a method of soil fertilization.⁵² By binding nitrogen from the atmosphere, legumes in a crop rotation system improved the grain yields per unit area. On the other hand, the production of maize, a crop known for its high yields that was introduced to the Anatolian agricultural economy in the early sixteenth century, tripled from 1531 to 1575 in Manisa. Malanima suggests that maize was the most important innovation in early modern Italy regarding calories, since its productivity was double that of other grains. Moreover, maize was associated with new forms of crop rotation that eliminated the need for fallow land in seventeenth-century northern Italy.⁵³

A further point is the change in crop composition in favour of staple food, whose share in the total agricultural production of the district rose from 75 per cent to 81 per cent. Kuru explains the decline in viniculture and fruit growing and stagnation in cotton production in Western Anatolia during this period as a consequence of exceptionally high precipitation – citing, in particular, the harmful effects of wet summers on cotton production and viniculture – without mentioning whether this resulted from a drop in yields or the abandonment of agricultural

⁵¹ F. Zarinebaf, J. Bennet, and J. L. Davis, *A historical and economic geography of Ottoman Greece: The Southwestern Morea in the eighteenth Century* (2005), p. 193.

⁵² Boserup, *The conditions*, pp. 37–9.

⁵³ G. Federico and P. Malanima, 'Progress, decline, growth: Product and productivity in Italian agriculture, 1000–2000', *ECHR* 57 (2004), pp. 437–64.

activities in favour of grains.⁵⁴ While this is not beyond the realm of possibility, a more likely and direct explanation is that cultivators replaced vineyards, orchards, and gardens with grain-growing fields in response to the rising commercial demand for staple food. While the rising prices of grains relative to non-staple goods should have provided an important motivation for this shift, it is also very likely that in a period of rising food demand, the central government directly intervened to boost grain production in Western Anatolia, a major supplier to the giant imperial capital.

We have seen that during this period, the expansion of output fell visibly behind demographic growth, which implies a decline in agricultural output per capita. Nevertheless, the estimations reveal no sign of a subsistence crisis, which according to many historians, occurred in late sixteenth-century Anatolia. For producers, the total agricultural production per capita net of seed, taxes and mill loss (for grains) equalled around 530 kg of wheat in the early sixteenth century, and regressed to 450 kg in the later part of the century, representing a decline of 15–16 per cent. Grain production per capita, meanwhile, decreased only by 7–9 per cent, falling from 335 kg to 310 kg. Alongside agricultural production, animal products (meat and milk) from sheep-breeding equalled about 30 kg and 20 kg of wheat per person, respectively, in the early and late sixteenth century. Considering that the annual minimum requirement of wheat consumption per person was 250 kg, it would not be wrong to argue that Manisa's agricultural economy provided direct producers with an average living standard that was well above the subsistence level even in the late sixteenth century. This also suggests that peasants themselves were left with a considerable agricultural surplus to exchange on the markets after taxation and consumption. Thus, in the last quarter of the century, per capita net agricultural output was still high enough to not only sustain the region's rural and urban population but also to supply Istanbul with grain, cotton, and other agricultural goods. Still, these findings also highlight the limits of pre-industrial agricultural economies. Although the estimations lead us to reject the arguments of a Malthusian crisis, it is clear that the rather moderate gains in land productivity achieved during this period far from completely compensated for the losses in labour productivity. Thus, it seems highly likely that there was a decline in the producer classes' living standards during periods of population growth in pre-industrial contexts in which the extension of arable acreage was not remunerative or possible.

III

Recently, an increasing number of studies have measured and compared labour productivity across pre-industrial Europe within the context of the Great and Little Divergence debates. The most important stylized fact from these studies was that apart from the Low Countries, there were no significant differences across Europe in terms of labour productivity in 1500. By 1800, however, there was a sharp regional differentiation, as north-western Europe displayed a clear superiority over the southern part of the continent. This implied that regional differences in the productivity of agricultural labour and thus, in incomes across Europe, largely stemmed from the agricultural revolution that occurred in England and the Netherlands somewhere

⁵⁴ Kuru, 'A magnificent climate'.

TABLE 4. Land, output, labour population indices (1531 = 1.00)

	<i>Arable land</i>	<i>Output</i>	<i>Population of producers</i>	
			<i>(Lower)</i>	<i>(Upper)</i>
1531	1	1	1	1
1575	1.03	1.12	1.32	1.3

Source: Table 2.

TABLE 5. Land, labour population indices (1531 = 1.00)

	<i>Output per unit of sown land</i>	<i>Output per worker (Lower)</i>	<i>Output per worker (Upper)</i>	<i>Output per capita (Lower)</i>	<i>Output per capita (Upper)</i>
1531	1	1	1	1	1
1575	1.09	0.84	0.85	0.86	0.85

Source: Table 2.

between the mid-seventeenth century and the mid-eighteenth century. Empirical evidence on physical productivity is much more limited, consisting mostly of rough estimations of national averages.

Allen suggests that the pre-industrial rural world was, in general, characterized by low physical yields (around 700 kg/ha, but often much lower).⁵⁵ The most important exception to this pattern was the North Sea area, with physical yields above 1000 kg/ha for wheat and rye. In many areas in the Low Countries, such as Friesland, Groningen, and Zeeland, output per hectare rose as high as 1200 to 1750 kg even in the late Middle Ages.⁵⁶ In terms of seed productivity as well, the region stood out. Seed-to-yields ratios were generally above 1:10, and even ratios close to 1:20 were not unusual.⁵⁷

In contrast, low yields-to-seed ratio and grain output per unit area characterized the agricultural economy of southern Europe (especially the Mediterranean) prior to the nineteenth century. Empirical evidence for this area is scarce, but not completely absent: In Iberia, the yield rate was roughly 5 to 1 (4.5–6 to 1 or more in Andalusia); and 3–4 to 1 in Provence.⁵⁸ In Italy, from the late medieval period until the second half of the nineteenth century, average yields for wheat revealed long-term stability at around 500 kg per hectare.⁵⁹ Spain's average in wheat yields in the eighteenth century is estimated at 470–480 kg/ha.⁶⁰ Similarly, in Southern

⁵⁵ R. C. Allen, *Enclosure and the yeoman: The agricultural development of the South Midlands 1450–1850* (1992).

⁵⁶ The figures of output per hectare given in this section are gross of seed, unless otherwise stated.

⁵⁷ Thoen and Soens, 'Contextualizing'.

⁵⁸ F. Tabak, *The waning of the Mediterranean, 1550–1870: A geohistorical approach* (2008), p. 119.

⁵⁹ Capasso and Malanima, 'Economy and population'.

⁶⁰ M. Á. B. Gutiérrez, *La productividad de los factores en la agricultura Española (1752–1935) [Factor productivity in Spanish agriculture]* (2000); C. Santiago-Caballero, 'Trapped by nature: Provincial grain yields in Spain in the mid-18th century', *Revista de Hist. Económica* 31 (2013), pp. 359–86.

TABLE 6. Wheat output per arable and sown hectare (kg/ha) from 1531 and 1575 fiscal surveys

a. Wheat output per *arable* hectare

	<i>Gross of seed</i>		<i>Net of seed</i>	
	<i>Lower</i>	<i>Upper</i>	<i>Lower</i>	<i>Upper</i>
1531	540	640	420	500
1575	610	730	470	570

b. Wheat output per *cropped* hectare

	<i>Gross of seed</i>		<i>Net of seed</i>		<i>Seed per hectare</i>	
	<i>Lower</i>	<i>Upper</i>	<i>Lower</i>	<i>Upper</i>	<i>Lower</i>	<i>Upper</i>
1531	800	970	620	750	180	220
1575	920	1100	720	860	200	240

Source: Table 2.

France, yields below 750 kg/ha were almost the norm even in 1830, and levels as low as 520 kg/ha⁶¹ were also observed.⁶²

Whereas a significant gap in physical productivity (for grains) between north-western and southern Europe in the pre-industrial period seems to be a well-established fact, this should not hide the substantial regional differences within each area. Thoen and Soens suggest that within the North Sea area, there were 'high-productivity' and 'low-productivity' regions with levels of gross output per sown hectare ranging between 950–1600 kg for the first and 640–800 kg for the latter (for wheat), such as England (a latecomer to the 'high-productivity' club) before the seventeenth century.⁶³ A similar categorization can also be made for southern Europe. Santiago-Caballero's study of mid-eighteenth-century Spain reveals a high regional variability (from 230 kg/ha to 940 kg/ha) in yields – provinces to the north of Castille reached the maximum values (840 kg/ha on average, with 940 kg/ha in Pontevedra) and the south-east posted the lowest production per cultivated unit of land (below 500 kg/ha).⁶⁴ In a similar fashion, physical yields in Southern France on the coastal arc extending from

⁶¹ H. Clout, *Agriculture in France on the eve of the railway age* (1980).

⁶² In between these two ends of the yields spectrum were India, Latin America, Canada, Australia, and the United States, with average grain yields of around 700 kg/ha (Allen, *Enclosure and the yeoman*, p. 131), and Germany, Ireland, the Yangtzi Delta, and the Nile Basin, with yields close to 1,000 kg/ha (R. C. Allen and C. Ó Gráda, 'On the road again with Arthur Young: English, Irish, and French agriculture during the industrial revolution', *JECH* 48 (1988), pp. 93–116; Thoen and Soens, 'Contextualizing'; G. P. H. Chorley, 'The

agricultural revolution in Northern Europe, 1750–1880: Nitrogen, legumes, and crop productivity', *EcHR* 34 (1981), pp. 71–93; R. C. Allen, 'Agricultural productivity and rural incomes in England and the Yangtze Delta, c.1620–c.1820', *EcHR* 62 (2009), pp. 525–50).

⁶³ Thoen and Soens, 'The low countries, 1000–1750', in Thoen and Soens (ed.), *Struggling with the environment*, pp. 221–58.

⁶⁴ Santiago-Caballero, 'The rain in Spain? Climate versus urban demand as causes of agricultural stagnation in Eighteenth-Century Spain', *European Rev. of Economic Hist.* 17 (2013), pp. 452–70.

Bouches-du-Rhône to Aude were close to 1000 kg/ha, whereas in the inner regions of Lozère, Aveyron, Ardèche, and Tarn, the output per hectare hardly reached 600 kg/ha as late as 1830.⁶⁵

It would not be wrong to assume that there were high-productivity regions in southern Europe as well and that these achieved levels of gross output per sown hectare (between 700 to 1,000 kg/ha) that were on a par with the low or even modest productivity of regions in north-western Europe. That said, we should recall that productivity per sown hectare alone is not a good proxy of the productivity of land unless we take into account the intensity of land use i.e., how much of the total land stock was under cultivation and, more importantly, how much of the arable was sown at any one time. As mentioned above, there might be a considerable gap in net output per unit of arable between two regions with the same level of gross output per unit of sown area. Thus, in terms of net yields per arable hectare, north-western Europe should have been much superior historically – or at least since the Middle Ages – considering that the agricultural economy in southern Europe was characterized by a higher share of fallow land in arable areas and lower seed yields, even in the most fertile areas. This implies that gaps in physical yields for grains across Europe preceded the agricultural revolution, and improvements achieved in physical yields in the Netherlands and England from the seventeenth century should have widened these gaps.⁶⁶

So, where do the results of this study place sixteenth-century Manisa in this picture? Endowed with large plains of alluvial soil along rivers and rivulets, Manisa seems to rank among the high productivity regions of southern Europe, with a gross output per sown hectare of around 885 kg in 1531 and 1010 kg⁶⁷ in 1575 – a level, which was clearly above the Mediterranean average of 500 kg.⁶⁸ At this point, an argument for the revisionist perspective on the debate of lagging Mediterranean agriculture deserves attention. Perez Picazo suggests that while low grain yields per unit area in the Mediterranean are widely perceived as a sign of agricultural backwardness, the comparative advantage of the region, which lay in viniculture and the cultivation of other labour-intensive non-grain crops, often went unnoticed.⁶⁹ Until now, I have focused on wheat yields in this comparison because this was the most common indicator of land productivity in the existing literature. But Perez Picazo's argument is supported by the fact that the aggregated output per sown hectare in arable farming (estimated at around 1100 in 1531 kg/ha and 1200 kg/ha in 1575) was considerably higher than wheat output per sown hectare in Manisa. In particular, viniculture and cotton production, which had higher productivity as wheat equivalent than grains, accounted for the difference. This suggests that it is highly likely

⁶⁵ Clout, *Agriculture in France*.

⁶⁶ This however, does not necessarily mean that the physical environment determined land productivity, although both climate and physical environment were important. For the decisive role of social organization through its determinant impact on the development and implementation of labour- and land-saving technical knowhow, see Thoen and Soens, 'Contextualizing'.

⁶⁷ The figure of 1010 kg is an average of upper and lower estimates.

⁶⁸ My estimates of wheat output per sown hectare in the early twentieth century for the same region are

1100–1500 kg, which implies an increase of at least one-tenth and, very likely, more. Such an improvement in physical yields is to be expected considering the emergence of large commercial estates producing for world markets from the seventeenth century onwards.

⁶⁹ M. T. P. Picazo, 'Essor de la production et gains de productivité agricole dans une région Méditerranéenne au XIXe siècle. Le cas de la province de Murcie [‘Boom in production and agricultural productivity gains in a Mediterranean region in the 19th century. The case of the province of Murcia’], *Histoire et Mesure* 15 (2000), pp. 217–32.

that differences in aggregated agricultural output per arable hectare between north-western and southern Europe were smaller than the gap in net grain yields per arable hectare.

IV

The present study has revealed that in sixteenth-century Manisa, where land reclamations were no longer possible or remunerative, land and labour productivity moved in opposite directions. In response to rapid population growth, output per worker declined, yet this decrease in labour productivity – and, thus, in agricultural incomes – was partially compensated by an increase in output per sown area. Although only scant and indirect evidence exists regarding changing agricultural practices in response to rising food demand and the fragmentation of land holdings; it is highly likely that the increase in output per sown area became possible thanks to a shift towards more labour-intensive forms of cultivation and some land-saving techniques.

As a result, even in one of the most densely populated areas of sixteenth-century Ottoman Anatolia (which also witnessed a considerable demographic expansion throughout the century), population growth did not usher in a subsistence crisis, as many Ottomanists have argued. In the late sixteenth century, agricultural output per capita, net of seed, taxes and loss in milling, was well above the subsistence level of 250 kg wheat equivalent. In fact, the findings suggest that after taxation and consumption, peasants in Manisa were left with a considerable agricultural surplus to exchange on the market.

Overall, findings from the fiscal surveys suggest that Boserupian innovations were underway in Manisa, and at least, in this part of sixteenth-century Anatolia, ‘agriculture could keep pace with the population increase to a large extent, beating the Malthusian traps’.⁷⁰ However, this does not imply that such mechanisms were in play in other parts of Ottoman Anatolia during the same period, or – even if they were – succeeded in preventing a subsistence crisis. In sixteenth-century Northern Italy, Alfani points to the coexistence of a variety of situations: namely, areas that experienced Boserupian and non-Boserupian (not related to the needs associated with demographic expansion) innovations and those that did not, as well as areas that could, at least in the short run, avoid a Malthusian crisis and those could not. Further regional studies on sixteenth-century Ottoman Anatolia are likely to reveal a similar story.⁷¹

⁷⁰ Thoen and Soens, ‘Contextualizing’, p. 464.

⁷¹ Alfani, ‘Population dynamics’.

Appendix

This paper calculated the extent of arable land as the sum of the amount of land held under different legal categories:

- (a) The level of personal taxes paid by regular peasants depended on the marital status and the amount of land in their possession. Therefore, Ottoman tax registers reported the number of taxable landed peasants in every village, according to categories referring to the size of the plots they held. These categories were expressed as the multiples of *çift*⁷² (three *çifts*, two *çifts*, one *çift*, etc.) There were also two categories for those who possessed plots smaller than one *çift* – *nim-çift* (half-*çift*) and *bennak* (smaller than half-*çift*). This study, thus, estimated the extent of the land held by the regular peasants under a *tapu* agreement from this frequency distribution, multiplying the number of peasants under each category by the relevant plot size expressed in *çift* before adding these together. In doing so, I assumed one *bennak* to have possessed 0.3 *çift*.
- (b) In sixteenth-century Manisa, semi-nomadic groups holding clan status, landless peasants, and poor peasants cultivated a considerable amount of land under simple tenancy agreements. This agreement stipulated the payment of a *resm-i dönüm/zemin* (land tax) in proportion to the size of the land cultivated (33 *akçe* per *çift*). From the amount of this tax, we can easily calculate the extent of land held under this type of contract.
- (c) *Zemins* were plots which were previously held under *tapu* and which were, at the moment of survey, hired by poor or landless peasants without *tapu* on the basis of the *resm-i dönüm/zemin* because their previous holders left no heir. The total extent of *zemins* is calculated the same way as (b).
- (d) There were also a small number of *hassa* holdings located in sixteenth-century Manisa. As a less regular practice, authorities allocated these holdings for the personal use of small *timar* owners, who often employed landless or poor peasants acting as sharecroppers to cultivate the land. The average size of *hassa* farms is considered to be 1 *çift* in the calculations.⁷³
- (e) The extent of private holdings was, in many cases, reported in the registers in terms of *çifts*. Entries involving private holdings whose extent was not indicated are excluded from the sample.
- (f) In a number of entries concerning uninhabited villages, I encountered notes stating that outsider peasants cultivated a certain amount of land, yet no corresponding land

⁷² *Çift* is an Ottoman surface measurement controlled for soil quality. Ottoman agricultural codes specified the extent of a peasant holding of one *çift* as a piece of land that could be cultivated by family labour and a pair of oxen in an agricultural season. Rather than being a standard unit, it denoted an ideal plot size that could meet the needs of a peasant household. Accordingly, it varied significantly across regions based

on the fertility of the soil. In the Western Anatolia, one *çift* ranged between 5.5 hectares on first quality soil and 13.8 hectares on low quality soil.

⁷³ In a number of entries, *bennaks* were recorded with the amounts of land in their possession, ranging between 20 and 45 *dönüms*. Based on this, *bennaks* are assumed to have held land of 0.3 *çifts*.

tax is indicated. In such cases, I added up the amounts mentioned in *çifts* to reach the total.

In converting to standard measurement units, I assumed an average *çift* as 100 *dönüms* (9.2 hectares), as conventionally assumed in the literature.⁷⁴ This figure seems quite reasonable, considering that different scenarios of soil distribution in Manisa based on fertility gave estimations that ranged between 95 (8.7 hectares) and 105 *dönüms* (9.7 hectares).

⁷⁴ Öz, '16. Yüzyılda Anadolu'da tarımda verimlilik'.