PROOF

Nature's End

History and the Environment

Edited by

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Preface

This book is the result of an ambition to formulate an environmental history that cares for the environment, cares for the salience of all knowledge including the sciences and cares for a history that is ultimately about the human condition.

With this book we try to say two things. The first is that environmental history is expanding the realm of history to comprise nature and the environment and to weave together as far as possible human experience with the workings of nature into a fuller understanding of the past and how it affects human decisions and destinations. In this regard environmental history is changing historiography and has the potential to change history as well by providing narratives that are novel and different, with more explanatory factors, and more vivid images: a new understanding. The second thing we try to say is that this can only be done if environmental history retains and relentlessly refines its status as history, belonging in the humanist tradition of studying complex phenomena with respect for humans as, ultimately, persons with intentions and morals, and belonging in the realm of the polity.

It is this dual ambition that has guided us as editors. We wanted to see if it was possible to embrace the widening agenda, and the broadening scales, of environmental history and at the same time allow it to address the issues as 'history', in frames and with concepts that make sense to the historical community in its largest extent and that will attract both scholars and students. A further ambition has been to make the end result accessible in a form that should be readable not just to historians, but to anyone in the social sciences or the sciences with an interest in how we could re-articulate the ways and means that we use to understand what we, as humanity, are up to in the never ending coexistence with nature.

We set out during 2004 and 2005 when we were both affiliated with the Centre for History and Economics at Cambridge University and organized a series of seminars and workshops to which we invited a range of eminent speakers and commentators. We also presented a paper that summed up our own position, subsequently published in the journal *Environmental History* (2007:1) as 'The Problem of the Problem of Environmental History: A Re-reading of the Field'. Finally, we invited some of the best people we could think of to help us and asked them to present papers at a workshop in Cambridge in January 2006 which was co-hosted by the Centre for Research in the Arts and the Social Sciences, CRASSH, and by the Department of Geography. After the workshop we continued working with several of the contributors who put in tremendous

efforts into revising the papers to serve the purpose and design of this volume. As we went along we invited more contributors to get a reasonable coverage of themes and world regions.

Without trying to be exhaustive we would like to thank several people who have contributed, with papers, comments, or as referees, to help shape the project and this volume to what it finally became. Apart from the authors of this volume, who deserve our special gratitude, we are thinking of: Peter Alagona, Alan Baker, Dorothee Brantz, Peter Burke, Christopher Bayly, Michael T. Bravo, Mark Cioc, Stefania Gallini, Wilko Graf von Hardenberg, Gerry Kearns, Mike Lewis, Emma Rothschild, Chris Smout, and Gareth Stedman Jones. For economic support we would like to extend our heartfelt thanks to CRASSH and the Centre for History and Economics, where Inga Markan tirelessly served us with all kinds of logistical, and emotional!, support.

Cambridge in March 2009

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Fiona Watson is a historian and was the Director of the AHRC Centre for Environmental History at the University of Stirling. She has published numerous works on Scottish medieval and environmental history, including *Scotland: A History* (Tempus, 2001), and (with Chris Smout and Alan Macdonald) *The Native Woodlands of Scotland: An Environmental History, 1500–1900* (Edinburgh UP, 2005).

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Making the Environment Historical – An Introduction

Sverker Sörlin and Paul Warde

‘History is a nightmare, from which I am trying to awake.’ Stephen Dedalus’ words in James Joyce’s novel *Ulysses* are not just the kind of words that sound familiar to a student in school who just cannot get the point of learning about all the familiar details of history: wars (mostly wars), battles (surprisingly important), royalty, leading politicians and their deeds, lineages of the welfare states, Raj and Mandarins, liberation struggles here and there, reforms and revolutions. Joyce was part of a modernist revolution of thought and form, of literary and artistic expression in early 20th century Europe, and in the mind of modernists, futurists and nihilists history was indeed, if not a nightmare, at least a burden, an unnecessary set of fetters that constrained human ingenuity and human deed. Friedrich Nietzsche, in *On the Advantages and Disadvantages of History for Life* (1874), wanted to free history from its backward looking obsession and nostalgia. History was part of making a new world; only feeble-minded *Ressentiment Menschen* would be interested in the fine tuning of ephemeral by-gones. History should be part of action, and therefore the worst enemies of future-embracing history were the historians.

It is not surprising that Nietzsche’s nihilistic credo has not had much success as historiography *per se*; his text has instead remained as a stimulating chapter in the history of the philosophy of history. But if we take a broader view his dissent, shared with Joyce and much of modernism, was nonetheless important. It heralded, long before it was realized by most historians, a historiography that departed from the ornamental national narratives that had become the mainstay of 19th century histories and that continued, often in popularized form, in the 20th. In that sense history *was* a nightmare, insofar that it seemed to tie eternally peoples and communities to the atrocities of war, to nations pitted against each other in eternal conflict, and to the heroism of *my* nation, not those of the others.

Long before it was generally discovered and discussed among professional historians, the modernists realized that there were more histories out there that

2 Introduction

needed to be told and that had to do with realities, entire continents of human experience, that were not present in the moralist and metaphysical historiographies that dominated the 19th century. Even more importantly, they were right in assuming that history fundamentally reflected the preoccupations, interests, and anxieties of the society in which it was written. History was a nightmare because the world as it was known was a nightmare, and history did not provide a way out of it, rather the opposite: history built the minds of men that, just because of their minds, produced precisely these nightmares: above all the First World War, which Joyce lived through, as so many others, never to become the same again.

This may seem an odd digression to introduce a book on environmental history. It would be much more commonplace, as has been done in most collections and textbooks in the field so far, to start out with the long list of environmental concerns and challenges that face humanity and argue, as we certainly also do, the case for addressing these concerns with a deeper understanding of how they are products of history, of human action, and why we therefore have to learn about them as historical realities, and how they can be managed, even solved, by just the same sort of humans as those who created them. In that sense the editors of this book are Nietzscheans: history is not just about understanding, it is also about action and about moral predicaments and determinations to guide action.

We do digress because we wish to underpin a bolder statement that we believe follows from our kinship with those rebel modernist thinkers. History today, no less than in the previous century, does ultimately reflect the preoccupations, interests, and anxieties of our times. And our times are marked by the increasing role of the environment, as the Earth of wonders and resources, as the threatened Planet, as a Nature full of surprises who can 'hit back' on ignorant humans, or as the material Context of our everyday lives wherever we are. Environmental history is a meaningful enterprise for just that reason: it seeks to provide the history that can tell us how we arrived here and what we need to know to handle our global environmental predicament.

The overriding image of the Earth in the last several decades – you may say since the environmental 'awakening' heralded by Rachel Carson's iconic best-seller *Silent Spring* (1963), although certainly not caused by it – has been one of gloom and pessimism. The title of this book, *Nature's End*, echoes that, and harks back to books with similar, more or less apocalyptic titles over the past few decades. The sorrow and despair and sense of loss that is communicated in titles such as *The End of Nature* (Bill McKibben in 1990) and *The Ends of the Earth* (Donald Worster in 1988) must of course be respected. But we do not believe that nature has reached its end, nor that this will ever happen. Rather we understand nature's end as the beginning of the environment, or even the age of environment. Nature needs no humans, but there is an environment

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Why Intensify? The Outline of a Theory of the Institutional Causes Driving Long-Term Changes in Chinese Farming and the Consequent Modifications to the Environment

Mark Elvin

The examination of a hitherto little studied fiscal aspect of a problem in Chinese environmental history suggests that, in cases like this, environmental history does not have a clearly defined separate character of its own. It is inextricably interwoven with other disciplinary perspectives. In turn it makes its own, often crucial, contribution to the comprehension of the subject-matter studied in these other perspectives. To the extent that the example presented here is representative, one could say that environmental history is thus both everywhere and nowhere.

The intensification of farming

Chinese farming during the last thousand years of the empire, and especially the last few hundred before the arrival of chemical fertilizers, has been famous as an example of fields farmed with a high input of hours of labour per hectare per year, and the subtlety of attention to detail that is normally associated with gardens. This is why it has sometimes been loosely described by the German term *Gartenbau*, 'garden-style farming' or some such equivalent. Wilhelm Wagner, the pre-eminent Western authority on the subject, preferred however to reserve 'Gartenbau' for agriculture that was predominantly irrigated and made minimal use of non-human labour, and to call farming that was mainly non-irrigated and made relatively greater use of animal-power *Ackerbau*, or 'field-farming'.¹

¹ Wagner (1926), 636–637. A viewpoint that differs from Wagner's in being more convinced of the traditional system's long-term sustainability is Franklin King (1949; rev. ed. 1972). A summary that inclines more to Wagner's side of this argument may be found in Elvin (1982). The basic reference for the long-term history is Motonosuke (1962).

Table 11.1 Simplified version of the calendar for farmwork in South China from Bao Shichen

Food plants omitted in the simplified version: scallions, tea, yams, red hibiscus, ginger, melons, gourds, eggplant, edible greens, lettuce, sweet potatoes, lentils, buckwheat, cabbages, turnips, carrots, jujubes, lotus leaves, "fruit." Fibre plants omitted: hemp, ramie. Others: mulberry trees, indigo, linseed, bamboos, pond fish, silkworms, etc. The sowing time of barley and harvest time of buckwheat are not given in this part of the source, and are supplied from other parts.

Key: † Hoe * Manure ¶ Weed ‡ Pinch off flowers Plant in final place Harvest 'E': early 'I': intermediate 'L': late Note: 'colza' = 'rape' 'Rice2' 'interplanted rice' '[?]' estimated Source: Bao Shichen, *Qimin sishu* [Four techniques for ruling the common people] (1844. Reprinted, n.p. Zhuqingtang 1872), j. 25, 291-30.

In a very approximate sense the first term can be used to describe later imperial-age rice-farming in the Yangzi valley and further south, and the second, in implied contrast, the wheat, millet and barley farming of this time in the North-China plain. For many purposes it is a useful distinction, but for the purposes of this chapter it risks being misleading. The phenomenon of the historically ever more intensified use of labour per unit of cultivated area applied equally to *both* areas, and in terms of going *as close as possible* to what was technically and economically locally possible it is fair to say that it affected both regions roughly *equally*. No one, I think, would deny that there were environmental possibilities of several kinds in the South, such as crops that produced more per cropping acre than their northern counterparts, and more hours of insolation each year, and fewer days of frost, not to mention more abundant relatively reliable supplies of water from both rains and rivers, that enabled the South in the last millennium of the empire to exploit a wider range of possibilities of labour-intensification than the North. But the North has also to be thought of as 'intensified' (Table 11.1).

By premodern standards, the late-imperial mean yields per hectare *per year* for rice- and wheat-based farming, including multiple cropping and intercropping with secondary crops of various sorts, were indubitably high for the age *prior* to the use of chemical fertilizers when compared to most other countries that were broadly similar in terms of climate and soils. Important possible exceptions to this remark are Tokugawa, Japan, and some parts of South India for rice, and eighteenth-century England for wheat. For the greater part of the thousand-year period there was no fallowing in China (a fact that boosted its overall average annual output per hectare relative to its European comparators). This meant an unrelenting attention to the conservation of soil productivity. In addition to the use of rotations, a wide variety of fertilizers had to be constantly collected and matured, or purchased, and then applied (see Table 11.1 on southern farm-work schedules). These fertilizers included materials of vegetable origin, animal and human manures, and river-mud plus, where appropriate, lime. Put in different terms: the late-imperial farming system increased *labour* costs per unit output in return for increased output per unit *area*. In different terms again: it did in a *shorter time* by human agency the work (namely fertility restoration) that 'nature' could probably have done, if not in quite the same way, in a *longer time* (through fallowing).

Chinese farming was not always intensive. For example, around 763 CE a large new development in Jiaxing in the lower Yangzi region used the broadcasting of rice-seeds 'by means of the breezes,' rather than growing sprouts in seedbeds and then transplanting them in rectangular grids of a size to optimize the use of the land-area.² This was in one of the more advanced regions for

² Elvin (2004), 181.

rice-farming. Four centuries later, non-intensive rice-farming was retreating to the economic margins. In 1178 an official remarked contemptuously of Qinzhou in the far southwest:

The farmers of Qinzhou are careless. When they work the soil with an ox they merely break up the clods; and when the time comes for sowing they go to the fields and broadcast the grain. They do not transplant seedlings. There is no more wasteful use of seed than this. After they have planted it, they neither hoe it nor irrigate it, but place their reliance on the forces of nature.³

But if land here was still plentiful, as seems likely, this style of farming may have been the best use of labour-power.

The simpler forms of intensive farming were however the foundation on which a significant proportion of China's population of perhaps 120 millions of people was already supported by around 1100 CE. A millennium and a half later, in its most developed form, circa 1850, it was the lifeline of a preponderant part of the late premodern population of perhaps 430 million people.

Outside the main domain of floodplain and valley-floor intensive farming there was also a periphery of semi-stable or shifting upland farming, often based on New World crops like maize and sweet potatoes, and using less-intensive methods. The difficulties of quantifying this peripheral but eventually significant sector, and incorporating it into meaningful aggregate historical statistics of arable land, farm labour, and per-hectare and per-worker output constitute something of an econometric headache.

Nonetheless, we may broadly say that the long-term relative success of intensive farming more than any other aspect of the economy made possible the massive weight of the demographic pressures bearing down in late premodern times and today on many aspects of contemporary China's environment. So what triggered, and then drove the millennial process of intensification in the first place?

I suggest in what follows that a combination of institutional factors, including first and foremost the structure of unit-area-based taxation on farmed land, and, in second place, social conventions shaping the levying of rents, and the status of those engaging in farm labour, with certain aspects of the technology of farming, plus, of course, as time went on, the growing pressure of population on farmable land, need to be looked at more deeply for their

³ Elvin (1973), 114. Presumably there was suitable seasonal flooding here, as in much of southeast Asia.

possible interacting effects on the process of intensification. Pressures on my time during the last year means that it is inevitably still a sketch.

The core argument

The crux of the analysis presented here is that the key factor, in the sense that it could relatively easily have been different, was the practice of the Chinese government of basing taxes on farmers, including their labour-service obligations, on the area of the land that they owned. The ultimate origins of this go back to the sixth century BCE, but other bases were also used at various points, and it is simpler to look at the issues by taking the beginning of the Song dynasty (960 CE) as the starting-point of our discussion since it was close to the normal mode after that point. A complementary practice that had an analogous, though weaker, effect was that of often levying rents from tenants mainly on the basis of the main cereal crop, but not on supplementary crops.

When tax is levied primarily on an area, even if this is roughly graded by estimated quality, it usually pays to look first to increasing output per unit area, so far as this is possible, rather than farming a larger total area. There are also two 'ratchet' effects. When the normal yields have risen and the tax take adjusted upwards to match this, it is ruinous to let yields slide back again. When a larger population is being supported through increased unit-area productivity, if the productivity slides backwards, out-migration of a proportion of the population may be the only alternative to starvation.

A structural social shift that largely took place in the seventeenth century so far as the rice-farming region was concerned was the virtual ending of farming using unfree farm labour, the proportion of which varied markedly from one place to another, but was often quite significant. This is likely to have increased the proportion after this date of those engaged in farming who were motivated to drive themselves to the limit of the possible in improving yields on what were often very small units of operation. An interesting unresolved question is how far the pioneering of methods of intensification in earlier times was done by larger units of operation, which I have in the past referred to as 'manors,' using labour often under non-economic forms of constraint. That they seem to have done so is possibly simply the consequence of their being better covered by our sources, though non-trivial resources were probably needed in a majority of cases to open new land where new infrastructure in irrigation and drainage was required. In the eighteenth and nineteenth centuries, however, the smaller units of operation are usually thought to have had a higher productivity per hectare than the larger ones. A complementary explanation is that most large landowners had by this time long since moved their residences into

the towns and cities, and were not as interested as before in farming technology and management.⁴

A formal and somewhat oversimple mathematical analysis of the economic logic of this core argument is presented at the end of this chapter just before the discussion. It seems likely that most readers will find it easier to understand at this point, once the fiscal and rent structures are more familiar. But the foregoing is, in simplified and non-formalized form, the heart of the theory that I am suggesting.

There is, however, an immediate objection that will occur to most of those already well acquainted with the economic history of late-imperial China, and which needs to be tackled at the outset. Was the burden of taxation and rents on farmers working relatively small areas of land heavy enough to have been a possible long-term influence of any important kind on their style of economic behaviour? In spite of some fine work on late-imperial Chinese tax history, such as that of Wang Yeh-chien and Ray Huang,⁵ the real nature of the tax 'burden' has not been well understood by historians of China. This is in good measure because the essential source materials are lacking until the early twentieth century. In spite of my admiration for the pioneering work of Wang Yeh-chien, it is essential to point out that even his most sophisticated formula

$$\begin{aligned} \text{Real land tax burden} &= \text{Land tax quota} \div \text{rate of collection (in money)} \\ &\quad \text{Cultivated} \div \text{acreage} \div \text{land yield} \div \text{price} \end{aligned}$$

does not give adequate insight into all the factors to which one needs to be sensitive.⁶ Essentially he leaves out costs, both actual and implied. Nor does he deal adequately with the horrifyingly difficult, but vital, issue of how far the official figures are usable at all for aggregate analysis.

Though it breaks the flow of the logic, it seems essential at this point to insert two excursûs, one on the nature of the tax burden and the second on the reliability of the late-imperial figures.

Excursus A: The nature of the tax burden on farmers

If we use the data from the early years of the twentieth century provided by Wilhelm Wagner,⁷ it is possible to establish the theoretical foundations of a

⁴ For a more detailed discussion and documentation of all these changes, see Elvin (1973), especially ch. 15, 'The disappearance of serfdom.' In comparison to that of the south, the agrarian history of north China under the Ming dynasty (1368–1644) is opaque, but it seems that unfree labour had diminished to a low level here very considerably earlier.

⁵ For example, Wang (1973); Huang (1974).

⁶ Wang (1973), 111.

⁷ Wagner (1926), 636–657.

more realistic approach to the question of the possible impact of taxation on intensification. Wagner's material was obtained through his students and relates only to Shandong, hence to northern dry-farming. None the less the principles emerge clearly enough. We will consider as illustrations two of his 'representative' examples, one an owner-operated farm that was free of debt, and the other a holding worked by tenants.

The first was a property of 42 mou, which were each locally 0.09 hectares, hence with a total farmed area of 3.78 hectares. Its capital value at market prices was 864 taels [ounces of silver], made up of the following:

Farmland at 12 taels per mou	504
Buildings	250
Livestock [1 mule, 1 donkey, 1 ox]	70
Other inventory [probably tools etc.]	40
Total capital in taels	864

The clayey soil each year produced winter crops of winter wheat, winter barley, and winter peas, summer crops of millet, gaoliang, summer peas, sweet potatoes, and peanuts, and 'intercrops'⁸ of beans (probably mainly soy), maize, sweet potatoes, and turnips, plus straw and leaves. The value at current market prices of this total output was 480.08 taels; and the farm also raised 6 pigs worth a total 42 taels (one of which was usually eaten by the family), poultry worth about 2 taels, and over 100 eggs. The household also produced straw braid worth about 5 taels.

This output had to support the owner, his wife, 3 sons and their wives, and four grandchildren. In this regard, Wagner counts females as 0.75 of a male, and children as 0.25 of an adult. There were thus the equivalent of 8 person-years to be looked after.

Except for a few days each year of hired help with the harvesting, no monetary wages were paid. The cost-equivalent in market prices of supporting the humans and animals from the unsold portion of the total produce was 327.98 taels. From this 70 taels as the annual cost of shoeing the three animals needs to be deducted. Thus supporting the adult labour force plus the 4 children required 257.98 taels. It cost approximately 8.06 taels a year to support one child, 24.18 taels to support an adult female, and 32.25 taels to support an adult male. The males had also annually to supply the state with a certain amount of unpaid labour services, but we have to leave this on one side in the estimation for lack of quantified information.

⁸ *Zwischenfruchte*. See Table 1 on the farming calendar for an illustration of what this term presumably referred to.

The calculable residue was just over 201 taels.⁹ When the land tax of 30 taels had been deducted this left about 171 taels. What of the remaining factor of production, the cost of the labour? Without the work done by the four adult men and women, or substitutes hired to replace them, the land would have produced nothing. The wages paid locally to a man, in addition to providing him with his food, were 20 taels a year. For women it was 8 taels. Adding in the additional harvest workers to the four men and women in the household, the total value of the year's labour was 117 taels, or about 2.8 taels per mou. This left a net profit of 54 taels. In other words, a return on the capital of 6.25%.

The local annual rate of interest was on the order of 10%. Thus the notional payment that would have been necessary to supply the non-land component of the farm capital, which amounted to 360 taels, was 36 taels. The total yield-based notional ground rent for the farmland (if it had had to be rented) can thus be estimated as (54–36). Dividing by 42, this gives 0.43 taels per mou per year. Capitalized over 10 years, this points to a yield-based land price of 4.3 taels per mou, rather than the market value of 12 taels.

Several conclusions emerge from this example, assuming that it is reasonably representative for owner-operated properties at this time and place. Farmland was 2.8 times the price that the value of its output warranted, given prevailing interest rates and agricultural commodity prices. Further intensification relative to area and time-density of cropping, where technically possible, would have made sense. The tax burden took away 36% of what would have been the net profit if there had been no tax. According to Wagner's calculations, the Chinese tax on farmland per hectare at the end of the Qing dynasty and start of the Republic was 15 times heavier than that in Prussia in the mid-nineteenth century calculated in the same ways; and the better access that Prussian farmers had to woodland and pasture land, close to lacking in most of the core areas of China by this date, has not been factored in to this assessment.

In the second case, that of a tenant holding of 20 mou of 0.09 hectares per mou, that is 1.8 hectares, but with the buildings, livestock, and tools owned by the tenant, the net profit, calculated on the same lines as in the case just presented, was just negative, by the slenderest of margins. (This can be seen as equivalent to accepting imputed wages below the current local mean value.) The family, consisting of a father and his wife plus his son and the son's wife, with five children, must have relied to a critical extent on their small but presumably non-rented garden and perhaps some other unlisted employments, as there were no domestic handicrafts recorded. They had one ox and one donkey, and normally fattened five pigs a year,

⁹ There are uncertainties, such as the income from eggs. Wagner gives a precise figure is 201.10 taels.

of whom they sold three. The normal tax levy on farmland in the area was reported to be twice the legal level, but their landlord was an influential merchant who, exceptionally, only paid at the legal rate of 5 taels a year for the property. Their total annual rent was 34.60 taels, paid in fixed amounts¹⁰ of two different grains, plus 5.10 taels in copper cash. The landlord in this particular case gained each year 1.48 taels per mou after tax. The ordinary landlord who lacked such political pull would have made 1.23 which capitalizes the land to a value per mou of 12.2 taels, very close to that in the first example. The pressure on the tenants to intensify in any technically and economically feasible way was even greater than in the first case.

Excursus B: The formal level and the actual level of taxes

Wagner marshalls a sample of evidence from informed foreigners long-resident in China during the later nineteenth and early twentieth century to suggest that the amounts of land tax collected were often over twice the legal amount, and in extreme cases (in Sichuan) up to ten times more. He also provides evidence for a *prima facie* case that the rates levied on farmland of comparable quality and nearby location sometimes varied significantly.¹¹

I long ago noted Chinese evidence from slightly earlier times suggesting that the formal burden might at times be misleadingly low compared to what was actually levied. A passage from the Qing-dynasty Veritable Records for 1806 notes that:

When the tribute grain is collected, the local officials in the provinces collect more than the amount sanctioned by law. They make arrangements to have gentry of bad character act as their agents.... They bribe them in advance, granting them the right to contract for a certain portion of the tribute grain. The rustics and the poor have a redoubled burden because these persons can levy and excess amount from them just as they please.¹²

A substantial number of other items from the same source confirm that this kind of malpractice could and did happen. Thus an entry from 1735 reads as follows: 'In one place after another reports of tax grain resulting from the opening of new land have added nothing to the state's [actual] quota of taxes. Not only has it not proved possible to do the land-surveying [required], but the clauses

¹⁰ Although it is hard to say for sure, some variety of crop-sharing, at least as regards the main crop, seems to have been somewhat more common in late-imperial China as a whole, but this question is hard to resolve.

¹¹ In one case of two small properties near Shanghai that he records the ratio of the difference between them as of the order of 2:3 per *mou*. Wagner (1926), 140.

¹² Elvin (1973), 267.

in the demand for the first reporting [of liability] have been the occasion for intimidatory and fraudulent assignments [to pay], the high officials [seeking] a reputation for zeal for the public good [by claiming to be raising more taxes] and the lesser officials having the additional motive of seeking for profits.¹³ A number of other passages from official sources quoted later show that taxes and labour-services (which were also based pro rata on the acreage owned) were seen as a serious burden in various places at various times because of official malpractice. The Emperor Kangxi in 1668 thought that official cheating of the taxpayers had been rife.¹⁴

Pressure from the land tax only affected small and perhaps some medium owners. Powerful local people had the political and social clout to defend themselves against extortion. This was why substantial numbers of free peasant landowners are reported as having 'commended' themselves as rent-paying tenants to such powerful local people.¹⁵ Those commending their own land may have paid lower than usual rents (the sources do not tell us such details), but ordinary rents were substantially higher than formal taxes, and tenants also risked losing tenure of their land by eviction after the passage of time had removed the memory of the commendation. That there were good reasons for paying more than the formal tax in order to avoid the actual tax, even taking this risk of losing the use of the land as well, seems reasonably plausible. This sort of behaviour is hard to explain if the total tax burden was not felt to be onerous.

Talking in terms of tax as a percentage of some such total as national product or income is likely to be an unsatisfactory guide to real-life economic behaviour. What mattered in the context of the analysis given in the Excursus A above was the impact on the family budgets of the smallholders, who were the ones who, more than others, intensified their farming. A Jesuit report from the later eighteenth century noted that '[The lands] of peasant proprietors are of an astonishing fertility, in contrast with the large estates.'¹⁶

Further, we need to think in terms of vulnerability to variability in the weather and to other hazards, like locusts. The per-area land tax was relatively inflexible, though bureaucratic mechanisms did exist for reducing it somewhat in circumstances of generally harsh local weather. It is unclear how far they were effective.¹⁷ Thus a prudent peasant would have wanted as big a buffer

¹³ Nankai University Department of History (1959), *Qing shilu jingji ziliao jiyao* [Digest of materials on economics from the Qing-dynasty 'Veritable Records,' hereafter *QSLJJ-ZLJY*], 75.

¹⁴ *QSLJJZLJY*, 664.

¹⁵ Example: *QSLJJZLJY*, 660.

¹⁶ Elvin (1982), 14.

¹⁷ There is a good discussion of them by Robert Marks for the far south of China in his *Tigers, Rice, Silk, and Silt* (1998).

as possible against uncertainty due to variability (which for rain in northern China was around 30% a year). What might be easily borne in an average year might be disastrous in a bad one.

The land-based levies included not only the formal tax but a variable number of surcharges like that for 'wastage,' miscellaneous fees, and, above all, obligatory conscripted labour. Some of the latter was outside the formal quota, though only imposed as needed.¹⁸ Some of the surcharges were legal, others illegal. The add-on in Jiaying prefecture before 1672 at one stroke put the land tax up by 80%. In Hunan province the unauthorized levies were reported to be several times the official tax.¹⁹

It is easy to multiply citations of the type just given. Bluntly, it is not possible to calculate useful statistics in this sort of situation, especially when one is concerned with the impact on peasant behaviour.²⁰

If we turn now to qualitative materials, the Qing-dynasty poems on aspects of everyday life reveal a view on the part of a number of different poets that the evil done by tax-collectors was at times literally murderous. These poems were somewhat like newspaper headlines – depicting extreme and shocking cases – but they would not have been anthologized if they had not spoken of something that was quite possible to imagine occurring.

In the Ballad of Date-Tree Lane by Li Fuqing on the decision of parents to sell their son because of the pressure of taxes we read that

The time for rearing silkworms had not run its course in full
When the red warrants demanding tax were sent to the countryside.
In the morning, people were pressed to pay, no hen or pig overlooked.
They were pressured again, late in the day, and the weak and the elderly died.

A poverty-stricken married couple, then living in Date-Tree Lane,
Set off to the county capital market, to dispose of their only son.
To feel affection for one's child is only human nature,
But when taxes have to be paid to the State, what else is there to be done? . . .

In due course, having used her last pennies to buy food for her son and husband, the mother hangs herself from a tree, but the father and son vow at once to follow her in death, and hang themselves on a branch beside her. So far

¹⁸ See Elvin (1973), 265, for an example.

¹⁹ *QSLJJZLJY*, 667.

²⁰ This remark is of course without prejudice to the massive efforts made by Angus Maddison in his *Chinese Economic Performance in the Long Run* (2007) to produce usable, albeit very rough-grained, estimates for China's overall economic performance in premodern times.

from indulging in Hardy-esque morbidity, the poet then honours their mutual devotion:

Like wings that support each other in flight they soar now in Heaven above.
On this Earth below they are linked, each with each, like intertwining
branches.
The physical souls of their essences keep, forever, in touch with each other,
Which far surpasses living on, if they'd had to live apart.²¹

A different situation is described by Liu Tianqian's *Reaping Wheat*. The poet has walked out into the country and sees much of the farmwork being done by women, which puzzles him. Then an old man explains that the able-bodied men have all been taken away by the tax-collectors, to be tortured to make them pay up. There is some exaggeration and hyperbole in the old man's tale (since, presumably, torture does not have to take a long time), but it too would not have been anthologized if it had not contained a significant element of truth:

The drought-parched autumn last year had desiccated the sprouts.
Weeds grew in the corners of stony acres, which turned into scrubby wastes.
We filled our bellies with bark from trees, and chalk ground into flour,
Yet even before our tax fell due they were quick to abuse and chase us.

At dead of night they come to a village. They seize and tie up their victims.
We tremble like people with fever when we go past the magistrate's court.
Our guts, burning with hunger, turn round inside like a windlass,
As we drive our bodies on and on, in terror of being tortured.

....

See that half-wit begging for rice? Beside that wall there. And yammering.
He's sold himself to a merchant, to drudge for him as his serf.
Once he'd his hands on the silver, the whole lot went to pay tax:
Two-thirds to clear the basic sum, 'official wastage' one third.

At the end the old man himself is seized by the tax-prompters, tied up in ropes, and carried away.²²

There are many other examples of this sort of poem. One must not make too much of them as regards specific details, but they fairly certainly convey a widespread popular attitude towards taxes. Taxes hurt.

²¹ See Elvin (1998), 172.

²² Elvin (1998), 134.

The linkage of taxes with land ownership

We resume the main line thought: The adherence of the Chinese state to the principle that the land tax and the levy of labour-services should be based on the quantity of land owned by a household is explicitly expressed in the comment of the Imperial Secretariat on a memorial from a censor in 1820 when its implementation was beginning to break down under the pressure of accumulated abuses, and needed to be re-established:

When the soil is transformed into taxes, it follows automatically that it is right that the grain tax is adjusted in accordance with the [amount of] farmed land. According to the memorial from the said censor, there are poor people in Jiangsu province who do not own even enough land for a dwelling, and yet pay a land tax every year of from several ounces of silver to several tens of ounces; and that there are others who possess merely several mou²³ whose yearly tax is that for fields of from more than ten to several tens of mou. In all these cases [according to his memorial] this has been the result of the failure of the owners of lands, when they earlier sold them, to transfer [the obligation to pay] the entire amount of land tax from their household to that of the purchaser, so giving rise to conflicts and confusions. . . . Those households who at present possess a given area of farmland, must pay the [corresponding] given amount of land tax in accordance with the regulations. 'Empty taxes' that cannot be attached to [farmed land] are all to be shifted to be collected from others [who do have the appropriate amounts of land].²⁴

The land was graded into three levels of quality, each grade being further subdivided into three, with a tax rating assigned to each. Differences in location and in crops harvested meant that there were innumerable variations in practice. In financial emergencies it occasionally happened that the grading system was ignored. This occurred in the late Ming, when an extra hundredth of an ounce of silver was levied on each mou of land, and this was repeated in 1661 under the Qing, but stopped the next year for fear of overburdening the population.²⁵ This additional burden raised a total of rather more than 577 million ounces of silver, which would have been of the (very) approximate order of magnitude of an extra 15 ounces of silver per household of five people in a total farming population of 200 million, and

²³ One *mou* was on average about 0.067 hectare under the Qing, and 0.07 under the Ming. There were wide local variations. See Excursus A for an example where the figure was 0.09.

²⁴ *QSLJJZLJY*, 695.

²⁵ *QSLJJZLJY*, 662.

almost immediately caused a political problem. From Excursus A it is easy to understand why.

Where the tax was collected in kind, which after the seventeenth century was mainly only the case when it was the grain that was shipped up the Grand Canal to supply the Capital, difficulties could be caused to this system by variations in the weather. In 1826 a memorial noted that:

It is specified that for the tax-grain supplied to the Capital from Jiangsu province late-ripening rice is to be collected.... In Jurong county there are many hills, however, and but few polders. Last year, the summer rains were somewhat delayed, and the majority of the peasants in this county planted early-ripening rice. This caused the colour of the rice delivered to the government granaries to be irregular.²⁶

This mattered more than it might seem, as early-ripening rice did not last so well in storage as the late-ripening kind. It was decided that henceforth the local officials would examine the weather each year to determine whether or not it was appropriate for the peasants to guard against a coming drought by planting early-ripening rice. This is unlikely always to have given decisions acceptable to locally experienced farmers who may be presumed to have preferred to trust their own judgements, and not to have to wait for a bureaucratic go-ahead.

Labour-services for water-system maintenance and construction and other tasks were, in principle, linked to the size of a landholding,²⁷ but in ways that varied from one region or even locality to another,²⁸ and were not always properly observed in practice. It is clear that poorer peasants sometimes greatly feared the loss of farm-labour that could be caused by these compulsory services. The linkage of labour-services and ownership of land emerges clearly from a report submitted by the governor of Gansu province in 1742:

The lands of Gansu are located on the frontiers. In the past the arable was extensive and the population sparse. Since our present dynasty was established, vagrants have little by little gathered, but at the beginning of the opening up of new lands for farming, the least well-off commoners were frightened of the labour-service levies, and always borrowed the names of

²⁶ *QSLJJZLJY*, 696.

²⁷ For example *QSLJJZLJY*, 647, 661, etc.

²⁸ Thus in 1726, when the Board of Finance wanted to bring the labour-services required from residents of the reed-lands associated with salterns into the main land-tax system, they had to leave out those areas where the inhabitants owned too little land for this to make fiscal sense. *QSLJJZLJY*, 670.

the gentry [as their nominal landlords] for cover. When reporting the clearance of new land and the undertaking of cultivation, they placed themselves in the condition of tenants who paid rent every year.

They also feared that once they had developed their acreage to a mature condition they would have nothing to rely on [legally] in the future if they were suddenly dispossessed, so they established contracts to serve as guarantees entitling them to cultivate in perpetuity, and not to be deprived of their tenancies.²⁹

Rents were quite often (though probably in rather less than the majority of cases) calculated on an acreage basis. This may be presumed to have had an impact on behaviour broadly similar to that of taxes on small landowners. An example of rents on a per-mou basis can be found in the report in 1746 of a censor who was in acting charge of the tax-grain transport:

The military colony fields of the Guard Area of Wenzhou have, according to a previous decision, paid a harvest rent [per mou] of 3 piculs for the land of the best quality, 2 piculs for land of middling quality, and 1.6 piculs for land of the lowest quality.³⁰ These quotas are far too heavy. Even in years when the harvest is abundant they cannot be met in full. It is now our considered decision that for every mou, in addition to paying in full [the grain for] the regular military rations, the best fields shall be charged an extra fee of four-tenths [of an ounce of silver], the middle-grade fields three-tenths, and the lowest-grade fields two tenths.³¹

Colony lands seem often to have been associated with heavy charges.

Since the foregoing quotations are drawn from the so-called 'Veritable Records' of the Qing dynasty, they are excerpts or summaries put together, after the fall of a dynasty, from its much more voluminous official archives. To some extent they were recorded and preserved because the problems with which they dealt were exceptional. This point should not be forgotten, nor should the recent experience of several scholars that the full archival files on particular cases quite often reveal the events of an incident in a significantly different light from these extracts. They are used here, not for their often intriguing particularities, but to shed light on the general assumptions and practices underpinning the system.

²⁹ *QSLJJZLJY*, 680.

³⁰ The picul (*dan* or *shi*) was, properly speaking, a measure of capacity of 10 pecks (*dou*), each of 10 pints (*sheng*). The *sheng* in Qing times was close enough to 1 litre for rough calculations of small totals.

³¹ *QSLJJZLJY*, 684–685.

These, then, were the very general features of the late-imperial land tax. When we look further, what emerges is that the experience of the burden of these taxes, which were in practice accompanied by varying arrays of additional surcharges and, more often than not, serious corruption and squeezing on the part of those who collected them, not infrequently both led peasants to abandon their homes, and the better-off to avoid investing in landholding. The imperial response made in 1703 to a report by an official from Hu'nan province sums up what was a bad but probably far from unique situation:

Hu'nan is placed between regions that have distant borders, and We have heard that the accumulated [mal]practices of the officials high and low are continuing as before, with no limits to the many kinds of the illegal levying of taxes. If one calculates the levies of tax and the assignation [of labour-services] every year, there are some instances where they reach a multiple of several times the formally specified quotas. When the authorities raise taxes they further take an allowance for 'wastage' that is uniquely heavy when compared to those of other provinces. The common folk are so distressed by their exhaustion that they cannot endure it, and many of them leave [their homes] and migrate from one place to another.³²

The emperor ordered that every effort be made to induce the vagrants to return home and take charge of their properties again.

Other areas also faced heavy surcharges. In 1672, in Jiaxing prefecture and Huzhou prefecture in the lower Yangzi valley, one of the most intensively farmed parts of the empire, the 'wastage' surcharges were, respectively, 80% (as mentioned earlier) and 55% of the nominal formal tax. They were both reduced in this year to 45%.³³

On taxes as a disincentive to owning more land, a censor wrote in a memorial on the province of Yunnan in 1668 as follows:

Of the various paths that the State has for developing financial resources, the most important is the opening up of uncultivated lands. This has been pursued for more than twenty years, but without results. This is the result of three disastrous circumstances. 1. Taxes and labour-services are too pressingly levied, and rich people consider that the possession of land is a burden. 2. There are no funds for persuading tenants to come [and sign contracts], and poor people regard having land bestowed on them as an affliction.³⁴

³² *QSLJJZLJY*, 667.

³³ *QSLJJZLJY*, 665.

³⁴ Perhaps also because of the lack of infrastructure and working capital.

3. The evaluation of the performance of the officials is too easy-going, and those in authority do not regard the opening of new lands for cultivation to be part of their duties....

Farmland comes in different grades. That which has only recently fallen into disuse should be charged tax after a grace-period of three years [following its reopening]; that which has been in disuse for a long period should be charged tax after a grace-period of five years; and that which is in an extreme condition of wilderness [before being developed for farming] should never be charged tax. If this is done, then the common people will be well-off for resources, and there will be numerous tenants cultivating newly opened fields....

People have different grades of wealth. Those who would [otherwise] migrate away should be endowed with [land run by] official 'manors'; those who are [merely] short of money should be loaned official cattle, and [provided with?] barrage-controlled reservoir-ponds and irrigation channels that are maintained by official funds. If this is done, then people will be well-off and those energetically opening up new land will be numerous.³⁵

Thus the tax burden was important, but only part of a more complicated economic pattern. The memorialist's enthusiasm notwithstanding, it seems reasonable to imagine that once a peasant, whether tenant or owner, was over the difficult 'hump' at the beginning of making a new holding workable, he would generally be more concerned, other things being equal, with maximizing his returns from what he already had in functioning order than with tackling, or being a participant in tackling, another transition across a new 'hump.' Opening new land on any scale also tended to need the involvement of rich landowners, merchants, or the government because of the capital required.³⁶

A simpler formulation appeared in the report of the governor of Guangdong province in 1671 about the military colony fields there that paid a land tax of 3 pecks for every mou, this being 'almost twice the rate on commoners' lands.' The people, he continued, 'fear the heavy burden of the land tax, and do not dare to admit it if they have opened new land for cultivation.'³⁷ By 1853, the estimated area of 'salty fields' along the Guangdong coastline not registered for taxation had reached 'some tens of million of qing', the qing being a unit of 100 mou. The authorities are said to have shrunk from the costs

³⁵ *QSLJJZLJY*, 64–65.

³⁶ *QSLJJZLJY*, 84, 87, 93, 97.

³⁷ *QSLJJZLJY*, 665.

and complexities of trying to survey such land, and everyone else concerned to be 'cringing in fear' at the possibility that this might happen.³⁸

In the course of the eighteenth century, it seems to have become officially established that very small parcels of land did not have to be reported for taxation. In Guangxi province in 1741, for example, a holding of less than 1 mou of ordinary wet-field paddy or 3 mou used for dry-land crops did not need to be registered. For land of the poorest quality, the tax-free limit rose to 5 mou for paddy-fields and 10 for dry-land crops. A roughly similar rule applied in Shanxi and Shaanxi.³⁹ In Guizhou province at the same period the land so poor that it had to be left fallow in alternate years did not pay tax.⁴⁰ It seems likely that it would often have been economically rational to extract the maximum from an untaxed small unit than rather more from a larger but taxed one.

Overall, there is now a *prima facie* case that tax pressure was a significant variable in the planning of farm management in late-imperial China, though other factors would surely have also played a significant part. At the same time, it seems to have been becoming tacitly accepted by the state as time went by that it was not worth the effort to try to extract tax from land of the poorest quality. One possibility is that doing so would have simply discouraged most of the owners from cultivating it at all, but this can only be conjecture.

The long-term historical process of intensification in Chinese agriculture

Let us define a 'revolution' in the economic domain as a whole as 'a rapid shift in the basic interrelationships between newly modified technologies of production, transport and communication, on the one hand, and the dominant types of interpersonal and inter-institutional transactions, on the other.' For it to be of any significance, we need to add that it sets its stamp on a long subsequent period during which these changed interrelationships develop, mature, and strengthen their hold. If this definition is accepted, then there was only one economic 'revolution' in imperial Chinese history. This was that of the Song about a thousand years ago. It was marked by a massive extension of monetization, commercialization, credit-use, urbanization, printing, greatly expanded inland and marine water-transport, increased use of various forms of machinery (including water-driven spinning-machines) and a modicum of mass production (as of iron arrowheads). It was also characterized by the first major steps on the road towards agricultural intensification, however

³⁸ *QSLJJZLJY*, 700.

³⁹ *QSLJJZLJY*, 74, 680, 679.

⁴⁰ *QSLJJZLJY*, 680.

geographically patchy, and, in this particular case, towards the round-year use of on-farm labour.

If one wanted to argue for a second 'revolution,' it would have to be applied to the changes over the rather more than a hundred years from the late sixteenth to the early eighteenth century. The most distinctive features of these changes were social (i.e., transactional). They included the near-total disappearance of a previously substantial sector of unfree rural labour that had existed in some areas (especially the south), the related move of the larger landowners into towns and cities, a corresponding need to reshape the structure of local power in the countryside for such collective tasks as the maintenance of water-control systems, a shift towards an even greater reliance on small units of operation in agriculture, with a linked rise in the small-scale credit provided by pawnshops, plus an increasing density of the market network, partially underpinning some new institutions like the long-distance trading guilds linking merchants from a given locality. Characteristics of secondary, but still substantial, importance included the adoption of a number of crops from the New World, the cultivation of spring-ripening crops like broad beans and colza in rice-fields, and many small but useful technical improvements. The main argument against labelling this complex of developments a 'revolution' is that all of them, as I argued in 1975 when describing the complex of technical advances during this period, probably had the effect of stabilizing the existing system in a period of strains caused by population growth and diminishing amounts of technologically accessible natural resources. It did not create a qualitatively new pattern of economic activity.⁴¹

Rural social structure apart, most of the central features of the Song economy remained clearly visible in this second phase, even if it had been without question modified significantly over the centuries. In both periods economic society was vibrantly entrepreneurial and competitive, and with a high social mobility for premodern times, clearly greater in the second period. Motive power in both phases was based mainly on human labour, with waterpower and animal-power at times playing a useful ancillary role, while wind-power was a limited but interesting addition in the second period. In the management of medium-scale hydraulic systems, consortia of major landlords played a significant role in the earlier period, but a much-diminished role in the second.

As regards fuel, let us note, as a brief excursus, that coal was known, used, and valued from the beginning of the first period, but coal-mining technology remained unnecessarily primitive. The pits are sometimes said to have become too difficult and costly to work once they had gone down to a certain depth, and this presumably implied a need for better drainage, ventilation, and lifting

⁴¹ Elvin (1996).

gear, and the protection of well-placed pit props. Some of the machinery needed for the first three operations already existed in China by the early eighteenth century, such as piston-and-cylinder pumps, and all of it before the middle of the nineteenth. What is interesting is that it seems never to have been used for the extraction of coal, even under the pressure of rising prices in eighteenth-century Beijing, where the fuel was regarded as a necessity of everyday life.⁴² Late-imperial China's lag relative to early modern Europe in the cost-efficient extraction of coal and metal ores is interesting in that it is almost the only case of potential major economic importance where the low level of the technology used cannot be wholly ascribed to the absence of early modern science. The techniques were still at a point before the steam engine could have made a crucial difference. Nor was the cause environmental factors since there were substantial quantities of coal, seemingly accessible with only modest improvements in technique; and deposits of coal and iron were not in fact in economic terms always that far from each other, provided water-transport was available, which it often was.⁴³ The failure was probably one of uncertainty as regards government policy. The government sometimes asked merchants – people with capital and some knowledge of what was going on in the country as a whole – to take the lead in opening coal mines,⁴⁴ but often also tried to limit their numbers out of fear that, in spite of the acknowledged benefits of coal, the concentrations of miners might provoke local disturbances, especially if the mines were in the hands of 'bad gentry' or 'traitorous merchants.'⁴⁵ Yet using the somewhat better technology already available might actually have helped reduce this problem by creating longer-lived and more profitable businesses.

To return from our excursus: When China's rural economy over the millennium from the Song to the Qing is contrasted, in the broadest terms, and without reference to interregional differences, with that of late mediaeval and early modern Europe, three further mutually reinforcing differences need to be taken into account. (1) China had virtually no fallowing. (2) Other than near the frontiers, there were few herds of large animals, as opposed to handfuls of individual beasts such as cows and sheep, plus scavengers like pigs and poultry.

⁴² *QSLJJZLJY*, 294 and 206. On the technology, see Elvin (1996), 67–68, 84, 88–92.

⁴³ Elvin (2001) gives more details.

⁴⁴ *QSLJJZLJY*, 203–204 gives a case for 1761 from Hami in the far northwest, noting that coal there was 'assuredly much more economical than firewood.' Page 296 gives another case in 1780 for Miyun not far from Beijing.

⁴⁵ *QSLJJZLJY*, 209 from Shanxi province in 1856 describes the breakdown of the state licensing system, extortionate behaviour by local government clerks, and the illegal reopening of mines that had been sealed up. The phrases in quotes come from following item, from Guangdong province, which dates from 1863, and is a forceful expression of central government fears. Allowance has to be made for both of these being in the disturbed period of the mid-nineteenth-century rebellions.

(3) Compared at least to England and Wales, there seems to have been a lack of skill in managing woodlands as sources of a continuing supply of timber and firewood.⁴⁶

That the Song was approximately the changeover point for the first two of these points emerges from some remarks of Chen Fu, the Song-dynasty agronomist:

When the fields were divided up in ancient times, it was the system always to have some fallow land for pasture.... In this way stock-raising and grazing were properly provided for. The animals were large and fat, and did not suffer from skin infections.... In later times there have been no fallow lands for pasturage, and since then [cattle] have not been properly provided for.⁴⁷

Tree plantations were known in mediaeval China, if we can include orchards under this heading. Plantations for same-age same-species timber-trees appear in the second of our two periods, most notably those of *Cunninghamia lanceolata* ('Chinese fir'). Timber-based local economies could be found in late-imperial times, sometimes run by large commercial companies with sophisticated premodern machinery. Most of these seem, however, to have been based on straightforward plundering,⁴⁸ resembling more the earlier days of the American lumberjacks than *Gartenbau*, though in a few places one can also find reforestation.⁴⁹

Running through the last thousand years, at a variable speed, but only rarely stopping entirely, was the long-term development of an ever-more sophisticated agricultural intensification that is our central theme. The core of this process was the production, on the basis of a probably slightly falling area of lowland land per person, of a more valuable household output through (1) technological refinements like improved seeds or more efficient pumps, (2) subtle experience-based environmental adjustments to specific local conditions of terrain, vegetation, fauna, water-supply, and soils, and, annually, to the variations in the prevailing weather, (3) symbiosis and synergy in the choice of crops and their uses (including conservation of the fertility of the soil) notably by means of rotations, multi-cropping, and intercropping, (4) optimal use of available

⁴⁶ Both coppicing and pollarding were known in late-imperial China, but there is insufficient evidence to establish how widely they were used. It seems that the Chinese generally treated trees somewhat similarly to crops as regards planting and harvesting. See Nicholas Menzies (1985), especially pages 621–623 and 626–629. On the developing shortages of both timber and firewood, see Elvin (2004), chapter 3. For the British Isles, see Rackham (1986).

⁴⁷ Elvin (1996), 26.

⁴⁸ Elvin (1993), 36–37, and id. (2004), 37–39.

⁴⁹ Elvin (2004), chapters 3, 4, and parts of 9.

family labour-power and skills, including both women and children, the details depending on the family's current position in the family age-cycle, but also comprising such non-farm components contributions to home-based artisanal industries like spinning and weaving, and (5) the exploitation of the market for the sale of farm and handcraft produce and of off-farm labour, the purchase of inputs like fertilizers and raw materials for home industries, such as raw cotton or cotton thread, and, finally, the renting in or out of assets like farmland and draught animals. Household planning had also to incorporate provisions for meeting the land tax, labour-service obligations on males, and the cloth tax on women. Finally, as the environmental buffer against natural and man-made disasters diminished with the clearing of ever more land, and the loss of woods, reducing access to wild plants, birds, fish, and game, an economic buffer to some extent replaced it – even if never fully adequate – as the meshes of the market economy grew finer.

Agriculture was thus embedded in an economic, social, fiscal matrix that extended far beyond the domain of farming in its restricted sense.

Chinese intensification in a comparative context

What did intensification mean in practice during the final period of the late-imperial economy, let us say roughly from 1700 on?

Since the Chinese normally thought of yields in terms of the volume of a given crop per unit area, it is not easy to find materials that let one estimate the crop in terms of seed sown to yield harvested. We have, for example, a reference from 1730 to a seed: yield ratio for wheat, *Panicum crus-galli*, and other dry-land crops in the far northwest of between 1:13 and 1:14,⁵⁰ and a more detailed account of about 1:36 for wet-field unhusked rice sown to husked rice put in the barn for Jiaying some time in the eighteenth century.⁵¹ There are, however, so few data of this sort that there is no reliable way at present of knowing how typical these ratios were. I would guess that the second represents good but not necessarily best practice for its area.

In the southern half of China a large proportion of fields were double-cropped, or even triple-cropped. Thus the average total annual output of a given area of farmed land was considerably larger than just its main cereal crop alone. In Table 11.1 I have rearranged in a simplified form the more important items in a southern farming calendar published by Bao Shizen in 1844 so that the possibilities for double-cropping are easy to see. The underlined entries show the time of planting in the final location (ignoring any prior preparation

⁵⁰ *QSLJJZLJY*, 73.

⁵¹ Translation of the data and numerical reconstruction in Elvin (2004), 208–209.

in seedbeds) and the entries in bold type that of harvesting. The calendar is cyclical, and the vertical lines indicate the months when the crops were in the fields. Thus rice on the one hand and colza (*Brassica rapa*) or broad beans on the other could have been grown in the same fields at different times of the year. The same applied to late wheat and barley on the one hand and soybeans, millet, and maize on the other. It should be borne in mind when looking at this table that the sowing and cropping dates would have been somewhat variable, depending on the location of the farm and the year's weather. It is also worth noting that for several crops manure was applied in the course of the growing season, which seems to have been a new refinement during the second period. (It is marked with a '*' in Table 11.1.) Bao's comments on the triple use of land are worth quoting:

Two harvests [of rice] are common in the southern regions. For the first harvest [the farmers] transplant the rice-shoots just as for early-ripening rice elsewhere. In the middle of the sixth lunar month, ten days before reaping, they broadcast seed beneath the stalks of grain ['Rice2' in Table 1]. When the first crop is cut, the sprouts of the second are four to five inches high. They are weeded with a hoe, as in dry farming. At the end of the eighth lunar month they are harvested, and barley planted as usual.... After the early-ripening rice has been harvested it is [also] possible to plant buckwheat for reaping in the eighth lunar month, and before this harvest to scatter-sow mud-beans beneath the grain-stalks in the same way as the second rice crop is sown. So long as there is plenty of fertilizing power, the fields are not damaged.⁵²

Speaking for the moment only of settled lowland agriculture, since the farming and especially the transient cultivation of the uplands is still poorly documented, when Chinese nonstop multi-cropping and the continuing use of fallowing in northwestern European farming at this period are further taken into account, it is evident that, as of the eighteenth century, south China by a large margin, and northern China by a more modest margin, must have surpassed Europe both in cereal seed-to-yield ratios averaged over a run of years (rather than as measured by individual harvests) and in the mean worth of farm output per unit of farmed area per year, using any reasonable measure of value. It is far from clear, however, if China was ahead or behind northwestern Europe on yields per hour of human labour. My guess would be that it was at least slightly behind, possibly substantially behind, because of the need to devote many more hours to the collection and preparation

⁵² Elvin (1996), 75–76. Rough Western dates are in Table 1.

of the large quantities of fertilizer needed to maintain the productivity of the soil, and also in the South to dredging the irrigation and drainage channels and repairing their fragile mud walls, as well as those of the barrages of water-control systems. Figure 11.1 suggests to the relatively wasteful use of around a third of farmers' energy, but his question is, in a serious sense, still undecided.

It is fair to say that in the domain of agricultural intensification, the foundation of many other social and economic feature of late-imperial China, and the source of many late-imperial environmental pressures, the divergence between China and Europe had been a long time in the making.

Complementary considerations

Chinese commentators in Song times from the economic heartland in the lower Yangzi valley often associated the low technical level of farming in relatively remote and backward parts of the empire with a low local density of population. Thus in the twelfth century, one scholar wrote that in what is today Hubei province, 'The land is thinly populated, and they are slipshod in their methods of cultivation. When they sow, they do not plant out, a practice which is popularly known as "diffuse scattering".' Another commented on the same region that, 'The land is so sparsely populated that they do not have to bestow any great effort on their farming. They sow without planting or weeding. If, perchance, they have weeded, they do not apply manure.... They cultivate vast areas, but have poor harvests.'⁵³ It is likely that what appeared as carelessness to observers from the more developed regions was in fact efficiency in the use of labour-time. In the context of what has been suggested earlier about the probable pressures from unit-area taxation, it would be interesting to see if it can be determined if, in this early phase of rice cultivation in such places, the state was still imposing quotas per unit-area that reflected an earlier, and less-developed, stage of agriculture, and, if so, how they in due course undertook to increase them.

Near the other end of the approximately millennial development of Chinese Gartenbau, we have the well-known contrasting picture painted by the Jesuit fathers in the middle of the eighteenth century:

Many farmers have a refined knowledge of weather and time, or, in other words, of the sequence of seasonal change, each one of them as it applies to his own small area.... The little extra efforts and knacks, inventions and discoveries, resources and combinations, which have caused people to exclaim

⁵³ Elvin (1973), 120–121.

at miracles in gardens, have been transported on a large scale out into the fields, and have done marvels....

They are not content to determine what sort of manure is suitable for each soil. They go on to desire that account be taken of what has been harvested, and what is to be sown, of the weather that has gone before, and that chosen [for a particular operation]....

That which has struck us most forcibly in our observations of the Chinese is that man who farms one acre instead of three is neither short of time, nor overwhelmed with work.... It is by these means that heavy toil is kept to a minimum, and the small cares of cultivation become the norm, wherein he is assisted by the women and the children.... [The small lands] of peasant proprietors are of an astonishing fertility, in contrast with the large estates.⁵⁴

The good fathers were inclined at times to romance a little about the virtues of the Chinese system,⁵⁵ but they were acute and sinologically literate observers. Their remarks about the part played by women and children in farmwork can be supported for the southern half of China by contemporary local gazetteers, poems on everyday life, and, for the early twentieth century, by photographs of women in the fields.⁵⁶ This use of female labour in farming, though at variance with ancient ideological norms, was an economically rational response to the perceived need for intensification.

The small size of the holdings owned by peasants in late-traditional times has often been associated with Chinese partible inheritance of lands among male heirs, and Muramatsu Yûji long ago documented for the close of the empire and the early years of the Republic the downward pressure on holdings of inherited lands caused by dividing them up in this way.⁵⁷ There is truth in this, but, for it to have any strong effect on intensification, the partible inheritance system needs to be placed a historical context of land shortage. When land can be opened easily or rented cheaply, it is labour power that is the determining factor in farm-family economics. It is also arguable that the most significant size as regards intensification is that of the unit of operation, rather than ownership as such, and this will be significantly affected by the labour power available to a family at any given moment, and its related renting in and out of land.

⁵⁴ Commented on in Elvin (1996), 13–14.

⁵⁵ As one of them so much as admitted, with a self-critical smile. See Elvin (2007), 14.

⁵⁶ Elvin (2004), xxvii, 209–211, and 213; Elvin (1998), 160–165; *Zhongguo nongcun diaocha ziliao wu zhong* [Materials from five surveys of Chinese rural villages] I, plates on unnumbered pages of photographs pages 16 and 17.

⁵⁷ Yûji (1949), xxx.

Last of all, to what extent were population dynamics – the age-pattern of female marriages, the age-pattern of mothers when their children were born, and the age-specific death rates – an independent variable? Recent research has shown three distinctive features for the lower Yangzi valley in the mid-Qing: a very high infant as compared to adult mortality, a mean age at marriage for females of about 17 years of age with cases clustered very tightly around the mean, and the ability to limit the birth rate within marriage after a fairly fast start to childbearing.⁵⁸ These suggest a straightforward historical interpretation of the celebrated Qing surge in population, insofar as it was not an artefact of improved statistics:

The social impact of the desire to quickly and securely replace the household labour force increased its hold on the region as rural servitude (more prevalent in south China than the north) weakened and then virtually vanished by the early Qing. Women and children were also of more use at an early age in high-intensity *Gartenbau* than in the older more extensive styles of agriculture. Hence support from the older generation for the almost universally early female first marriage. A fairly rapid start to childbearing aimed at replacement as soon as possible before anything went wrong, but would be eased off once two or three children had reach an age between five and ten years, when child mortality had dropped dramatically, and the future was relatively assured. The Chinese were aware that too rapid childbearing, without spacing, was good for the health neither of a mother nor her children,⁵⁹ and also, we can probably assume, that more than a fairly limited number of children could have damaging effects on the household budget. For the moment this pattern can only be demonstrated as applying to the lower Yangzi valley, but here it fits in plausibly with everything relevant we know or can reasonably conjecture.

The theoretical model

The patterns sketched in the foregoing sections can be condensed into a rudimentary formal model. Figure 11.1 shows a hypothesized pattern of rising yields in a given unit area ('field') for increasing inputs of hours of labour. The 'non-intensive' and 'intensive' farming form a continuum, but a moment

⁵⁸ See Elvin and Fox (2009); and Elvin and Fox (2008). For data and programs, see Mark Elvin, Josephine Fox, and Tzai-Hung Wen, 'Qing Demographic History. The Lower Yangzi Valley in the mid-Qing', website <http://www.sinica.edu.tw/~wenthung/Demography/index.htm>.

⁵⁹ Angela Leung, 'Autour de la naissance: la mère et l'enfant en Chine aux XVIe et XVIIe siècles,' *Cahiers internationaux de sociologie* 76 (1984).

Figure 11.1 Illustrative relationship for North China, early 20 C, of the input of owner-farmer labour-time to crop yield from a given area under premodern conditions

of transition from the first to the second can conveniently, if arbitrarily, be defined as the moment when the rate of growth of the continuous curve showing yields for the input of labour-time, having previously increased steadily, starts to decrease. Here the inflection is around *e* at point (9, 10.128) on the L and Y axes. This transition can also be seen more dramatically in the dashed curve which represents the size of the increase in yield for the last time-unit of labour input up to that point. Note that, in order to make it easier to read, it follows a different scale along the right-hand margin, though the units of measurement are the same.

The significance of this definition is this: if cultivable land were freely and readily available, and labour was the only input that was limited, and the farmer had a total of 18 units of labour-time available to him, then, since 9 units produce a yield of 10.128 units but 18 labour-units, applied to one-and-the same field, only 19.047 units of output, this transition point would roughly be where he would do better to shift half of his labour to an additional

second field, so his total yield is 20.256 units. Of course in real life considerations of the actual or implied rental costs of the second field, and other factors, intervene.

The curve used here is a logistic, but it needs to be stressed that, while this is plausible, it is not based on empirical data. The parameters selected, and listed in the lower left-hand corner of Figure 11.1, are also plausible but formally arbitrary. The calculations for matters related to taxes are, however, based on data from the first case from Wagner cited in Excur-sus A. Another caution that needs to be made is that the curve shown is not symmetrical, first appearances notwithstanding. It is also likely to have been very significantly different in varying real-life circumstances, according to particular environmental, technological, and socio-economic factors.

Nonetheless, the basic economic logic, which it can now be used to illustrate, is simple:

The main curve (the solid line that goes from the lower left to the upper right) represents the output from the unit of land. It is represented in units of yield along the vertical or Y axis. It can be thought of either as physical output of a single crop or, more usefully, as the cash value of a complex mix of crops as shown in Table 11.1. As the input of labour increases (measured along the horizontal or L axis) the rate of yield for an extra input of a unit of labour falls towards zero. (A maximum possible output for given technology is set notionally at 20.) The ratio of extra marginal input to extra marginal output (dY/dL) rises to the point $L = 9$, where it becomes momentarily stationary ($d^2Y/dL = 0$), and then gradually decreases, as equal amounts of work bring in less and less return. We have defined this (that is, e in the graph) as the point of transition from non-labour-intensive cultivation to labour-intensive farming. Obviously the actual transition will have been less clear-cut in real life than this. The input of just a moderate amount of extra labour after point L_e will bring in more in the field already opened up than just starting a new field whose cultivation is not done very thoroughly.

It was apparent, however, from the first of Wagner's cases that it is the net profit that is likely to have the strongest impact on peasant motivation, and not the total output. We have therefore to reconceptualize the meanings of the diagram. Net profit before tax was in this case about 15.88% of the total income. After tax it was about 12.5%. On the graph the amount of output needed for tax out of the pre-tax profit is shown by the arrowed line YT and the amount of labour needed to produce it by the arrowed line LT. Seen in this context the tax was equivalent to about 36% of the pre-tax profit, and a very serious burden. This farm was a relatively prosperous one, and the situation for most tenants was fairly certainly much less favourable.

A moment's examination of the scored line, showing the 'momentary'⁶⁰ ratio dY/dL , in the areas to the right of point t , shows – at least in one quite reasonable perspective – that the effect of the need to pay tax under these circumstances is 9.5 units of work, just below half of the total labour input, at a steadily falling efficiency as regards the production of output. Looked at another way, we could say that for an owner-farmer buying more land (valued in this area at this period at 2.8 times its proper economic cost in terms of annual output) in order to increase the productivity of labour would seem to have been to a significant degree checked by the loss that this would entail for ordinary farmers, without social immunity from overcharging, from tax levied on the basis of the farmed area.

To the extent that rent was paid on a per-unit-area basis the same would have held, *mutatis mutandis*, for tenants. Actual conditions, as has been noted, varied more widely as regards payment of rents than of taxes. Speaking generally though, rent would always have tended to have exceeded tax by a significant margin to allow the landlord, assuming he was effectively taxed, his own margin of profit.

Conclusion

The terms on which farmland was taxed thus seems likely to have had a more than trivial impact on the environment. If the hypothesis presented in this chapter stands the test of time, it seems hard to avoid the conclusion that penetrating to the heart of the origins of China's most pressing long-term environmental problem, namely her population, huge relative to her resources, and based on intensive agriculture, requires going far beyond environmental history as ordinarily conceived in order to do environmental history.

Much more work is of course needed on the earlier centuries of this process, during which the pattern described in these pages was originally crystallized. I have already begun to assemble materials for this, but it is a slow business.

*Tarago, New South Wales 2007, and
Long Hanborough, Oxfordshire 2008*

Editorial notes

'...': direct quotation from an identified source; quotes outside stop and comma.

⁶⁰ The inverted commas are a reminder that in fact the calculation is based on steps of finite size and is not in fact continuous.

'...' : all other uses (such as contents to be considered as a word not a meaning);
quotes inside stop and comma.

x'x : syllable break in a Chinese word where transcription is otherwise ambiguous.
All italics in quotations have been added by the present author.

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