# Forest History and the Great Divergence: China, Japan and the West

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Abstract

This paper surveys changing interrelationships between man and the earth's forest cover over the past several centuries. The focus is on the interplay between population increase, deforestation and afforestation at both ends of Eurasia. By looking at three numerical indicators—percentage forested, per capita forest resource and the population elasticity of deforestation, Japan is compared with Lingnan, south China, and the East Asians with two European countries, England and France. Based on the two-way comparisons, the paper examines the proposition made by Ken Pomeranz that although both ends of Eurasia were ecologically constrained at the end of the early modern period, East Asia's pressure on forest resources was 'probably not much worse' than in the West.

# I

There is a widely accepted view that the rise of a civilisation is accompanied by an increase in population, which after a period of balance, outstrips its material base, leading eventually to the destruction of the environment. This is a popular view. But it is worth emphasising that the view is in line with the classical Malthusian theory of population. Malthus himself did not refer to forest, but he could have easily accommodated forest in his theory of population pressure on land. Thus, when population grew forestland receded, while population stagnation (or decline) was followed by the spontaneous return of the forest; but once population increase became sustained, the continuous destruction of forests started.

In history, we have a number of accounts by contemporaries, as well as by later-day historians, that are not inconsistent with this interpretation. Take the Japanese case, for example. In the seventeenth-century when peace returned after a prolonged period of war, with population increasing, farmland expanding and castle towns being built, the Confucian scholar Kumazawa Banzan saw a number of forests cut down and hills denuded. He went on to suggest that the country's forest cover must have followed a Malthusian-like cyclical movement corresponding to alternating periods of war and peace, and to alternating deceleration and acceleration of population growth.[1] If this would go on for millennia, its history would never be sustainable. Indeed this is exactly what Mark Elvin says about China, whose environmental history is portrayed as 'three thousand years of unsustainable growth'.[2]

Two centuries later, when a mission led by Prince Iwakura travelled Europe, the official chronicler of the journey Kume Kunitake made the following observations:

> 'Before the advance of industry in Europe, in an age when people did not know that iron could be used in place of timber, vast woodlands were cut down and forests decimated in Greece, Spain, France and Britain.

[1] Kumazawa Banzan, *Daigaku wakumon*, cited in Saito 1998, pp.140-141.
[2] Elvin 1993.

> 'The level plains of Prussia, too, were once covered with extensive woodlands, but *population increases have led to much of this being cleared to make way for cultivation and pastureland*, so that only a quarter of the forests remain and trees are now increasingly rare.[3]

They learnt that in historic Europe too, there was a close association between man's procreation and deforestation.

On the other hand, however, what we are witnessing *now* in many parts of the world is a kind of forest rehabilitation in formerly degraded areas. The present-day French Pyrenees, for example, is greener than in the seventeenth century.[4] The area of woodlands in Great Britain has doubled since 1919 when the Forestry Commission was established in the government.[5] Today, while deforestation is still going on in developing countries, especially in tropical rain forest areas, *afforestation* takes hold in many developed countries. This latter phenomenon reflects, first, the substitution of forest and other organic resources by a mineral-centred material base which characterised the English industrial revolution in the late eighteenth century and the subsequent industrialisation processes in other European countries.[6] The iron and steel industry is no longer a predator of the forest reserve, and its products are used in place of timber. This move eased the population pressure on the forest resource substantially. However, other factors were also operating in the European past. One such factor was the establishment of forestry as a science of resource management and rehabilitation. It was Germans who pioneered in this field. But even in England where deforestation had been taking place extensively, there grew interest which placed emphasis on the planting of trees. One reason was undoubtedly fears of timber shortage. But more importantly, there emerged a new 'non-utilitarian attitude to the natural world' at the upper levels of society. Landowners and the middling sort of people began to see the landscape differently, which marked the beginning of the present-day concern for forests as a component of the landscape as well as the

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[3] Kume 2002, III, pp.209, 270.
[4] Fruhauf 1980.
[5] Henderson-Howat 1996.
[6] Wrigley 1988.

natural environment in general.[7]

This suggests that there were two somewhat different scenarios in the history of the interplay between population and forests. One is the conventional story of continuous degradation, which is still a plausible story in, at least, some parts of the world. The other is a U-shaped pattern of deforestation and afforastation. The latter may be best illustrated in a very long-run process of interrelationships between population, farmland and forest areas in France, probably one of the best-documented countries in the world as far as forest history is concerned. For the first six to seven centuries population and farmland moved in much the same way, while forestland's ups and downs went in the opposite direction. Population increase was followed by the clearance of forests, and hence by an increase in farmland: the cycles were Malthusian. This long period of Malthusian cycles was followed by a modern phase of afforestation. As long as the early modern and modern periods are concerned, therefore, a U-shaped pattern becomes apparent. The 1990 level is a return to that of *circa* 1600.

The U-shaped pattern may be regarded as a corrective to the conventional story of continuous deforestation. What I would like to argue in this paper, however, is that two contrasting forces were at work in history. One is exploitation of natural forests, and the other regenerative forestry. In response to rising demand for forest products, an entrepreneur will go to a forest to cut down trees and bring them to the market (here is a question of who owns the forest; and also involved are cost-benefit calculations in which geography plays a crucial part in many cases). When the entire hill is denuded, in this exploitative mode the entrepreneur simply moves on to another hill, leading to a continuous process of deforestation. In the regenerative mode, on the other hand, felling is combined with re-planting; a rotation system is one of its oft-used methods. This allows the entrepreneur to stay with the original site, increasing the level of land utilisation and thus enabling him to maintain his market-oriented silvicultural business.

As the U-shaped scenario suggests, there are cases where the two modes appeared

[7] Grainger 1981, and Thomas 1983.

as stages of development. However, we need not to assume that the two appeared always in succession in history. There could be a time period in which both destabilising and stabilising forces worked side by side. Indeed this paper will show that early modern East Asia was in a forestry regime of this kind, and also that what took place in Japan after this phase was in sharp contrast with what happened in imperial China. Indeed, it is very likely that a substantial divergence emerged within pre-modern East Asia. According to the work by Conrad Totman on Tokugawa Japan, there took place a significant shift from exploitation forestry to regenerative forestry and the turning point was the late seventeenth century.[8] Based on this work, John Richards concludes that 'despite the rise of silvicultural knowledge and practice, only Tokugawa Japan appears to have done this relatively successfully—but only with strict rationing and conservation measures'[9]. It is of particular interest, therefore, to see whether or not there existed significant differences between traditional China and Japan in terms of deforestation with respect to population growth, and if pre-modern East Asian forest situations were no much worse, to explore whether this was, as Richards suggests, the result of stringent state regulations. That is, to ask whether deforestation accelerated or decelerated in each country over the period from traditional to modern times, and what forces were at work throughout the early modern and modern periods of the two East Asian countries.

## II

The idea that there must have been a phase in which the destabilising and stabilising forces worked side by side occurred to me when I read Ken Pomeranz's stimulating *The Great Divergence*. One of his arguments is that in the eighteenth century, China and western Europe at both ends of Eurasia were ecologically in serious trouble, implying that it was after 1800 that both went divergent.[10] One area he explored quantitatively is the relationship between population and forestland in Lingnan, China's 'second most commercialized and densely populated macro-region', and in France, a country singled out as representing western

[8] Totman 1989
[9] Richards 2003, p. 622.
[10] Pomeranz 2000, ch. 5.

Europe in this respect. His conclusion is that although both regions were ecologically constrained at the end of the early modern period, China's pressure on land resources was 'probably not much worse' than in France, and more specifically that 'with respect to trees and soil, the rate of decay in China was probably slower than that seen in eighteenth-century Europe'.[11] The East-West gap became apparent only when the West switched to resource-intensive production regimes.

This is a strong argument. However, I have a couple of methodological quibbles with his comparative analysis. One is that Pomeranz's analysis is a straight, two-way comparison between East and West. However careful he may have been in the selection of areas studied, it is a dichotomous comparison, which cannot rule out the possibility that divergence, if any, in a pre-industrial context may have been found, not necessarily between East and West, but also within each of the pair, especially *within the East*. The second is that Pomeranz does not explicitly relate this environmental question to another theoretical issue he raised with respect to the question of the Great Divergence, i.e. market forces. While the level of commercialisation in agriculture and processing industry is extensively surveyed for both China and the West, no investigation is made with respect to the question of whether or not market forces played a part in slowing down the rate of forest degradation in East Asia.

In addition, there are a couple of technical problems as well. One is a measurement problem. In order to assess how serious the ecological problems were, two separate measures may be used: average and sensitivity measures. Pomeranz provided 'percent forested' and 'fuel supply per capita', both of which are average measures. Unfortunately, however, when he talked about the 'rate of decay', no sensitivity measure was explicitly used in order to compare Chinese rates of change with those for France, although it is evident that in order to arrive at those average figures, he did use a concept of numerically defined relationship between deforestation and population increase, which is expressed as:

$$\triangle F \div \triangle P,$$

[11] Pomeranz 2000, p. 236.

where $F$ stands for forestland and $P$ for population. When $\triangle F$ takes a negative value, $\triangle F/\triangle P$ indicates lost forest per additional person. The use of this coefficient in his calculation implies that Pomeranz actually tried to measure, as a parameter, the sensitivity with which deforestation proceeded with respect to population growth.

However, as a sensitivity measure, *elasticity* is a better one. In this case, it is expressed as:

$(\triangle F/F) \div (\triangle P/P)$,

which measures a per cent loss in forestland with respect to a per cent increase in population. Apparently the former coefficient is affected by variation in the size of forested land or population, or both, whereas this population elasticity of deforestation is not.

The second problem is concerned with the period covered. Pomeranz looked at Lingnan in the 1753-1853 period and compared the Lingnan situations with those in late eighteenth-century France. However, the comparisons should be placed in a much longer-term time frame. There are a couple of reasons for this. First, situations in a period immediately before the new era began may not be assumed to be representative of situations in the early modern period. Second, over the longer-run, the parameter may have changed. It is likely that the population elasticity would decrease with the declined level of forest cover; but it is equally likely that deforestation would accelerate, rather than decelerate, under a certain set of circumstances. Ideally, therefore, population elasticities should be examined period by period, covering the entire period with medieval, early modern and modern times combined, thus allowing elasticity estimates to change from period to period.

## III

This can be done, thanks to the United Nations' Geneva Timber and Forest Study,

for two of the European countries.[12] Estimates, however crude, of both population and forest areas in England and France are available for several benchmark years from the High Middle Ages onwards. For Japan and China no medieval data are available, but calculations can be made for both early modern and modern sub-periods.

As far as south China is concerned, figures and percentages assembled by Robert Marks and Ken Pomeranz about Lingnan provide us with estimates for three benchmark years, 1700, 1853 and 1937.[13] It is obvious that south China cannot represent the whole empire, but the size of this macro-region, 39 million hectares, is large enough to make a comparison with Japan and other countries significant. Its climate and flora share the same characteristics with Japan, although Lingnan is a little more subtropical. Moreover, Lingnan was one of the macro-regions where eighteenth-century population growth was strongest, which will make the pre-modern Lingnan-Japan comparison particularly revealing with respect to the impact of population increase on the region's forest cover. According to Marks and Pomeranz, the forested area was 18,300,000 hectares in 1700, which declined to 2.900,000 hectares in 1937. During the same period, population is estimated to have increased from 11,500,000 to 47,600,000 (see Table 1, lower panel).

For Japan after the mid-nineteenth century, there are two series of data. One is government land statistics and the other geographers' estimates based on the Geographical Survey Institute's successive 1 to 50 thousand scale maps. The government statistics is yearly but subject to frequent changes in definition and category. The geographers' are compiled by Yukio Himiyama and his associates, available only for benchmark years of 1850, 1900, 1950 and 1985. Their results, especially those for prewar years, give us substantially larger forest-area estimates than the government's forestry statistics. But Himiyama's methods are systematic and mutually consistent, so changes that actually took place in land use are likely to be better reflected in the Himiyama series than in government statistics which are said to have been affected by frequent changes in definition and category. Also, the Himiyama estimates start with the end of the Tokugawa period. Since the

[12] UN Economic Commission for Europe 1996.
[13] Marks 1998, and Pomeranz 2000.

government statistics began in the Meiji period, this is of considerable merit. For the period after 1850, therefore, the Himiyama estimates will be used. They give 24,818,000 hectares for the forested area today, which is only slightly smaller than that of 25,497,000 hectares estimated for 1850 (see Table 1, upper panel).

For earlier periods, no such estimates are available. However, a cursory look at the Tokugawa historiography reveals that there were two areas in which important moves took place. One is in the supply of timber. There is evidence that the period of 1570-1670 saw a vast number of trees depleted since the demand for construction timber was strong in that period of population growth and town building. After the late seventeenth century came an age in which plantation forestry was established. Increasingly trees, especially conifers, were planted in cut-over places, felled forty to fifty years later, then sold at the market. This county-wide emergence of regenerative forestry implies that the proportion forested declined during the seventeenth century but returned to the initial level by the end of the Tokugawa period.[14]

The other story is concerned with agriculture. The period of timber depletion was coincided with that of land reclamation. Most of arable fields created during this period were found in marshy flood plains, implying that reclamation itself was not associated with the clearing of forests.[15] However, recent case studies have shown that peasants did clear the wood on the village common in order to create grassland for collecting a vast amount of grasses. The grasses were put into compost, mixed with cattle excrement and used as fertiliser. This type of home-made fertiliser, widespread in western provinces, played a significant role in yield growth but caused the denudation of village-owned hills. No return of the wood occurred in those grasslands since peasants kept using the commons for that purpose.[16] Himiyama and others give an estimate of 4.4 million hectares for 'rough land' in 1850, showing that the area consisted of village commons used for grass cutting as well as fuel gathering, fields used for sifting cultivation, completely

[14] Totman 1989, and Saito 1998.
[15] Saito 1998.
[16] Isoda 1996. See also Chiba 1991, and Mizumoto 2005.

denuded forest areas and other types of 'rough land'.[17] It is difficult to determine exactly what proportion of the 4.4 million hectares had been converted from the 'forest' category to the grassland type of village commons since the early seventeenth century, but an assumption may be made that as much as one-third of this total 'rough land' area in 1850 had been wooded in 1600.

All this gives us an estimate of 27 million hectares for Japan's forest area at the beginning of the seventeenth century. Given the nature of the evidence we have, this estimate is probably on the high side. For the corresponding figure of population I choose 17 million, which is substantially larger than Akira Hayami's widely accepted estimate of 12 million.[18] According to my estimates, therefore, the degree of deforestation during the period up to 1850 is probably *over*stated and that of population increase somewhat *under*stated. In other words, it should be noted, the population elasticity of deforestation calculated from these figures is likely to have an *upward* bias.

## IV

Let us now have a look at the average measures of deforestation for the four countries. Tables 2 and 3 set out the proportion of forests to the total land area and the forestland per capita. Both tables broadly confirm that both England and France exhibit a U-shaped curve. For East Asia, since the time period covered is short, it is difficult to identify a long-run trend; seemingly Lingnan's is continuous deforestation, while Japan exhibits long-run stability.

[Table 2; Table 3]

In addition, there are some more findings that merit attention. First, England's forest cover in the High Middle Ages was already much thinner than on the European continent. It is difficult to know to what extent this was a historical consequence of the Saxon invasion, and to what extent explained by the British Isles' climatic or geological conditions. Whichever the explanation, it is evident

[17] Nishikawa et al. 1995, pp.4, 78-79.
[18] Reported in Miyamoto 2004, p.38.

that there were already substantial differences in the initial conditions within medieval Europe.

Second, Lingnan's early modern level of 1.6 hectares in per capita forestland comes between the medieval English and French levels, and its mid-nineteenth century value of 0.3 hectares in the middle the early modern English and French levels. In terms of the proportion forested, moreover, Lingnan in the mid-nineteenth century was clearly higher than the French level at the beginning of the eighteenth century. These findings, while not entirely consistent with Richards' account of China's forest cover steadily disappearing during the late imperial period[19], seem to support Pomeranz's claim that in the eighteenth century China's ecological situations were 'probably not much worse' than in France.

Third, however, different contrasts emerge if we turn to changes over time. In the long history of deforestation, the largest reduction in forest cover of both England and France occurred before the end of the seventeenth century, not in the eighteenth century, nor in the subsequent century of industrialisation. In contrast, the tempo of Lingnan's deforestation became faster during the late nineteenth and early twentieth centuries than in the earlier period. Ways in which deforestation proceeded during the early modern period were thus different.

Fourth, Japan's initial level of forest cover was high, over 70 per cent, and exhibits little change in the subsequent four-century period. The proportion forested in 1985 still stood at 67 per cent. Her per capita forestland, on the other hand, displays a steady decline as population increased. Taken together, it suggests that the relationships between population change and deforestation were somewhat different from those operating in the other countries.

This final point leads us to examine our third measure, population elasticity of deforestation, which measures the sensitivity of decline in the forest area with respect to population increase. The elasticity of -0.1, for example, implies that a 10 per cent increase in population was followed by a mere 1 per cent decline in the

[19] Richards 2003, ch. 4.

forest area; on the other hand, a much higher elasticity of -1.0 means that a 10 per cent increase in population resulted in a 10 per cent loss of forest cover. Unlike the previous two tables, the calculation is made for the intervals between all the benchmark years indicated in Appendix tables. From Table 4 and Figure 2, three observations can be made.

[Table 4; Figure 2]

First, the pattern of change over the second millennium is surprisingly similar for both England and France. True, there are some noticeable differences between the two graphs, such as more serious forest degradation taking place early in modern England than in France in the same period, eighteenth-century deceleration in deforestation being more marked in England than in France, and France's drive for re-forestation more intensive than in England in the nineteenth and twentieth centuries. However, it is also true that these differences look minor if compared with the broad pattern of change: that there occurred an acceleration of degradation in the early modern period, but deforestation became less serious in the eighteenth century and afforestation advanced since the nineteenth century.

Second, Table 2 and Figure 2 confirm that deforestation in eighteenth-century China was not much worse than in western Europe in the same period. In elasticity terms, too, the Chinese level comes in between the English and French levels in the eighteenth century. As Pomeranz argued, the 'great divergence' took place after this stage. However, it should be noted that as for Europe, the eighteenth-century levels were not a good indicator of what was happening in the early modern period. In the eighteenth century, Europe was in transit from the stage of deforestation to that of afforestation. For Lingnan, south China, unfortunately, it is not possible to extend the calculation of elasticities back into periods before 1700. However, Marks's study on Lingnan shows that there were close links between population growth, the expansion of food base and the clearance of forests, suggesting that if two of the three are known, conjecture may be made about the third. According to his estimates, both population growth and arable expansion between 1700 and 1853 were fastest in the entire period since the end of the fourteenth century. The rates of increase in the period up to the

mid-seventeenth century were modest, while during the Ming-Qing transition the arable area increased only marginally and population even decreased.[20] It is very likely, therefore, that the elasticities had remained at modest levels from the Song to the early Qing, and hence, that there had been neither an acceleration nor a deceleration in deforestation during the period up to 1700.

Third, just as percentages forested did, the Japanese elasticities too seem to fit with the pattern of *long-run stability*. However, this does not mean that the original flora was kept intact, nor does it suggest that trees and shrubs native to the particular forest site were well protected. The stability in the level of forest cover was never a product of any conservationist policies or cultural beliefs. Forest tree species did change substantially as plantation forests advanced. Broadly speaking, the change was from broad-leaves to conifers. Today, there are more plantations of *sugi* (Cryptomeria japonica) and *hinoki* (Japanese cypress) than in the Tokugawa period.[21]

The paucity of numerical data for Tokugawa Japan does not allow us to break down by period, but there were two periods of deforestation throughout the early modern and modern eras. The first was in the seventeenth century. Literary sources strongly suggest that from *circa* 1570 to 1670, there was a timber shortage and the destruction of forests took place all over the country, with numerous reports of erosion and flooding and of village-versus-village, district-versus-district disputes flared up by such environmental hazards. Yet it should be remembered that even the very low elasticity of -0.09, estimated for the entire Tokugawa period, was somewhat overstated. This implies either that the degree of seventeenth-century forest degradation was comparatively less serious, or that the tempo of re-forestation in the subsequent period was substantially fast, or both.[22] The second period of deforestation was in the second half of the nineteenth century when industrial demands for fuel wood increased. But the degree of acceleration in this period was *considerably modest* compared with early modern European and with modern Chinese deforestation. Moreover, from about 1900 Japan entered a

[20] Marks 1998, pp.158, 280.
[21] Nishikawa et al. 1995, ch.1.
[22] Totman 1989, and Saito 1998.

stage in which the rate of felling trees exceeded that of planting trees. Apparently Japan took a path different from the Chinese path.

## V

The tripartite comparison of Japan, China and the West have made it clear that there were more contrasts than similarities. Contrasts among the countries were found not only in modern but also in traditional times; contrasts emerged within East Asia as well as between East and West. So the question is: what are the factors affecting these differential courses? More precisely, what factors made Japan's historical pattern so different from China's and from western Europe's pattern?

One obvious factor is agriculture, for in earlier stages of development, as we saw in the French case (Figure1 above), population increase, forest clearance and the expansion of farmland were closely linked. Undoubtedly, this also played a considerable role in Lingnan in the seventeenth and eighteenth centuries. The strong growth of population was accompanied by internal migration flows, which meant, in most cases, clearing forests on hillsides and in mountains. In Japan too, the seventeenth century saw an increase in population and in land reclamation. On the face of it, this suggests, as Totman did,[23] that this direct kink between population and the clearance of woodland was at work in early Tokugawa Japan. However, as we have already seen, the seventeenth-century expansion of farmland was made possible chiefly by converting low-lying, marshy areas in river deltas into paddy fields.[24] The only negative factor that was operating in relation to agricultural growth in this period was, as we have also seen, the clearance of woodlands near villages in the western provinces.[25] On balance, however, the loss of forests caused by the push of settlement frontiers into mountains must have been relatively insignificant in the case of seventeenth-century Japan.

Another factor is demand for forest resources, timber and fuel, which could act as a

[23] See charts in Totman 1989, pp.176-177.
[24] Saito 1988, pp.179-187.
[25] See references in footnote 16 above.

factor stimulating domestic regenerative forestry. It is evident that in modern western Europe both state initiative and market forces are operating in that process.[26] In pre-modern China and Japan, it was primarily market forces that were at work in making provisions for the domestic needs for timber and fuel. On occasion the market acted as an agent of exploitative felling, leading to massive deforestation. It was more likely to happen in areas where topography was not favourable for the spontaneous regrowth of the forest, such as granite hills in Mediterranean Greece and in Japan's Inland Sea coast, especially when large-scale construction works such as the building of new palaces, castles and towns were carried out. However, under some circumstances the market could also act as a *stimulus* to the emergence of regenerative forestry.

Take the Tokugawa case first. There is much evidence that the old growth was heavily logged in the seventeenth century. Forests after forests were cleaned to supply the materials for building castle towns. By the 1710s, however, a number of provinces became known as market-oriented suppliers of timber to metropolises such as Kyoto, Osaka, Nagoya and Edo. With this move, two different types of regenerative forestry emerged. One was a type of forestry dependent largely on spontaneous regeneration of the forest. This was possible only in areas where daimyo's regulations such as banned access and rationing were tightly kept. Kiso, Hida, Akita, Tsuruga and Tosa are its notable examples, most of which were large and powerful daimyo territories located in rather remote provinces in the north-east or the south-west. The other type was plantation forestry, in which more emphasis was given to replanting design and planning. This market-oriented type of timber production was mostly found in areas surrounding the metropolises. Ome, for example, was in Edo's hinterland while Tanba targeted the Kyoto market. There is evidence, according to a case study of Tanba, that in this type of the timber trade no particular intervention was made by the local daimyo government except for a transit tax—a relatively light levy of 5 per cent on each raft—collected at a river landing. Although the forest area was generally small in this type of commercially oriented timber production, its productivity was higher than in the case of forestry of the first type. As a result, during the latter half of the Tokugawa

[26] Morin 1996, and Henderson-Howat 1996.

period, output in areas of the plantation forestry type tended to grow faster than in provinces of the first type.[27]

Of the metropolitan markets, Osaka occupied a central place in the Tokugawa period as it was on the top of the country's distribution networks. Fortunately, there is a trade statistics for 1714, which enables us to examine the composition of Osaka imports shipped from various provinces of the country.[28] Since the 1714 statistics covered all the merchandise produced in rural provinces as commodities for Osaka (thus excluding tax rice sent by daimyo authorities themselves), Table 5 indirectly indicates the relative importance of the timber trade to other trades in the early eighteenth century. Not surprisingly rice and other agricultural products constituted the largest group, i.e. 39 per cent; next to the agricultural produce came textiles and then timber and chacoal, constituting 11 and 10 per cent respectively of the total value of imports. On the face of it, the level of weight does not seem to have been particularly high, but it should be realised that much of rural non-agricultural pursuits such as weaving and logging was done by village farm populations as by-employments. By the early eighteenth century, therefore, the 1714 trade statistics suggests that timber as well as cotton cloth had already been established as important commodities marketed in the metropolis. According to the 1736 trade statistics of a similar, though less comprehensive kind,[29] timber came not only from districts surrounding Osaka, but from remote north-eastern and south-western provinces as well. This suggests that at this stage the share of timber shipped from districts of the first type was still large, and it is expected that timber imports from nearby conifer plantations such as those in Tanba, Yoshino and Kumano of the Kinai region, as well as charcoal imports from similar districts, increased substantially in the subsequent periods.

The advance of plantation forestry became possible because importing foreign timber was not an option in Tokugawa Japan where the economy was virtually closed to foreign trade. There is evidence that this new type of forestry was

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[27] Nishikawa 1961, and Totman 1995, ch.4. For other districts, see Mihashi 1960, Murai and Takahashi 1960, Tokoro 1970, and Totman 1985.
[28] Oishi 1975, Appendix 2 to ch.3.
[29] Osaka-shi Sanjikai, vol.1, 1913, pp.769-779.

regarded by contemporaries as commercially viable. A look at farm and silvicultural manuals and encyclopaedias, published in increasing numbers from the turn of the seventeenth century, reveals that the writers encouraged commercially minded rural entrepreneurs to cultivate *sugi* (cryptomeria) and *hinoki* (cypress) as demands for construction timber remained strong. They argued that prices of good timber in metropolitan markets would rise more than proportionally to the size of timber, and that such high market prices would justify the input of labour and capital in a plantation business whose gestation period tended to be as long as 30-50 years. The manual writers thus provided entrepreneurs with techniques and general know-hows in forest management. Similar market linkages were, though to a much lesser extent, found for the cultivation of fuel wood as towns' demand for charcoal and fuel wood increased in the latter half of the Tokugawa period.[30]

Turning to south China, Robert Marks notes that 'By the twentieth century, the Yao btribesmen who Fenzel observed had taken to replanting trees after they moved on; but the Chinese did not do so then and probably had not in earlier times either'.[31] It seems true that ethnic minorities such as the Miao as well as the Yao played the prominent role in the timber trade from very early periods in south China,[32] and recent studies of documents concerning the Miao of south-eastern Guizhou and their cultivation of Cunninghamia, a coniferous tree used as construction timber, suggest that their timber trade was sustainable with external links to the timber markets of the Lower Yangzi and also to the procurement of the building material for the palace in Beijing.[33] For this commercial link, both local Miao-speaking merchants and city-based Han dealers played an equal part, making the timber trade sustainable and keeping re-forestaton commercially viable. As Nicholas Menzies notes, Cunninghamia cultivation was probably the 'longest lived, most resilient example of forest management'.[34] As far as south China is concerned, therefore, the ways in which market demands were translated into the practice of regenerative forestry were probably also similar to those found

[30] Saito 1998, pp.146-149.
[31] Marks 1998, p.320.
[32] Menzies 1994, p.99.
[33] Daniels 1999, Daniels 2003, and Aihara 2007.
[34] Menzies 1994, p.133.

in Tokugawa Japan. In this sense, as Mark Elvin says, 'the cultivation of trees could be a form of premodern high-tech'.[35] All this may give an impression that never market-oriented regenerative forestry was practised only by minority people but never by Han Chinese. Indeed, among several types of forestry in traditional China examined by Menzies, logging operations in deep mountains organised by Chinese merchants was probably the most straightforward, as well as the most exploitative, form market activity.[36] Han settlers in the Yangzi highlands (called *pengmin* or shack people, many of whom worked for Cunninghamia plantations) are also said to have led to environmental degradation as they usually cleared woods on hill slopes to convert them to fields of maize, causing soil erosion downstream.[37] At social organisational levels, on the other hand, they formed lineage groups and the groups often owned and carefully maintained forested land. Although not for commercial purposes, as the Huizhou case shows, the forest was kept harvested regularly to earn income for maintaining the ancestral halls and for other purposes. Villages and temples also maintained woods in a similar manner. Forest management of this kind, therefore, must have contributed to slow down the long-run rate of depletion.[38] In other words, in imperial China too, both destabilising and stabilising forces were at work side by side.

Thus, long-run trends depended on whether or not the rate of depletion was lower than the rate of renewal. Once the former exceeded the latter, the pressure to harvest immature trees would start 'a downward spiral'. Such a cash-in imperative was a product of market forces. But Elvin thinks that a phase of environmental degradation 'did not become clearly established until the eighteenth and the nineteenth centuries'. According to him, one critical factor in plantation owners' cost-benefit calculations was the theft of wood, which 'became a widely prevalent scourge, which inhibited production by small producers with inadequate means to defend themselves; and market pressures probably tended to compel not only a concentration on cultivating quick-growing species but also sales of relatively

[35] Elvin 2004, p.78
[36] Menzies 1994, ch.8.
[37] Richards 2003, pp.126-131.
[38] Menzies 1994, pp.76-77.

immature trees as soon as a profit could be taken'.[39] Probably it is not coincidence that the disappearance of village forests and clan forests did not accelerate before the 1911 revolution.[40] It is not unlikely, therefore, that the real cause of the 'downward spiral' that is believed to have taken place in the late Qing and in the Republican period was to be found in the area of 'law and order' rather than in the market sphere.

## VI

'Law and order' is one of the issues closely associated with the 'role of the state' question. As long as what economists call 'externalities' exists to environmental issues, we cannot leave the issues entirely to the market. And since much of forestland was owned by the state and the procurement of forest resources made for the state, some kinds of regulations and institution building carry prime importance. Just as the Tokugawa shogunate and local daimyo did, the state could control forest resources with banned entry or access, thus allowing the area to regenerate eventually, or by issuing edicts to regulate usage of forest products. The latter is interpreted by John Richards as constituting 'a system of public rationing that seems to have has some impact'. In villages, peasants developed their own rules to regulate access to fuelwood, green fertliser and fodder, which also 'constituted a system of rationing'.[41] However, what the Tokugawa state did was not just strict rationing. Indeed, a careful reading of Totman's *The Green Archipelago* reveals that institution building was the key in accounting for the rise of regenerative forestry in response to the growth of market demand, hence for Tokugawa Japan's record in forest management in general, for which the state played a part.[42]

Throughout history, however, the state has not always been a reliable agent of control, maintenance and management with respect to forests. In fact, in his discussion of temple and monastic forest conservation, Menzies contends that

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[39] Elvin 1998, and Elvin 2004, pp.81-85.
[40] Menzies 1994, p.87.
[41] Richards 2003, p.185.
[42] Totman 1989, especially ch.7.

imperial policies of successive Chinese dynasties were inconsistent. National interests often took precedence over concern for forests. Prohibitions could be followed by state-initiated incentives to colonisation and land clearance, while in the area of commercially oriented plantation forestry state intervention, be restrictive or market-friendly, seems to have been minimal.[43] On the other hand, the Tokugawa shogunate's policies were less inconsistent. But in the case of Japan, probably more important than the attitudes of this central government was what took place at regional levels. In the Tokugawa decentralised system, the local daimyo government was increasingly interested in forest management—as a public body in charge of the prevention of erosions and flooding and as a fiscal body in want of new sources of revenue. What emerged in many parts of the country during the eighteenth century was an agreement between the daimyo government and local farmer-entrepreneurs or village officials. One form called *nenki-yama* was simply a foxed term lease contract between the two parties. Another form, which as institution building proved to be more important, was to share the harvest on the daimyo-owned forestland. It was called 'shared-yield forest' (*buwake-yama* in Tokugawa terminology), another kind of lease arrangement under which it was the lessee who planted trees and sell the tree products at the market.[44] This enabled the local entrepreneur to expand the cultivation of trees the market wanted by making a deal with the local government with respect to the state-owned forestland. The emerging system proved to be effective, especially areas having good access to the metropolitan markets, giving the local government revenues and the local people profits, by keeping forest areas replanted. In other words, this can be regarded as a *decentralised* way in which the state exercised its influence in maintaining the nation's forest cover.

Another pronounced difference between China and Japan seem to have emerged after the demise of the old regime. Given the magnitude of population elasticity for Lingnan from 1853 to 1937, it seems to me that the entire system of resource control and management started to crumble in the late Qing-Republican period.[45]

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[43] Menzies 1994, pp.91-92.
[44] For this type of arrangement, see Totman 1989, pp.163-165.
[45] As I am no specialist in Chinese history I simply await future research by experts in this field

In contrast, Japan's new Meiji government took a firmer stance on forest management. Part of the reason for that stance is found in what the Iwakura mission of the 1870s learnt from the West. After noting how seriously forests were under attack in the European past, the chronicler Kume added that:

> 'It was in light of this [state of forest degradation] that forestry systems were subsequently promoted so that nowadays, while liberal politics are increasingly practised in Europe, in forestry laws alone the freedoms of former times are actually being curtailed.[46]

And, after the Prussian visit, he noted:

> As a result, laws have recently been introduced to protect the forests, and the government has been making intensive efforts to plant large quantities of saplings during the felling season.[47]

They learnt that the government should take the initiative in forest management. Subsequently, government officials and experts looked to continental Europe, especially Germany for the science of forestry, through which they absorbed its protectionist philosophy. All this meant centralisation in policy-making, which was a clear departure from Tokugawa governance tradition.

In practice, however, what occupied a central place in government policy-making was to promote commercially viable plantation forestry. It simply endorsed the tendency towards coniferous plantation forests that had been taking place from traditional times. Moreover, as the Meiji era progressed, the government's forestry bureau began to rely more on hands-off than on hands-on measures. The late-Meiji government re-introduced traditional institutional frameworks, especially century-old 'shared-yield forest contracts', as a means of promoting afforestation in the state sector and in forest areas owned by local authorities and private landlords. And this functioned well, just as the system had worked for local

[46] Kume 2002, III, p.209.
[47] Kume 2002, III, pp.270-271.

daimyo-owned forestland in the late Tokugawa period.[48]

## VII

Ken Pomeranz argued, based on a comparison between China and France, that early modern East Asia's forest degradation was 'not much worse' than in eighteenth-century western Europe, and the foregoing observation made in terms the population elasticity of deforestation with Japan and England added has revealed that the elasticity values for Tokugawa Japan and Qing China were certainly not much worse than those for England and France in roughly the same period. This may be taken to imply that Pomeranz was right.

However, there are a couple of caveats to be made. First, the observation in this paper with respect to the population elasticity of deforestation should not be taken to mean that, as Pomeranz seems to have implied, both East Asia and Europe were ecologically seriously constrained at the end of the eighteenth century. As we have seen, forest degradation in England and France was far worse in earlier centuries and western Europe in the eighteenth century was in the middle of the process from deforestation to afforestation. Second, as far as the East Asian countries are concerned, it is evident that stabilising as well as destabilising forces were operating during the early modern period, and that market linkages are likely to have exerted under certain circumstances positive influences on forest management and the advance of regenerative forestry.

Divergence took place in the nineteenth century and widened thereafter in this area of forest history. In the West, deforestation was associated with pre-modern economic growth. And the substitution of minerals and fossil energy for forest resources, on the one hand, and the rise of a new environmental thinking, on the other, led the way to reforesting Europe in the modern period. In contrast, China's pre-modern systems of regenerative forestry collapsed, which resulted in uncontrolled deforestation in the post-imperial period. It is probably not because

[48] Nishio 1988, pp. 108-109, 138-140. A brief account by a contemporary of the Meiji system and its relations with Tokugawa practice is found in Matsunami 1919, pp.263-277.

her resource substitution was delayed, but because something more fundamental collapsed at the end of the imperial era, which in turn affected the economic and social aspects of people's living seriously. On the other hand, only Japan saw afforestation taking hold and its systems established in an early modern setting. But it was not because, as John Richards tried to argue, the state took strict restrictive measures to promote a regenerative mode of forestry. Institutions that emerged during the early modern period were a product of processes in which both governments and local entrepreneurs played a part. It was those early modern institutions that kept the country's forest cover from degradation throughout the modern period.

To conclude, while there was a sharp contrast between China and western Europe, Japan was also in marked contrast with both China and the West. The observed contrasts are believed to have reflected differences in the ways in which the sustainability of the forest resource was sought in both early modern and modern periods, and differences in the ways in which 'tradition' played a role in the process of transition to modernity.

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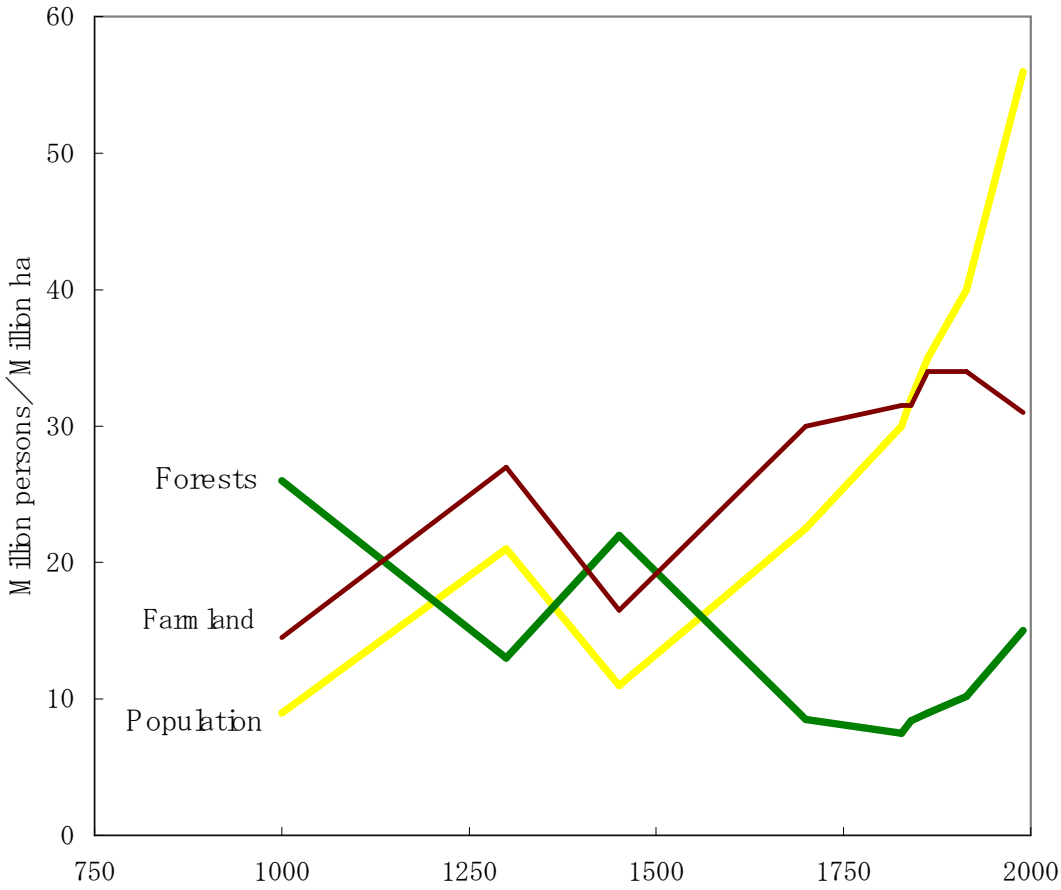
Figure 1　Population, farmland and forest areas in France, 1000-1990




Source: Morin 1996, p.19.

Table 1　Population and Forest Area estimates for Lingnan, south China, and Japan, 1600-1985

| Year | Population (million) | Forest area (million ha) |
|---|---|---|
| *Japan* | | |
| 1600 | 17 | 27 |
| 1850 | 32.3 | 25.5 |
| 1900 | 43.8 | 24.3 |
| 1950 | 83.2 | 24.9 |
| 1985 | 121.0 | 24.8 |
| *Lingnan* | | |
| 1700 | 11.5 | 18.3 |
| 1853 | 30.6 | 9.6 |
| 1937 | 47.6 | 2.9 |

Notes on sources:

*Japan*

1. Population for 1600 is a provisional estimate by O. Saito, the 1850 estimate from Miyamoto 2004, and the other figures from Kokuritsu Shakai Hoshō Jinkō Mondai Kenkyūjo 2004, pp.8-10.
2. For estimate of forest area in 1600, see text. Other estimates are from Nishikawa et al. 1995, ch.1, pp.4, 6, 8, 10.

*Lingnan*

3. Population figures are from Marks 1998, pp.158, 280. 1700 and 1937 are interpolated from other benchmark years.
4. Forest areas are Ling Daxie's estimates quoted in Pomeranz 2000, pp.309-310. 1700 and 1937 are calculated from percentages forested.

Table 2　Proportion forested (%)

| | Japan | Lingnan | England | France |
|---|---|---|---|---|
| Medieval | — | — | 15 | 47 |
| Early modern | 73 | 47 | 8 | 15 |
| Mid-19th century | 69 | 25 | 4 | 14 |
| Early 20th century | 65 | 7 | — | 19 |
| Late 20th century | 67 | — | 7 | 27 |

Source: Japan and Lingnan, Table 1 above; France, same as for Figure 1. For England, population figures for 1086, 1350 and 1992 are from Henderson-Howat 1996, pp.23-24; 1688 and 1871 from Wrigley and Schofield 1981, pp.531-535. All forest-area figures are from Henderson-Howat 1996, pp.23-24, except for 1871, which is taken from Coppock 1973, p.623. Figures for 1086, 1350 and 1688 are calculated from percentages forested, the first two of which are believed to have been based on Rackham 1990, pp.50-51, 55.

Table 3　Per capita forestland (ha)

| | Japan | Lingnan | England | France |
|---|---|---|---|---|
| Medieval | — | — | 1 | 3 |
| Early modern | 1.6 | 1.6 | 0.2 | 0.4 |
| Mid-19th century | 0.8 | 0.3 | 0.02 | 0.3 |
| Early 20th century | 0.6 | 0.06 | — | 0.3 |
| Late 20th century | 0.2 | — | 0.02 | 0.3 |

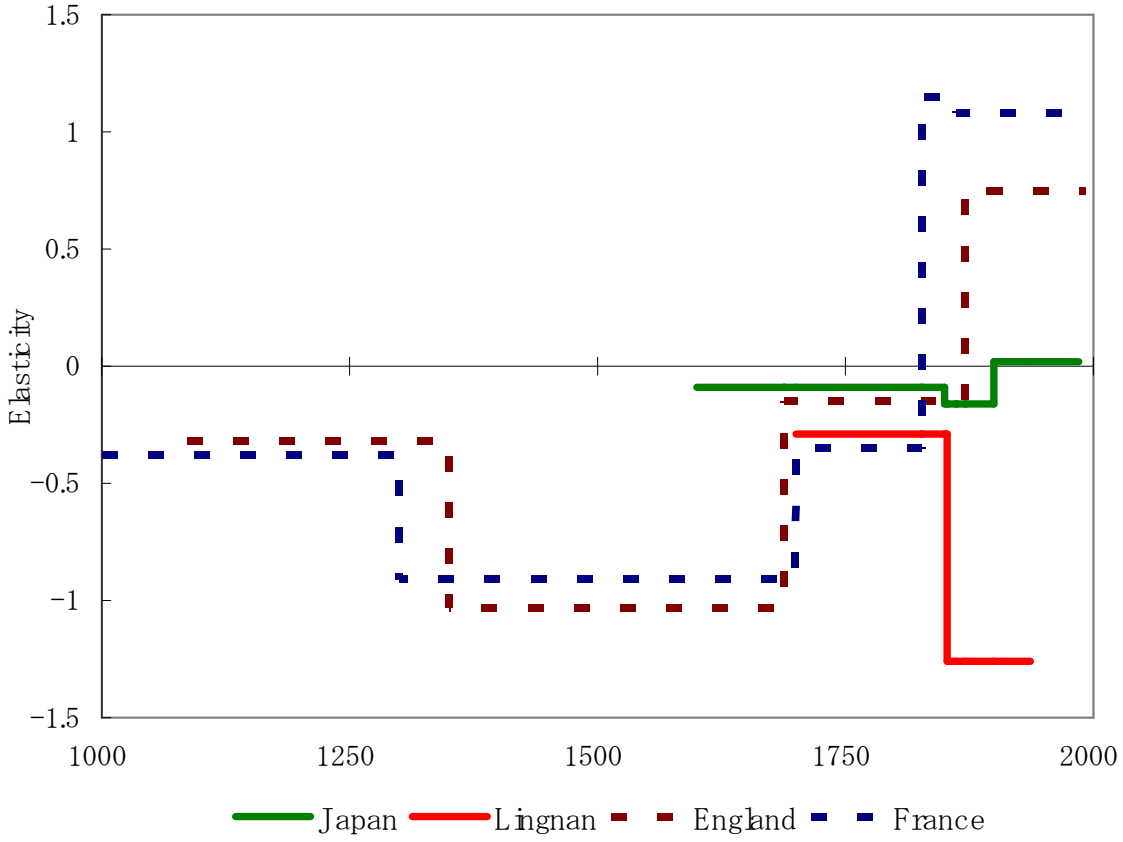
Source: Same as for Table2.

Table 4　Chaging population elasticities of deforestation, in Japan, Lingnan, England and France

| | |
|---|---|
| Japan | |
| 1600-1850 | -0.09 |
| 1850-1900 | -0.16 |
| 1900-1985 | 0.02 |
| Lingnan | |
| 1700-1853 | -0.29 |
| 1853-1937 | -1.26 |
| England | |
| 1086-1350 | -0.32 |
| 1350-1688 | -1.03 |
| 1688-1871 | -0.15 |
| 1871-1992 | 0.75 |
| France | |
| 1000-1300 | -0.38 |
| 1300-1700 | -0.91 |
| 1700-1827 | -0.35 |
| 1827-1862 | 1.15 |
| 1862-1990 | 1.08 |

Source: Same as for Table2.

Figure 2　Changing population elasticities of deforestation




Source: Table 4.

Table 5　Osaka imports, 1714

| Commodity | Value ('000 silver *kan*) | Share (%) |
|---|---|---|
| Agricultural products and processed goods | | |
| Grain | 54 | 19 |
| Other agricultural products | 58 | 20 |
| Cloth | 31 | 11 |
| *Tatami* and mats | 7 | 2 |
| Forest products and processed goods | | |
| Timber | 26 | 9 |
| Chacoal | 3 | 1 |
| Other forest products | 13 | 5 |
| Paper | 14 | 5 |
| Marine products | 33 | 11 |
| Mining products | 21 | 7 |
| Others | 27 | 10 |
| Total | 287 | 100 |

Source: Oishi 1975, pp.154-167.

Notes:

1. 'Grain' does not include tax rice transported to Osaka by daimyo administrations. It amounted to nearly two-thirds of the total merchandise listed above.
2. This table differs from a similar table in Hauser 1974, p.28 and another in Shimbo and Hasegawa 2004, p.172. Hauser's table does not include grain in the total, while Shimbo and Hasegawa's seems to have adopted somewhat different grouping criteria for commodities (for example, their 'forest products' are too small).