Productivity and Comparative Advantage in Rice Agriculture in Southeast Asia since 1870¹

Abbreviated title:
Productivity and Comparative Advantage in Rice Agriculture

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This version: 12 May 2004.

To be published in *Asian Economic Journal*, 18 (4) 2004.

1. I am grateful to Randolph Barker, Jean-Pascal Bassino, Taco Bottema, Peter Timmer, Kees van der Meer and Jeffrey Williamson for their comments on previous versions of this paper.

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Abstract

Rice long dominated the agricultural economies of Southeast Asia. Given the economic predominance of agriculture, the development of rice production had a significant bearing on the economies in the region. This article explains why the countries of mainland Southeast Asia long dominated the international rice market. It quantifies labour productivity in rice production and argues that simple, low-cost and labour-extensive, but low-yielding production technology allowed farmers in mainland Southeast Asia to achieve significantly higher levels of labour productivity than in the more densely populated rice-producing areas in Southeast Asia and Japan. High levels of labour productivity were a major source of comparative advantage in rice production for Burma, Thailand and Southern Vietnam. (110 words)

Key words: agriculture, technology, productivity, rice, Asia

JEL-codes: N55, Q16, Q17

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1. Introduction

As the main staple food, rice long dominated the agricultural economies of Southeast Asia. Given the economic predominance of agriculture, developments in rice production had a significant bearing on the economies in the region. An analysis of these developments therefore helps to understand economic change or stagnation in the region. The countries of Southeast and East Asia are often lumped together and typified by their main staple food.² However, substantial differences in the technologies used to produce rice in particularly Southeast Asia are ignored in efforts to generalise the development experience of the region.

In broad terms, but largely on the basis of China and Japan, Bray (1983, 1986) and Oshima (1983, 1987: 17-27) argued that most of Asia was densely populated and that only irrigated rice could sustain high population densities because it produced higher yields than other staple foods. Such yields could only be achieved with high inputs of labour per hectare on small farms. For that reason, mechanisation of agriculture and therefore large-scale agricultural production, as in Western Europe, was impossible. In short, rice production in Asia offered few opportunities for producers to reap economies of scale and higher levels of labour productivity, unlike wheat production in Western Europe.

Unfortunately, this thesis takes no account of the fact that particularly in Southeast Asia population densities varied considerably, and that farmers in the rice-exporting countries were apparently able to produce rice more economically than colleagues in rice-importing countries such as Japan. Hence, this interpretation is at best applicable to the densely populated parts of Southeast Asia, rather than the rice-exporting countries of mainland Southeast Asia. Few attempts have actually been made to quantify long-term changes in labour productivity in rice agriculture, or to compare levels of labour productivity across the rice producing countries in Asia. Such estimates help to assess whether Asian rice farmers were indeed unable to achieve higher levels of labour productivity. They may also help to understand the basic cause of

² Rice producing Southeast Asia comprises an area including: Myanmar, Thailand, Laos, Cambodia, Vietnam, The Philippines, Malaysia, and Indonesia. Rice producing East Asia comprises Japan, North and South Korea, Eastern China, and Taiwan. This article compares productivity in the main rice producing areas of Southeast Asia with Japan. The geographical coverage of this paper is therefore different from what Oshima (1987: 20) has

comparative advantage of the rice-exporting countries.

The next section discusses the position of Southeast Asia in the international rice economy. Section 3 highlights the paradigms that have been used to understand the development of rice production technology. Section 4 argues that not land productivity, but labour productivity is the key factor in understanding comparative advantage in rice production. It uses disparate historical estimates of labour input per hectare to quantify the levels of labour productivity in rice agriculture in Southeast Asia and Japan. The differences in labour productivity across East Asia are explained in section 5.

For lack of space, several factors that influenced long-term changes in rice production in the countries of Southeast Asia cannot be discussed here, such as the fact that rice and non-rice food crops were substitutes in production and consumption, land tenure, access to capital, postwar government market interventions and the organisation of the rice trade.³ For the sake of the argument, the article focuses on the key factor underlying labour productivity and comparative advantage in rice production: production technology.

2. Southeast Asia in the world rice economy

Table 1 shows that around 20 percent of world rice production originated in Southeast Asia during 1920-90, but that the region dominated the world market up to World War II with 80-90 percent of world rice exports. Intra-regional rice trade took up to 23 percent of Southeast Asia's rice exports during the interwar years. Intra-regional rice trade was less important for Burma, Thailand and Indochina together than extra-regional trade. Until World War II, most exported rice went to other parts of Asia - in particular India, China, Hong Kong and Japan.

(Insert Table 1 about here)

Figure 1 shows the continuous increase of rice exports from Southeast Asia. Thailand, Indochina and especially Burma dominated the global rice market before World War II. After the war, exports from Burma and Indochina declined. Thailand maintained its exports at level, but did not increase its share in the world market until the late 1970s. Until then China, the USA

labeled 'Monsoon Asia', which includes India, Bangladesh and Sri Lanka.

3. See *e.g.* Wickezer and Bennett (1941), Barker and Herdt (1985).

and several smaller producers, such as Egypt, Pakistan, Australia and Italy, took advantage of the expansion of the global demand for rice.

(Insert Figure 1 about here)

Around 1860, the countries in mainland Southeast Asia started a gradual expansion of exports, at the expense of traditional exporters in Asia such as Bengal and Java (Coclanis 1993ab). The rapid increase of rice production in these areas was facilitated by the opening up of vast areas for rice production. In part this was an autonomous response to the increasing demand for rice outside the region. It was also facilitated by the extension of colonial rule to Lower Burma and to Cochinchina, followed by government initiatives favouring the development of rice production.⁴ The opening of the Suez Canal in 1869 was not a turning point in the development of the rice trade. Rice exports from Southeast Asia were mainly directed to South and East Asia, while the shipping of rice with sailing ships via the Cape to Europe and the America's continued until about 1900, because it was cheaper despite of the longer journey (Hlaing 1964: 91-3; Manarungsan 1989: 53). More relevant was the sustained decline in ocean freight rates during the 19th century due to the technological improvements in the design and construction process of sailing ships, and the gradual change to steel steamships with increased cargo capacity (North 1958; Knick Harley 1988).

Southeast Asia's share in world rice trade declined after the 1920s, in part because Japan increased rice imports from its colonies Korea and Taiwan. Another explanation is that international cereal markets had become interlinked in the 19th century.⁵ Table 2 shows that wheat dominated the global cereal market in the 20th century. Several wheat-producing countries introduced measures to protect their farmers from the impact of the global slump after 1929 (Taylor and Taylor 1943: 111-24). International demand for wheat and wheat prices decreased. Cheap wheat replaced rice on cereal markets outside Asia. In addition, rice-importing countries such as Malaya, Indonesia and the Philippines introduced measures to support and protect their rice farmers, causing a slight fall in intra-Southeast Asian rice trade in the 1930s.

4. This followed the British annexation of Lower Burma in 1852 and the opening up of Rangoon for trade, the signing of the Bowring Treaty between the United Kingdom and Thailand in 1855, the French capture of Saigon in 1859 and the annexation of Cochinchina in 1862. The authorities in the three river deltas removed trade restrictions and took measures to enhance rice production. For a comparison, see: Owen (1971: 83-6) and Siamwalla (1972).

5. See Latham and Neal (1983) and Latham (1986a) for an analysis of these linkages up to 1914.

The gradual fall of Southeast Asia's share in world exports continued after World War II up until the late 1970s, when Thailand started a rapid expansion of its exports. Figure 1 shows that, instead of replacing countries that had entered the world market as exporters after World War II, Thailand set the pace of the expansion of the world market at large since the late 1970s, and was joined by Vietnam in the 1990s.

(Insert Table 2 about here)

Table 1 shows that intra-Southeast Asian rice trade increased significantly during 1950-75. Demand for imported rice even increased to the extent that rice had to be imported from outside the region following crop failures in Thailand in the early 1970s. The subsequent increase in intra-Southeast Asian rice trade was largely due to the expansion of rice imports by Indonesia until the mid-1980s, when the country achieved self-sufficiency.

The reasons for the structural decline of Southeast Asia's share in world rice exports during the period 1930-80, despite postwar expansion of the world market, are complex. Heavy taxation of rice exports decreased the domestic profitability of rice production, especially in Burma and Thailand. In addition, world rice production increased at a lower rate than wheat production. Hence, on a world scale, consumers preferred wheat-based food products to rice. The difference in growth rates may also imply that technological development in cereal agriculture was skewed towards wheat production.⁶ The discussion below will indicate that technological change in the main rice exporting countries of Southeast Asia was indeed slow.

After World War II, the international rice market became very thin. Only around 4 percent of production reached the international market after the war, down from 8 percent during the interwar years. This caused a low price elasticity of world demand for rice, implying that the more the main exporters would have wanted to export, the lower the international price of rice would have been (Barker and Herdt 1985: 188-200). Rice importing countries adopted policies to enhance rice production, importing rice only to balance deficits caused by adverse natural conditions. There was therefore a high potential supply, but a low and volatile international demand. These factors contributed to a high degree of price variability in the rice

6. The global yield of paddy per hectare increased 2.2 percent during 1959/61-1979/81, compared to an increase of 4.1 percent of wheat yields. However, in the 1980s rice producers gained ground with an increase of paddy yields of 3.4 percent during 1979/81-1988/90, compared to 2.9 percent of wheat yields. Calculated from *FAO Production Yearbook*.

market, and an increasingly lower degree of market integration (Cha 2000). Small changes in the balance between production and consumption in individual countries, especially in large countries such as Indonesia and China, translated into relatively big changes in supply or demand in the rice market. This differed from international markets for other cereals, especially wheat and maize. These commodities were traded in much larger quantities than rice and therefore determined the underlying international price trends for cereals.

An increasing part of the world cereal market became dominated by multilateral trade agreements, in which rice and wheat were traded under conditions favourable to the parties involved. The rice exporting countries of Southeast Asia were generally not involved in such arrangements, although several rice importing countries in the region received rice from the USA under favourable conditions. A related factor is the policies of agricultural protection in the USA and the European Community, which resulted in overproduction and occasional sales of considerable amounts of surplus cereals, particularly wheat. Such sales depressed the general real price of cereals on the remaining free part of the international market, and reduced the price of wheat relative to rice (Tyers and Anderson 1992: 16-42). Consequently, more rice-importing countries increasingly replaced wheat for rice.

3. Technological paradigms in rice production

Why did mainland Southeast Asia dominate the world rice market up to World War II, outdoing other major rice producers such as China, Japan and the USA? During the interwar years, the world rice market was relatively free from government intervention and significantly integrated, particularly in Asia (Cha 2000). Explanations therefore have to be found on the supply side of the market: production and marketing of rice. Moreover, it has to be acknowledged that most rice was exported to other rice producing countries in Asia, which suggests that explanations will have to be found in the comparative advantages that rice producers in mainland Southeast Asia may have had.

Rice was grown throughout Asia in many different ways. In the past the rice plant only dominated the swampy lowland areas of mainland Asia, but from there it gradually spread, reaching the Eastern part of the Malay archipelago after 1500 and replacing roots and tubers as the main staple foods. Although largely grown in swamp-like conditions, rice became cultivated under a wide range of climatic and geographical conditions, with a variety of different

production techniques. It is possible to suggest that the choice of cultivation practices correlated with population density, but climate and geography were also important variables.

It is often argued that population growth and greater population density determined the choice of rice cultivation techniques. This has led to the perception that there is a mandatory sequence of technological paradigms in agricultural development of rice-producing societies, in which the prevailing production technique at a certain moment is indicative of population density and the phase of economic development. The ranking of production techniques is often in order of intensity of land use, and runs as follows.⁷ In underdeveloped areas with low population density random gathering of wild rice gradually gives way to shifting cultivation in a forest-fallow system. In this swidden system trees are felled and burned, and seeds are planted in unploughed land using a dibble stick. After the harvest the area is left to recuperate. The next phase in the sequence is a grass-fallow system of mixed agriculture. The fallow period becomes shorter, livestock is herded on the harvested fields and their droppings help the field to recover during the fallow period. A subsequent phase involves sedentary cultivation of annually ploughed fields with a broadcasting technique. In the case of rice, the process of intensified land use has been refined further. In its most elaborated form rice seedlings are transplanted from nurseries onto intensively prepared irrigated fields. Permanent irrigation structures enable multiple cropping. The intensive use of current inputs (in particular fertiliser) on selected high-yielding and fertiliser-responsive rice varieties allow high crop yields. These are the main characteristics of the Green Revolution in rice agriculture, which spread throughout Southeast and East Asia during the past 30 years.

The above sequence of *technological* paradigms is often accepted as an intuitive model of agricultural development in which population growth and the demand for labour outside agriculture, *i.e.* the changing opportunity cost of agricultural labour, are easily identified as the main forces driving this process. But it is questionable whether the sequence and therefore the dominant rice production technique in a particular region can be taken as a proxy for the stage of *economic* development. The main problem is that the sequence is at best adequate to analyse change in subsistence-based rice-producing societies that maintain superficial contacts with the outside world. Populations in most of the settled areas in the Southeast and East Asian region

7. The different production techniques in rice agriculture have been described in much greater detail in *e.g.* Terra (1958), Angladette (1966: 223-45), Hanks (1972: 25-43), Barker and Herdt (1985: 27-32) and Tanaka (1991). The model of agricultural intensification is not specific to rice societies, see *e.g.* Boserup (1965: 56-64) and Clark and Haswell (1967: 27-130).

have always been in contact with each other. Therefore agricultural development in one country has to be analysed in the light of agricultural changes elsewhere, because of the comparative advantage that some regions may have had over others in rice production.

4. Comparative advantage and labour productivity in rice agriculture

What constituted that comparative advantage? The production technique chosen and the combination of factor inputs it required are likely to have depended on relative factor prices, given the range of determinants such as water supply, soil conditions, climate and rice varieties preferred by producers and consumers. For the sake of the argument it is possible to disregard the ecological differences between the rice producing areas in Southeast Asia, because the main conditions that determine rice cultivation, such as water supply and soil conditions can be manipulated. For instance, water supply can be regulated with the construction of dams, canals and dykes. Water shortage can be overcome with irrigation from artesian wells or reservoirs. Soil fertility can be augmented with fertilisers. However, all manipulations require the commitment of greater amounts of labour and capital. It was therefore a trade-off between higher crop yields and a greater commitment of productive resources to rice production.

The process of technological change in rice production can be assessed with the ‘extended Ishikawa-curve’, shown in Figure 2. The original Ishikawa-curve only described the solid line in the chart.⁸ The curve shows the paths of technological change societies may follow if they seek to increase total factor productivity (TFP) in rice agriculture, or rice production with a given combination of production factors (labour, land and capital). An important reason for seeking to increase TFP, in particular labour productivity, is intrinsic to the process of economic development (Timmer 1988). The demand for non-agricultural goods and services rises with economic growth. Producers of such goods and services will compete with agricultural

8. Ishikawa’s (1980: 240 and 1981: 37) original curve mirrored Figure 2, because it had labour input per hectare (the inverse of the area of land worked per day) along the X-axis. Figure 2 is a new interpretation of the curve, because it extends it with the dotted line. But it is not a new interpretation of the process of agricultural development in general. The ‘extended Ishikawa-curve’ is roughly the same as the interpretation of international differences in agricultural development presented by Hayami and Ruttan (1985: 117-37). The two differences are: (1) We refer to rice only, where Hayami and Ruttan referred to total agricultural output (2) We consider the flow of *total* labour input in rice agriculture, where Hayami and Ruttan used the available stock of *male* employment in agriculture. Hayami and Ruttan (1985: 124) presented a specific ‘Asian path’ of agricultural development. But their sample of countries is biased towards the East Asian experience and excludes for instance Burma and Thailand, which do not conform to this ‘Asian path’.

producers for productive resources. Workers drop out of agriculture, but only if they are assured that they can purchase food at attractive prices. If food is not imported in greater amounts, workers remaining in agriculture will have to maintain or increase agricultural production, to produce the food surplus for the non-agricultural workers in exchange for non-agricultural goods and services. Increasing labour productivity or TFP in agriculture is indeed a major prerequisite for economic growth.

(Insert Figure 2 about here)

In Ishikawa's interpretation of agricultural development in rice-producing societies the path of advancement leads from a level of subsistence production upwards to higher crop yields (Y-axis), first with labour-absorbing techniques (X-axis), but gradually with techniques which allow more workers to drop out of agriculture and farmers to adopt labour-replacing techniques. During this process societies cut across the isometric lines indicating labour productivity, which implies that rice production per unit of labour input is steadily increasing.

Ishikawa (1981: 2) compared the historical evidence on labour input and yields in rice production in Japan and Taiwan with similar evidence from China, India and the Philippines in the 1950s and 1960s and concluded: '[...] countries with the smaller per hectare labor input and per hectare output are found to be the countries where the problems of employment and rural poverty are the most acute.' Ishikawa presupposed that all developing countries have an unused labour surplus, which can be tapped by enhancing land productivity in rice production.⁹ He concentrated his argument on the *technological* reasons why labour input was low in India and the Philippines and concluded that rice producing societies necessarily follow a path of technological change in rice production similar to that of Japan and Taiwan during the process of economic development. This paragon dictates that a country will be in a position to mobilise an agricultural surplus in order to finance investment in the non-agricultural sectors, and that higher productivity eventually allows workers to drop out of agriculture to take up full-time jobs in non-agricultural sectors.¹⁰

9. Ishikawa (1967: 289) elaborated the analytical concept of 'surplus labour' of Lewis (1954).

10. Elsewhere Ishikawa (1967: 108) concluded: 'Thus, the experience of Taiwan and Korea, together with that of Japan, seems to indicate that the technological pattern of productivity increase in Asian agriculture is broadly the same.' With some disclaimers the Japanese case has been presented by several authors, such as Hayami and Ruttan (1985: 257-98) as a path to economic development for the other rice producing Asian countries to follow.

Ishikawa's findings helped to rationalise the commitment of governments in developing countries in Asia since the 1960s to public investment in irrigation facilities and the spread of high-input labour-absorbing technologies in rice agriculture, generally known as the Green Revolution. Governments in all countries in Southeast Asia engaged resources in the development of rice agriculture along the lines of the Japanese paragon. Some were more committed than others, which may explain the different rates of 'success' of the Green Revolution in Southeast Asia (Hayami 1988). However, evidence on the actual paths of productivity change in rice agriculture shows that the countries of Southeast Asia, despite rapid economic growth in recent decades, did not exactly follow the Japanese paragon.

The evidence is contained in Table 3. It is necessarily patchy, because, apart from Japan, estimates of labour input in rice agriculture in Asia are rare. Still, the table illustrates the key differences between the main rice producing areas of Southeast Asia and Japan in terms of average yields and labour productivity. Firstly, prewar Java and Tonkin were at similar positions as pre-1900 Japan. Secondly, Burma in the 1930s, Thailand during the first half of the 20th century and since the late 1970s, South Vietnam during the 1930s and 1950s, Cambodia during the first half of the 20th century and the Philippines moved in directions which were different from Japan in the past.¹¹ Thirdly, these countries managed to produce significantly more rice per day worked than Japan until the 1960s, Java until the 1970s, North Vietnam in the 1930s, and prewar West Malaysia. Output was 15-17 kg of rice per day worked in prewar mainland Southeast Asia, compared to only 5-7 kg in prewar Java, Tonkin and Malaya and pre-1900 Japan.

(Insert Table 3 about here)

5. Explaining differences in labour productivity

How could labour productivity in rice production in mainland Southeast Asia be so much higher than in other parts of Southeast Asia and Japan before World War II? One possible explanation is that the higher opportunity cost of labour, and therefore production costs in rice agriculture, in

¹¹ Since the 1950s, the direction of The Philippines was a net result of a simultaneous expansion of rice farming in under-populated frontier regions such as Mindanao, and the development of input-intensive rice cultivation in older rice producing areas such as Luzon. James (1978) assesses the implications of the simultaneous process for the analysis of productivity change in rice agriculture.

mainland Southeast Asia necessitated a higher level of labour productivity. Although evidence is patchy, Table 4 indicates that it is unlikely that the cost of labour and therefore the production costs of rice were three times higher in mainland Southeast Asia than in Java, Tonkin and Malaya.¹² The conclusion therefore has to be that rice producers in, say, Java had to put a much greater effort into the production of the same quantity of rice as farmers in, say, Burma. As explained below, the population densities in mainland Southeast Asia were relatively low, which makes it unlikely that the cost of land was higher in mainland Southeast Asia, while the use of current inputs in rice agriculture was limited in both mainland and island Southeast Asia. Clearly, rice farmers in Burma, Thailand and Southern Indochina enjoyed a significant comparative advantage over their colleagues elsewhere.

(Insert Table 4 about here)

Why was labour productivity so much higher in mainland Southeast Asia, when low crop yields would suggest that production techniques were underdeveloped? It has to be acknowledged that Ishikawa's argument implicitly takes land productivity as a proxy for TFP and underexposes a much more important factor in the process of economic development: labour productivity.¹³ This omission is important to countries with relatively low population densities, as the main rice exporting countries in Southeast Asia were, as Table 5 illustrates. Ishikawa's hypothesis therefore prompts the question: Why would farmers in countries with relatively high labour productivity in low-input rice production adopt technologies which would have compelled them to work their rice fields harder, when the 'law of diminishing returns' would inevitably have confronted them with a declining marginal productivity of labour?

A flaw in Ishikawa's argument is the assumption that there was a labour surplus in all rice-producing societies in Southeast Asia, which had to be mobilised with labour-absorbing technological change as part of a strategy to further economic development. Given the substantial prewar inflow of migrants from India and China into Lower Burma, Malaya, Thailand and also Cochinchina (Latham 1986b), it is difficult to regard these areas as being

12. Wage rates of course reflect the *marginal* productivity of labour, which cannot be strictly compared with *average* production per day. But for the sake of the argument it is assumed here that both are comparable.

13. Ishikawa (1967) did not present estimates of labour productivity, although they are implicit in his data. They show, for instance, that gross rice output per day worked in a country with a low labour input as the Philippines was higher in the 1960s and 1970s than Japan in the 1950s, and that net rice output per day worked in Bengal in 1956/57

troubled by surplus labour. That may at best have been the case during the off-season. But during the main rice season there were considerable labour shortages, when - by and large - farm households required all available labour to cultivate and harvest as much land as they could possibly handle. This situation is different from the more densely populated areas, such as Japan, where not maximisation of cultivable land, but maximisation of yields was paramount.

Hence, depending on relative factor endowments, there are actually different paths leading to higher labour productivity in rice agriculture, as Figure 2 indicates. From a low level of land and labour productivity, one possible path leads upwards, as Ishikawa conceived. Another possible path leads to the right of the chart, cutting across the isometric lines indicating labour productivity on the basis of labour-saving production technology. It may be obvious that both paths command different production technologies, and that producers following different directions require different innovations to enhance labour productivity. In short, technological change akin to Japan in the past cannot have been a necessary prerequisite for the development of rice production in all Asian countries.

By focussing on the land-saving *technological* possibilities of enhancing land productivity, Ishikawa and other proponents of the East Asian path of agricultural development may have neglected that the choice of a rice production technique is likely to have been determined by the relative costs of the main production factors, in particular labour and land. As explained above, ecological conditions can be manipulated, but such operations demand the commitment of more resources, such as fertiliser, fixed capital or labour. The adoption of labour-absorbing technologies depends on whether farm households consider it worth while to invest time and effort in activities which enhance labour input in rice production, such as the construction and maintenance of irrigation facilities or the collection and dispersion of organic manure. The direction of technological change therefore depends on the opportunity cost of available labour and land.¹⁴ The low crop yields as a result of extensive production techniques can only pose a problem to a developing society if labour productivity is low as well. This situation implies that per capita rice production is low, and rice supply perilous. But Table 3 shows that areas with low crop yields mostly had high labour productivity in prewar years, hence that domestic rice supply is unlikely to have been jeopardised.

was higher than net labour productivity in Japan in 1950.

14. The relevance of labour productivity may explain why in some parts of Southeast Asia rice production in labour extensive shifting cultivation patterns emerged *after* labour intensive wet rice agriculture had been developed. (Hill 1977, Dao 1985: 47, Tanaka 1991)

The most conspicuous difference between the main rice exporting areas in mainland Southeast Asia and *e.g.* Japan, Java and Tonkin is population density (Zelinsky 1950). The top section of Table 5 shows that only Java after 1950, and recently the Philippines reached density levels comparable to Japan in 1875. Concerning rice production, the bottom part of the table shows that only Java after 1925, North Vietnam after 1950 and the Philippines after 1975 reached density levels comparable to Japan at the time of the Meiji restoration. The implication is that attempts to further rice yields in order to maintain per capita production at level became relevant at a much later date than in Japan. An interpretation of the high densities shown in the bottom half of Table 5 for the Other Islands of Indonesia and Malaya should take into account that relatively large sections of the rural population in these areas were not engaged in rice production. Revenues from export crop production enabled these farmers to purchase imported rice.

(Insert Table 5 about here)

Table 5 shows that the number of people per hectare of rice in Burma, Thailand, Cambodia and Cochinchina declined up to 1950. Given that production increased continuously in these countries, it seems likely that farmers in these areas expanded production by enlarging their farms where possible, rather than increasing crop yields. In fact, shifting the land frontier may well have led to a fall in average rice yields, because of the use of broadcasting techniques and the expansion to marginal lands.¹⁵ But lower yields do not mean that comparative advantage in rice production was lost, because the crucial factor in such cases is labour productivity. Table 6 summarises the main sources of changes in rice production and indeed confirms that up to 1950 the expansion of harvested area explains most of the production increases in Southeast Asia. This was in contrast with Japan, where up to 1970 increases in yields explain most of the production gains.

15. Ramsson (1977) elaborated this thesis for Thailand and Sansom (1970: 266-67) for Cochinchina. Ishikawa (1967:65-78) did not ignore the presence of a land frontier. However, he suggested that in 'most' cases reclamation of reserves of waste land only happened in recent years under government-sponsored colonisation schemes and with state farms (p.66) and therefore with subsidies. Secondly, on the basis of an example from China he assumed that the cost of clearing and cultivating wasteland may be higher than the conversion of land (pp.67-8) into irrigated fields, a point later elaborated by Hayami and Kikuchi (1978ab) for the Philippines. However, Ishikawa's conclusions were not based on a cost-benefit analysis.

(Insert Table 6 about here)

The results in Table 3 imply that, in order to capture income opportunities in rice production, farmers in the rice exporting countries of Southeast Asia successfully increased labour productivity by using production techniques different from those in Japan.¹⁶ Instead of the usual hectare of rice for household consumption, a rural family in mainland Southeast Asia produced a rice surplus by cultivating two to three hectares. In Japan farmers increased surplus rice production after 1875 by increasing rice yields and in Java farmers increased harvested area through irrigation facilities which enhanced multiple cropping. But in mainland Southeast Asia farmers sought to use labour-saving techniques. Animal traction was used throughout Asia for land preparation, but the ratio of work animals and arable land was significantly higher in mainland Southeast Asia compared to Japan and Java. In Japan farmers largely resorted to manual labour to prepare their land with hoes or spades. They also cultivated seedlings on seedbeds for transplanting, whereas in mainland Southeast Asia farmers broadcasted seed onto the fields. In Japan farmers would fertilise their fields with human waste, compost or even mud from fertile areas, and later with imported fertilisers. Fertilising fields was practically unheard of in mainland Southeast Asia. For those reasons labour input per hectare in rice agriculture differed significantly throughout Asia.

The comparative advantage of rice farmers in mainland Southeast Asia lay in the fact that they could expand their farms and continue rice production with traditional low-input labour-extensive techniques. Under free-market conditions prevailing in Southeast Asia until the 1930s, rice could only be produced with a noteworthy profit on such farms. The reason is that rice was a low value-added product. Almost all farmers in Southeast and East Asia could produce rice if they considered it to be worthwhile. But, given that land was relatively scarce, farmers in *e.g.* Java most likely preferred to use land and labour which was not required for the production of rice for subsistence, for the production of other crops. In Java other food crops and a range of labour-intensive cash crops indeed yielded higher net financial returns per hour worked and per hectare, than rice (Van der Eng 1996: 173-74). Labour was relatively scarce in the other rice importing areas in Southeast Asia, and farm households most likely preferred to use any surplus labour for the production of cash crops with high net returns to labour with labour extensive techniques. Farmers in the Other Islands of Indonesia indeed produced a range

16. This paragraph relies on Van der Eng (2003).

of crops such as rubber, copra, coffee, pepper and cloves. Most smallholders in Malaya produced rubber.¹⁷ In the Philippines many produced hemp, copra and sugar cane. A common characteristic is that most farm households producing cash crops did not neglect the production of food crops.¹⁸ They continued to produce rice for household consumption. Indonesia, Malaya and the Philippines largely imported rice to feed the urban and non-agricultural population and those working on plantations.

Technological change in the densely populated areas of Southeast Asia was thus inhibited by low marginal returns in rice production under the free market conditions prevailing until the 1930s. In contrast with Japan, where technological change continued to enhance rice yields, largely because farmers were increasingly shielded from free market conditions through tariffs on rice imports and through input subsidies (Saxon and Anderson 1982).

6. Conclusion

Supply-side factors appear to be paramount in explaining why the countries of mainland Southeast Asia dominated the prewar world rice market, because they help to define the comparative advantage of these countries in rice production. The advantage was that simple labour-extensive, low-cost, low-yield production technology allowed farmers in mainland Southeast Asia to achieve levels of labour productivity that were much higher than in the other, more densely populated rice producing areas in Southeast and East Asia.

This conclusion has repercussions for recent interpretations of the historical delay in economic development in rice producing Asian countries, based on the suggestion that most countries were late in developing irrigation facilities and adopting the seed-fertiliser technology that seemed to have blazed the trail of development in Meiji Japan in the late-19th century. On the whole, such labour-absorbing technologies would not have been appropriate for the rice-exporting areas of mainland Southeast Asia, as long as the land frontier had not been reached.

17. For indications of the considerable profitability of rubber, see *e.g.*: Jack (1930: 33-35); Bauer (1948: 62); Lim (1967: 287-94). Other crops continued to be far more profitable than rice after World War II, despite government policies to boost returns from rice to farmers. See: Black *et al.* (1953: 11); Huang (1971: 109); Taylor (1981: 113); Mamat (1984: 57-58); Kato (1991).

18. In the case of rubber smallholders in the Other Islands of Indonesia, see: Smits (1928: 57); Luytjes and Tergast (1930: 6-7); Luytjes (1937: 712); Bauer (1948: 319-20). Ding (1963: 24) cites a study of Trengganu in 1928, showing that rice production sufficed to feed the family, and was still cheaper than buying rice, but was not remunerative enough for commercial production.

Appendix 1: Sources for labour input per hectare in Table 3

Japan: 1877-1943 Hara, Y., 1980, Labour absorption in Asian agriculture: The Japanese experience. In W. Gooneratne (ed.) *Labour Absorption in Agriculture: The East Asian Experience*. (Bangkok: ILO-ARTEP) 16-17 and Yamada, S., 1982, Labour absorption in Japanese agriculture: A statistical examination. In S. Ishikawa *et al.*, *Labour Absorption and Growth in Agriculture, China and Japan*. (Bangkok: ILO-ARTEP) 46-48. **1951-90** Kome Oyobi Migirui no Seisanki. [Production costs of rice, wheat and barley] (Tokyo: Norin Teikei, various years).

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Table 1: Production and Trade of Rice in the World and Southeast Asia, 1920-1999 (five-year averages)

	World			Southeast Asia			% Share of Southeast Asia in World		Intra-trade as % of Total Southeast Asian rice export (5/4)
	Produc- tion -(mln.tons rice)-	Ex- port rice	% Share	Produc- tion -(mln.tons rice)-	Ex- port rice	Intra- Trade ^d	Produc- tion	Trade	
	(1)	(2)	(2/1)	(3)	(4)	(5)	(3/1)	(4/2)	
1920-24	82.2 ^a	4.9 ^b	6.0	17.1	4.3	0.7	20.8	87.7	16.6
1925-29	83.9 ^a	6.1 ^b	7.3	18.7	5.2	1.2	22.2	84.2	23.0
1930-34	87.2 ^a	6.5 ^b	7.5	19.0	5.0	0.9	21.8	76.9	18.8
1935-39	88.7 ^a	7.1 ^b	8.0	19.9	5.3	0.9	22.4	74.5	17.4
1940-44	88.1	2.7	3.1	20.1	2.0	0.2	22.9	74.5	12.3
1945-49	91.5	2.9	3.2	16.9	1.9	0.9	18.5	65.5	47.5
1950-54	116.4	4.6	4.0	22.7	3.2	1.0	19.5	67.9	30.3
1955-59	141.7	6.4	4.5	26.0	3.9	1.1	18.4	60.7	29.6
1960-64	152.3	7.7	5.0	30.2	3.7	1.8	19.8	48.1	48.7
1965-69	179.0	9.1	5.1	34.1	2.4	1.7	19.0	26.4	70.7
1970-74	209.1	9.8	4.7	39.8	1.9	2.7	19.0	19.5	139.3 ^c
1975-79	238.5	11.0	4.6	46.7	2.6	2.5	19.6	23.8	94.7
1980-84	278.4	14.3	5.1	59.7	4.5	1.6	21.4	31.2	36.4
1985-89	311.8	14.9	4.8	68.6	6.3	0.9	22.0	41.5	14.9
1990-94	342.3	17.7	5.2	76.9	7.4	0.8	22.5	41.6	10.3
1995-99	375.2	26.8	7.1	119.1	10.5	4.1	31.8	39.2	38.7

- a. Only Burma, Indochina, Thailand, Korea, Taiwan, Japan, India, Malaya, Sri Lanka, Java, the Philippines and China. These countries produced about 98 percent of world output in 1950/51.
- b. Exports of Burma, Indochina, Thailand, Korea, Taiwan only. Other main rice exporting countries such as the USA, Italy, Spain and Brazil would add 3-5 percent to total exports. (Taylor, H.C. and A.D. Taylor (1943) *World Trade in Agricultural Products*. (New York: Macmillan) pp.137-138)
- c. More than 100% implies a net inflow of rice from outside the region. In this case largely from the USA to South Vietnam, the Philippines and Indonesia, following crop failures in Thailand in 1972 and 1974.
- d. Net imports of Malaysia, Singapore, Indonesia and the Philippines, plus after 1965 net imports of the countries of Indochina.

Sources: World production and trade: 1920-39 Wickezer, D. and M.K. Bennett, 1941, *The Rice Economy of Monsoon Asia*. (Stanford: Food Research Institute) 316-17; 1940-49 *The World Rice Economy in Figures (1909-1963)*. (Rome: FAO, 1965) 15 and 42; production in China estimated assuming 100 kg paddy per capita and population interpolated from 430 million in 1913 to 547 million in 1950; 1950-99 *FAO Production Yearbook*, *FAO Trade Yearbook* and FAOSTAT database (online). All paddy data converted to milled rice with 0.65 milling rate.

Table 2: World Cereal Exports, 1909-2000

	1909/13	1924/28	1934/38	1959/61	1969/71	1979/81	1989/91	1999/2001
<i>Total (million tons, annual averages)</i>								
Wheat	18.3	24.0	17.0	34.0	54.7	95.2	111.9	127.2
Maize	6.9	9.3	10.9	11.6	29.1	78.4	71.9	80.0
Rice	5.2	6.6	6.9	6.1	7.7	12.8	13.6	25.2
Total	30.4	39.9	34.9	51.7	91.5	186.4	197.4	232.3
<i>Shares (percentages)</i>								
Wheat	60	60	49	66	60	51	57	55
Maize	23	23	31	22	32	42	36	34
Rice	17	17	20	12	8	7	7	11

Note: Wheat includes wheat equivalent of flour.

Sources: Taylor, H.C. and A.D. Taylor, 1943, *World Trade in Agricultural Products*. (New York: Macmillan) 126, 137 and 147; *FAO Trade Yearbook* and FAOSTAT database (online).

Table 3: Productivity in East Asian rice agriculture, 1870s – 1980s (annual averages)

Year	Labour Input per Hectare (days)	Gross Rice Yield (ton/ha.)	Area per Day Worked (m ² /day)	Kg Rice per Day Worked
Japan				
1877/1901	283	1.93	35	6.8
1908/17	287	2.43	35	8.5
1924/30	253	2.61	40	10.3
1931/43	254	2.69	39	10.6
1951/57	237	2.96	42	12.5
1958/63	206	3.50	49	17.0
1964/70	169	3.79	59	22.4
1971/80	106	4.13	95	39.1
1981/90	68	4.46	147	65.3
Java				
1875/80	232	1.22	43	5.3
1923/30	210	1.11	48	5.3
1955/61	189	1.17	53	6.2
1968/69	166	1.39	60	8.4
1977/80	152	2.04	66	13.4
1987/92	116	2.93	86	25.2
Thailand				
1906/09	63	0.97	158	15.4
1930/34	50	0.88	202	17.8
1953/69	84	0.84	119	10.0
1970/79	87	1.06	114	12.1
1980/88	76	1.19	132	15.7
Tonkin/North Vietnam				
1930s	213	1.35	47	6.3
1950	215	1.49	47	6.9
Cochinchina/South Vietnam				
1930s	65	0.87	154	13.4
1950	73	1.33	137	18.2
1960s	69	1.26	145	18.2
1990	89	2.18	112	24.5
Cambodia				
1899	67	0.91	149	13.6
1930s	79	0.65	127	8.2
1950s	66	0.74	151	11.2
1988/89	148	0.86	68	5.8
Philippines				
1950/61	66	0.76	150	11.4
1965/74	76	0.97	132	12.7
1975/82	109	1.28	92	11.8
1985/90	81	1.69	124	21.0
Burma				
1932	57	0.93	175	16.3
1977/81	79	1.41	127	18.0
West Malaysia (Malaya)				
1919/28	147	0.83	68	5.6
1948/50	97	0.91	103	9.3
1962/69	131	1.62	76	12.3
1973/83	169	1.93	59	11.4

Notes: The basic data on labour input in rice agriculture are obtained from a wide range of local surveys. Unless specified differently in the source, labour input measured in hours was converted on the assumption that one workday equals eight hours. It is assumed that the average of several surveys for a particular period is representative for the entire area. Rice yields are averages for the whole country or region, generally obtained from national sources, converted to rice equivalents. 1 ton/ha equals 0.1 kg/m².

Sources: See Appendix 1.

Table 4: Rural Wages for Male Unskilled Labour in Southeast Asia and Japan, 1890-1980 (US\$/Day)

	1890	1900	1910	1920	1930	1950	1960	1970	1980
Burma					0.33 ^a	0.39 ^b	0.52	0.43	0.27
Thailand	0.38 ^c	0.20 ^d	0.24	0.32	0.34 ^e		0.48 ^f	0.59 ^g	1.83 ^h
Malaya		0.21	0.23	0.24	0.16	0.90	1.18	1.26	2.38 ⁱ
South Vietnam		0.09 ^j	0.15 ^k	0.13 ^l	0.19	0.67	0.45	0.52	
Java	0.11	0.11	0.12	0.18	0.17	0.25	0.05	0.37	1.33
Other Islands			0.28 ^m	0.30	0.37	0.49	0.08	0.60	2.00
Philippines				0.41 ⁿ	0.43 ^o	0.65	0.75	0.61	1.33
Japan	0.14	0.19	0.26	0.72	0.33	0.66	1.67	7.56	23.47

a. 1929, 1931

b. 1953

c. 1889-90

d. 1899, 1902, Bangkok

e. Bangkok

f. 1965

g. 1970, 1972

h. 1981

i. 1979

j. 1898

k. 1911

l. 1920-22

m. 1911-14

n. 1925

o. 1931

Note: Where possible, five-year averages of which the first year is given. Domestic prices converted to US dollars with current exchange rates and black market rates approximating the purchasing power of currencies.

Sources: Data from a wide range of sources was used to compile this table. The postwar data are generally from: *ILO Yearbook*; *ECAFE Bulletin*; *FAO Production Yearbook*; Palacpac, A., 1991, *World Rice Statistics. 1990*. (Los Banos: IRRI). The most important additional sources are: Malaysia, Thoburn, J.T., 1977, *Primary Commodity Exports and Economic Development: Theory, Evidence and A Study of Malaysia*. (London: Wiley) 284-86; Thailand, Feeny, D., 1982, *The Political Economy of Productivity: Thai Agricultural Development, 1880-1975*. (Vancouver: University of British Columbia Press) 132-33; Indochina, Murray, M.J., 1980, *The Development of Capitalism in Colonial Indochina 1870-1940*. (Berkeley: University of California Press) 284 and 331, *Bulletin Économique de l'Indochine* and *Annuaire Statistique de l'Indochine* (1932-41); Indonesia, Van der Eng, P., 1996, *Agricultural Growth in Indonesia: Productivity Change and Policy Impact since 1880*. (New York: St.Martin's Press) 32; Philippines, *Statistical Handbook of the Philippines*; Japan, *Long-Term Economic Statistics of Japan Vol.9: Agriculture*. (Tokyo: Toyo Keizai Simpo-sha, 1967). Exchange rates from Van der Eng, P., 1993, *The Silver Standard and Asia's Integration into the World Economy, 1850-1914. Working Papers in Economic History No.175*. (Canberra: Australian National University) 27-30.

Table 5: Population Densities in Japan and Southeast Asia, 1850-1990

	1850	1875	1900	1925	1950	1975	1990
<i>People per Hectare of Cultivated Arable Land (Nutritional Density)</i>							
Japan		7.6	8.4	10.1	14.2	20.1	23.6
Burma		2.5 ^a	1.9	3.1	3.1	3.0	4.2
Thailand			5.2 ^b	3.9	2.9	2.5	2.7
Laos					3.7 ^c	4.3	4.8
Cambodia				3.2 ^e	1.9 ^c	3.5	2.3
Cochinchina/South Vietnam			2.3 ^f	2.2	5.2 ^g	6.5 ^h	9.8 ^d
Tonkin/North Vietnam				5.3 ⁱ	5.1 ^j	8.5 ^h	
Malaya/Malaysia				1.9 ^k	2.1 ^c	2.6	2.6
Philippines			5.8 ^f	3.2 ^l	5.1	6.2	7.6
Indonesia, Java		4.9 ^m	5.0	4.8	6.0	9.5	12.3
Indonesia, Other Islands		3.4 ^m	2.8	2.3	2.8	3.3	2.4
<i>People per Harvested Hectare of Rice</i>							
Japan		13.2	15.6	19.1	27.6	40.5	59.6
Burma	5.9	4.8	3.0	3.0	5.0	5.8	8.8
Thailand	5.6		6.5 ^f	4.0	3.6	4.9	5.4
Laos				5.2 ^l	2.7 ^g	5.0	6.7
Cambodia			4.8	3.6	2.5	6.4	4.6
Cochinchina/South Vietnam		3.6 ^q	2.5	1.9	6.2	7.5	9.0
Tonkin /North Vietnam		5.4	6.4 ^o	7.2 ^p	6.1	11.1	13.3
Malaya/Malaysia			11.5 ^b	13.2	15.8	15.8	26.2
Philippines				6.7	9.0	11.9	18.5
Indonesia, Java		11.0 ^m	11.1	12.0	14.3	17.0	19.1
Indonesia, Other Islands					11.8	12.5	14.2
a. 1901	b. 1911	c. 1961	d. Vietnam total				
e. 1930	f. 1902	g. 1951	h. 1973				
i. 1939	j. 1955	k. 1930	l. 1926				
m. 1880	o. 1924	p. 1940	q. 1870				

Sources: Data from various statistical sources from individual listed countries was used to compile this table. This data was augmented after World War II with data from: *ECAFE Bulletin*; *FAO Production Yearbook* and FAOSTAT database (online); Palacpac, A. (1991) *World Rice Statistics 1990*. (Los Banos: IRRI).

Table 6: Growth of Rice Production in Southeast Asia and Japan, 1875-1990

	1875-1900	1900-25	1925-50	1950-70	1970-90
Burma:					
Annual Av. Growth (%)	3.0	1.0	-1.0	1.8	3.3
Harvested Area		131	54	49	4
Yield		-28	45	49	96
Thailand:					
		1902-25			
Annual Av. Growth (%)	1.6	2.1	1.8	3.3	2.0
Harvested Area		157	155	41	45
Yield		-63	-55	59	55
Malaya/Malaysia					
		1911-25			
Annual Av. Growth (%)		0.2	2.7	4.5	0.7
Harvested Area		266	33	54	-36
Yield		-165	67	45	138
Java					
	1880-1900				
Annual Av. Growth (%)	0.4	1.0	0.7	2.9	4.0
Harvested Area	161	104	75	30	23
Yield	-61	-4	24	69	76
Other Islands, Indonesia					
	1880-1900				
Annual Av. Growth (%)	0.7	1.5	1.1	3.3	4.5
Harvested Area				70	38
Yield				29	60
Indochina (Total):					
Annual Av. Growth (%)	2.1	1.9	0.7	3.2	2.8
Harvested Area		131	80	14	36
Yield		-30	18	86	63
Cochinchina:					
Annual Av. Growth (%)	5.5	0.9	-1.6	5.1	
Harvested Area	101	212	95	43	
Yield	0	-114	4	55	
Philippines:					
		1908-25			
Annual Av. Growth (%)		2.0	1.4	2.8	3.5
Harvested Area		84	97	48	7
Yield		16	3	51	93
Japan:					
Annual Av. Growth (%)	1.0	1.2	0.1	1.3	-0.8
Harvested Area	47	37	-139	-39	151
Yield	53	62	240	140	-51

Note: In some cases total production was estimated with per capita rice supply and exports. The growth rates were calculated from five-year averages of which the first year is given. Contributions of changes in harvested area and crop yields are calculated with the following equation:

$g(O) = g(HA) + g(O/HA) + [g(HA) \times g(O/HA)]$, in which g is the compounded growth rate, O is production and HA is harvested area. The last term in the equation is tangential to zero.

Sources: Data from various statistical sources from individual listed countries was used to compile this table. This data was augmented after World War II with data from: *ECAFE Bulletin*; *FAO Production Yearbook* and FAOSTAT database (online); Palacpac, A., 1991, *World Rice Statistics 1990*. (Los Banos: IRRI).

Figure 1: World Rice Exports, 1860-1999 (cumulative, million tons of rice, 10-year averages)

Sources: See Table 1. Additional sources, Burma: Grant, J.W., 1939, The rice crop in Burma: Its history, cultivation, marketing and improvement. *Agricultural Survey No.17*. (Rangoon: Dept. of Agriculture) 55; Cotton, H.J.S., 1874, The rice trade of the world. *Calcutta Review*, 58, 272; Cheng Siok-Hwa, 1968, *The Rice Industry of Burma 1852-1940*. (Singapore: University of Malaya Press) 237-38; Khin Win, 1991, *A Century of Rice Improvement in Burma*. (Manila: IRRI) 147-48; Thailand: Manarungsan, S., 1989, *Economic Development of Thailand, 1850-1950: Response to the Challenge of the World Economy*. (Groningen: Faculty of Economics, University of Groningen) 209-11; Wilson, C.M., 1983, *Thailand: A Handbook of Historical Statistics*. (Boston: Hall) 212-15; Indochina: *Bulletin Économique de l'Indochine* (1925) 390-91; *Annuaire Statistique de l'Indochine* (1932-41).

Figure 2: Schematic Illustration of Growth Paths in Rice Production in Asia with Regard to Productivity Change

Note: The three variables in this chart are interrelated, because labour productivity (O/L) = land productivity (O/A) $\times$ land-labour ratio (A/L).