

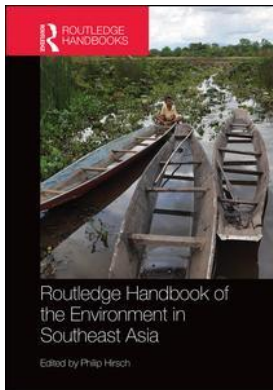
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ENVIRONMENTAL HISTORIES OF SOUTHEAST ASIA

Peter Boomgaard

Introduction

Environmental history, broadly speaking, deals with the way the natural environment changes, particularly (but not exclusively) by human actions, and with the way humans and human behaviour have changed due to environmental factors, in particular environmental change. Change begetting change is therefore at the heart of environmental history. This chapter should therefore be read as a way of interpreting the present through the past (Hughes, 2006). Presently, I explain the choices I had to make from among the various approaches or subgenres of environmental history.

In this chapter, I argue that population growth and economic change, the latter brought about largely by the development of trade, can be regarded as the prime drivers of environmental change in Southeast Asia. I also argue that the combined environmental impact of trade-induced economic activities – such as plantation agriculture, export-oriented smallholder agriculture, mining and particularly logging – did not overshadow the effects of land clearing resulting from population growth until the 1960s.

Both population growth and the development of long-distance trade can be thought of as having been part of a long process of globalization, in which I distinguish four stages or phases. These phases also had floral, faunal and microbial components, constituting a convenient framework for the environmental history of Southeast Asia. In addition, and in order to make sense of the intra-Southeast Asian diversity of environmental change and the linkages between developments in Southeast Asia on the one hand and those in Eurasia, Africa and America on the other, I present my adapted version of a world-systems approach.

Environmental historical research and publications are unevenly spread over the Southeast Asian region. Indonesia is well represented and, to a somewhat lesser extent, so are Malaysia and the Philippines. For all other areas, publications are scarce, and often the coverage in time is shallow, with very little on anything prior to c. 1960. This unfortunate situation can be attributed to various factors, such as a lack of archival material or archival access, a lack of interest among historians teaching at local universities or a political climate that is not conducive to such publications. Fortunately, the last two factors can change (and, in some cases, have already changed); the first factor is, alas, a given. I hope that this chapter will be a wake-up call for those historians (and possibly environmentalists, biologists, geographers and anthropologists) who are fortunate enough to have good archives and libraries at their disposal.

In this chapter, little is said about environmental consciousness and environmental movements – two approaches to environmental history – nor are recent developments given pride of place, assuming that most people reading this book are familiar with the changes, problems and opportunities of recent decades and that they will read of recent developments in later chapters of this book. Rather, this chapter emphasizes structural developments in the long run, stressing that environmental change is not a recent phenomenon, even though the scale on which it now takes place is much larger than before. Structural environmental developments include, but are not limited to, changes in land use, changing landscapes, forest cover, erosion, crop and livestock mixes, the extinction of species (and, in the remote past, their arrival), changing disease patterns, changing population densities, climate change, increasing use of fossil fuel and the general increase of mining.

The level of abstraction is relatively high, because this chapter, given its limited length, has to generalize across time and place, presenting a framework for future case studies. I refer those whose appetite has been whetted by this chapter to a book containing much more detail on the same topic that I published on the subject in 2007 (Boomgaard, 2007).

Southeast Asia is home to over 600 million people and is annually visited by many millions from elsewhere. Those who were born and bred in the region, and who are in their 60s or 70s, have lived through a great many environmental changes, many of which are clearly visible to the naked eye. Outsiders who visit Southeast Asia, or even those who choose to live there for considerable periods of time, often come to the region with unrealistic expectations, certainly when they are tourists (and one should not underestimate how much tourists shape the image of a region). It is not unlikely that they are drawn to Southeast Asia by pictures of sunny and sandy beaches with palm trees, or orangutans against a backdrop of lush forest vegetation. When they arrive, they find that the beaches are overrun by their own kind, the forests have been depleted and the orangutans are not to be found, outside one or two centres where people care for orphaned orangutan babies.

This is not to say that it is impossible for nature lovers to find places in Southeast Asia where nature is still attractive. The point I want to make is that high rates of population increase and fast economic growth from the 1960s often have changed Southeast Asian landscapes beyond recognition. For this period, the term *globalization* has been coined, but I argue that this is just the last of four globalization phases that can be discerned in Southeast Asia – an issue to which I return presently. Nevertheless, it is quite clear that this last globalization phase has coincided with very high rates of environmental change, and that rapid environmental change has been an essential feature of globalization as usually understood.

Environmental change

Environmental change did not start in the 1960s. Rather, it has been an ongoing process from as long ago as our records go back, and even earlier. At this stage of the story, it should be pointed out that environmental change is not necessarily human-induced. This becomes immediately clear if one considers phenomena such as volcanic eruptions, tsunamis and, on a much larger scale in the remote past, the Ice Ages, lasting thousands of years, when large parts of the globe were covered with ice, and water levels consequently dropped considerably in those regions not under the ice cap. This included regions such as Southeast Asia, where the hot and humid extent of the equatorial zone contracted. Tropical rainforests disappeared in these regions, and their place was taken by savannah-type landscapes. The drop in temperature in the lowlands of Southeast Asia during glacial periods was probably rather small, but in the highlands it might have been as much as 8° Celsius, which would have had consequences for human habitation if those areas had been inhabited.

Drastic floral and faunal changes occurred several times on a worldwide scale, so that one could find palm trees in Antarctica and hippopotamuses where we now find the North Sea (Europe). But the biggest change of all, and even further back in time, was that of the so-called continental drift, with the land masses moving to their present positions over millions of years. Most of Southeast Asia is positioned on a continental shelf called Sundaland. The only areas that are not part of this shelf are the Philippines, eastern Indonesia (Sulawesi, the Lesser Sundas minus Bali and Moluccas) and New Guinea. The Philippines and eastern Indonesia constitute an area that has been called Wallacea (after the famous naturalist Alfred Russel Wallace), while New Guinea (along with Australia) is part of another shelf called Sahulland. Long ago, Sahulland and large sections of Wallacea were part of a large continental mass, far to the south of their present position; they drifted northward over millions of years. Proof of this can still be found in the enormous differences between the fauna and flora of Sundaland and Sahulland, with Wallacea as a transitional zone (see Figure 3.1).

Sundaland has a rich and highly diverse Asiatic flora and fauna, characterized by, among other species, large placental mammals (elephant, rhinoceros, banteng and seladang, Asiatic buffalo, deer, pig, monkey, gibbon and orangutan), including large predators (tiger and leopard). Sahulland, in contrast, has an almost entirely different, relatively poor, Australian flora and fauna, of which the marsupials (kangaroo, wombat, cuscus (*Phalanger*) and Tasmanian devil) are typical representatives. The only two types of placental mammals in Sahulland in prehistoric

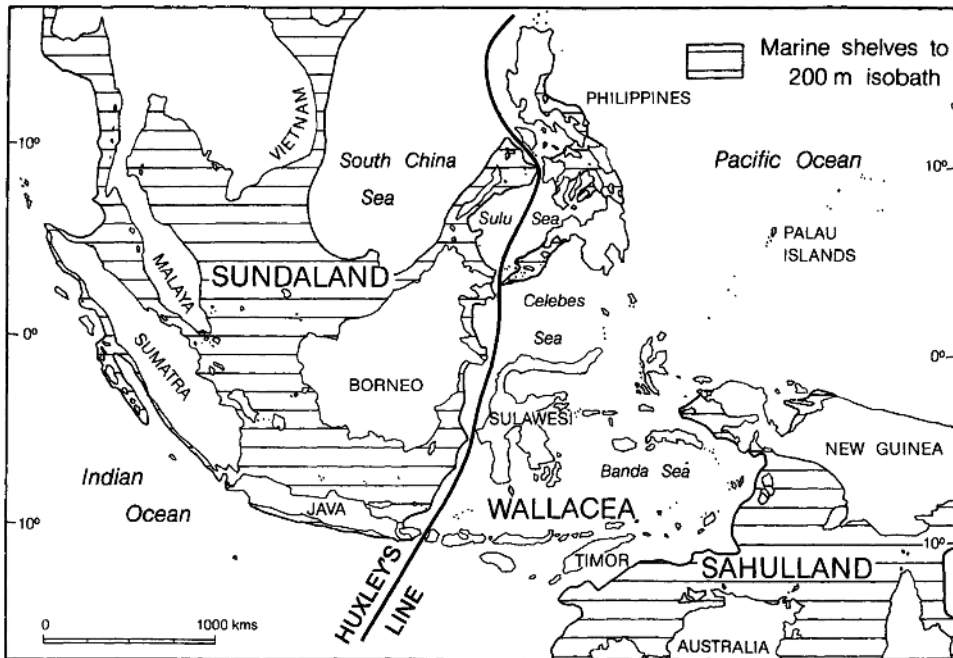


Figure 3.1 Major biogeographical divisions within the Indo-Malaysian region

Separate Philippine landmasses during glacial periods of low sea level would probably have comprised (a) Greater Luzon; (b) Mindanao, Samar and Leyte; (c) Masbate, Panay, Negros and Cebu. Bohol and Mindoro remained separate. Palawan was linked during some glacial maxima with Borneo.

Source: Bellwood, 1997.

times – rodents and bats – must have somehow crossed the sea without the help of humans. The flora and fauna of Wallacea, often called ‘impoverished’ by naturalists such as Wallace, contain elements of both Sundaland and Sahulland (Bellwood, 1997).

Arrival of people and agriculture

Even looking at human-induced environmental changes alone, it should be pointed out that such changes are longstanding. They date from as long as humans or, if you wish, hominids, have been around. Of course, during the early phases of the presence of humanlike beings, the scale and frequency of the changes would have been restricted and, in most cases, hardly perceptible. Nevertheless, there would have been change, the more so as humans/hominids discovered the control of fire a few hundred thousand years ago.

Homo erectus, a hominid originating in Africa some 1.8 million years ago, might have reached the region by around one million years ago (or somewhat later). However, modern humans, called *Homo sapiens*, did not appear until much later, perhaps around 60,000 BP (before present). In 2003, a spectacular discovery occurred when, on the Indonesian island of Flores, bones of nine individual hominids of an entirely new type were found – *Homo floresiensis*, dated between 95,000 and 12,000 years ago, and therefore partly contemporary with *H. sapiens*.

If we may characterize the arrival of *H. erectus* and that of *H. sapiens* as the first and the second ‘wave’ of humanlike creatures reaching Southeast Asia, and *H. floresiensis* as an endemic phenomenon, current orthodoxy suggests that a third wave started possibly around 6000 BP. We know little about the numbers involved in each wave. By the time of the third wave, there was only one type of human left, *H. sapiens*, so this was a case of one subspecies of *H. sapiens* slowly advancing into the territories of another subspecies. The biological grouping that undertook this expansion has been called Southern Mongoloid, as their area of origin is the southern part of what is today China. They took the place of, or interbred with, a grouping that had developed locally from the second wave, and that may be called Australo-Melanesian. The Southern Mongoloids have dominated Southeast Asia ever since, but remnants of the Australo-Melanesians are still to be found in the region (Papuan and Negritos).

It has long been assumed that the Australo-Melanesians were foragers (hunter-gatherers), while the Southern Mongoloids were agriculturists. Their numbers were probably much larger than those of the Australo-Melanesians, who in most areas of Southeast Asia seem to have disappeared from the face of the Earth, probably because their genes were a drop in the ocean constituted by the gene pool of the newcomers (Bellwood, 1997; Higham, 2002). Lately, this model has been called into question, based upon new research, and the transition from foraging to agriculture may have been more gradual, earlier and not necessarily brought about by the Southern Mongoloids (Barker *et al.*, 2011). It is early days, however, and it seems prudent to wait for more evidence before declaring a paradigm change.

Depending on the area, agriculture seems to have appeared in Southeast Asia between 4000 and 1000 BCE (Before Common Era). For this first phase of agriculture, prior to the use of bronze and later iron, the term Neolithic (Late Stone Age) or, more dramatically, Neolithic Revolution, is conventionally employed.

The term Metal Ages is often used to cover the Bronze Age and the Iron Age. In mainland Southeast Asia, those two phases can be clearly distinguished. Bronze was introduced, in all likelihood from China, probably after 2000 or 1500 BCE. Iron, probably also from China, arrived around 500 BCE. In insular Southeast Asia, the two phases cannot be distinguished, and copper and iron arrived on the scene around the same time, *c.* 500 BCE (Bellwood, 1997; Higham, 2002).

The presence of bronze (an alloy of copper and tin) and iron represents significant technological improvement. This resulted in more sophisticated instruments of agriculture and war, and also more durable vessels. Thus, the productivity of land and labour increased, as did the ability of humans to manipulate and increase their impact on the natural environment.

Population growth, trade and economic change

Population growth and economic change can be regarded as the prime drivers of environmental change in Southeast Asia. Environmental change, in turn, influenced population growth rates and the scope and composition of commodity flows. Thus, the environmental histories of the region can be seen as a chain of interlocking changes.

A key question arises from the interlocking nature of these changes. Was Southeast Asian population growth driven by economic (and technological) development, or was it the other way around, and was population growth the motor of the economy? There are indications for both possibilities.

Population growth has always been the main driving force of extensive agricultural expansion through the clearing of new land, which in a preindustrial society is the main motor of economic growth. Growing population density led to a limited degree of urbanization, diversification and specialization, or, in other words, structural economic development, which must have resulted locally in a modest increase in real income per capita (often called Smithian growth). Here, clearly, economic growth was generated by population growth.

On the other hand, a number of economic developments were evidently set in motion by outside forces, of which foreign demand for local commodities – including spices, resins, fragrant woods, dyes, medical herbs, rhino horn and rice – was the most important. The introduction of foreign crops and livestock was at least a very good second. Both factors were, directly or indirectly, conducive to higher rates of population growth.

Changes in the political economy also stimulated higher rates of population growth. These changes included the laying out of wet rice fields by monarchs and monasteries at least by the ninth century, but probably earlier; the introduction of Western medicine by colonial regimes as early as 1800; and the increasing demand for labour generated by Western capital.

It appears likely that trade, throughout Southeast Asian history, has stimulated population growth, directly or indirectly, while population growth, in turn, has stimulated trade. External demand for commodities usually created new economic opportunities, even if those who produced the commodities seldom received the full market price for their pains. Furthermore, human fertility seems to have been positively related to opportunities created by the demand for labour (Christie, 1998; Boomgaard, 2007).

When, during the nineteenth century, colonial states took the place of European trading companies, they attempted to bring about higher birth rates and lower mortality. These policies appear to have functioned as intended, and population growth rates increased, which made for stagnating and even falling wage rates from 1900 onward. Low labour costs, in turn, attracted outside capital and technology, creating more and cheaper commodities for the international market, thus stimulating long-distance trade.

The above discussion shows how intimately the two prime drivers of environmental historical developments in the region – population growth and expanding trade – were linked. The discussion also shows that this linkage involved both external developments and changes endogenous to the region.

Phases of globalization

Population growth and the development of long-distance trade can be thought of as part of a long process of globalization, in which four phases can be distinguished. These phases also had floral, faunal and microbial components.

The first globalization phase began around the beginning of the Common Era (CE) and lasted until the fourteenth century. Long-distance trade developed between the Mediterranean world (until the fifth century with the Roman Empire, and later with various Mediterranean polities), India and China on the one hand, and Southeast Asia on the other. Population growth rates were very low. Various alien plants (crops), animals (livestock) and diseases reached Southeast Asia. The list of newly introduced crops is fairly long: black pepper, safflower dye, cotton, Indian indigo, coriander, fennel, tamarind, sesame, mung beans and garlic, which came from China, India or the Mediterranean. The water buffalo and banteng-type cattle are indigenous to the region (the latter was domesticated there), but humped cattle came from outside (albeit very early), as did horses, goats and sheep (Hill, 2004). It stands to reason that particularly the larger types of livestock left their mark on the landscape, as did pepper, a perennial upland crop, which made for an increase in production for the market and growing inequality in income and status among producers.

There was some long-distance trade before the CE, and interregional trade during the CE was sometimes interrupted. However, I refer to the early CE as the start of the first globalization phase because during this period long-distance maritime and overland trade began to play a much greater role in these societies, among other things in being instrumental in turning chiefdoms into early states such as Funan, Angkor, Champa, Srivijaya and the first Mataram; these states, in turn, facilitated long-distance trade.

The second globalization phase coincided with the early modern period in Southeast Asia. Long-distance trade increased considerably, not only with the Mediterranean world but also with India, China and the Americas. The list of commodities exported from Southeast Asia – not only by Europeans but also by people from the region, and traders from India and China – is a long one, consisting of forest products and minerals, but also agricultural commodities. For example, the list of the main forest products includes benzoin, camphor, cardamom, cutch, deer hides, eaglewood, ebony, elephants (and parts of them, such as tusks/ivory), honey, lacquer, mats, musk, rattan, resins, rhino horn, sago, sandalwood, sappanwood, timber and wax (Boomgaard, 2007, pp. 148–149).

From the Americas came large numbers of new crops and other plants (the so-called Columbian Exchange), while Southeast Asia's participation in the 'civilized disease pool' increased as well. The term is from William H. McNeill, but the idea was launched around the same time by Emanuel Le Roy Ladurie. The Black Death (the plague) is a good example of this 'microbial unification'. Many of the American food crops – such as maize, sweet potato, chillies and peanuts – were enormously successful (Crosby, 1972; McNeill, 1979).

With this phase, globalization expanded and accelerated, as did its impact on the Southeast Asian environment. Population growth, while still very low by modern standards, may have increased somewhat in comparison with the first globalization phase. During the millennium prior to the fifteenth century, one could postulate, based on heroic assumptions, an average annual growth rate of between 0.05 and 0.1 per cent, while the figure between 1600 and 1800 was probably closer to 0.15 or 0.25 per cent. But it has to be emphasized that the figures upon which these calculations are based are not very reliable, and that there were differences between areas within the region. At the tail end of the period, the century or so prior to 1870, population growth in some Southeast Asian areas was certainly higher, reaching between 0.5 and 1.5 per cent per year on average in Java and parts of the Philippines (Boomgaard, 2007).

Foreign capital, technology and people (migrants) were imported on a much larger scale than before. States started to rely for their income to a large extent on foreign trade and traders. In a number of Southeast Asian states, income from foreign trade in the eighteenth century was probably the largest single source of Crown revenue. Such income, in turn, was instrumental in strengthening the position of the rulers in the core areas, among other things with the help of modern weapons, thus ushering in (or at least strengthening) the absolutist state in Southeast Asia (Reid, 1997).

The third globalization phase coincided largely with the colonial period and its aftermath, from around 1870 to the 1960s. High growth rates obtained between 1870 and 1930, as the share of international trade in world income and production accelerated, reaching unprecedented levels. Between 1930 and the 1960s, the share of trade relative to global economic output stagnated.

Planted on the substratum of an indigenous peasantry and indigenous states, foreign investment, technology, crops, medicine and people (civil servants and soldiers, but also coolies and plantation administrators) taken together made for high growth rates of exports, both in absolute terms and as a proportion of GDP, particularly between 1870 and 1930. This shows up in the available agricultural statistics as a faster expansion of the cultivated area under perennials (permanent crops) than that under annuals (temporary crops). The perennials – notably pepper, coconut, abaca, coffee, tea, cacao, rubber and oil palm – were mainly produced for the world market and thus represent the growth of exports, while many of the annuals were subsistence crops, consumed by their producers. However, it has to be emphasized that the most important annual – rice – became an export product in the recently cleared swamps and river valleys of mainland Southeast Asia from around 1850, thanks to improved irrigation/drainage, capital investment and local migration. While the total cultivated area of Southeast Asia grew from 16 to 46 million hectares (an increase of 30 million hectares) between 1880 and 1950, the wooded area decreased over the same period from 366 to 313 million hectares (a drop of 53 million hectares). The difference between the figures for increase and decrease is accounted for by the increase of grass and shrub lands – formerly wooded areas where livestock and fire had prevented the growth of secondary forest – and of the built-up area (Richards and Flint, 1994; Elson, 1997).

Despite the increase in area cultivated for cash crops, in 1950 the share of land devoted to meeting subsistence needs was still much larger than that of the export crop area – roughly 4.5 times as large. Therefore, although the share of agricultural production geared towards international commerce, and therefore the influence of the latter on Southeast Asian land use, evidently was growing during the period under consideration, by 1950 the role of population growth as represented by the share of subsistence crops was still much more important.

Population growth accelerated almost constantly, largely because of Western medical progress but possibly also as a response to growing economic opportunities and the continuing expansion of wet rice cultivation. During the nineteenth century, population growth was probably just below 1 per cent per year on average, while the population growth rate between 1900 and 1930 was on average 1.4 per cent annually for the whole of Southeast Asia. Amazingly enough, the available figures suggest that the annual growth rate was even higher between 1930 and 1960; while we know that the 1930s was a depressed period, and the War in the Pacific (1941–1945) saw high mortality, available population figures suggest that the period 1945–1960 more than compensated for the low growth between 1930 and 1945 (Elson, 1997).

During the nineteenth century, relatively high growth rates were to be found in Java and the Philippines, at least most of the time. Between 1820 and 1870, the average annual increase of the population of the Philippines may have been as high as 1.6 per cent, but, owing to various

disasters, it was much lower – around 1.2 per cent – between 1870 and 1900. In Java, it appears to have been the other way around – 1.4 per cent before 1850, and perhaps as much as 1.75 per cent (but possibly less) thereafter. High rates also obtained in the Minahasa (northern Sulawesi) between 1860 and 1900 (1.5 per cent), and possibly in what is now Vietnam between 1840 and 1900 (1.3–1.4 per cent).

Given the fact that the average annual growth was less than 1 per cent for the whole region, there must have been various low-growth areas in order to compensate for the high rates quoted here. That was indeed the case – there is an estimate for Southeast Borneo (now Kalimantan) of 0.8 or 0.9 per cent between 1840 and 1870, and of a growth rate close to zero for Bolaang Mongondow (northern Sulawesi) during the period 1850–1900. The areas of high growth rates were often also wet rice regions (Henley, 2006; Boomgaard, 2007, pp. 206–218).

As during the eighteenth and earlier parts of the nineteenth centuries, foreign livestock breeds were imported after around 1870, but now on a much larger scale. They brought diseases such as rinderpest with them, which may have caused larger epidemics than in the past. Rinderpest epidemics were raging in many parts of Southeast Asia in the 1880s and 1890s. There are also indications that such epidemics were transmitted to wild ungulates (hoofed mammals) as more and more livestock invaded the shrinking forests, while it is even possible that some epizootics were transmitted to nonungulate mammals as well. This would have contributed to the disappearance of wildlife in the more densely settled areas. Between 1880 and 1950, the human population in the region was growing somewhat faster than livestock numbers; horses were doing particularly badly. All this was caused by the arrival of alternative means of transportation (Brown and Gilfoyle, 2010).

As a result of foreign demand, plantation agriculture made its appearance on a much larger scale than before and grew at a higher rate than subsistence agriculture. Cloves and nutmeg/mace, so important from the sixteenth century, had lost much of their importance by 1870, but pepper, also long-established, had still been increasing during most of the nineteenth century. Coffee was a new plantation crop in Southeast Asia in the eighteenth century, and tea was introduced in the early nineteenth century. Abaca and coconut were indigenous products, but increasing world market demand led to considerable expansion. From around 1870, cinchona, rubber, oil palm and cacao were introduced from outside and became quite successful.

During the period under consideration, the scale of mining operations in Southeast Asia increased considerably. Growing European and US demand was met by an increased supply because of the influx of Western and Chinese capital and technology, supported by growing numbers of workers, particularly from China. What almost all mines had in common is that they were established in rather inaccessible (upland) areas. These hitherto more or less ‘empty’ areas were suddenly invaded by all-weather roads, narrow-gauge railways, workers’ housing and small-scale agriculture to feed the miners. Therefore, the environmental impact of mining operations was not restricted to the effects of the mine itself. Some minerals had not been exploited in the region on any scale to speak of prior to the 1870s, as was the case with coal, oil, mica and nickel. Oil in particular would turn out to be of great economic importance for various countries in the region. However, the industry that arguably had the largest environmental impact in the region was probably not oil but tin, at least in the short run.

The influx of alien plants and animals (bio-invasions) continued. Some examples of fairly widespread bio-invasions in Southeast Asia during this period are *Lantana camara*, *Chromolaena spp.*, the water hyacinth (*Eichhornia crassipes*) and various species of eucalypts, particularly the blue gum tree. Many important export crops were, and still are, originally exotics. A number of new diseases (Spanish flu and plague) kept death rates from falling further than was already the case (Boomgaard and Henley, 2004; Boomgaard, 2007, pp. 229–235, 261–264).

Finally, from the 1960s, the fourth globalization phase took hold in Southeast Asia. Population growth rates were higher than ever before, but at the end of the period a slight drop in the growth rate occurred, a result of the so-called Demographic Transition. This fourth phase also witnessed unprecedented rates of economic growth and of increasing real income per capita – developments at least partly fuelled by growing exports, not only to the traditional importing regions but now also to Japan, China, Taiwan and South Korea. The combined environmental impact of trade-induced economic activities – such as plantation agriculture, export-oriented smallholder agriculture, mining and particularly logging – finally came to overshadow the effects of land clearing resulting from population growth.

During this last phase, pollution and the depletion of resources became major concerns. As was the case elsewhere in the world, these two were the bedfellows of industrialization, modernization and urbanization. When the depletion of natural resources in Southeast Asia is mentioned, it is likely that the first phenomenon that comes to mind is logging, which increased enormously due to growing demand from the United States, Europe, Japan and China. The environmental effects of the rapid increase in large-scale exploitation of the forests of Southeast Asia from the 1960s have been disastrous. Thailand witnessed a drop of its area under forest cover from almost 55 per cent in 1960 to approximately 20 per cent around 2000. During the same period, forest cover in the Philippines dropped from 45 per cent to 20 per cent, while the comparable figures for Indonesia are about 70 per cent and 50 per cent (Hirsch, 1996; Dauvergne, 1997; Ross, 2001; Tuck-Po *et al.*, 2003; Kathirithamby-Wells, 2005; Akimichi, 2009; Usher, 2009).

Mining also had a strong impact on the natural environment, showing high rates of growth and often leading to three types of problems: landscape destruction; pollution of land, soil and water; and social problems. The story of fishing in post-1960 Southeast Asia is quite similar to those of forestry and mining – growth rates were very high, at least until the 1980s, driven by continually increasing demand from Japan, the United States and Europe. Depletion of fish stocks was reported from the 1990s, as a result of overfishing. A very important shift that took place from around 1980 is the one from capture to culture, but the boom in aquaculture also encountered and caused various problems, some of which are of an environmental nature.

Pollution became a major problem in Southeast Asia from the 1960s. It appears to be the inevitable companion of ‘early’ industrialization, advanced urbanization, high productivity in agriculture and aquaculture, and high rates of deforestation and mine exploitation. Air pollution is a familiar phenomenon to those who have lived in or even visited any big city in Southeast Asia. Even during the dry season, when skies in rural areas are quite clear, the urban sky appears to be permanently overcast. To this should be added the growing production of greenhouse gases carbon dioxide, methane and nitrous oxide (CO₂, CH₄ and N₂O respectively), and in some cases including chlorofluorocarbons (CFCs). Increased levels of methane are, perhaps surprisingly, the result of the expansion of increased wet rice cultivation (Adas, 2009). Finally, tourism – now a major source of income for various Southeast Asian countries – should be mentioned separately as an important and growing source of pollution.

Another way in which logging, fishing, mining, urbanization, pollution and the like have influenced the natural environment in Southeast Asia is that they threaten the survival of many species of plants, as well as terrestrial and marine animals. Locally, many species either have become rare, and are now in danger of disappearing, or have become extinct. Much of this has happened since the 1960s, although even during the nineteenth century some species – such as the tiger, rhinoceros, orangutan, tapir, wild buffalo and wild cattle – had become locally extinct (Furukawa *et al.*, 2004; Boomgaard, 2007, pp. 256–258, 299–326).

At the same time, environmental awareness began to play a role in Southeast Asia, though hardly before the late 1970s. A number of wake-up calls marked this shift to a heightened environmental consciousness. One of the earliest was Rachel Carson's *Silent Spring* (1962), followed shortly by Paul Ehrlich's *The Population Bomb* (1968), Garrett Hardin's article 'Tragedy of the commons' (1968) and the 1972 report to the Club of Rome entitled *The Limits to Growth*. In the 1980s, Southeast Asian governments increasingly started to draft laws that reflected this increased global awareness, but weak law enforcement, a weak judicial system, corruption and a lack of democratic accountability have limited the effectiveness of this legislation.

World-systems approach

In order to place the stages described above in a framework that takes into account the position of Southeast Asia in the global economy and society, and to analyse and explain intra-regional differences in state formation and in economic, demographic and environmental change, I propose to look at a more dynamic model, for which the so-called world-systems approach appears to be appropriate. This model, launched by Immanuel Wallerstein in the 1970s (Wallerstein, 1974), in its original form can be described as follows: since the sixteenth century, the so-called European world-economy has dominated economic life on this planet. The model distinguished a core area in North-western Europe, a periphery in the Americas and a semiperiphery in Central and Eastern Europe. These areas were connected by trade links that were directed from Europe and financed with European capital, while they determined the modes of production and the labour relations in the three types of areas. The core was characterized by free labour; chattel slavery was important in America, while serfdom dominated in Central and Eastern Europe. Asia and Africa remained outside this world-economy until around 1750.

This model, though well received by many historians, has also been criticized (Abu-Lughod, 1989; Chase-Dunn and Hall, 1991), and I propose to revise it as follows. Instead of a European world-economy, I posit a Eurasian world-economy, with its roots in the Pre-Modern Era (and therefore much earlier than Wallerstein suggested), comprising three core areas (instead of one): Europe, India and China. The model roughly covers the last two millennia. One of the (semi) peripheries was Southeast Asia, where state formation, economic life, population growth and environmental change were all partly shaped by the demand for commodities from the core areas. The core areas needed the Southeast Asian periphery for its raw materials and its foodstuffs, and as an outlet for their capital and its surplus population. The economies of Southeast Asia required the industrial products of the core areas, their investment capital, their technology (including firearms) and their migrants. The Southeast Asian periphery itself consisted of core areas and internal peripheries, which were also mutually interdependent, and whose relationship mirrored that between the three Eurasian core areas and the Southeast Asian periphery.

The Eurasian core areas generated a growing demand for commodities from Southeast Asia. Part of that demand (particularly rice) was met by the Southeast Asian core areas, but a great many commodities had to come from Southeast Asia's internal periphery: almost all forest products and minerals, and crops such as tobacco, pepper, coffee and rubber. Thus, through a hierarchy of markets, demand was transmitted from the Eurasian core areas to the Southeast Asian (semi)periphery, which in turn transmitted a large part of it to its own internal peripheries, in the meantime siphoning off part of the profits. Generally speaking, the largest share of the profits went to the merchant-capitalists-cum-entrepreneurs from the Eurasian core areas, although the rulers of the Southeast Asian core areas acquired large shares as well.

The internal peripheries, therefore, produced a large share of the total commodity flow from Southeast Asia to the Eurasian core areas, without receiving a proportionate share of the proceeds.

While relatively high rates of economic development were obtained in the Eurasian core areas, and somewhat lower rates in the Southeast Asian semi-periphery, economic development in the internal peripheries was very restricted if not as good as absent. The moneys that did arrive here in exchange for commodities were often spent traditionally: prestige goods that could be used for bride prices, slaves, and livestock for feasts of merit. Through various mechanisms, the scope and the nature of these returns contributed to low rates of natural population increase, and this population constraint was reinforced by outmigration, slave raids and the abduction of war captives by the Southeast Asian core states.

A two-track model

Based on the foregoing historical considerations, I have developed the notion of a two-track demographic, economic and environmental system in Southeast Asia: a model linked to the position of the region's internal periphery within the Eurasian world-economy (Boomgaard, 2007, pp. 132–134, 208–209; Boomgaard, 2012).

Generally speaking, we appear to find multifamily households, late marriages and relatively high celibacy, relatively low fertility, and therefore low rates of natural increase in the rather isolated inland and upland areas of Early Modern Southeast Asia, where shifting cultivators (also called slash-and-burn agriculturists or swiddeners) and hunter-gatherer groups, living surrounded by a relatively 'undisturbed' vegetation, constituted an important share of the population. In many of the (coastal) lowlands and mid-altitudes, where wet rice production was important and much of the original vegetation had long since gone, we encounter nuclear families, early and universal marriage, high fertility and therefore relatively high rates of population growth, at least when mortality was not unusually high.

It is not easy to find hard quantitative evidence to support this model. The population growth figures presented for the nineteenth century earlier in this chapter, however, are illustrative of the demographic aspect of the model: relatively high growth rates in Southeast Asian core areas such as Java, and parts of the Philippines and Vietnam, and low rates in internal peripheries such as Borneo and Bolaang Mongondow.

Looking at differences in population densities within Southeast Asia is also helpful. High densities obtained around 1600 in parts of Indonesia, such as Bali (80 people per square kilometre) and Java (35); in parts of the Philippines, such as greater Manila (Luzon) (more than 20); and in northern and central Vietnam (20), all of them arguably core areas. Very low figures were found in Borneo (1) and Mindanao-Sulu (the Philippines) (1.5), representing the internal peripheries (Reid, 1988, p. 14; Boomgaard, 2007, p. 117; Newson, 2009, p. 252). Generally speaking, much of the original fauna and flora were still present in the low-population-density areas, the levels of deforestation and pollution were low, and agriculture and livestock keeping had little impact on the surrounding environment. The opposite was true in the high-density areas.

There is a theoretical justification for this two-track pattern. In slash-and-burn areas, labour requirements were lower than in wet rice regions, while in the case of hunter-gatherers, even when the female activities were quite strenuous, sometimes to the point of amenorrhea, young children would have been quite a burden on the foraging mothers. It is not surprising, therefore, that fertility was low on this track. Wet rice production is highly labour-intensive, with a high degree of female participation. It has been argued in the 'demand-for-labour' hypothesis that this gave women an incentive to bear (more) children, since even young children – who participated in agricultural activities at quite an early age – would lighten a woman's burden (Henley, 2006).

Moreover, many of the upland and inland populations were animists, or at least only marginally influenced by the so-called world religions (Buddhism, Hinduism, Islam and Christianity), while the wet rice-producing zones – usually the core areas of the Southeast Asian states, where cities were established – converted to those religions either before or during the early modern period. As the position of women in Southeast Asia appears to have been more autonomous prior to the arrival of patriarchal world religions, and as it is also often supposed that if women could do what they wanted they would have fewer children than when men impose their wishes, we would have an additional explanation for lower fertility in the upland and inland areas.

This two-track demographic, economic and environmental pattern was reinforced by slave-raiding incursions from the lowlands into the uplands and by the deliberate transplantation of large groups of war captives from the highlands to the lowlands. It was also reinforced by the differential sensitivity of the two types of area for epidemics, the densely settled areas having become part of the civilized disease pool while the more isolated, sparsely populated regions had not. As more trade, and therefore people, came to the densely settled areas, some increase in morbidity might be expected, but immunity would increase as well. The sparsely settled areas initially might often have been spared, because the traders and their diseases often did not reach as far as the isolated uplands, but, as contacts increased from the nineteenth century onward, death rates would soar.

As the population in the rice bowls was growing more rapidly than that in the uplands, we may suppose that at the beginning of the early modern period the proportion of the population living in the slash-and-burn and forager areas was larger than in the nineteenth century. This implies that the low-fertility areas had a much larger weight at the beginning than at the end of the period, which, in turn, implies that – other things being equal – the average Southeast Asian birth rate would be gradually increasing.

In fact, a case could be made for Andre Gunder Frank's famous dictum (Frank, 1966) that development in the core areas led to underdevelopment in the Third World, in this case the internal peripheries of Southeast Asia. Thus, while the Eurasian and Southeast Asian core areas were developing at high and low rates, respectively, at least until the 1960s, the internal peripheries stagnated, and initially small differences between Southeast Asian core areas and internal peripheries were increasing over time, the core areas becoming more and more 'modern' and the internal peripheries staying 'traditional'. That state of affairs has led many observers to believe, mistakenly, that much of the Southeast Asian hinterlands had not been touched by capitalism or the world market and had remained pristine, perhaps even until the 1960s.

In all of these 'peripheral' areas, environmental changes did indeed occur as a result of world market demand, and even in the most remote highlands foreign crops were introduced, such as maize (corn), tobacco, coffee, tea, cinchona, rubber, oil palm and cacao. The hinterlands were also the main source of non-timber forest products, while they were the location of many mining operations as well. The population had been working for the world market, enriching some local leaders, who spent much of their income on conspicuous consumption in the form of bride prices, jewellery, slaves and livestock, thus reinforcing their 'tribal' lifestyles. As a result, the ecological footprint or shadow of the Eurasian world-economy in these internal peripheries, though clearly visible to the (environmental) historian, was not easily seen by many contemporary observers.

In contrast, the ecological shadow cast over the Southeast Asian core areas was difficult to miss, at least in hindsight, although even here many observers talked about 'hermit kingdoms'. Increasing rates of population growth and expanding rice bowls, reinforcing each other, were to a large extent the products of external trade and market-related forces. Monarchs of the

Southeast Asian core states enriched themselves through managed trading, siphoning off some of the profits from their own core areas and from the internal peripheries and buying guns and support with the proceeds, thus enhancing their absolutist, patrimonial rule. Their role was taken over in the nineteenth century by the colonial states, which, in turn, were supplanted by independent states after the Second World War in the Pacific. In all these cases, authoritarian rule was made possible and perpetuated – at least in part – by the exploitation of natural resources in response to world market demand. All these types of states ruled over fairly rapidly changing landscapes and agro-ecosystems and over shrinking forest areas, the visible embodiments of the above-mentioned ecological shadows.

Rhythm and nature of environmental changes

What is the best way to describe, in summary, the long-term rhythm and nature of the environmental changes in Southeast Asia? The impact of humans was gradually growing, first from zero to more than zero. Impact increased very gradually from the few migrating *Homo erectus* representatives who came to the region at an early stage, and whose impact on the natural environment must have been very limited, to the Neolithic shifting cultivators who manipulated nature on a larger scale. From the Metal Ages, people with iron tools accelerated the impact, leading on to landscape transformations by the wet rice-cultivating peasants, and then to large-scale plantations and the double-cropping Green Revolution farmers. If it had been possible to take snapshots of Southeast Asian landscapes at various locations at various points in time throughout the period we are talking about, we would have seen many of these landscapes changing very slowly, but accelerating in pace, over a very long time. However, after around 1500, the snapshots would show change beyond recognition during the course of a few centuries. Old ecosystems that had evolved in the absence of human intervention – forests and swamps – were transformed into agro-ecosystems. Among the crops to be found in the agro-ecosystems, exotic plants played an important part: pepper at a very early stage (before 1500), corn, sweet potato, the other potato (sometimes called Irish potato), chillies, peanuts, tobacco, coffee, tea, cassava, cinchona, rubber and oil palm. Not only did they change the landscape and the agro-ecosystem; they also changed the diets of the people of Southeast Asia and the composition of exports.

Another feature that had considerable impact on the landscape was the expansion of live-stock keeping. The numbers of endemic and imported animals were growing constantly, at times even faster than did the population, and they needed larger areas for grazing. Deforestation was the ubiquitous companion of expanding crops and livestock.

Forests gave way to perennial crops, arable lands with annuals, and pasture. In addition, mining operations and the growth of urban settlements claimed areas hitherto covered with vegetation. Urban centres tended to have an environmental impact incommensurate with the surface area they covered, more than proportional to the number of people living there. This latter phenomenon is caused by the fact that many urbanites aspire to a somewhat higher standard of living than do rural folks. Towns and cities, therefore, often have an ecological footprint or shadow far beyond their immediate environs.

Mining operations have a more localized influence than deforestation and urban centres, which could be the reason why, at least as regards Southeast Asia, few historians have reported on their impact on the natural environment. Nevertheless, this impact is considerable – not only because of the access roads brought in by mines as described above, but also because many mining operations leave totally ruined landscapes and a natural environment destroyed and poisoned by the mine's tailings and overburden, to use the specific terms for waste from mining activities.

The damage done by overfishing and by the exploitation of other resources of the sea is not always visible to the naked eye – although those in the know would have been aware of the increasing absence of some rather conspicuous animals, such as certain species of whales. The destruction of reefs has not gone unnoticed, and neither has the depletion of many species of fish.

In all these cases, the effects described became more visible as time went by. Every globalization phase had a larger impact than its predecessor, even if, because of temporarily lower rates of economic growth, such as happened between 1930 and the 1960s, a temporary slowdown in the rate of environmental depletion did occur occasionally. In principle, however, almost continuously accelerating rates of population growth – lately in combination with constantly increasing real income per capita – made for an equally accelerating impact on the natural environment.

Two fallacies

There are two fallacies that should be avoided when discussing the historical impact of human actions on the Southeast Asian environment. The first is the erroneous notion that environmental changes and environmental problems in the region are of recent date. It is easily demonstrated that locally long-distance trade and population growth led to changes in the natural environment, as was the case, for instance, with the production of pepper in remote upland areas and a number of wet rice bowls in the mid-altitudes and the lowlands even prior to 1500.

The second fallacy is the opposite of the first – the equally erroneous notion that the large-scale destruction we witness now in the region dates in large areas from significantly before the 1960s. In fact, prior to *c.* 1960, the natural environment of many Southeast Asian areas, particularly the uplands and the equatorial ever-wet zone, although not really ‘pristine’, had not changed all that much, while the changes that had occurred were relatively minor. To sum up in one phrase: locally there were some – occasionally extensive – changes in the natural environment at an early stage, but in many other localities there were few conspicuous changes prior to the 1960s.

It was not until the 1960s that the environmental problems started to worry some people, first in the countries where at that moment environmental destruction had taken place on the largest scale, but later also in late-comer Southeast Asia. This environmental consciousness was partly called into being by another phenomenon that had been largely absent from the region prior to the 1960s – pollution. As was argued above, it was not until the fourth and last phase that pollution and the depletion of resources – the bedfellows of industrialization, modernization and urbanization – became major concerns. During the first three phases, there certainly was environmental change, driven by the growth of trade from the Eurasian core areas and by population growth. However, though locally significant, it had been limited compared to what had happened in the Eurasian core areas. It could be argued, therefore, that the period that is nowadays often called the Anthropocene (Steffen *et al.*, 2007) – that is, the human-dominated geological epoch, beginning roughly around 1800 – could hardly be perceived in Southeast Asia prior to 1960.

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