Forest transition in Asia-Pacific economies

past experiences and future options

Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet)

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A summary of the APFNet-APAFRI "Comparative Analyses of Transitions to Sustainable Forest Management and Rehabilitation" project

Wil de Jong

Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet)

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Acronyms

5MHRP	Five Million Hectare Reforestation Project
APFNet	Asia-Pacific Network for Sustainable Forest Management and Rehabilitation
APAFRI	Asia-Pacific Association of Forestry Research Institutions
DENR	Department of Environment and Natural Resources (Philippines)
FAO	Food and Agricultural Organization of the United Nations
GDP	gross domestic product
ha	hectare(s)
IFMA	integrated forest management agreement (Philippines)
PC-GDP	per capita gross domestic product
US$	United States dollars

Executive summary

This report summarizes the findings of the Comparative Analyses of Transitions to Sustainable Forest Management and Rehabilitation project, which was supported financially by the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) and implemented by the Asia-Pacific Association of Forestry Research Institutions (APAFRI, 2013 a; APAFRI, 2013b).

The APFNet–APAFRI project consisted of local studies carried out in nine Asia-Pacific economies: China, India, Indonesia, Japan, the Republic of Korea, the Lao People's Democratic Republic, Malaysia, the Philippines and Viet Nam. In each economy, local teams analysed the causal factors of forest decline and forest recovery. This report summarizes forest transition analyses of the economies covered in the project with the exception of the Lao People's Democratic Republic, for which the data were of insufficient quality and quantity.[1]

"Forest transition" implies a process of decline in total forest area in a given territory followed by a reversal of that decline. The forest transition has been the subject of academic study, and the assumption guiding the APFNet-APAFRI project was that a better understanding of forest transitions in Asia-Pacific economies would provide important insights into how sustainable forest management objectives can best be achieved.

China, India, the Philippines and Viet Nam are the most recent economies to experience a forest transition

China, India, the Philippines and Viet Nam have all seen dramatic recoveries in forest area in recent decades. In each of these economies, the respective governments, responding to a need for forest goods and services, have invested considerable effort in restoring forest cover. Both government projects and policies and private-sector initiatives have assisted the forest transition in India. The Philippines recently passed through a forest transition, with a mix of state-supported and private-sector reforestation. In each of the four economies, a broad mix of forest recovery mechanisms and actors came together, contributing to the outcomes.

Japan and the Republic of Korea – two economies with earlier forest transitions

Japan and the Republic of Korea are economies with high per-capita gross domestic product. Both experienced forest transitions many years ago: Japan has had two such transitions, one towards the end of the nineteenth century and another in the 1950s. The forest cover of both economies is now stable, but there is still a forest transition effect and forest conditions continue to change because of stand aging and changes over time in forest management practices.

Malaysia and Indonesia – economies at early transition stages

Forest cover is still declining in Indonesia and Malaysia. In one scenario for Indonesia, forest area will have achieved a transition by 2020 and will increase thereafter; under other scenarios, however, forest area

[1] The case of the Lao People's Democratic Republic is puzzling. Data in FAO's 2010 global forest resources assessment (FAO, 2010a) indicated a progressive decline in forest cover from 1990 to 2010. FAO's 2015 assessment (FAO, 2015), however, indicated an increase in forest cover in the economy from 2000.

will continue to decline. Malaysia foresees planned forest-cover reduction to 2020, but there is a policy to increase the area of "permanent forest" by at least 1 million hectares between 2005 and 2020.

The drivers of forest transitions are diverse

An elaborate narrative is required to adequately represent the forest transition process in each of the eight economies discussed in this report. Rather than an accidental outcome of economic and social changes, forest transitions happen in response to needs for forest or forest landscape goods and ecosystem services. Although this need is the primary driver of forest transitions, changing social and economic conditions also greatly shape the efforts of government, the private sector and civil society to enhance those forest goods and services.

If a society recognizes that forest goods and services are required, it can pursue a number of approaches for restoring its forests, depending on local legal, political, social and economic circumstances. Government policies and private-sector initiatives were key factors in bringing about forest transitions in six cases in this study.

Understanding forest transitions can help in sustainable forest management

Governments can implement major projects, as has been the case in China, Viet Nam and, to some extent, India. Governments can also create favourable conditions for the private sector, as they have done in India and the Philippines, or promote the involvement of small-scale landholders and local communities, which was one of the strategies also pursued in India and the Philippines. Measures that appear to favour a forest transition include creating favourable conditions for foreign direct investments in industries that relieve pressure on land and forests, and reducing restrictions on timber imports, as was the case in the Republic of Korea and Japan.

Forest policy design can benefit from the use of hypothetical forest transition scenarios to identify possible strategies for progressing towards a desired forest cover. Such scenarios can assist in identifying the configurations of factors that will lead to forest transition.

The Asia-Pacific region has accumulated valuable experience in forest transition that may be relevant to other regions. Whether the approaches, experiences and lessons learned in Asia-Pacific economies are applicable elsewhere is a question requiring further analysis and reflection.

1 Introduction

In many contemporary visions of the future, forests are seen as a fundamental part of a globalized green economy. In such visions, forests provide broad economic and ecological services, from ensuring the livelihoods of rural communities and contributing to gross domestic product (GDP), to protecting watersheds and helping mitigate climate change by increasing carbon stocks. Forests help regulate downstream water flows and contribute to biodiversity conservation, and they constitute places for enjoyment, relaxation and recreation in both rural and urban areas.

The capacity of forests to provide the socioeconomic and ecosystem services needed by society depends on the ecological conditions and quantity and quality of forests, which are influenced by multiple factors. Forests remain under threat worldwide. For example, corporations are seeking large areas of tropical forests for the production of palm oil, cacao and other commodities. Forests continue to be affected by agricultural expansion, with millions of small-scale farmers seeking to grow crops, both for subsistence and to generate income.

On the other hand, forest science has reached a point at which the benefits of forests can be extracted without compromising the resource. Sustainable forest management is within the reach of contemporary forest managers – be they governmental forestry agencies, companies, civil-society organizations, smallholders or communities.

Why forest transition?

The term "forest transition" describes a process whereby forest cover in a particular territory declines to a low point, after which it increases. Understanding forest transition may be helpful for efforts to achieve sustainable forest management, but the concept remains little recognized.

Forest transition was first observed in Europe (Mather, 1992), then later in the Asia-Pacific region (Mather, 2007). Forest researchers and other scientists recorded, reported and attempted to explain the phenomenon and its underlying drivers, and the concept of "forest transition pathway" arose to explain the process.

Can recognizing and understanding forest transition help reduce and stop deforestation, achieve sustainable forest management, and restore forests? Can an understanding of forest transition help in speeding up the process of forest and landscape restoration and boost the provision of forest goods and ecosystem services? These are the key guiding questions of this report. They will be answered by drawing on the results of the "Comparative Analyses of Transitions to Sustainable Forest Management and Rehabilitation" project funded by the Asia-Pacific Network for Sustainable Forest Management (APFNet) and led by the Asia-Pacific Association of Forestry Research Institutions (APAFRI); this report also serves, therefore, as a summary of the project. It explores the concept of forest transition as well as the drivers behind it and whether it can assist forest management and policy design. The report is intended for a broad range of readers, although it is targeted especially at policymakers and decision-makers in the forest sector.

Researching forest transition in Asia-Pacific

The APFNet-APAFRI project consisted of local studies carried out in nine Asia-Pacific economies. In each, local teams[2] analysed the local causal factors of forest decline and recovery. The nine economies were: China, India, Indonesia, Japan, the Republic of Korea, the Lao People's Democratic Republic, Malaysia, the Philippines and Viet Nam. These economies were selected based on the importance of forests at the local level and recent trends in forest-cover change. Table 1 summarizes forest-cover trends in each economy.

Table 1. A general characterization of forest trends in nine Asia-Pacific economies

Economy	Characterization of forest transition
China	Massive forest rehabilitation efforts and logging bans since the mid-1990s have enabled China to achieve a forest transition from forest-cover decline to recovery
India	Strong regulations have stopped deforestation. The production of timber to meet domestic demands is a driver of forest restoration
Indonesia	Deforestation in Borneo, Sumatra and West Papua is declining because of declining forest resources and improved control. Tree plantations compensate partly for forest loss
Japan	A forest transition occurred in the late nineteenth century. With the exception of impacts arising from the Second World War, forest cover has been largely stable
Republic of Korea	Since the 1960s, the Republic of Korea has made major investments in environmental restoration, including forests
Lao People's Democratic Republic	The Lao People's Democratic Republic has experienced chaotic economic growth, in part resulting from foreign investments that benefit from abundant natural resources, corruption and minimal law enforcement. Deforestation is high, but so is investment in tree estate crops. The Lao People's Democratic Republic was recently reported as having increased its forest cover
Malaysia	On peninsular Malaysia, forests are subjected to detailed monitoring, and deforestation is based on planned land conversion. Illegal forest conversion continues on Borneo, however, in addition to planned deforestation
Philippines	The total forest area in the Philippines has increased since the late 1990s, according to official statistics. Private-sector tree-planting, government-supported social forestry projects, and successful forest protection efforts have contributed to overcoming deforestation
Viet Nam	Government policies and rehabilitation efforts have been successful in reducing pressure on forests and forest-cover decline, and there has been an increase in the area of natural and planted forests since the mid-1990s

The APFNet–APAFRI project was co-implemented by Renmin University (China), Seoul National University (Republic of Korea), and Kyoto University (Japan). Its aim was to identify the causal factors of forest-cover change in Asia-Pacific economies, based on the underlying assumption that understanding the factors of

[2] The local study teams involved in the project were: China: School of Agricultural Economics and Rural Development, Renmin University. India: Forest Research Institute. Viet Nam: Forestry University of Hanoi. Indonesia: Bogor Agricultural University. Malaysia: Universiti Putra Malaysia. Philippines: University of the Philippines Los Baños. Japan: University of Tsukuba. Republic of Korea: Seoul National University. Lao People's Democratic Republic: National University of Laos.

forest decline and recovery can help in the formulation of policies, policy instruments, strategies and actions to reduce deforestation and achieve forest recovery.

The project assessed the underlying processes of forest-cover change; formulated categorization models to characterize the economic and environmental benefits of forests; and increased regional capacity in reducing deforestation, inducing rehabilitation and fostering sustainable forest management.

One of the project's international workshops in Indonesia in February 2013.

Collaborators of the project have published a set of papers based on the project in a special issue of the scientific journal, *Forest Policy and Economics*.

Scope of report

This report summarizes the APFNet–APAFRI project's analysis of forest transition in the economies listed in Table 1, with the exception of the Lao People's Democratic Republic, for which data were of insufficient quality and quantity.

Chapter 2 provides a general discussion of the history and theory of forest transition. Chapter 3 discusses recent cases of forest transitions in China, India, the Philippines and Viet Nam, Chapter 4 covers the advanced forest transitions in Japan and the Republic of Korea, and Chapter 5 reviews the cases of Indonesia and Malaysia. Chapter 6 presents a comparative analysis, exploring commonalities and differences in forest transitions in the eight economies. Chapter 7 draws conclusions and makes recommendations for policymakers.

2 Forest transition: light at the end of the deforestation tunnel?

A brief introduction to forest transition

There has been widespread concern about tropical deforestation since the 1980s. Around that time, FAO's global forestry statistics, including trends in forest cover, showed an alarmingly high global rate of deforestation, exceeding 10 million hectares annually. There were predictions of the disappearance of tropical forests, which continue today.

Sandy Mather, a Scottish geographer, published "The forest transition" in the early 1990s (Mather, 1992), the first report of a phenomenon that appeared to be good news after years of alarming reports of deforestation.[3] Mather observed that the forest area in France and Hungary had, through a historical process, declined to its lowest ebb and subsequently recovered. Mather recognized the possible value of understanding this forest transition – why and how it occurred. Essentially, he suggested that deforestation and forest degradation were not a one-way, irreversible process but that, at least in some economies, historical forest decline could be followed by forest recovery.

The publication of Mather's paper was the beginning of study on forest transition, at a time when forestry professionals and the concerned public were trying to reverse tropical deforestation. It led to observations of similar trends in many other economies, the exploration of the possible drivers of forest transitions, and the relevance of forest transitions and forest transition theories to forestry objectives such as sustainable forest management, the maintenance of forest ecosystem services, and forest restoration. This chapter reviews some of the most relevant aspects of forest transitions and forest transition theory, and the possible practical relevance of this knowledge and understanding.

Forest transition refers to the historical process of forest-cover decline, followed by forest recovery. In his 1992 paper, Mather provided data on France and Hungary as evidence of two cases of a forest transition and suggested that similar transitions had also occurred in the United Kingdom of Great Britain and Northern Ireland and the United States of America. He also compared net forest-cover trends in developed and developing market economies, observing that the former had experienced net forest-cover decline in the period 1970–1980, but a net forest-cover increase in 1980–1990, and that developing economies had experienced a decline in total forest area over the entire period (1970–1990). The paper considered "prospects for forest transition in the tropical world and the world as a whole".

After Mather's initial paper, forest transitions have been identified in an increasing number of economies. Rudel *et al.* (2005), for example, reported forest transitions in 20 economies for which "reliable data" could be obtained.[4] Meyfroidt and Lambin (2011) undertook a more detailed analysis of economies that have experienced forest transitions, indicating that 21 European economies, eight economies in the Asia-Pacific and seven economies in the Americas had undergone such transitions; seven of those 36 economies are tropical developing economies. A wiki page on forest transitions[5] reports that 30

[3] Mather was not the first one to use the term "forest transition"; scientists used the term "prairie–forest transition" in the 1960s (e.g. Iverson *et al*., 1967; Anderson, 1983), but this refers to a separate phenomenon.
[4] The economies were: Bangladesh, China, Costa Rica, Cuba, Denmark, the Dominican Republic, France, the Gambia, Hungary, Ireland, peninsular Malaysia, Morocco, New Zealand, Portugal, Puerto Rico, Rwanda, Scotland, the Republic of Korea, Switzerland, and the United States of America.
[5] https://en.wikipedia.org/wiki/Forest_transition, accessed August 2015.

economies have experienced a forest transition, including African economies not in the list of Meyfroidt and Lambin (2011). Unlikely economies where forest transition has reportedly occurred include Cuba, the Dominican Republic, El Salvador, the Gambia, Morocco, Rwanda and, since 2015, the Lao People's Democratic Republic. Bangladesh is also in the list, but Mather (2007) suggested that the forest area in that economy has declined since 2000–2005.

The analysis presented in this report shows that forest transition is a unique process in each economy. In this report, forest transition is categorized according to two dimensions: the period in which it occurred, and the percentage of forest area remaining in the economies as forest transition happened.

Both Rudel *et al.* (2005) and Meyfroidt and Lambin (2011) distinguished the period of forest transition of the economies they analysed. Meyfroidt and Lambin (2011) grouped the 36 economies in which they observed forest transition into four categories: forest transition occurs 1) before the twentieth century; 2) between 1900 and 1940; 3) between 1940 and 1970; and 4) after 1970. With the exception of Japan, only European economies experienced forest transitions before the twentieth century (Mather, 2007). In other European economies – such as Finland, the Russian Federation and the United Kingdom of Great Britain and Northern Ireland – and parts of the United States of America, the transition happened in the early twentieth century. Economies that have seen forest transition from the 1970s include China, India and Viet Nam (all three of which feature as case studies in this report).

Both Rudel *et al.* (2005) and Meyfroidt and Lambin (2011) also compared the percentages of forest cover remaining at the time of forest transition. These were relatively high – about 30 percent or higher – in some European economies as well as in the Republic of Korea, Costa Rica, the United States of America and Viet Nam. In the majority of economies, however, forest transition occurred when the percentage forest cover was below 20 percent. Rudel *et al.* (2005) suggested that the percentage of forest cover at which forest transition occurs has increased slightly in the past 300 years.

Forest transition in Asia-Pacific economies

Meyfroidt and Lambin (2011) listed eight economies in Asia that had experienced forest transition, namely: Bhutan, China, India, Japan, New Zealand, the Philippines, the Republic of Korea and Viet Nam (and the Lao People's Democratic Republic could now be added). Of these economies, Japan and New Zealand experienced forest transitions before (Japan) or early in the twentieth century (New Zealand). In the view of Meyfroidt and Lambin (2011), Japan experienced both an "early-modern" transition and a "modern" forest transition. The latter occurred following massive deforestation during the Second World War.

Other than Japan and New Zealand, all Asia-Pacific economies experienced their forest transitions after the middle of the twentieth century. The transition in the Republic of Korea was followed by transitions in China and India and then in the Philippines and Viet Nam. Mather (2007) and Rudel *et al.* (2005) mentioned Bangladesh as an economy that has experienced forest transition, although Mather (2007) indicated that an initial period of forest expansion in that economy since 1990 was followed by a period of forest decline in 2000–2005, with forest cover now less than it was in 1990.

There are some important anomalies in forest-cover decline and recovery. One is geographic variation in such decline and recovery within a single economy. This is the case, for example, in Indonesia, where, overall, forest cover is still declining but where there are significant variations in forest-cover dynamics in some islands. A similar situation can be observed in Malaysia: Meyfroidt and Lambin (2011) suggest that the forest area has stabilized in peninsular Malaysia, and Mather (2007) holds that forest transition has probably already occurred there, and forest stocks are increasing.

Explaining forest transition: pathways and the forest transition Kuznets curve

Forest transition is the result of the following direct causes: forest area is restored, either because forests grow naturally on land that was previously converted to agricultural land, or forests are planted or replanted; and the area of land subject to such restoration exceeds the area of forest being converted to other land uses. When these conditions exist, total forest cover increases, and the territory experiences forest transition.

A question that has intrigued forest transition researchers is the structural conditions linked to forest transition. The question also applies to analyses of tropical deforestation, which recognize that there are both direct and indirect causes of deforestation. The direct causes include the conversion of forests to agriculture by a range of actors, such as companies planting oil palm or soy, large and small entrepreneurs expanding pastures for cattle, and rural smallholders expanding their agricultural fields to produce crops for subsistence or sale. Other direct causes of deforestation include logging operations and the subsequent degradation of logged-over forests, and the expansion of urban or industrial areas.

Indirect causes of deforestation are also called underlying causes or drivers of deforestation; these terms refer to structural economic, social and cultural factors that explain deforestation trends. An important structural cause of deforestation may be demand (e.g. in developed economies) for commodities such as beef, palm oil, coffee, soybean and biofuels, which leads to deforestation to make way for the production of these products. Another deforestation driver may be the socioeconomic conditions that cause the migration of large numbers of people from one region of an economy to another where there are abundant forests. Policies in non-forest sectors may also stimulate deforestation, directly or indirectly. Researchers have used various approaches to explore the wider structural factors that may influence forest transition, and there is an ongoing debate on these.

Earlier analysts of forest transitions essentially conducted historical analyses of direct and indirect causes of forest decline and recovery in the economies of interest. Mather (1992), for example, used a detailed analysis of available information to explain the process of forest transition and the same approach was used by Mather *et al.* (1999) for France and by Mather (2004) for Scotland. Mather (1992), and later Grainger (1995), Rudel (1998), Rudel *et al*. (2002; 2005) and Lambin and Meyfroidt (2010) proposed certain structural factors as the underlying causes of forest transition. These structural drivers have become known as "forest transition pathways".

Forest transition researchers have progressively added to the number of possible forest transition pathways. In early studies, explanations of forest transition focused on the complex pattern of land-use modernization, which was linked to the wider modernization of economic life. This "economic development" forest transition pathway remains perhaps the most compelling explanation of (especially) earlier forest transitions in European economies. According to this explanation, population growth leads to smallholder agricultural expansion, much of it into low-productivity lands. A mixed process that includes a shift to industrial production and related changes in production costs and thus remuneration results in shifts in economic sectors, and agriculture progressively relinquishes its dominance to the industrial and services sectors. This creates a demand for labour, and agricultural workers migrate to the industrial sector, freeing up land that becomes available for reforestation. Simultaneously, there is an intensification of agriculture because of technological progress and an increase in the relative costs of labour, land and capital. The result of this process is that agricultural production is focused on smaller areas with better soils, freeing up land for reforestation.

A second prominent forest transition pathway, first proposed in the 1990s (Rudel *et al*., 2000) and further developed later (Rudel *et al*., 2005), is “forest scarcity”. On this pathway, the scarcity of forest products, especially wood, is a major trigger for investments in tree and forest production, leading to the conversion of agricultural land for the establishment of tree plantations. Evidence for the forest scarcity pathway is drawn from Costa Rica (Rudel *et al*., 2000) and many other economies in which private-sector tree plantations account for much of the return of agricultural land to tree or forest cover (Rudel *et al*., 2005; Lambin and Meyfroidt, 2010).

The forest transition pathway discussion has opened up more recently, with authors suggesting that limiting the number of forest transition pathways to two may be too restrictive (Mather, 2007). Lambin and Meyfroidt (2010) proposed at least three other forest transition pathways: the “government policy” pathway, the “globalization” pathway and the “smallholder land-use intensification” pathway.

The government policy pathway invokes government policies and projects as the main drivers of forest transitions. Such policies and projects may be put in place in response to concern about the negative consequences of deforestation, to boost forest production, or to enhance forest ecosystem services. The globalization forest transition pathway is a result of cross-border investments, for example in wood production, but also the shifting of wood sourcing internationally, thereby reducing pressure on domestic forests and allowing forest recovery. The smallholder land-use intensification pathway implies that smallholders reorganize their agricultural production, intensifying agricultural production in smaller areas and converting other parts of their holdings to semi-intensive managed tree production.

Many authors observe that more than one forest transition pathway may be at play simultaneously, and the increased number of proposed forest transition pathways could make it more difficult to distinguish between them. Wiersum (2014) proposed identifying forest transition pathways by their dominant drivers (Table 2).

Table 2. Dominant drivers of forest transition

Main driver of forest transition	**Explanation**
Economic development	Economic development provides new opportunities for alternative employment and income outside agriculture in urban areas. This draws people away from the countryside, and forest returns on abandoned agricultural lands
Forest and forest product scarcity	A scarcity of forests and forest products encourages the protection of existing forests and planting of new forests
Improved market prices for forestry	An improvement in incomes derived from forest products promotes forest conservation and expansion. The improved incomes may be due to increased demand for products, or the reduction of subsidies for competing agricultural products. The recent development of payment schemes for ecosystem services from forests could enhance this process in the future
Improved forest policies	Forest policies are introduced with measures to boost forest production on the one hand and forest protection on the other, resulting in better forest management and afforestation
Globalization	Concern about the negative effects of tropical deforestation and the growing market for ecotourism provide new sources of funding for forest conservation and expansion

Source: Adapted from Wiersum (2014).

Refocusing the forest transition pathway approach to drivers would make it easier to explore and understand possible linkages between drivers and to understand that multiple drivers may be at play and are likely to interact. Arguably, this has the advantage that, in addition to a narrative inductive approach to analysing and understanding forest transitions, it will be easier to pursue quantitative analyses of forest transitions, which will result in more evidence of statistically relevant correlations between drivers and forest transitions. This should provide better evidence of the underlying causes of forest transitions.

The value of a more quantitative approach to the analysis of forest transitions is assessed here by exploring whether an environmental Kuznets curve regularity applies. The Kuznets curve concept implies that, during a trajectory of economic development, economic inequality first increases and then decreases; it is used to explore environmental trends during a trajectory of economic development. It has been suggested, for example, that environmental contamination would first increase during economic development and later decrease as an economy improved. The measure for economic development commonly used in such analyses is per capita GDP (PC-GDP). Several environmental pollutants (e.g. sulphur dioxide) have been assessed as first increasing and then decreasing over time, when an economy goes through a process of economic growth and PC-GDP increase.

The environmental Kuznets curve principle has been explored to investigate the link between economic development and deforestation. A Kuznets curve relationship between deforestation and PC-GDP sees a positive link between deforestation and an increase in PC-GDP to a certain level of PC-GDP, after which deforestation declines, stops and is reversed. This potential relationship is illustrated in Figure 1: the y axis shows percent forest cover and the x axis shows PC-GDP. The curve declines (indicating decreasing forest cover) until it reaches the lowest point, after which forest area increases.

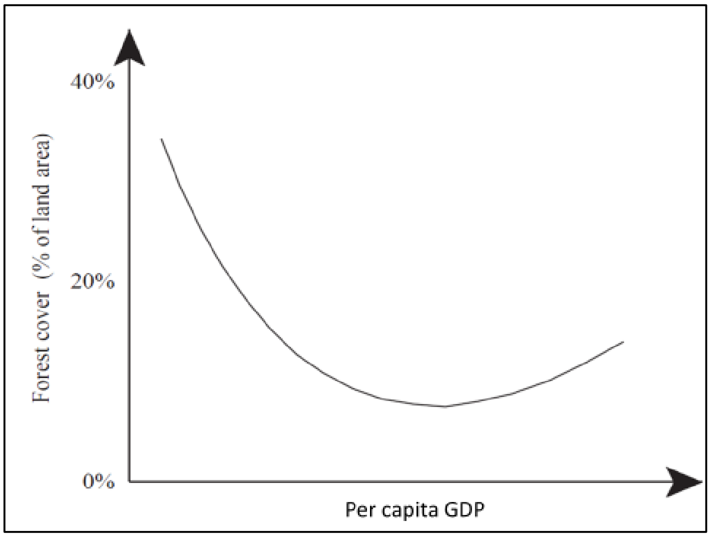

Figure 1. Inverted Kuznets curve representation of forest transition

This inverse Kuznets curve relationship between forest cover and PC-GDP is appealing, and the concept has been explored in several studies. One aim of such studies is to determine whether there is a PC-GDP value at which there is a reversal from forest decline to forest increase. Should such a regularity exist, it would have predictive value of when a forest transition might occur. It might also inform decisions on efforts to reverse forest-cover decline or stabilize forest area.

The relationship between PC-GDP and deforestation and forest recovery is difficult to prove, however, and there is a lack of convincing evidence (Chowdhury and Moran, 2012). Panayotou (1993) estimated that a forest transition would occur at a PC-GDP value of US$823, but later analyses have suggested much higher values in the tropics. Copper and Griffith (1994) suggested forest transition inflection points at a PC-GDP of US$4 670 in Latin America and US$5 420 in Africa, and Mather *et al*. (1999) found that a forest transition occurred when an economy reached a PC-GDP of US$5 000. Chapter 6 of this report returns to this issue with respect to Asia-Pacific economies.

What transitions in forest transition?

The forest transition concept has appeal because it suggests that deforestation is not a one-way process of universal forest loss and that, rather, forest recovery occurs as an economy or region undergoes a certain economic development process. It is important, however, to address the question of the quality of the returning forest: to what extent are such forests able to supply the forest ecosystem services that were lost when the original forest was cleared?

The simple answer to the question is that the forest that comes back is not the same as the one that disappeared. This is less applicable where the original natural forest had low diversity and complexity, or when forest transition occurred many years ago. Where deforestation is more recent, or where it involves natural tropical forests (with very high biodiversity), the returning forest will almost certainly be less structurally and biologically diverse and (at least initially) contain less wood and biomass than the original. Such forests will provide fewer ecosystem services, produce less-valuable timber, and contain fewer valuable genetic materials for potential future use in medicine, agriculture and other fields. Notwithstanding this, the returning forest will most likely provide more ecosystem services than the previously deforested landscape.

A serious limitation of forest transition analysis and its theoretical explanation is the unreliability of data. Forest transition analyses conducted to date in the literature and in the APFNet-APAFRI project reported here all use forest-cover data obtained from subnational or national sources or compiled by FAO (e.g. FAO, 2010a; FAO, 2015). Forest transition analysis involves not much more than using forest-cover data as a dependent variable and seeking relationships between this and socioeconomic data such as land use, population density and employment.

In some cases, including in this project, the data used as dependent variables – for example forest cover, forest stock and wood volume – have been scrutinized and disaggregated. Forest transition is closely related to land use, which can be linked to the socioeconomic and political dimensions of an economy or region. A greater theoretical understanding is needed, however, of the linkages between shifts in forest cover and the provision of ecosystem services, which arguably is the most important aspect of forestry today. Nevertheless, this should not diminish the value of forest transition analysis that relies mainly on forest area or growing stock.

3 Forest transformation tigers of the Asia-Pacific

This chapter discusses forest transitions in four economies: China, India, the Philippines and Viet Nam. All four economies have been identified – by Rudel *et al*. (2005), Mather (2007) and Meyfroidt and Lambin (2011) – as relatively late forest transition economies, for example compared with Japan and the Republic of Korea. Meyfroidt and Lambin (2011) estimated that India experienced forest transition between 1950 and 1980, and Bhojvaid *et al*. (2013) narrowed this to about the late 1970s. China experienced forest transition in the period 1971–1980, according to data provided by the economy's State Forest Agency (Liu *et al*., 2013; but see Song and Zhang, 2010, for a different interpretation). Viet Nam's forest transition was more recent, estimated to have occurred in 1991–1993 (Meyfroidt and Lambin, 2011; de Jong *et al*., 2006), a similar period of transition to that of the Philippines.

The four economies all had comparable percentages of forest cover when their transitions began. China reportedly had a forest cover of 12 (Liu *et al*., 2013) or 13 (Lambin and Meyfroidt, 2011) percent when its forest transition began. According to Meyfroidt and Lambin (2011), 15–20 percent of India's territory was under forest cover when that economy's forest transition started. Bhojvaid *et al*. (2013) estimated that the lowest ebb of India's forest area was 62.9 million hectares in 1970, which is 19.1 percent of its state territory. Lambin and Meyfroidt (2011) estimated that Viet Nam had a forest cover of 25–31 percent at the time of forest transition. De Jong *et al.* (2006) proposed a figure of 9.2 million hectares of natural forests and tree plantations, which is 27.2 percent of the economy's territory. The minimum forest cover of the Philippines was 65 million hectares in 1988, which is 21 percent of the territory.

This report categorizes the eight Asia-Pacific economies into three groups, and this chapter discusses forest transition of the group comprising economies that experienced a forest transition recently but convincingly – that is, the turnaround from net forest area decline to net forest area increase occurred in a short time and the forest-cover trend shows a sharp upward curve. The four economies in this group differ from a second group consisting of Japan and the Republic of Korea, which is discussed in Chapter 4. The four economies in the first group are, or were until recently considered to be, developing economies with low PC-GDP. Although Japan and the Republic of Korea had comparably low PC-GDPs when they experienced their forest transitions, those transitions happened much earlier.

The third group consists of Indonesia and Malaysia, both of which are still experiencing net forest-cover decline. Damayanti *et al.* (2013) argued that forest transition may happen in Indonesia soon; Malaysia, on the other hand, claims to apply planned, controlled deforestation and has therefore stopped undesired forest loss (Razali Wan and Mohd Shahwahid, 2013). Peninsular Malaysia is considered to have already passed through forest transition (Mather, 2007).

Mega forest transition in China

China's historical forest cover is about 400 million hectares, or somewhere between 48 and 60 percent of its national territory. This is land with the environmental attributes to support forests, so it constitutes a natural upper limit of forest cover (Gutierrez and Ruiz, 2013). China's forest cover has declined gradually since about 4 000 years before present, when China's population began to grow and economic activities requiring timber and woodfuel expanded. The economy has known several phases of more intensive forest depredation. For example, forest declined drastically at the turn of the twentieth century, largely due to political turbulence and struggles between competing political factions. Gutierrez and Ruiz (2013) cited sources that estimated a forest cover of 25.8 percent in 1700 and 16.7 percent in 1900. Sources vary on the area of forest in 1949. For example, Song and Zhang (2010) estimated it at 83 million hectares, but Gutierrez and Ruiz (2013) mentioned a figure of 109 million hectares.

In the analysis in Song and Zhang (2010), China experienced a slight increase in forest cover from 1949 to 1976 (followed by forest decline) related to various state-imposed campaigns to expand basic economic industries. One campaign, for example, encouraged citizens to plant trees each year (Mather, 2007). The Government of Viet Nam engaged in similar popular tree-planting promotional campaigns at around the same time (de Jong *et al*., 2006; de Jong, 2010).

A second turnaround in forest cover in China occurred in about 1980. Forest cover declined between 1976 and 1981, from 121 million hectares to 115 million hectares, but increased again to 125 million hectares in 1988 (data from Song and Zhang, 2010). PC-GDP was US$163 in 1976, US$195 in 1981 and US$281 in 1988. Gutierrez and Ruiz (2013) reported a similar trend in forest cover but also that, since 1976, there had been a progressive increase in total timber volume, even when total forest cover declined slightly during 1976–1981.

Song and Zhang (2010) pointed out that the area of natural forest decreased until well after 1981 (the year that others have estimated marked the lowest forest cover in China). During the building up of the economy in the first decades after the birth of the People's Republic of China, natural forests were nationalized and timber extraction was accelerated to contribute to the economic recovery. Thereafter, a total area of 69 million hectares of natural forests were harvested for timber but, in the same period, 70 million hectares were replanted with trees.

China's forest cover continues to increase today. From its lowest point in 1981, at about 115 million hectares (Liu *et al*., 2013), to 2008, State Forestry Administration data indicate that the forest area increased by 80 million hectares to 195 million hectares, thus nearly doubling in less than 30 years.[6] This is truly a remarkable comeback for forests, and it makes China the economy with the largest absolute forest-cover increase by far.

The increase of forest area is explained partly by a large increase in forest plantations; the total area of forest plantations increased from about 22 million hectares in 1981 to 62 million hectares in 2008. By 2008, therefore, about one-third of China's forest cover was composed of forest plantations. The data also suggest that plantations accounted for about 50% percent of forest cover increase since 1981, demonstrating the importance of forest plantations in forest transition in China and thus also the importance of the policies and actions that resulted in plantation establishment at such a scale. Nevertheless, the data also indicate that other types of forest increase were also important, and this tends to be poorly recognized in various discussions on forest transition in China.

Using data from Song and Zhang (2010), the total forest area in 1981 was 115 million hectares, of which 22 million hectares comprised plantations. In 2008, the total forest area of 195 million hectares included 62 million hectares of plantations (Liu *et al*., 2013). In 1981, China had 93 million hectares of non-plantation forest, and this increased to 133 million hectares in 2008 (Figure 2). If this area was composed only of natural forest, then the area of natural forest in China increased by 40 million hectares, about the

[6] China's 8th National Forest Inventory states that China's forested area extended to 208 million hectares in 2013 (State Forestry Administration of China 2014).

same as the increase in plantation forests during the same period. These figures differ from those provided by Song and Zhang (2010), who estimated the increase in natural forest between 1984 and 2003 at 2 percent of the national territory, or about 20 million hectares. According to Song and Zhang (2010), the harvesting of timber and other wood products shifted to planted forests after 1982, allowing natural forests to recover.

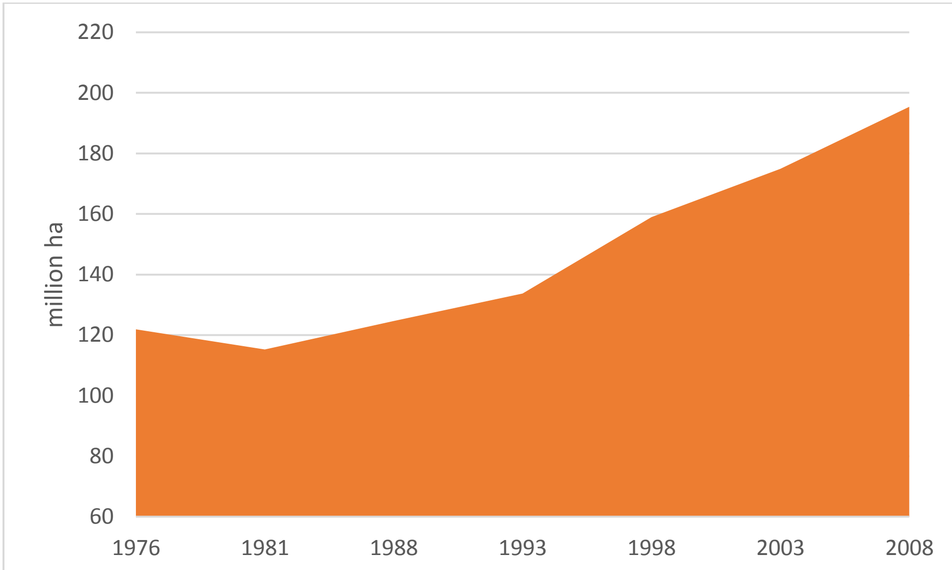

Figure 2. Forest-cover trends in China, 1976–2008

Source: Adapted from Liu *et al*. (2013).

China's reforestation and afforestation efforts have been truly massive since 1949. Song and Zhang (2010) asserted that, between 1949 and 2003, China established 241 million hectares of tree plantations, of which reportedly 90 million hectares matured to become established forests. Gutierrez and Ruiz (2013) list 11 reforestation and afforestation programmes between 1978 and 1998, during which period the area of forest plantations increased by 24.5 million hectares (Song and Zhang, 2010).

A key driver of the massive investment in forestry programmes in China was the dramatic flooding of the economy's major rivers – the Yangtze, Nen, Songhua and Pearl – in 1998. The flooding caused tremendous material damages and the loss of 4 150 human lives. The government blamed deforestation and poor agricultural practices for the extreme nature of the flooding and the following six major forestry programmes were instituted, with a committed investment of US$85 billion: 1) natural forest protection, 2) returning agricultural lands to forests, 3) shelter forest systems in the middle-to-upper reaches of the Yangtze River, 4) controlling dust and sand sources from blowing to Beijing and Tianjin, 5) wildlife protection and natural resource conservation, and 6) the development of fast-growing, high-yield plantations in key regions.

One of the measures to address future flooding was a logging ban in natural forests in the middle and upper reaches of the affected rivers; as a result, commercial logging had declined by 92 percent by 2000 (Yang, 2001, cited by Mather, 2007). The massive reforestation and afforestation effort in key watersheds affected 23 million families and 123 million people, which was more than 10 percent of the total population at that time. Efforts were required to provide alternative livelihoods for these affected people.

Since 2004, forest restoration and afforestation efforts have refocused on the most critical lands: those with slopes greater than 25 degrees, desertified areas, riparian zones, and low-productivity lands. By 2009, these efforts had cost US$58 billion and resulted in the conversion of 9.3 million hectares of croplands to forest.

An interesting point can be made on the link between forest transition in China and the customary explanatory drivers and factors, as suggested in the literature and summarized above. Mather (2007) and Gutierrez and Ruiz (2013) tried to connect the empirical evidence of China with forest transition theory. Mather (2007) proposed the possibility that it would be necessary to identify additional forest transition pathways to the economic development and forest scarcity pathways, a call taken up by Lambin and Meyfroidt (2010). Mather (2007) also argued that modernization and economic development indicators such as rural exodus or rising crop yields had limited value in explaining forest transition in China and other Asia-Pacific economies. Gutierrez and Ruiz (2013) reviewed the notion of development-related modernization, which, among other things, implies a process of land-use modernization and consequent return to nature and forests to provide ecosystem services. Gutierrez and Ruiz (2013) also examined Rudel’s (1998) argument of unique historical forces that account for each case of forest transition and concluded that it was necessary to focus on the agency of forest transition rather than rely only on explanations that consider the instrumentalism of forest transition drivers. Although this is correct, forest transition agency also has underlying causes because it is triggered by social awareness and a commitment to the creation of a better socioecological environment, thus shaping policies and programmes.

Finally, it is relevant to draw on insights that focus more narrowly on China’s forest restoration efforts, which account for the majority of the vast area of land that has been converted back to forests or land with trees. In a series of studies on the success or failure of forest restoration, Chokkalingam *et al.* (2006) explored efforts in China to assess which efforts were successful and why. They found that the outcomes of forest restoration were mixed, and there were many failures in the mega-projects that led to forest transition. They argued that locally driven or supported initiatives obtained better outcomes because these were better tuned to local needs and that it is also necessary for benefits to flow from restoration efforts. The latter can be enhanced by improved tenure, good partnerships and adequate arrangements. Although these conclusions are valid, they probably do not apply to forced agricultural land restoration, in which the removal of rural people from the land was supposedly an important contributor to successful forest establishment (Gutierrez and Ruiz, 2013). The insights from the present study also indicate that forest transition theory should take more account of agency in forest transitions and not be limited to an instrumentalist view of the economic factors shaping such transitions.

Economic development and policy-driven forest transition in India

Until now, India has figured less prominently as an economy that has experienced forest transition, mostly because researchers have focused their attention on China and Viet Nam. Despite the inference of Mather (2007), evidence indicates that India underwent forest transition in the 1970s (Bhojvaid *et al*., 2013). Bhojvaid *et al.* (2013) suggest that forest-cover decline and recovery in that economy can be linked to a plethora of direct causes and indirect drivers.

The history of deforestation in India is equally long to that of many other economies in the region. Up to the early twentieth century, when the economy was under British rule, a majority of people lived in rural areas and subsisted on low-technology agricultural production. India lost 14 million hectares of forest in the first half of the twentieth century. The trend of clearing forests for agriculture continued after independence, largely because India's economy remained dominated by agricultural production. India began its transformation to industrialization about two decades after independence and also progressively improved its land-use planning and policies. Deforestation continued in the early modernization years, however official figures show a decrease in forest cover from 75.8 million hectares in 1950 to 62.9 million hectares in 1970. Forest cover had increased again to 63.4 million hectares by 1980, and to about 68 million hectares by 2010 (Figure 3) (Bhojvaid *et al*., 2013).

India has had economic growth since the 1950s. The relative contribution of the agricultural sector to the overall economy declined but remained important, and deforestation continued due to the expansion of agricultural lands. Population growth was modest compared with later periods and does not appear to have been a direct factor in agricultural expansion and the conversion of forestlands. Bhojvaid *et al.* (2013) also pointed to foreign interests in India's timber and domestic energy consumption as crucial contributing factors during pre-independence years.

The large-scale development wave that began after independence resulted in rapid industrialization, new railway and highway networks, widespread construction and the modernization of agriculture. New industrial sectors related to forest production included paper and plywood industries, and timber processing. Forest estates were an often-turned-to resource to meet land requirements or as capital for financing other economic growth measures. State governments were therefore one of the main agencies that turned to forests when they needed land or financial resources.

The onset of a decline in deforestation can also be linked to government initiatives. Soon after independence, there was a trend to classify forests as "notified forest". Notified forests are subject to the Forest Act, which qualifies them as reserved or protected. In the 1950s, the area of notified forest was 40.48 million hectares, but this had increased to 63.83 million hectares by 1970 and to 67.46 million hectares by 1980. These figures indicate that, from 1970 to 1980, the area of notified forest actually exceeded the area of land recognized as forested in official statistics.

An important driver of forest transition in India was what Mather and Needle (1998) identified as land transformation, which is essentially a process of land-use intensification linked to broader economic growth and increases in the cost of production as well as technological improvements. There was an expansion of agricultural lands in India of 22 million hectares in the period 1950–1970. The area of agricultural land stabilized in the period 1970–1980, largely because of production intensification. Wheat productivity increased from 663 kg per hectare in 1950 to 1 307 kg per hectare in 1970, 2 708 kg per hectare in 2000 and 2 938 kg per hectare in 2010 (Bhojvaid *et al*., 2013). This productivity growth eased pressure on forests, reduced deforestation and made an important contribution to forest transition.

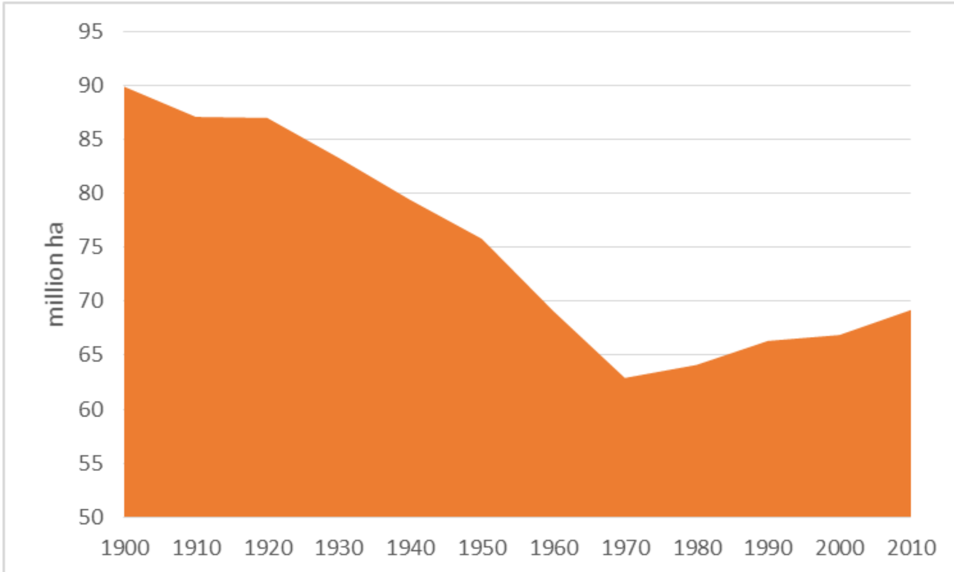

Figure 3. Forest-cover trends in India, 1900–2010

Source: Adapted from Bhojvaid *et al*. (2013).

India began its period of forest-area stabilization and expansion from about 1980, coinciding with a shift in the economy towards the dominance of the industrial and services sectors and the associated migration of rural people to urban areas. The urban population increased progressively from 1971 to 1981 and has continued to do so since. In 2001–2011, for example, the urban population increased from 27.81 percent of the total population of India to 31.16 percent, while the rural population declined from 72.19 percent to 68.84 percent. Due to a combination of these various factors, deforestation declined in India from the 1970s.

The Indian government enacted the Forest Conservation Act in 1980, which acted as a new hindrance to the use of forestlands for non-forest use. The Act also became an important trigger for reforestation and afforestation, coinciding as it did with efforts of the National Commission on Agriculture to promote social forestry, thus beginning a process of large-scale reforestation. Reforestation and afforestation focused mostly on the production of woodfuel, fodder and small-sized timber on wastelands, degraded forests, private marginal lands, village commons and agricultural farms. From 1950 to 1980, 3.54 million hectares of land was planted to trees, with an investment of approximately US$40 million (Bhojvaid *et al*., 2013). During the sixth five-year plan (1980–1985), 4.64 million hectares of tree plantations were established with an investment of approximately US$155 million, much of it from international financing for social forestry. In the seventh five-year plan (1985–1990) approximately US$430 million was invested for the establishment of 8.86 million hectares of tree plantations. In summary, the large-scale efforts of state and central governments on reforestation, afforestation, social forestry and agroforestry were among the main drivers of forest expansion and therefore the forest transition in India.

As in China, forest condition changed dramatically over the course of India's forest transition. Typically, in a forest transition, the area of primary and natural forests remains largely stable, and forest cover increases mostly because of the expansion of planted forests. In India, however, the degradation of primary forest, older secondary and planted forests has continued due to biophysical and socioeconomic factors, described below.

An additional factor that played a key role in bringing about forest transition in India was a constitutional amendment in 1976, which imposed the notion that any central government law would prevail over any state law on forests. As a result, the central government's 1980 Forest Conservation Act required that the diversion of forestland to other uses was allowed only with the approval of the central government. This reportedly reduced the annual rate of forest conversion from 160 000 hectares to 36 000 hectares (Bhojvaid *et al*., 2013). This decline reflected a shift in priorities from economic deliberations and profits in forest decisions towards a prioritizing of environmental functions. The shift was also evident in the National Forest Policy of 1988, the joint forest management initiative, and a Supreme Court of India order to increase the scope of forests to embrace all areas recorded as forests in government records (Godavarman case (W.P. (C) No.202/1995).

In 1996, a new national policy facilitated wood and wood product imports, reducing pressure on domestic resources. Since then, teak, for example, has been imported from Myanmar, Côte d'Ivoire, Ghana, Ecuador, Costa Rica and Benin.

The private sector added its weight to forest transition in India. Wimco Limited at Bareilly in Uttar Pradesh, for example, responded to a shortage of quality timber with a public–private partnership to expand agroforestry projects and poplar (*Populus deltoides*) plantations. Later, eucalypts were added as agroforestry species. The states of Haryana, Punjab and Uttar Pradesh increased wood production to 2.2 million, 3.5 million and 4.2 million m^3 per year, respectively (Bhojvaid *et al*., 2013). Other states experienced similar increases.

Such private-sector initiatives have also been pursued by small farmers, who have been substituting agriculture on low-productivity lands with tree planting, agroforestry and farm forestry, for example in the states of Telangana and Tamil Nadu. Such initiatives receive state support, but they must compete with livestock grazing.

A balanced view of India's forest transition is required. Drivers of deforestation and forest degradation persist, in part because of the large number of rural and urban inhabitants who continue to rely on woodlands for their livelihoods. The annual consumption of woodfuel is estimated at 58.75 million tonnes, but official annual production is only about half that (Bhojvaid *et al*., 2013). The difference is derived from uncontrolled forest harvesting. The total number of livestock feeding on or fed by forests is estimated at 86.4 million head, which also contributes to forest degradation. Uncontrolled (illicit) felling, the collection of woodfuel and small timber, the extraction of non-timber forest products, unregulated livestock grazing, and fodder collection lead to forest degradation and in some cases to deforestation. Under the provisions of the Forest Rights Act, 2005, forest communities hold rights for the use of community forest resources for the collection of non-timber forest products and for grazing and to access water bodies, but these rights are to be exercised within the frame of sustainable forest management. Demand for forest biomass is widespread, and the Forest Survey of India insufficiently captures the change in forest condition resulting from this demand. There is, for example, an ongoing replacement of dense and moderately dense forests by open forests (Davidar *et al*., 2010).

DeFries and Pandey (2010) found that the consumption of woodfuel declined from 30 percent to 22 percent among urban households and from 78 percent to 75 percent among rural households over the period 1993–2005. But because of the overall increase in the urban population, the total number of urban families consuming woodfuel still increased. This consumption pattern results in localized forest degradation and even deforestation, but it is insufficient to negate India's progressive increase in forest cover. Davidar *et al.* (2010) suggested that the availability of wage labour is an important explanatory variable in woodfuel collection for sale to urban buyers (e.g. teashops). This also indicates that the forest sector, even after a forest transition, can remain an important economic factor in many peri-urban settings and that this economic importance may influence forest condition, even if it may have little influence on official data on forest area.

Economic liberalization and forest transition in Viet Nam

According to available data, Viet Nam had 14.3 million hectares of natural forests in 1943, accounting for 43 percent of the economy's land area. Forest cover decreased dramatically, especially in 1976–1990, when about 98 000 hectares of forest were logged annually and spontaneous migration into the economy's highlands led to deforestation. Viet Nam's forest cover had declined to 27.2 percent by 1990 but increased to 28 percent by 1995. Although overall forest area continued to expand from 1991, the area of natural forests continued to decline, albeit at a slower pace than in previous years (Figure 4). The establishment of plantations has increased rapidly since the 1990s, with the net result that the total forest area first stabilized and then increased. By 2004, Viet Nam's forest cover had reached 12.3 million hectares (37 percent of the total land area); in 2010, the forest area was 13.7 million ha (41 percent; FAO, 2010a).

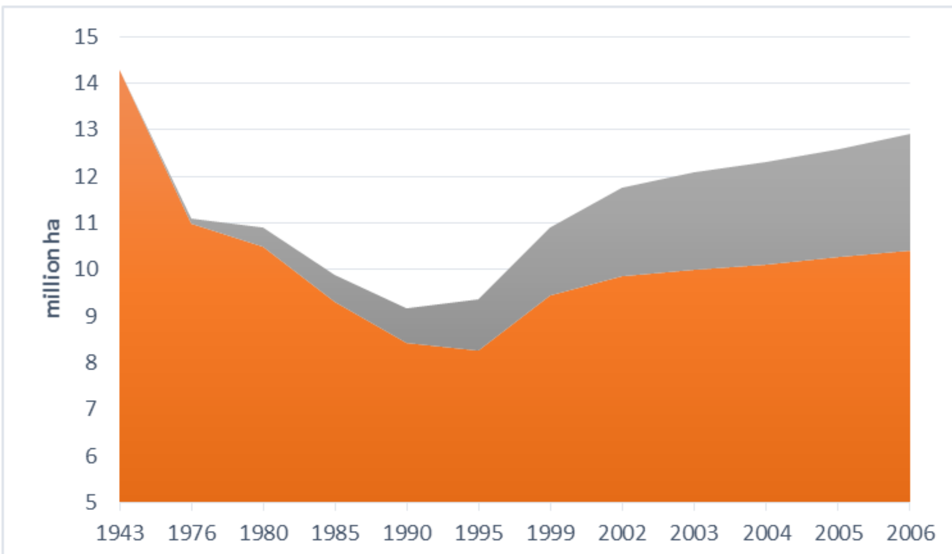

Figure 4. Forest-cover trends in Viet Nam, 1943–2006

Note: orange = natural forest; grey = plantations.

Adapted from FAO (2009b,2009c).

The causes of forest-cover decline between 1943 and 1990 are complex, diverse and somewhat debated. Commentators tend to agree that the main cause was land conversion to farmland, including the expansion of swiddens and estate crops. Viet Nam's accelerated population growth in much of the second half of the twentieth century and its persistent levels of poverty were factors contributing to an accelerated need for agricultural land. Wars in 1945–1954 and 1961–1975 contributed to the loss of 2 million hectares. Overharvesting for woodfuel and timber by state forest organizations, and illegal logging by individuals and units, played a part.

Viet Nam's forest area increased by 2.8 million hectares (31.18 percent) from 1990 to 2004, comprising an increase of 1.5 million hectares of natural forest (a 13.9 percent increase) and 1.3 million hectares of plantations (a 163.5 percent increase). The area of well-stocked, biodiverse natural forests declined, however, especially in the Central Highlands and Southeast regions. Poor-quality natural forests, with a forest stock of less than 80 m^3 per hectare, were recently estimated to constitute up to 80 percent of the total forest area (de Jong *et al*., 2006).

Plantations, especially industrial plantations, are distributed unevenly among ecological zones. The dominant plantation tree species are acacia, eucalyptus, pine, bamboo and some indigenous species. The Mekong Delta has major plantations of indigenous species such as *Rhizophora apiculata* and *Melaleuca leucadendra*; this region also has extensive rubber plantations, and rubberwood is now an important raw material for the wood-processing industry in Viet Nam.

An important element of Viet Nam's forest transition was the effort to conserve and enhance protection and special-use forests. In 2006, Viet Nam had an official list of 128 special-use forests, with a total planned forest cover of more than 2.2 million hectares. These special-use forests comprised 28 national parks with a total area of nearly 1 million hectares; 62 natural reserves with a total area of 1.1 million hectares; and 38 landscape protected areas, with the total area 147 894 hectares.

Viet Nam provides one of the most remarkable cases of a forest transition in the Asia-Pacific and worldwide. It is also quite well documented because Viet Nam received considerable external support in the 1990s, including for its plans to achieve a national forest cover of 16.2 million hectares by 2020. Several major initiatives contributed to the transition. The government pursued important forest policies and land reforms that had considerable bearing on forests and forest landscapes, and it also implemented two major projects with the major objective of restoring forests. These projects targeted deforested lands and degraded natural forests to increase the protection and market value of forests.

The two projects are the Greening the Barren Hills Programme (Programme 327) and the Five Million Hectare Reforestation Project (5MHRP). They are the two largest forest initiatives in terms of objectives, invested funds, and the political support they have received. The Greening the Barren Hills Programme was conducted in the 1990s, and the 5MHRP started in 1998 and had a final horizon of 2010.

Programme 327 was an ambitious undertaking initiated shortly after the 1992 Rio Earth Summit. Launched by the Council of Ministers' Decision No. 327-CT of 15 September 1992, it emphasized forest rehabilitation in Viet Nam's highlands while pursuing an integrated rural development approach (de Jong *et al*., 2006), and it aimed to restore forest cover on barren land and hills and protect existing forest areas, natural regeneration and forest plantations. In addition to its focus on the forest sector, the associated infrastructure development and social investment also had important impacts on forestry activities. Projects under Programme 327 received a large share of the central government's transfer payments to provinces, amounting to some US$70 million per year in 1993 and 1994. The Government of Viet Nam spent US$213 million on the programme from 1993 to 1998.

There is considerable variation in the achievements attributed to Programme 327. About 299 000 hectares of forest were successfully regenerated under it, and 397 000 hectares of new plantations were established. In addition, 1.6 million hectares were assigned under Forest Protection Contracts to some 466 000 households. An area of 6 791 700 hectares of forest became protected as a result of the programme, 700 000 hectares of forests were enriched or planted, and 640 000 hectares of new forests were established (de Jong *et al*., 2006).

The 5MHRP was approved by parliament in 1997 and by the Prime Minister in Decision No. 661/QD–TT dated 29 July 1998 (hence it is often referred to as the Decision 661 programme). The 5MHRP aimed to reforest or restore 2 million hectares of special-use forest and protection forest and 3 million hectares of production forest. It also had objectives related to timber and woodfuel production to reduce pressure on natural forests and create employment as a contribution to poverty alleviation, hunger eradication and the development of rural mountainous areas.

Do Dinh Sam *et al.* (2004) reported good progress in restoring and protecting Viet Nam's forests, with forest cover increasing from 33.2 percent in 1999 to 35.8 percent in 2003. Progress towards forest plantation establishment targets complied with annual plans. McElwee (2009) and de Jong *et al*. (2006) offered more critical evaluations of the outcomes of the 5MHRP.

The policy measures that Viet Nam implemented to contribute to restoring forest cover related to land allocation and forest contracts. Forest and forestland allocation policies were put in place in 1983 (through Decision No. 184 of that year) and strengthened with the promulgation of the 1993 Land Law (Decree No. 02/CP on forestland allocation). The revised Land Law of 2003 clearly defined the rights of land-users in terms of land use, transfers, concessions, leases, mortgages and the contribution of capital on the basis of land value. The law stipulated that forestland allocation areas could be up to 30 hectares in size and held for a period of 50 years. Households and individuals were to be allocated production and protection forests. The state also leased forest and forestland to other economic sectors for business and production objectives. By 2006, the area of forested land allocated to non-state economic actors was 3.7 million hectares, or 30.32 percent of the economy's total forestland. The allocations included around 1 million hectares of barren land and denuded hills, which were mostly allocated to households, amounting to 15 percent of the total area of barren land to be used for forestry purposes. By 2006, the total area of allocated forestland (forested and non-forested) comprised 23.2 percent of Viet Nam's total forestland area planned for 2020. In practice, households were mainly allocated production forestland: the area allocated to households was 46.2 percent of the total area planned for production forest.

Communities were hesitant to receive allocated forestland because of the strict conditions that came with such allocations; forest use rights were often more limited than before allocation (de Jong *et al*., 2006). Particularly in remote and isolated areas, local people rely on swidden cultivation as their main source of food, and they were not very interested in forestland that restricted agricultural production.

According to Sikor (1998), forestland allocation and similar measures only encouraged farm households in relatively high economic development regions to join forest restoration efforts because people in those regions could access timber markets and thus had good economic incentives to participate; these programmes, therefore, contributed mostly to forest recovery in the Central Region (de Jong *et al*., 2006). In more remote locations, forest allocation and forest protection contracts did not significantly change people's access to forests, and people continued following their customary practices.

Recent forest transition of the Philippines

Carandang *et al*. (2013), citing colonial sources, suggested that the Philippines had about 27 million hectares of forest when it was invaded by Spain in 1521. The Philippines undertook its first forest inventory in 1934, which found an area of 17 million hectares of forest (57 percent of the land area). This had declined to 10.6 million hectares by 1969 and to 6.5 million hectares in 1988, the lowest point in the economy's forest cover, which has increased since then (Figure 5).

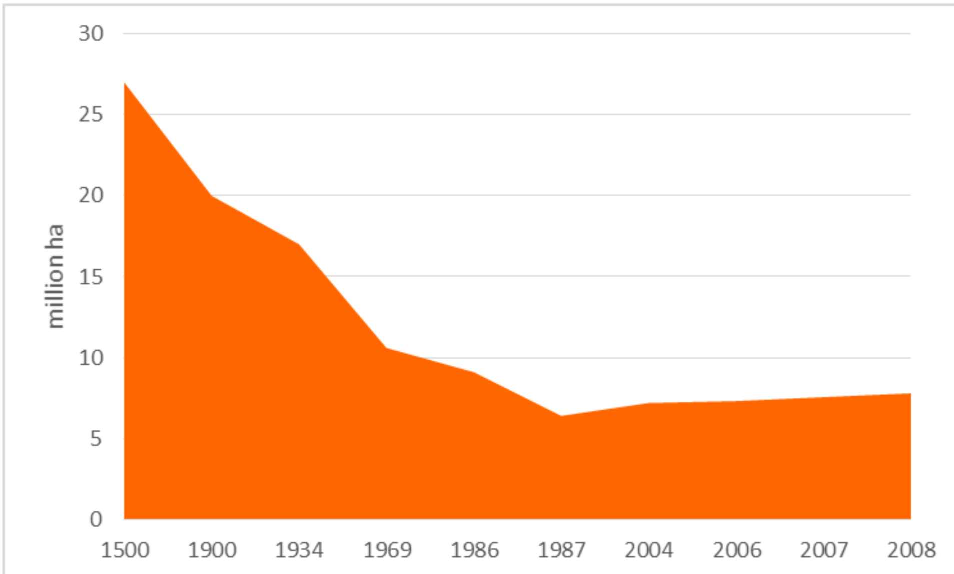

Figure 5. Forest-cover trends in the Philippines, 1500–2008

Source: Adapted from Carandang *et al*. (2013).

The main drivers of deforestation were commercial logging and the conversion of forestland to agriculture. The Philippines was one of the first economies in which modern tropical logging began, coinciding with the beginning of large volumes of tropical timber imports by markets such as Japan. This timber demand contributed to the protracted decline of primary forests in the Philippines between 1970 and 1985 (Lasco *et al*., 2001).

Similarly to other economies in the region, the logging boom in the Philippines was marred by mismatches between official policies and regulations and actual practice. Indicative of this is the large difference between the volume of timber that Japan reported to import from the Philippines and the volume reported by the Philippines as exported to Japan. Unsustainable logging that largely ignored the prescribed selective logging regulations – which had been in place since the 1950s – was commonly the precursor to total deforestation. An additional impact of the logging boom, and the subsequent logging ban of 1992, was that much of the remaining forest in the Philippines became post-logging secondary forest. In 2000, for example, 5 million hectares (83 percent of the total forest area at that time) was secondary forest (Lasco *et al*., 2001); also in 2000, only 3 percent of the economy's total forest cover consisted of forest plantations.

An important recent, well-researched analysis (Hansen *et al*., 2013) suggested that the Philippines' total forest cover had increased to 7.1 million hectares by 2012, comprising 829 000 hectares of primary forest, 5.7 million hectares of "modified natural forests" and 620 000 hectares of plantation forest.

The restoration of forests in the Philippines has followed multiple pathways, including the natural recovery of logged-over forests. Specific measures to restore forests on deforested lands can be distinguished between those implemented by government agencies and those implemented by civil-society actors (Carandang *et al.*, 2013) (Figure 6). A key government measure included contract reforestation, in which contractors received payments for three years for reforesting a given area of land. The expectation was that over 80 percent of planted seedlings would survive and that trees would have reached a height of 0.8 m by the time the contract was concluded. After the three years, the reforested area was to be turned over to the government's Department of the Environment and Natural Resources (DENR).

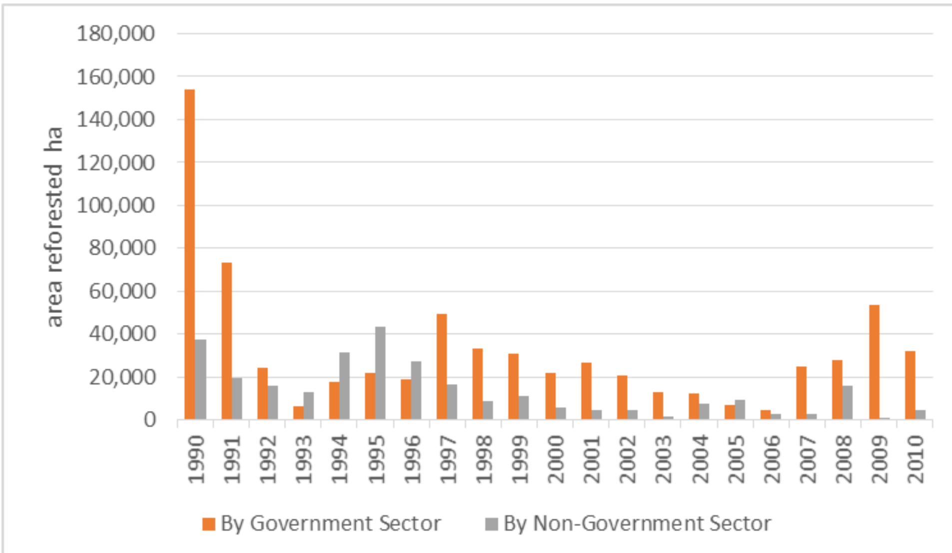

Figure 6. Annually reforested area in the Philippines, 1990–2010

Source: Carandang *et al.* (2013).

The Philippines also launched two large-scale reforestation initiatives, the Community Based Forest Management programme in 1995 and the National Greening programme in 2011. Both had high profiles and were launched by executive orders of the governing presidents. The two programmes both had poverty alleviation and carbon sequestration objectives in line with global sustainable development and climate-change mitigation commitments.

The government-supported initiatives focused especially on restoring degraded and denuded lands, while private-sector initiatives also contributed to the recovery of degraded forests. The main objective of the latter, however, was to increase forest production, and thus commercial interests were at stake. The government promoted private-sector involvement through Integrated Forest Management Agreements (IFMAs), which are agreements between DENR and appropriate applicants. IFMAs grant rights to develop, manage, protect and use specified forest areas for an initial 25-year period, with the option of extending the agreement for another 25 years. In 2010, 154 IFMAs had been signed covering 906 000 hectares, but, by that time, only 91 000 hectares had been planted. A second mechanism devised to engage the private sector in reforestation and forest restoration is Socialized Industrial Forest Management Agreements.

4 Forest transition veterans of the Asia-Pacific

Japan and the Republic of Korea experienced their forest transitions much earlier than did China, India, the Philippines and Viet Nam. The Republic of Korea went through a process of forest recovery from the 1960s. According to some, Japan's forest transition occurred in the eighteenth century (Meyfroidt and Lambin, 2011), but others put the date about one century later (Tachibana *et al*., 2013). Meyfroidt and Lambin (2011) also reported a "modern" forest transition at around 1950–1960.

The Republic of Korea is the more recent case and is well documented, whereas Japan's forest transition relies on less-accessible documentation. The two economies also have in common that they are part of a group of developed economies in Asia-Pacific with high PC-GDPs. Japan's forest transition, at least its historical forest transition, took place largely as a national process independently of major international commitments, pressure or support. The case of the Republic of Korea can be seen as a precursor to forest transition that occurred in China, India and Viet Nam.

Pre-modern forest transition in Japan

Information on Japan's environmental history is not easily accessible, but Totman (1982) provided a useful review with insights into pre-modern forest trends. Severe environmental impacts occurred in the early seventeenth century and were addressed through forestry responses. Totman (1982, 1986) identified two phases of Japanese forestry: the first spanned from the mid-seventeenth century to the late nineteenth century and the second, which Totman labelled the modern forestry period, began in the late nineteenth century and is ongoing. Others (e.g. Meyfroidt and Lambin, 2011) have highlighted Japan's forest decline in relation to the Second World War and recovery after 1950.

According to some estimates, Japan had a forest area of close to 27 million hectares in the mid-sixteenth century (Saito, 2009). The seventeenth century and onward was the era of Tokugawa rule, also called the Edo period. Forestry practices became more sophisticated during this time, largely to address environmental challenges. From about the mid-sixteenth century to the mid-seventeenth century, Japan's forests were harvested destructively, mainly linked to population increases and the expansion of agricultural lands, social changes as a result of an expanding independent smallholder class, and the expansion of timber use in castle and city construction. The excessive cutting down of forests caused severe problems, even beyond the previously forested areas, such as extreme downstream flooding.

In response, active reforestation began from the mid-seventeenth century to address environmental problems and restore timber supplies. Trained agronomists and government agencies improved reforestation techniques and supported dissemination. These efforts enabled widespread reforestation and afforestation and helped reverse forest destruction (Totman, 1982). Forests were planted and yielded incomes, and were also valued for their social roles. It is unclear, however, whether the reforestation of the seventeenth century resulted in an overall increase in forest area in what is today Japan's territory.

Tachibana *et al.* (2013) and Saito (2009) suggested that the true forest transition in Japan began towards the second half of the nineteenth century. Forest cover reached 69 percent of the total land area, which was about 4 percent less than in the mid-sixteenth century but possibly higher than during the mid-seventeenth century. Population pressure and economic modernization increased demand for woodfuel, timber and agricultural land, and this took its toll on forestlands.

Saito (2009) mentioned a forest cover of 65 percent by the early twentieth century and 67 percent towards the end of that century. Tachibana *et al*. (2013) suggested an oscillating forest cover: they reported Japan Forestry Agency data indicating a forest area of 17.7 million hectares in 1886, increasing to 25.2 million hectares in 1891, declining to 22.2 million hectares in 1916, and increasing again to 23.5 million hectares in 1939. Tachibana *et al*. (2013) also mentioned a decline in forest cover during the Second World War. By 1945, Japan's forest cover had decreased to 19.6 million hectares, before increasing to 25 million hectares by 1960 (Figure 7).

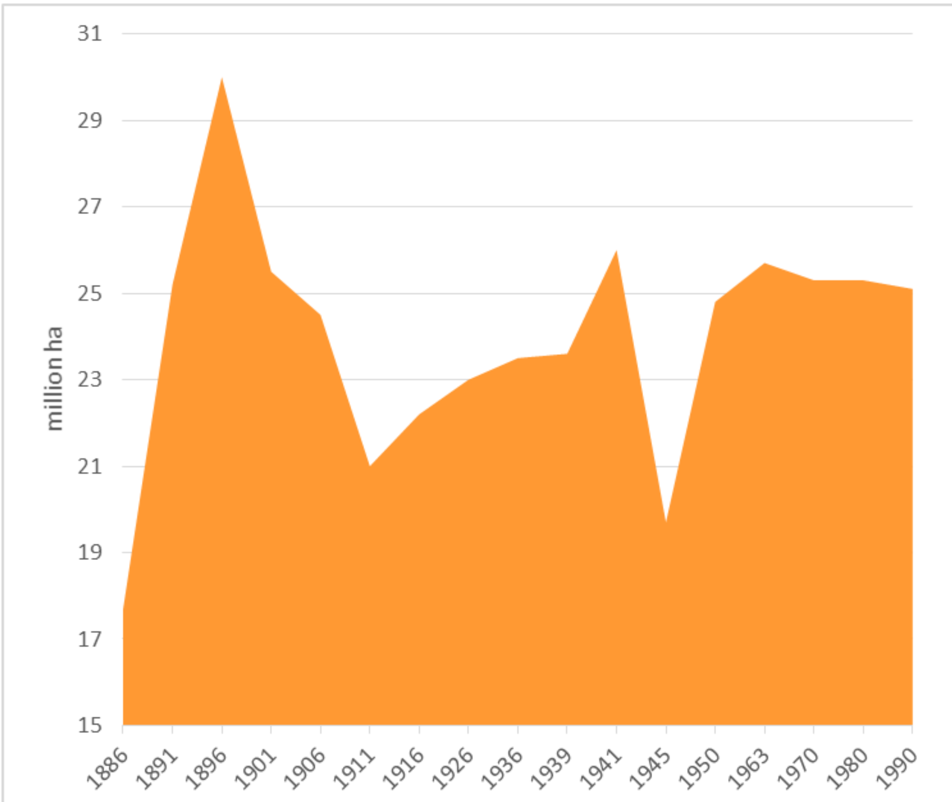

Figure 7. Forest-cover trends in Japan, 1886–1990

Source: Adapted from Tachibana *et al*. (2013) and Youn *et al*. (2016).

The Meiji government, which followed the last Edo government in the early 1870s, implemented policies and laws to prevent natural disasters caused by environmental degradation. Japan's 1897 forest law recognized protection forests as a legal land classification, which, for example, aimed to protect the headwaters of river systems and avoid soil erosion. In the early Meiji years, 100 000 hectares of land were reforested annually. In summary, a complex interplay of forest protection, reforestation, increased efficiency in forest production and timber harvesting, and waves of agricultural expansion and timber and woodfuel consumption and war all shaped forest-area decline and recovery in the late nineteenth century to the middle of the twentieth century.

Demand for construction wood expanded after the Second World War as Japan embarked on its economic growth path, almost tripling from 1946 to 1961. The majority of this construction wood was supplied from domestic sources, which encouraged forest owners to maintain forests and pasture owners to plant trees, especially conifers. An important factor in post-Second World War forest expansion was the revised forestry law. The liberalization of timber imports from the mid-1960s, and rural depopulation, have had negative impacts on Japan's forestry industry. Arguably, this has resulted in a decline in forest management and forest health in Japan, although this has not (yet) had a serious negative impact on total forest cover, which has been almost constant since 1960 at about 25 million hectares.

Post-wars forest transition in the Republic of Korea

Like Japan, the Republic of Korea experienced a period of forest area increase in the early-to-mid twentieth century, from about 4 million hectares in 1927 to about 5 million hectares in 1945 (Bae *et al.*, 2012). At that time, there was no division between North and South Korea; the forest cover of the entire peninsula has been estimated at 11.3 million hectares (Bae *et al.*, 2012). The Republic of Korea's forest cover declined steadily after the Second World War to its lowest point around 1955, when slightly more than 3 million hectares of forests remained. To some extent, the data are confusing because reports differentiate between stocked and un-stocked forestlands, with the latter appearing to include degraded forests. Growing stock declined from 74 million m^3 in 1945 to 49 million m^3 in 1957 (Park and Youn, 2013) as a result of deforestation and forest degradation.

The decline in forest cover and wood volume can be linked to a population increase, persistent poverty resulting from the Second World War, and years of political uncertainty before and after the Korean War. The growing population and limited industrial development meant that large numbers of Koreans turned to forests to grow their food and as a source of woodfuel and additional income. Bae *et al.* (2012) identified the Korean War as the most important cause of forest degradation in the Republic of Korea.

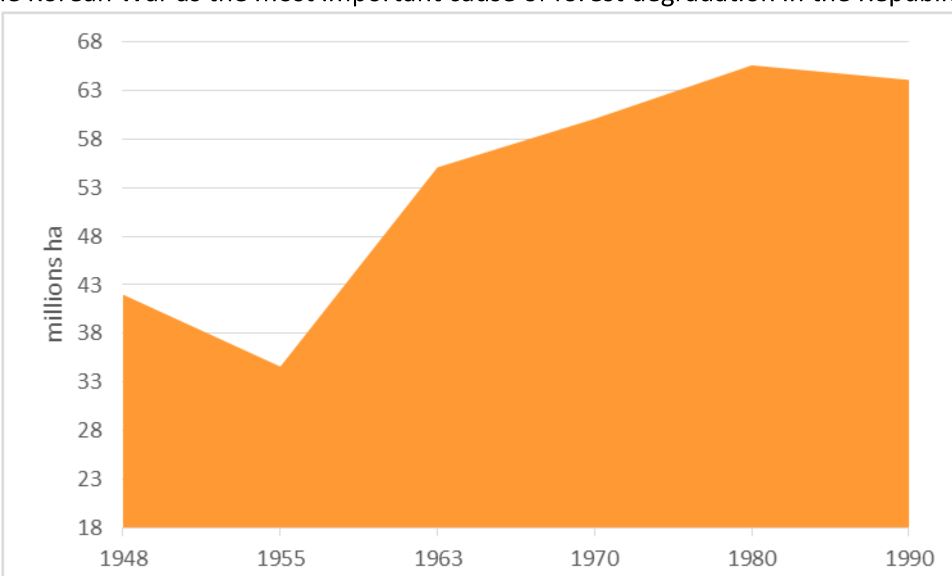

Figure 8. Forest-cover trends in the Republic of Korea, 1948–1990

Source: Adapted from Youn *et al*. (2013).

Ultimately, the total forest area increased from about 3 million hectares (35 percent of the total land area) in 1955 to 6.2 million hectares in 2007. The maximum forest area was achieved in 1980, when 65 percent of the economy was under forest cover (Figure 8). Bae *et al.* (2012) identified the following periods in the forest transition in the Republic of Korea: the expansion period (1972–1942), the reduction period (1943–1955), the re-expansion period (1955–1981), and the stabilization period (1981–2007).

As in the case of China, India and Viet Nam, the Republic of Korea implemented important forest restoration efforts that ultimately were responsible for the large increase in forest area. But forest transition itself happened in a short period in the 1950s, at a time when the economy was recovering from the Korean War and also experienced a military coup. Korea was economically and politically in chaos, with PC-GDP at US$79 in 1960. Bae *et al.* (2012) have suggested that much of the forest return was caused by natural recovery – and not because agricultural lands were abandoned or forests were planted to boost the supply of timber or other forest products.

The Republic of Korea began a massive programme of forest restoration from the 1960s. The government prohibited illegal logging and forest conversion and backed this up with strong implementation (Bae *et al*., 2012). The economy restored 1.4 million hectares of forests (23 percent of the forest area in 2007) in the 1960s, a period that also witnessed a massive decline in woodfuel consumption replaced by fossil fuels. Despite these efforts, however, land conversion for agriculture continued in remote rural areas, along with woodfuel collection, often on forestlands that continued to be recognized as such but which became progressively degraded.

For this reason, the timber volume was restored to pre-transition levels much later than was forest area. Indeed, Bae *et al*. (2012) suggested that forest transition in the Republic of Korea did not take place in the 1950s but in the 1970s, when the pre-transition growing stock had been restored. It was also in the 1970s that appropriate conditions for a sustained forest transition were created, including: economic development and a decline in the importance of the forest and agricultural sectors in the national economy, an effective democratic government and the implementation of the rule of law, and adequate environmental and forest policies that were implemented effectively.

Park and Youn (2013) found that integrated policies that pursued multiple integrated goals and relied on intense collaboration across policy sectors accounted for the successful implementation of multiple government efforts that resulted in forest transition. The integration involved coordinated national plans and also sought and obtained adequate support from the economy's people. The first national forest development plan focused on restoring forests on denuded forestlands, and the second such plan emphasized timber supply and included the restoration of degraded forests. Under the first plan, unproductive agricultural lands were taken out of production and households were relocated.

Forest development plans were successful because they were linked to economic development plans and territorial development plans (Park and Youn, 2013). The first five-year development plan, for example, emphasized energy generation, which helped reduce pressure on forests for woodfuel. The second and third development plans also emphasized reforestation as economic development priorities.

The linking of government plans and programmes – such as through intersectoral agency cooperation, especially those in charge of economic development, energy supply and forestry – was another aspect of the successful forest transition and its continuation. For example, the national energy policy was designed and implemented by the Ministry of Commerce and Industry, the Ministry of Home Affairs and the Ministry of Agriculture and Forestry. The Ministry of Construction carefully controlled and eliminated the ineffective and inappropriate use of timber in construction work. The Korea Forest Service, which was originally under the Ministry of Agriculture and Forestry, was moved to the Ministry of Home Affairs in 1973, which also helped improve intersectoral linkages (Park and Youn, 2013).

5 Forest transition hinterlands of the Asia-Pacific

Malaysia's forest area is still declining overall, although it has stabilized on the peninsula. Indonesia is still experiencing deforestation, despite national efforts to stop it, but the forest area is near stabilization on Java and the overall rate of deforestation is declining. The two economies, therefore, can be viewed as near or just past the point of forest transition. They are of interest for understanding forest transition at a moment when economies are on the brink of controlling deforestation and restoring forest cover.

Approaching forest transition in Indonesia

Indonesia is still experiencing a net total forest decline, according to recent data. The dramatic deforestation of the 1980s and 1990s, which brought the economy into the global deforestation spotlight, has declined more recently. According to FAO (2010a), the economy lost 1.9 million hectares of forest annually in 1990–2000; the rate declined drastically to 310 000 hectares annually in 2000–2005 and rebounded to 685 000 hectares in 2005–2010. According to Damayanti *et al.* (2013), annual deforestation was 310 000 hectares in 2000–2003, 910 000 hectares in 2003–2006, 900 000 hectares in 2006–2009 and 530 000 hectares in 2009–2012. Thus, deforestation in Indonesia is on a declining trajectory and possibly at the start of a process of forest transition (Figure 9).

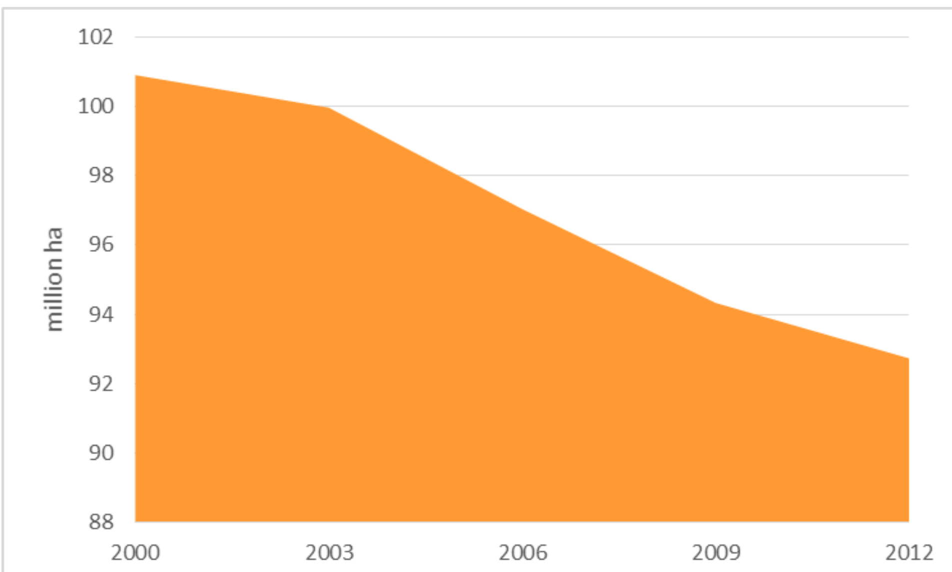

Figure 9. Forest-cover trends in Indonesia, 2000–2012

Source: Adapted from Damayanti *et al*. (2013)

Important differences exist in deforestation rates among Indonesia's major islands: Java, Kalimantan, Sumatra and West Papua. The island with the lowest deforestation rate is Java, which also has one of the world's highest population densities. Java has several of Indonesia's largest cities (Jakarta, Surabaya, Bandung and Yogyakarta), but agricultural production remains an important land use there and the island's rural population is largely agrarian. The land under agricultural production declined from 59 percent to 51 percent between 2000 and 2012, and the island's forest cover also declined but only minimally. Total forest cover was 1.02 million hectares in 2000, which was 7.9 percent of the land area, and this declined to 940 000 hectares (7.4 percent) in 2012, which was an annual forest loss of 6 508 hectares per year (Damayanti *et al*., 2013).

Sumatra and Kalimantan had a far higher deforestation rate between 2000 and 2012. Sumatra lost 281 000 hectares (0.6 percent) of forest annually. Its forest cover declined from 33 percent in 2000 to 26 percent (47.35 million hectares) in 2012. Kalimantan lost 290 000 hectares annually during the period, a rate of about 0.5 percent. Damayanti *et al*. (2013) estimated that, although deforestation remains significant on both islands, it is slowing, and they anticipate that a forest transition may begin in the near future.

Over the years, various authors have identified a number of causes of deforestation in Indonesia, although the contributions of each have been disputed. Logging has been a considerable contributor, in similar ways to the Philippines. Logging operations exceeded legally stipulated maximum harvesting levels, and fires and other deforestation agents often occurred in the wake of such logging. Large-scale resettlement ("transmigration") programmes and the expansion of estate crops and smallholder agriculture are other contributors to forest decline.

The expansion of oil-palm plantations is a contributing factor, and demand for palm oil for food production and as a fossil-fuel substitute is increasing. In the early days, the expansion of industrial tree crops was also an important contributor to forest conversion, but this essentially replaces one type of forest with another in forest statistics. Spontaneous encroachment continues to be a factor but its contribution is declining, partly because of a stabilizing forest frontier and also because of improved control.

Sustainable forest management transition in Malaysia

Forestry in Malaysia is complicated by the fact that part of the economy is located on peninsular Southeast Asia and the rest is on Borneo, and also by the way in which the economy is organized politically. Under the federal structure, states largely govern autonomously on environmental issues.

Although Malaysia was occupied by colonists from 1511, serious exploitation of its timber resources and the expansion of agriculture did not start until the nineteenth century. The era of expanding agricultural lands at the expense of forests reportedly began after independence in 1963; this included reserving the timber-rich lowlands as agricultural production expansion zones.

Since independence, therefore, lowland forests have been replaced by cultivated rice and rubber plantations, as intended in the economy's agricultural development programme. Some areas have been subject to mining, which has left surrounding lands virtually barren. A new estate crop, oil palm, appeared in the early 1970s and has expanded dramatically since. As a result, forests are now largely confined to hilly terrain in much of the economy.

Forest cover data on Malaysia are controversial. The latest Global Forest Resource Assessment (FAO, 2015) suggests a forest cover trend as the blue line in Fig. 10. However, these data do not match the observations by Hansen et al, (2013), that between 2000 and 2014 Malaysis experienced about 2 million ha of forest loss, a figure also suggested by Mongabay7. FAO (2010) equally suggests a forest cover decline from 22.3 million hectares in 1990; to 21.5 million hectares in 2000; and to 20.45 million hectares (62.3 percent of the territory of the economy) in 2010. According to the latter source, Malaysia's forest is 19 percent primary forest, 72 percent other naturally regenerated forests, and 9 percent planted forest.

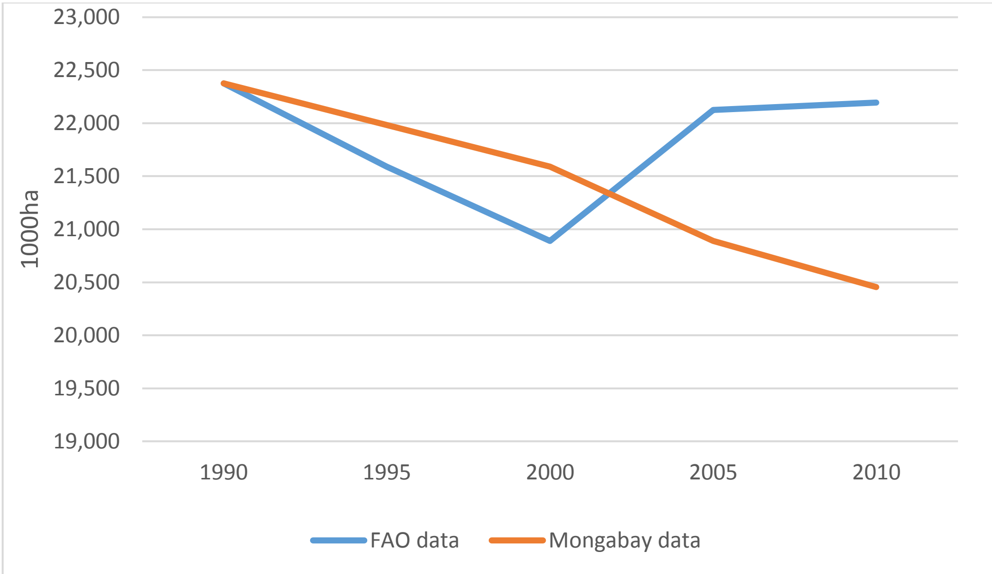

Figure 10. Forest-cover change in peninsular Malaysia, Sabah and Sarawak, and overall, 2000–2010

Source: FAO (2015) and Mongabay[7]

Malaysia's forest conversion followed a path typical of the majority of tropical forest economies, but the economy also defined an elaborated land-use regime that included forests and their major functions. Following Razali Wan and Mohd Shahwahid (2013), Malaysia's forest legislation distinguishes three categories of forests: 1) permanent reserve forests; 2) state or alienated forest; and 3) national parks and wildlife and bird sanctuaries. In 2010, the extent of the first was 14.61 million hectares, the second was 2.04 million hectares, and the third was 1.83 million hectares. The stated forest policy is to ensure that at least 50 percent of the economy's territory remains permanently under natural forest cover (Razali Wan and Mohd Shahwahid, 2013).

Of crucial importance for fluctuations in forest cover is the economy's land-use policy, which follows the land capability classification principle. Under this principle, a large portion of the present productive lowland forests has been assigned for agriculture, while forest production is confined to land unsuited to permanent agriculture. Forests are considered to generate lower rents than competing uses such as rubber and oil-palm plantations (Razali Wan and Mohd Shahwahid, 2013). These considerations were followed through much of the 1970s and 1980s, and they defined land-cover change. Hence, deforestation in the 1980s was driven by the perception that returns from agricultural production would exceed those from forest production. It can be assumed that political factors also played a role. Requests for forestlands for productive purposes were usually granted by the states, and forest departments posed little opposition. The slowing of land conversion because of industrialization and urbanization caused the rural labour market to tighten and agricultural returns to fall. This was also reflected in official policy when, under the Sixth Malaysia Plan (1991–1995), no new land was allocated for agro-productive expansion, except for projects already underway.

[7] http://rainforests.mongabay.com/deforestation/2000/Malaysia.htm

Given the economy's land-use and forest policy, the extent to which the economy may be considered on the threshold of a forest transition requires analysis. Fluctuations in forest area are linked not only to drivers of deforestation, reforestation and afforestation but also to shifts in the economy's broader related land-use policies. The national forestry policy of 1978, revised in 1992, and the enactment and enforcement of a national forestry act in 1984 (amended in 1993), and other environmentally related policies and acts, changed forest-related activities and the management of the economy's permanent production forests, protected forests and alienated state forestland. It can be argued that Malaysia has successfully adopted sustainable forest management, protected its conservation forests, and planned and approved the conversion of alienable state forest (Razali Wan and Mohd Shahwahid, 2013).

6 Forest transition histories and trajectories in eight Asia-Pacific economies

This chapter explores commonalities and discrepancies in forest transition of the eight economies, taking into account that they are at different stages and that they likely have had, or will have, divergent trajectories.

The analysis uses the narratives in chapters 3–5 of this report and the various sources drawn on in those chapters, especially the reports prepared by the local teams of the APFNet-APAFRI project. It also refers to papers published by the local teams in a special issue of *Forest Policy and Economics* titled "Forest transition in Asia" (Youn *et al*., 2016; Li *et al*., 2016; Liu *et al*., 2016; Ashraf *et al*., 2016). A fourth source of information comprises other published papers and reports on forest transitions and related topics in the eight economies.

Commonalities and divergences in forest transitions in Asia-Pacific economies

Figure 11 shows trends in the percentage of forest cover in the eight economies from 1990 to 2010. China, India, the Philippines and Viet Nam all show increases, with the most dramatic increase in Viet Nam, followed by China, India and the Philippines. Because of differences in the total area of the respective economies, China added much more to its total forest cover than any other economy. The average annual increase in China was: 1.9 million hectares (1990–2000); 3.2 million hectares (2000–2005); and 2.7 million hectares (2005–2010). India added 145 000 hectares annually in 1990–2000, 464 000 hectares per year in 2000–2005 and 145 000 hectares per year in 2005–2010. Viet Nam added 236 000 hectares per year in 1990–2000, 270 000 hectares in 2000–2005 and 144 000 hectares in 2005–2010 (FAO, 2010a). An important outcome of these increases is that, for Asia-Pacific as a whole, the area under forest cover exceeded the area deforested during the period.

There were fluctuations in forest cover in Japan and the Republic of Korea. Japan's forest area declined and increased over the 20-year period, but the Republic of Korea had a net total decrease. Both Indonesia and Malaysia showed a trend of decreasing deforestation, suggesting that the two economies may be moving towards a forest transition.

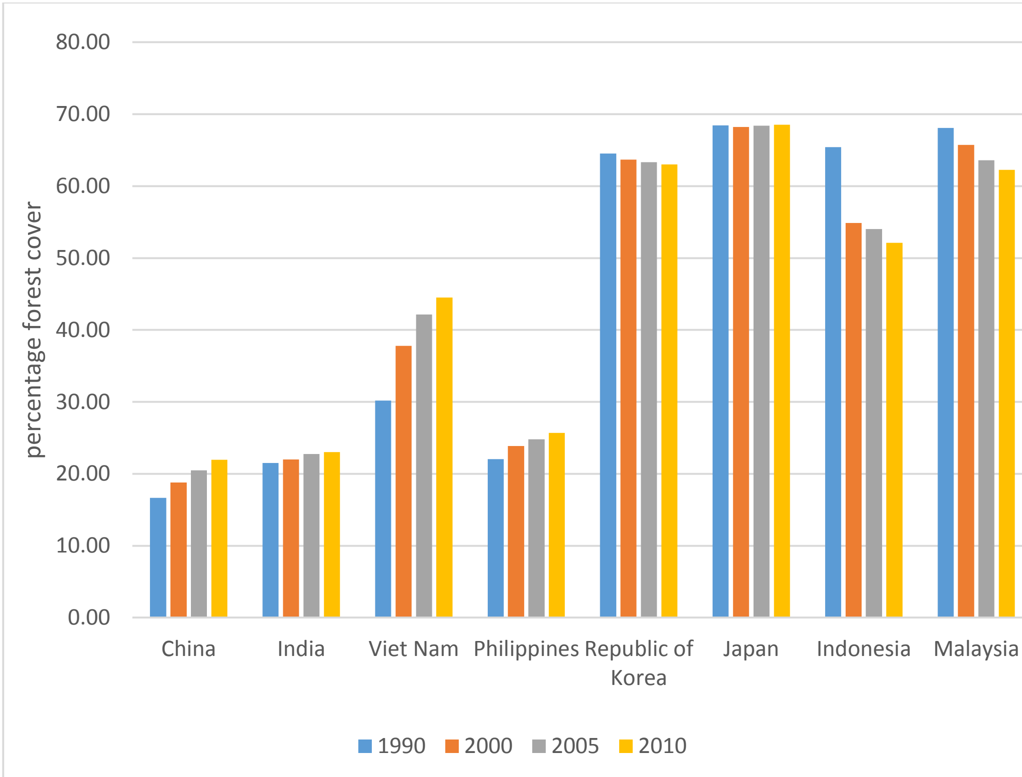

Figure 11. Changes in percentage forest cover in eight Asia-Pacific economies, 1990–2010

Source: Based on FAO (2010a).

Given the forest-cover trends outlined above, relevant questions include the following: What conditions are considered to have contributed to declines in deforestation and increases in forest cover? Does the forest transition pathway concept apply to the six economies that have experienced forest transitions? Did the economies follow the same or different forest transition pathways? Does a forest transition analysis tell us something about the two economies that appear to have entered periods of declining deforestation, suggesting that they may be moving towards forest transitions?

Four analyses were carried out as part of the APFNet-APAFRI project. Youn *et al.* (2016) used a qualitative comparative analysis to suggest that the economies followed multiple pathways in their forest transitions and experienced unique constraints. The following indicators were used to help explain forest transition: PC-GDP; food provision; percentage of forest cover; timber import barriers; ownership status of forests; and the adequacy and effective implementation of forest policies.

The analysis by Youn *et al.* (2016) indicates that forest transitions coincided with the following two sets of conditions: 1) low PC-GDP, sufficient food provision, liberalized timber imports, private forest ownership or forest tenure given to individuals, and the existence of an effective forest policy (forest transition periods in China, India, the Republic of Korea, the Philippines and Viet Nam); and 2) sufficient food provision, high forest cover, liberalized timber imports, private individual forest ownership, and the existence of effective forest policies (forest transition periods in Japan, the Republic of Korea and Viet Nam).

These results tentatively suggest that the liberalization of timber imports and private forest ownership are necessary conditions for a forest transition, and also that a minimal food supply must be assured and effective forest policies implemented. In other words, food supply is satisfied, the pressure on forestland is limited, forest product demand is displaced, and serious government efforts are invested in forest restoration. Youn *et al.* (2016) concluded that low forest cover and intensive efforts to restore forests need to coincide with liberalized timber imports and privatized forest ownership for a forest transition to take place.

Hence, the cases analysed in the APFNet-APAFRI project shed new light on what has triggered forest transitions in six economies. Economic development and the scarcity of forest resources are important but insufficient drivers of forest transition, even if they result in active policies to restore forests. The liberalization of timber imports and the privatization of forest ownership are also important conducive factors.

Youn *et al.* (2016) examined the conditions that might deter a forest transition (i.e. promote deforestation). They found the following five combinations:

1) Low PC-GDP, liberalized timber imports, non-private forest ownership, and the absence of effective forest policy – e.g. in Indonesia and the Lao People's Democratic Republic, as well as the deforestation periods of Viet Nam and the Philippines.
2) Low PC-GDP, insufficient food provision, low forest cover, non-private forest ownership, and the absence of effective forest policy – e.g. the deforestation periods in China and India.
3) Low PC-GDP, insufficient food provision, high forest cover, no liberalization of timber imports, private forest ownership, and the absence of an effective forest policy – coinciding with deforestation periods in Viet Nam and the Republic of Korea.
4) High PC-GDP, sufficient food provision, high forest cover, but no liberalization of timber imports, private individual forest ownership, and the existence of an effective forest policy – coinciding with the deforestation period in Japan.
5) High PC-GDP, sufficient food provision, high forest cover, liberalized timber imports, non-private forest ownership, and the existence of an effective forest policy – the combination in Malaysia, where the forest transition is arguably yet to occur.

In the multi-economy comparison of Li *et al.* (2016), population pressure was negatively correlated with forest cover. Moreover, the authors found planted forest area to be an important determinant in forest transitions. Planted forests differ significantly from natural forests, however, and achieving a forest transition through afforestation has important and complex effects on forest ecosystems not reflected in the simple parameter of forest cover.

A more important reflection relates to deforestation "leakage" and forest transition. As also pointed out by Youn *et al.* (2016), forest product imports are positively correlated with both forest area and standing timber volume. On the other hand, the contribution of forest products to exports correlates negatively with forest area and standing timber volume, suggesting that a shift from forest product exports to imports can contribute to a forest transition (although it might exacerbate deforestation elsewhere). Forest product imports likely reduce pressure on domestic forest resources, and the three economies in this study with exemplary forest transitions (China, India and Viet Nam) all experienced rapid increases in forest product imports – in the 1980s in China, the 1990s in India and the 2000s in Viet Nam. The other side of the story is that, as forest product exports from Indonesia and Malaysia increased, domestic pressures on forests also increased, apparently inhibiting forest transition. Notably, the Philippines was a net exporter of forest products until the 1990s, but its shift to become an importer of forest products after 1990 coincided with the beginning of that economy's forest transition. This appears to be a common element in forest transition economies in the Asia-Pacific (Li *et al*., 2016).

There is a more positive correlation between the value of an economy's total export value (i.e. for all products and services combined) and forest condition. Although a higher proportion of forest products in total exports implies more pressure on forests and thus may constrain forest transition, total export value appears to be positively correlated with both forest area and standing timber volume (Li *et al*., 2016). This may be due to an economic modernization effect, or an increase in production costs and the dual effects of labour moving from rural areas to industrial areas and marginal lands being taken out of the agricultural production cycle. It is important to note, however, that this is a wider process than the economic development forest transition pathway, which suggests an effect of domestic economic growth on forest transition. Where it concerns the link between total exports and forest condition, an additional element is the international integration of economic activities, international trade and foreign direct investment. Thus, foreign direct investment in the manufacturing and service sectors (possibly in combination with other factors, as suggested by Youn *et al.*, 2016) is likely to have positive effects on forest transition, possibly because it generates jobs and encourages rural out-migration and because it diminishes dependence on land-based economic activities. These patterns can conceivably be viewed as elements of a globalization forest transition pathway.

Liu *et al.* (2016) analysed forest transition in eight economies and tried to make specific links with the forest transition pathway concept. They found that two pathways – the economic development and state forest policy pathways – were most common in the eight economies. They found no clear evidence, however, of a link between PC-GDP and the forest transition curve. In addition to economic factors, adequate forest laws and rigorous national environmental planning have clearly shaped forest transition in China, India and the Republic of Korea. As indicated also by Youn *et al.* (2016), China began its forest transition at a PC-GDP of US$200. Forest area may be still declining in Malaysia, on the other hand, where the PC-GDP was US$6 000 in 2012. India, Viet Nam and the Philippines underwent forest transitions with PC-GDPs of approximately US$350, US$300 and US$1 000, respectively (Liu *et al.*, 2016).

An important factor in forest transitions when PC-GDP is low (and thus the effect of economic modernization on restoring forest cover may be minimal) is governance, and China, the Republic of Korea and Viet Nam are clear examples of this. Liu *et al*. (2016) suggested that, in China, forest transition followed the economic development, state forest policy and globalization pathways; in the Philippines it followed the state forest policy pathway; and in the Republic of Korea, Viet Nam and India it followed the economic development and state forest policy pathways.

Ashraf *et al.* (2016) made links with various forest transition determinants, showing, for example, that agricultural area and cereal production have increased consistently in China, India, Indonesia, Malaysia, the Philippines and Viet Nam in the past few decades but decreased in Japan and the Republic of Korea. In the developing economies, PC-GDP increased slowly in the early 1960s and 1970s but grew rapidly in the last two decades. Total populations grew in all eight economies, as did urban populations.

Regression analysis suggests a linear relation between PC-GDP and forest cover. This, in turn, suggests that even if there is no Kuznets curve relationship – as indicated by Li *et al*. (2016) and Liu *et al*. (2016) – increasing PC-GDP coincides with increasing forest cover in the absence of other determining factors.

Ashraf *et al*. (2016) observed a cubic relationship between forest area and agricultural area in China, Japan, the Philippines and Viet Nam, and an exponential relationship in India. This suggests that agricultural area determines forest area, although the nature of the relationship may differ because of the relative areas of other land uses. Other tentative relationships between socioeconomic variables and forest cover include the contribution of agriculture to GDP, as well as population density and forest area (Ashraf *et al*., 2016). These findings suggest that multiple factors determine forest area and thus forest transition.

Ashraf *et al.* (2016) found that China's forest transition was statistically correlated with the area of arable land and the livestock population. China expanded its agricultural land from 40 percent of the land area in 1970 to 59 percent in 2005 (Ashraf *et al*., 2016). A possible explanation of the observed positive link between forest area and livestock is that livestock increased land-use intensification, which is corroborated by an increase in income per m^2 of land since 1990 (Ashraf *et al*., 2016). Land-use intensification also occurred in India, coinciding with that economy's forest transition. India's example also shows that there is no simple correlation between urbanization and forest transition because an urban population may continue to depend on forests to meet subsistence needs (see also Chapter 3).

Refinements in explanations of forest transitions emerge from the study by Ashraf *et al.* (2016). The Asia-Pacific forest transition tigers – China and India – have been able to contain deforestation and achieve fairly stable land use and land cover. Japan and Korea addressed forest loss early and, while doing so, invested in modernizing their economies in the industrial and services sector (rather than in the agricultural sector). Indonesia, Malaysia and the Philippines, on the other hand, are investing heavily in boosting agricultural production. Although this has resulted in more intensive land use in each of these three economies, it has coincided with a forest transition only in the case of the Philippines.

Prospects for a forest transition in Asia-Pacific economies

It is likely that forest area will increase in China, India, the Philippines and Viet Nam, the four economies that have experienced fairly recent forest transitions (e.g. Bhojvaid *et al*., 2013; FAO, 2009a, 2009b, 2009c, 2009d). Relevant questions are: How will forest quality evolve in those four economies? In addition to a forest area transition, will there also be transitions in timber volume and forest biodiversity?

Another important question is, how will Indonesia and Malaysia fare? What will happen to Malaysia's forest estate? Will the economy continue its planned land-use design and convert more forest to other uses, until the target of 50 percent forest cover is reached? Or is another scenario possible? Indonesia's forest-cover trend is equally an enigma: deforestation is declining, but will this continue?

Japan and the Republic of Korea can be expected to maintain their current forest areas, with only slight changes. The national forest estates are aging in both these economies, and demands on forests are changing. How will these factors affect forest management, and how will the forests themselves change?

To anticipate how forest transition trends may develop in the future, a review was made of forestry outlook studies prepared in recent years for the Asia-Pacific region (FAO, 2009a, 2009b, 2009c, 2009d, 2009e, 2009f, 2010b, 2012). Relevant national forestry plans were consulted for China and Viet Nam (Seligsohn and Hsu, 2011; Government of Viet Nam, 2007). In addition to FAO (2009b), the information on India draws on the study by Bhojvaid *et al.* (2013), which dedicates a chapter to the future of forests and forestry in India.

Japan and Republic of Korea

The forest areas of these two economies have been reasonably stable and are likely to remain so. The major changes, therefore, are likely to be in forest condition. For example, **Japan's** modern forest transition, which began soon after the Second World War, and the subsequent opening up of Japan's market to imported tropical woods, have resulted in important shifts in the use and management of forests in that economy and there is an overrepresentation of forests aged 40–50 years (FAO, 2009a). The plan was to harvest most such forests at around age 50 years, but thinning was required periodically in the meantime to ensure healthy stands and optimal tree sizes and volumes. Because of changes in market demand and operational costs, such thinning has been insufficient, and harvesting is not taking place as initially planned. FAO (2010b) predicted that the area of single-story forests would decline to 2020. The area of multistorey forests was expected to increase, the majority of which has a designated forest function of soil conservation and watershed protection.

The role that forests can play in efforts to reduce greenhouse gas emissions could be an important factor in Japanese forestry. Domestically produced wood could be used as a carbon-neutral energy source, or as a carbon sink if used in construction or similar long-life uses. For forests to play a larger role in Japan's efforts to reduce emissions, however, a new direction in its forest policies would be needed. Whether this will occur – and help solve the forest abandonment dilemma – remains to be seen (FAO, 2010b).

In the **Republic of Korea**, FAO (2012) envisioned that forest cover would increase slightly, from 6.377 million hectares in 2010 to 6.382 million in 2020. The total wood volume was also expected to increase because of an overall increase in the age-class structure of forest stands, and an increase in forest product consumption would be met through imports. Average forest age would increase, and there would be an increase in forest fire and disease. Current and recent afforestation practices would result in a shift towards a larger proportion of deciduous forests at the expense of coniferous forests. The increase in the area of forest in the 40–50-year age classes, and the limited management undertaken in these forests, would lead to an increase in biodiversity in these forests.

The Republic of Korea, like Japan, is considering the role of its national forest estate in meeting carbon emission reductions, but it does not yet have well-developed plans (as Japan has). The role of forests in recreation and other social functions is given more prominence in the Republic of Korea than in Japan.

China, India, Viet Nam and the Philippines

China updates its forest and forestry plans and aspirations each time it launches a new five-year plan. The 12th five-year plan contains ambitious targets to increase forest area by 12.5 million hectares between 2010 and 2015; this would be an increase from 20.36 percent of the total land area to 21.66 percent. There was also to be an increase in forest stock of 6 million m^3, from 137 million m^3 in 2010 to 143 million m^3 in 2015 (Seligsohn and Hsu, 2011). There is some uncertainty on forest area, however. Using data from FAO (2010a), China had a forest cover of 21.55 percent in 2010, not 20.36 percent as indicated in the five-year plan. An increase of 12.5 million hectares from 2010 to 2015 would increase forest cover to more than 219 million hectares, which would be only 1 million hectares short of the 2020 target of 220 million hectares (FAO, 2009a).

The 2020 China forestry outlook study (FAO, 2009a) predicts an average stock volume of 105 m^3 per hectare in 2020 and an increase in public ecosystem services, with a remarkable 14–14.5 percent of the land area (135–140 million hectares) to be set aside as nature reserves, including 110 million hectares

(11.3 percent of the land area) of forestlands (FAO, 2009a). An estimated 13.33 million hectares of fast-growing timber species are to be established to increase the domestic wood supply, including of large-diameter timber. Significant areas of forests are also to be developed for bioenergy.

The forest outlook study for **India** (FAO, 2009b) estimated forest cover at 23.39 percent of the total land area in 2005, and this was expected to increase to 30 percent by 2012, with a goal of 33 percent forest and tree cover by 2020. Bhojvaid *et al.* (2013) predicted a forest cover of 71.34 million hectares by 2020, and they cite an estimate of 72.19 million hectares of forest by 2030.

Bhojvaid *et al.* (2013) proposed several scenarios for the future forest area in India, including one under the economy's Green India Mission, which has specified a target of 5 million hectares of additional forest plantations, to be located outside official forestlands. This may mean that the forest area could reach 75 million hectares, even before 2020. Nevertheless, the target of one-third of the total land area under forest, as proposed in the 1988 National Forest Policy, is still a long way off.

Both FAO (2009b) and Bhojvaid *et al.* (2013) indicated that the fairly high dependency of India's rural and urban populations on forests creates special circumstances that affect forest trends in India. According to Bhojvaid *et al.* (2013), 70 million tribal and 200 million non-tribal rural people – or about one-quarter of the economy's population – depend on forests. On one hand, the ongoing use of forests for woodfuel, fodder and timber (feeding local industries) will continue to affect India's forests. On the other, this reliance on forest and tree products and the past and ongoing support and promotion of joint forest management in the form of agroforestry and community and smallholder forestry will also increase on-farm tree and forest production; the small patches of trees and forests outside forestlands created by such production are poorly reflected in forest statistics (Bhojvaid *et al*., 2013). No socioeconomic factors appear likely to reverse existing forest development trends. Forest-cover increases are likely to continue, and forests will exhibit significant signs of anthropogenic influence.

Viet Nam had a forest area of 14.6 million hectares in 2011 (MARD, 2012), and there is a plan to increase this to 16.24 million hectares (FAO, 2009c), which would be a forest cover of 47 percent of the land area, conditional on sufficient investment for afforestation. In 2020, the forest area is expected to include 5.68 million hectares of protected areas, and special-use forest is not to exceed 2.16 million hectares. The area of production forest is expected to increase to 8.4 million hectares, of which 3.63 million hectares is to be natural forest and 4.77 million hectares forest plantations (Government of Viet Nam, 2007). Essentially, this would mean that 12.09 million hectares would be natural forest, which would be 2 million hectares less that the area of natural forest in 1943.

The Philippines has undergone a forest transition and, according to forest transition theory, its forest area should continue to expand before stabilizing at a certain point. In a somewhat similar fashion to India, however, the future of forests in the Philippines is not yet secure and will depend on a number of factors, including some that may be positive for forests and others that may have negative impacts.

The challenges ahead include population pressure, which is unlikely to decline soon and will continue to feed migration into forested areas. Demands on forests for fuel and other resources by a growing but not wealthy population will also continue to put pressure on forests (FAO, 2009d). The Philippines government envisages that present and future forest reserves will provide a possible source of energy, when fossil fuels eventually become too expensive or unavailable. Hence, a significant area of forest has been designated for energy production. This will ensure that those areas remain forested, but the character of the forests may change. For example, to meet the goals stated in the 2006 Biofuel Act, the government plans to establish 2 million hectares of *Jatropha* plantations, and oil-palm and sugarcane plantations will also be expanded (FAO, 2009d).

It is foreseen that the total area of forest will increase in the Philippines, but the area of natural forest will decrease because of illegal harvesting for timber and woodfuel, conversion to cropland, and woodfuel production. Future needs and market opportunities for forest products, in combination with government incentives, will encourage the expansion of smallholder plantations. Private-sector plantations will also continue to expand, and some large corporate owners will engage in large-scale watershed rehabilitation (FAO, 2009d). In addition, it may be envisioned that the area of protected areas will increase, and they will be better protected in the future. Lastly, the recreational needs of a more affluent population will result in the establishment of forests near urban areas.

Indonesia and Malaysia

In **Indonesia**, various scenarios are foreseen for how forests and forestry might evolve to 2020, taking the situation in 2005 as the departure point. FAO (2009e) estimated the total area of forestland at 130.4 million hectares, comprising 42.6 million hectares of primary forest, 39.8 million hectares of secondary forest, 2 million hectares of plantations, and 45.3 million hectares of forestland without trees[8]. Each of these four forest categories are assigned to four forest functions – production forest; convertible production forest; protection forest; and conservation forest.

The four forest-cover scenarios involve varying areas of the four forest categories; scenarios 1 and 4 in Figure 12 are the two “extreme” scenarios. In scenario 1, the area of primary forests declines to 27.6 million hectares by 2020 and the area of secondary forests declines to 37.7 million hectares; on the other hand, the area of plantations increases to 6 million hectares and the area of forestland without forest cover increases to 59.1 million hectares. Under scenario 4, primary forests decline only slightly by 2020, to 37.3 million hectares, secondary forests increase to 52.2 million hectares, plantations increase to 8.19 million hectares, and the area without forests declines to 32.3 million hectares. The plantation forests will comprise 3.29 million hectares of pulpwood plantations, 3.24 million hectares of community timber plantations and 1.66 million hectares of other timber plantations.

[8] The total is 129.7 million. We assume the difference to be unspecified “others”.

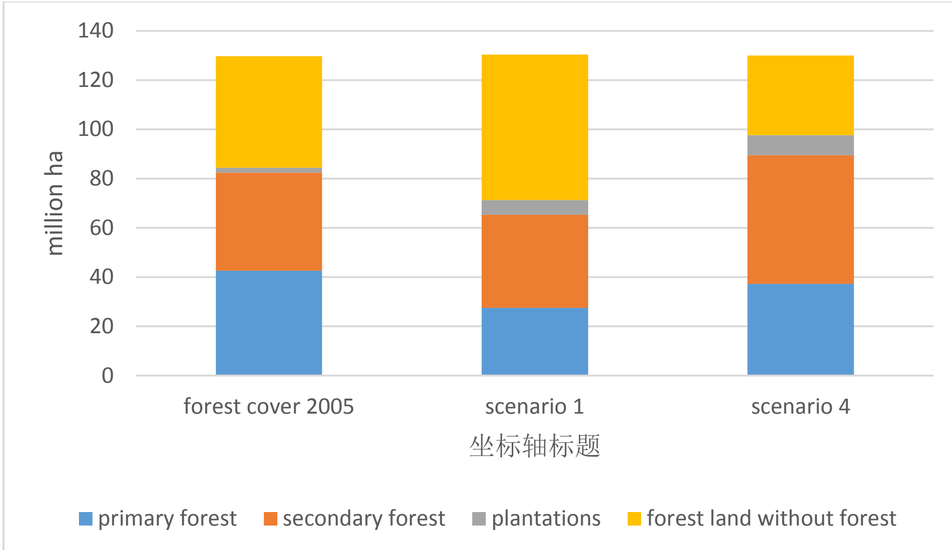

Figure 12. Scenarios until 2020 of forest cover in Indonesia

Source: Based on FAO (2009e).

Under scenario 4, the total forest cover increases by 10.4 million hectares by 2020. Notably, the contribution of forest plantations to this increase is relatively minor, with the gain largely due to a reduction in the loss of primary forest and a large expansion of secondary forest. The differences assume the following trends. Primary forest will decline in all scenarios – but especially scenario 1 – because of illegal conversion and logging. In scenario 2 the area of secondary forest under protection and conservation increases, in part because of forest rehabilitation, but the proportion of secondary forest in the production forest category declines because of illegal conversion or logging (FAO, 2009e). The increase in non-forested forestland in scenario 1 is due to illegal logging or conversion, the main contributors to deforestation. In the alternative scenario, much of the currently unforested forestland would be either rehabilitated or converted to plantation forests.

Which of these scenarios prevails will depend in large part on the policies and actions of influential forest stakeholders. Approaches proposed by FAO (2009e) include the identification of new options for benefit-capture and partnerships, but these require appropriate incentives. Forest rehabilitation must become more effective and focused, and land-use distribution needs to be adjusted as necessary and appropriate. Importantly in the Indonesian context, good governance is required, including improved accountability and transparency in decision-making, chain-of-custody monitoring, and public disclosure. Legality compliance in all aspects is an issue that requires special attention, including increased capacity in law enforcement and improved laws.

Malaysia has declining forest cover[9], but it claims that the area in permanent forest reserves will increase by at least 1 million hectares between 2005 and 2020 (FAO, 2009f), in addition to the increase of 1.11 million hectares in permanent forest reserves in the period 1995–2005. By 2020, the total area in permanent forest reserves is projected to be 16.30 million hectares, which is 49.6 percent of the total land area. The total area of forest will decline to 16.73 million hectares by 2020, which would be more

[9] Assuming the orange line in Fig. 10 is the correct one.

than 1 million hectares less than in 2010 (17.81 million hectares; see Chapter 5). Forestland will be replaced by agricultural land, infrastructure and settlements (FAO, 2009f).

FAO (2009f) also estimated that, by 2020, Malaysia's plantation area will have increased by 1.75 million hectares, of which 500 000 hectares will be in Sabah and 1.2 million hectares will be in Sarawak. The total area of forest plantations will be 2.15 million hectares, of which 55.8 percent will be in Sarawak (FAO, 2009f).

According to Razali Wan and Mohd Shahwahid (2013), the 16.3 million hectares of permanent forest reserve in 2020 will be managed sustainably using reduced impact logging and applying criteria and indicator tools to define management practices, and all logged timber will be certified by independent third-party certifiers. Total timber production will increase slightly above the level in 2005, and 58.3 percent will come from plantations. Thus, about 19 million m^3 per year is expected to be harvested in natural forests. According to Sist *et al.* (2014), however, it is doubtful whether this level of harvest can be achieved sustainably, given current cutting cycles.

7 Conclusions and recommendations

The concept and theory of forest transitions have contributed a new analytical frame that increases understanding of the link between forests and wider socioeconomic processes. The concept of forest transitions adds a dimension to theories and models attempting to explain deforestation (e.g. Kaimowitz and Angelsen, 1999). It has brought attention to historical changes in forest cover, such as those in Japan and many economies in Europe, and also to the more contemporary processes of returning forest cover, such as those analysed in this report.

Although the theory of forest transitions makes a valuable contribution to academic efforts on understanding society–forest interactions, it also poses challenges, as argued in Chapter 2. Forest transitions in European economies can be explained using fairly clear principles, but these do not necessarily apply strongly to recent cases of forest-cover decline and recovery, such as those in the Asia-Pacific. The economic development and forest scarcity pathways do not adequately explain forest transition in China, India, Viet Nam or the Philippines, and additional pathways are needed.

This is not an unusual phenomenon in academia, especially social sciences, where theories are proposed and subsequently further elaborated. Early versions of forest transition pathways, however, had appeal because they were straight-forward. Proposed revisions to forest transition pathways (e.g. Rudel *et al*., 2005) have added depth to the understanding of forest transition drivers. More complex theories and models pose challenges when the question arises: How can an understanding of forest transitions be used to formulate recommendations for policies or action?

A comprehensive overview of forest transitions in the Asia-Pacific region, as provided here, sheds light on forest-cover trends and gives insight into future trends. Six of the eight economies reviewed have reversed their forest-cover declines, although forest degradation and the replacement of biodiverse forest with less-diverse forests may remain issues. It is not impossible for Indonesia to also achieve a forest transition in years to come, although it may not have all the preconditions for the transition that were present in Japan, the Republic of Korea, China and Viet Nam. Malaysia is still experiencing forest-cover decline according to some analyses but it appears to be progressing towards a controlled eventual cessation of this (Razali Wan and Mohd Shahwahid, 2013; FAO, 2009f). Malaysia has among the highest percentage forest cover of the economies reviewed here (similar to Japan and South Korea; Figure 10). On the other hand, reports of illegal and unplanned forest conversion and logging continue (Lawson and MacFaul, 2010).

The concept of forest transitions is still relatively new, and the development of forest transition theory is limited by a relative lack of case material. The APFNet-APAFRI project reported here is an important step forward because it focused on nine economies in a single research and training project. Local teams collected detailed information and data that are not easily available in public information repositories. The reports referenced in Chapter 6 show what a project like this can achieve, and there are good prospects for additional future research on forest transition.

Like deforestation, forest transitions are driven by many factors, which are not easily disentangled. In each economy, an elaborate narrative is required to adequately represent the process, as presented in chapters 3, 4 and 5. Research of multiple cases using the same framework and tools can reveal important commonalities.

The accumulated experiences captured by the APFNet-APAFRI project on forest transitions in Asia-Pacific economies suggest revisions to understanding of the phenomenon. Rather than accidental outcomes of economic and social changes, forest transitions occur in response to demand for goods and services from forests and forest landscapes. Changing social and economic conditions greatly affect the roles of governments, the private sector and civil society in their efforts to meet such demand.

Assuming this to be the underlying principle of forest transition, the economic development forest transition pathway can be seen as subservient to the forest scarcity pathway. The economic development pathway may have played a more important role in some early and historical cases of forest transitions but, in modern times, the provision of environmental goods and services is not a given, and competing land-use options pose additional challenges. The government policy forest transition pathway is also secondary to the forest scarcity pathway. In several of the economies reviewed here, government has been a dominant actor in forest transition. In such instances, whether a forest transition takes place is determined by the strength of demand for forest goods and services, the extent to which those can compete with other goods and services demanded from land, and the effectiveness of government policy. The globalization forest transition pathway essentially encompasses other actors engaged in a forest transition and the influence of outside factors that help determine the capacity of forests to compete with other land-use options.

If a society or government recognizes the need for increased forest goods and services, various options are available to halt or slow deforestation and increase reforestation – that is, to achieve a forest transition. The best option will depend on the economy and its legal, social, economic and political circumstances. Governments can implement major projects – as they did in China, Viet Nam and, to some extent, India. Governments can also create favourable conditions for engaging the private sector – as, to a large extent, was done in India and the Philippines – and promoting smallholder, local and community involvement, which was a strategy pursued in India. The best mix of approaches can be informed by well-documented analyses, such as those arising from the APFNet-APAFRI project (and discussed in detail in Chapter 6).

Those analyses propose factors that favour or do not favour a forest transition, but it is less clear how these factors are influenced by policies and incentives. For example, it is no easy proposition to increase PC-GDP or foreign direct investment, although governments can promote the latter by creating enabling conditions. Another policy measure with an apparent positive correlation with forest transition is the liberalization of timber imports (Li *et al*., 2016; Youn *et al*., 2016). Hence, this can be recommended as a potential part of the policy mix for a forest transition.

A more specific recommendation is that concrete and hypothetical forest transition scenarios should be developed as a tool in the development of strategies for encouraging a forest transition by enabling the identification of the configuration of factors most likely to lead to it. Such exercises can also help in understanding the interventions required and the impacts they are likely to have. This may be especially helpful in Asia-Pacific economies, which are dynamic and where a number of forest transitions have occurred recently or are likely to occur soon. Although the cases of China and Viet Nam are quite different from those of the Philippines and Indonesia, there may be similarities, for example, between the latter two economies and India. Important lessons can be derived from India's forest transition that would have much value for other economies in tropical Asia.

Finally, to what extent are the experiences in the Asia-Pacific region relevant elsewhere, especially Africa and Latin America (where only a few examples of forest transitions have been reported to date – Meyfroidt and Lambin, 2011)? This question cannot be answered easily and deserves further analysis and reflection. Some reflection on this topic can be found in de Jong et al. (2016).

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