COMPARATIVE ANALYSES OF TRANSITIONS TO SUSTAINABLE FOREST MANAGEMENT AND REHABILITATION IN ASIA

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GLOSSARY OF TERMS

Forest

FAO's Global Forest Resources Assessment 2010 (FAO 2010): Land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. The definition has the following additional explanatory notes:

1) Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m in situ. Areas under reforestation that have not yet reached but are expected to reach a canopy cover of 10% and a tree height of 5 m are included, as are temporarily unstocked areas, resulting from human intervention or natural causes, which are expected to regenerate.
2) Includes areas with bamboo and palms provided that height and canopy cover criteria are met.
3) Includes forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest.
4) Includes windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 ha and width of more than 20 m.
5) Includes plantations primarily used for forestry or protection purposes, such as rubber-wood plantations and cork oak stands.
6) Excludes tree stands in agricultural production systems, for example in fruit plantations and agroforestry systems. The term also excludes trees in urban parks and gardens.

Primary Forest

Forest of native species, in which there are no clearly visible indications of human activity, and ecological processes are not significantly disturbed (FAO 2010).

Other Wooded Land (OWL)

Land not classified as forest, spanning more than 0.5 ha; with trees higher than 5 m and a canopy cover of 5–10%, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above10%. It does not include land that is predominantly under agricultural or urban land use (FAO 2006).

Plantations

Forest or other wooded land of introduced species and in some cases native species, established through planting or seeding. May included areas of native species characterized by few species, straight tree lines and/or even-aged stands (FAO 2006).

Semi-natural Forest
Forest or other wooded land of native species, established through planting, seeding or assisted natural regeneration (FAO 2006). Areas established by planting are described as planted semi-natural forest.

Planted Forests
The concept of planted forests combines the areas of plantations and of planted semi-natural forest, the justification being that planted semi-natural forest has more in common with plantations than with semi-natural forest regenerated by seeding or natural regeneration, in terms not only of regeneration method but also planting stock, tending and management techniques.

ACRONYMS

C&I Criteria and Indicators
CBD Convention on Biological Diversity
CBFM Community-based Forest Management
CDM Clean Development Mechanism
CIFOR Centre for International Forestry Research
EU European Union
FAO Food and Agriculture Organization (of the United Nations)
FLR Forest Landscape Restoration
FRA (FAO) Global Forest Resources Assessment
Ha Hectare
ITTO/ITTA International Tropical Timber Organization/Agreement
IUFRO International Union of Forestry Research Organizations
JFM Joint Forest Management (India)
M Million
NGO Non Governmental Organization
PFM Participatory Forest Management
REDD Reduced emissions from deforestation and forest degradation in developing economies
REDD+ As REDD, but with conservation, sustainable management of forests, and stock enhancement in addition
SFM Sustainable forest management
UNCCD United Nations Convention to Combat Desertification
UNCED United Nations Conference on Environment and Development (1992)
UNDP United Nations Development Programme
UNEP United Nations Environment Programme
UNFCCC United Nations Framework Convention on Climate Change

SUMMARY

Forests play a vital role in sustainable development, providing a range of economic, social and environmental benefits, including essential ecosystem services such as climate change mitigation and adaptation. The worsening global climate change and other environmental issues have been calling for better understanding and approaches to reduce deforestation, enhance forest rehabilitation and improve quality of forests. In general, deforestation and forest transition were driven by complex of social, economic and political factors, however these studies of the last two decades have generally failed to provide workable models and tools, and leading to the concrete policy recommendation, that can be effectively used to achieve these objectives.

The Asia-Pacific region is rich in forest resources, and experiences diverse and complex forest deforestation, reforestation and rehabilitation. Some newly industrialized economies, for instance, Japan and South Korean, increased their forest resources with the same pace of urbanization process. In some economies, in particular, the Philippines, Thailand and Indonesia, their forest resources had been declined for three decades. However, in recent years, their forest resources started to increase, or the rate of decreasing has declined dramatically. In some economies, for instance, China, India and Vietnam, forest resources had increased rapidly and contributing greatly to reversal of global forest resources. This two-year research project – Comparative analysis of transitions to sustainable forest management and rehabilitation in Asia – aims to assess the underlying processes that explain forest cover changes in the region and formulate categorization models using data collected from nine economies: China, India, Indonesia, Japan, South Korea., Laos , Malaysia, Philippines and Vietnam.

Approaches

Three Technical Assistance Partners: RUC, SNU and KU identified and appointed national Focal Points from the nine participating economies. These nine Focal Points met with the three Technical Assistance Partners several times during the two-year period, to share and exchange ideas and firm up various aspects of the project including case study approaches, report format and analyses.

Underlying processes and drivers were identified and their interaction and linkages to forest cover changes analyzed. The information and data from the national reports of the nine participating economies were then pooled for comparative analyses.

Transition to sustainable forest management and rehabilitation

The 21st century has been considered the century of Asia as homes to around half of the world population. In these nine selected economies, the aggregate GDP

accounted for 21% of the world's total GDP in 2012, growth of GDP is 6% during the period 1961–2012 against around 3.6% the average global economic growth. Representative in each phase of the so called “Asia Miracles”: Japan in 1960’s, Korea was one of the “Four Asian Tigers”, Malaysia one of the “Tiger Cub Economies”; and China and India are two members in BRICS. More than that, Asia has been also in the frontline for leading this planet into new era for forest transition, which can illustrate in forest cover gain in the region while forest cover has been continuing in loss globally, in valuing forests, in management purpose.

In Asia, the year 2000–2005 can be approximately regarded as a transitional milestone, as the annual change rate in forest area grew positively around that turning point. Forests used to be valued as a source of raw materials feeding to the growing demands for timber and pulp, contributing to economic prosperity, wealth of the state and richness of the people. Today, there is a much greater and diversified understanding of the values of forests. Besides the enormous value of these forests in terms of the provision of forest products and environmental services , forests are also vital carbon stores, reservoirs of biodiversity, homes to millions of ethnically rich indigenous people and sources of medicinal plants, food and both timber and non-timber forest products. Forests have been valued as an essential life support system; sustaining farming and agriculture, biodiversity conservation, carbon sinks, landscape restoration, green economy and sustainable development.

In the Asia-Pacific region, the objectives of forest management have transformed accordingly from materials and energy generation purpose to multifunctional purpose. Besides producing timber, fiber, energy, NTFP, forest management also takes into consideration the provision of services, such as carbon sequestration, biodiversity conservation, water and soil erosion control. Ideologies of forest management has being transferred from resource for development and welfare to harmonization of human and nature, ecological civilization, and revitalizing spiritual and cultural values of forests.

Asia has quickly become the world center for global trade on timber and related products. China is the major importer and exporter of wood products. Malaysia is currently a leader in tropical timber exports and has begun to explore the market for certified timber. Indonesia is a leading producer of wood pulp from a limited number of integrated producers.

Asia has been in the frontline for transforming paradigm of development, from removal of forests for other land use to more focus on forest protection., Several Asian nations had increased their forest cover through revaluing forest resources, building up institutional and regulatory framework, strengthening environmental friendly behaviour of consumers, and positively engaging civil societies and timber industry, and harmonizing development between forest rich states and forest pool states.

Drivers analysis

A better understanding of the drivers of forest cover changes would help to improve the understanding beyond the broad factors of demand for resources from increasing population and levels of consumption, – fundamental components for implementing REDD+. High complexity and great variation of drivers occurred among different economies and different locations in one economy, including the social causes of deforestation and arid land degradation, the role of institutions in land-use decisions and understanding the reciprocal relationships between population and land changes. This study has demonstrated that more people could have more forests. From the findings of the nine economies forests can persist under high population densities. China, India, Japan, South Korea and Vietnam demonstrated that favourable government policy, appreciative institutionalized rules of management, play critical role. Cultural traditions and land tenure rules, are critical in influencing how land can be used and by whom. Globalization has deeply influenced forest cover changes in either forest poor economies or forest rich economies. Commercial agriculture is the most important driver of deforestation, followed by subsistence agriculture, in particular in Indonesia and Laos. Timber extraction and logging drive most of the degradation, followed by fuelwood collection and charcoal production, uncontrolled fire, and livestock grazing. Other drivers identified are mining, infrastructure and urban expansion. Policy analyses have shown that underpinning these direct drivers are often national policies, such as tax and trade regimes; monetary policies and economic development strategies; and market forces – all these indirectly drive deforestation.

The proximate and underlying causes of deforestation proved to have poor similarity between forest transition and non-forest transition economies in Asia, but the economies between tropical region and temperate region are more likely to display similar deforestation pattern or drivers. The successful story about forest transition in Asia economies in the past decades, especially in Vietnam and Philippines, is a powerful respond to the popular belief that there is no cure at all about tropical deforestation due to their low income level or complex deforestation pattern. However, it is crucial to understand that deforestation problem did not arise in a vacuum, but is formed as an integral element of national development strategy influenced by political system, property right system, and government governance capacity. Therefore, solution to deforestation requires the adjustment of economic development strategy, policy and institutional changes, rather than only economy growth.

Economic Pathway model

China, Philippines and India depict a relatively significant Kuznets curve correlation. Japan and Republic of Korea remain stable in forest area in long-term and do not exhibit the linkage between forest area changes and GDP per capita growth. Malaysia and India showed no obvious relationship in the inverted U-shaped curve. The total impact of growth of GDP per capita on forest area changes, the differences of R^2 between economies suggest that the impact of economic growth on economies also

was significantly different. India, for example, whose R^2 value is large means the economic growth has a very significant impact on forest area changes; however, for Malaysia the role of economic growth is limited.

For China and Laos, there is a negative correlation between rural population and forest area changes, while for the Philippines, Malaysia and India, there is a positive correlation. The increase of agricultural land does not necessarily lead to a decline in forest area. Cereal land and forest area have a positive association in India, Laos and Indonesia. In these three economies, both forest and cereal land area changes have the same trend. According to national reports of Laos and Indonesia, continuous expansion of tropical crops planting area is a major reason. In some tropical economies, expansion of tropical crops planting area not only occupies the farming land, but also causes deforestation to some extent.

Increase of cereal yields per hectare can be used as a measure of agricultural technology improvement. In some economies such as China, Japan and Indonesia, cereal yields has a positive effect on forest area, which means with the increase of cereal yields per hectare, the pressure of food supply decrease and consequently cause a decreasing demand for arable land and finally reduce deforestation.

Usually, the forest management system, forestry administration and regulation are considered as important factors of forest area changes. Though population growth and shifting cultivation, and commercial logging and timber harvesting, are frequently cited as leading factors for excessive deforestation, the relationship between these factors and deforestation is filtered and shaped by institutions and policy conditions. Thus, the impact of institutions on deforestation deserves special scrutiny. But these factors are difficult to accurately measure by mathematical methods. How to better and more accurately analyze the impacts of the above factors needs more extensive and more in-depth discussions.

Globalization pathway model

There is a diversity of levels of economic and society development and forest resource conditions in Asia-Pacific economies, providing a good opportunity to study process and mechanism of recent forest transition against a globalization background. Empirical results suggested that, planted forest area (PFA) has positive effect on forest area (FA) and forest volume (FV), but negative effect on forest density (FD). Forestry products import (FIMP) has a positive effect on FA and FV. Proportion of forestry products in total exports (PFEXP) has negative effect on FA, FV and FD. Total exports value (EXP) has a positive effect on FA and FD, while no significant effect on FV. Besides, GDP per capita (GDPP) is negatively associated with FA and FV, but positively associated with FD. Population density (POPDEN) has negative effect on FA, FV and FD.

Studies from the nine Asia-Pacific economies show that afforestation initiatives were important driving forces to realize local forest transition. But afforestation activities had negative effects on local forest density (FD), which was probably due to the low

density of saplings. Realizing forest transition through afforestation may have more complex effects on forest ecosystem. The analyses here also confirmed the function of "leakage effect", i.e. imports of forest products had positive effects on forest area and forest volume. In China, India and Vietnam, which realized forest transition in the late 20th century, there were large net imports of forest products. Deforestation was still on the way in Indonesia, Malaysia and Laos, where huge net forest products exports occurred.

PFEXP had negative effect on FA, FV and FD with other things being equal, the larger the proportion of forest products in total exports, the bigger the pressure on forest resource conservation. Total export value (EXP) had positive effect on FA and FD, so when total export increased in one economy, forest resource condition tend to be improved. This has reflected the effect of export structure changes from primary products to manufacturing products dominated on forest resources. Against the background of global economic integration, one economy or region could promote local forest resource conservation when economic growth of the economy or region relies more on manufacturing industry and thus reduce dependence on land and land-based resources. China, India, and Vietnam, which realized forest transition during the last three decades in Asia-Pacific region, promoted their sustainable forest use and forest conservation when they absorbed foreign direct investment (FDI) and developed export-oriented labour-intensive manufacturing industry. Unlike the cases of "leakage effect", the effect of sending manufacturing goods is different to sending forest products, on forest resources. Promoting manufactured products-based exports could reduce economic dependence on land-based resources and help realize local forest conservation. One shortcoming of this analysis was the focus only on the main body of FDI, i.e. FDI that flowed to manufacturing and infrastructure industry, and neglected the effect of FDI in agriculture sector. A recent research indicated that FDI in agriculture sector may lead to "land grab" process driven by production of food and biofuel for export. More than 50 million ha of farmland was under this kind of deal in 2009 in Africa. Considering the close relationship between forest and farm land, the effect of FDI on forest resource changes need further study.

Conclusions

Asia has been on the track for forest cover increasing. Dynamical mechanism of forest growth or reduction varies among economies, different regions in one economy and in different periods. Forest areas in China., Japan, Korea and Vietnam had grown in the take-off stage of industrialization, rather than after the industrialization. India and Philippines, although at early stage of forest transition, but forest cover increased during very early stage of industrialization. Relationship between forest changes and economic growth among the economies in this study, and also among Chinese provinces, does not follow an Environmental Kuznets U Curve, but follows an S-type curve.

Forest transition in Asia is the result of a combination of political, social, institutional and economic factors. Explanation for forest transition in Asia required looking at the multiple and comprehensive political, economical, social and cultural perspectives, rather than just a single perspective. There was no doubt that the government, farmers, and private sectors in forest transition economy response to the scarcity of forest resources and ecological crisis in the process of industrialization promoted the growth of forest. Forest scarcity should not be regarded as a pathway, but a premise of forest transition. As the forest scarcity pathway is unlikely to interpret how the forest reverses like other pathways, forest scarcity pathway shall be queried in forest transition theory.

The role of government was confirmed. The direct involvement of the government in forest transition economy, by implementing large-scale national forestation programmes, strengthening forest policy system and forest governance, carrying out decentralization reform, and adopting timber Import liberalization policy, played a primary and essential role in promoting forest transition in Asian economies. As all forest transition economies are key timber importers, and non-forest transition economies are key timber exporters, it seems to imply that it is a single choice between timber import and forest transition. Economic development had a complex influence on forest transition. But, economic growth made sense to forest transition, as the project shows that no economy can realize forest transition without urbanization and agricultural development. It is likely that economic development is not necessary in the initial stage of forest transition, but necessary for a sustainable forest transition as experience of Japan, South Korea, and other developed economies indicated.

The attempt to better understand drivers of forest transition in Asia has been hampered by unclear definition, lack of data, and lack of knowledge on the influence and interaction of drivers. Further effort should be made to examine carefully the linkage of these drivers with deforestation, forest, and forest rehabilitation. Some of these linkages and mechanism such as economic development, state role, and globalization with forest changes are still debatable, and they need to be tested and summarized after further research.

China, India and Vietnam experienced a large increase in forest area in the last three decades and the forest transition in these economies contributes to global carbon sequestration, biodiversity conservation and in improving local and regional environment. Great achievements have been made in forest generation and conservation in China, India, Japan, Korea, and Vietnam. However, these economies have high population density and poor per capita forest resources, requires importing of large quantity of forest products to feed their demands. It required coordination within the region to develop a fair trade policy to reduce negative impact of globalization to those economies with rich forest resources. It is required to continue strengthening the forest governance and improve forest policy; and promoting decentralization of forest management and stakeholder participation.

CHAPTER 1 INTRODUCTION

Forests in Asia – Paradise of Changes

Forest lands across Asia cover an area of over 600 million ha, around 17% of forest worldwide. The majority of which are located in China (34.9%), Indonesia (15.9%), India (11.5%), Myanmar (5.5%), Japan (4.2%), Malaysia (3.4%), Thailand（3.2%）and Laos (2.6%) (FAO 2010).

Asia has become a global focus, not only in the issues of leading global economy into a new era, having great potential in development or constituting a large share of global population. Asia has been also in the frontline for leading this planet into a new era for forest transition, which can be illustrated in forest cover gain in the region while forest cover has been declining globally.

Table 1. Forest cover changes by region and subregion,1990–2010

Region/subregion	**1990–2000**		**2000–2010**	
	1000ha/yr	**%**	**1000ha/yr**	**%%**
Northeast Asia	1762	0.81	2781	1.16
South and Southeast Asia	-2428	-0.77	-677	-0.23
Western and Central Asia	72	0.17	131	0.31
Total Asia	-595	-0.10	2235	0.39
Africa	-4067	-0.56	-3414	-0.49
Europe	877	0.09	676	0.07
North and Central America	-289	-0.04	-10	-0.00
Oceania	-41	-0.02	-700	-0.36
South America	-4213	-0.45	-3997	-0.45
World	-8327	-0.20	-5211	-0.13

Forest area was declining per year throughout the world from 1990 to 2010, but then slowed down since 2001 (Table 1). Africa and South America reported very high rate of deforestation, both over 4 million ha net loss per year in the 1990s and over 3 million ha per year in the 2000s, although the trend needs to be treated with caution since few economies in Africa have reliable data from comparable assessments over time (FAO 2010). However, when most continents like Africa and South America saw continuing deforestation this decade, Europe experienced steady increase in forest area and Asia got a transition point around the year 2000.

For Asia, the years 2000–2005 can be roughly regarded as a transitional milestone, as the annual change rate in forest area grew positively around that turning point. Although Asia as a whole has gone through the turning point of forest transition, not all sub-regions experienced the same process. South and Southeast Asia, the only sub-regions in Asia having decrease in forest area, reported a net loss of 2.4 million

ha per year during the period of 1990 to 2000 and 0.67 million ha per year from 2001 to 2010. East Asia, on the contrary, saw great increase in forest area: 1.7 million ha per year from 1990 to 2000 and 2.78 million ha per year between 2001 and 2010. This contrast was primarily a result of large-scale afforestation reported by China (where the forest area increased by 2 million ha per year in the 1990s and by an average of 3 million ha per year since 2000). There were also other net gains taking place in the temperate and boreal zones in some emerging economics, but were also due to a reduction in the rate of deforestation in some economies, including Indonesia (FAO 2010).

Forests used to be valued as a source of raw materials feeding the growing demand for timber and pulp, contributing to economic prosperity, wealth of the state and richness of the people in Japan, Korean and China. Malaysia, Indonesia and Laos consider these as fundamental values of forests. Today, in the region, there is a much greater diversified understanding of the values of forests. Forests are vital carbon stores, reservoirs of biodiversity, homes to millions of ethnically rich indigenous people, and sources of medicinal plants, food, and both timber and non-timber forest products. Much more than this, forests have been valued as an essential life support system, sustaining farming and agriculture, biodiversity conservation, carbon sinks, landscape restoration, green economy and sustainable development.

In the region, objectives of forest management have transformed accordingly from materials and energy purpose to multifunctional purpose, including production, such as timber, fiber, energy, NTFP, and service, such as carbon, biodiversity, water and soil erosion control. Ideologies of forest management has being transferred from resource for development and welfare to harmonization of human and nature, ecological civilization, and revitalizing spiritual and cultural values of forests.

Asia has quickly become the world center for global trade on timber or related products. China is the major importer and exporter of wood products. It is also the world leader in wood-based panel production. In 2005 it became the world’s leading furniture exporter and in 2008 it surpassed the United States as the world’s leading paper manufacturer. Malaysia is currently a leader in tropical timber exports and has begun to explore the market for certified timber. Indonesia is a leading producer of wood pulp from a limited number of integrated producers, and has dramatically increased its wood pulp processing capacity in recent years – a trend which set to continue.

Deforestation and afforestation

Tropical forests in the region have suffered high rates of deforestation. Asia is the home to 16% of the world's remaining tropical forests, but the region accounts for over one-third of global tropical forest loss (Hansen *et al.* 2008). According to FAO Forest Resource Assessment Report, Indonesia is categorized as a highly deforestation economy. In this study, Indonesia, Laos, and Malaysia had been selected as case economy.

Despite tropical deforestation, Asia has actually reported an overall net gain in forested areas over the last decade, primarily due to large-scale afforestation projects in China. Economies such as Indonesia and India have increased their forest plantations significantly, and China is becoming the global leader in plantation development, accounting for one-third of the world's plantations.

Table 2. Ten economies with largest loss in forest area in Asia, 1990–2010

Economy	**1990–2000 (1000ha/yr)**	**Economy**	**2000–2010 (1000ha/yr)**
Indonesia	-1914	Indonesia	-497.5
Myanmar	-435	Myanmar	-309.5
Cambodia	-140	Cambodia	-145
Democratic People's Republic of Korea	-127	Democratic People's Republic of Korea	-127
Nepal	-92	Malaysia	-113.5
Mongolia	-82	Mongolia	-82
Malaysia	-79	Lao People's Democratic Republic	-78
Lao People's Democratic Republic	-78	Pakistan	-43
Thailand	-55	Nepal	-26.5
Pakistan	-41	Sri Lanka	-22.5

Southeast Asia was the major deforestation region in Asia (Table 2). From 1990 to 2000, Indonesia reported largest net loss in forest area, 1.9 million ha per year. Myanmar and Cambodia followed with 0.44 and 0.14 million ha per year. Indonesia, Myanmar, Cambodia, and DPRK still reported large decreases in forest areas from 2000 to 2010, although Indonesia had made some progress in reducing deforestation rate, forest cover loss sharply reduced from 1.9 to 0.49 million ha per year.

Table 3. Ten economies with largest gain in forest area in Asia, 2000–2010

Economy	**1990–2000 (1000 ha/yr)**	**Economy**	**2000–2010 (1000 ha/yr)**
China	1986	China	2986
Viet Nam	236	India	304.5
India	145	Viet Nam	207
Philippines	55	Turkey	119
Turkey	47	Philippines	55
Uzbekistan	17	Bhutan	11
Bhutan	11	Japan	10.5
United Arab Emirates	7	Kyrgyzstan	9.5
Syrian Arab Republic	6	Uzbekistan	6.5
Kyrgyzstan	2	Syrian Arab Republic	6

As shown in Table 3, China was leading in terms of expanding area of forests area, of which net gain exceeded 1.9 million ha in 1990–2000, due to large-scale afforestation projects. Vietnam and India followed with 0.24 and 0.15 million ha net gain in forest area. From 2000 to 2010, China, India and Vietnam still reported largest net gains in forest area in Asia, with 2.99, 0.30 and 0.21 million ha per year respectively.

Forests in the regions and sustainable development

Forest links development and environment, and the international community has recognized strong linkage between forests and sustainable development. Without health of a forest, all of its functions and services are threatened: the protection of watersheds, the habitat it provides to maintain biodiversity, and its role in storing carbon (WCFSD 1999). The effects of forests on environment, economy and society interconnect and affect one another, compounding cause and effect, transcending national boundaries, and undermining our ability to sustain forests and development (WCFSD 1999). With population increases and greater technology improvement, human demands on forests have been continuously increasing. Not just from increase in one or few particular products such as timber and energy, but also from expanding of products, including NTFPs and biodiesel, as well as ecological, social and spiritual values. Not just increase on the quality, but also on the quantity of products and services.

Climate change has become a dominant discourse, transforming landscape of environmental politics, and shaping development strategy and approach globally. Deforestation and land-use changes account for 12–20% of human-generated carbon dioxide emissions. Forests are central to combating climate change, as forests store more carbon than the atmosphere. REDD+ is on the table as part of legally binding

agreement globally, although the functioning of REDD+ has been questioned by academicians and practitioners, since these negotiations are typically carried out by representatives of the ministry of environment, despite the fact that responsibility for taking action may fall within the ministry of agriculture and forestry (FAO 2010). Also, REDD+ is poised to interrupt decentralized forest management that allows local actors increased rights and responsibilities, and given the implications for tropical forest management, REDD+ governance links should be a research priority (Phelps *et al.* 2010).

About 36% of the forests that covered the Earth are gone. Each year, another 4.45 million ha of virgin forests disappear (FAO 2010), and there will be further deforestation and forest degradation in the foreseen years. Continuing erosion of the natural capital of forest resources, one-third of land cover of the earth, further reduction in the capacity of economies to meet their development needs in a sustained way, and social and political unrests related to land use, have been testified by many cases nowadays .

Paradigm of development – move forests to man-made land use system

The journey of human development is a continuous process of land use transformation. Technology evolution, theories of natural ecosystems management, relationship adjustment between human and nature, trace of philosophy development, all lies in how to create a new method of land use, including the prosperity of modern cities.

It is unquestionable that human populations have affected the structure and function of the earth system, but this impact increased in pace, magnitude, and kind, with the advent of the industrial revolution (Meyer 1996). As Mr Ban Ki-moon, Secretary General of the United Nations said on the first International Day of Forests (2013): “Forests are often at the frontlines of competing demands. Urbanization and the consumption needs of growing populations are linked to deforestation for large-scale agriculture and the extraction of valuable timber, oil and minerals. Often the roads that provide infrastructure for enterprises ease access for other forest users who can further exacerbate the rate of forest and biodiversity loss”. Human-induced forest cover decrease has been substantial (William 2003), and they have affected to alter biogeochemical cycles and thus to deteriorate life supporting system. Mr. Ban Ki-moon urged: “governments, businesses and all sectors of society to commit to reducing deforestation, preventing forest degradation, reducing poverty and promoting sustainable livelihoods for all forest-dependent peoples”.

Paradigm of development – removal of forests for other land use, has been transforming now. Forest assets could be revalued considering carbon credit markets established in the future. International communities and every economy, in particular those economies with rich tropical forests, are, with some multi-lateral assistance,

active in building the necessary institutional and regulatory frameworks. Meanwhile entrepreneurs are developing schemes to capitalize on the emerging practice of preserving forests as valuable resources. Consumers are also becoming increasingly enlightened. Timber industry and civil society have been looking for wood from sustainably managed forests.

CHAPTER 2 SOCIAL AND ECONOMIC BACKGROUND

Economic development

Among the continents, Asia is the largest and has the most population, while its economic development and regional cooperation have been developing rapidly with a wide range of influences in the world. In the late 20th century, the Japanese economy took off first, becoming a member of developed economies, and then the Asian "four tigers" created the economic miracle; now both China and India have become the focus of the world. In this project, the nine participating economies have an aggregate GDP equivalent to 21% of the world's total GDP in 2012, occupying very important positions in the world economy.

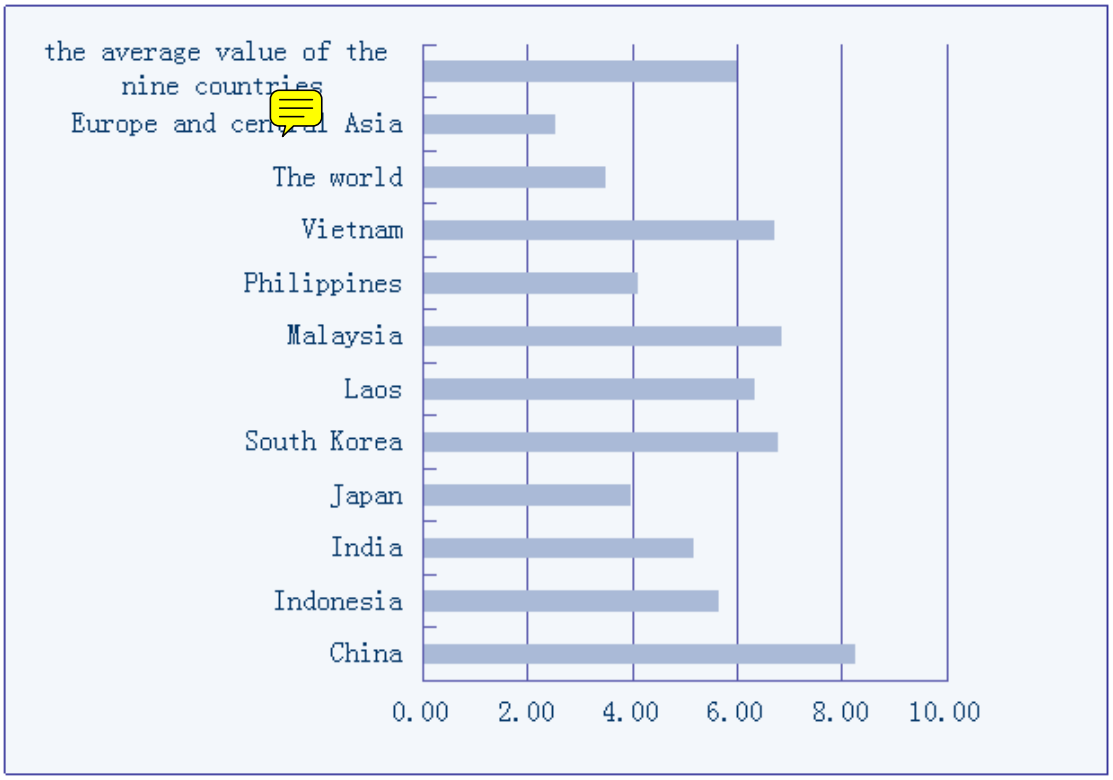


Figure 1. The average GDP growth (1961–2012)
Data sources: the World Bank

The average growth of GDP is 6% in these participating economies (1961–2012), which is higher than the average growth rate of GDP in the world (less than 4%). Among them, the average GDP growth rates of Vietnam, Laos, Malaysia, South Korea, India, Indonesia and China are highest during these years, while those of Philippine and Japan are growing more slowly. Comparing to the others, economic developments in these economies are higher than those in Europe and central Asia. Figure 1 reflects that during the recent 50 years, the economic development of East Asian economies has obtained certain achievement.

International trade

Figure 2. Share of international trade in GDP (%)
Data sources: the World Bank

Figure 2 shows respectively the merchandise trade of the nine participating economies and a number of other economies and areas in 1985 and 2012. The nine participating economies have achieved an increased trade during 1985–2012. In 2012, the whole world's trade value accounted for 50% of its total GDP. Among the economies in the study, the trade values of Vietnam, Laos, Malaysia and South Korea were more than 50% of their GDPs and trades of these economies occupied an important position in each national economy. But, the trade percentages to their GDPs of China, Indonesia, India and Japan were lower than the world level, indicating that trade importance in the development of the national economy was not particularly high. From 1985 to ~~1985~~, Vietnam trades increased most significantly.

Grain production

Table 4. Per capita grain yield（tonne）

Year	1961	1971	1981	1991	2001	2011
China	0.1620	0.2486	0.2851	0.3438	0.3117	0.3864
Indonesia	0.1581	0.1948	0.2504	0.2802	0.2822	0.3420
India	0.1905	0.1994	0.2064	0.2179	0.2293	0.2357
Japan	0.2140	0.1439	0.1175	0.1055	0.0964	0.0732
South Korea	0.2577	0.2445	0.2203	0.1815	0.1660	0.1308
Laos	0.2568	0.3035	0.3581	0.2957	0.4473	0.6382
Malaysia	0.1301	0.1636	0.1430	0.1048	0.0904	0.0944
Philippines	0.1906	0.2001	0.2302	0.2257	0.2204	0.2489
Vietnam	0.2622	0.2443	0.2347	0.3018	0.4359	0.5378
Cambodia	0.4357	0.3981	0.2329	0.2623	0.3435	0.6501

Data sources: the World Bank

Table 4 is about the per capita grain yields of some economies in Asia. From 1961 to 2011 per capita grain yields of these economies had significantly improved. Due to less arable land, large population, per capita grain yields of Japan and South Korea were lower compared with other economies in Asia. Those of Laos and Cambodia were over 0.6 tonne while China was less than ~~4.0~~ tonne In general, it can be seen that due to the large populations, the per capita of grain yields of most economies in Asia were at a low level.

Population growth and urbanization

Table 5. Rural population in participating economies（%）

Year	1970	1980	1990	2000	2010
China	82.60	80.64	73.56	64.12	50.77
Indonesia	82.93	77.90	69.42	58.00	50.08
India	80.24	76.90	74.45	72.33	69.07
Japan	28.12	23.83	22.66	21.35	9.46
South Korea	59.30	43.28	26.16	20.38	17.07
Laos	90.38	87.62	84.56	78.02	66.88
Malaysia	66.55	57.96	50.21	38.02	27.99
Philippines	67.02	62.52	51.41	52.01	51.35
Vietnam	81.70	80.75	79.75	75.63	69.61

Since 1970, the participating economies have been experiencing rapid urbanization, during which the agricultural populations have continued to ~~reduce~~. For example, in China, rural population decreased from 82.60% down to 50.77% of the total population, between 1970 and 2010. This was higher than in Europe and other western developed economies, but less than that of Africa. Table 5 shows that economic development promoted rural population moving to cities. Among the nine

economies, the trends of urbanization of Japan and South Korea, which were the first to experienced rapid urbanization, and whose agricultural population were less than 20%, had reversed. While most rural populations of India, Laos, Vietnam and other economies were more than 60%. The participating economies, except Japan and South Korea, had realized that they were in an accelerate process of urbanization and the urban population proportions were expected to further reduce.

Agriculture

Table 6. Share of agriculture in GDP (%)

Year	1970	1980	1990	2000	2010
China	35.22	30.17	27.12	15.06	10.06
Indonesia	44.94	23.97	19.41	15.60	15.28
Japan	5.13	3.08	2.09	1.50	1.18
South Korea	29.25	16.17	8.94	4.63	2.64
Laos			61.23	45.17	32.75
Malaysia	29.44	22.61	15.22	8.60	10.39
Philippines	29.52	25.12	21.90	13.97	12.13
Vietnam			38.74	24.53	20.58

Data source: The World Bank.

Table 6 shows the added value from agriculture as percentage of GDP). All participating economies have decreasing over the past 40 years. China, for example, the agriculture contribution to GDP dropped from 35.22% in 1970 to 10.06% in 2010. In Japan, South Korea and the European Union, the added values of agriculture as shares of their GDPs were already very low. This is a common feature in all the developed economies around the world. With the rapid development of economy, the trend in these Asian economies would continue to decline.

CHAPTER 3 THE FOREST RESOURCES

Definition of forests

Table 7. Forest definition parameter adopted by the participating economies

Economy	Tree crown cover (%)	Minimum area (ha)	Minimum tree height (m)	Forest area ('000 ha)
Indonesia	30	N/A	N/A	88,495
Malaysia	30	0.5	5	20,890
Viet Nam	30	0.5	3	12,931
Philippines	10	0.5	5	
China	20	N/A	N/A	N/A
Republic Korea	30	N/A	N/A	
Japan	30	N/A	N/A	
India	15	0.05	2	67,701

The participating economies have various definitions of forests, tree crown cover varies from 10–30%, and minimum area varies from none requirement to half ha (Table 7).

In some economies, due to various reasons, definition of forest has been changed. China has changed its forest definition in 1994, in accordance to the change of definition by FAO (Table 8).

Table 8. Change of forest definition for NFI

County	Period	Tree crown cover (%)	Minimum area (ha)	Minimum tree height (m)
FAO	Before 1992	30	N/A	N/A
	After 1992	10	N/A	N/A
China	Before 1994	30	0.067	N/A
	After 1994	20	0.067	N/A
Malaysia	Before 1986	N/A	N/A	N/A
	After 1986	30	0.5	5

Extent of forest resource in the participating economies

Forests in the participating economies cover over 459 million ha, or over 11% of the world's forest area. The participating economies have a wide range of definitions of

forests however, Table 9 here refers to forests with a canopy cover of more than 10% and an area of more than 0.5 ha, include all types of forests from primary forests, secondary forests, planted forests.

In the economies in this research, three of them: China (around 207 million ha of forests, ranked 5th), and Indonesia (94 million ha, ranked 8th), India (68 million ha, ranked 10th) are among the world's top 10 economies with the largest extent of national forest estates. The proportion of land area covered by forest varies greatly among the economies: Japan, the highest with 69%, then Laos (68%), Korea (63%), Malaysia (62%). China (22%), India (23%) and the Philippines (26%) are among the lowest (Table 9). If one consider the area of forest per capital, which to a large extent can represent potential contribution of forests to the economy's environment, economy and culture; Laos would rank first with 2.538 ha of forest/capital, to be followed by Malaysia (0.757 ha) and Indonesia (0.415 ha). Korea, China and Japan are quite similar in terms of per capita forest area with about 0.15 ha; and India (0.058 ha) and the Philippines (0.085 ha) are the lowest.

Table 9. Forest area in the participating economies in 2010

Economy	Forest			Other wooded land
	Area (000 ha)	% land area	ha/head	Area (000 ha)
China	206 861	22	0.154	102012
Korea ~~R~~	6 222	63	0.129	0
Japan	24 979	69	0.196	0
India	68 434	23	0.058	3267
Indonesia	94 432	52	0.415	21003
Laos	15 751	68	2.538	4834
Malaysia	20 456	62	0.757	0
Philippines	7 665	26	0.085	10128
Vietnam	13 797	44	0.158	1124
Total	458,597	29	0.146	142368
World	*4,033,060*	*31*	*0.6*	*1,144,687*

Extent of resource of other wooded land (OWL)

Areas, covering more than 0.5 ha, with trees more than 5 m high and a canopy cover of 5–10% can be defined as forests (FAO 2006). Farm forest in China could be a model. Pandey (2008) pointed out that trees have been planted outside forests for hundreds of years in India. However the resource was boosted after the initiation of social forestry programmes from 1980. It is estimated that tree plantations outside forests made up more than 70% of the total plantation area, involving small farmers, farmers' organizations, and private wood-based enterprises, for many different

reasons, including planting for timber, shade, fuelwood, wealth accumulation, or long-term investment. Agroforestry is very much encouraged in the Philippines, Malaysia and Indonesia.

There is no standardization of methodology for inventory of this resource because it is so heterogeneous, which leads to incomplete estimation of trees on OWL. India and China use a method based on number of trees. OWL cover ~~1.4 million~~ ha in the nine economies in this study, about 13% of the global total. Most of these forests are systematically managed stands in agroforestry system, urban forests, plantation on the sides of rivers, residential areas, roads. These trees serve a number of environmental and economic functions, often especially important to rural people, and to the poor in particular, who may rely on a wide range of NTFPs for self-sufficient energy and livelihoods.

Planted forests

Planted forests include forest areas formerly called plantations and planted semi-natural forests, which were considered separately before 2005 (FAO 2006c). China has around 500 years of history of planted forests. Over 100 year ago, forest plantations in India were originally established to provide industrial timber, supplying to UK-Holland Company for ship building. Large scale forest plantations were originally established providing timber for housing in Japan around 1950s; for fuelwood in Korea around 1960s; and for greening mountains in 1990s; and for environmental improvement in 2000s in China.

Since the mid-1980s, forest plantations have assumed greater importance as a source of wood in nearly every economy, whatever their forest covers, and also for protective functions (Evans 2009). The total reported area of planted forests in the participating economies in 2010 was 109 million ha (Table 10). Planted forests make up 24% of the 2010 forest estates of the participating economies, compared with a global average of 7%. The rate of increase in the planted forest areas has appeared to grow faster, in particular, in these 40 years in the participating economies. Japan's planted forests make up 41% of the total forests, followed by China (37%), Korea (29%) and Vietnam (25%). Globally, planted forests constitute about 7% of the world's forest area, but may contribute up to 70% of the world's industrial wood and fibre (Evans 2009).

Within the participating economies, there are several economies where planted forests are highly important in the provision of goods and services.

Table 10. Planted forests in the participating economies, 2010

Economy	Area of plantation,1000ha	% of the total forests
China	77157	37
Japan	10326	41
Korea	1823	29
India	10211	15
Indonesia	3549	4
Laos	224	1
Malaysia	1807	9
Philippines	352	5
Vietnam	3512	25
Total	108961	24

Forest ownership

Ownership of forests in the participating economies is highly diversified. Table 11 shows that the economies with significant proportions of private forests in 2005 were: Korea (69%), Japan (59%), China (32%) and Vietnam (24%). The average percentage of private forests in these nine participating economies was 24%, 6% higher than the global average. These data actually could not reflect the importance of the private sector in these participating economies in forest management.

Table 11. Forest ownership structure in the participating economies (2005)

Economy	Public (%)	Private (%)	Other (%)
China	68	32	0
Japan	41	59	0
Korea	31	69	0
India	86	14	0
Indonesia	91	9	0
Laos	100	0	0
Malaysia	98	2	0
Philippines	85	15	0
Vietnam	74	24	2
Total	76	24	0
World	*80*	*18*	*2*

Take the example of China, according to the Seventh National Forest Inventory (2004–2008), 62 million ha of plantations which accounts for 31.8% of the total forests in China has been established, contributed to China's rapid forest cover increment. Newly afforested areas are mostly owned by local communities or private enterprises (Table 12), largely as a result of the reallocation of land-use rights, financial incentives

to communities or private sector participation in governmental initiated projects (Liu 2003, Liu and Yuan 2007). Community involvement and the integration of rural development with environmental protection have become key prerequisites for the success of these projects or initiatives – such management approaches are completely different from those traditionally adopted in forestry (Liu 2006), which is essential to understand forest transition in China. Philippines and Vietnam shared similar conclusion in this aspect. During the past 30 years, through community forest programmes in the Philippines and Indonesia, the Joint Forest Management in India, and collective forest tenure reform in China, many participating economies have decentralized forests which were formerly owned by the State or the commune, to the local communities or individual householders.

Table 12. Change of ownership of production forests in China

Ownership	6th National Inventory（1999–2003）		7th National Inventory（2004–2008）	
	Acreage (million ha)	Percentage (%)	Acreage (million ha)	Percentage (%)
State	35.36	42.36	18.14	28.27
Community	32.68	39.15	22.02	34.32
Private	15.43	18.49	24.00	37.40

Forest transition

The total area of forests in the participating economies appears to have increased by 32 million ha, 7% of forest cover increase between 1990–2010. This may have been attributed to the contribution of China (50 million ha, 32%), Vietnam (4.4 million ha, 47%) and India (4.5 million ha, 7%). Indonesia lost 21 million ha of forest, 20% of forest cover; Malaysia and Laos lost 9% of forest cover during this period. The nine participating economies can be categorized into four groups as shown in Table 13. Laos and Indonesia could be categorized as pre-transition economies. Malaysia and Philippines are in the stage of early transition. India, China and Vietnam are in the stage of late transition, and Japan and Korea are in the stage of post transition (Figure 3).

Table 13. Categorization of forest transition to each participating economy

Categories	Economy	Nature
Pre-transition Period	Laos, Indonesia	Rapid decline of forest cover, rapid increase of population, rapid expansion of farming
Early transition	Malaysia, Philippines	Deforestation rate slows down; plantation area increasing; transforming forest institutional arrangement.
Late Transition	India, China, Vietnam	Rapid increase of forest cover, Rapid urbanization, rapid economic progress
Post-Transition	Korea, Japan	High urbanization rate, high per capita GDP, stable of forest cover, improving quality of forests

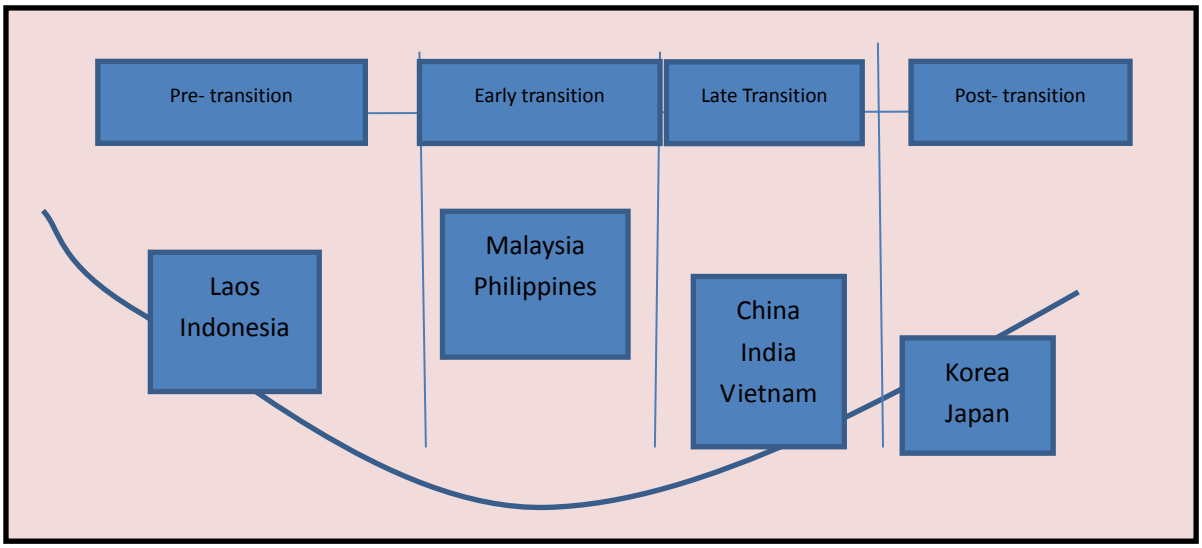


Figure 3. Four phases of the FT model as applied in this study

CHAPTER 4 DRIVERS OF FOREST TRANSITION IN ASIA

Introduction

Over the past several decades, Asia has gained worldwide attention with its remarkable economy development and forest resources changes (World Bank 1993, FAO 2010). Some Asian economies have experienced the most rapid economy growth in the world. Japan, South Korea, Hong Kong and Singapore are among the high income economies. Malaysia, Thailand, Indonesia, China and India have entering into the medium-income group; while Laos, Cambodia and North Korea are still struggling for poverty reduction. At the same time, with large scale plantation forests in China, India and Vietnam, Asia as a whole had turned from suffering net loss to having net gain in forest area. Indonesia, Malaysia, North Korea, Laos and Cambodia, however, are still in the group of high deforestation economies with their rapid disappearance of primary forests (FAO 2010).

As the first non-western continent that achieve rapid economy development and forest transition, the experience of Asia is offering an opportunity to test and develop the forest transition theory which was originally proposed based mainly on the experiences of EU and North America before World War II (Mather 2007, Perz 2008, Walker 2008). A regional comparative approach is served to highlight the significance of regional as well as national drivers in shaping and understanding forest transition in Asia.

Since proposed by Mather (1992, 2001) based on the experiences of some European and American economies, forest transition–the first concept linking forest with socio-economic dynamic changes, has becoming one of the top research areas in the forestry economic policy against the background of global climate change, international forest problem negotiation, and Millennium project. Along with knowledge explosion on forest transition, increasing confusion and query arise on what are the essential factors which drive forest transition, and how do these work? Specially, controversy arises on the relationship between economy development (Koop and Tole 1999), agricultural intensification (Mather and Needle 1998), government (Mather 2007, Bae *et al*. 2012), and globalization (Ehrhardt-Martinez *et al*. 2002, Lambin and Meyfroidt 2011), and forest transition, which lead to some confusion among researchers and policy makers. The reason is partly due to the limitation of methodology. More attention was paid into single sample case study in the local (Rudel *et al.* 2002, Xu *et al*. 2007), national (Mather 1998, 2004, Zhang 2000, Bae *et al*. 2012), and global levels (Mather and Needle 1998, Rudel *et al*. 2005), or statistics regression analysis (Foster and Rosenzweig 2003), rather than multinational comparative analysis. It is the multinational comparative analysis to be strengthened indeed, apart from the unique one by Mather (2007) that focused on policy factors in Asian forest transition.

This paper overcomes the difficulties of data collection, statistics regression, and sample limitation in the national case study and cross national analysis by comparing drivers of deforestation, afforestation and forest rehabilitation in Asia. Nine economies have been selected: China, India, Japan, South Korea, Vietnam and Philippines that have experienced forest transition; and Indonesia, Laos and Malaysia that have not

yet experienced forest transition.

Each participating economy has been requested to provide analysis on the drivers of forest cover changes. It has academic and practical significance to understand the drivers of forest cover changes. From academic side, it helps to improve understanding beyond the broad factors of demand for resources from increasing population and levels of consumption. From the practical side, it is a fundamental component for implementing REDD+. High complexity and great variation of drivers occurred among different locations, including the social causes of deforestation and arid land degradation (Lambin *et al.* 2003); the role of institutions in land-use decisions (Klooster 2003); and understanding the reciprocal relationships between population and land changes (Crews-Meyer 2001). Perception of the role of population against forest cover changes that more people always meant less forest has also changed. Ostrom *et al.* (2002) through a number of cases suggest that forests can persist under high population densities. Communities, and institutionalized rules of management play a critical role in such cases, emerging from a variety of sources, among them scarcity of the valued good (Laris 2002). Studies have shown how political and economic structures constrain individual choices about management of land resources (Robbins 1998). Cultural traditions and land tenure rules are also critical in influencing how land can be used and by whom (Lambin et al. 2001). Rudel *et al.* (2005) suggested that globalization has deeply influenced forest cover change in either forest poor economies or forest rich economies. Kull *et al.* (2007) provided cases to testify these globalization factors: neo-liberalism, migration and tourism; and international conservation agendas had made tropical forest transitions hard to be analyzed.

Hosonuma *et al.* (2012) provide an assessment of proximate drivers of deforestation and forest degradation by synthesizing reported empirical data. Commercial agriculture is the most important driver of deforestation, followed by subsistence agriculture. Timber extraction and logging drive most of the degradation, followed by fuelwood collection and charcoal production, uncontrolled fire and livestock grazing. CIFOR (2012) has reported that according to a recent assessment of the direct drivers of deforestation and forest degradation in 100 developing economies, agriculture is the cause of 73% of deforestation, divided between commercial agriculture (40 %) and subsistence agriculture (33%). Other drivers were mining (7%), infrastructure (10%) and urban expansion (10%). Timber extraction and logging were found to cause 52% of forest degradation (mainly in Latin America and Asia), with fuelwood collection and charcoal production (mainly in Africa) accounting for 31%, uncontrolled fire 9% and livestock grazing 7%. Policy analyses have shown that underpinning these direct drivers are often national policies, such as tax and trade regimes, monetary policies and economic development strategies; and market forces – all of which indirectly drive deforestation. Little research has been implemented to develop the analytical framework to explain how these indirect causes have influenced forest cover changes.

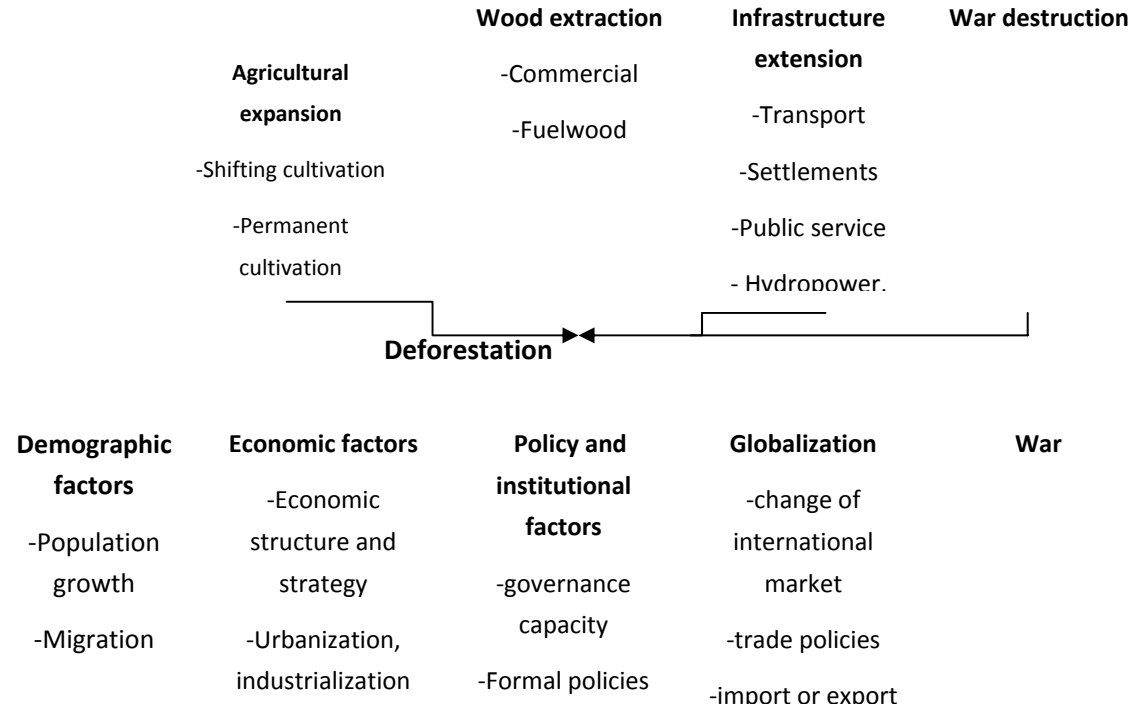
Do Asia forest transition economies share a similar deforestation pattern? Does deforestation pattern affect forest transition? What are the driving forces in Asia forest transition? This chapter aims to respond to these questions by comparing forest transition economies with non-forest transition economies in Asia.

Definition, framework and data

Although the unclear and inconsistent definitions in forest, deforestation, forest degradation, and forest transition, may lead to some biases in the data and distorts analysis to some extent, it is common to measure forest transition in terms of forest cover changes (Sunderlin and Resosudarmo 1996, Mather 2007). Generally, increases in forest cover can reduce soil erosion, increase carbon sequestration, and improve water quality. Deforestation refers to the conversion from forest into other land use categories, while forest degradation refers to the loss of density, structure and species composition. Deforestation and forest degradation would not be distinguished strictly due to no distinction made between deforestation and forest degradation in the data estimate and analysis (Angelsen 1995). It would not have great influence in the analysis because both deforestation and forest degradation prevail in the deforestation stage, and they will be on a decline in the forest transition stage in term of forest transition.

The drivers of deforestation are divided into proximate (direct) causes and underlying (indirect) causes. The framework of proximate causes and underlying causes on tropical deforestation adopted by Geist and Lambin (2001) is adjusted to conduct this driver analysis on deforestation (Figure 4). This mode of explaining deforestation through historical analysis of changing forest and land uses can be used at one or more scales, from local through national to global. The former refers to human activities that directly affect environment (Geist and Lambin 2001), including agricultural expansion, wood extraction, infrastructure extension, and war destruction. While the latter means macroeconomic-level variables and policy instruments affecting deforestation, including demographic factors, economic factors, government, policy, and property factors, globalization, and war (Angelsen and Kaimowitz 1999). Each land use category was further subdivided. For example, agricultural expansion is mainly divided into permanent cultivation and shifting cultivation, or subsistence agriculture and commercial agriculture, so are the underlying causes.

Figure 4. The framework of proximate causes and underlying causes of deforestation



The drivers to afforestation and forest rehabilitation are focusing on forest transition pathways (Rudel *et al.* 2005, Lambin and Meyfroidt 2011), including economic development pathway, forest scarcity pathway, state forest policy pathway, agricultural intensification pathway, globalization pathway. Energy transition from fuelwood to fossil fuel was added into the economic development pathway as economic development and urbanization generally reduce reliance on fuelwood consumption in the energy transition theory (DeFries and Pandey 2010). The forest scarcity pathway is measured by the turning point in forest transition economies and the current forest coverage in non-transition economies. National forestation programme, strengthening forest law system and forest governance, reforming forest land ownership system, and improving participatory by innovative institution, are indicators of state forest policy pathway. So is timber trade for globalization pathway. Agricultural intensification pathway is measured in terms of whether rapid agricultural productivity growth (agricultural revolution) happened before or during the same period with forest transition.

Data are mainly from national reports submitted by the participating economies, as well as secondary data from sources such as FAO. Specifically, drivers of deforestation and forest transition are from national reports. Various published materials about deforestation and forest transition in target economy were also reviewed to minimize author preferences and errors or omissions. The drivers of deforestation and forest transition are data since World War II, unless mentioned otherwise.

Proximate causes of deforestation and degradation

Although a suggested list of drivers have been provided to national Focal Points before carrying out this study, it is open for each economy to report the drivers for forest cover changes. Table11 shows that different drivers have been reported by these economies in their reports. Furthermore, importance of these drivers varied among them too.

Table14. Summary of proximate causes of deforestation and degradation in participating economies

Direct Drivers of DD	China	Japan	Korea	Vietnam	Indonesia	Malaysia	Philippines	Laos	India
Forest products extraction									
Legal/illegal logging/poaching	X	X	X	X	X	X	X	X	X
Charcoal making		X					X		
Fuelwood gathering	X			X			X	X	
NTFP gathering	X						X		X
Agricultural expansion									
Shifting cultivation					X		X	X	
Conversion of forests				X	X	X	X		X
Grazing									X
Infrastructure expansion									
Mining							X	X	X
Expansion of residential area			X						
Road construction			X	X					X
Hydropower dam construction								X	X
Biophysical factors									
Natural Calamities	X								
Forest/brush fire	X				X				

Note: Philippines has reported all the above factors, however some factors weighted to less than 1%.were not considered in this analysis.

National Report from the Philippines analyzed weights of various drivers to deforestation and forest degradation through stakeholder survey. Logging either legally or illegally has been weighted the highest, accounted to about 41%; followed

by shifting cultivation by indigenous people (17%), natural calamity (13%), mining (8%), charcoal making (8%), fuelwood gathering (4%), and conversion of forest for farming (3%).

Indonesia is one of the most serious globally in terms of deforestation and forest degradation. Drivers of deforestation and forest degradation could be grouped into direct causes (timber production/logging concessions, cash crops, transmigration, shifting cultivation, illegal logging, and forest fires) and indirect causes (investment policy, economic crisis, population, transition to regional autonomy) of forest conversion. The report from Indonesia emphasized expansion of farming driven by population growth, and cash crop development and logging driven by foreign investments being the main drivers. Casson and Obidinski（2002） stated that by the year 2001, illegal logging was thought to be one of the most critical threats to Indonesia's forest capital, accounting for 50–70% of total log production. Another report (Lawson and MacFaul 2010) suggested that illegal forest production in Indonesia reached 70–80%, consisting of 60% of hardwood production, 100% of log exports, 65% of lumber exports, and 55% of plywood exports; obviously driven by the globalization process. Much more than that, economic crisis, democratic or decentralizing governance has influenced forest loss. Encroachment for cash crop, shifting cultivation, illegal logging, and population growth, are the results of unsettled property rights over national forest areas, weak oversight, and weak law enforcement.

India has quite good data records in terms of forest land use changes. As one of Commonwealth members, India inherited a forest administrative system established by the British during the colonial era, a very top-down system dominated by government authority. During 1951–1976, around 4.2 million ha of forests was transferred to other land use purposes, including agriculture expansion (2.5 million), industry (0.1 million), and river valley (0.6 million). During the period 1980–2011, another 1.1 million ha of forests was converted, mostly due to encroachment (0.4 million), mining (0.1 million), irrigation (0.1 million), and transportation (0.1 million) and hydropower (0.1 million). It has shown that drivers for deforestation and forest degradation are different in these two periods, shifting from agriculture to industry and illegal activities, which might be induced by industrialization and social inequity, and the enlarged income gap among different social groups.

Reflecting Laos' two basic social and economic features, the drivers to deforestation and forest degradation were primarily illegal logging, shifting cultivation, infrastructure development and conversion of forests to farming. With rapid rural population growth, and their livelihood depended on subsistence farming, shifting cultivation is still one of major forces for loss of forest cover. However in the recent 10 years, Laos followed China's path on economic reform. Exploitation of resources including, rich and fertile land, timber resource and mining, hydropower resource, has attracted foreign investment. Enlarged social inequity in some extent has accelerated illegal activities

on forests. Laos has been listed among the economies with severe illegal logging, and high deforestation similar to Indonesia.

In Vietnam, a case study of two villages illustrated the correlation between prices for fertilizer and deforestation. In general, higher fertilizer price prompted more labour intensive farming and require new land through deforestation. However this was not always the case in the villages studied. With the tighter control on land clearing and the long history of intensive farming, higher costs associated with increased fertilizer prices may also make agriculture in general less profitable. Especially with the recent loss of cashew harvests, which can ultimately lead to a reduction in the amount of land devoted to this crop. In the studied communes, in some cases increasing input costs increases the area farmed, while in some cases the farm area decreases.

It is believed that agricultural expansion was the major proximate cause of deforestation in Asia. This view is mainly based on agriculture history in East Asia and South Asia, and shocking deforestation rate in Southeast Asia after World War II. It was true in India, Vietnam, Philippines, Laos, Malaysia and Indonesia. However, agricultural expansion in Japan, South Korea, and China was not as important as in those tropical economies during the past few decades. In South Korea, agricultural land area increased slightly during the period of 1955–1970 from 2.0 million to 2.3 million ha (Park 2012). In China, logging in the state-owned forest farms was the most important driver of deforestation since 1949, accounting for 69.83% of national timber production during 1959–1986, while arable land even decreased by 3 million ha from 1950–1980.

Agricultural expansion and logging were the major proximate causes of deforestation in Indonesia, Laos, Malaysia, India, Vietnam, and Philippines, but also was the most important one that has long been controversial due to unclear definition, uncertain estimates, and political biases (Angelsen 1995). On the one hand, the expansion of permanent cultivation and shifting cultivation driven by population pressure were blamed as the primary cause of tropical deforestation, as the rural poor cleared forests for agricultural land, fuelwood and other daily needs. On the other hand, there were explanations that commercial logging induced by government failure and the short term concern of timber sector was the major driver of forest loss (Bautista 1990). In fact, tropical deforestation pattern prevailed in these economies tends to begin with commercial logging which opening up the forests and providing access roads for agricultural expansion. Agriculture has expanded in concert with logging through both spontaneous settlements after logging and government-planned agricultural projects (Kummer and Turner 1994). The World Bank and World Resources Institute (WRI) stated that the leading cause of Indonesian deforestation in the 1990s has been large-scale commercial logging. This opens up previously unexploited forest, thus allowing other economic activities such as agricultural conversion and shifting cultivation to take place (Palmer 2001).

Apart from the pattern of large scale commercial logging followed by agricultural expansion, the shifting cultivation and the commercial agriculture also played a significant role in the deforestation in tropical economies, especially in Indonesia, Laos, Malaysia, India, Vietnam, and Philippines, while these seldom happened in

Japan, South Korea and China. Logging and shifting cultivation may lead to forest degradation, not necessarily to deforestation. However, as the main producers of oil palm and rubber in the world market, farmers and investors in Indonesia, Laos and Malaysia were able to get higher cash benefits from cash crops than staple crops, where the expansion of land under permanent cultivation and shifting cultivation were mainly planted for oil palm, rubber, and coconut, leading to severe forest loss. The analysis by Koh and Wilcove (2008) showed that during the period of 1990–2005, between 55% and 59% of oil palm expansion in Malaysia was due to forest conversion, and between 41% and 45% of oil palm expansion was likely due to the conversion from pre-existing agricultural lands (including rubber plantations).

Table 15. The major proximate causes of deforestation in Asia after World War II

Economy	Proximate causes
Japan	War destruction, logging, agricultural expansion(permanent cultivation), fuelwood, infrastructure expansion
South Korea	Korean War destruction, firewood, agricultural expansion(permanent cultivation), logging, infrastructure expansion
China	Logging, agricultural expansion(permanent cultivation), fuelwood, infrastructure expansion
India	Agricultural expansion (shifting cultivation permanent cultivation), logging, fuelwood, infrastructure expansion
Vietnam	Agricultural expansion, logging, war destruction, infrastructure expansion
Philippines	Agricultural expansion (shifting cultivation, cash crop), logging, illegal logging; infrastructure expansion
Indonesia	Agricultural expansion (shifting cultivation, cash crop), logging, illegal logging, infrastructure expansion
Laos	Agricultural expansion (shifting cultivation, cash crop), logging, illegal logging; war destruction, infrastructure expansion
Malaysia	Agricultural expansion (shifting cultivation, cash crop), logging, illegal logging, infrastructure expansion

Source: Reports submitted by case study economies.

Table 15 provides a summary of major proximate causes of deforestation in the participating economies after World War II. Firewood extraction was an important force to deforestation and forest degradation in Japan, South Korea, India and China, even more important than agriculture expansion in some periods, but its influence in tropical region appeared to be smaller. The reason might be that, firewood in tropical region is mainly for cooking, which is much less than that for temperate region as firewood will also required for heating, and heating needs more wood than just cooking. In Japan, more than 30% of national timber consumption was used as

firewood in 1955. Firewood was the biggest cause of deforestation and forest degradation In South Korea, and firewood and charcoal accounted for 62.5% of the total primary energy sources in 1960. Today, fuelwood remain a predominant source of energy in rural India, fuelwood collection for household energy significantly contributes to pressure on forests and adds to the rate of forest degradation and deforestation.

Illegal logging is a major contributor to deforestation and forest degradation in Indonesia, Laos, Malaysia, and Philippines, while it was less serious in Japan, South Korea, India, Vietnam, and China. Indonesia and Malaysia are in the group of high illegal logging economies in the world. ITTO (2001) stated that by the year 2001, illegal logging was thought to be one of the most critical threats to Indonesia's forest capital, accounting for 50–70% of total log production. In China, illegal logging accounted for 500 thousand cu m in 1990s, but it was in control after an integral forest administration system including forest police, forest station and timber check point was established to strengthen law enforcement. In South Korea, the social chaos created by the Korean War also encouraged some illegal logging, aggravating already devastated forest resources due to the divide. It might imply that forest transition economies had better forest governance than non-forest transition economies.

In all economies, the direct impact of infrastructure extension on deforestation was not bigger than other proximate causes. The reason may be that forest transition happened at a low income level in Asia economies when infrastructure construction still developing slowly. However, in Indonesia, Laos, Malaysia, Vietnam, and Philippines, roads were built to facilitate timber extraction and to increase colonial control over remote areas. In Laos, natural forests have been seriously damaged from the activity of dam construction and mining since government placed a central role for them to support economic development. Investigation records that between 1997 and 1998, dam project sites alone supplied over 50% (600,000 cu m) of the total timber harvested in Laos.

It is noted that war destruction contributed to the forest loss in China, South Korea, Laos, and Vietnam directly or indirectly. During the war, forests were seriously destructed by bombs and chemical substances. In addition, roads, trenches, army camps and defense works were built in the forest, and timber and food were demanded to support war that aggravated forest decrease. In China, more than 10% forest stock volume was lost during the Anti-Japanese War in the years 1937–1945. The Korean War may be the most critical cause of forest degradation in South Korea. The U.S.-Vietnam War had a devastating impact on Laos and Vietnam's forests, and since the war logging has played a large role in forest destruction. During the war, it was estimated that the Laos lost about one-fifth of the total forest area (Phongxiong Wanneng 2012).

In summary, forest decline in Asia is determined by different combinations of various proximate causes, influenced by the agriculture history and pattern, geography, resource endowment, and also other underlying causes. Summarizing from the national reports of the nine participating economies, no universal pattern between proximate causes and deforestation exists in Asia. It even does not exist among the forest transition economies; or among non-forest transition economies. But it do exists among temperate economies (Japan, South Korea and China), and among the

tropical economies (Indonesia, Laos, Malaysia, Vietnam, and Philippines). Indonesia, Laos, Malaysia, India, Vietnam and Philippines seem to display similar pattern in the forest loss as agriculture expansion, logging, shifting cultivation, and cash crop were significant causes of deforestation. Among the forest transition economies, the proximate causes of deforestation in Vietnam and Philippines looked like those of in Indonesia, Laos, and Malaysia. While there were some similar causes in South Korea, China, and Japan. It can be concluded that the type of proximate causes is not the determinant of forest transition.

Underlying causes of deforestation and forest degradation in Asia

Population growth that associated with poverty was a primary underlying cause of deforestation in the Asia. Large scale population migrations to forest areas, were mainly in Indonesia, Laos, Malaysia, India, Vietnam and Philippines; but not obvious in China, Japan and South Korea; during the past decades. Population growth always brings an increased demand for land for food and settlement, as well as fuelwood and timber. Generally, in China, Japan and South Korea, population growth was linked with expansion of permanent cultivation and fuelwood demand, rather than shifting cultivation or commercial cultivation. Agricultural expansion in the upland or forest was often caused by migration from the lowlands or agricultural area in Indonesia, Laos, Malaysia, India, Vietnam, and Philippines. Deforestation usually synchronizes with population migration and shifting cultivated land expansion. In those economies, apart from population pressure, migration was affected by such factors as inequitable land distribution, scarce off-farm employment opportunities, and transmigration policy. Since the independence, transmigration in Indonesia began either because of the population density, disaster, or development of infrastructure in the original place. Each household receives 2 ha of land. According to the Indonesia National Report, the total number of transmigration households from 1969 to 2013, for both common transmigration (under the government programmes and budget) and spontaneous-autonomous transmigration, is approximately 2 million households, causing serious deforestation. In the Philippines agricultural expansion in the uplands was often caused by push-migration from the lowlands, about one-third of the population was located in the uplands, of which about 50% farmed on forestland (World Bank 1989).

The wood and wood products, cash crops production for industrialized construction, capital accumulation, and foreign exchange earnings, were other key underlying causes of deforestation in Asia, which was a consequence of forest endowment, economic structure, economic development strategy, and political context. In the rich forest economies like Indonesia, Laos and Malaysia, their economy relied heavily on logging forest area and agricultural expansion for rubber, palm oil, cacao, coffee, and sugarcane to support economic development and earn foreign exchange earnings, which had a significant influences on the rate of deforestation in these economies. Approximately 70% of all tropical wood products in the global market after World War II originated from Southeast Asia; this proportion had risen to 83% by the mid-1980s (Gillis 1988). Indonesia and Malaysia continue to be major exporters in the world timber products and cash crops markets till today (Wicke *et al.* 2011). In the case of Laos, the government aimed to generate national revenue by harvesting timber by establishing nine state-owned enterprises. Timber products for both national and

international trades in Laos contributed about 6% of the national GDP and covering about 30% of the all industrial production in Laos. After implementing forest harvesting for 15 years, the Lao forest cover rapidly decreased from 60% in 1975 to 47% in 1990. However, in the relative scarce forest economies such as China, Japan, India, and South Korea, they also placed timber production as the central goal of forestry development in the take off stage of industrialization. The primary forests in these economies have been harvested on a large scale to fulfill domestic market demand. Especially in China and India, a large number of state-owned enterprises were established for large-scale timber extraction that played a significant role in the timber production and the loss of natural forests.

Illegal logging and high rates of deforestation in Indonesia, Laos, Malaysia, Vietnam, and Philippines were driven by government mismanagements such as corruption, weak enforcement and monitoring capacity, and rent-seeking behaviour. As the main owner of forest resource, government assumed the roles of both athletes and judges. Their private interest over public interest had dominated state forest policy and structure. In Indonesia, Vietnam, Malaysia, Laos and Philippines, central and local governments played an important role in illegal logging. Government and its staff had to find their own sources of income, and logging concessions became one of the more lucrative ways of raising revenues. In these economies, logging concessions were allocated to those influential people and companies that had benefited coalition with government and government staff. The forestry department failed to enforce sustainable cutting, timber transport and export management, and forest replanting, leading to prevalence of illegal logging.

The loss of forest in Asia was associated with policy factors towards using forest resources, including population policies, agriculture and food policies, logging policies, poverty reduction policies, and timber trade policies. In China, Laos and Vietnam, a policy of rice self-sufficiency at the provincial level initialed by the socialist regime encouraged farmers to clear upland forests for rice cultivation which caused rapid loss of forest in 1970s. Transmigration in Indonesia was started since 1969 and mainly programmed by the government due to population pressure, disaster, and developing the marginal areas. The failure of logging concession policy was a key driver of forest removal and lack of tree planting in Indonesia, Malaysia and Philippines. The forest area had been allocated to the transmigration households by government leading to serious deforestation. Low forest charge and export tax in Malaysia and Philippines also accounted for the high demand of log concession and timber export. The short cutting period and low price in the logging concession encouraged the licensed holders to exhaust the standing forests within or outside their concession area, undermining incentive of long term management. But in Indonesia, the illegal logging was partly driven by high export tax and low price of logging concession. The forest decline caused by conversion of forest to shifting cultivation and cash crop has been strongly influenced by the rural development and poverty alleviation policy, trade incentive policy in Indonesia, Laos, Malaysia and Philippines.

Property factors were responsible for a large share of deforestation in the economies except Japan and South Korea. The conflict between legal land rights system and indigenous customary system, between those with legal claim to forest such as government agencies, agriculture companies, timber license holders and indigenous residents prevailed and induced devastating deforestation in the tropical economies

like Indonesia, Malaysia, Philippines, Laos and Vietnam. The weakness of management and enforcement of state property system made large parts of forests turn into public domain. In addition, migration toward an open-access forest was further induced by the land tenure policy which allocated land to those first occupied and managed. In the period of 1958–1987, collective forest regions in China have experienced three severe deforestation peaks due to insecure forest land ownership and political movement, and forest resources have been seriously damaged. In India, the failure of government to secure people's participation was also one of causes of deforestation.

In summary, the underlying causes of deforestation in Asia economies were complex, which were a combination of demographic, economic development, policy and institutional and international factors. The underlying causes of deforestation proved to be different between forest transition and non forest transition economies. The economies in tropical region and temperate region are more likely to display similar underlying causes of forest loss. It is found that population migration, export-oriented economy structure in agriculture and forestry sector, government failures in managing forest, government policy failure in forest and other sectors, and chaotic forest land ownership, were responsible for the rapid forest cover decline in the tropical nations like Indonesia, Malaysia, Philippines, Laos and Vietnam, while those factors were not as significant as in Japan, China, South Korea and India. It seems that significant reform require in the economic development strategy, policy and institutional changes if deforestation will be reversed.

Drivers to afforestation and forest rehabilitation

Table 16.The economy development, forest scarcity and agricultural intensification

Economy	Urbanization, increasing off-farm employment	Energy transition from firewood to fossil fuel	The lowest point in forest coverage	Rapid agricultural productivity growth, or agriculture revolution
Japan	Yes	Yes	_	Yes
South Korea	Yes	Yes	35% (1955)	Yes
China	Yes	Yes	12.1% (1981)	Yes
India	Yes	Yes	19.27% (1998)	Yes
Vietnam	No	No	25%（1990）	Yes
Philippines	No	No	21.5%（1988）	No
Indonesia	No	No	52%（2010）	No
Laos	No	No	40%（2010）	No
Malaysia	No	No	62%（2010）	No

If a driver is ranked as important in the national report, then a “Yes” will be given, otherwise it is “No”.

Data source: Reports from case study economies; forest coverage data of South Korea from Bae *et al.* (2012); India from Government of India: Ministry of Environment and Forests Annual Report 2005–06.

Economic development has a complicated and mixed influence on forest transition in Asia. As Figure 5 shows, annual income per capita may not be an important factor for forest transition. Indonesia and Vietnam are at the same level of per capita income, but forests in Indonesia are losing and Vietnam is in the opposite. Urbanization, increasing off-farm employment, and energy transition, may have contributed positively to forest transition in Asia, but it is not necessary or has limited effect. Hence, forest transition can be realized without spontaneous reforestation driven by urbanization and increasing off-farm employment. For among the forest transition economies, Japan, South Korea, China and India have highly emphasized that urbanization and increasing off-farm employment helped to ease the pressure upon forest, and promoted spontaneously reforestation in marginal cultivated land, but they are not emphasized in Vietnam and Philippines, as well as non-forest transition economies. Change of rural energy source from firewood to fossil fuel was expanded dramatically since the 1960s in Japan and South Korea, and rural-urban migration also influenced reforestation and energy transition from firewood to fossil fuel. Urbanization rate in China increased from 29.36% to 49.33% in 1980–2010 according to official statistics. The contribution of urbanization and increasing off-farm employment to afforestation and forest rehabilitation shall be larger if migration of hundreds of millions rural residents from rural area to city is considered from 1980s. Since 1980s, fuelwood for household was also gradually changed into coal, electricity, gas and petroleum in China. The obvious trend of rural energy transition in Japan,

South Korea, China and India indicated that these economies effectively responded to the shortage of rural energy during the forest transition. However, there is less evidence on positive influence of urbanization and off-farm employment to afforestation and forest rehabilitation in the Philippines and Vietnam, as a large number of surplus labours still exist, and industrialization and urbanization have relative limited contribution on absorbing rural surplus labour force. In India, economic development promote large scale afforestation and forest rehabilitation in private forest through upgrading in energy and meeting the fuelwood demand in rural area (Foster and Rosenzweig 2003, DeFries and Pandey 2010). When concluding on the relation between economic development and forest transition in Asia, it should be reminded that the lower contribution of economic development on afforestation and forest rehabilitation in the Philippines and Vietnam may attribute to the primary stage of forest transition and slow economic growth. In Vietnam, the impact of urbanization is appearing in recent years (Meyfroidt and Lambin 2009).

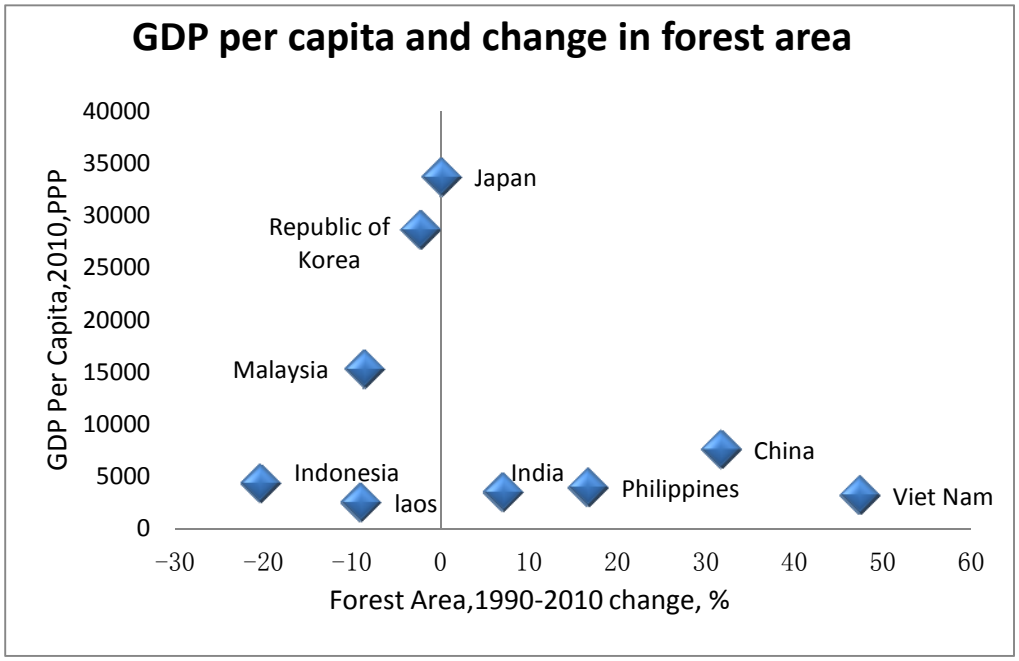


Figure 5. GDP per capita against forest cover changes

Table 16 also shows that the turning point of forest transition is lower than the current forest coverage in non-forest transition economies, suggesting that the forest transition in Asia was induced by forest scarcity to some extent, and forest scarcity pathway may not be an exception in forest transition. Forest transition economies except Japan did witness a sharp decline of forest in the past decades, and a scarcity of forest products and a decline in the flow of ecological services made afforestation and forest rehabilitation urgent and profitable. National forestation programmes were established to respond to timber crisis and ecological crisis. In China and South Korea, the national reforestation programmes were established in response to floods and soil erosion, while forest planting responds to rising prices for forest products and shortage of fuelwood. However, forest scarcity is not necessarily linked with forest transition, depending on policy and institution changes by government and incentive of private sector. In Laos, although a sharp decline of forest has attracted attention of government, government afforestation projects, allocation of forest land, and control

of shifting cultivation had little effect on reducing deforestation because of lack of technology and financial support, as well as shortcomings in policy design and implementation. Relatively high forest coverage in Indonesia and Malaysia implies that it will take time for them to suffer from increasing pressure from forest loss.

Rapid agricultural productivity growth that once happened before or in the same period with forest transition mainly exists in forest transition economies, rather than in non-forest transition economies, indicating that rapid agricultural productivity growth has a positive effect on forest transition. Since 1950s, agriculture in Japan and South Korea had experienced rapid growth by introducing land ownership reform, improving crop seed varieties, increasing share of irrigated land, and increased use of chemical fertilizer and pesticides. Green revolution happened mainly in India and Philippines since 1960s, which brought about tremendous increase in per capital output of wheat and rice. As agricultural development in Philippines has slowed down due to lack of government input since 1990, it has become a key rice importing nation in the world grain market. That is why the Philippines has reported that as “No” in rapid agricultural productivity growth. In the1980s, the allocating land to household reform, input and output markets liberalization reform in agriculture, the increased use of fertilizer in China and Vietnam made a significant contribution to agriculture development and poverty reduction. A smallholder agricultural intensification path was proposed in Vietnam by Meyfroidt and Lambin (2009). However, in non-forest transition economies, shifting agriculture and cash crop are still a vital approach to increase grain production and reduce poverty in rural area, where deforestation continues.

National forest programmes are essential for achieving forest transition, as all forest transition economies have larger scale, and more effective and efficiently implemented national forest programmes than non-forest transition economies. Clear evidence shows that governments in forest transition economies are more involved in afforeatation and forest rehabilitation activities than non-forest transition economies. The role of national forest programmes in China, India and Vietnam were identified by Mather (2007). Large scale national forestation projects were launched by Japan and South Korea governments, respectively in 1950s and 1960s. National forest planting area rapidly expanded from 50 thousand in World War II to 500 thousand in the early of 1950s since Japan government initialed “expansive afforestation policy”, accounting for more than 60% of total tree plantation in that period. In ~~respond~~ to forest loss in Korean War and soil erosion, the First and Second National Forest Development Plans in South Korea brought complete restoration of the denuded hillsides and coastal areas from 1973 to 1982. In the Philippines, CBFM Programme and Forestry Sector Projects (FSP) I and II under the so-called National Forestation Programme (NFP) commenced since 1980, and were responsible for forest expansion since 1990 (Pulhin *et al.* 2006). Governments in Indonesia, Malaysia and Laos ~~initialed~~ some national forestation projects too, but most of them had little influence on forest expansion due to finance shortage, insufficient social participation and incentive, weak management, and ownership conflict. For example, since the beginning of Regreening Programme in Indonesia implemented in 1970s, almost 85% of Ministry of Forestry budget were allocated for this project, but the result was very minimum (Nawir *et al.* 2007). Laos government set up an ambitious forestry strategy that ~~intend~~ to recover forest back to 70% in 2020, it looks impossible ~~when~~ deforestation continues.

Table 17. Factors of governmental policy, institution, and globalization in forest transition

Economy	National Forestation Program	Strengthen forest policy system and Forest governance	Forest land ownership reform, improve social participation by innovative institution	Timber import
Japan	Yes	Yes	Yes	Yes
South Korea	Yes	Yes	Yes	Yes
China	Yes	Yes	Yes	Yes
India	Yes	Yes	Yes	Yes
Vietnam	Yes	Yes	Yes	Yes
Philippines	Yes	Yes	Yes	Yes
Indonesia	Yes, limited	No	No	No
Laos	Yes, limited	No	No	No
Malaysia	Yes, limited	No	No	No

If a driver is ranked as important in the national report, a “Yes” is given, otherwise “No”.

Data source: National reports submitted by case study economies

Table 17 provides a summary on these factors related to governmental policy, institutions and globalization, which has driven forest transition in participating economies. Forest transition economies had a better performance in improving forest policy system and strengthening forest governance than non-forest transition economies. Measures include strengthening logging management system and law enforcement capacity, protecting natural forest, implementing organizational reform, combating illegal logging. In 1951, forest planning system and cutting permission system were introduced in Japan after amendment of the Forest Law. The move of Korea Forest Service under Ministry of Agriculture and Forestry to the Ministry of Home Affairs in South Korea ensured national forestation plan was strictly implement by local government. In the Philippines, the massive cancellation of the erring timber license agreements (TLAs) and the non-renewal of the expired ones were introduced since 1980, from around 7.9 million ha of forestlands licensed to 261 TLA holders in 1980, licensed areas was significantly reduced to around 0.91 million ha by 2000 (Pulhin and Dressler 2009). Strict logging license system and the logging ban for natural forest were implemented in China, Vietnam and India since 1980s. Since 1980, Chinese Government has established a basic forest resource management system, including harvesting, transportation, timber processing, forest law enforcement, fire protection, and market management, which become the foundation for the government to carry out forestry reform, reduce forest fire risk, and increase forest area. However, the rent seeking behaviour in Indonesia, Laos and Malaysia continue to prevail, and illegal logging activities are out of control to some extent. In Indonesia, number of logging concessions and areas given for timber exploitation were also increasing.

The different achievements in afforestation and forest rehabilitation can be explained by different impacts of institution and institutional changes between forest transition economies and non-forest transition economies. Forest ownership reform and

institutional innovation in forest transition economies that endowed more land use right, management freedom, and participation to local residents have a positive effect on public and private forest expansion, while the competition of forests ownership among various actors and shifting cultivation were induced by failure of private property right reform and chaotic land ownership in non-forest transition economies. In Japan, the Forest Owners' Cooperatives System introduced under the revised Forest Law in 1951 had significant influence on promotion of forest management and expansion of forest area. In China and Vietnam, the market-oriented reform in forest land ownership and forest product market has sharply promoted forest planting in collective forest region. The timber production from collective forest region in China already accounts for more than 60% total timber production, but the reform in Vietnam suffered from some criticism (Sikor 2001). The ideas of social forest was introduced and adopted in India and Philippines since 1980s. Since 1990, all states in India have adopted Joint Forest Management (JFM), over 99 000 local forest committees have been established, and an estimated 21.4 Million ha (equivalent to 31% of India's forest area) is now under JFM (Government of India 2006). According to the Philippine National Report, in Philippines, the Integrated Forest Management Agreement (IFMA), and Socialized Industrial Forest Management Agreement (SIFMA) that grant rights to various stakeholders to develop, manage, protect and utilize a specified forest area contribute significantly to forest expansion. In non-forest transition economies, forest allocation was also carried out, but forest land has been shifting to unsustainable forest practice or agriculture production by indigenous residents due to lack of technology and financial support, and secure property right.

All forest transition economies and non-forest transition economies are important importers and important exporters in world timber market respectively. Forest resource in timber importing economies like Japan, South Korea, China, India, Philippines and Vietnam, have greatly benefited from globalization by displacement of deforestation to rich forest region, while timber export in non-forest transition economies have to bear deforestation pressure from wood and wood product globalization. Timber Import Liberalization policy with low import tariff and high export tariff has been introduced by all forest transition economies to reduce the domestic demand-supply gap, which have alleviated pressure from natural forests leading to eventual reduction in overall deforestation. There was a sudden increase in the import after liberalization policy in all forest transition economies. In Japan, the timber self-sufficiency ratio declined from 94.5% in 1955 to 18.2% in 2000; in South Korea this was 5.5% in 2002 after decades' decline; and in China it was about 50% in 2010 since timber import began in 1980. So is the trend in India and Vietnam. Japan, South Korea, China and Vietnam have developed a strong forest product industry by importing timber from forest-rich economies that most are non-forest transition economies, and export wood products such as furniture, panel boards, ~~and~~ paper and paper products to EU and America. Philippines is a good example that changed its timber trade policy from timber export to timber import to achieve forest transition. The Philippines was once the major timber export economy globally in the 1960s–1980s. At that time, more than 50% of national timber production were exported, ~~party~~ accounting for the fastest rate of deforestation in the same period (Bautista 1990). Since 1990, timber export was almost halt totally, and timber import increases with reducing timber tariff; all these had made Philippines evolve into timber import and forest transition. In non-forest transition economies, wood and wood products, cash crop exports are still playing an essential role in national economic development

strategy currently, which make it difficult for them to reduce deforestation and agricultural expansion. The logging concession policy, land private property reform, and trade policy are thought to make export convenient. In addition, large scale forest areas in Indonesia, Malaysia and Laos, are owned and exploited by foreigner investors specializing ~~for~~ export. The timber material in non forest transition economies was mainly exported to forest transition economies, which push forward deforestation in tropical region. Since early 21st century, Laos timber products were mainly exported to neighbouring economies, which accounted for about 40% of the total Laos exporting products or about 30% of the national foreign currency earning.

There is no doubt that the forest transition economies do better in driving afforestation and forest rehabilitation than non-forest transition economies, including accelerating urbanization and energy transition, improving agricultural productivity, addressing forest scarcity, enhancing government intervention, and maximizing benefit of globalization to ease natural resource pressure. Clear evidence shows that state policy pathway exists in Asia forest transition. Forest transition economies in Asia actively involved in addressing forest scarcity through various approaches, such as implementing large-scale national forestation programmes, strengthening forest policy system and forest governance, carrying out decentralization reform, adopting timber Import liberalization policy. Economic development had a complicated and mixed influence on Asia forest transition, as urbanization and energy transformation may have positive impact on forest transition economies except Vietnam and Philippines. Forest land reform and institutional innovation, that endowed more management freedom and farmers' participation, such as social forestry in India and Philippines, and allocation of forest lands to households in China and Vietnam, could induce forest transition. But chaotic forest ownership, such as happening in Indonesia, Malaysia and Laos, may lead to deforestation. Globalization pathway also exists in Asia forest transition, as timber Import liberalization has formed as a key timber trade strategy to relieve domestic timber demand and develop timber product industry by increasing external dependence. It is suggested that policy reform and institutional changes should be paid more attention to reduce deforestation and drive afforestation and forest rehabilitation, rather than solely through economy development.

Conclusion and discussion

In summary, the comparative analysis in Asia confirms that whether realizing forest transition or not cannot be connected with deforestation pattern. The proximate and underlying causes of deforestation proved to have poor similarity between forest transition and non forest transition economies in Asia, but the economies within tropical region, and temperate region, are more likely to have similar deforestation pattern or drivers. The successful story about forest transition in Asia economies in the past decades, especially Vietnam and Philippines, forms a powerful response to the popular belief that there is no cure at all about tropical deforestation due to their low income level or complex deforestation pattern. However, it is crucial to understand that deforestation problem did not arise in a vacuum, but is formed as an integral element of national development strategy influenced by political system, property rights system, and state governance capacity. Therefore, solution to deforestation requires the adjustment of economic development strategy, policy and institutional changes, rather than just economy growth.

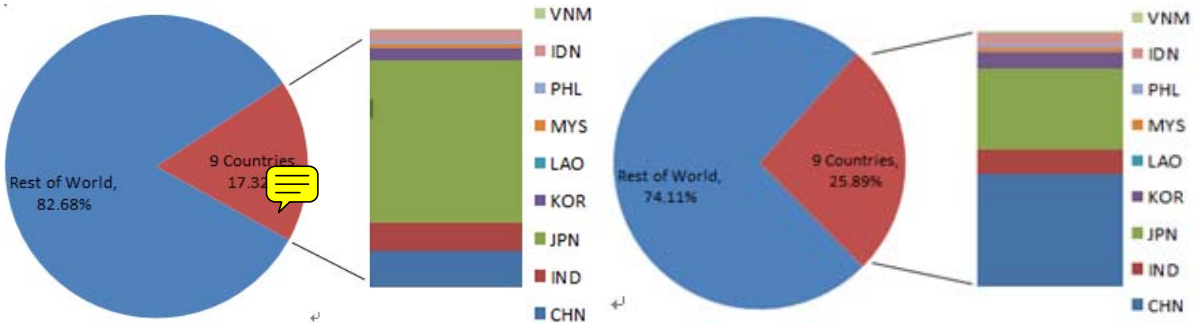
Forest transition in Asia is the result of a combination of political, social, institutional and economic factors. Explanation for forest transition in Asia required ~~understaning~~ the multiple and comprehensive perspectives of political economy and social culture, rather than a single perspective. There was no doubt that the government, farmers, and private sectors in forest transition economy response to the scarcity of forest resources and ecological crisis in the process of industrialization promoted the growth of forest. Forest scarcity should not be regarded as a pathway, but a premise of forest transition. As the forest scarcity pathway unlikely interpreted how the forest reverses like other pathways, forest scarcity pathway proposed by Rudel *et al.* (2005) shall be queried in forest transition theory. The role of government proposed by Mather (2007) was confirmed here, but actually more contribution, and more means. The direct involvement of the government in forest transition economy, by implementing large-scale national forestation programmes, strengthening forest policy system and forest governance, carrying out decentralization reform, and adopting timber Import liberalization policy, played a primary and essential role in promoting forest transition in Asia. As all forest transition economies are key timber importers, and non-forest transition economies are key timber exporters, it seems to imply that it is a single choice between timber import and forest transition. Economic development had a complex influence on forest transition, like Mather (2007) proposed. No one region can realize forest transition without urbanization and agricultural development. It is likely that economic development is not necessary in the initial stage of forest transition, but necessary for a sustainable forest transition as the experience of Japan, South Korea, and other developed economies indicated.

The attempt to better understand drivers of forest transition in Asia has been hampered by unclear definitions, lack of data, and lack of knowledge on the influence and interactions of the drivers. Further effort should be made to examine carefully on the linkage of these drivers of deforestation, afforestation, and forest rehabilitation. Some of these linkages and mechanism, such as economic development, state role, and globalization with forest changes are still debatable, need to be tested with further research.

CHAPTER 5 DIVERSIFICATION OF ECONOMIC PATHWAYS FOR FOREST TRANSITION

Introduction

For the past three decades, the average economic growth in Asia-Pacific is much faster than other parts of the world, and China has gradually become the core engine of global economic growth. The nine economies participating in the APFNet funded project on forest transition: China, Japan, South Korea, India, Indonesia, Malaysia, Philippines, Laos and Vietnam, have a combined population equivalent to 45.88% of the world's population, and the combined GDP equaled 25.89% of total GDP of the world (Figure 6).



1985 2012

Figure 6. Combined GDP of the nine participating economies as portion of GDP of the total world in 1985 and 2012
Source: World Bank, World Development Indicators (1985, 2012)

Meanwhile, the pace of plantation establishment in the Asia-Pacific region is also the fastest. Since the 1980s, reforestation and afforestation has become a growing concern among policy-makers in many developing nations. In East Asia, for ~~examples~~, China and South Korea have adopted and implemented forestland policies, including settlement programmes, land classification, devolution of forest management and reforestation schemes (Clement and Amezaga 2008). However, in the other parts of the Asia-Pacific region, especially near to the Tropics, deforestation and forest degradation are becoming increasingly serious. Under the combined effect of so many factors, there are doubts that whether the economies in Asia-Pacific region are experiencing totally different forest change pathways?

These economies involved in the comparative study project are respectively located in Northeast Asia, East Asia, Southeast Asia and South Asia, which have completely different geographical and socio-economic, residents' income, population, forest management administrations and regulations. Therefore, a cross-national comparative study has been proposed to determine the pathway of changes in forest area of these economies. Besides determining the pathway of national forest area changes, the effects of different factors impacting ~~on~~ forest area changes will also be analyzed.

Economic growth and Environmental Kuznets Curve

Literature Review and Descriptive Analysis

Following Kuznets' (1955) notion that income inequality worsens from low to intermediate levels of development but attenuates as development advances, this environmental analog suggests that ecological damage worsens during early development as nations draw heavily upon their natural endowments to secure industrial "takeoff " and subsequently peaks at intermediate levels of development. A number of studies have shown that there is deforestation Environmental Kuznets Curve (Deforestation EKC), which is a hypothesized relationship between environmental quality and economic development, for some economies in South America and Africa. In these economies, the forest area will be gradually reduced as a nation's economy grows. When the residents' income reaches a certain level, the forest area stopped declining and began to rise along with the rapid economic growth (Cropper and Griffiths1994, Mather *et al.* 1999).Another study establishes the same relationship using urbanization as the development indicator (Ehrhardt-Martinez 1998).

Such findings are part of a larger debate over what has become known as "ecological modernization theory" (EMT). EMT argues that capitalist economies have the ability to reform or reinvent themselves to promote environmental goals, although the exact processes are matters of debate. The ultimate question is whether an EKC implies that nations can grow their way out of ecological catastrophes. That is, should one consider environmental degradation a "natural" but ultimately self-correcting problem of modern development? The theories used in recent investigations of deforestation offer very different explanations, thus providing a critical experiment as to the possible links between development and forest loss (Ehrhardt-Martinez *et al.* 2002).

In the past 30 years, almost all participating economies, except for Japan the only developed nation in this project, have been maintaining a continuous economic growth, with an average annual GDP growth rate of more than 5% and occupied a larger portion of the world compared with what 30 years ago (Figure 7).

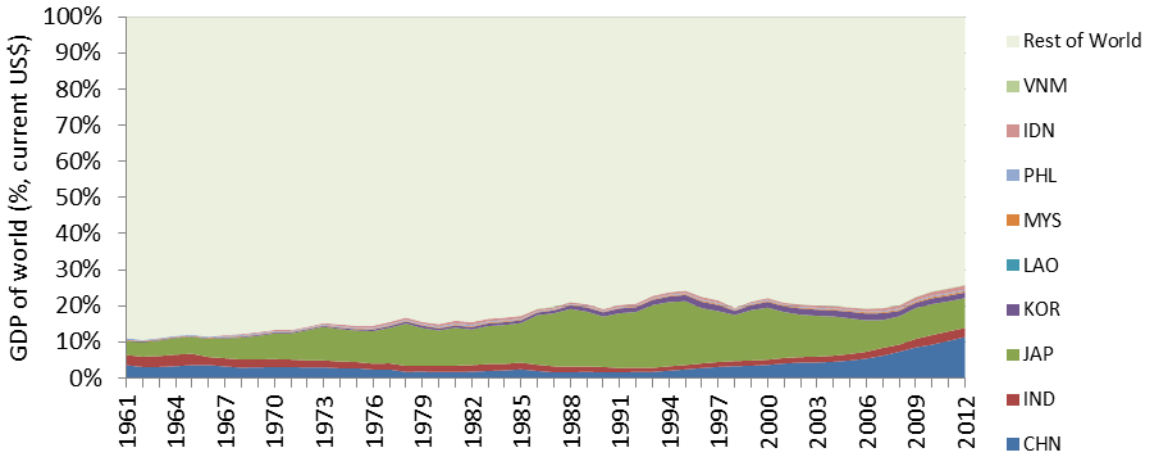


Figure 7.GDP Growth trends of the nine participating economies (1961–2012)
Source: World Bank, World Development Indicators (1961–2012)
**Data is in current USD, converted from local currencies using single year official exchange rates (World Bank 1961–2012).*

According to the hypothesis of deforestation EKC, the pathway of forest area changes of each economy should have been along a uniform curve. However, many studies done on the developing economies have found the link between the higher national per capita incomes with greater deforestation (Krutilla *et al.* 1995, Barbier and Burgess 1996). However, Angelsen and Kaimowitz (1999) indicated that there is no strong short-term or medium-term relation between economic growth rates and average per capita national income. In fact, higher incomes associated with more deforestation do not necessarily imply higher growth rates. The historical trend disagreed with this conclusion and showed that the nine participating economies have different pathways of forest area changes (Figure 8).

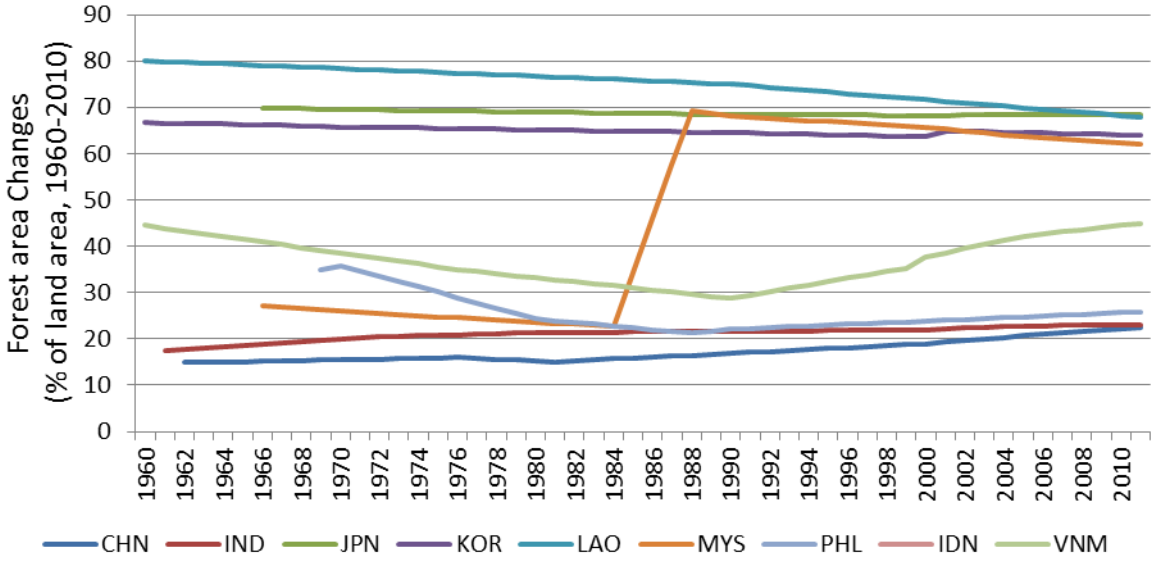
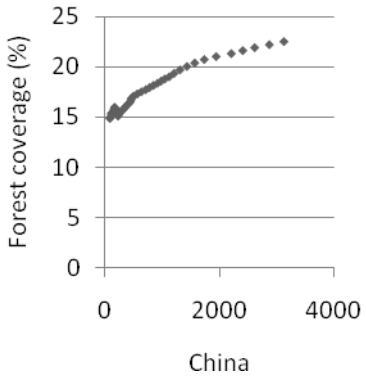
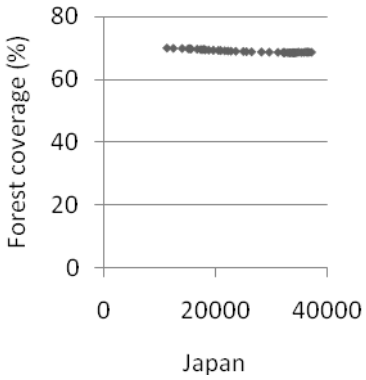
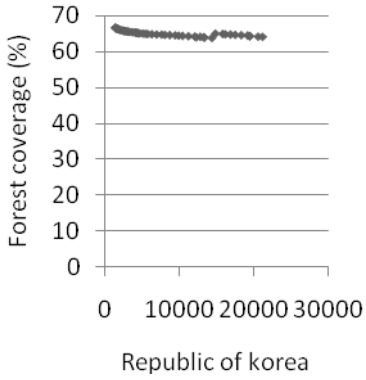


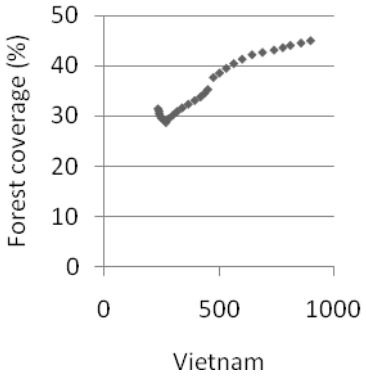
Figure 8. Forest Area Changes (% of total land area,1960–2011**)**
Source: FAO, World Bank (1990–2010), data before 1990 are from reports of the nine economies.

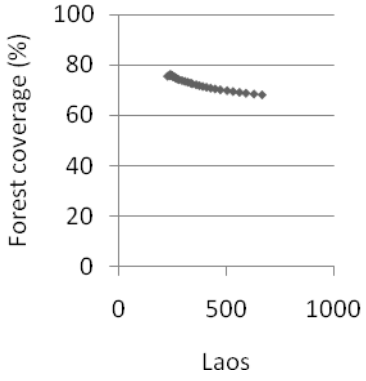
Changes in the correlation between forest area and growth of GDP per capita is not the same, to a certain extent verify that higher incomes do not necessarily imply higher or lower forest growth rate. Japan and South Korea, these two developed economies' GDP per capita continuously increase while the forest area almost has not changed since 1961. For China, Vietnam and India, forest area has been declining in early phases while GDP per capita is at low level, and with the growth of per capita GDP, forest area continues to increase. For Indonesia and the Philippines, there is some distortion and overlap of the change curves. The reason is that both the level of forest area and GDP per capita in these two economies has been up and down many times. Malaysia's change curve is rather special, according to the national report this is due to the adoption of National Forestry Policy in1978 and the enactment of National Forestry Act in1984 (Wan Razali and Mohd Shahwahid 2012). Figure 9 depicts the correlation between the national forest area changes and per capita GDP growth.

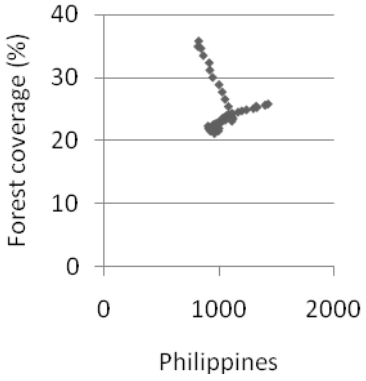

Forest coverage (%)
25
20
15
10
5
0
0
2000
4000
China

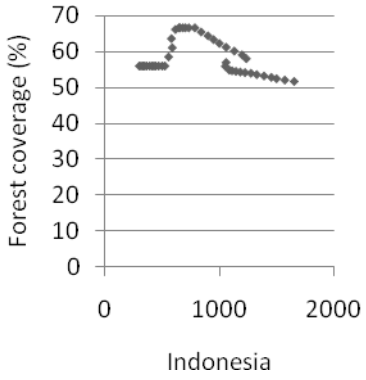

Forest coverage (%)
80
60
40
20
0
0
20000
40000
Japan

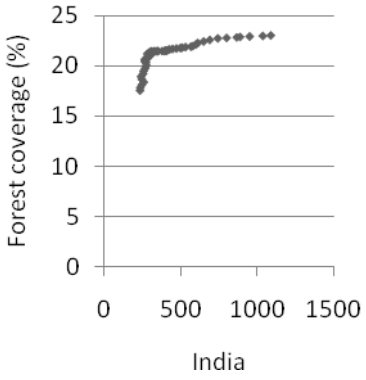

Forest coverage (%)
70
60
50
40
30
20
10
0
0
10000
20000
30000
Republic of korea


Forest coverage (%)
50
40
30
20
10
0
0
500
1000
Vietnam


Forest coverage (%)
100
80
60
40
20
0
0
500
1000
Laos


Forest coverage (%)
40
30
20
10
0
0
1000
2000
Philippines


Forest coverage (%)
70
60
50
40
30
20
10
0
0
1000
2000
Indonesia


Forest coverage (%)
25
20
15
10
5
0
0
500
1000
1500
India

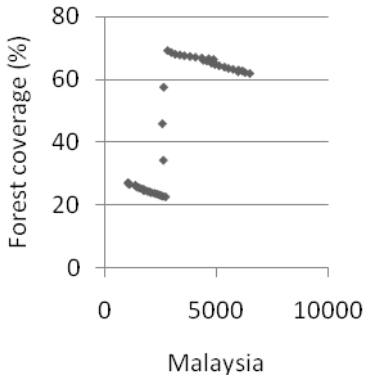


Figure 9. The correlation between GDP Per Capita and Forest Coverage Rate
** GDP Per Capita is in constant 2005 USD*
Source: FAO (forest coverage after 1990), World Bank (GDP Per Capita, 1961–2011), forest coverage before 1990 is from reports of the nine economies.

Quantitative Methodology and Empirical Analysis

On the basis of descriptive analysis of the correlation between changes in forest area and GDP per capita in these nine economies, an econometric regression was used for empirical analysis. As some researches on EKC found that there are non U-shaped relationships, such as the N-type, S-type and logarithm, between pollution and per capita GDP, this may also apply to the relationship between per capita GDP and forest area. Formulae (1) and (2) are respectively the quadratic model and cubic model of per capita GDP, as follows:

$$\ln FA = a_0 + \ln GDPPC + \ln GDPPC^2 + u \quad (1)$$

$$\ln FA = a_0 + \ln GDPPC + \ln GDPPC^2 + \ln GDPPC^3 + u \quad (2)$$

** ln FA = ln (Forest Area, % of Total land)*
ln GDPPC = ln (GDP per capita)
ln GDPPC^2 = (ln (GDP per capita))^2
ln GDPPC^3 = (ln (GDP per capita)) ^{3}

Since the time series data contains trends over time, it will cause the sequence unstable. That each variable has a same trend direction of growth or decline in the observation period will cause R^2 of regression abnormally significant, but in fact there is no significant relationship between the variables, which is a common fallacy often appears in the article using ordinary least square (OLS) to make time series regression. So unit-root test is necessary before adopting regression to remove trend on time series and make the sequence smooth. In addition, this regression using white robust correction method to reduce the impact of the AR(1) and heteroscedasticity (Table 18).

Table 18. Descriptive statistics for regression variables of basic model

Explanation	Unit	Time Span
Dependent Variables		
ln(Forest area coverage) [a b]		
CHN		*1962–2011*
JPN		*1966–2011*
KOR		*1960–2011*
VNM	*% of land area*	*1960–2011*
LAO		*1960–2011*
PHL		*1969–2011*
IDN		*1968–2011*
IND		*1968–2011*
MYS		*1966–2011*
Independent Variables		
ln (GDP per capita) ln (GDP per capita)^2 ln (GDP per capita)^3	*constant 2005 USD*	*1960–2011*

[a] *Data except for Forest area mainly sources from FAO and World Bank website;*
[b] *Data of Forest area, especially that before 1990, is from reports of the nine economies. But due to different definition and statistical caliber of forest and forestland in each economy, data of forest area before 1990 has been converted to a uniform statistical standard.*

The Regression results are as follows (Table 19):

Table 19. Regression results of basic model

	CHN	IND	JPN	KOR	LAO	MYS	PHL	IDN	VNM
Dependent variable: ln (Forest Area, % of Total land); Independent variable: ln (GDP per capita) quadratic									
GDPPC	-0.240***	-8.343***	-0.130*	-0.0560	-0.0153	0.548	-12.38***	1.525***	0.702
	(-9.13)	(-3.73)	(-1.95)	(-1.00)	(-0.86)	(0.26)	(-3.26)	(2.75)	(0.34)
GDPPC^2	0.0286***	0.746***	0.0055	0.00286	0.00151	-0.0758	0.890***	-0.108**	-0.0336
	(13.20)	(4.27)	(1.66)	(0.99)	(0.89)	(-0.49)	(3.30)	(-2.83)	(-0.19)
Const term	3.216***	3.024***	4.986***	-0.000440	-0.000205	0.0448	-0.00787*	-7.965***	0.000704
	(41.33)	(258.82)	(14.82)	(-0.53)	(-1.02)	(1.43)	(-2.37)	(-5.15)	(0.25)
R^2	0.3733	0.4454	0.9535	0.0154	0.0384	0.1005	0.1276	0.1184	0.0652
Dependent variable: ln (Forest Area, % of Total land); Independent variable: ln (GDP per capita) Cubic									
GDPPC	-0.622**	-92.58***	11.484***	-0.0801	-0.501	38.98	-185.1	-9.177	-48.09
	(-3.04)	(-2.83)	（10.17）	(-0.26)	(-0.90)	(0.66)	(-0.93)	(-1.00)	(-1.40)
GDPPC^2	0.0900**	14.43***	-1.161***	0.00568	0.0837	-5.031	25.58	1.532	8.046
	(2.67)	(2.77)	（-10.21）	(0.14)	(0.90)	(-0.67)	(0.90)	(1.07)	(1.42)
GDPPC^3	-0.00359*	-0.736**	0.0391***	-0.000109	-0.00461	0.212	-1.176	-0.0834	-0.444
	(-1.98)	(-2.66)	(10.24)	(-0.07)	(-0.90)	(0.66)	(-0.87)	(-1.13)	(-1.44)
Const term	0.00332**	3.019***	-33.51***	-0.000437	-0.000250	0.0468	-0.00736*	-0.00562	0.00137
	(2.20)	(241.27)	（-8.97）	(-0.55)	(-0.99)	(1.43)	(-2.01)	(-1.27)	(0.45)
R^2	0.3866	0.5156	0.9839	0.0154	0.0559	0.1109	0.1371	0.1420	0.1171
Number of obs	50	50	46	50	27	45	42	43	26
Kuznets curve	Yes	Yes	No	No	?	No	Yes	No	?

Notes:
1.t statistics in parentheses, $^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$
*2.**Kuznets curve** means whether there is a Kuznets curve turning point in the period of 1961–2011, which is the time span of observations. For some economies such as Japan, the curve depicts a steady line and have gone across the turning point before 1961; and Laos, which depicts a steady descend in the observed period and have not yet reached the turning point.*

The following two criteria will determine whether the relationship follows a Kuznets curve: the t statistic of ln (GDP per capita) quadratic is significant and the sign is positive. From the regression table, China, Philippines and India depict a relatively significant Kuznets curve correlation. Japan and South Korea remain stable in long-term and do not exhibit the forest area changes with GDP per capita growth.

Malaysia and Indonesia showed no obvious relationship between the inverted U-shaped curve. Limited by the GDP per capita of missing data of Vietnam and Laos, only data of GDP per capita after 1984 available from the database of FAO and the World Bank, it is hard to accurately determine the Kuznets curve turning point of these two economies by just 26 and 27 observations. The differences of R^2 between economies suggest that the impact of economic growth on economies also were significantly different. Such as India, whose R^2 value is large means the economic growth has a very significant impact on forest area changes; however, for Malaysia the role of economic growth is limited.

Other Drivers to Deforestation and Forest Degradation

Literature Review and Descriptive Analysis

There are many kinds of drivers to deforestation and forest degradation. Agricultural expansion, population pressure, destructive logging, infrastructure development, fire are considered the main reasons for deforestation worldwide, and hence exploring the driving forces that move forest resources into an upward trend constitutes a major content of forest transition (Mather 2007). Besides these main drivers, the driving forces to forest transition may vary in different economies or regions at different stages of development. Agricultural intensification, demographic trend, rural-urban migration, changes of resource perceptions, timber price, policy intervention and institution development, are all possible factors that could function in certain circumstances to promote forest transition.

In historical analyses, Mather *et al.* (1999) described forest transition as a broad set of interrelated economic, political, institutional, and cultural processes in the agriculture, forestry, and energy sectors. Rudel *et al*. (2005) identify two broad pathways of forest transition: the economic development path and the forest scarcity path. Lambin and Meyfroidt (2011) expanded forest transition pathways to five: forest scarcity, state forest policy, economic development, globalization and smallholder, and tree-based land use intensification pathways.

According to national-scale statistical modeling, forest area changes in Asia-Pacific economies were due to a combination of economic and political responses to forest and land scarcity, economic growth, and international market integration. The predominant causes of deforestation and forest degradation are large-scale clearing of forests and exploitation of forest resources. Expansion of agriculture also caused deforestation. After 1970s, with the development of agriculture, some forest lands were converted to agricultural lands and then converted to residential, industrial and other uses. Slash-and-burn cultivation was a cause of deforestation in some economies. For example, in the Gangwon Province, South Korea, where forests comprised 80% of total land, the illegal slash-and-burn fields occupy 31% of total forest area in 1974 (Ho 1975).

Quantitative Methodology and Empirical Analysis

A dataset related to the socio-economic and forest condition factors across the nine economies since 1960 was developed from the reports submitted under the project. Additional data including forest area, forest coverage, population, incomes, were acquired from the World Bank and FAO websites. The complete dataset follows the

format as in Table 20.

Table 20. Descriptive statistics for regression variables of extended model

Explanation	Unit	Time Span
Dependent Variables		
ln (Forest Area) [a b]		
CHN	% of land area	*1962–2011*
JPN		*1966–2011*
KOR		*1960–2011*
VNM		*1960–2011*
LAO		*1960–2011*
PHL		*1969–2011*
IDN		*1968–2011*
IND		*1968–2011*
MYS		*1966–2011*
Independent Variables		
ln (GDP per capita) ln (GDP per capita)^2 ln (GDP per capita)^3	constant 2005 USD	*1960–2011*
Rural population	Capita	*1960–2011*
Agricultural land	sq. km	*1960–2011*
Land under cereal production	ha	*1960–2011*
Cereal yield per ha	tonne/ha	*1960–2011*

Notes:
[a] Data except for Forest area mainly sources from FAO and World Bank website;
[b] Data of Forest area, especially that before 1990, is from reports of the nine economies. But due to different definition and statistical caliber of forest and forestland in each economy, data of forest area before 1990 has been converted to a uniform statistical standard.

The extended model has two formulae:

$$\ln FA = a_0 + \ln GDPPC + \ln GDPPC^2 + \ln RP + \ln AL + \ln CL + \ln CY + u \quad (1)$$

$$\ln FA = a_0 + \ln GDPPC + \ln GDPPC^2 + \ln GDPPC^3 + \ln RP + \ln AL + \ln CL + \ln CY + u \quad (2)$$

** ln FA = ln (Forest Area, % of Total land)*
ln GDPPC= ln (GDP per capita)
ln $GDPPC^2$= (ln (GDP per capita))^2
ln $GDPPC^3$= (ln (GDP per capita))^3
ln RP =ln(Rural Population)
ln AL = ln (Agricultural land)
ln CL = ln (Land under cereal production)
ln CY = ln (cereal yield per ha)

The Regression results are as follows (Table 21):

Table 21. Regression results of extended model

	CHN	IND	JPN	KOR	LAO	MYS	PHL	IDN	VNM
Dependent variable: ln (Forest Area, % of Total land); Independent variable: ln (GDP per capita) quadratic									
GDPPC	0.00881	-2.824**	-0.119*	-0.0460	-0.0405	3.304	-9.045**	1.478	-1.317
	(0.09)	(-2.53)	(-1.70)	(-0.96)	(-1.29)	(0.92)	(-2.43)	(1.34)	(-0.41)
GDPPC²	-0.000370	0.230**	0.00494	0.00240	0.00357	-0.250	0.656**	-0.110	0.156
	(-0.04)	(2.47)	(1.43)	(0.91)	(1.40)	(-0.98)	(2.45)	(-1.41)	(0.55)
RP	-0.0287*	0.185***	0.0237	-0.0747	-0.011***	0.297*	0.593**	0.0375	0.0249
	(-1.87)	(7.34)	(0.97)	(-0.92)	(-8.63)	(1.70)	(2.65)	(0.92)	(0.83)
AL	0.0778	0.866	0.00468	-0.0586	-0.00237	1.979	-0.811***	-0.0273	-0.217
	(1.02)	(1.35)	(0.26)	(-0.94)	(-0.86)	(1.08)	(-4.44)	(-0.43)	(-1.30)
CL	0.00917	0.478***	-0.00347	0.0294	0.00321*	-0.337*	-0.0534	0.103**	0.328
	(0.32)	(5.56)	(-0.51)	(1.04)	(1.96)	(-1.74)	(-0.99)	(2.48)	(1.59)
CY	0.0174**	0.0254	0.00295	0.000274	-0.000632	0.271	0.0505	0.385**	-0.174
	(2.42)	(0.45)	(0.82)	(0.12)	(-0.37)	(0.61)	(0.78)	(3.23)	(-1.66)
Constant term	0.573**	-21.95**	4.929***	-0.000293	0.170***	-0.148	-0.00203	-0.710	-0.441
	(1.87)	(-2.70)	(14.00)	(-0.29)	(8.46)	(-0.04)	(-0.62)	(-0.93)	(-0.83)
R^2	0.3733	0.9496	0.9579	0.1213	0.8959	0.2082	0.4227	0.4120	0.3369
Dependent variable: ln (Forest Area, % of Total land); Independent variable: ln (GDP per capita) Cubic									
GDPPC	-2.193***	17.42	11.84***	0.127	-0.255	55.53	-153.9	-40.61	-64.92
	(-3.00)	(1.39)	(10.95)	(0.20)	(-0.32)	(0.99)	(-0.71)	(-1.56)	(-1.09)
GDPPC²	0.377***	-3.027	-1.197***	-0.0178	0.0396	-6.953	21.34	6.042	10.75
	(3.01)	(-1.52)	(-11.00)	(-0.24)	(0.30)	(-0.97)	(0.69)	(1.58)	(1.09)
GDPPC³	-0.021***	0.173	0.0402***	0.000778	-0.00199	0.285	-0.984	-0.299	-0.585
	(-3.02)	(1.65)	(11.02)	(0.26)	(-0.27)	(0.95)	(-0.67)	(-1.60)	(-1.08)
RP	-0.081***	0.192***	0.00633	-0.0755	-0.012***	0.346*	0.576*	-0.148	0.0600
	(-3.11)	(8.11)	(0.51)	(-0.88)	(-6.77)	(1.69)	(2.54)	(-1.35)	(1.16)
AL	-0.00476	1.034	0.00898	-0.0602	-0.00247	2.030	-0.806***	-0.0211	-0.240
	(-0.07)	(1.59)	(1.02)	(-0.89)	(-0.93)	(1.07)	(-4.26)	(-0.35)	(-1.34)
CL	0.0470	0.455***	0.00399	0.0294	0.00315*	-0.286*	-0.0481	0.127**	0.323
	(1.31)	(5.25)	(1.17)	(1.02)	(1.88)	(-1.72)	(-0.87)	(2.67)	(1.59)
CY	0.0273***	0.0104	0.00489*	0.000273	-0.000653	0.242	0.0327	0.338***	-0.191*
	(3.40)	(0.19)	(2.42)	(0.11)	(-0.38)	(0.58)	(0.48)	(3.05)	(-1.95)
Constant term	1.638***	-24.11***	-34.72***	-0.000324	0.174***	-1.624	-0.00131	2.737	-1.065
	(3.11)	(-2.90)	(-9.71)	(-0.35)	(6.66)	(-0.44)	(-0.37)	(1.35)	(-1.16)
R^2	0.5420	0.9523	0.9839	0.1218	0.8962	0.2244	0.4282	0.4535	0.4060
Number of obs	49	50	46	49	27	45	42	43	26

*Notes: t statistics in parentheses, *p< 0.1, **p< 0.05, ***p< 0.01*

Population

Population dynamics have been widely considered as an important element in land cover change dynamics. Many studies have singled out population growth as one of the most important causes of deforestation (Vanclay 1993, World Bank 1992). In fact some studies have argued that population growth explains more than half of the loss in forest area worldwide (Mather and Needle 1998, Myers 1991).

Population growth and rural population density are two population-related variables that have been widely used in previous empirical studies on deforestation. Excessive population growth and population pressure in developing economies are commonly cited as key factors inducing excessive tropical deforestation (Myers 1994, Cropper and Griffiths 1994, World Bank 1992, Allen and Barnes 1985). Templeton and Scherr (1999) argued, however, that population pressure is a two-edged sword. They suggested that population pressure initially may cause increased tropical deforestation, but once population grows to a certain level production processes are changed to improve efficiency, thus conserving remaining natural resources. Considering the controversial role of population pressures on the tropical deforestation process, two separate variables: population growth and rural population density, are used in the deforestation model. This approach highlights the impact of population structure; whether it is rural population pressure or the overall population level that affects the deforestation process. It is hypothesized that an increase in both population growth rate and rural population density will lead to increased deforestation (Bhattarai and Hammig 2001). From the regression results, there is a controversial role of population for different economies. For China and Laos, there is a negative correlation between rural population and forest area changes; while for the Philippines, Malaysia and India, there is a positive correlation between rural population and forest area changes.

Agricultural land Expansion

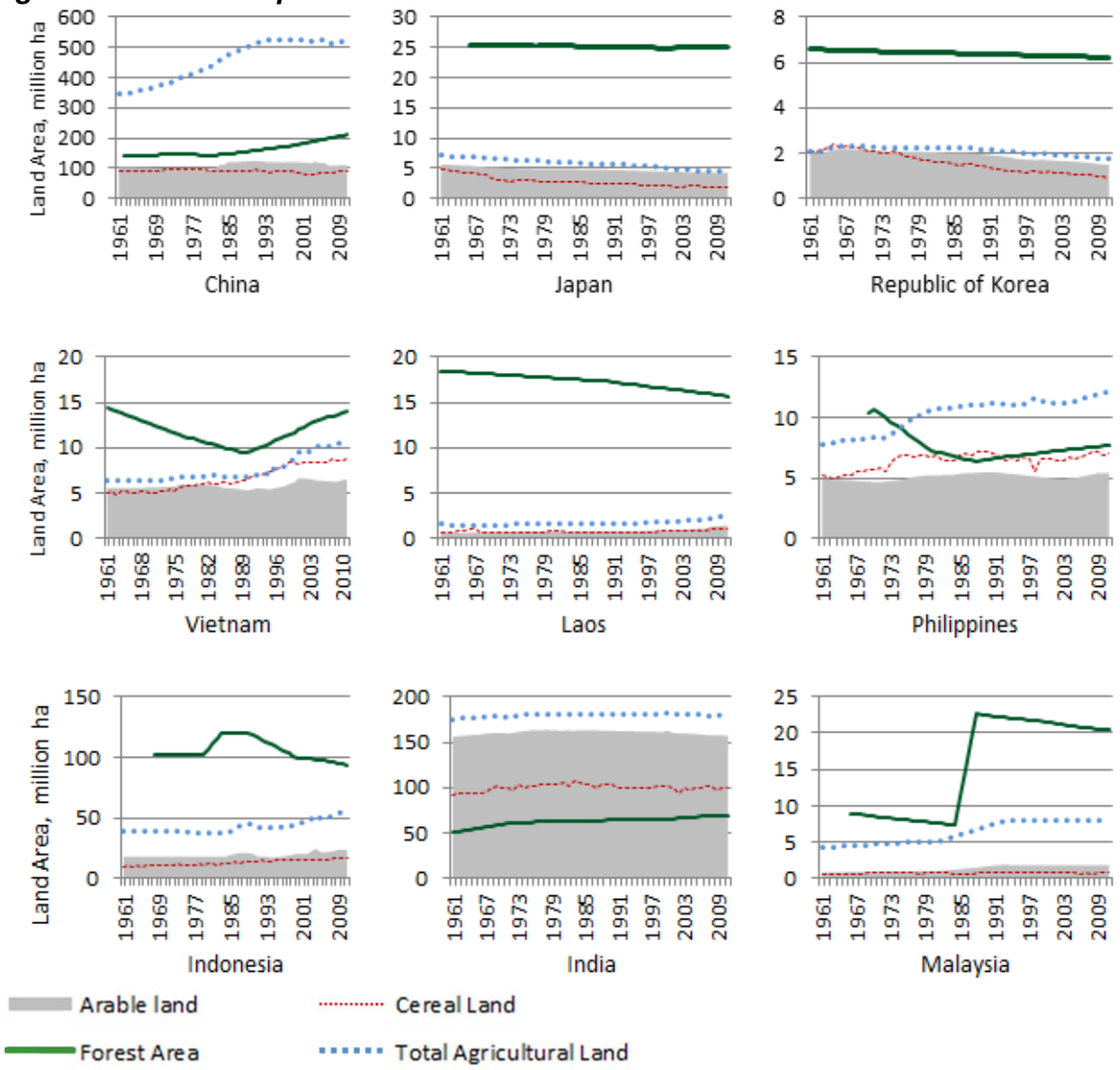


Figure 10. The changes of Arable land, Cereal Land, Forest Area and Agricultural Land (1961–2011)
Source: FAO, World Bank, national reports

In many developing economies, rural poverty, skewed land ownership, and population growth were major causes of deforestation. Koh and Wilcove (2008) used national land-use data compiled by FAO to determine the types of land that have been converted to oil palm lands in Malaysia and Indonesia. They have presented a framework for assessing the impact of converting different land uses to oil palm on biodiversity. Although, it has generally been acknowledged that oil palm plantations in Malaysia and Indonesia have been created from existing agricultural lands and forests, the relative contributions of these two land uses to oil palm expansion have to be investigated.

Recently, the causal factors behind the processes that lead to conversion of forests into farmland, tropical cropland, and other non-forest lands have attracted

considerable attention in the literature on forest land changes in less developed economies (Zhang *et al.* 2000). Forest loss has many serious negative environmental and socioeconomic impacts in less developed economies, especially in the long-term. However, land conversion that leads to forest land expansion has received only little attention in the literature on land use economics.

In the regression results shown in Table 21, the increase of agricultural land does not necessarily lead to a decline in forest area, for only the regression result of the Philippines is significant. This sounds strange, but looking closely at Figure 10 reveal that changes in forest area and agricultural land area do not be along a constant direction from the beginning till now in most economies. In the case of the Philippines and Vietnam, the forest area declined with the increase of agricultural land in the first phase, and both the forest area and agricultural land begin to increase in the second phase.

However, cereal land and forest area have the same change direction in India, Laos and Indonesia, except in Malaysia. In these three economies, both forest area and cereal land follow the same trend in the same period. According to national reports of Laos and Indonesia, continuous expansion of tropical crops planting area is a major reason. In some tropical economies, expansion of tropical crops planting area not only occupies the cereal land, but also causes deforestation to some extent.

Cereal Yields

Increase of cereal yields per hectare can be used as a measure of agricultural technology development. In those economies whose t-value of cereal yields is significant, such as China, Japan and Indonesia, cereal yields has a positive effect on forest area. With the increase of cereal yields per hectare, the pressure of food decreases, and consequently causes a decreasing demand for arable land and finally reduce deforestation.

Discussion

Usually, the forest management system, administration and regulation, are considered as important factors of forest area changes. Though population growth and shifting cultivation, and commercial logging and timber harvesting, are frequently cited as leading factors for excessive deforestation, the relationship between these factors and deforestation is filtered through and shaped by institutions and policy conditions. Thus, the impact of institutions on deforestation deserves special scrutiny. But these factors are difficult to accurately measure by mathematical analysis methods. How to better and more accurately analyze the impacts of the above factors needs more extensive and more in-depth discussions.

There are yet some factors that did not happen in other economies but it is very significant for a specific economy, and it is often difficult to measure this distinct factor using quantitative model. In the case of South Korea, the Korean War is a non-negligible factor for deforestation. Korean War, which occurred from 1950 to 1953, caused rapid deforestation and forest degradation in large areas. In 1945 the total area and total volume of growing stock of South Korean forests were estimated as 6.8 million ha and 74 million cu m respectively. After the Korean War, in 1955, the total

area and total volume of growing stock of South Korean forests decreased to 6.7 million ha and 49.4 million cu m (Bae 2012, Park 2012).

The qualitative analysis results are robust to the model specification. However, their reliability depends on data quality. The data quality is constrained by several factors. For example, the time span of some available data is limited, such as the key variable: forest area, FAO database contains only data after 1990. Such short time span results in difficulties to accurately depict the whole picture of the pathway of forest area changes. Some economies have national records before 1900s. But due to different definitions and statistical calibers of forest and forestland, data of forest area before 1990 has to be converted using a uniform statistical standard, which further weakens the data quality.

CHAPTER 6 TRADE, FDI AND FOREST TRANSITION IN ASIA-PACIFIC REGION

Introduction

In the last few centuries the world economy has made tremendous progress. But at the same time forest area continued to decrease, exerting great pressure on biodiversity conservation and sustainable development. Greenhouse gas emission from deforestation and forest degradation accounted for 20% of total emissions, ranking only second to the energy sector (Angelsen 2008). Reducing carbon emission from deforestation was considered as an effective tool to mitigate climate change (Canadell and Raupach 2008). UN-REDD Programme was devoted to reduce forest and land-based emissions in developing economies through performance-based REDD+ stimulation mechanism, and realize national development goals in sustainable and equitable ways (UN-REDD Programme 2013). It is of vital importance for initiatives aimed at reducing deforestation and forest degradation such as REDD, to identify the underlying causes for forest loss, as well as the factors promoting forest increase.

Ever since 1980s, international trade and liberalization of investment developed rapidly, making the world economy a closely linked whole. The process of economic globalization had huge impact on politics, economics, society and culture; and also had profound influence on conservation and utilization of natural resources including forests. Some attention during the past several years has been directed towards understanding the factors through which globalization promote reforestation and forest rehabilitation. These include trade in agricultural and forestry products (Meyfroidt *et al.* 2010), remittance (Hecht *et al.* 2006), emigration (Klooster 2003), and tourism (Kull *et al.* 2007). But the mechanism of how globalization affects forest transition was still poorly understood.

Asia-Pacific region was among the fastest economic growth regions during the last three decades and is rich in biodiversity. But huge differentiation of economic growth pattern and forest resource conditions existed across Asia-Pacific economies. For example, Japan and South Korea realized industrialization before 1980s, meanwhile their forest area reached and stayed at a high level. China benefited from globalization later by absorbing huge FDI and introducing advanced technology to transform and upgrade its manufacturing industry. Export-oriented economic development pattern made a great success and promoted economic growth in China. Nearly at the same time, trend of deforestation in China reversed and forest resource began to increase rapidly. Similar cases also happened in India and Vietnam, although scale of FDI and exports were relatively smaller. Some other developing economies in this region such as Indonesia and Malaysia, also joined the global market but with a fluctuated inflow of FDI and the proportion of primary products in their exports stay high or decline quite slowly. Forest resource continued to decline in

Indonesia and Malaysia in the last three decades.

Previous research on FDI mainly addressed on relationship between FDI and economic growth. Such as the way FDI affects economic growth (Markusen and Venables 1999, Borensztein *et al.* 1998, Xu 2000) and endogenous relationship between FDI and economic growth (Gao 2005, Li and Liu 2005). However, study on influence of global industrial capital expansion on natural resources, such as forests, was still not enough. The comparative study, analyzing the national reports submitted by the nine Asia-Pacific economies, attempt to determine how international trade and FDI expansion affect forest resource changes in the process of globalization, and to gain a better ~~understand~~ of the relation between trade, FDI and forest transition.

Background

China, India and Vietnam have realized forest transition in 1980s and 1990s respectively, and were recognized as models that successfully reverse the long deforestation trend. Forestry development and forest resource conservation policies were considered to have positive effect in this process (Mather 2007). Especially, the afforestation activities under policy support were closely related with forest resource increase (Figure11). By contrast, since 1980s, afforestation scale declined or remained stable in deforestation economies, such as Indonesia, Malaysia and Laos. Japan and South Korea realized forest transition before 1980s, and forest resource maintained a high level while afforestation area remained stable. Forest in Philippines was severely destructed before 1990s, but forest area began to increase slowly after 1990. In the last three decades, afforestation activities remained at a low level in Philippines (Figure11).

Against the globalization background, another significant variable that was closely related to forest resource changes was international trade of agriculture/forest products. Global forest products export value in 1961 was USD 5.16 billion, and increased rapidly to USD56.65 billion, USD144.85 billion, and USD231.25 billion in 1980, 2000 and 2012 respectively (FAO 2013). In the case of Asia, forest products export value increased from USD0.39 billion in 1961, to USD7.19 billion, USD17.79 billion, and USD38.98 billion in 1980, 2000 and 2012 respectively. Imported forest products value in Asia increased more rapidly, from USD0.62 billion in 1961, to USD16.55 billion, USD43.32 billion and USD92.39 billion respectively in 1980, 2000 and 2012 (FAO 2013). Global expansion of market economy put double pressures from both domestic and international markets on agriculture/forest product exporting economies. "Leakage effect" can be observed when one economy or region transfers pressure on natural resources and ecosystem to other places through migration or agriculture/forest products imports (Lambin and Meyfroid 2011, Wittemyer *et al.* 2008, Gan and McCarl 2007). An analysis from 176 economies suggested that rich economies meet their demand through appropriating resources from poor economies, and realized local preservation (Julianne 2013). Another study on seven developing

economies that recently realizing forest transition indicated that, displacement of forest extraction abroad accompanied local reforestation (Meyfroidt *et al.* 2010). About 39% of the regrowth of Vietnam's forests from 1987 to 2006 was achieved by the displacement of land use to other economies (Meyfroidt and Lambin 2009).

"Leakage effect" may cause illusion of resources conservation. This "leakage effect" can also be revealed through this comparative analysis of the nine participating economies: rapid increase of forest products import in China, India and Vietnam began in 1980s, 1990s and 2000s respectively, and the large net imports of forest products relieved pressure on domestic forest resources. On the contrary, large net exports of forest products in Indonesia, Malaysia and Laos, have put double pressure from both domestic and international markets on domestic forest resources. "Leakage effect" also exists in Japan and South Korea where imports exceed exports of forest products and imports tend to stabilize. Before 1990, Philippines was a net exporter of forest products, and forest coverage continued to decline to 22%, and after it became an importer of forest products after 1990, forest area began to increase slowly (Figure11). In summary, among nine Asia-Pacific economies participated in the project , economies realizing forest transition have all imported more forest products than they exported and thus relieved pressure on their forest resources. In economies where deforestation continued, large net exports of forest products have played an important role.

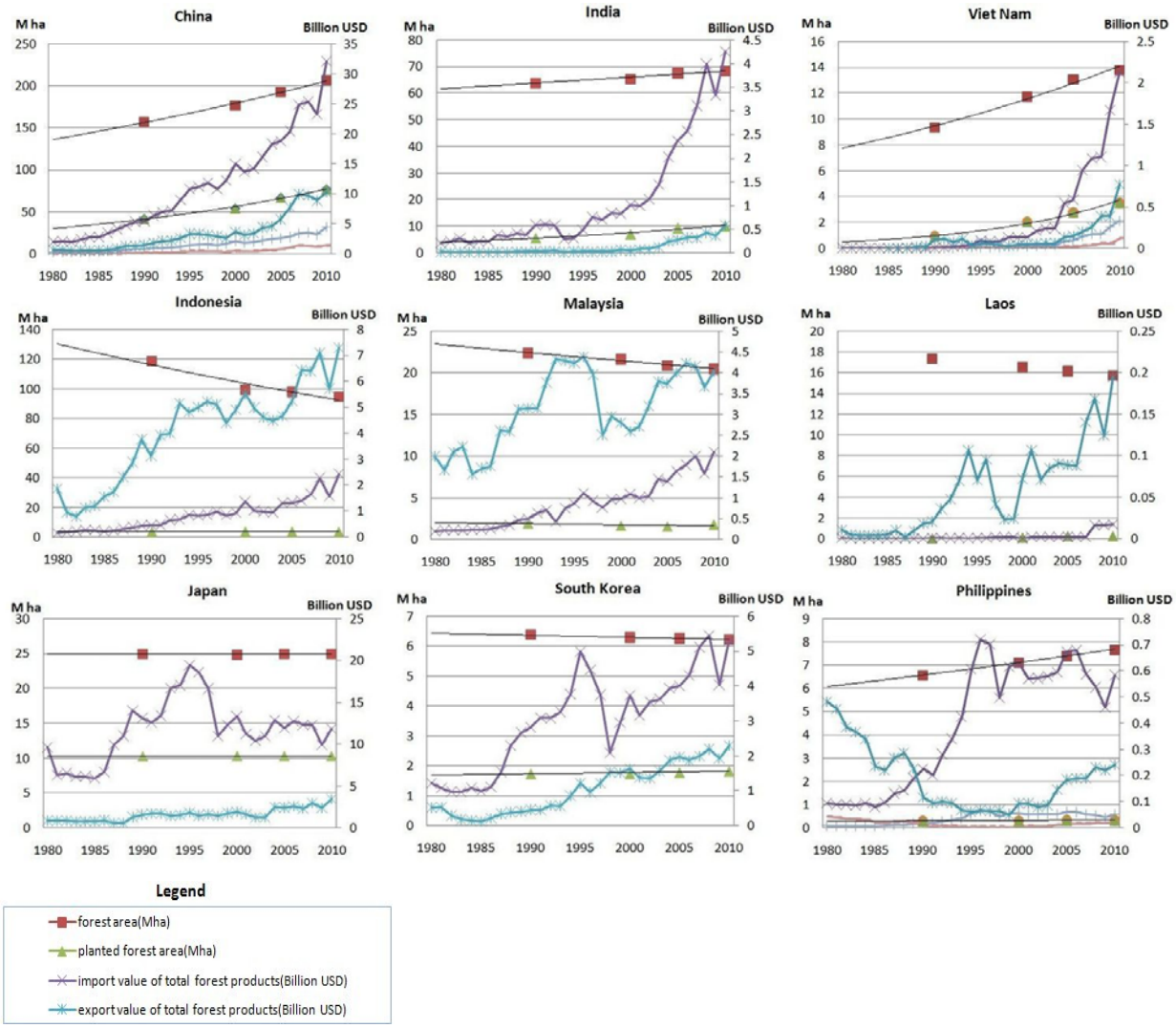


Figure 11. Historical changes in forest area and trade value

Paul and Anthony (1995) explained how global economic integration make manufacturing sector first concentrated in developed, and then in developing economies. Decline of transportation costs and wage rate played a vital role in this process (Paul and Anthony1995, Paul 1991). Under the condition of global decline of transportation costs, low labour cost in some labour-rich developing economies laid a foundation for them to absorb foreign investments and technologies, practicing export-oriented strategy and develop labour intensive processing industries. Since the 1960s, chase of capital to cheap labour force and improvement of terms of trade such as tariff cut, have brought worldwide boom in FDI. FDI inward flow amounted to USD13.35 billion in 1970, and this increased rapidly to USD54.07 billion, USD207.36 billion, and USD1413.17 billion in 1980, 1990 and 2000 respectively (UNCTAD 2013). It was during 1980 and 2000 that global FDI flow increased most rapidly. FDI inward flow maintained a high level since 2000. Inward FDI promoted processing industry in host developing economies and help them getting rid of high dependence of economic growth on land and land-based resources.

After 1980s, China, India and Vietnam began to actively absorb FDI, develop external processing trade and promote transformation of economic structure to manufacturing and processing industries. Especially after 1990, inward FDI and export-oriented manufacturing sector increased rapidly in these three economies, causing decline of proportion of primary products in total exports (Figure 12). However, in Indonesia, Malaysia and Laos, FDI inflows fluctuated and were at a relative small scale since 1980s. Although proportion of forest products in total exports was in a declining trend, the absolute proportion was still high in these three economies (Figure 12). FDI inflows also fluctuated in Japan and South Korea that realized industrialization a long time ago, and proportion of forest products in their total exports were relatively small. FDI inflows increased in the Philippines after 1990, but also experienced fluctuation (Figure 12). Proportion of forest products in total exports declined in the Philippines. The relative scarcity of forest resource in the Philippines after 1980s was also an import factor driving decline of forest products export.

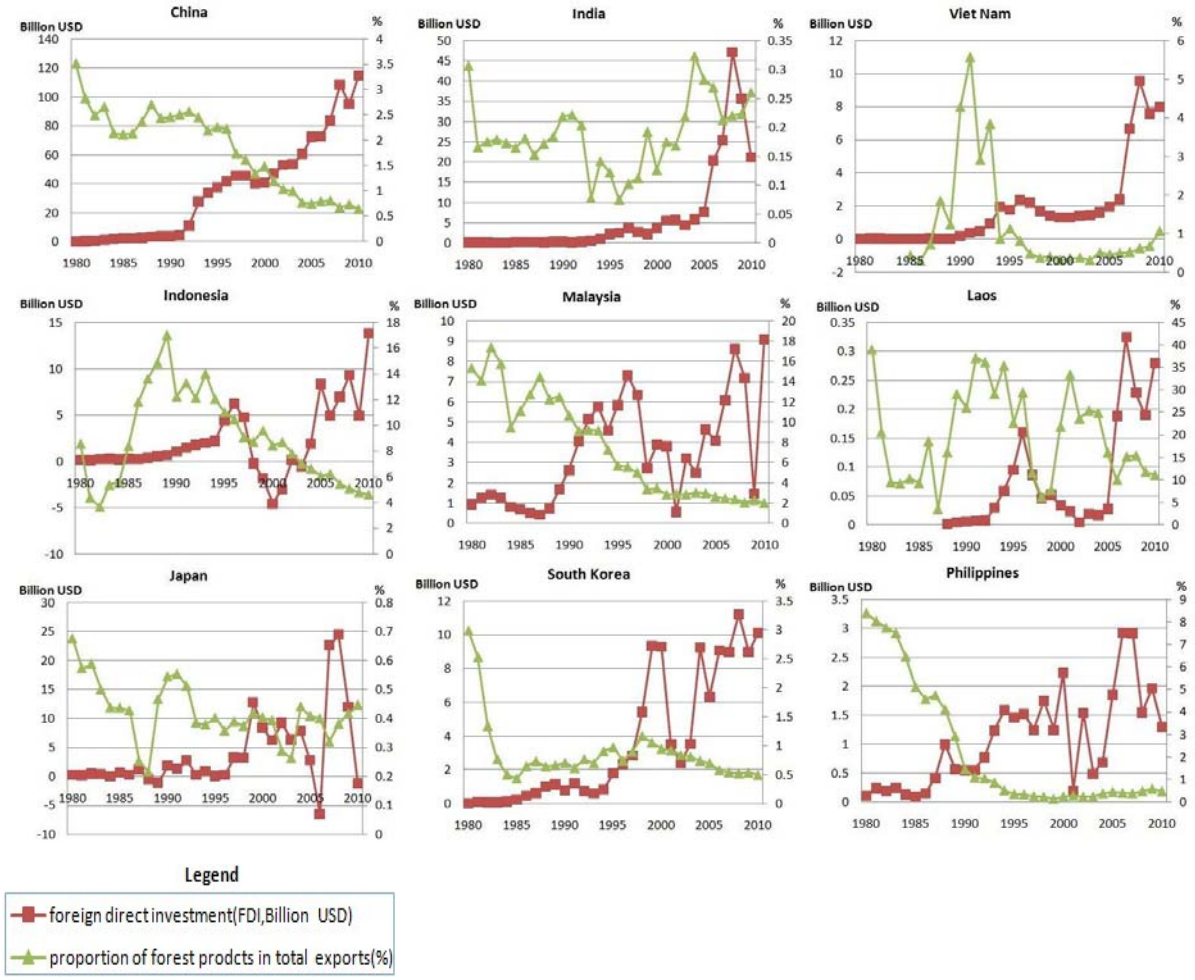


Figure 12. Historical changes in FDI and trade of forest products

Model specification and results

A dataset was built based on officially published statistics to further examine the possible correlations between trade, FDI and forest change dynamic in the nine economies studied. Due to limited forest resource data, the dataset covers only four time-points: 1990, 2000, 2005 and 2010. Data were sourced from FAOSTAT and UNCTADSTAT. The sample size was 36. Description of the variables is shown in Table 22.

Forest area (FA), forest volume (FV) and forest density (FD) were chosen as dependent variables. The independent variables can be divided into four categories:

1. Macroeconomic income factor. Economic growth may increase demand for agriculture/forest products at the early stage, leading to aggravation of deforestation. But as GDP per capita further increased, the consumption preference and structure would change and environmental service demand would increase, causing increase of forest area. Economic growth may also reduce deforestation through creating more non-farm employment opportunities (Xu et al. 2007), and transforming energy source via urbanization (DeFries and Pandey 2010). Exploring the relationship between forest area and GDP per capita constitute the main content of research on EKC for deforestation (Culas 2012). GDP per capita (GDPPC) was used as a control variable in the proposed model.
2. Demographic factor. In developing economies, population pressure would, on one lead to increase in conversion of forest land to agriculture land due to food scarcity, and on the other hand lead to over-use of forests due to unemployment and poverty, causing deforestation. Some other research argued that population pressure could reduce deforestation through innovation and technological progress (Templeton and Scerr 1999).—Population density (POPDEN) was included as another control variable in the model.
3. Policy factor. In the last three decades afforestation policy in Asia economies played an important role in forest dynamic changes. Planted forest area (PFA) was another variable included to account for the effects of policy in the model.
4. Trade and FDI. FDI inflows could promote development of export-oriented manufacturing and processing industries, and help developing economies to reduce dependence of economic growth on land and land-based resources. Data from the nine economies studied suggested that FDI inward was positively associated with total export value (spearman's rho = 0.6777, p-value = 0.0000).To avoid co-linearity, total export value (EXP) was used in the model, and also added another variable – the proportion of forest products in total exports (PFEXP) to determine the effect of export structure changes that was related to FDI on forest resource changes. Import value of forest products (FIMP) can be used to reflect influence of "leakage effect". PFEXP can be used together with EXP to explore internal relevance between trade and forest transition.

Table 22. Details of variables

Variables	Explanation	Unit	Expected sign
Dependent variables			
FA	Forest area	million ha	
FV	Forest volume	million cu m	
FD	Forest density, FV/FA	cu m per ha	
Independent variables			
GDPPC	GDP per capita	USD	not clear
POPDEN	Population density	people per hectare	negative
PFA	Planted forest area	million ha	positive
FIMP	Import value of forest products	million USD	positive
		million USD	
EXP	Total export value	%	positive
PFEXP	Percentage of forest products in total exports		negative

The panel-data linear model was estimated by using feasible generalized least squares (FGLS), and the empirical model corrected for heteroscedasticity and autocorrelation (AR1). Results are as reported in Figure 14.

Empirical results suggested that, planted forest area (PFA) has positive effect on forest area (FA) and forest volume (FV), but has negative effect on forest density (FD). Imported value of forestry products (FIMP) has a positive effect on FA and FV. Proportion of forestry products in total exports (PFEXP) has negative effect on FA, FV and FD. Total exports value (EXP) has a positive effect on FA and FD, while no significant effect on FV. In addition, GDP per capita (GDPP) is negatively associated with FA and FV, but positively associated with FD. Population density (POPDEN) has negative effect on FA, FV and FD.

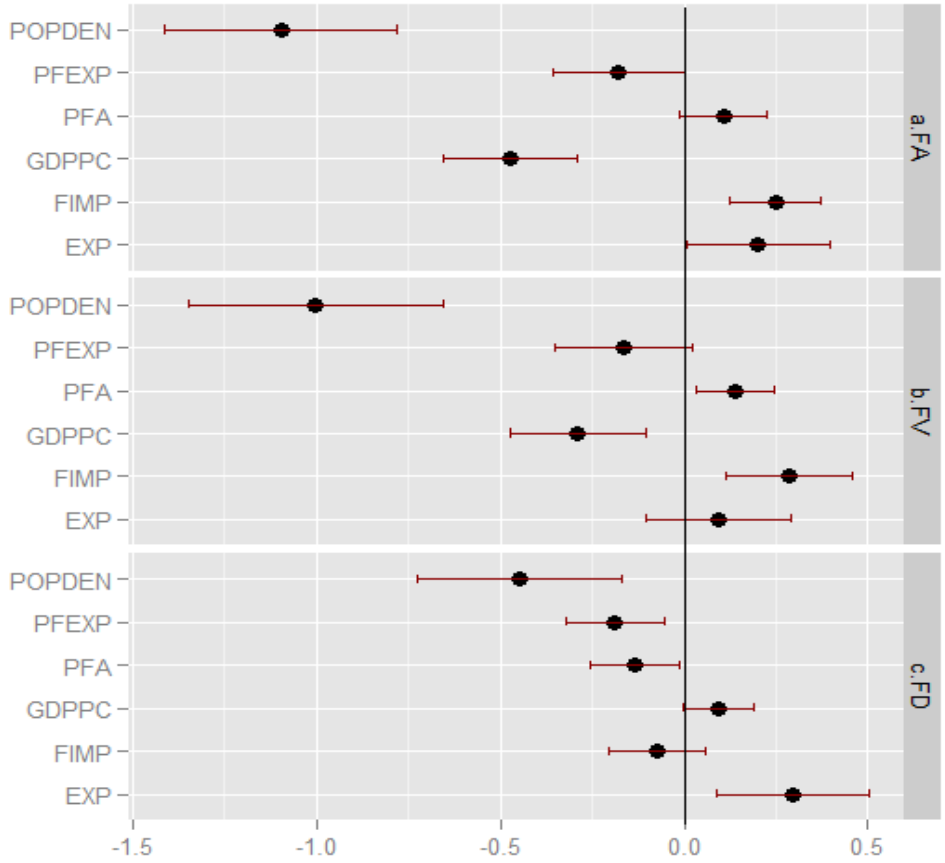


Figure 13. Feasible generalized least squares regression for FA, FV and FD

Discussion

There is a diversity of levels of economic and society development and forest resource conditions in Asia-Pacific economies, providing a good opportunity to study process and mechanism of recent forest transition against globalization background. Empirical study on the nine Asia-Pacific economies suggested that, afforestation initiatives were important driving forces to realize local forest transition (Figure 14). But afforestation activities had negative effects on local forest density (FD), which was probably due to the low density of saplings. Realizing forest transition through afforestation may have more complex effects on forest ecosystem. This study also confirmed the function of "leakage effect", i.e. imports of forest products had positive effects on forest area and forest volume (Figure 14). China, India and Vietnam that realized forest transition in late 20th century, were all net importers of forest products. Deforestation still continues in Indonesia, Malaysia and Laos, which are huge net forest products exporters (Figure 12).

PFEXP had negative effect on FA, FV and FD (Figure 14), i.e. other things being equal, the larger the proportion of forest products in total exports, the bigger the pressure on forest resource conservation. Total export value (EXP) had positive effect

on FA and FD, i.e. other things being equal, when total exports increased in one economy, forest resource condition tend to be improved. This has reflected the effect of export structure changes from primary products to manufacturing products dominated on forest resources. Against the background of global economic integration, one economy or region could promote local forest resource conservation when economic growth of the economy or region rely more on manufacturing industry and thus reduce dependence on land and land-based resources. China, India, and Vietnam that realized forest transition in the last three decades in Asia-Pacific region, enhanced their sustainable forest use and forest conservation when they absorbed FDI and developed export-oriented labour intensive manufacturing industry. Unlike the cases of "leakage effect", the effect of sending manufacturing goods is different to sending forest products on forest resources. Promoting manufacturing products-based exports could reduce economic dependence on land-based resources and help realize local forest conservation. One shortcoming of this analysis was that, only the main body of FDI inward, i.e. FDI that flowed to manufacturing and infrastructure industry was considered, and the effect of FDI in agriculture sector has been neglected. A recent research indicated that FDI in agriculture sector may lead to "land grab" process driven by production of food and biofuel for export (Zoomers 2010). For example, more than 50 million ha of farmland was under this kind of deal in 2009 in Africa (Friis and Reenberg 2010). Considering the close conversion relationship between forest and farm land, the effect of FDI on forest resource changes need further study.

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