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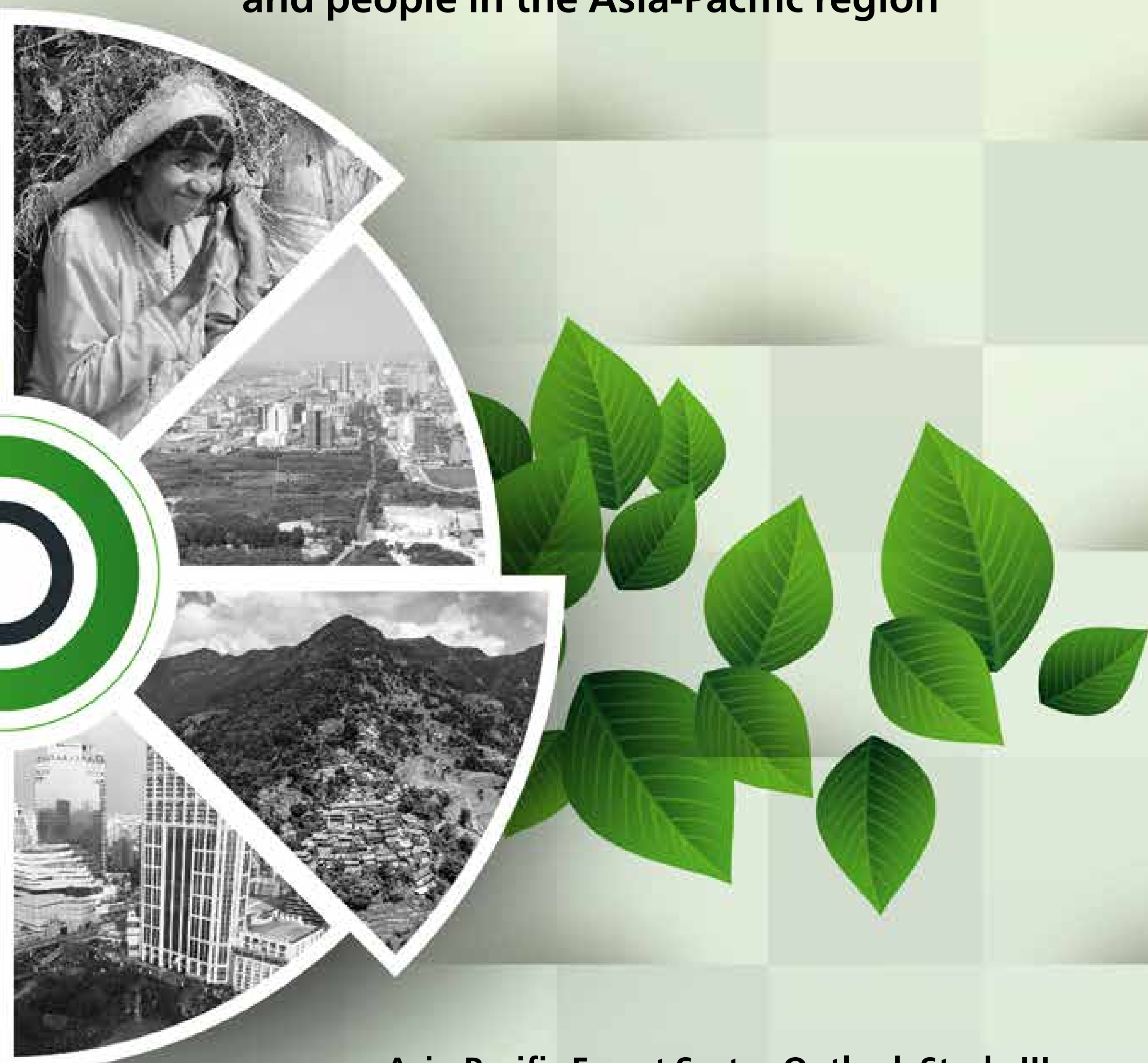
FOREST FUTURES

Sustainable pathways for forests, landscapes and people in the Asia-Pacific region



Asia-Pacific Forest Sector Outlook Study III

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Foreword

This report on the future of forests and the forest sector in the Asia-Pacific region comes at a crucial moment. The pace of change in the region is relentless – with populations expanding, economies surging and pressure on resources increasing. Climate change has already affected forests and is expected to do so more in the future. The rapid emergence of digital technologies marks a new direction for societies, with major implications for forests.

The consumption of forest products is changing in the region. The traditional use of wood as a source of domestic energy is declining rapidly as incomes rise and people move to cities, leading to the increased use of electricity and liquefied petroleum gas; on the other hand, the use of industrial roundwood (for sawnwood, paper and paperboard, and wood-based panels) is growing to cater to increased demand for housing, furniture and exports. Demand is also increasing for new types of forest products and ecosystem services, such as amenity values, health-and-beauty products, and green space in urban landscapes. New wood-based products – such as biomaterials and biochemicals – are entering the market, and technological innovations are enabling the increased recycling of wood products.

Such changes have helped transform the region's forests. In many countries, large areas of forest have been converted to other land uses, such as agriculture, infrastructure, mining and oil-palm plantations. About 64 percent of the region's forests are now secondary, with varying levels of degradation. The area of planted forests doubled in the region between 1990 and 2015 to meet the growing demand for industrial roundwood. But not all forests are equal, and the shift from primary forests to secondary and planted forests entails sacrifices in the delivery of ecosystem services. Moreover, the region imports timber from other parts of the world to help meet demand, placing stress on forests outside the region.

Although the region faces plenty of challenges, it has made tremendous progress. For example, the total forest area increased by more than 17 million hectares between 1990 and 2015 due to the establishment of new forests, mainly in China. Some countries have undergone "forest transitions" – in which forest area ceases to decline and begins increasing. Efforts to improve forest health and quality are underway to ensure that forests can deliver ecosystem services. Progress has been made in tackling the illegal trade of forest products, and regional cooperation has been strengthened. The role of forests in climate-change mitigation and adaptation has gained momentum, and countries have set aside large areas of forest for the protection of soil and water resources.

At the global level, the Sustainable Development Goals, the Paris Agreement on climate change, and other commitments place great responsibilities on countries and offer visions for the future. They also provide hope that the world will unite in collaborative efforts to achieve sustainable development, ensure food security, eliminate poverty and mitigate climate change. Such a united response is needed urgently.

The region is highly diverse and there is no "one-size-fits-all" solution to the region's forest-related challenges. Nevertheless, this report explores commonalities that apply to all or most countries. One of these is the huge potential of landscape approaches – which are gaining traction in the region – to bring about positive change. Such approaches require the positioning of forests as a component of broader landscapes in which cross-sectoral cooperation ultimately becomes the norm.

A key message of the report is that the region must respond to the challenges ahead sooner rather than later if we are to ensure the resilience of forests, landscapes and communities. It is time to move forestry to the centre stage of development efforts and for sectoral policymakers to work together in a new paradigm of collaboration and synergy. Building resilience and the capacity to respond to uncertainties is crucial. The report sets out seven fundamental actions and a range of policy options that will enhance positive outcomes and mitigate negative disruptions in the future.

This publication is the product of outstanding collaboration among institutions, networks and more than 800 individuals across the region. It explores the demographic, economic, technological, environmental and governance drivers of change that are likely to affect forests to 2030 and 2050. It presents scenarios and a strategic analysis to help policymakers and other actors understand the future roles of forests and the forest sector within the broader economy and how best to address the challenges ahead. Importantly, it presents the views of young people: nearly 300 forestry students and young professionals from more than 30 countries consulted for this report considered that they can shape a sustainable future by taking leadership roles, generating momentum through collaboration and social media, and changing rigid institutions from within by shaking them up.

The region's previous two forest-sector outlook studies have been contributing to forest-related decision-making for two decades. I fully expect this third edition to perform an even more strategic role to 2030 and even further into the future by broadening the debate beyond forests to include their roles in economies and landscapes. I hope this report will trigger policy discussions and provoke healthy debate within and outside the forest sector on how best to enable sustainable landscape management to flourish. All of us have a stake in our forests and can make a difference!

Kundhavi Kadiresan
FAO Assistant Director-General and Regional Representative for Asia and the Pacific

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Acronyms and abbreviations

APFC	Asia-Pacific Forestry Commission
APFSOS	Asia-Pacific Forest Sector Outlook Study
CBF	community-based forestry
CDM	Clean Development Mechanism
COP	Conference of the Parties
EU	European Union
EUR	euro(s)
FAO	Food and Agriculture Organization of the United Nations
FLEGT	Forest Law Enforcement, Governance and Trade
FRA	Global Forest Resources Assessment
FSC	Forest Stewardship Council
GDP	gross domestic product
ha	hectare(s)
ICDP	integrated conservation and development project
IDR	Indonesian rupiah
JPY	Japanese yen
kg	kilogram(s)
km	kilometre(s)
LULUCF	land use, land-use change and forestry
m	metre(s)
NDC	nationally determined contribution
PCCL	partial canopy cover loss
PEFC	Programme for the Endorsement of Forest Certification
REDD+	reducing emissions from deforestation and forest degradation, plus the sustainable management of forests and the conservation and enhancement of forest carbon stocks
SDG	Sustainable Development Goal
SFM	sustainable forest management
SMEs	small and medium-sized enterprises
TLAS	timber legality assurance system
TOF	trees outside forests
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar(s)
VND	Vietnamese dong
VPA	voluntary partnership agreement

Key **messages**

The ongoing decline of biodiversity and resilience in natural forests in the Asia-Pacific region must be reversed.

Forests and landscapes in the Asia-Pacific region are under increasing pressure from climate change, economic growth, infrastructure development, forest conversion, conflicts and other stressors. Despite an overall increase in forest area since 2000 due to the establishment of new forests, biodiversity and ecosystem resilience in natural forests are declining along with the capacity of these forests to deliver water and soil protection, climate regulation, amenity and cultural values, and wood, foods and medicines. Reversing this trend must be a priority for all countries in the region now and in the next decade to ensure our survival, especially in the face of dangerous climate change.

Avoiding further environmental catastrophes by mid-century requires a transformation in the way forests and landscapes are managed.

This report examines the drivers of change in the forest sector in the Asia-Pacific region and analyses three scenarios – business-as-usual, aspirational and disruptive – for 2030 and 2050 to help policymakers and others decide on actions for avoiding environmental catastrophe. It finds that sustainable development will only be achieved in the region if we commit to transformational change (i.e. the aspirational scenario) by working cross-sectorally and across borders, investing massively to restore forests and landscapes, reforming forest tenure and outdated institutions, empowering communities, and embracing innovation. Business as usual will be insufficient.

Strengthening management of the region's forests and landscapes requires that countries work much more closely together.

Demand for forest products and ecosystem services goes beyond borders. Water, wildlife, fire and forest pests don't recognize administrative or sectoral boundaries. Logging bans and restrictions in some countries have put pressure on forests in others. Achieving sustainable forest and landscape management, therefore, requires strong regional and global collaboration. Existing cooperation, although commendable, needs to be greatly strengthened to enable active transboundary resource management.

Primary forests must be conserved – but time is running out.

Primary forests are those forests largely unaffected by human activities, and they are therefore extremely important for biodiversity conservation and other reasons. Of the region's 723 million hectares of forest, however, only 19 percent (140 million hectares) is primary, which is much lower than the global average (32 percent). The conservation of primary forests in the region and the sustainable management of other natural forests are urgently needed to safeguard biodiversity, ecosystem services and the quality and health of the physical environment.

The future of forests depends on us.

The region's population is projected to grow from 4.1 billion people in 2017 to 4.5 billion in 2030 and 4.7 billion in 2050, and economic growth and purchasing power are also on the rise. Home to 55 percent of the world's population, the region contains only 18 percent of global forests. It is urbanizing rapidly, and 67 percent of the population is likely to live in cities by 2050. Innovative adaptive approaches are needed for governance and forest and landscape management – making use of powerful new technologies – to cope with future demands on forests and landscapes, including in urban and peri-urban areas. There is an urgent need for societies to reduce consumption, increase reuse, and sustainably produce biomaterials in forests. We need to find innovative ways to balance competing demands that will benefit us all.

It is not too late to restore the region's forests and landscapes for the benefit of all, but it requires leadership and immediate action.

Realizing an aspirational future – and avoiding catastrophic outcomes – is plausible for all countries in the region if the seven robust actions recommended in this report are implemented. These are to 1) adopt adaptive landscape management; 2) increase cooperation among stakeholders; 3) improve forest quality; 4) invest in alternative economic models; 5) achieve good forest governance; 6) build resilience; and 7) commit sufficient resources for forest and landscape management. With strong political will, these actions will give countries the best chance of ensuring the sustainability of ecosystems, economies and communities.

Executive summary

This report addresses two key questions:

1. Taking into account the major drivers of change, what will forests and forestry look like in 2030 and 2050?

2. What robust actions should be taken today and in coming years to realize an aspirational future for forests?

Building on two previous forest-sector outlook studies in the Asia-Pacific region (in 1998 and 2010), the report:

- provides a strategic analysis of forests and landscapes in the region to help policymakers and others decide on the actions needed to realize a sustainable future;

- explores three scenarios – business-as-usual, aspirational and disruptive – for the future of forests and the forest sector in the region to 2030 and 2050; and

- provides options for robust actions that various stakeholders can take to address challenges in forest and landscape management and attain an aspirational future.

The report has three main parts: an overview of forests in a larger landscape context to set the stage; an examination of the key drivers of change with impacts on forests and forestry; and an exploration of scenarios for 2030 and 2050.

I Setting the stage

The region's forests and landscapes are changing rapidly

Landscapes in the Asia-Pacific region continue to evolve through four broad phases – pre-agrarian, agrarian, industrial, and post-industrial. Today, the region's landscapes consist largely of land-use mosaics and are highly dynamic. Both landscapes and land uses continue to transform in response to changes in land policies and laws.

Most forest landscape changes in the Asia-Pacific region in recent decades can be attributed to policies favouring timber concessions, the large-scale expansion of commodity plantations like rubber and oil palm, infrastructure development, and mining. Landscape approaches are gaining traction, seeking to transcend traditional agricultural, forestry and other land-use governance mechanisms and apply evidence-based participatory decision-making. The average forest area per capita in the Asia-Pacific region is 0.18 ha per person, considerably lower than the world average of 0.54 ha.

Overall, forest cover increased in the region by 17.6 million ha between 1990 and 2015. A few countries may be undergoing forest transitions – in which forest area ceases to decline and begins increasing – due almost entirely to the expansion of planted forests. The area of planted forests almost doubled in the region between 1990 and 2015, from 69 million to 126 million ha, although the rate of new planted-forest establishment apparently slowed in 2010–2015. Most planted forests are monocultures, and questions remain about their capacity to provide certain ecosystem services.

The area of primary forests continues to decline in the region and now comprises only 19 percent (140 million ha) of the total forest area (723 million ha). There is evidence of ongoing forest degradation, which is concerning because of its effects on ecosystem services such as biodiversity conservation and watershed protection.

The percentage of agricultural land with tree cover (although not necessarily forest) increased in almost all countries in the region between 2000 and 2010. Planted forests and trees outside forests are becoming more important for wood production, although the logging of primary forests still predominates in some countries.

Maintaining or increasing wood production from planted forests will require addressing constraints on the availability of productive land, the impacts of climate change, and, in many cases, a lack of capacity in forest management agencies.

Big shifts are happening in forest value chains

There has been a major geographical shift in the wood and wood products industry in recent decades, with the Asia-Pacific region's share of global production, trade and consumption growing quickly. The region has become a major producer, consumer and exporter of wood products. Industrial roundwood production has grown but demand is rising faster, increasing dependence on imports.

A few countries, especially China, India, Indonesia and Japan, have had especially significant impacts on regional and global trends in wood trade and consumption. Japan dominated in the 1970s and China has been the leading force more recently.

Total roundwood consumption has been relatively stable in the region for the last two decades at about 1.2 billion m^3 per year, with efficiency gains and recycling reducing the volume of virgin industrial wood required. Industrial roundwood accounted for 41 percent of total roundwood consumption in 2017 (the rest being woodfuel), up from 26 percent in 1990. The region's production of wood panels grew more than eightfold between 1990 and 2017.

The traditional use of wood as a source of domestic energy is declining rapidly, due largely to increasing incomes, urbanization and substitution with fossil fuels and electricity. The share of wood in the region's production of modern biofuels is relatively low.

The increased consumption of panels and reconstituted wood, and higher rates of wood recovery mean that industrial roundwood consumption has grown only modestly in recent decades compared with economic and population growth. Nevertheless, new wood-based products such as bioplastics are entering the marketplace, with potentially major impacts on the region's forest sector. The emergence of a bioeconomy could stimulate growth in wood demand, although this may face constraints in production due to the limited availability of land and water.

Health-and-beauty products derived from non-wood forest products are proliferating, driven by developments in processing technologies and demand for "natural" products. Value chains linked to the amenity values of forests are developing quickly, especially due to rising incomes and urbanization, and payments for ecosystem services are emerging.

Global forest value chains are replacing local value chains, with positive and negative impacts. The trend has increased choice for forest product consumers but caused declines in some local industries.

II Drivers of change

The region's population is growing and people are on the move

Although covering less than one-quarter of the global land area, the Asia-Pacific region accounted for more than half (55 percent) of the world's population in 2015. Pressure is likely to increase on forest resources, with the region's population projected to grow by 16 percent by 2050 (an additional 666 million people).

The region's lower-middle-income and low-income countries face the greatest challenges in population growth to 2050. Many already have low per-capita natural capital as well as low human capital, posing immense difficulties for sustainable forest use. As resource pressure accelerates, low-population-density, forest-rich countries have emerged as deforestation frontiers, essentially to cater to demand from resource-scarce countries.

The Asia-Pacific region is urbanizing rapidly, with the proportion living in cities growing from 30 percent in 1990 to 46 percent in 2015, increasing demand for forest products and ecosystem services. The need for urban green spaces is also rising, but urban-planning capacity is limited in some countries, leading to disorganized urban development.

In some countries, especially in South Asia, the migration of men away from rural settings means that older people and women are increasingly responsible for forest and landscape management. Combined with international remittances, this is reducing land-use intensity in some areas and thereby increasing forest growth. Migration due to climate-change-related factors – such as water stress, declining land productivity and increased disaster severity and frequency – will increasingly affect land use, including forestry.

Economies are booming, with opportunities and threats for forests

Asia-Pacific, led by China and India, is the fastest-growing of the world regions, and it now commands more than 40 percent of global gross domestic product. Continued economic growth coupled with a rapidly expanding middle class will increase demand for forest products.

Housing booms in China, India and Indonesia have increased demand for forest products. In the past, however, the bursting of housing bubbles has had severe impacts on the forest sector.

There have been dramatic decreases in the number of extremely poor people in the region. In some countries, however, some of the most impoverished people live in forested areas.

Globalization has brought major changes in the production, processing, trade and consumption of forest products. A recent backlash against globalization could slow investment, trade and technology transfers in the forest sector.

The structure of economies in the region is undergoing rapid change. The share of agriculture (including forestry) in value added has dropped sharply in recent decades, although the sector remains a major employer in many countries.

Increases in bovine and other livestock populations in the region, due in part to changing diets linked to increased incomes, have caused widespread forest degradation and deforestation, including for the production of livestock and poultry feed. Investments in infrastructure, mining, urban development and industrial crops are expected to continue growing in the region, with the potential to unleash a new era of deforestation.

Environmental challenges threaten – and countries seek ways to increase ecosystem services

The proportion of greenhouse-gas emissions in the region contributed by land use, land-use change and forestry declined from 40 percent of total emissions in 1990 to 20 percent in 2014, due to a significant increase in the region's fossil-fuel emissions. Forests remain a net source of greenhouse-gas emissions.

Most of the countries in the Asia-Pacific region involved in the implementation of REDD+ have made progress in REDD+ readiness and a few are moving to the implementation of national REDD+ strategies. The complex economic, social and political environment in which REDD+ must operate poses many challenges in making it an effective results-based payment system.

The area of forests set aside for biodiversity conservation in the Asia-Pacific region increased from 68 million ha (12.4 percent of all natural forests) in 1990 to 119.2 million ha (16.5 percent) in 2015. The forest sector can play a leading role in biodiversity conservation but, in most of the region, "development first" still dominates policymaking, limiting the scope to prevent further biodiversity losses.

Countries in the region face acute water deficits, which will be exacerbated by climate change. Twenty-one countries have designated, on average, 35 percent of their forests for soil and water conservation, but little information is available on how these forests are actually managed for stable water supply.

The number of people living in degraded agricultural lands is increasing in the Asia-Pacific region. Arresting and reversing land degradation through forest and landscape restoration is emerging as a key priority in most countries. Governments continue to seek ways to finance forest and landscape restoration and sustainable forest management for the provision of ecosystem services, including combinations of regulatory and market-based approaches.

People's desire to reconnect with nature is rising as urbanization continues and incomes grow. Forestry institutions need to adapt quickly to ensure that increased demand for forest amenity values – which can be viewed as highly positive for environmental awareness – does not jeopardize sustainability.

New technologies are transforming forestry – but uptake is patchy

Technological advances in, for example, remote sensing and data analysis are revolutionizing forest management and environmental monitoring, but the rate of uptake is far from uniform in the region.

There is greater uptake of technologies to increase forest productivity and industrial efficiency in the planted-forest sector than in the management of natural forests. Governments are beginning to leverage new technologies to improve land mapping, the management of land-ownership information, and forest governance.

Increasing access to the Internet has the potential to enable forest-dependent communities, including those in remote areas, to participate more in forest-related monitoring and decision-making. Huge volumes of forest data will be generated and collected in the future, requiring increased human-resource capacity in data processing and analysis.

Product innovations, such as engineered wood, are enabling new uses of wood; among other things, these will assist the quest to achieve low-carbon economies.

Enabling conditions for accelerating technological uptake in the region's forest sector, especially in countries that are lagging behind, include conducive policies and laws; agile governance; improvements in communication infrastructure; public investment in technology transfer; the strengthening of forest research, development and education institutions; and strategic partnerships. Young people consulted for this study indicated that the uptake of new technologies in the forest sector has been too slow. They called for more opportunities for young people to learn and apply these new technologies.

Participation in forest governance grows, but conflicts loom

Four broad governance discourses have helped shape the region's forest landscapes and governance institutions – 1) forestry for timber; 2) participatory forestry; 3) multiple benefits; and 4) climate change and sustainable development.

Efforts to strengthen forest governance in the region include increasing stakeholder participation, market-based approaches, forest-related conflict management, and institutional reform. Most government officials in charge of forestry perceive that forest governance has improved since 2010, especially in terms of stakeholder participation.

In 16 countries in the region, the area designated for or owned by indigenous peoples and local communities grew by about 17 million ha between 2002 and 2017 as governments started to recognize their rights. Nevertheless, many indigenous peoples and local communities still face tremendous challenges in the face of development, marginalization, the loss of lands, and conflict.

The commitments made by governments as part of global policy processes will influence national forest-related priorities to 2030, but a lack of adequate finance is a major challenge.

An increasing number of importer countries are putting in place laws and regulations to prevent illegal timber imports. In 2017, Indonesia became the first country to export legality-verified timber to the European Union under a voluntary partnership agreement.

Conflicts related to protected areas, land-grabbing, tenure and benefit sharing, among other things, are prevalent in the region and may be exacerbated by climate change in the future. Despite a shift in the role of forest agencies from dominant players to facilitators of participatory approaches, many countries lack effective mechanisms for resolving forest-related conflicts.

Young people have shown capacity to mobilize transnationally on environmental causes, especially climate change. A survey and consultation of young people conducted for this study found a strong expectation among youth of greater participation and transparency in the region's forest governance.

III Scenarios for 2030 and 2050

Forests face divergent futures to 2030 and 2050

Three scenarios – business-as-usual, disruptive and aspirational – are discussed for 2030 and 2050, assuming differing outcomes from the drivers of forest change. Scenario building provides an opportunity for stakeholders to discuss possible futures, identify robust actions and develop strategies for steering the future along desirable pathways.

In the business-as-usual scenario for 2030, the role of forests and the forest sector in addressing global challenges and achieving global targets such as the SDGs, the Paris Agreement on climate change, the Bonn Challenge and the Global Forest Goals will be suboptimal.

In the disruptive scenario for 2030, deforestation and forest degradation will accelerate, few countries will achieve forest restoration targets, forest-based livelihoods and ecosystem services will deteriorate, forest-related tensions will escalate, and forest-based industries will fail to ensure resource sustainability. This could have major ramifications for food and water production, human well-being and overall ecological stability well beyond forests.

In the aspirational scenario for 2030 and in line with the Global Forest Goals, forest area in the region will increase by 22 million ha. With the current pace of establishment of new forests, the region could even aspire to more than this (e.g. an additional 50 million ha by 2030). Additionally, the forest-related SDGs and other targets agreed in global processes will be achieved, although this will require transformational changes in forest and landscape management.

The business-as-usual, disruptive and aspirational scenarios for 2050 involve similar outcomes to those for 2030, driven to further extremes. Building the resilience of forests, landscapes and people would help ensure that the region has the capacity to respond to future shocks and uncertainties.

Nearly 300 forestry students and young professionals from more than 30 countries consulted for this study considered that they can shape a sustainable future by taking leadership roles, generating momentum through collaboration and social media, and changing rigid institutions from within by shaking them up.

Forestry can lead the region towards a sustainable future

Sustainable forest and landscape management poses a “wicked problem” because of its many intertwined challenges at various scales.

Alternatives to the prevailing economic development model may be needed to achieve a sustainable future. Counter-narratives to the “growth first” model are yet to gain traction, but an increasingly vocal youth may help bring about change. New approaches to forest and landscape governance are also needed, involving greater transparency, the increased participation of women, indigenous peoples, youth and other marginalized groups, equitable tenure, and effective conflict-management mechanisms, among other elements.

The Asia-Pacific region has the capacity to achieve a sustainable future. Attention to the following seven “robust actions”, which should be taken now or in the near future, will be crucial:

1. Promote and institutionalize a learning culture and adaptive management.

2. Consolidate efforts to make global visions work nationally by increasing coordination and cooperation among stakeholders.

3. Put much more emphasis on maintaining and improving forest quality and restoring degraded landscapes.

4. Explore and invest in alternative economic development models that consider progress beyond growth.

5. Put more effort into achieving good forest and landscape governance at all levels, and institute effective conflict-management mechanisms.

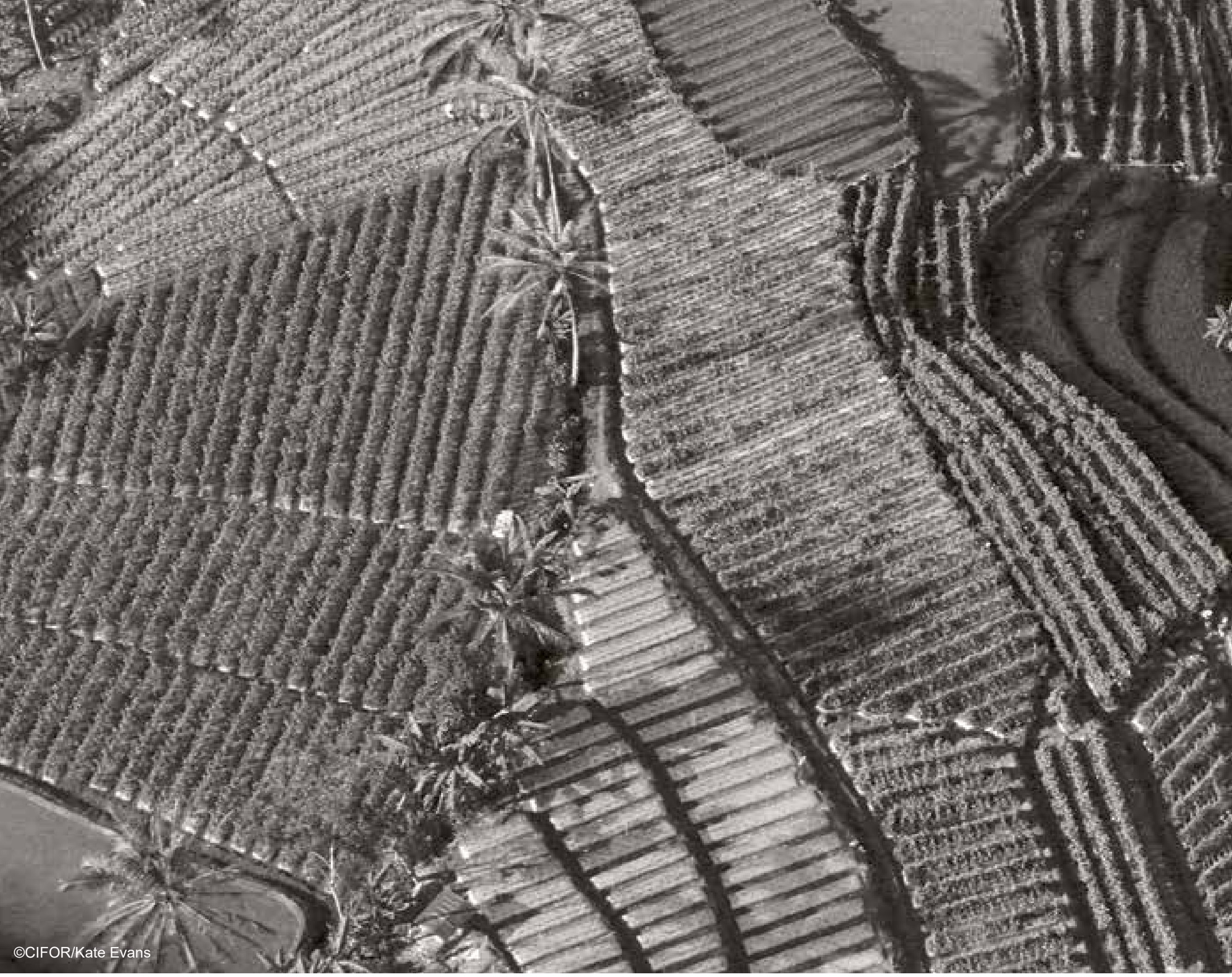
6. Build the resilience of forests, landscapes and people in coping with climate change, shocks and uncertainties.

7. Commit sufficient resources and effort to make landscape approaches work.

Forest-sector actors in the region could use this outlook study as an entry point for obtaining buy-in from diverse actors and bringing about rapid positive change at the national level. The forest sector has huge potential to lead regional efforts towards a sustainable future and thereby to set an example for other regions and the world.

PART I

Setting the stage



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Key **points**

- Enormous demographic, economic, environmental, technological and governance changes are taking place in the Asia-Pacific region at an unparalleled pace, with major implications for forests.
- The good news is that net forest area is increasing in the region, due mainly to the expansion of planted forests in China. Overall, forest cover increased in the region by 17.6 million ha between 1990 and 2015. The bad news is that natural forests rich in biodiversity continue to be lost or degraded, and forest health and quality are declining sharply.
- Two key questions addressed in this report are:
  - Taking into account the major drivers of change, what will forests and forestry look like in 2030 and 2050?
  - What robust actions should be taken today and in coming years to realize an aspirational future for forests?

1 | Introduction: a sustainable future is possible

- The report:
  - builds on two previous forest-sector outlook studies in the Asia-Pacific region (in 1998 and 2010);
  - provides a strategic analysis of forests and landscapes in the region to help policymakers and others decide on the actions needed to realize a sustainable future;
  - explores three scenarios – business-as-usual, aspirational and disruptive – for the future of forests and the forest sector in the region to 2030 and 2050; and
  - provides options on robust actions that various stakeholders can take to address challenges in forest and landscape management and attain an aspirational future.

This report is about planning for a sustainable future for forests, landscapes and people in the Asia-Pacific region.[1] Forests are crucial for the attainment of the Sustainable Development Goals (SDGs) and for tackling climate change, food insecurity, water scarcity and issues related to urban development and energy. To continue treating forestry in isolation would be a fatal mistake: a sustainable future will be attained through integration, coordination and synergies – the spirit embodied in the SDGs.

What will the world look like in 2030 and 2050? What are the major drivers of change that will shape it? The region is already home to 4.1 billion people (55 percent of the world population), and its population is projected to expand to 4.5 billion by 2030 and to 4.7 billion by 2050. Urbanization is occurring at unprecedented speed: 55 percent of the region's people will likely live in cities by 2030, and the proportion is projected to swell to 67 percent by 2050. The region could boast three of the world's top five economies in China, India and Indonesia by 2050, but there are also geopolitical tensions. The people of the Asia-Pacific region are among the world's most tech-savvy, but future technological change will have far-reaching consequences for them and the region.

Amid such flux, making the best-possible decisions now and in coming years is essential for realizing positive future outcomes. This third Asia-Pacific Forest Sector Outlook Study (APFSOS III) is a tool for doing so.

What is the future of forests and the forest sector?

The future of forests and the forest sector[2] will be shaped by demographic, economic, environmental, technological and governance drivers. This report examines each of these and discusses their impacts on forestry, now and into the future.

Almost all landscapes in the region consist of diverse land uses reflecting varying intensities of human intervention. Forests are part of these wider landscape systems, and the outlook for forests and the forest sector, therefore, must be assessed in this broader context – how landscapes are changing as societies evolve and how societal welfare depends on sustainable landscapes. This study takes a broad perspective – "forests beyond forestry" – by exploring the relationships between forests and a range of actors, land uses and sectors.

Looking into the future

APFSOS III provides a strategic analysis of forests and the forest sector in the Asia-Pacific region. The aim is to help stakeholders understand what the future may look like and thereby to enable a strategic

[1] The World Commission on Environment and Development (1987) defined sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

[2] The terms "forestry" and "forest sector" are used interchangeably in this report, broadly defined as all economic activities that mostly depend on the production of goods and ecosystem services from forests.

response to maximize the potential for sustainable development. Such analyses are important for the following reasons:

- Long-term thinking has always been a tradition in forestry. Unlike other sectors that may plan weeks, months or a few years ahead, forestry must plan for decades. The time from planting to maturity may be 7–8 years for a fast-growing tree species like an acacia and 120 years for slower-growing species like teak. The management of natural forests also requires long-term planning to ensure sustainability (e.g. a single sustainable selective logging cycle in a tropical forest may span 35 years or more).

- A long-term perspective helps decision-makers prioritize actions, allocate limited resources wisely, and determine priorities for investment. To ensure sustainability, even immediate decisions should take into account longer-term threats and opportunities.

- Forests are part of wider landscapes. Changes in landscapes affect forests and vice versa, and changes in forestry can affect other sectors, such as agriculture, water and energy, and have significant economic, social and environmental impacts. Understanding the long-term implications of change in the forest sector is crucial for society's future.

- Strategic analysis enables the positioning of forests and forestry as significant means for addressing society's challenges, and it can help in identifying trade-offs and synergies. For example, increasing tree cover can assist in the protection of water catchments, which may involve a change in land use from intensive agriculture towards agroforestry and forestry through forest and landscape restoration.

Analysing past trends in major drivers of forest change provides guidance on what might happen to forests, forest landscapes and forest-dependent communities in the future. This doesn't mean that the future will unfold predictably: shocks and surprises may happen and, indeed, this seems increasingly likely given the unprecedented rate of change in many drivers. Nevertheless, the ability of societies to cope with shocks can be strengthened by learning from past lessons, building adaptive management capability and taking actions that will increase the likelihood of achieving preferred outcomes and avoiding undesirable consequences – called "robust actions" in this report.

The report analyses three broad scenarios:

- *Business-as-usual* – major drivers will continue to evolve following historical trends, and the future of forests and the forest sector can be extrapolated from these.

- *Aspirational* – certain targets and goals will be achieved, such as those embodied in the SDGs and the Paris Agreement on climate change, assuming the implementation of robust actions.

- *Disruptive* – shocks will occur, such as environmental catastrophes and economic crises, with major negative repercussions for forests. This might also be termed the nightmare scenario; robust actions are required to maximize the resilience of forests and the forest sector in the event that such shocks eventuate.

The world at the crossroads

Major demographic, economic, environmental, technological and governance changes are happening worldwide at an unparalleled pace. Population growth continues, albeit at varying rates from country to country, and other major demographic shifts are taking place.

The world's economy is also changing, with trade protectionism increasing in several leading economies. This development, and other recent geopolitical moves such as the expected exit of the United Kingdom of Great Britain and Northern Ireland from the European Union (EU), run counter to what had previously been a reasonably steady global progression towards increasingly free trade and globalization. Long-term shifts in economic strength are also apparently underway, with the centre of economic gravity moving towards the Asia-Pacific region. Economic growth in the region has involved the conversion of forestland for, for example, oil-palm estates, mining, agriculture and infrastructure.

The International Panel on Climate Change released a report in October 2018 warning that the world has only 12 years to avert a climate-change catastrophe. Human activities have already caused an increase in the global temperature of 1.0 °C above pre-industrial levels, and this is likely to reach 1.5 °C between 2030 and 2052 if greenhouse-gas emissions continue to grow at the current rate. The present generation is the first to experience the impacts of human-induced climate change and global warming: melting glaciers, rising seas, heatwaves, flooding, disappearing islands and severe droughts are just some of the signals that the climate is changing. Humans are causing the climate to change at a rate 170 times faster than natural forces (Davey, 2017) yet continue to overexploit resources. In 2018, Earth Overshoot Day – the day on which humanity's resource consumption for the year is estimated to exceed the Earth's capacity to regenerate those resources that year – was on 1 August, the earliest it has ever been (Earth Overshoot Day, 2018).

Information and communication technologies have had a profound impact on societies in the last several decades. A further rapid transformation is underway in what has been termed the fourth industrial revolution (Schwab, 2016) involving the exponential advance of digital technologies such as artificial intelligence, big data, robotics and blockchain. These technologies have huge implications for all facets of human life and potentially also for forests, forest landscapes and forest-dependent communities.

Governance in and beyond the forest sector is a determining factor in the future of forests. Efforts to improve forest governance are underway in many countries in the region; nevertheless, governance-related problems such as corruption, a lack of transparency, top-down decision-making, conflict, and the poor enforcement of forest laws continue to hamper the sector.

Forestry does not operate in a vacuum – it is embedded in the larger context of development and is affected and shaped by global, regional, national and local changes and trends. Climate change, for example, has profound implications for forests. E-commerce, a technology-driven innovation that barely existed 15 years ago, is now a major factor in many forestry businesses. Satellites increasingly enable

BOX 1.1

The role of forests in addressing global challenges

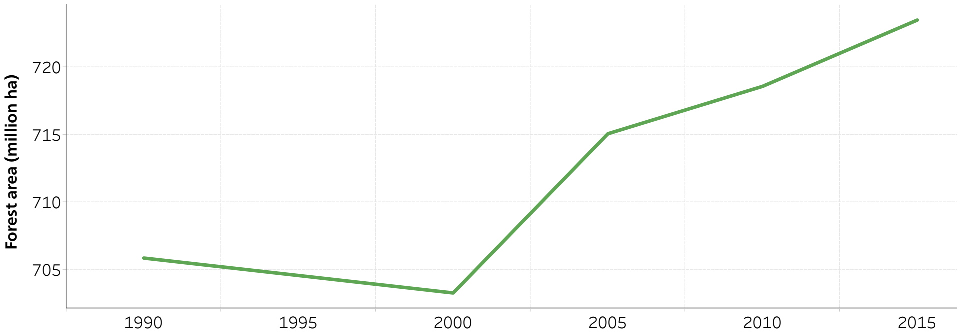
Forests and forest landscapes play important economic, social and environmental roles that are often overlooked or underestimated in policymaking. For example:

- Forests globally could help mitigate climate change by about 4 gigatonnes of carbon dioxide per year through avoided deforestation and by 1.0 gigatonnes of carbon dioxide through avoided forest degradation (without afforestation).
- About 50 percent – 1.86 billion m^3 – of global roundwood production derived from forests is used as fuel for cooking and heating in households, small industrial activities (e.g. brickmaking and tea processing), and, to a lesser extent, generating electricity.
- Forest products make significant contributions to the shelter of at least 1.3 billion people (18 percent of the world's population).
- Forests mediate the provision of drinking water to one-third of the world's largest cities, including Jakarta, Melbourne, Nairobi, New York, Rio de Janeiro and Tokyo.
- Trees in urban areas can cool the air by up to 8 °C, reducing the need for air-conditioning by 30 percent. Urban forests improve social cohesion among city dwellers, reduce stress and ameliorate noise and air pollution.
- About 2.4 billion people – 40 percent of the population of less-developed countries – cook with woodfuel, and 764 million people may also boil their water using woodfuel from forests.

If properly understood and integrated into policies and strategies, therefore, forests can be part of the solution to many global challenges.

Source: FAO (2018a).

Figure 1.1. Forest transition in the Asia-Pacific region, 1990–2015



Note: Data for 1995 were unavailable and the value shown for 1995, therefore, is the average of data for 1990 and 2000.
Source: FAO (2015a).

the real-time monitoring of forest activities and can help in cracking down on illegal logging. Artificial intelligence could be a game-changer for forest management, enabling the generation of detailed forest-related information at a global scale in almost real time.

It is essential, therefore, to take the broader picture into account when considering the regional outlook for forests and the forest sector. Forests have crucial roles to play in addressing global challenges, such as hunger, food insecurity, water quality, energy, climate change and urbanization (Box 1.1). Positioning forestry in this broader context will assist policymakers in meeting such challenges now and in the future.

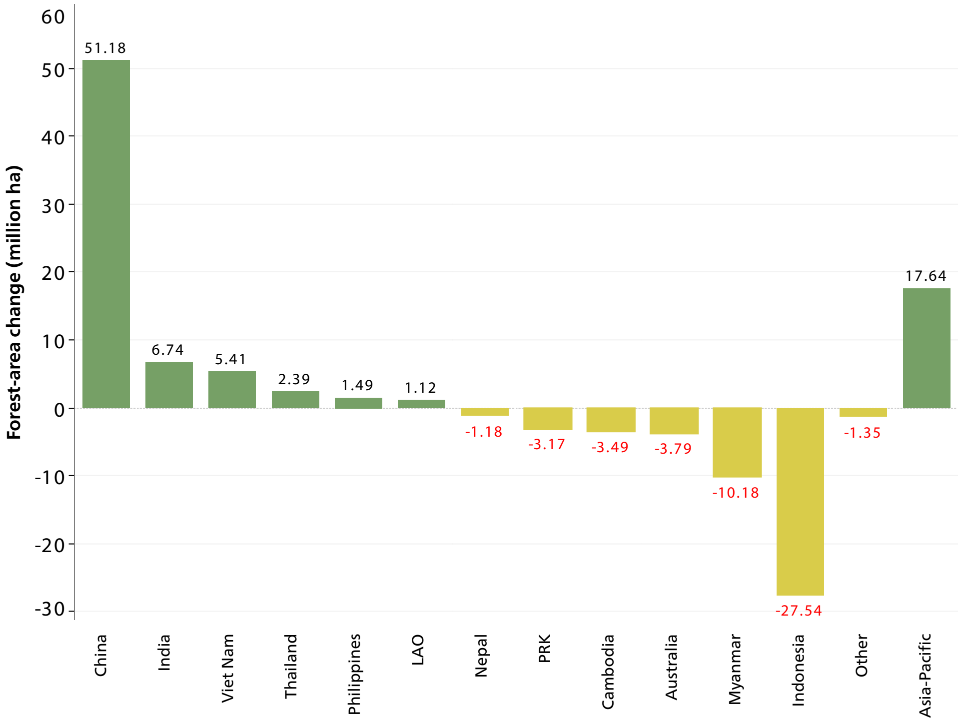
Forest transition: the good news and bad news

The good news is that net forest area is increasing in the Asia-Pacific region. Having declined overall for decades, there was a turning point in about 2000 (Figure 1.1), and net forest area increased by 17.6 million ha between 1990 and 2015 – nearly the equivalent of Cambodia's total land area. The increase must be viewed with caution, however, because the regional picture is heavily influenced by China, which added more than 50 million ha of net forest area between 1990 and 2015 (Figure 1.2).

Of the region's 723 million ha of forests, about 83 percent (597 million ha) are classified as natural. Most (76 percent) of these have been logged and are now classed as secondary or other naturally regenerated forests; thus, only 24 percent of the region's natural forests are primary,[3] considerably less than the global average of 32 percent. Seventeen percent of the

[3] Primary forests are naturally regenerated forests of native species where there are no clearly visible indications of human activities and ecological processes are not significantly disturbed.

Figure 1.2. Forest-area change, selected countries and regional total, Asia-Pacific region, 1990–2015

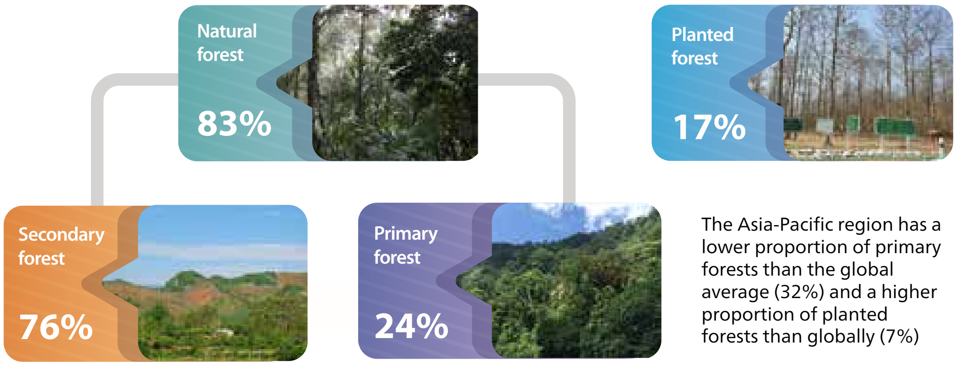


Note: LAO = Lao People's Democratic Republic; PRK = Democratic People's Republic of Korea.
Source: FAO (2015a).

region's forests are classified as planted, which is much higher than the global average of 7 percent (Figure 1.3).

Although the region can be hailed for its success in increasing forest cover, there are doubts about the ecological integrity of at least some of the new planted forests. Moreover, the loss of natural forests continues in many countries, with total forest area declining significantly between 1990 and 2015 in, for example, Australia, Cambodia, Indonesia, the Democratic People's Republic of Korea and Myanmar. The conversion of natural forests – including carbon-rich peatland forests – to oil-palm plantations has been a big issue in Southeast Asia. Deforestation, therefore, remains a challenge in the region. Some countries continue to log natural forests unsustainably, and this and other pressures are also increasing forest degradation and could be causing biodiversity losses. The region has a very large area of degraded forests, pointing to reduced forest health and quality.

Figure 1.3. Forest types in the Asia-Pacific region



Photos: ©FAO/Yurdi Yasmi

Some countries in the region have been pursuing economic development policies involving (among other things) rapid deforestation in the early stages and corrective measures in later stages. For example, recent data indicate that forest loss in Indonesia declined from 3.5 million ha per year in the 1990s to just less than 0.5 million ha in 2017 (MOEF, 2018). The Government of Indonesia has imposed a moratorium on new concessions in primary forests and peatlands since 2011. In the Pacific, forest area increased by 37 000 ha in Fiji between 2000 and 2015, due partly to the expansion of planted forests and partly to the regeneration of natural forests. Significant areas of Fiji's natural forests are still allocated to production forestry and have been converted from primary forest to other naturally regenerated forest, but it is promising to see that the country has transitioned to a net gain in forest area.

Maintaining and improving forest quality will be crucial in the future to ensure continued productivity and the ongoing provision of ecosystem services related to, for example, water quality, soil health, biodiversity conservation, carbon sequestration and local climatic effects.

Key questions, countries and target audiences of APFSOS III

The Asia-Pacific Forestry Commission (APFC) endorsed the production of APFSOS III at its 27th session in Colombo, Sri Lanka, in October 2018. The work to put it together took place from May 2018 to May 2019 through a participatory process involving APFC member countries, key partner institutions and other stakeholders, including from outside the forest sector and among young people. An advisory committee comprising more

Table 1.1. APFSOS countries, by subregion

Subregion	Countries
East Asia	China, Democratic People's Republic of Korea, Japan, Mongolia, Republic of Korea
Oceania	Australia, Fiji, Kiribati, New Zealand, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu
South Asia	Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka
Southeast Asia	Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Viet Nam

than 40 members from various disciplines and sectors, including youth representatives, provided strategic guidance and direction.

Building on the two previous outlook studies (published in 1998 and 2010), APFSOS III addresses the following two main questions:

1. Taking into account the major drivers of change, what will forests and forestry look like in 2030 and 2050?

2. What robust actions should be taken today and in coming years to realize an aspirational future for forests?

These questions require a broad look at development drivers and the various impacts of these on forests and the forest sector. Based on this, recommendations are proposed to best prepare forestry for dealing with future challenges.

APFSOS III encompasses all member countries of the APFC except France, the Russian Federation and the United States of America.[4] APFSOS III, therefore, covers 34 countries in four subregions (Table 1.1).

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[4] These three countries are also members of other regional forestry commissions, and they are included in outlook studies in those other regions.

Throughout the report, unless otherwise indicated, the term "Asia-Pacific region" refers to these 34 countries.

The main target audience of APFSOS III comprises policymakers dealing with issues at the landscape scale and making decisions relevant to land use, forestry, agriculture and other land-based sectors. APFSOS III explores the interlinkages between landscape actors with the aim of encouraging intersectoral approaches to decision-making. It provides recommendations for decision-makers and governments on how to deliver on national commitments under global frameworks such as the SDGs and the Paris Agreement on climate change.

APFSOS III is also aimed at development partners interested in supporting countries and regional bodies in tackling forestry and land-use issues. It will be a useful resource for the private sector, civil-society organizations, researchers and intergovernmental and development assistance agencies.

Report structure

Figure 1.4 shows the structure of the report, which is divided into three parts.

Part I (chapters 1–3) provides an overview of forests in a larger landscape context to set the stage. It reviews land-use changes over time, forest-area change in the region, forest transitions, trees outside forests, and forest production systems and value chains.

Part II (chapters 4–8) examines the key drivers of change with impacts on forests and forestry. These are grouped broadly as demographic, economic, environmental, technological and governance. The report canvasses how these drivers have changed forests and forestry and discusses their potential future impacts.

Part III (chapters 9 and 10) explores scenarios for 2030 and 2050. It draws key lessons and presents recommendations for various stakeholder groups on the robust actions they can take to maximize the potential for achieving an aspirational future for forests and the forest sector.

Figure 1.4. Report structure

PART I. SETTING THE STAGE

I

Chapter 1	Introduction: a sustainable future is possible
Chapter 2	The region's forests and landscapes are changing rapidly
Chapter 3	Big shifts are happening in forest value chains

PART II. DRIVERS OF CHANGE

II

Chapter 4	The region's population is growing and people are on the move
Chapter 5	Economies are booming, with opportunities and threats for forests
Chapter 6	Environmental challenges threaten – and countries seek ways to increase ecosystem services
Chapter 7	New technologies are transforming forestry – but uptake is patchy
Chapter 8	Participation in forest governance grows, but conflicts loom

PART III. SCENARIOS FOR 2030 & 2050

III

Chapter 9	Forests face divergent futures to 2030 and 2050
Chapter 10	Forestry can lead the region towards a sustainable future

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Key **points**

- Landscapes in the Asia-Pacific region continue to evolve through four broad phases – pre-agrarian, agrarian, industrial, and post-industrial. Today, the region's landscapes consist largely of land-use mosaics and are highly dynamic. Both landscapes and land uses continue to transform in response to changes in land policies and laws.

- Most forest landscape changes in the Asia-Pacific region in recent decades can be attributed to policies favouring timber concessions, the large-scale expansion of commodity plantations like rubber and oil palm, infrastructure development, and mining.

- Landscape approaches are gaining traction, seeking to transcend traditional agricultural, forestry and other land-use governance mechanisms and apply evidence-based participatory decision-making.

- The average forest area per capita in the Asia-Pacific region is 0.18 ha per capita, considerably lower than the world average of 0.54 ha per capita.

- Forest area is declining in most countries in the region. On the other hand, a few countries may be undergoing forest transitions – in which forest area ceases to decline and begins increasing – due almost entirely to the expansion of planted forests. Overall, forest area increased in the region by 17.6 million ha between 1990 and 2015.

2 The region's forests and landscapes are changing rapidly

- The area of planted forests almost doubled in the region between 1990 and 2015, from 69 million to 126 million ha, although the rate of new planted-forest establishment apparently slowed in 2010–2015. Most planted forests are monocultures, and questions remain about their capacity to provide certain ecosystem services.
- The area of primary forests continues to decline in the region and now comprises only 19 percent (140 million ha) of the total forest area. There is evidence of ongoing forest degradation, which is concerning because of its effects on ecosystem services such as biodiversity conservation and watershed protection.
- The percentage of agricultural land with tree cover increased in almost all countries in the region between 2000 and 2010.
- Planted forests and trees outside forests are becoming more important for wood production, although the logging of primary forests still predominates in some countries.
- Maintaining or increasing wood production from planted forests will require addressing constraints on the availability of productive land, the impacts of climate change, and, in many cases, a lack of capacity in forest management agencies.

Societies and landscapes have co-evolved in the Asia-Pacific region over many centuries, and changes in forests and forestry should be assessed in this larger context. This chapter describes the rapid changes occurring in the region's landscapes, land uses and forests. It describes the state of forests and forest management and discusses broad trends in "forest transitions", thereby providing essential background information for analysing the outlook for the region's forest sector.

Taking a landscape view

Asia-Pacific landscapes are changing

The concepts of landscapes and landscape approaches have received increased attention since the 1980s, primarily in an effort to reconcile multiple, often-competing objectives such as those related to conservation, food production, poverty alleviation and climate change. Landscapes are spatial human-ecological systems that deliver a wide range of functions valued by humans for economic, sociocultural and environmental reasons. Two key characteristics of landscapes are that they are 1) geographically determined spaces and 2) defined from a human perspective; the breadth of the concept has given rise to a wide array of definitions. The European Landscape Convention defines landscape as "a holistic, spatial and mental dynamic entity, which is the result of people–place interactions". A holistic view implies the hierarchical organization of landscapes with a clear understanding of the relationship between the various landscape elements.

Landscapes have evolved and changed in response to natural and anthropogenic factors, the latter influenced by larger societal changes. The following four broad phases can be identified in the evolution of landscapes in the Asia-Pacific region (Figure 2.1):[5]

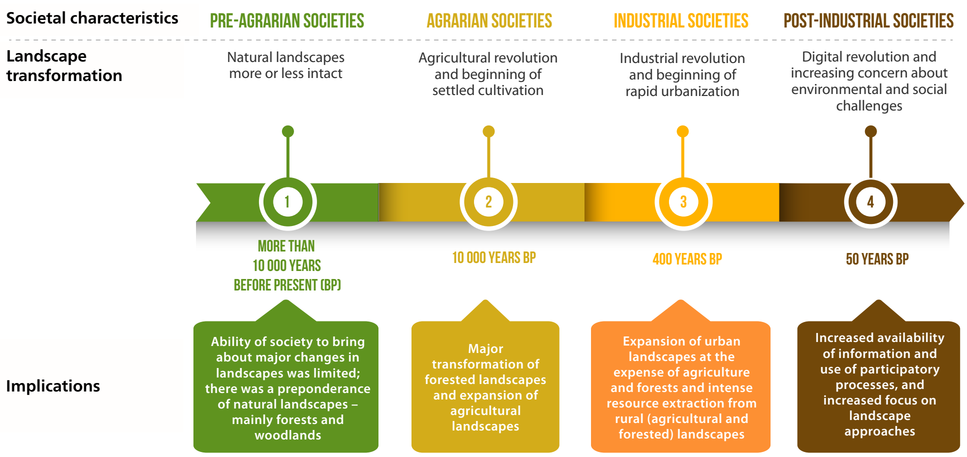
Pre-agrarian phase – natural landscapes (e.g. forests, other wooded lands and grasslands) remained more or less intact, largely because the existing hunter–gatherer societies brought about no major modifications. Forested landscapes and pre-agrarian societies still co-exist in many areas in the Asia-Pacific region.

Agrarian phase – shifting cultivation and settled agriculture (which, in some areas, began about 10 000 years ago) transformed landscapes, including by clearing forests. Landscape mosaics of shifting-agriculture regimes, permanent farmlands, relatively small settlements, and forests and other land-use types evolved, driven by agrarian and pastoral communities. Many parts of the Asia-Pacific region remain in an agrarian phase today, with people deriving subsistence from a mosaic of land uses.

Industrial-development phase – both forested and agricultural landscapes began undergoing major transformations as industrial societies established in the Asia-Pacific region in the early-to-mid twentieth century. Large areas of natural forests were logged to meet urban and industrial wood demand; many such

[5] Note that this characterization is for illustrative purposes, and the development process has differed widely across the region.

Figure 2.1. Changes in landscapes and societies



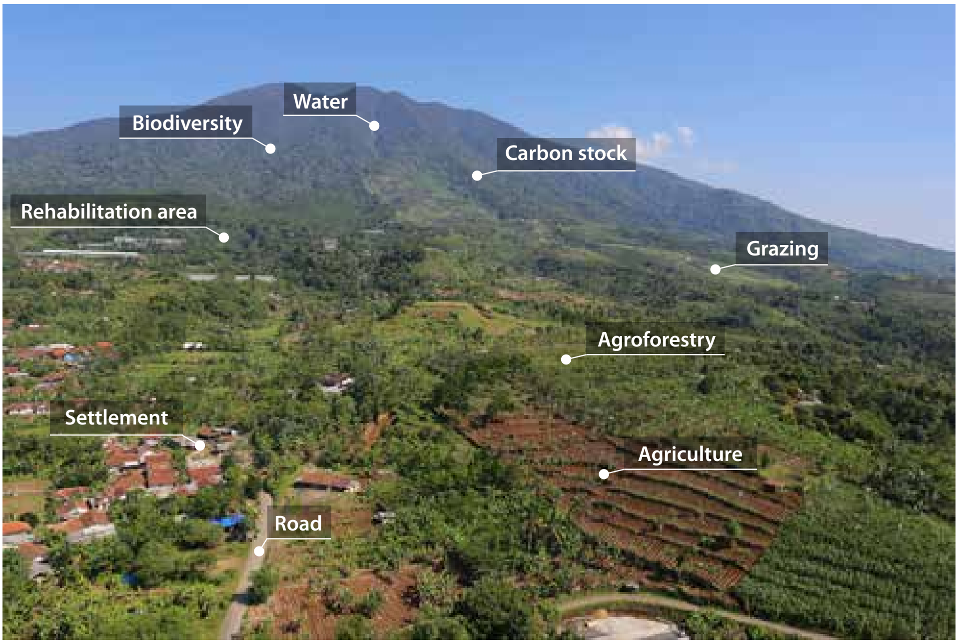
forests were subsequently cleared, and agriculture and urban development began to dominate landscapes. In many countries in the region (e.g. Bangladesh, Fiji, India, Indonesia, Malaysia, Myanmar, Pakistan, Sri Lanka and Viet Nam), colonial governments brought about major landscape changes, especially through the cultivation of commercial crops such as tea, coffee, sugarcane, rubber and teak that catered largely to external markets. In most cases, the large-scale cultivation of commercial crops intensified in the post-colonial period. Continued industrial and urban development also led to the diversion of forest and agricultural lands for infrastructure and mining.

Post-industrial phase – the digital revolution and the rapid accumulation of knowledge on ecological and socio-economic processes are ushering in new landscape changes as societies grapple with issues such as climate change, biodiversity loss, population growth, urbanization, poverty, food insecurity, poor governance and inequality. Landscape-scale approaches to land management and governance are gaining attention, and more value is being placed on the provision of ecosystem services. Land is being set aside for biodiversity conservation, watershed protection and amenity, and "connecting nature and people" is emerging as a new conceptual framework (IPBES, 2018a).

Landscape approaches are gaining traction

Almost all landscapes in the Asia-Pacific region consist of land-use mosaics (Figure 2.2) that reflect varying intensities of human intervention. The outlook for forests and forestry must be assessed in this broader context – how landscapes are changing as societies evolve and how societal welfare depends on sustainable landscapes, including forested landscapes.

Figure 2.2. The forest landscape mosaic



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Note: The image shows an aerial view of the landscape around the Halimun Salak National Park, West Java, Indonesia.

In many countries in the region, local communities have pursued holistic approaches to land use that recognize the linkages between, for example, agriculture, grazing lands, water bodies, and woodlands.[6] Woodlands provide fodder, green manure and woodfuel, ensure stable water supplies for irrigation and domestic use, and support biodiversity (which provides long-term security for food production). Although many of these approaches have worked successfully at the local level, their scaling up faces several constraints. The sweeping land-use changes that have occurred in the industrial-development and post-industrial phases have disrupted the evolution of local-scale integrated approaches (although examples of these still exist).

Policymakers and planners increasingly recognize that landscape approaches are essential for reducing conflicts between land uses and to take full advantage of complementarities. Integrated conservation and development projects (ICDPs), which may be considered precursors of landscape approaches, recognize the need to address the livelihoods of local communities in conservation efforts. Learning from the failure of exclusionary approaches to conservation, many ICDPs attempted to "mainstream" the participation of local communities and the

6 The term "woodlands" is used here to encompass forests and other wooded lands.

improvement of livelihoods. Nevertheless, win–win outcomes for ICDPs have often been illusory (Yang, 2006; Gurney *et al.*, 2014; Schuett, Dahal and Nepal, 2016). To some extent, contemporary landscape approaches draw lessons from ICDPs and address their shortcomings by taking a broader perspective. There is now increased appreciation for the capacity of certain land uses to perform multiple functions: for example, some farming landscapes can produce substantial quantities of wood and non-wood forest products and also contribute to biodiversity conservation.

Efforts in the last two decades have provided a better understanding of landscape approaches, especially of the principles that make them stand out (Box 2.1), and the concept is being tested in various places in the Asia-Pacific region. Yasmi *et al*. (2017), for example, noted that most countries in the Greater Mekong Subregion have adopted policies on sustainable forest management (SFM) with multiple objectives, giving due attention to participatory approaches aimed at achieving win–win outcomes. The Kailash Sacred Landscape Conservation and Development Initiative is an important transboundary landscape approach involving China, India and Nepal (Box 2.2). Other examples are the Heart of Borneo Initiative (involving Brunei, Indonesia and Malaysia) and the Terai Arc Landscape Initiative, which covers 49 500 km^2 in India and Nepal.

BOX 2.1

Key principles of landscape approaches

Because landscapes are conceived and defined by people based on their visions, cultures and activities, rigid descriptions of what constitutes a landscape approach to management and governance are difficult. Nevertheless, there is broad consensus in intergovernmental and interinstitutional processes that landscape approaches involve:

- Continual learning and adaptive management
- Common-concern entry points
- Multiple scales – awareness about higher- and lower-scale processes
- Multifunctionality
- Multiple stakeholders
- Negotiated and transparent change logic
- Clarification of rights and responsibilities
- Participatory and user-friendly monitoring
- Resilience
- Strengthened stakeholder capacity.

Sources: V. Gitz, personal communication, 2018; Sayer *et al.* (2013); Valles-Plannells, Galiana and Van Eetvelde (2014).

BOX 2.2

The Kailash Sacred Landscape Conservation and Development Initiative

The Kailash Sacred Landscape Conservation and Development Initiative (KSLCDI) is a collaborative transboundary conservation partnership involving China, India and Nepal aimed at promoting the sustainable development of the Kailash Mountain Range and adjoining areas over an area of 3.1 million ha and encompassing a population of about 1 million people. The KSLCDI aims to ensure the long-term conservation of ecosystems, habitats and biodiversity by encouraging sustainable development, increasing the resilience of communities and landscapes, and safeguarding cultural linkages among local communities. The KSLCDI, which is coordinated by the International Centre for Integrated Mountain Development, has five components: 1) innovative livelihoods; 2) ecosystem management; 3) access and benefit sharing; 4) long-term conservation and monitoring; and 5) regional cooperation on enabling policies and knowledge management. Although the initiative is a unique transboundary landscape conservation effort, it has highlighted the challenges of putting a landscape approach into practice in complex political and social settings. For example, an overreliance on existing institutional arrangements is not conducive to the implementation of transdisciplinary approaches. The dominance of state agencies reduces the space available for the genuine involvement of local communities. Existing sensitivities around international relations add to the fragility of cross-border environmental cooperation. There is also concern about an overemphasis on the economic benefits of tourism and insufficient attention to cultural and spiritual dimensions. A key lesson is that developing landscape approaches involving multiple stakeholders in different sectors and countries requires significant investments of time and resources.

Sources: Kotru *et al.* (2017); Singh (2018); Zomer and Oli (2011).

Notwithstanding such examples, several challenges hinder the wider uptake of landscape approaches, including the following:

- The landscape concept is elastic – many definitions, interpretations and expectations exist, reflecting the diverse perceptions of stakeholders.
- More significantly, operationalizing a landscape approach requires breaking away from the entrenched policy and institutional frameworks that have developed in the last two centuries to support sector-based approaches to land and natural resource management.

- The adoption of a landscape approach is highly dependent on obtaining a convergence of objectives among landowners and managers. Those who benefit from large monocultures, for example, may be less willing to support integrated land uses that, in the short term, do not work to their advantage.

- The transaction costs of changing from sector-based strategies to landscape approaches could be significant given the resistance inherent in existing institutional arrangements, which may have a strong interest in maintaining the status quo (but the cost of not pursuing landscape approaches could be higher in the long run).

On the other hand, considerable experience in community forestry and other participatory approaches in recent decades provides valuable insights into how to approach forest and landscape management successfully.

Land policies and landscapes

Landscapes in the Asia-Pacific region are a product of a multitude of policies on, for example, ownership, distributive justice, economic efficiency and environmental protection shaped by drivers such as colonial history, changing power relations in society, market forces, and varied perceptions of economic and social development. Major shifts in land policies have often been triggered by political change: for example, the emergence of centrally planned economies in some countries led to the abolition of private ownership and government appropriation of all lands; on the other hand, economic liberalization policies have led to the privatization of public lands. Some countries have policies and laws relating to the use of land in its totality; in most, however, land use is determined largely by sectoral policies (such as those of agriculture, forestry, livestock and fisheries) aimed at achieving specific sectoral objectives. The absence of overarching land policies that provide a framework for determining trade-offs between competing objectives has accentuated conflicts among sectors. Nevertheless, major reforms to land policies and land tenure can be extremely difficult (Box 2.3).

Various pathways exist for changing land policies

Several pathways for changes in land policies and laws can be identified in the Asia-Pacific region. The communal ownership of land, including forests, was common in many countries in the region in pre-colonial times and remains predominant in Pacific Island countries. Surplus extraction under native rulers and subsequently by colonial administrations encouraged the development of private ownership, resulting in the emergence of a land-owning class. Land that was not cultivated or lacked ownership records was brought under state control, purportedly to fulfil "public purposes" such as safeguarding strategic timber supplies and protecting environmental values; most forest reserves created in South Asia in the nineteenth and twentieth centuries arose in this way. Where land under communal ownership cannot easily be brought under state control, other policy

BOX 2.3

Land policy and forests in Pakistan

Pakistan has diverse forest resources, although they cover only 1.9 percent of the total land area and were lost at a rate of about 42 000 ha per year between 1990 and 2015 (FAO, 2015a). Among the drivers of this deforestation, and a major barrier to sustainable development, is the lack of appropriate land policies and an equitable land-tenure system.

Because of its great sensitivity, the issue of forestland tenure and ownership rights has not been addressed in any policy statements or reforms in Pakistan, with existing land reforms focused mainly on agricultural land. Titles to forestland are determined through land revenue records and records maintained by forestry departments. Historically, forestland was available for everybody to use, and records show that tenure arrangements have been made to provide access for grazing, tillage and water. The tenure system is complicated by variations between provinces in the relationship between customary and formal law.

Pakistan's forests encompass reserved forests; protected forests; *guzara* or community-managed forests; and private or community forests. Reserved forests belong to the state, and local people have no legal rights to their management, conservation or revenue distribution. The Khyber Pakhtunkhwa Forest Department has recently introduced the concept of joint forest management, under which local communities are recognized as key stakeholders in forest conservation and management and their rights, privileges and obligations are spelled out. But questions remain about the role of communities; moreover, joint forest management committees have no female participation (the inclusion of women in forest-related decision-making is resisted in local tribal societies in certain areas of Pakistan).

The land in protected forests also belongs to the government, but local people have certain rights and privileges. In Khyber Pakhtunkhwa Province, local communities were concerned that the government was excluding them, and they were beginning to resist forest developments like plantations. In response, "forest protection committees" were established under the 2002 Forest Act to enable local communities to play a role in forest conservation and management. Nevertheless, a recent FAO mission to the Diamer district of Gilgit Baltistan found that forest protection committees were mainly on paper only, and there was no representation of women.

There is little effort in other provinces to involve local communities in forest management, and force is still used as a means of forest protection. On the other hand, farm forestry is expanding rapidly in many areas of Pakistan, facilitated by clear ownership rights. Similarly, forest conservation improved in the riverine forests of Sindh Province when local communities were given rights to the land.

Overall, there is a strong case for tenure reform and the development of comprehensive land policies in Pakistan, but these are likely to be difficult and highly complex tasks.

Source: M. Dowlatchahi and F. Bari, personal communication, March 2019.

instruments have been used to extract resources – such as timber rights purchase agreements in Papua New Guinea, under which the state purchases rights over the trees in customary land and then awards licences to logging companies to harvest the trees.

As land has become more valuable, new policy instruments have developed to bring about changes in land use, such as economic land concessions in Cambodia (Box 2.4) and special agricultural and business leases in Papua New Guinea. The major trigger for the creation of such instruments has been growing demand for agricultural commodities like rubber and palm oil. Deforestation has often been blamed on stakeholders such as indigenous peoples (and their shifting-cultivation practices) with little voice or power; however, many of the major land-scape changes that have occurred in the Asia-Pacific region in recent decades can be attributed to policies favouring timber concessions (which often degrade the forests to which they apply and increase road access), followed by policies that have enabled the large-scale expansion of commodity crops.

Some countries have pro-poor land-use policies

Although timber and land concessions have brought about major changes in

BOX 2.4

Land policy and economic land concessions in Cambodia

A series of land laws in recent decades has brought about major change in Cambodian landscapes. The 1990s were characterized by the allocation of large logging concessions, which led to large-scale timber extraction. Log exports were banned in 1996 under pressure from various sources, and a total ban on logging was imposed in 2001. In the post-2000 period, however, economic land concessions (ELCs) emerged as a model for social and economic development and were granted to investors with the purported objectives of: 1) developing an intensive agricultural base and promoting capital invest-ment in industrial agriculture; 2) increasing employment in rural areas to improve and diversify livelihood opportunities; and 3) generating revenue from concession fees, tax-ation and other charges. As of the end of 2013, ELCs covered 2.6 million ha, which is 14 percent of Cambodia's total land area. Almost 80 percent of ELCs are in production and protected forests, and rubber accounts for more than 40 percent of the ELCs by area. Under intense pressure, a moratorium on ELCs was imposed in 2012, but this is applica-ble only to new concessions, and those who obtained concessions earlier can continue extracting timber and converting forests to rubber and other crops. ELCs have led to land conflicts, especially on land occupied by local communities.

Sources: Drbohlan and Hejkrlik (2018); Forest Trends (2015); Milne and Mahanty (2015); Yasmi *et al.* (2017).

forest landscapes, many governments have also pursued policies to improve rural livelihoods and, in some cases, even reverse the past forceful appropriation of land. A notable example of the latter is India's 2006 Forest Rights Act, which aims to restore individual and community rights to forestlands. China and Viet Nam have also implemented far-reaching forest-tenure reforms, conferring rights to local communities and thereby triggering major landscape changes. Another example of a landmark reform is Indonesia's Social Forestry Programme (*Perhutanan Sosial*), the aim of which is to allocate 12.7 million ha of land to people living in or near forests for agricultural, forestry or aquacultural use. By July 2018, about 1.75 million ha had been allocated under this programme, benefiting 395 000 households (Shahab, 2018). Social land concessions have been introduced in Cambodia with the aim of increasing access to land by landless or homeless people.

Changes in forests and forest landscapes

Forest landscapes are landscapes in which forests and trees play significant economic, social and environmental roles. They are not necessarily homogenous, potentially including, for example, complex mosaics of land uses such as primary forests, secondary forests and planted forests managed for various objectives, as well as urban areas and agricultural lands.

Definitions of forest vary

Many governments adopt legal definitions of forests in which any government-owned land under the administrative control of forestry departments is considered forest (regardless of whether such land performs forest functions or even has trees). Other definitions focus on ecological characteristics and may therefore differ significantly from legal definitions. FAO's Global Forest Resources Assessment (FRA) uses canopy cover as the main basis for defining forests and assessing change in forest area. Despite its limitations, the FRA approach has generated consistent national-level data on forest cover over time, enabling the monitoring of long-term change. This report, therefore, uses the FRA definitions of forest, other wooded land, and other land (Box 2.5). Figure 2.3 shows the estimated land area in each of these three land-use categories globally and by region in 2015 (the most recent year for which these data are available).

Although there have been significant improvements in the ability to assess forest resources, many challenges persist in obtaining accurate, timely information on the state of forest and tree resources at the global, regional, national and subnational levels.

There is considerable variation in the Asia-Pacific region in the proportions of the three broad land uses. For example, forests comprise less than 10 percent of the total land area in several countries (Afghanistan, the Maldives and Mongolia). On the other hand, more than 70 percent of the land area is forested in Bhutan, the Lao People's Democratic Republic, Papua New Guinea and the Solomon Islands. Considerable variation also exists at the subnational level, reflecting differences in economic, social and environmental conditions.

BOX 2.5

Defining forest, other wooded land and other land

The 2015 Global Forest Resources Assessment uses the following definitions of the three main categories of land:

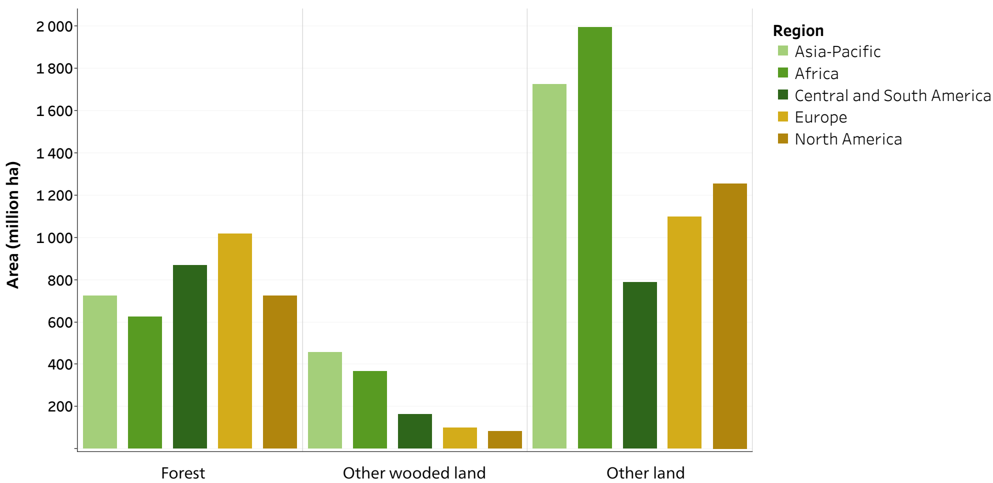
Forest – land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10 percent or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban use.

Other wooded land – land not defined as forest spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of 5–10 percent, or trees able to reach these thresholds; or a combined cover of shrubs, bushes and trees above 10 percent, excluding land that is predominantly under agricultural and urban use.

Other land – all land not classified as forest or other wooded land, including agricultural land, meadows and pastures, built-up areas, barren land, land under permanent ice, among others. This category encompasses a wide array of farming systems in agricultural landscapes, as well as urban lands.

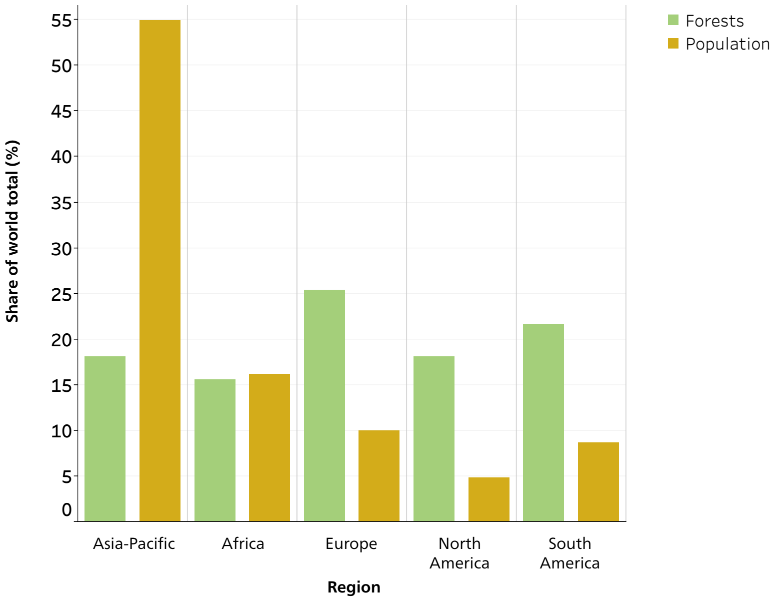
Source: FAO (2012a).

Figure 2.3. Land use in the Asia-Pacific and other regions, 2015



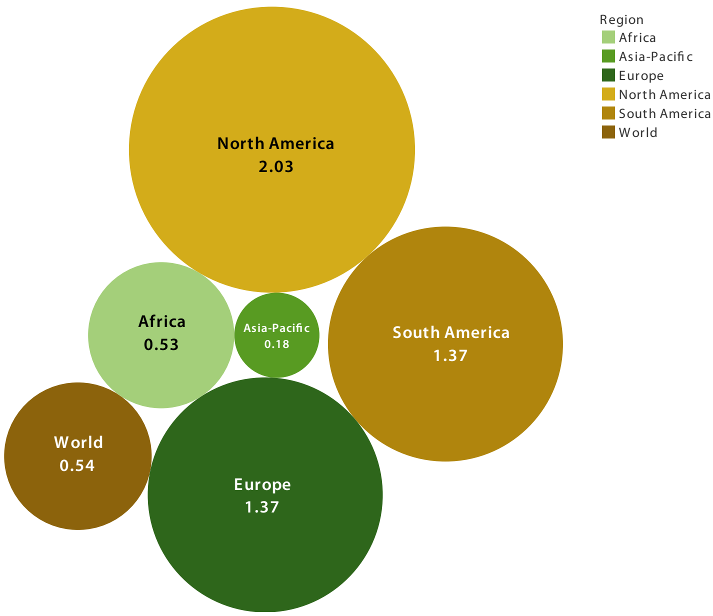
Note: "Other land" includes inland water bodies.
Source: FAO (2015a).

Figure 2.4. Distribution of forests and human population, by world region, 2015



Sources: FAO (2015a); United Nations (2017).

Figure 2.5. Per-capita forest area, by world region, 2015



Note: Numbers indicate average forest area (ha) per capita.
Source: FAO (2015a).

Asia-Pacific has low per-capita forest area

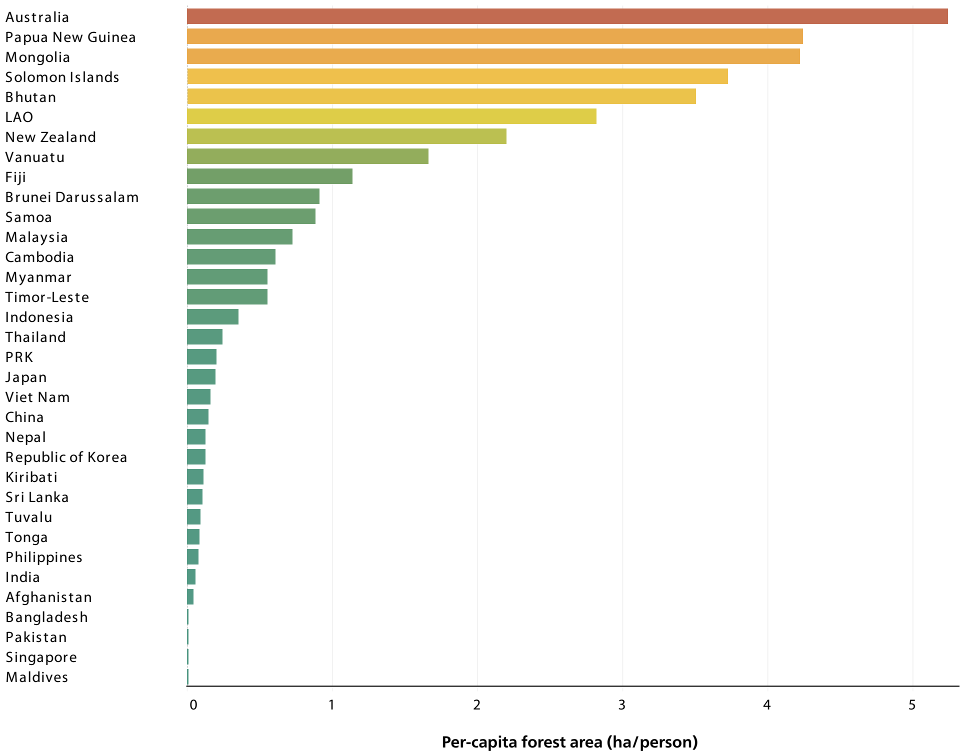
The Asia-Pacific region has more than half the world's population but only about 18 percent of its forests (Figure 2.4); its 0.18 ha of forest per capita is the lowest of any of the world's major regions and about one-third the global average (0.54 ha; FAO, 2015a; Figure 2.5). Forest area per capita varies within the region from almost zero (in the Maldives and Singapore) to more than 5.0 ha (Australia) (Figure 2.6).

Of the Asia-Pacific's four subregions, South Asia is the least-forested and most-populated: it contains one-fourth of the world's population but just more than 2 percent of its forests. The situation is particularly challenging in Bangladesh, India and Pakistan, where meeting future demand for forest products and ecosystem services will require significant increases in the resource base, such as through measures to improve forest conservation and increase productivity, an increase in wood imports from forest-rich countries, or a combination of these.

The region's forest cover is in flux

Forest area is increasing in some countries in the Asia-Pacific region but declining in many others. There was an overall

Figure 2.6. Per-capita forest area, Asia-Pacific countries, 2015



Note: LAO = Lao People's Democratic Republic; PRK = Democratic People's Republic of Korea.
Sources: FAO (2015a); United Nations (2017).

increase in forest area of 17.6 million ha in the region between 1990 and 2015, to 723 million ha, but this masks enormous differences among subregions and countries. Forest area increased overall in East and South Asia but declined significantly in Southeast Asia and Oceania (Figure 2.7). Divergent political, economic, social and environmental conditions have resulted in a range of forest development pathways. Most of the regional increase in forest area was due to only a few countries, especially China, India, the Philippines, Thailand and Viet Nam. Forest area also increased in Bhutan, Fiji, New Zealand and Samoa but, in absolute terms, the impact of these increases on the overall regional situation was minimal. Cambodia, the Democratic People's Republic of Korea, Indonesia, Myanmar, Nepal and Pakistan were the top forest-losing countries in the region in the period 1990–2015 (Figure 2.8).

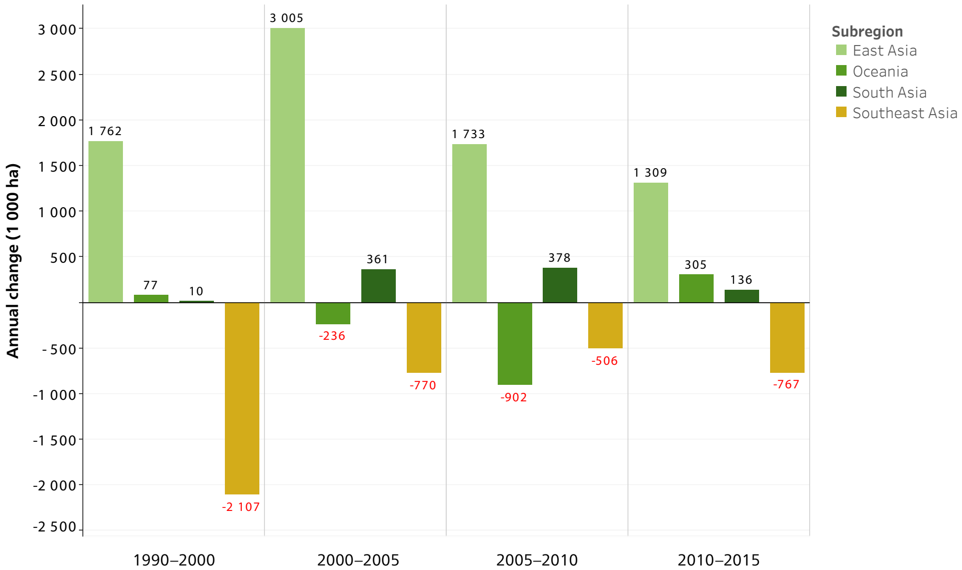
The area of primary forests is declining, but planted forests are expanding rapidly. Forests may be classified as primary forests, other naturally regenerated forests or planted forests on the basis of broad ecological characteristics (Box 2.6). Primary forests accounted for only 19 percent of the forest area (140 million ha) in the Asia-Pacific region in 2015. Other naturally regenerated areas (which include logged-over secondary forests) accounted for 64 percent (457 million ha), and the remaining 17 percent (126 million ha) comprised planted forests.

Quantitative changes in the Asia-Pacific region's forest resource in the period 1990–2015 include the following:

- The area of primary forests declined in all countries except Japan and Malaysia, with Indonesia and Papua New Guinea registering some of the region's sharpest reductions. In Papua New Guinea, the area of primary forest almost halved, from 31.3 million ha in 1990 to 17.6 million ha in 2015 (Box 2.7), due mainly to logging, conversion to industrial crops, and shifting cultivation; in Indonesia, the area of primary forest declined by 3.3 million ha over the period. Assessing change in the area of primary forests is difficult, especially given the limited capacity of national reporting agencies to undertake systematic assessments. Several countries reported no change in primary-forest area between 1990 and 2015, but this probably reflects the absence of effective forest monitoring rather than the on-the-ground reality.

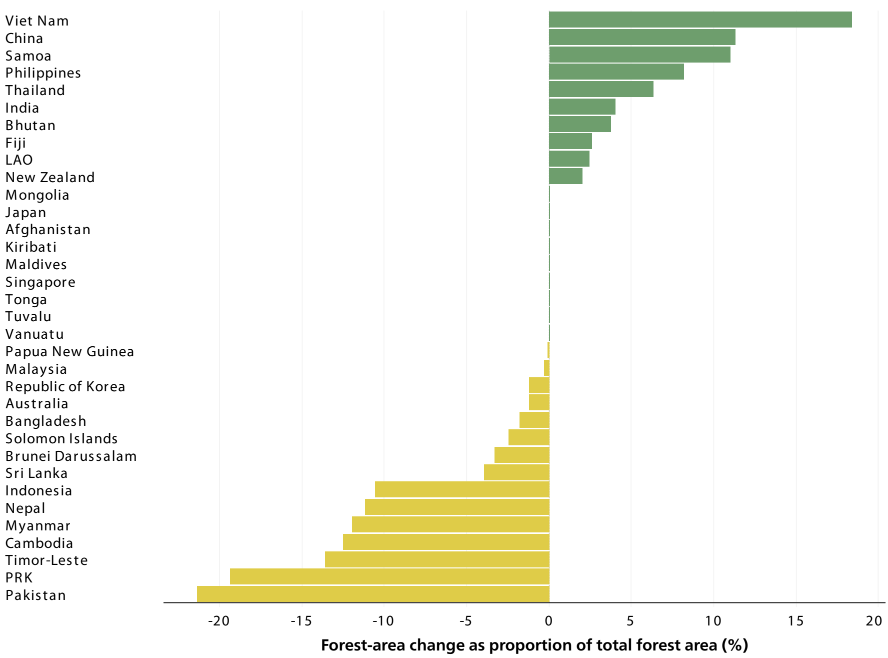
- Change in the area of other naturally regenerated forests varied among countries in 1990–2015. Countries with significant increases over the period include China (up by 14.2 million ha), Papua New Guinea (+13.4 million ha) and Viet Nam (+3.0 million ha). Countries reporting significant declines included Myanmar (-10.7 million ha), Indonesia (-6.5 million ha), Australia (-3.1 million ha), and the Democratic People's Republic of Korea (-2.3 million ha). Increases in other naturally regenerated forests were due to several factors, most notably the logging of primary forests and the discontinuation of shifting cultivation, thereby permitting forest regrowth. Decreases were due primarily to conversion to non-forest land uses (often facilitated by the increased access provided by logging).

Figure 2.7. Forest-area change, Asia-Pacific region, 1990–2015, by subregion



Source: FAO (2015a).

Figure 2.8. Forest-area change in the Asia-Pacific region, by country, 1990–2015



Note: LAO = Lao People's Democratic Republic; PRK = Democratic People's Republic of Korea.
Source: FAO (2015a).

BOX 2.6

Broad forest groupings

Forests may be categorized as primary forests, other naturally regenerated forests or planted forests, as follows:

- *Primary forests* are forests that have regenerated naturally with native species where there are no visible human activities and ecological processes are not significantly disturbed.
- *Other naturally regenerated forests* are forests where there are clearly visible indications of human activities, such as selectively logged-over areas, areas regenerating following agricultural land use, and areas recovering from human-caused fires. Naturally regenerated forests also include a mix of naturally regenerated trees and planted trees, where the former accounts for more than 50 percent of the growing stock at stand maturity. Most "other naturally regenerated forests" are secondary forests that have been degraded due to logging, fire and other human interventions.
- *Planted forests* are those forests established through planting or deliberate seeding.

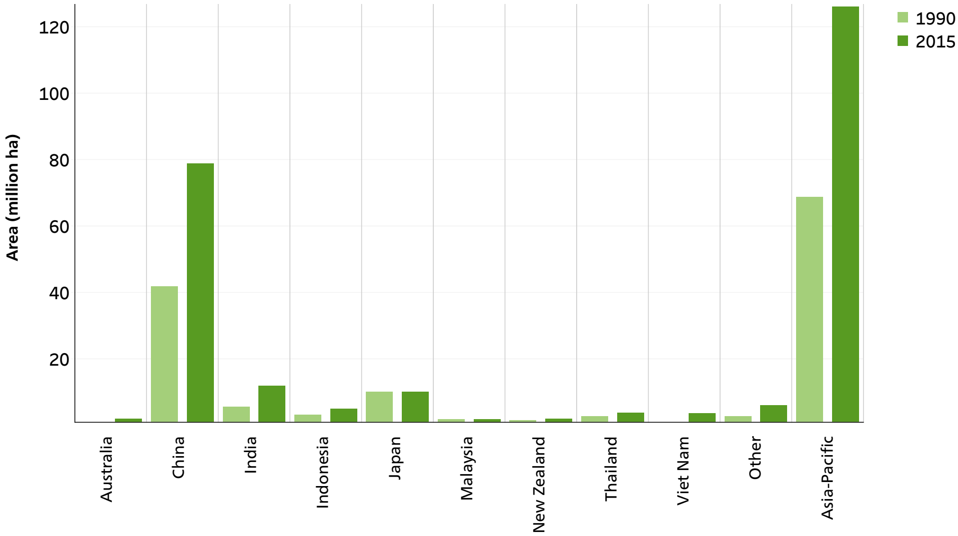
A change in the area under different categories is indicative of the impact of human interventions. For example, the logging of primary forests may result in their conversion to other naturally regenerated forests. The regeneration of abandoned shifting-cultivation areas may lead to the formation of secondary forests (a form of other naturally regenerated forest).

Source: FAO (2012a).

- Almost all countries in the Asia-Pacific region registered increases in planted-forest area between 1990 and 2015, with the regional total increasing from 69 million ha to 126 million ha over the period. Most of the expansion took place in a small number of countries, with China accounting for the lion's share – its increase of 37 million ha was 65 percent of the region's overall increase. Other countries with significant increases in planted-forest area between 1990 and 2015 were India (+6 million ha), Viet Nam (+2.7 million ha), and Thailand (+1.3 million ha); Indonesia's planted-forest estate grew by 1.6 million ha in the period 2000–2015 (Figure 2.9).

Changes of area in the three main forest categories have important implications for the provision of forest goods and ecosystem services. The decline in the

Figure 2.9. Area of planted forests, selected countries in the Asia-Pacific region, 1990 and 2015



Note: The data shown for Indonesia in 1990 are from 2000.
Source: FAO (2015a).

area of primary forests, for example, has had negative impacts on biodiversity and many other forest values. The increase in planted-forest area, on the other hand, has boosted the wood supply, with an increasing share of (especially) industrial roundwood now sourced from planted forests in the region.

The pace of establishment of planted forests is slowing. A preliminary assessment suggests that the rate of expansion of planted forests slowed in 2010–2015 in most countries in the Asia-Pacific region that had previously been at the forefront of planted-forest development (Payn *et al*., 2015). Several factors will determine the future expansion of planted forests, such as land availability, competition with alternative uses, investment needs, productivity and economic viability.

Not all planted forests have been established for wood production. Some focus on the provision of ecosystem services and combating land degradation, but no detailed functional categorization of planted forests (e.g. whether for production, conservation or multiple use) is available. There are also considerable differences in species, rotation lengths and wood end uses.

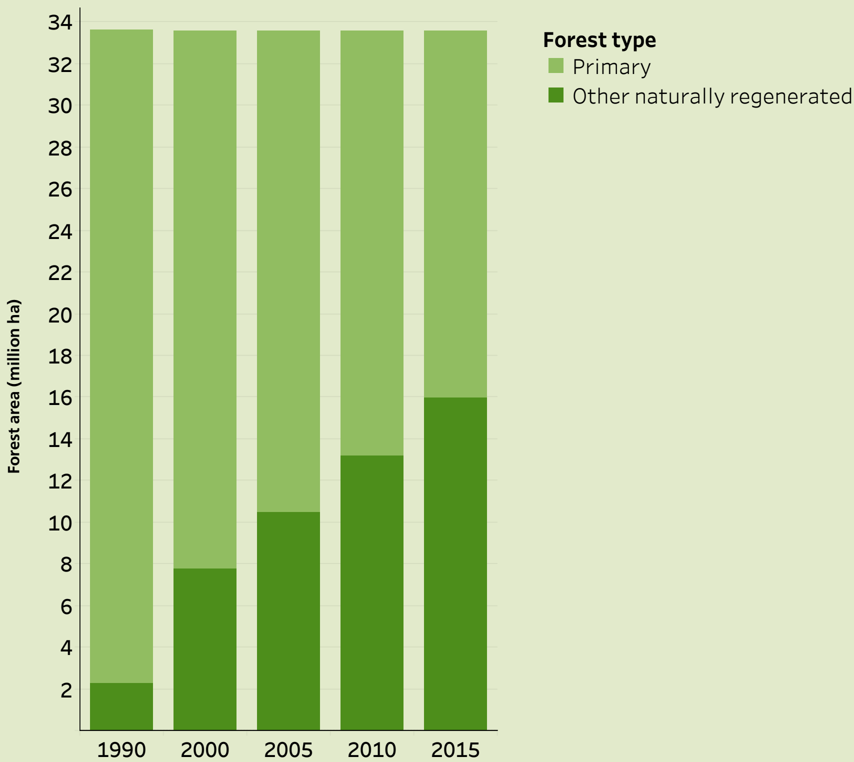
Decline in forest quality due to degradation remains a serious problem. Forest degradation can be defined broadly as changes in the structure and functions of a forest that reduce its capacity to provide goods and ecosystem services. The absence of widely applicable and reliable measures of forest degradation and a lack of data remain key challenges in assessing forest degradation (although

BOX 2.7

Primary forests decline rapidly in Papua New Guinea

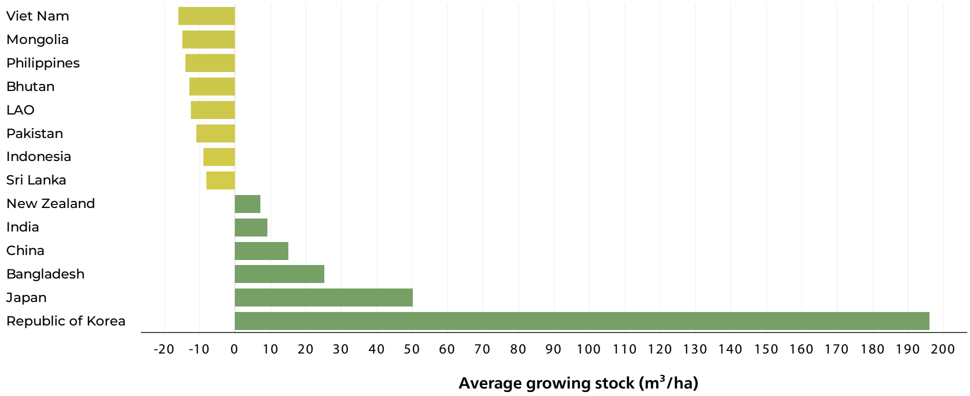
Papua New Guinea had the second-largest area of primary forests – 31.3 million ha – in the Asia-Pacific region in 1990, but this had declined to just 17.6 million ha in 2015 (with a corresponding increase in the area of other naturally regenerated forests – Figure 2.10). This was one of the sharpest declines in primary forest in any country in the region in recent decades. Although industrial logging was a key driver, a large area of primary forests was also cleared under special agricultural business leases. Notwithstanding the findings of the Special Agricultural Business Leases Commission of Inquiry (see Box 5.5), primary-forest logging continues in Papua New Guinea, and the country is the largest exporter of tropical timber in the Asia-Pacific region.

Figure 2.10. Area of primary forest and other naturally regenerated forest, Papua New Guinea, 1990–2015



Source: FAO (2015a).

Figure 2.11. Change in average growing stock per unit area, selected Asia-Pacific countries, 1990–2015



Notes: A positive value indicates an overall increase in average wood volume per hectare; a negative value indicates an overall decline in this measure. LAO = Lao People's Democratic Republic; PRK = Democratic People's Republic of Korea.
Source: FAO (2015a).

technological advances such as lidar are helping improve the situation – see Chapter 7). Figure 2.11 presents data on one measure of forest condition – change in growing stock – reported in previous FRAs. Note, however, that few countries conduct regular forest inventories, and estimates of per-hectare growing stock may therefore fail to reflect the actual situation; also, declines in growing stock per unit area may be due to a high proportion of recently established planted forests (which have very small growing stock). Moreover, changes in growing stock may not be an effective indicator of forest quality: for example, an intensively managed planted forest may achieve large increases in wood volume compared with an unmanaged natural forest but remain biodiversity-poor. Declines in growing stock may occur due to a wide range of stressors, such as fire, pests, soil degradation and overharvesting. Poor site management may also reduce productivity. On the other hand, promising research in China could assist in improving the multifunctionality of both existing and future planted forests (Box 2.8).

Partial canopy cover loss (PCCL), which may be caused by a range of natural and anthropogenic factors, is another measure of forest degradation (FAO, 2016a). For example, PCCLs were recorded in the period 2000–2012 in about 50 million ha of forest in South and Southeast Asia, 5 million ha in Oceania, and 1 million ha in East Asia. PCCLs do not affect estimates of forest area but can have significant negative impacts on forest functions such as wood production, carbon sequestration and biodiversity conservation.

The area of other wooded land is growing

Globally, the area of other wooded land was estimated at about 1 200 million ha

BOX 2.8

Transforming China's restoration forests

China is engaged in a massive reforestation programme with the aim of redressing the environmental problems caused by previous deforestation. Most of China's new forests are monocultures of fast-growing species considered to have high economic potential, such as eucalypts, poplars, larch and pines. Not all the new forests have established successfully, however, especially in marginal areas. Moreover, many plantations have begun to exhibit low productivity, poor soil stability and a high vulnerability to pests and diseases, and their biodiversity is low.

More than a decade ago, scientists at the Experimental Center of Tropical Forestry (ECTF) in Pingxiang embarked on an experimental programme to test a range of approaches to close-to-nature forestry in China's subtropics. Close-to-nature forestry is a potential means for diminishing the risks to monocultural forests posed by climate change, pest outbreaks and other threats through the use of simple management interventions. Rather than mimicking nature, close-to-nature forestry uses it to best advantage: the aim is to achieve a healthy, functioning, productive forest that is resilient in the face of stressors and economically profitable, using as few human interventions as possible. Genetic and structural diversity help confer resilience, which is a precondition for species in adapting to changing climatic conditions.

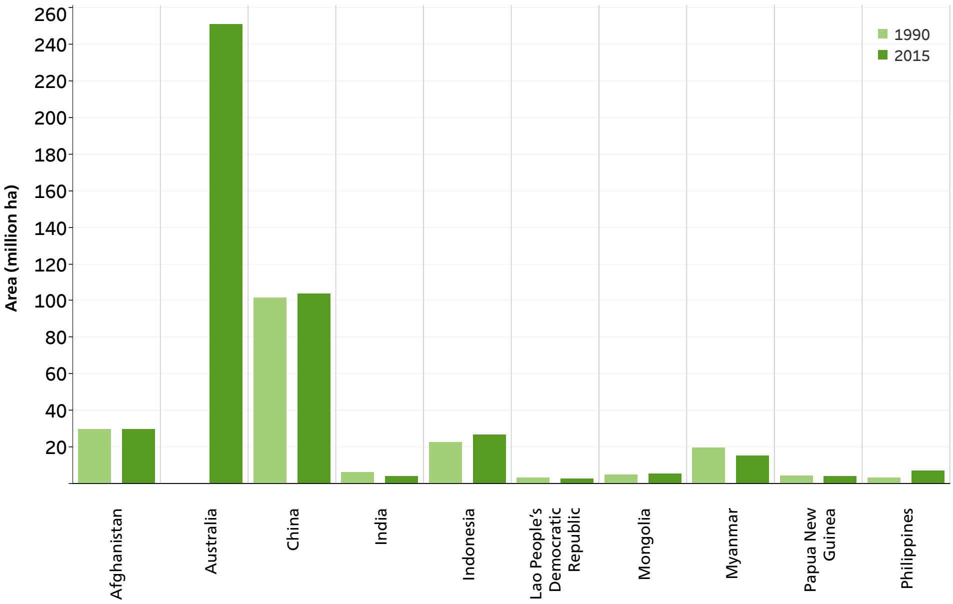
The ETCF has developed a range of experimental designs using two main approaches. One of these is to retrofit existing monocultural plantations by cutting stems – either in clusters, or the selective cutting of individual trees – and planting rare, high-value native broadleaved species in the gaps to promote uneven-aged, mixed-species forests with two or more canopy layers. The other approach is – in new plantations – to intercrop fast-growing *Eucalyptus* with nitrogen-fixing (and also rare, native and high-value) broadleaved species as *Dalbergia odorifera* and *Erythrophloeum fordii* to develop mixed-species even-aged and (ultimately) uneven-aged forests.

Early results are highly promising, with measurable increases in tree growth, improved tree form, and increased structural and biological diversity, among other benefits, for a range of experimental designs.

The ECTF's long-term aim is to develop multifunctional, close-to-nature forestry that ensures ecosystem sustainability, generates income in the short term and over the longer term, produces large-diameter trees of broadleaved species suitable for high-value end uses such as the manufacture of furniture, facilitates increases in biodiversity and provides ecosystem services. Encouraged by the ECTF's results, all twelve of China's major forest experimental centres are now pursuing similar research with the aim of developing close-to-nature forestry to suit conditions in other biogeographic regions and landscapes. The ECTF's approach could be applied elsewhere in tropical and subtropical Asia.

Sources: Daoxiong *et al*. (2015); APFNet and ECTF (2015).

Figure 2.12. Area of other wooded land, selected countries in the Asia-Pacific region, 1990 and 2015



Notes: Data for 1990 were unavailable for Australia. The data shown for Indonesia in 1990 are from 2000. LAO = Lao People's Democratic Republic. PNG = Papua New Guinea.
Source: FAO (2015a).

in 2015, with the Asia-Pacific region accounting for 456 million ha (Figure 2.12). Within the region, Australia and China together accounted for 78 percent of this land category in 2015.

The absence of systematic assessment makes it difficult to gauge the extent of changes in the area of other wooded land. Several countries (e.g. China, Fiji, Indonesia, Mongolia, Nepal and the Philippines) reported increases in 2015, which may be due to one of two processes – the abandonment of agricultural land (thereby enabling the natural growth of trees and other vegetation), or the loss of forest canopy cover to the extent that there is a change in definition from forest to other wooded land.

The 2015 FRA (FAO, 2015a) provided estimates of growing stock on other wooded land for only five countries in the Asia-Pacific region. These vary from 11 m^3 per hectare in the Lao People's Democratic Republic to 71 m^3 per hectare in New Zealand. China reported a total growing stock of 1 280 million m^3 (about 12 m^3 per hectare) in its other wooded land.

The management of forests and trees

The forest production systems and value chains that exist today in the Asia-Pacific region are largely a legacy of the twentieth century: a key question is whether ongoing structural and functional changes will enable these systems and value chains to meet the future needs of societies. In several countries, intensively managed planted forests have become the main source of wood production, and the role of natural forests in the wood supply has declined. Trees outside forests – including trees grown on farms and along roads and canals – have also become important sources of industrial wood, and production models such as cooperatives of small-scale producers and smallholder–company partnerships are emerging to facilitate this. As the focus of wood production moves towards privately owned planted forests, the direct role of public-sector forestry departments in this aspect of forestry is declining.

Forest production systems in the Asia-Pacific region are highly dynamic and diverse (Table 2.1), and they have evolved in response to a wide range of political, institutional, market, technological, economic, social and environmental factors. Considerable efforts have been made in recent decades to implement SFM, including the development and deployment of criteria and indicators with the aim of ensuring that the economic, social, environmental and cultural dimensions of forest management are taken fully into account. Despite ongoing efforts, however, the implementation of SFM is yet to be widely achieved, and timber-centric management still predominates.

Wood production in the region

In most countries in the region, wood is still the most economically important forest product. It has three main sources:

1. natural forests;
2. intensively managed planted forests; and
3. trees outside forests.

The relative importance of these wood sources is changing, although there is a lack of data to fully quantify this change. In most countries, disaggregated data on wood quantities from the various sources are unavailable; for example, national statistics often fail to fully capture wood production in farm woodlots and even in private planted forests. Some broad trends in wood production are described below.

The supply of wood from natural forests is declining

The logging of natural forests, although declining in importance in the region, remains the dominant wood production system in several forest-rich countries, including Cambodia, Indonesia, Malaysia, Papua New Guinea and the Solomon Islands, generating substantial income for governments through royalties and export taxes.

Timber extraction is still in the government domain in a handful of countries; in most countries, however, concession-holders – including transnational corporations – dominate natural-forest logging. In concession production systems, large tracts of forests are allocated to logging companies, which pay royalties or taxes according to the quantity of timber extracted (or some other measure). Concession systems have been criticized for a lack of SFM and, where governance is weak, for illegal practices (Hensbergen, 2018).

Table 2.1. Characteristics affecting forest production systems

Key elements	Possible situations
Products and services produced	▪ Industrial wood ▪ Woodfuel ▪ Non-wood forest products ▪ Ecosystem services (e.g. biodiversity conservation, watershed protection, carbon sequestration and amenity) ▪ Multiple products and services
Ecological conditions	▪ Forest type (e.g. tropical, subtropical, temperate and alpine) ▪ Slope, terrain and soils ▪ Temperature and precipitation ▪ Biodiversity and species composition
Resource characteristics	▪ Natural forests – primary and secondary ▪ Planted forests ▪ Trees in farms/agroforestry systems/homegardens ▪ Urban and peri-urban forests
Resource ownership	▪ Governments ▪ Private sector (e.g. companies, corporate investors and timber investment management organizations) ▪ Individuals, households, smallholders, farmers, indigenous peoples ▪ Community groups
Technology	▪ Low-cost traditional technologies ▪ Energy-intensive technologies ▪ Low-energy, environmentally friendly technologies
End uses/markets	▪ Subsistence use by local communities ▪ Local markets ▪ Subnational and national markets ▪ Global markets

Natural-forest management systems have evolved over time in the region's various forest types. Research institutions in India, Indonesia, Malaysia, the Philippines and Thailand pioneered efforts – based on classical European forestry practices – to develop sustained-yield systems suitable for the ecology of tropical forests. These systems rely largely on the natural stock of trees and natural regeneration and aim to limit harvesting to sustainable volumes. Logging is done selectively, with a focus on commercially important species above a specified diameter and restricting the number of trees that may be removed per hectare (Box 2.9).

Despite considerable effort over many decades to develop systems for the sustainable management of natural forests in the Asia-Pacific region, wood production is declining in natural forests, for the following reasons:

- Natural regeneration is an uncertain process. Despite many years of research to develop appropriate regeneration techniques, such as assisted natural regeneration and gap planting and seeding, the adequate regeneration of logged-over forests remains a challenge. One factor in the less-than-ideal forest regeneration achieved is the relatively limited extent to which reduced impact logging (see Box 7.2) has been applied.

- Rapid growth in wood demand and the sometimes windfall profits available have led to the overharvesting of natural forests, which has undermined future wood production. In many cases, logged-over areas have developed into less-productive secondary forests overgrown with weeds, including invasive species.

- In most countries, concessionaires carry out timber extraction. Systemic governance failures, especially in regulating logging concessions, have meant that unsustainable logging has been widespread in many countries (on the other hand, timber extraction by government agencies provides no guarantee of sustainability and legality – Box 2.10).

- Some countries have imposed logging bans in response to major environmental problems – such as flooding and landslides – attributed to overharvesting. The efficacy of such bans is questionable – often, for example, they merely encourage informal logging (which is challenging to regulate) or more intensive logging in other countries. Nevertheless, many countries continue to pursue this approach (see Box 8.2).

- The designation of natural forests as protected areas to conserve biodiversity and protect watersheds has excluded large areas of natural forests from wood production.

There is considerable public concern about forest illegality and the need for SFM, and global efforts to address illegal logging have made progress (see Chapter 8). Forest certification is increasingly applied in the Asia-Pacific region, partly as a way of providing the public with information on the quality of forest management,

BOX 2.9

The Selective Management System in Peninsular Malaysia

Malaysia's pioneering research on the management of its lowland dipterocarp forests led to the development and adoption of the Malayan Uniform System. As vast stretches of lowland dipterocarp forests were converted to other uses, however, timber extraction shifted to hill dipterocarp forests. These forests are often on very steep slopes; moreover, the poor regeneration of commercially important species made the Malayan Uniform System unworkable. This led to the introduction in the 1970s of the Selective Management System (SMS), which is sufficiently flexible to accommodate local ecological differences. Key features of the SMS are pre-felling assessment, especially of regeneration and the number of trees or volume of timber that can be harvested sustainably; determining the number of trees to be harvested selectively or the quantity of timber to be extracted; and post-harvest operations to ensure that the area regenerates and that smaller-girth trees become harvestable over the next cutting cycle (25–30 years). Stipulations on the minimum number of trees to be left standing also ensures sufficient seed sources for the regeneration of gaps created by logging. The success of the SMS depends on leaving adequate mature trees to facilitate seeding, a sufficient number of trees in the pre-exploitable class, the minimization of felling damage, and post-harvest treatments such as assisted regeneration, especially if natural regeneration is insufficient. Reduced impact logging is a key requirement of the SMS.

The SMS is practical, flexible and easily monitored in the field. There is concern, however, that residual growth is poor because of the overharvesting of valuable species. Some assessments have indicated that the regime is causing a change in the species' mix in forests, with a reduction in the proportion of commercially important species. Efforts are underway to address this: the SMS requires fine-tuning to ensure that timber yields – and ecosystem services – are sustained over successive harvesting cycles.

Source: M. Shamsuddin, personal communication, October 2018.

including its legality. Overall, however, the area of natural forests used for wood production is likely to continue to decline as more planted forests and trees outside forests reach maturity, more lower-cost wood is imported from other regions, and more used wood is recovered.

The share of wood production from planted forests is increasing

Planted forests are becoming the major source of wood supply in the Asia-Pacific region, although there is a lack of reliable data on their share of wood production. Most of the initial development of

BOX 2.10

The management of teak forests in Myanmar

The extent of natural teak forests in India, the Lao People's Democratic Republic, Myanmar and Thailand has been estimated at about 29 million ha, half of which is in Myanmar. Myanmar has been at the forefront of managing teak forests, first under the Brandis Selection System and then under the Myanmar Selection System. A recent study suggested that natural-forest management has been ineffective in ensuring the sustainability of teak wood production due to factors such as overharvesting, illegal logging, agricultural expansion, shifting cultivation and grazing (Kollert and Kleine, 2017). As demand for teak wood has increased, the principles of sustained yield (e.g. minimum exploitable diameters and cutting cycles) have been compromised, resulting in declining productivity and degradation (Tin Tin Myint, 2012). The divergence of priorities among key institutions has been a key contributor to unsustainable practices: for example, the Myanmar Forest Department is focused on managing teak forests sustainably, but the primary concern of the Myanmar Timber Enterprise is the extraction of maximum volume.

industrial-scale planted forests involved long-rotation hardwoods such as teak or softwoods such as radiata pine, grown primarily for saw and veneer logs. Later, the development of the region's pulp-and-paper industry shifted attention to fast-growing species, particularly acacias, eucalypts and tropical pines. Developments in wood-processing technologies (e.g. spindleless lathes that can peel small-dimension logs) are increasingly enabling the use of plantation-grown, small-dimension timber for most end uses and significantly shortening rotation lengths (for example, the rotation length of planted teak has been reduced from 80 years to 15–20 years).

New players are entering the planted-forest sector

For many years, governments dominated the planted-forest sectors in most countries in the Asia-Pacific region. This has changed significantly in the last couple of decades, however, and corporate investors, wood product companies, institutional investors (especially pension funds through timber investment management organizations), smallholders and local community groups have increasingly entered the domain (Table 2.2). This is causing enormous changes – such as in the objectives of management, the technologies employed, productivity and end uses.

In some countries, governments continue to play leading roles in the establishment of planted forests as a source of future wood supplies or for the provision of ecosystem services, including by providing technical support, subsidizing planting materials and improving policy and legal frameworks (most importantly by removing disincentives). Specific government policies and initiatives aimed at promoting tree planting in the region include China's Decision on Accelerating Forestry Development (2003), which subsequently led to the Six Key Forestry Programmes; Viet Nam's Five Million Hectares Reforestation Programme; and the Philippines' National Greening Programme. Some governments are recognizing the potential of planted forests for offsetting carbon emissions. For example, both New Zealand (see Box 9.3) and Australia have announced government tree-planting programmes, with carbon sequestration a key objective.

There are now stronger linkages between planted forests and processing industries. When rotation lengths were longer it was difficult to plan planted forests to meet future needs, and the links between wood production and its industrial use were tenuous. This has changed significantly as rotations have become shorter, and wood product companies are increasingly investing in planted forests to ensure stability in their wood-supply chains.

Table 2.2. Key players in planted-forest development in the Asia-Pacific region

Player/institution	Nature of involvement
Government forestry agencies, including public-sector enterprises	Still the most important player in planted-forest development Lack of sufficient management input results in low-productivity and potentially economically unviable resource Resource needs to fulfil several objectives in addition to wood production
Corporate investors/ companies/timber investment management organizations	Generally high-quality planted forests aimed at providing raw material for further processing
Communities/individual landowners/farmers	Important wood producers in several countries; wide variety of tree-growing systems employed, many of which are highly productive
Partnership arrangements between farmers and companies	Contract tree farming widely used in several countries, enabling industrial wood production on farmland

Farm forestry is an emerging source of wood. Farm forestry is characterized by enormous differences in structure and functions, which, in turn, are influenced by a range of economic, social, environmental and cultural factors. At one end of the spectrum are the highly diverse mixes of species found in homegardens; at the other end are intensively managed farm woodlots producing industrial wood, often established and managed by farmers under contract with companies or as part of producer associations.

Smallholder tree farming has a particular challenge related to the scale of production, especially when products are sold in national and global markets. A range of institutional arrangements – especially in the form of tree-grower cooperatives – has been developed to address this (e.g. teak-growers in Indonesia; Box 2.11). Increased access to timely information through the use of information and communication technologies is empowering smallholders to venture into markets that were previously the sole domain of large-scale producers.

Other arrangements have emerged linking farm foresters and wood product companies. One of these, contract tree farming, has considerable potential for increasing wood supply and generating income for farmers (Box 2.12). Various challenges to this approach must be addressed, especially ensuring that participating farmers can operate on a level playing field and maintain productivity and economic viability in the long term. As information and communication technologies continue to improve and enabling policy and legal frameworks develop, contract tree farming could emerge as a win–win option for farmers and the wood industry.

The planted-forest sector faces two key challenges

The planted-forest sector must address two key challenges if it is to continue

BOX 2.11

Teak cultivation by smallholders in Indonesia

Teak is an important farm tree crop in several countries in South and Southeast Asia. In Java, Indonesia, about 1.5 million farm families are involved in growing teak on an average holding of about 1 ha. It has been estimated that Javanese smallholders produced more than 2.0 million m^3 of teak wood in 2011. Eighty percent of the wood demand from small and medium-sized companies producing furniture is met by smallholder wood production. Many farmers invest in teak as a form of long-term savings to be used when large cash outlays are required. Farmers have overcome the problem of small-scale production by developing cooperatives to market their products, create wood-processing enterprises to add value to the wood, and provide other services.

Source: Finlayson (2017).

growing: expanding the forest estate, and maintaining productivity, as discussed below.

Will planted forests compete successfully with other land uses? Most of the increase in the area of planted forests in the last several decades in the Asia-Pacific region has been in a handful of countries, where there are indications that the rate of expansion is slowing. Increasingly, land availability is a key constraint: where suitable land exists, planted forests often compete with other potentially more remunerative uses, especially industrial crops. Although large stretches of degraded lands exist in the region, low productivity and the high cost of establishment and maintenance may limit the economic viability of planted forests in such areas. Planted-forest programmes are important components in the climate-change mitigation strategies

BOX 2.12

Contract tree farming

Contract tree farming has emerged as an option for supplying wood raw material to industries, especially the pulp-and-paper industry, in land-scarce countries such as India, Thailand and Viet Nam. As more public forests are set aside for the provision of ecosystem services, wood product companies are increasingly relying on farms for their wood supplies through long-term contracts entered into with landowners. In areas where agriculture has become uneconomic, tree farming is an increasingly attractive option for landowners, although its long-term viability has not been assessed systematically. The obligations of contracting parties – landholders and wood product companies – are specified in contracts (FAO, 2017a), often including the quantity of wood to be supplied and the price. In most cases, companies provide farmers with financial and technical support, including the supply of high-quality planting materials. A key advantage for wood product companies is that outsourcing their wood supply decreases the need to manage their own forest resources, reducing operational costs and the need for capital. Contract tree farming enables companies to minimize their exposure to risk, especially that related to productivity declines due to natural and human factors, and it can also boost their image by demonstrating corporate social responsibility through their support for rural development. Contract tree farming enables landholders to become integral parts of wood-product supply chains.

Several examples of contract tree farming exist in India, Thailand and Viet Nam. In India, the Tamil Nadu Newsprint and Papers Ltd and the Karur and Seshasayee Paper Board have established contract agreements with small and marginal farmers near the city of Erode to supply primarily casuarina and eucalypt species (Parthiban, Sreenivasan and Rao, 2006). An estimated 70 percent of eucalypt plantations in Thailand – about 336 000 ha – are subject to contractual arrangements between companies and landowners (Boulay, 2010).

and nationally determined contributions of several countries in the region, but it remains unclear whether these will lead to significant increases in planted-forest area.

Will it be possible to maintain or increase the productivity of planted forests? The productivity of planted forests will continue to be a major challenge in most countries in the region. Concerns include the following:

- Many public-sector planted forests suffer from underinvestment due to budgetary constraints and institutional problems. Even when productivity-enhancing technologies are available, many public institutions lack the capacity to adopt them.

- Large tracts of degraded lands are available for planted forests, but increasing their productivity may require substantial investments in, for example, water supply, fertilizers and pesticides that could reduce the economic viability of wood production and increase the ecological footprint.

- Climate change may increase the vulnerability of large-scale planted forests – especially monocultures – to risks such as those posed by pests, fire and climatic extremes.

The quality of management in publicly owned planted forests is often inferior to that in industry-managed planted forests. Large-scale private investors have the means to adopt modern management practices and are usually more flexible than government departments in their management approaches. More importantly, the private sector is necessarily highly responsive to the needs of downstream processors regarding the quantity and quality of wood; public-sector management, on the other hand, is subject to less commercial pressure but has fewer management resources.

Trees in agricultural landscapes

Trees outside forests (TOF) encompass a wide range of arrangements, such as agroforestry, farm forestry, avenue trees, trees planted along canal banks, shelterbelts, windbreaks and urban trees (Table 2.3). TOF have enormous diversity due to divergent ecological, socio-economic, cultural, historical and institutional contexts, making it difficult to provide comprehensive perspectives on their overall importance at the global, regional or national scale. There is no doubt, however, that they fulfil diverse economic, social, environmental and cultural functions (de Foresta *et al*., 2013).

Despite the importance of TOF, comparatively little attention has been paid to realizing their full potential. Departments of agriculture, considering that trees are not part of agriculture, have largely ignored them; on the other hand, forestry departments have also paid insufficient attention to TOF because they grow on non-forest lands. Moreover, policies, rules and regulations aimed at protecting trees under the control of forestry departments have tended to disincentivize the TOF segment. Nevertheless, many farmers continue to manage trees as integral components of their lands to the extent that, in some countries (e.g. Bangladesh and Sri Lanka), TOF have become important sources of wood and non-wood forest products.

Several (mostly small-scale) studies have been conducted on various aspects of TOF, especially the divergent economic, social and environmental contexts in which TOF are grown; technical and economic aspects of TOF, including product marketing; and policy, legal and institutional aspects of management. Some national-scale studies (de Foresta *et al.*, 2013) have examined the contributions of TOF to the production of wood and other products and their socio-economic impacts, especially in providing farmers and local communities with income. In Bangladesh, for example:

- Thirty percent of the country's cultivated area has tree cover.
- An estimated 4.09 million ha of land features uses involving TOF.
- The total TOF aboveground biomass is 569 million tonnes (compared with 278 million tonnes for forests).

In assessing change in the canopy cover of trees in and outside forests in Bangladesh, Potapov *et al*. (2017) noted that although canopy cover declined in forests by 83 600 ha from 2000 to 2014 it increased by 219 300 ha outside forests, resulting in a net increase of 135 700 ha. An assessment of TOF in the Philippines in 2003–2005 estimated the gross wood volume on "other land" at 365 million m^3, of which

Table 2.3. Groupings of trees outside forests, by predominant land use

Grouping	Examples
Trees on land predominantly under agricultural use	▪ Agroforestry parklands ▪ Trees scattered in mixed cropping systems ▪ Trees on pasturelands ▪ Trees in hedges ▪ Tree crops in monoculture plantations ▪ Trees in homegardens ▪ Trees in agroforests in the humid tropics ▪ Trees in shifting-cultivation areas
Trees on land predominantly under urban use	▪ Trees in large urban centres ▪ Trees in small urban centres ▪ Trees in peri-urban areas
Trees outside forests on land not predominantly under agricultural or urban use	▪ Trees in small woods ▪ Trees in narrow linear formations

the commercial volume (diameter at breast height = 50 cm or greater) was estimated at 24 million m^3. Regular assessments of TOF by the Forest Survey of India indicate an increasing trend in India's TOF growing stock (Box 2.13).

Zomer and Öborn (2019) used geospatial mapping to analyse tree-cover change on agricultural land in the Asia-Pacific region between 2000 and 2010 for three agricultural land-use types: cultivated and managed areas (intensive agriculture); cropland and other natural vegetation; and the cropland/tree-cover mosaic. The assessment concluded that:

- Of the 670 million ha of agricultural land in the Asia-Pacific region in 2010, 16.3 percent had tree cover. The proportion of agricultural land with tree cover varied between countries, from about 0.6 percent in Afghanistan to almost 52 percent in Papua New Guinea and 69 percent in Vanuatu. Fourteen of the region's thirty-four countries had more than 25 percent tree cover on their agricultural lands.
- There was an overall increase in tree cover on agricultural lands in the region, from 15.0 percent in 2000 to 16.3 percent in 2010, although there was considerable variation between countries. Figure 2.13 shows tree cover on agricultural land in the region in 2010.

Many farming systems in the Asia-Pacific region have significant tree components that fulfil various economic, social and environmental functions. Such systems have evolved in light of the larger economic and environmental contexts, and there may be significant variations, even between adjoining farms in similar ecological conditions. The following three broad types of TOF are worthy of particular attention:

1. *Homegardens* are multistoried systems featuring seasonal, annual and perennial crops and a range of tree species that produce various products. Homegardens, which are privately owned, mostly by smallholders, are an important land use

BOX 2.13

Trees outside forests in India

The Forest Survey of India has been assessing the state of trees outside forests in India since 2001 as an integral component of biennial national forest resource assessments. The extent of trees outside forests has increased from about 8.15 million ha (2.48 percent of the land area) in 2001 to 9.4 million ha (2.85 percent of the land area) in 2017. The growing stock of wood in trees outside forests in 2017 was estimated at about 1.60 billion m^3, or 27.6 percent of the total growing stock of all wood in and outside forests.

Source: Forest Survey of India (2011, 2017).

in several humid tropical areas in the Asia-Pacific region. In many situations they are linked closely to other components of the landscape mosaic, particularly rice cultivation. Homegardens are common in, for example, Bangladesh, Indonesia, Malaysia, the Philippines, Sri Lanka and the Indian states of Karnataka and Kerala.

Homegarden systems continue to evolve in response to changes in the conditions of households and in light of larger socio-economic trends. The partitioning of lands among household members can negatively affect some homegardens, which may subsequently be cleared to make way for house construction. Many homegardens have also been replaced by more remunerative crops, such as rubber. On the other hand, alternative sources of income – such as remittances – have reduced the dependence of many landholders on their land for income, enabling homegardens in some areas to flourish.

Homegardens continue to be important sources of wood and other products. For example, most rural households in Bangladesh meet their woodfuel needs from homegardens, notwithstanding the small size of individual plots. It is likely that homegardens will remain an important component of rural landscapes in many parts of the Asia-Pacific region.

2. *Trees grown for fruits, latex and other products* constitute another important category of TOF. Several species grown in monocultures or with other species (e.g. areca palm, coconut, durian, jack, mango, mangosteen, rambutan, rubber and tamarind) are also important sources of wood and other products. In several countries in the region, wood from rubber and coconut plantations supports thriving furniture industries.

3. *Trees grown primarily for wood production* in diverse farm-forestry systems are becoming increasingly important in the region. In recent decades there has been rapid growth in on-farm tree planting, especially using eucalypt, acacia, poplar and teak.

Trees are important in agricultural landscapes for more than their wood: they also provide food, medicines and a range of non-wood forest products for subsistence consumption and sale, and they can fulfil important conservation objectives (see Chapter 6). The aim of China's massive Sloping Land Conversion Programme is to convert marginal agricultural lands to forests, primarily for environmental purposes. Many cultures in the region have bestowed sacred standing on individual trees and groves, seeing them as deities or the abodes of certain spirits (Jim, 2018; see Box 6.7). Overall, existing (albeit fragmented) data indicate that TOF are growing in importance in the region.

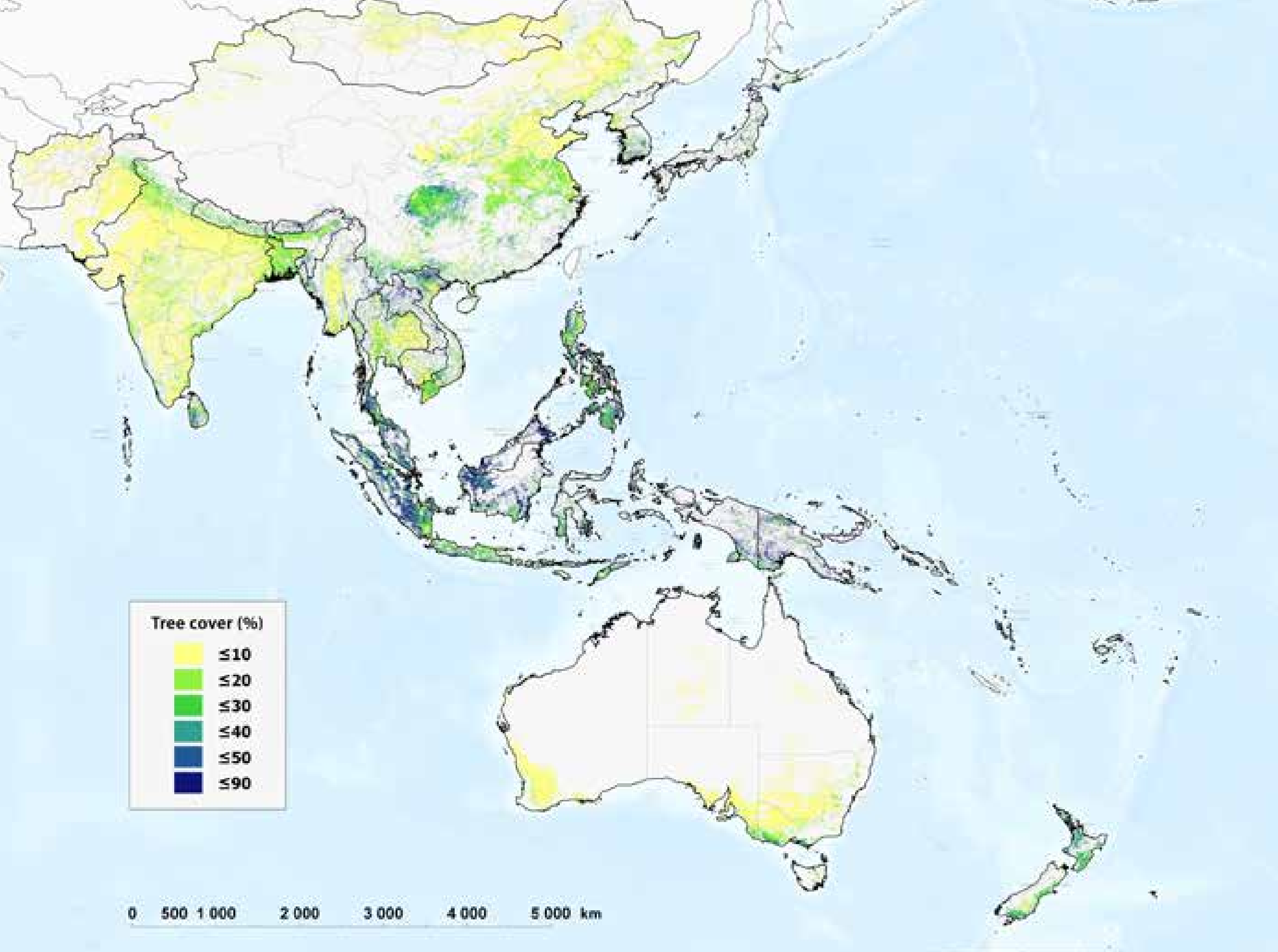


Figure 2.13. Tree cover on agricultural land, Asia-Pacific region, 2010

Note: The depiction and use of boundaries, geographic names and related data shown on this map are not warranted to be error free nor do they necessarily imply official endorsement or acceptance by the United Nations. The map is for representation purposes only and is not intended to provide scale or jurisdictional information.
Source: Zomer and Öborn (2019).

Trees in urban landscapes

Demand for urban green spaces is rising

One of the most pronounced demographic changes in the last few decades has been the accelerating pace of urbanization (as explored in Chapter 4). Urban areas are highly modified landscapes, the economic strength of which stems primarily from the infrastructure-intensive industrial and service sectors. Rural landscapes are drastically modified in the process of urban development, resulting in the removal of most pre-existing vegetation. Nevertheless, there is increasing realization that the quality of urban life also depends on "green infrastructure",[7]

[7] The green infrastructure of a city comprises the strategically planned network of high-quality natural, semi-natural and cultivated areas designed and managed to deliver a wide range of ecosystem services and protect biodiversity in urban and peri-urban settings (FAO, 2016b).

and this has drawn attention to the need to develop urban and peri-urban forestry (Box 2.14).

Urban green infrastructure provides multiple benefits

Several studies have highlighted the multiple benefits that urban green spaces[8] can contribute to sustainability and resilience in urban areas (Dobbs *et al*., 2018; Cariñanos *et al*., 2018). Although some of these benefits – such as air-quality improvement, cooling, flood abatement, water-quality improvement, climate-change adaptation and mitigation, the provision of employment and recreational opportunities, and health promotion – are important in all contexts, others might be more relevant to the urban poor. In low-income settlements, trees and forests are important sources of fresh food, herbal medicines, woodfuel, building materials and fodder (Castro *et al*., 2018). Many urban dwellers in developing countries rely on wood for heating and cooking.

Urban green spaces encourage outdoor recreational and sporting activities and promote healthy lifestyles. Regular contact with greenery and the associated natural ambience can help reduce stress and improve urban dwellers' health and physical and mental well-being. It has been demonstrated that patients in hospitals in green areas recover or heal better and faster, resulting in reduced healthcare expenditure. High-quality green spaces and trees in cities can bring considerable economic benefits: for example, studies in Hong Kong and Guanzhou in China showed that access and proximity to green spaces increased the sale value of residential properties (Jim and Chen, 2006a, 2006b, 2007).

Countries are undertaking urban greening initiatives

Several initiatives are underway to improve urban green infrastructure in Asia-Pacific countries. In China, for example, urban forestry is becoming a fundamental urban landscaping norm (Li and Yang, 2016). The National Forest Cities Programme, launched in 2004, resulted in an increase in urban tree cover in participating cities to more than 40 percent of the land area, up from less than 10 percent in 1981. By 2018, 138 cities in China had earned the title of "national forest city",[9] and the country aims to have 300 such forest cities by 2025 (FAO, 2016b; Yang, Yang and Zhao, 2018). In 2007, the Korea Forest Service launched the Urban Forest Plan, a strategy based on the vision "city in forest, and forest in city", the aim of which is to improve the liveability of urban areas through the development of an effective urban green network comprising urban forests, street trees, school forests, forest parks and landscape forests; the goal is to increase urban green cover from

[8] Green space may be defined as any open, undeveloped piece of land that is partly or completely covered with grass, trees, shrubs or other vegetation. It includes parks; community gardens; cemeteries; schoolyards; playgrounds; public seating areas; public plazas; and vacant lots (FAO, 2016b).

[9] To acquire the status of a national forest city, a city must pass a screening process based on 38 standards and indicators referring to three domains: 1) administration and organization; 2) management system; and 3) forest development.

BOX 2.14

What are urban and peri-urban forests?

Urban forests are networks or systems comprising all woodlands, groups of trees and individual trees in urban and peri-urban areas; they include, therefore, forests, street trees, trees in parks and gardens, and trees in brown fields and derelict enclaves. Urban forests are the backbone of green infrastructure, bridging rural and urban areas, connecting urban neighbourhoods and ameliorating a city's environmental footprint. Urban and peri-urban forests comprise the following:

- *peri-urban forests and woodlands* – forests and woodlands surrounding towns and cities that can provide goods and services such as wood, fibre, fruit, other non-wood forest products, clean water and opportunities for recreation and tourism;
- *city parks and urban forests* (>0.5 ha) – large urban or district parks with a variety of land cover and at least partly equipped with facilities for leisure and recreation;
- *pocket parks and gardens with trees* (<0.5 ha) – small district parks equipped with facilities for recreation and leisure, and usually enclosed private and institutional gardens and green spaces;
- *trees on streets or in public squares* – linear tree strips, small groups of trees, and individual trees in squares and parking lots and on streets, etc.; and
- *other green spaces with trees* – for example urban agricultural plots, sports grounds, vacant lands, lawns, river banks, open fields, cemeteries and botanical gardens.

Source: FAO (2016b).

9.91 m^2 per inhabitant (as of 2015) to 15 m^2. Malaysia has also been investing in efforts to increase urban tree cover after recording a net decline in this measure between 2000 and 2014; the country aims to achieve the status of a "garden nation" by 2020. Singapore and Hong Kong are other important cities investing in urban green spaces.

Several regional and global initiatives aim to support the efforts of national governments and city administrations towards urban greening, especially to increase learning from the sharing of experiences. The aim of the Tree Cities of the World Programme, launched at the World Forum on Urban Forests in November 2018, is to support cities in stepping up urban and peri-urban forestry to help accomplish the SDGs. Participants at the Second Asia-Pacific Urban Forestry Meeting, held in Seoul, the Republic of Korea, in 2017, developed the Seoul Action Plan, the aim of which is to provide a coherent framework for countries and cities in the Asia-Pacific region that want to use urban and peri-urban forests and green infrastructure as strategic components of their urban development plans.

But many challenges persist

Many challenges need to be surmounted to make urban and peri-urban landscapes healthy, sustainable, clean and green. The capacity to do so will depend largely on the state of urban economies and the ability of people and governance systems to develop appropriate policies and strategies and to implement these while enabling the broad involvement of citizens. Although some cities have mainstreamed green planning (Box 2.15), many are yet to pay sufficient attention to creating and managing high-quality green infrastructure. The challenges are especially complex in situations characterized by unplanned urbanization, limited resources at the disposal of city administrations, weaknesses in urban governance, and limited technical knowledge on the establishment and upkeep of urban forests and trees. City administrations struggling to cope with rapidly growing demand for grey infrastructure find it difficult to allocate resources for green spaces – a problem exacerbated by soaring urban land prices, which may prohibit the setting aside of land for green spaces, especially in poor areas that lack political and economic clout. Bringing order to disorderly urban development is often politically difficult, too, especially given the diverse objectives of heterogeneous populations.

BOX 2.15

Greening the Christchurch red zone

A major earthquake struck the city of Christchurch on New Zealand's South Island in February 2011. It caused major damage to the central city area, ultimately leading to the demolition of almost the entire business district, and soil liquefaction in the eastern suburbs resulted in the "red-zoning" (i.e. slated for demolition without the option of rebuilding) of more than 5 000 houses covering more than 600 ha. Part of the plan for regenerating Christchurch involves the incorporation of red-zone lands into the Otakaro Avon River Corridor, which will constitute an 11-km-long "green spine" for the city. The corridor will integrate walking, running and cycling pathways with thematic "landings" (each reflecting artistic, heritage and cultural aspects), picnic spots, recreational activities, and parklands. Nature areas, including trees and forested areas, will comprise an integral part of the corridor.

Source: Regenerate Christchurch (2018).

Forest transitions in the Asia-Pacific region

A fundamental question asked by many policymakers and planners, especially in the context of climate-change mitigation efforts, is whether forest area is declining, stabilizing or increasing. Considerable attention is paid to trajectories of forest-cover change and to the inflection point at which a country's forest area ceases to decline and then begins to increase. Many studies exist of various aspects of this "forest transition" and especially on the extent to which initiatives such as REDD+ might help bring it about.

The theory of forest transitions holds that, in the early phases of economic development, countries tend to suffer

Table 2.4. Forest-area change and trends in key countries, by income grouping, Asia-Pacific countries

Income grouping	Forest-area change, 1990–2015 (million ha)	Trends in forest area		
		Increase	Stable	Decline
High-income	-3.5	New Zealand	Japan, Singapore	Australia, Brunei Darussalam, Republic of Korea
Upper-middle-income	53.5	China, Fiji, Samoa, Thailand	Malaysia, Maldives, Tonga, Tuvalu	
Lower-middle-income	-28.0	Bhutan, India, Lao People's Democratic Republic, Philippines, Viet Nam	Kiribati, Mongolia, Papua New Guinea, Vanuatu	Bangladesh, Cambodia, Indonesia, Myanmar, Pakistan, Solomon Islands, Sri Lanka, Timor-Leste
Low-income	-4.4		Afghanistan	Democratic People's Republic of Korea, Nepal

deforestation as forests are logged to fuel development and to clear land for agriculture; as countries become economically better off, the forest area stabilizes and then increases – thereby achieving a transition from forest loss to forest increase. The theory is based on the assumption that an increase in income reduces the need to overexploit "common" resources such as forests and increases the ability of countries to invest in conservation and sustainable management. Notwithstanding its general validity, however, there are exceptions to the theory of forest transitions: for example, contrary to expectations, several lower-middle-income countries in the Asia-Pacific region have achieved increases in forest area (Table 2.4).

There are also examples of forest loss in high-income countries. In Australia (a high-income country), for example, a significant part of the forest loss recorded between 2000 and 2015 has been attributed to the expansion of the livestock sector (DSITI, 2016). Another apparent outlier is the Lao People's Democratic Republic (a low-income country), where the estimated forest area increased overall by 6.3 percent between 1990 and 2015; there are grounds for questioning this increase, however.

Japan was one of the first countries in the Asia-Pacific region to accomplish a forest transition, doing so in the early 1960s, followed by the Republic of Korea, which underwent its forest transition in the 1970s. Today, several Asia-Pacific countries – notably China, India, the Philippines, Thailand and Viet Nam – are thought to be on pathways towards forest transitions (or have recently accomplished them) due to various factors that are highly context-dependent and which may vary not only between countries but also within them. Such factors include demographic change; industrialization; urbanization; reduced dependence on agriculture as a source of income; an increased ability to import timber to meet domestic demand; high demand and consequently high prices for wood, encouraging investment in tree cultivation; increased resource allocation for forest conservation, forest rehabilitation and reforestation; and policy, legal and institutional reforms. Nevertheless, inferences on forest transitions could be misleading due to the following:

- *Reliability of forest-area data* – notwithstanding improvements in forest-area assessments, the available data on forest-area change may not fully reflect the situation on the ground (and do not capture forest degradation processes).

- *Deforestation leakage* – several countries have accomplished forest transitions by imposing logging bans, thereby increasing their dependence on timber imports. There is a risk that achieving a forest transition in one country, therefore, increases deforestation and forest degradation in others.

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Key points

- There has been a major geographical shift in the wood and wood products industry in recent decades, with the Asia-Pacific region's share of global production, trade and consumption growing quickly.

- The region has become a major producer, consumer and exporter of wood products. Industrial roundwood production has grown but demand is rising faster, increasing dependence on imports.

- A few countries in the region, especially China, India, Indonesia and Japan, have had significant impacts on regional and global trends in wood trade and consumption. Japan dominated in the 1970s and China has been the leading force more recently.

- Total roundwood consumption has been relatively stable in the region for the last two decades at about 1.2 billion m^3 per year, with efficiency gains and recycling reducing the volume of virgin industrial wood required. Industrial roundwood accounted for 41 percent of total roundwood consumption in 2017 (the rest being woodfuel), up from 26 percent in 1990. The region's production of wood panels grew more than eightfold between 1990 and 2017.

3 Big shifts are happening in forest value chains

- The traditional use of wood as a source of domestic energy is declining rapidly, due largely to increasing incomes, urbanization and substitution with fossil fuels and electricity. The share of wood in the region's production of modern biofuels is relatively low.

- New wood-based products such as bioplastics are entering the marketplace, with potentially major impacts on the region's forest sector. The emergence of a bioeconomy could stimulate growth in regional wood demand, although this may face constraints in production due to the limited availability of land and water.

- Health-and-beauty products derived from non-wood forest products are proliferating, driven by developments in processing technologies and demand for "natural" products.

- Global forest value chains are replacing local value chains, with positive and negative impacts. The trend has increased choice for forest product consumers but caused declines in some local industries.

- Value chains linked to the amenity values of forests are developing quickly in the region, especially due to rising incomes and urbanization, and payments for ecosystem services are emerging.

The varied forest production systems described in Chapter 2 generate a diverse range of products, and in recent decades new value chains have emerged in the Asia-Pacific region for almost all forest products as well as for ecosystem services. Major trends in the development of these value chains include the following:

- Until recently, the inherent structural properties of wood – strength, durability and workability – were crucial for determining end use and value. Increasingly, however, the chemical characteristics of wood have become paramount, paving the way for the development of a wide range of new products, processes and value chains.

- Traditional approaches to the processing of non-wood forest products are giving way to the scientific assessment of properties and the development of products based on a clear understanding of these. The production of an increasing number of non-wood forest products has moved beyond hunter–gatherer systems to domestication and organized cultivation and processing.

- Forest ecosystem services are gaining prominence, with large areas of forest now managed primarily for biodiversity conservation, watershed protection, carbon sequestration and, increasingly, the provision of amenity values.

- The reach of forest product value chains is expanding, with localized production and use often overtaken by global networks as information and transportation technologies develop rapidly.

Although it is clear that important changes are taking place in the production, processing, trade and consumption of various forest products, systematic assessments are constrained by data limitations. Substantial quantities of wood are produced, processed and consumed in the informal sector, and national statistics seldom capture these. The illegal logging and trade of timber is widespread, especially in countries with weak governance, and some non-wood forest products are also subject to illegality. Many small and medium-sized forest enterprises operate in the informal domain because of challenges in operating formally, such as rigid rules and regulations and high transaction costs (which may outweigh the benefits of operating in the formal system). Such data gaps should be taken into account in the analysis and interpretation of official statistics, which may, however, provide broad indications of overall trends.

Wood value chains

Wood is the starting point for several forest-related value chains involving a wide array of processing technologies. Figure 3.1 shows the key products derived from wood; broad trends in their production, trade and consumption are discussed below.

Asia-Pacific is now a major producer of wood and wood products

Total global roundwood production increased from 3.5 billion m^3 in 1990 to 3.8 billion m^3 in 2017, a compounded annual growth rate of only 0.3 percent (FAO, undated [a]). Although the Asia-Pacific region accounts for only 18 percent

Figure 3.1. Key wood products

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of the world's forest area, it has emerged as a leader in the production of certain important wood products (Table 3.1). Total roundwood production has changed little in recent decades, but the proportions of the two components (i.e. industrial roundwood and woodfuel) have shifted significantly – the production of industrial roundwood growing substantially and woodfuel declining by a similar amount.

East Asia accounted for 43 percent of industrial roundwood production in 2017, due mainly to China. Oceania's industrial roundwood production more than doubled between 1990 and 2017 due to increased production from planted forests in Australia and New Zealand and the increased logging of natural forests in Papua New Guinea and the Solomon Islands. Given that several countries in the

Table 3.1. Production of key wood products, world and Asia-Pacific region, 1990, 2010 and 2017

Product	World			Asia-Pacific region		
	1990	2010	2017	1990	2010	2017
Roundwood (million m^3)	3 538	3 529	3 777	1 191 (33.7)	1 169 (33.1)	1 171 (31.0)
Industrial roundwood (million m^3)	1 710	1 705	1 885	295 (17.2)	403 (23.6)	444 (23.6)
Woodfuel (million m^3)	1 828	1 824	1 892	896 (49.0)	766 (42.0)	727 (38.4)
Sawnwood (million m^3)	463	376	476	105 (22.7)	86 (23.4)	129 (27.1)
Wood-based panels (million m^3)	129	288	420	27 (20.9)	145 (50.3)	247 (58.8)
Pulp for paper (million tonnes)	150	167	173	17 (11.6)	30 (18.0)	34 (19.6)
Paper and paperboard (million tonnes)	239	392	410	58 (24.2)	169 (43.1)	190 (46.6)

Note: Numbers in brackets indicate percentage of world production.
Source: FAO (undated [a]).

region banned or scaled down logging in natural forests in the period, the overall share of wood production from natural forests declined, with most of the increase in production coming from planted forests (including farm forestry) and increased logging in a few countries still relying on natural forests.

The region's share of production has increased in recent decades for all product categories shown in Table 3.1, but the most remarkable growth has been in wood-based panels and paper and paperboard. China, Indonesia and Viet Nam have provided significant incentives for investment in forest industries, especially those two product categories, and this has led to the rapid expansion of production capacities. The production of wood-based panels increased more than eightfold in the region between 1990 and 2017 and the production of paper and paperboard grew more than threefold, making Asia-Pacific the major producing region of these. Within the region, most of the growth has been in East Asia and to a limited extent in Southeast Asia, as indicated below.

- East Asia's wood-based panel production was just 13 million m^3 in 1990, which was 48 percent of the region's production. The subregion's production had jumped to 220 million m^3 by 2017, led by China, now the world's largest wood-based-panel producer, which was 89 percent of the region's production. Southeast Asia accounted for 44 percent of regional production of wood-based panels in 1990. Although wood-based panel production in the subregion increased – from 13.0 million m^3 in 1990 to 19.0 million m^3 in 2017 – its share of regional production declined to 7.6 percent.

- The paper and paperboard industry in East Asia increased production by about 100 million tonnes between 1990 and 2017 (when the subregion produced 79 percent of the region's total paper and paperboard production). Most of the production increase was in China. There has also been rapid growth in paper and paperboard production in Southeast Asia and South Asia, albeit from a low base. Indonesia has become the major producer in Southeast Asia, and India accounts for most of the production expansion in South Asia.

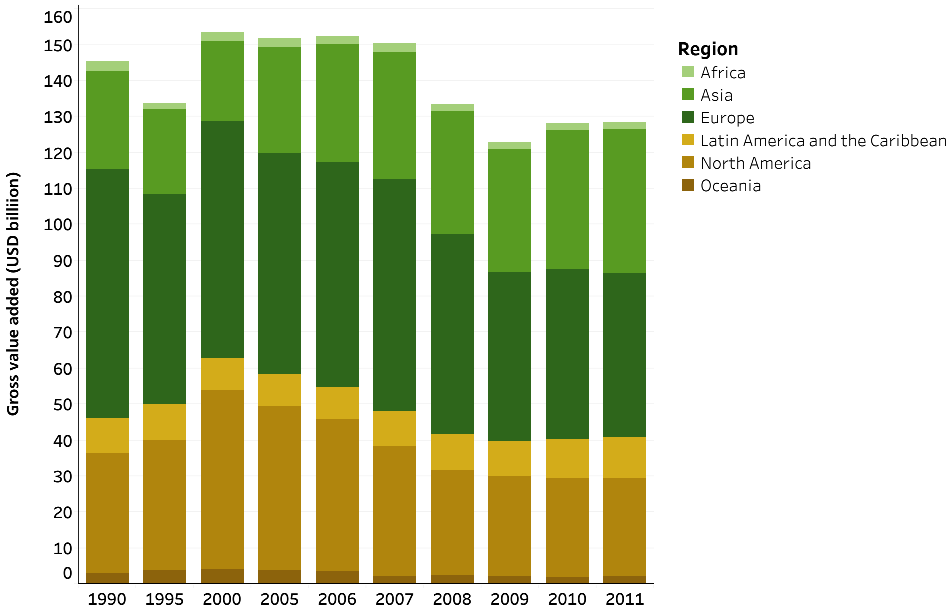
The Asia-Pacific region has emerged as a large producer of wood furniture. Globally, gross value added in the wood-furniture sector declined from USD 145.3 billion in 1990 to USD 128.5 billion in 2011 (FAO, 2014; Figure 3.2). In the same period, however, gross value added in wood-furniture production in Asia (Oceania is treated separately in the data in Figure 3.2) increased from USD 27.4 billion to USD 40.0 billion. Europe recorded a sharp decline over the period, from USD 69.2 billion to USD 45.7 billion. In Asia, lower wages (especially in China) have encouraged the rapid growth of furniture production, most of which is exported to Europe and the United States of America.

Table 3.2. Gross value added in the wood-furniture sector in Asia, 1990 and 2011

Region/country	**Wood-furniture gross value added (USD billion, 2011 prices and exchange rates)**	
	1990	2011
China	1.0	21.0
Indonesia	0.4	1.3
Japan	20.2	6.2
Republic of Korea	1.6	3.1
Malaysia	0.2	0.8
Viet Nam	0.05	1.3
Other	3.95	6.3
Total	**27.4**	**40.0**

Source: FAO (undated [a]).

Figure 3.2. Share of wood-furniture value added, by world region, 1990–2011



Note: Country-level data were unavailable for the segregation of APFSOS III countries.
Source: FAO (2014).

Within the Asia-Pacific region, there have been major shifts in furniture production, most notably from Japan to China (Table 3.2). China's wood-furniture value added leapt from USD 1.0 billion in 1990 to USD 21.0 billion in 2011; Japan's wood-furniture value added, on the other hand, nose-dived from USD 20.2 billion to USD 6.2 billion over the same period. Indonesia, the Republic of Korea, Malaysia and Viet Nam have become important wood-furniture producers: for example, the total value of wood-furniture exports from the Asia-Pacific region in 2016 was USD 32 billion, of which China accounted for USD 22 billion and Viet Nam for USD 5.7 billion. About one-third of these wood-furniture exports were intraregional, and most of the remainder went to Europe and the United States of America. Several factors have contributed to the wood-furniture dynamic, including the following:

- The 2008 global financial crisis resulted in a sharp drop in wood-furniture production in Europe and the United States of America due to a precipitous decline in new housing starts (as well as a longer-term trend of increased competition from low-cost producers in the Asia-Pacific region).

- In Japan, many years of economic stagnation combined with population decline, ageing and a rise in single-person dwellings affected furniture consumption and wage increases further reduced the economic viability of furniture production. The shrinking domestic market and higher costs of production encouraged Japanese furniture manufacturers to invest in China, Indonesia and Viet Nam, primarily for exports.

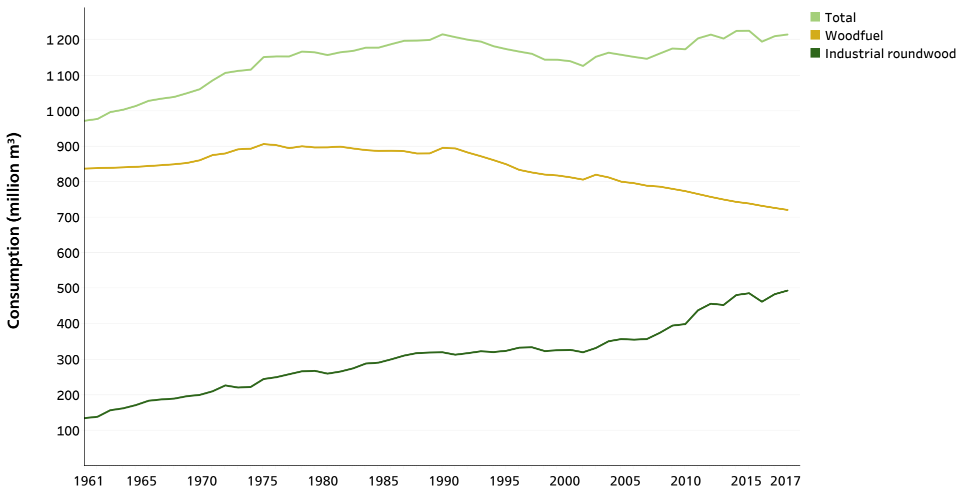
Uncertainty exists about the future of the wood-furniture sector, globally and in the Asia-Pacific region. Production could shift again as wages rise in China and other previously low-cost countries. Alterations in trade-related factors such as tariffs and exchange rates would also affect investments in the sector. Changes in import duties arising from a trade dispute between China and the United States of America have the potential to bring about key location changes in furniture production.

Consumption is declining for woodfuel but increasing for industrial wood products

Total roundwood consumption – industrial roundwood plus woodfuel – in the Asia-Pacific region remained largely unchanged between 1990 and 2015 at about 1.2 billion m^3, but the proportions of the two components changed significantly. In 1990, industrial roundwood accounted for 26 percent of total roundwood consumption (the rest being woodfuel). This proportion had grown to 41 percent by 2017, with a corresponding decline in the woodfuel component (Figure 3.3).

Several factors determine wood consumption, and it is unrealistic to assume a direct relationship between consumption and changes in a single factor, such as income. For example, per-capita roundwood consumption in 2015 ranged from 0.17 m^3 in

Figure 3.3. Trends in roundwood consumption, Asia-Pacific region, 1961–2017



Source: FAO (undated [a]).

Bangladesh to 6.85 m^3 in Bhutan (both low-income countries) and from 0.18 m^3 in the Republic of Korea and 0.19 m^3 in Japan to 1.25 m^3 in Australia and 3.16 m^3 in New Zealand (all high-middle-income or high-income countries). Access to forest resources is crucial in some low-income countries, such as Bhutan, where high per-capita forest area and high demand for woodfuel (largely because of the cold mountainous environment requiring substantial quantities of woodfuel for space heating) means very high per-capita consumption. In Bangladesh, the relatively warm environment reduces the need for woodfuel; moreover, low per-capita forest area means that, based on domestic resources, high levels of wood consumption are unlikely.

One of the most important shifts in wood use in the Asia-Pacific region has been a reduction in woodfuel consumption, stemming largely from rising incomes and increasing urbanization and the resultant increased access of people to commercial sources of energy, especially liquefied petroleum gas and electricity. The region's woodfuel consumption declined from 896 million m^3 in 1990 to 721 million m^3 in 2017, despite the overall increase in population over the period. There were differences between subregions: consumption declined by nearly 40 percent in East Asia between 1990 and 2017 (from 295 million m^3 to 179 million m^3), and there was also a slight decrease in Southeast Asia; in South Asia, on the other hand, woodfuel consumption continued on an upward trajectory until 2010, when it peaked at 390 million m^3 and declined slightly thereafter to 2017 (the latest year for which data are available).

A few countries strongly influence the region's wood consumption

Several factors have driven rapid growth in demand for wood products in the Asia-Pacific region. They include rising incomes and domestic demand and an increase in exports encouraged by, among other things, changes in tariff regimes and currency exchange rates, improved access to raw materials, and a favourable environment for domestic and transnational investment. Some countries have taken full advantage of the opportunities stemming from the rapid pace of globalization in the last four decades.

Given the huge economic and demographic differences between countries, it's unsurprising that a handful of countries has driven most wood demand in the Asia-Pacific region (and, to some extent, globally) since the 1960s. Much of the regional demand for wood in the period 1960–1990 was from Japan and, to a lesser extent, the Republic of Korea. Since the plateauing and ultimate decline of Japanese demand, China has become the dominant market, with its demand greatly exceeding the peak achieved by Japan. Trends in some of the key products are discussed below.

The consumption of **industrial roundwood** – the first stage in the value chain for most wood products – has grown rapidly in the Asia-Pacific region in the last few decades. The region consumed 143 million m^3 of industrial roundwood in 1961 (about 14 percent of the global total), and this more than tripled to 494 million m^3 in 2017 (26 percent of global consumption). Other key changes in industrial roundwood consumption in the Asia-Pacific region are summarized below (and depicted in Figure 3.4).

- Japan was the region's most important consumer of industrial roundwood in the 1960s and early 1970s. Japanese industrial roundwood consumption peaked at 90 million m^3 in 1973, which was almost 40 percent of regional consumption in that year. The country's industrial roundwood consumption declined thereafter due to economic and demographic changes, reaching 24.9 million m^3 in 2017 (about 5 percent of total regional consumption).

- China's industrial roundwood consumption has grown dramatically, from about 87.4 million m^3 in 1980 (32.4 percent of regional consumption) to 219 million m^3 in 2017 (44.3 percent of regional consumption). Domestic demand has been spurred mainly by the fast growth of incomes and urbanization (resulting in the rapid expansion of the construction sector) and by burgeoning exports (especially of furniture and panel products). A key question is whether demand in China has peaked and will start declining, especially in light of demographic and economic changes and an apparently less-favourable trade environment.

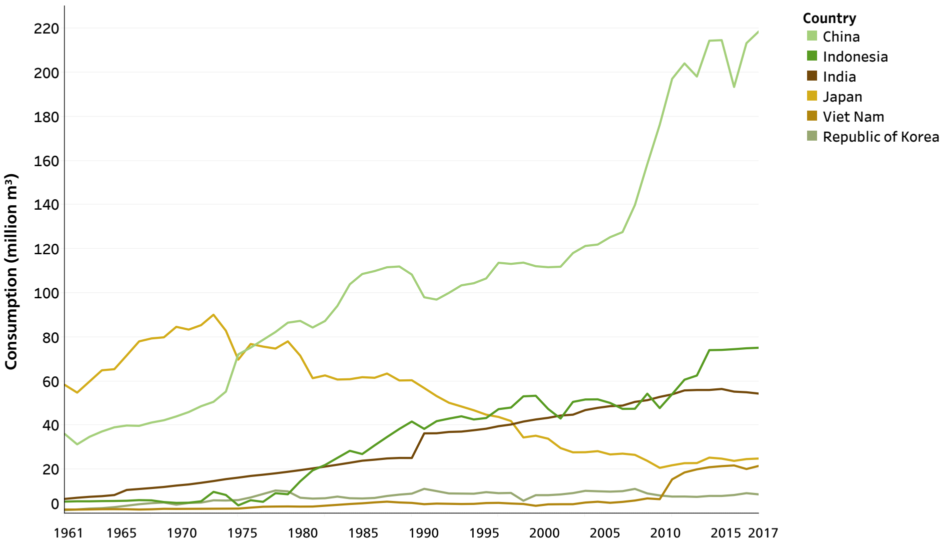
- The consumption of industrial roundwood by Indonesia and India has increased steadily since 1990: it more than doubled in Indonesia between 1990 and 2017 (from 36.4 million m^3 to 75.2 million m^3) and grew by 50 percent in India (from 36.3 million m^3 to 54.4 million m^3). It remains uncertain whether industrial roundwood consumption will accelerate in these two countries over the next two decades to the extent that, in combination, they take the place of China as the region's top wood consumers.

- Industrial roundwood consumption has been trending upward in Viet Nam since 2009, with the country emerging as a key producer of both wood furniture and woodchips for pulp production. Viet Nam has the potential to become a key producer of wood products.

Data on the sources of wood supply – that is, whether from natural forests, planted-forest estates or farm forestry – are unavailable, but it is likely that most of the increase in East Asia and Southeast Asia has been from planted forests, given the logging bans in place in many natural forests and the rapid growth in the planted-forest area (as discussed in Chapter 2). In South Asia (e.g. India), some of the increase in industrial roundwood production is attributable to farm forestry, often supported by wood product companies through contract tree farming.

Sawnwood constitutes the raw material for several value chains, such as construction, joinery, flooring and furniture, and growth in its consumption is linked strongly to these downstream sectors, especially housing. The increased use of plywood and other panel and composite products in construction has reduced demand for sawnwood, however, and production growth has been relatively

Figure 3.4. Industrial roundwood consumption, selected countries in the Asia-Pacific region, 1961–2017



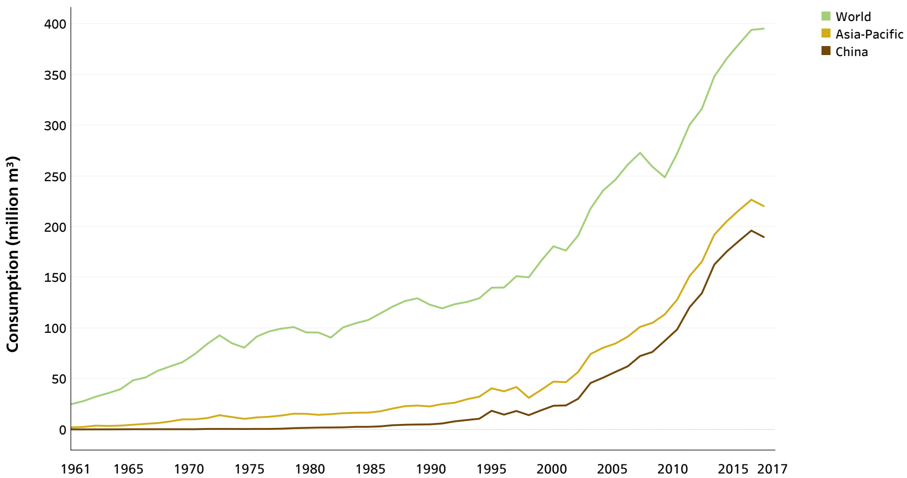
Source: FAO (2014).

modest. Sawnwood consumption in the Asia-Pacific region increased from 54 million m^3 in 1961 (17 percent of global consumption) to 181 million m^3 in 2017 (38 percent of global consumption), with most of the increase attributable to China, where sawnwood consumption grew from 11 million m^3 in 1961 to 125 million m^3 in 2017. China accounted for 22 percent of Asia-Pacific's sawnwood consumption in 1990 and for 69 percent in 2017.

The worldwide escalation in the consumption of **wood-based panels** has been dramatic, with most of the increase occurring in the Asia-Pacific region and especially China. Wood-based panel consumption was just 25 million m^3 globally in 1961, but it had reached 395 million m^3 by 2017; the Asia-Pacific region's share increased from 9 percent to 56 percent over the period (Figure 3.5). China's consumption of wood-based panels comprised less than 1 percent of global consumption in 1961; in 2017 the proportion was 48 percent, with the country's consumption growing by a compounded annual rate of 13 percent from 2000 to 2017. Such a high growth rate is unlikely to be maintained in the long run.

Another big change in wood consumption has been the growing importance of panel products and the decrease in the relative importance of sawnwood. Globally, sawnwood consumption increased from 469 million m^3 in 1990 to 481 million m^3 in 2017, a compounded annual growth rate of only 0.01 percent. In the same period, global wood-based panel consumption increased from 123 million m^3 to 395 million m^3, a compounded annual growth rate of 4.4 percent. Data for the Asia-Pacific

Figure 3.5. Wood-based panel consumption, Asia-Pacific region, China and the world, 1961–2017



Source: FAO (undated [a]).

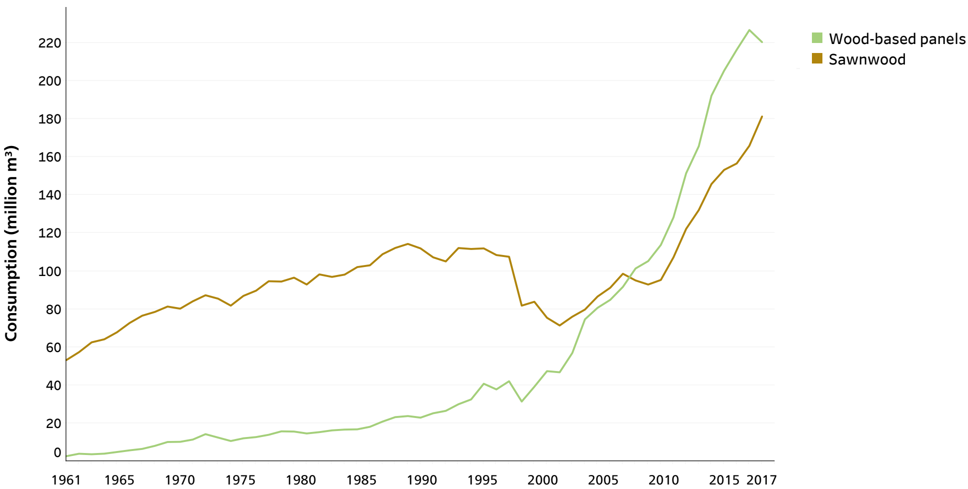
region show increases in wood-based panel consumption of even greater magnitude (Figure 3.6). A key implication of the substitution of sawnwood with panel products is the significant reduction in the demand for industrial roundwood. Recovery rates for panels have increased considerably as production technologies have improved.

The consumption of **paper and paperboard** has grown rapidly in the Asia-Pacific region, from 10 million tonnes in 1961 to 62 million tonnes in 1990, 102 million tonnes in 2000 and 196 million tonnes in 2017. The Asia-Pacific region accounted for about 13 percent of global paper and paperboard consumption in 1961; by 2017 the share had increased to 48 percent (Figure 3.7). China accounted for most of the increase, with its consumption growing from a very low 2.6 million tonnes in 1961 (24 percent of regional consumption) to 114 million tonnes (58 percent of regional consumption) in 2017 (Box 3.1). Other key paper and paperboard consumers are India, Indonesia, Japan and the Republic of Korea; combined with China, these countries accounted for 87 percent of the region's paper consumption in 2017.

It is unlikely that the growth in consumption witnessed in the region in the last two decades will be sustained; Japan and the Republic of Korea, for example, are already experiencing declines. Although it is difficult to predict what might happen to consumption in China, at least some segments of paper and paperboard production are likely tail off, as happened in Europe and North America (Box 3.2).

Another important development in the paper and paperboard industry has been growth in the use of recycled paper,

Figure 3.6. Consumption of sawnwood and wood-based panels, Asia-Pacific region, 1961–2017



Source: FAO (undated [a]).

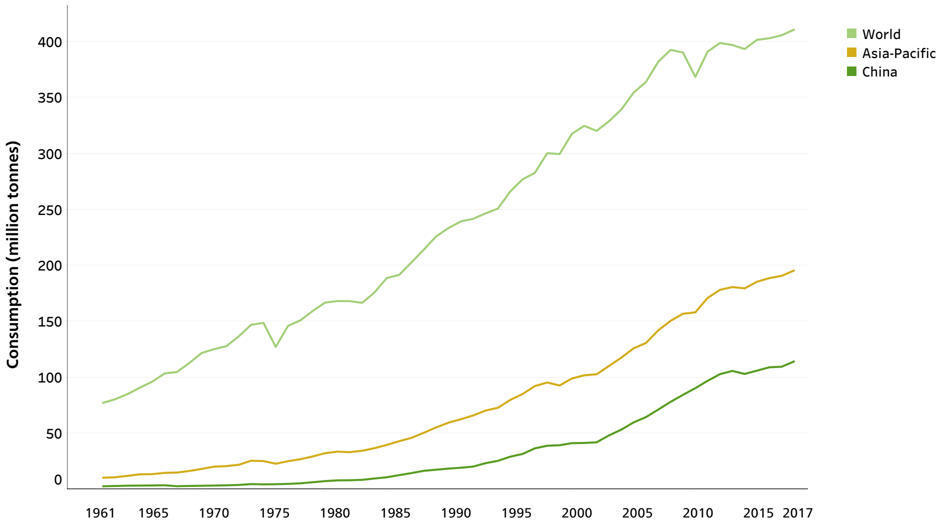
BOX 3.1

Rapid growth of packaging paper and paperboard in China

Packaging paper and paperboard is a key segment of the paper and paperboard industry, and it has grown rapidly in the last two decades to cater to the needs of the packaging industry. China produced 5.7 million tonnes of packaging paper and paperboard in 1990, which was about 33 percent of the country's total paper and paperboard production. This had grown more than twelvefold to 71.7 million tonnes (62 percent of all paper and paperboard production) by 2017 to cater to escalating demand for packaging material. The surge in production and consumption more or less mirrors the rapid growth in income in China and the growth of exports. The fast uptake of e-commerce in China has led to a rapid increase in demand for packaging paper, which accounts for 40 percent of all packaging materials. On the other hand, growing concern about the environmental impacts of single-use packaging has led to regulations emphasizing the sustainability of packaging materials, and the government is aggressively closing down paper and paperboard production units that do not comply with environmental regulations. These developments suggest that the production and consumption of packaging paper and paperboard could decline in China in coming years.

Sources: Chan (2016); FAO (undated [a]).

Figure 3.7. Paper and paperboard consumption, Asia-Pacific region, China and the world, 1961–2017



Source: FAO (undated [a]).

BOX 3.2

Transformational change in the pulp-and-paper industry

There have been recent significant shifts in the pulp-and-paper industry globally, stemming largely from declining demand for graphic papers, especially newsprint and printing and writing paper. Worldwide demand for graphic papers fell in 2015, following a trend that first manifested in Europe and North America. The compound annual growth rate of newsprint declined from +1.1 percent in 1992–2007 to -5.6 percent in 2010–2015; demand for printing and writing paper declined from +3.2 percent to -1.5 percent over the same period. Although demand for these products is declining, other product segments continue to grow. Of particular interest are cartonboard and containerboard, the growth of which is expected to be robust because of the expansion of e-commerce (and the consequent need for packaging for shipping goods to consumers). Thus, although technological development is causing declining consumption for some products, it is boosting demand for others.

Source: Berg and Lingqvist (2017).

thereby reducing the need for virgin fibre. Paper and paperboard production increased globally by 71.4 percent between 1990 and 2017 but pulp production increased by only 15.4 percent, with the shortfall met by the greater use of recycled fibre. Nearly 57 percent of paper and paperboard produced globally in 2012 comprised recovered and recycled fibre, and this is projected to increase to 64 percent by 2028 (RISI, 2013). The rate of recovery of wood fibre is reaching a practical maximum in developed countries: it is nearly 70 percent in the United States of America, slightly more than 70 percent in Europe, and approaching 80 percent in Japan (WBCSD, 2015).

Dependence on tropical timber from natural forests is declining

Few countries are able to disaggregate production, trade and consumption data on the basis of sources of wood supply – especially between natural and planted forests and between tropical and non-tropical. Diverse sources of information indicate the following:

- Dependence on tropical wood from natural forests is declining in the Asia-Pacific region (Box 3.3).
- There is increasing dependence on planted forests for wood supply, both from within the region (especially New Zealand) and beyond it.
- Boreal forests in the Russian Far East and Canada have become major sources of wood supply in the Asia-Pacific region, especially for large consumer countries such as China.

The trade of wood products

Trade flows among countries in the Asia-Pacific region are influenced by enormous differences in forest resources, populations, incomes, the overall state of development, policies, institutions and the investment climate. Often, wood product value chains are spread over several countries to take advantage of the unique strengths of each. Moreover, import sources and export destinations change in response to national and international policies and regulations and other factors such as currency exchange rates, labour costs, tax breaks for investments and proximity to markets. Primarily influenced by changes in production and consumption in China, the Asia-Pacific region has become a major importer of industrial roundwood and sawnwood and an exporter of wood-based panels (Box 3.4). The major trade flows of wood products in the region consist broadly of:

- exports of industrial roundwood and sawnwood from resource-rich countries in the region (e.g. Australia, Cambodia, Indonesia, Malaysia, Myanmar, New Zealand, Papua New Guinea and the Solomon Islands);
- imports of industrial roundwood and sawnwood by countries with high demand but limited resources – key importers are China, Japan, the Republic of Korea and, more recently, India and Viet Nam, which increasingly are sourcing wood from outside the region, including from Canada, the United States of America and the Russian Federation, and the share of tropical timber imports is therefore declining;

BOX 3.3

Tropical timber from natural forests: declining in importance

The consumption of tropical timber in the Asia-Pacific region increased from 113 million m^3 in 2000 to 192 million m^3 in 2016, with China and India combined consuming about 75 million m^3 of the latter. Nevertheless, tropical timber consumption declined in the Republic of Korea and Japan over the period, from 19 million m^3 in 2000 to 7 million m^3 in 2016. The Asia-Pacific region accounts for about 66 percent of tropical industrial roundwood production, but it is also the biggest importing region because internal production and intraregional trade are insufficient to meet the region's industrial roundwood demand. Imports of tropical roundwood to the Asia-Pacific region were estimated at about 8 million m^3 in 2016, of which about 7 million m^3 was from Africa and 1 million m^3 was from Latin America and the Caribbean (ITTO, undated; Comtrade, undated).

Although the consumption of tropical industrial roundwood has increased, there are indications that its share of total industrial roundwood consumption, and the share sourced from natural forests, are declining. Some major consumers – particularly China and India – increasingly rely on non-tropical timber, especially from Canada, New Zealand, the Russian Federation and the United States of America. Both Indonesia and Malaysia, which traditionally have been large producers and exporters of tropical hardwoods from natural forests, have scaled down production, with Indonesia largely switching to plantation-grown wood, especially for pulp and paper. India, another major producer of industrial roundwood, has also reduced its dependence on natural forests, relying largely on forest plantations and farm forestry for its timber supply. Viet Nam is increasingly reliant on wood produced by smallholders, which is considered "low-risk" in terms of legality requirements. There are indications that wood production in Papua New Guinea and the Solomon Islands will not be sustained for long. Concerns about biodiversity conservation, climate-change mitigation, watershed protection and other ecosystem services are likely ultimately to reduce logging in natural tropical forests, especially if coupled with payment schemes for these.

Note: The International Tropical Timber Agreement (2006) defines tropical timber as: "tropical wood for industrial uses, which grows or is produced in the countries situated between the Tropic of Cancer and the Tropic of Capricorn. The term covers logs, sawnwood, veneer sheets and plywood". The total consumption of tropical timber is calculated by adding the following components: production and net imports of industrial tropical roundwood; and net imports of tropical sawnwood, tropical veneer and tropical plywood converted to roundwood equivalent volumes by using the United Nations Economic Commission for Europe's Forestry and Timber Division conversion factors.

BOX 3.4

The Asia-Pacific region: a major importer of wood and exporter of processed products

Given its limited resources and large population, the Asia-Pacific region has been a net importer of wood – especially industrial roundwood and sawnwood – for the last three decades, with the gap between consumption and production increasing. For example, industrial roundwood consumption exceeded production by 25 million m^3 in 1990, and the gap increased to 36 million m^3 in 2010 and to 50 million m^3 in 2017. The consumption of sawnwood in the region exceeded production by 7 million m^3 in 1990, with the gap increasing to 19 million m^3 in 2010 and to 52 million m^3 in 2017. On the other hand, the region (mainly China) is a major exporter of wood-based panels: production (contributed mainly by Indonesia, the Republic of Korea and Malaysia) exceeded consumption by 4 million m^3 in 1990, with the gap increasing to 20 million m^3 in 2015 and to 27 million m^3 in 2017 (contributed almost entirely by China).

Source: FAO (undated [a]).

- exports of processed products – such as wood-based panels, pulp, paper and paperboard, and wood furniture – made from domestically produced or imported wood (e.g. China and Viet Nam); and

- imports of processed products by countries with limited ability to invest in processing.

The global trade of wood products has undergone significant changes in the last three decades, especially in its quantity, value and direction. Most notably, China has emerged as a major importer of roundwood and sawnwood and an exporter of value-added wood products. China's wood product imports were worth USD 5.4 billion in 1990, which was less than 5 percent of the global value (USD 113 billion) in that year. In 2017, China imported wood products worth USD 51.3 billion, which was 20 percent of the global value of such imports. The following points on the trade of wood products in the region are also worth noting:

- China's wood product exports increased from USD 1.52 billion in 1990 to USD 14.8 billion in 2017, due mainly to paper and paperboard and wood-based panels. Additionally, China has become the world's leading exporter of wood furniture, valued at USD 23.0 billion in 2015.

- The total value of Japan's wood product imports declined from USD 13.2 billion in 1990 to USD 10.4 billion in 2017 due to declining demand, largely as a result of economic and demographic factors.

- There has been a major change in Indonesia's wood product exports. In 1990, the country exported wood-based panels worth USD 2.74 billion, about 87 percent of the value of all its wood product exports in that year. By 2017, pulp for paper and paperboard had become the most important export product, valued at USD 5.64 billion, which was 67 percent of the total value of wood product exports (USD 8.42 billion) in that year. Exports of wood-based panels had declined to USD 1.78 billion (about 21 percent of the total export value) by 2017.

- There has been a big shift in the sourcing of imports, mainly towards temperate and boreal forests. China's most important trading partners by value are Canada, the Russian Federation and the United States of America, but the country is also increasingly reliant on tropical countries such as Brazil and Indonesia for woodpulp from planted forests. China and Japan both source most of their woodchips from Viet Nam.

- India is emerging as a major importer of wood products, with its import bill increasing from USD 0.6 billion in 1990 to USD 6.7 billion in 2017.

The trade of wood products is highly dynamic, and predicting future shifts is difficult. It is unclear, for example, whether China will continue to dominate the region's trade or whether other large, rapidly growing countries – such as India and Indonesia – will emerge as key players.

Value chains for bioenergy

Biomass can be used directly for energy – as is the case in most subsistence economies – or converted to other forms of fuel (although the conversion process entails energy losses). Woodfuel features in a range of value chains involving various products, players and markets. They include:

- fuelwood (i.e. firewood) collected from forests, woodlands and farmlands and used directly by households for cooking and heating;

- fuelwood collected locally and traded in local markets or transported to nearby towns for use in households, restaurants and industries such as brickmaking, pottery and tea processing;

- charcoal traded in local and national markets;

- wood pellets traded in global markets;

- liquid fuels produced from wood and other biomass; and

- electricity generated using wood-fired power plants.

Almost all woodfuel produced is consumed nationally, and the quantity traded globally, therefore, is very small: of the global woodfuel production of 1 890 million m^3 in 2017, only 8.3 million m^3 was exported.[10]

[10] This was the volume of woodfuel exported as roundwood. A larger volume was exported as pellets.

In the Asia-Pacific region, roundwood woodfuel exports were almost insignificant, and most of the woodfuel produced in the region in 2017 (721 million m^3) was consumed in the region.

Two broad trends in the use of bioenergy can be discerned in the Asia-Pacific region:

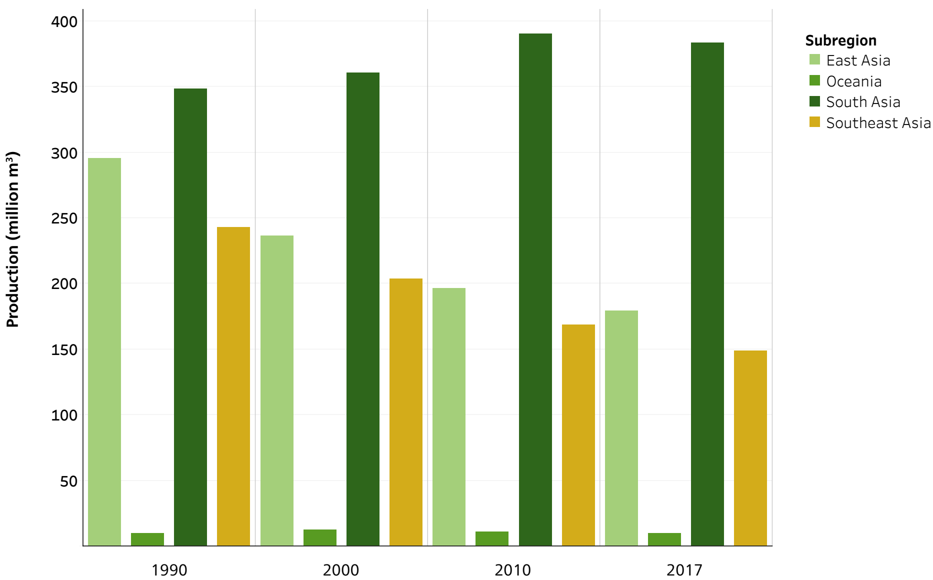
1. a shift away from the use of wood and other solid biomass for cooking and heating to more convenient fuels, such as liquefied petroleum gas, natural gas and electricity; and

2. the conversion of solid biomass to liquid fuels and electricity for domestic and industrial uses.

Improved access to more convenient fossil-fuel resources (largely due to increases in income and improved transportation and distribution networks) in the Asia-Pacific region resulted in a significant reduction in the use of wood as a solid fuel between 1990 and 2017, from 896 million m^3 to 721 million m^3; the proportion of the region's total wood production used as fuel also declined over the period, from 74 percent to 59 percent. Globally, the share of woodfuel in total wood production was stable between 1990 and 2015, at just above 50 percent.

There was a sharp decline in the share of woodfuel in total wood production in East Asia between 1990 and 2016, from 71 percent to 51 percent, and a similar decline in Southeast Asia (Figure 3.8). South Asia, on the other hand, is still a major producer (and user) of woodfuel (which comprises 87 percent of all wood production in the subregion). India produced 77 percent of South Asia's

Figure 3.8. Change in woodfuel production, Asia-Pacific subregions, 1990–2017



Source: FAO (undated).

woodfuel in 2015, but government policies to increase access to liquefied petroleum gas could decrease that country's woodfuel use. In particular, attention is being given to increasing the availability of liquefied petroleum gas in rural areas to reduce the negative health impacts stemming from indoor pollution due to the use of biomass fuels. As incomes and access to alternative sources of energy increase, a sharp decline in woodfuel use is likely in South Asia – as has occurred already in East and Southeast Asia.

Interventions in the bioenergy sector in the Asia-Pacific region have focused on increasing supply, especially through the establishment of woodfuel plantations, and on demand-reduction strategies such as increased energy efficiency. Several countries have created significant areas of planted forests for woodfuel: although these have helped increase supplies for urban and industrial users, they have often proved economically unviable for meeting the needs of highly dispersed households in rural areas.

Considerable efforts have been made in the region – with mixed success – to develop and popularize fuel-efficient wood-burning cookstoves to reduce indoor pollution, with smoke from such stoves known to be a major predisposing factor for pulmonary ailments. There has also been research into the development of domestic-scale wood-gasification units. Overall, the trend of replacing woodfuel at the household level with more convenient fuels is likely to continue in the region, especially as incomes rise and the availability of electricity, natural gas and liquefied petroleum gas increases. Nevertheless, woodfuel is likely to remain the primary source of energy for households that lack access to other fuels and to electricity distribution networks.

The use of solid wood in electricity generation has increased almost fourfold in the Asia-Pacific region since 2000, although still its share in total energy use remains very low. The region is emerging as a large market for bioenergy electricity due to a combination of increasing energy demand and long-term targets in emerging economies such as China, India and Thailand (Thran, Peetz and Schaubach, 2017), although the long-term availability of low-cost biomass is a key challenge. Japan is giving considerable attention to biomass energy production, especially through its 2009 Basic Act for Promotion of Biomass Utilization. There has been an increase in investment in power generation using woody biomass in Cambodia, China, the Republic of Korea, the Philippines and Thailand. Demand for wood pellets is growing, mainly in Japan and Korea (Box 3.5).

Wood and wood products in a bioeconomy

Wood was the most important material for a wide range of uses until the emergence of the fossil-fuel economy at the beginning of the twentieth century (Bowyer *et al*., 2017). The impacts of climate change due mainly to fossil-fuel emissions, however, have drawn attention to the need to reduce reliance on fossil fuels and shift towards a "bioeconomy" through the efficient and sustainable use of biomass, including for energy and chemicals.

BOX 3.5

Wood pellets: an alternative source of clean energy?

Wood pellets (also referred to as densified biomass) have emerged as an important form of woodfuel globally and a potential low-carbon substitute for coal in thermal power-generation plants. The use of wood pellets has grown rapidly globally due to the European Union's binding target of obtaining 20 percent final energy consumption from renewable resources by 2020. World production of wood pellets increased from 18.0 million tonnes in 2012 to 31.2 million tonnes in 2017, with Europe and North America accounting for 77 percent of the increase; Europe produced 57 percent of global wood-pellet production in that year. The European Union also imports substantial quantities of wood pellets, mainly from Canada and the United States of America: of the total world import volume of 17.0 million tonnes in 2017, 14.6 million tonnes went to the European Union.

In the Asia-Pacific region, Japan and the Republic of Korea are the two largest users of wood pellets as part of their domestic clean-energy policies; together, they consumed about 4 million tonnes of pellets in 2017. The Republic of Korea produced 980 000 tonnes of wood pellets in 2017 and Japan produced 126 000 tonnes. Other significant pellet producers in the Asia-Pacific region in 2017 were Australia, China, Indonesia, Malaysia and Viet Nam, all focused on exports to Japan and the Republic of Korea. It is reported that Japanese wood-pellet demand could reach 15 million tonnes per year by the mid 2020s.

The extent to which wood pellets constitute a clean source of energy depends on how they are produced. Some studies suggest, for example, that wood pellets may not be carbon neutral given the energy consumed in densification and transport. Nevertheless, wood pellets are likely to cause much lower carbon emissions than fossil fuels per unit energy generated if produced from sustainably managed forests.

Sources: FAO (undated [a]); Thran, Peetz and Schaubach (2017).

There are many definitions and interpretations of the bioeconomy concept, but essentially it involves "the production of renewable biological resources and the conversion of these resources and waste streams into value added products such as food, feed, bio-based products as well as bioenergy" (European Commission, 2018). The main aim is to decarbonize economies and to build more circular economies by increasing reliance on renewables, especially biomass. For example, lignocellulosic materials obtained from plant parts can be refined (in the same way that crude oil is refined) to produce chemicals that can be used in many industrial sectors. Some pulp-and-paper mills have already been transformed into biorefineries to produce energy and to convert lignin to useful products. Nevertheless, the development of modern biorefineries using ligno-cellulosic materials is in its early stages, and various technical, policy and economic challenges need to be addressed (Biookonomierat, 2018).

The viability of a bioeconomy in the Asia-Pacific region will depend on the availability of a large, sustainable supply of feedstock despite increasing pressure on land and water resources, thus requiring trade-offs between competing needs. The rapid development of a bioeconomy in Europe and the consequent increase in wood demand would likely have implications for the Asia-Pacific region. The distribution of benefits along bioeconomy value chains would also need to be considered.

Non-wood forest product value chains

Non-wood forest products are forest products other than timber and woodfuel (Box 3.6), such as bamboo, rattan, honey, resins, cork, gums, medicines, mushrooms and aromatic products. In many countries in the region, timber-focused forest management has tended to regard non-wood forest products as "minor" products, notwithstanding their crucial roles in the livelihoods of rural communities. In recent decades, however, there has been a surge of interest in non-wood forest products for the following reasons, among others:

- There is greater understanding now of (and policy attention to) the role of non-wood forest products in alleviating poverty and improving the livelihoods of rural communities, especially forest-dependent people.

BOX 3.6

What are non-wood forest products?

According to FAO (1999), "non-wood forest products consist of goods of biological origin other than wood, derived from forests, other wooded lands and trees outside forests". Most countries have their own definitions, which may encompass items such as river sand and stones. FAO recognizes 16 categories of non-wood forest product – eight each of plant and animal origin. The plant-based categories are: 1) food; 2) fodder; 3) raw materials for medicines and aromatic products; 4) colorants and dyes; 5) utensils, handicrafts and construction; 6) ornamental plants; 7) exudates; and 8) other plant products. The animal-based categories are: 1) living animals; 2) hides, skins and trophies; 3) wild honey and beeswax; 4) bush meat; 5) raw material for medicines; 6) raw material for colorants; 7) other edible animal products; and 8) other non-edible animal products.

- Scientific and technological advances have increased the economic potential of many non-wood forest products. New uses are being discovered, especially through the analysis of chemical properties.

- Interest is growing in the sustainable use of non-wood forest products as a means for biodiversity conservation – tied to implementation of the Convention on Biological Diversity's Nagoya Protocol[11] – because of their role in increasing the economic attractiveness of natural forests as a land use.

- Many non-wood forest products are cultural products and therefore play crucial roles in maintaining unique cultures.

The enormous diversity of non-wood forest products, and of the systems for producing them, makes it difficult to account accurately for their overall economic contributions. This diversity manifests in the following ways:

- Production systems are highly diverse, ranging from collection in the wild (essentially hunter–gatherer systems) to highly organized systems of domestication and cultivation.

- Economic significance varies from primarily subsistence use by rural households to trade in global markets.

[11] The full title is the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity.

- The technologies used in processing non-wood forest products vary from very simple traditional means to sophisticated technologies for isolating and combining active ingredients at the molecular level.

- Value chains range from local to globalized. Some local value chains are becoming global, and some traditional uses are gaining wider acceptance, leading to the development of new value chains (e.g. in the case of edible insects – Box 3.7).

- The governance of production, processing and trade varies from informal (including totally illegal) systems to well-structured formal systems. Some non-wood forest product value chains have both formal and informal components.

Important issues for the non-wood forest products sector in the Asia-Pacific region include the sustainability of production; processing, marketing and trade; and the distribution of benefits – which is strongly linked to governance. The first two of these are discussed below (forest governance is reviewed in detail in Chapter 8).

Sustainable production requires fair remuneration

The sustainability of production of non-wood forest products in the wild is a challenge, for several reasons. The wide diversity of non-wood forest products makes it difficult to systematically assess the available stock and the quantity that may be harvested sustainably. Moreover, the production of many products fluctuates

BOX 3.7

Edible insects: an emerging “future food” value chain?

Edible insects have been a preferred component of diets in many countries in the Asia-Pacific region for millennia. In recent years, the positive attributes of edible insects have led to a surge of interest, with insects increasingly viewed as an environmentally friendly and sustainable food source for humans and livestock. Extremely rich in protein and packed with vitamins, minerals and essential amino acids, insects also have high food-conversion efficiencies and low negative impacts on the environment.

Until recently, edible insects were largely collected from forests; increasingly, however, they are being raised in controlled environments. Technologies for rearing, management, harvesting and processing have all been modernized in the last two decades. Thailand – which leads the way in insect-rearing in the region – now has more than 20 000 registered insect-farming enterprises. The edible-insect sector generates many millions of dollars and provides income and employment for thousands of people. In Thailand and elsewhere in the Asia-Pacific region, entrepreneurs are improving product packaging, labelling and marketing and working to increase the shelf life of insects sold in urban areas. One startup in Thailand has expanded into a multimillion-dollar company in just five years, specializing in insect snacks sold in modern hygienic packaging similar to that used for potato chips and other convenience snack foods.

in response to changes in environmental factors such as rainfall and temperature.[12] Achieving a sustainable harvest requires buy-in by all stakeholders, including those involved in collection, processing, trade and consumption. A key issue is whether sufficient incentives are in place along value chains to encourage sustainable production. Many countries in the region have put in place rules and regulations designed to ensure sustainability, but these are seldom adhered to because of the lack of incentives to adopt sustainable practices. Efforts to implement FairWild Standards, which pay attention to sustainability, fairness and equity, may have more success (Box 3.8). One of the most successful examples of the domestication and cultivation of a non-wood forest product to ensure its sustainable production is that of bamboo in China (Box 3.9).

There are many systems for the production of non-wood forest products, ranging from cultivation in homegardens under mixed cropping systems to intensively managed monocultural crops.

[12] Nevertheless, it has been possible to reliably estimate the sustainable harvest of some non-wood forest products – such as bamboo, rattan and resins.

BOX 3.8

FairWild Standards

Rapid growth in demand for wild plants and animals has led to intensive collection that undermines sustainability. Moreover, many of those involved in the collection and processing of non-wood forest products have little social or economic power, reducing their ability to obtain a fair share of the benefits. The FairWild Foundation was established in 2008 to promote the sustainable collection of products in the wild and to ensure that the people involved obtain fair shares of the income generated and have ethical working conditions. The FairWild Foundation has helped develop best-practice standards to enable third-party verification. Several wild products are now collected according to FairWild Standards, building the concepts of sustainability and fairness into entire supply chains. As of February 2019, one company in the Asia-Pacific region (based in India and harvesting *Terminalia bellerica* and *T. chebula*) was participating in the FairWild certification scheme.

Source: FairWild (undated).

BOX 3.9

The economic significance of bamboo in China

- China has 6 million ha of bamboo forests, comprising 40 genera and 500 species.
- Bamboo is the raw material for an enormous variety of uses, including in construction, furniture, decoration, paper, packaging, transportation, medicines, food, textiles and chemicals.
- The value of output of Chinese bamboo and rattan products was estimated at USD 31.8 billion in 2016. The China Bamboo Industry Development Plan projects that it will reach USD 48 billion by 2020.
- China's bamboo and rattan industry employs about 10 million people.
- The value of Chinese exports of bamboo and rattan products increased from USD 1.28 billion in 2007 to USD 2.08 billion in 2017. The European Union and the United States of America are the main export destinations, importing bamboo and rattan products with a combined value of USD 943 million in 2017.
- The value of China's imports of bamboo and rattan fell from USD 55.5 million in 2007 to USD 37.2 million in 2017. Almost 50 percent of this value comprised raw rattan cane from Malaysia.
- China has developed a highly efficient system for the integrated use of bamboo and rattan, ensuring that 100 percent of harvested material is converted into products.

Source: INBAR (2018).

Many species of bamboo, rattan, pine (for resin) and medicinal plants and spices have been domesticated and are widely cultivated. A classic example of such domestication is rubber (*Hevea brasiliensis*), which was once harvested almost entirely in the wild in its natural range in the Amazon and is now cultivated on a vast scale in the Asia-Pacific region using intensive practices, including genetic improvement. Sandalwood cultivation is gaining increased attention due to growth in demand for high-value sandalwood oil (Box 3.10). Several countries in the South Pacific have embarked on programmes to develop sandalwood (especially *Santalum austrocaledonicum* and *S. yasi*) plantations, and many farmers are cultivating sandalwood as an important source of income.

Domestication has become inevitable for many non-wood forest products, given rapid growth in demand and declining supplies in the wild, especially due to deforestation and overharvesting. Nevertheless, domestication can be challenging: for example, some non-wood forest products are susceptible to boom-and-bust cycles in which upward trends in prices lead to rapid expansions in cultivation, causing, in turn, an oversupply and a consequent sharp decline in prices. Such ups and downs can have major consequences for the livelihoods of smallholders with limited capacity to shift to other crops. Moreover, considerable knowledge gaps exist on cultivation practices for many non-wood forest products, with most research to date focused on a small number of high-profile products. There is also concern that cultivated non-wood forest products will lack some of the most desirable properties found in specimens collected in the wild.

Markets are moving towards high-value uses

The extent to which smallholders or communities derive benefits from the commercialization of non-wood forest products depends on their involvement in processing and value adding and their ability to control a significant part of the value chain. Challenges that need to be addressed if the producers of raw materials are to participate in downstream components of value chains include a lack of access to processing technologies, markets and training; deficiencies in enabling policies, laws and regulations; and inadequate energy, transport and communication infrastructure.

New technologies for producing, processing and marketing non-wood forest products have enormous potential to add to the incomes of local communities in the Asia-Pacific region, although this has been realized to date in only a few countries. For some non-wood forest products, collection and processing generate meagre returns. Beedi leaves (*Dyospyros melanoxylon)*, for example, are an important non-wood forest product in India for the manufacture of cigarettes. The leaves once provided substantial revenue for some state governments, but demand is declining as people become more conscious of the adverse health impacts of smoking. Moreover, the industry has a less-than-satisfactory reputation for the working conditions it provides for women, who account for almost 90 percent of the workforce. The beedi leaf sector, therefore, is a sunset industry, notwithstanding its role in providing rural incomes. Nevertheless, the prospects

BOX 3.10

Sandalwood: a high-value species with rapidly growing demand

Sandalwood, obtained from several species of the genus *Santalum*, has considerable commercial potential. The distribution of *Santalum* extends from Hawaii (United States of America) in the east to most of the Pacific Islands, Australia, Southeast Asia, China and South Asia. *Santalum* species have multiple economic, social, cultural and religious values. Oil extracted from the heartwood is used in a range of products, such as perfumes, pharmaceuticals and soaps, and demand is soaring due to its increased use in aromatherapy. The wood is also used in carving, and powdered wood is a valued component of incense sticks. Of the 18 species of *Santalum*, the most commercially important are *S. album*, *S. yasi*, *S. spicatum* and *S. austrocaledonicum*. All *Santalum* species produce aromatic heartwood, but that of *S. album* (Indian sandalwood) is the most valuable because of its high oil content and high levels of alpha and beta santalol. Good-quality Indian sandalwood heartwood fetches up to USD 1 000 per kg. Recent estimates of future demand suggest a compounded annual growth rate of 10 percent, due mainly to the rapid increase in demand for perfumery and aromatherapy.

Historically, sandalwood was harvested in the wild, but poor management, illegal removals, and disease led to a drastic reduction in availability in many countries, including India and Pacific Island countries. Broadly, three systems of sandalwood cultivation have emerged:

1. In most of India, sandalwood resources – mainly natural stands – are under government management. Until recently, the ownership of all sandalwood trees – irrespective of where they grew – was vested with the government, and this was a major disincentive for private investment. The rules and regulations have now changed to permit the involvement of landowners in sandalwood cultivation.

2. In Pacific Island countries such as Fiji, Papua New Guinea, Samoa and Vanuatu, most sandalwood cultivation is by smallholders in various agroforestry systems.

3. Large-scale private-sector sandalwood cultivation has expanded considerably in Australia this century. One company, for example, has established more than 12 000 ha of sandalwood plantations comprising more than 5.4 million trees – although it has run into financial difficulties.

Sources: Soundararajan, Kumar and Murugesan (2015); Subasinghe (2013); Thomson *et al.* (2012); Weber and Fowler (2018).

for other non-wood forest products may be improving with the development of new high-value markets (Box 3.11).

The future use of non-wood forest products is likely to be affected by two main trends:

- To a significant extent, forest-dependent communities in more remote areas will continue to rely on non-wood forest products for their livelihoods. As transport improves, urbanization increases and the wage economy expands, however, subsistence non-wood forest products for which there are modern substitutes will become increasingly less important. This process has been observed for many non-wood forest products used traditionally as medicines and food.

BOX 3.11

Hand-made paper production in Nepal: from local to global value chain

The production of hand-made paper from *lokta (Daphne papyracea* and *D. bholua*) has a long history in Nepal dating to the twelfth century. Local communities collect stems from the plant, extract its bark and develop the paper, which is used in a wide array of products. *Lokta* paper was once used extensively in government documents, religious texts and literature because of its durability, including its resistance to insects, but the widespread use of modern paper since the 1930s significantly eroded the market for *lokta* paper, resulting in a drastic decline in its production. Production has been revived in the last two decades with the support of international organizations (e.g. GTZ and the United Nations International Children's Emergency Fund) for global niche markets such as greeting cards, paper bags and wrapping papers.

Institutional arrangements have evolved to revive local-level *lokta* paper production. For example, community forest user groups in the districts of Dolakha and Bajhang manage the sustainable harvesting of *lokta* plants. *Lokta* paper is handmade in four community-based paper production units and sold to Himalayan Bio Trade (a company founded by the communities) to produce cards, wrapping paper and other items for trade in global markets. Himalayan Bio Trade has obtained certification under the Forest Stewardship Council for production and processing, ensuring higher prices. The domestic market absorbs about 10 percent of production, and the remainder is sold outside Nepal, especially to the United States of America and Europe. The development of the *lokta* paper industry demonstrates how a collapsing local value chain can be revived through shifts in markets and by building appropriate institutional frameworks.

Source: Subedi *et al*. (2015).

BOX 3.12

Beauty from forests

The global market for health-and-beauty products grew by more than 4 percent per year between 2000 and 2010, generating sales worth USD 382 billion in 2010; this value is expected to reach about USD 675 billion by 2020 and USD 717 billion by 2025 (Loboda and Lopaciuk, 2013). Several factors are contributing to the rapid growth, including rising incomes; urbanization; women's increased participation in work; and changing perceptions about health and beauty. Demand for anti-ageing products has grown as populations have aged. The health-and-beauty industry was previously largely oriented towards women, but recently there has been a significant increase in products for men and children.

Many natural products have been used for hundreds of years to foster health and beauty; nevertheless, until recently the share of natural or organic products in the overall health-and-beauty products market has been very low, with 90 percent based on synthetic compounds. This is changing: natural or organic health-and-beauty products were worth about USD 11.6 billion in 2014, primarily in Europe and North America (Sahota, 2014), and their value is growing at an annual rate of 8–10 percent. Natural products are considered healthier and more environmentally friendly than synthetic products.

The consumption of wild forest honey has grown in some countries in the region as a niche food product, and there is potential to develop a similar niche in health-and-beauty markets. For example, the Indonesian Forest Honey Network (*Jaringan Madua Hutan Indonesia*) and related social enterprises have developed a forest-honey shampoo and are exploring other honey-based health-and-beauty products, such as liquid soap.

Thanaka (*Murraya* spp.) and sandalwood (*Santalum* spp.; see Box 3.10) have established dominant positions in specific markets as health-and-beauty products. Sandalwood oil is a major constituent in fragrances, reputedly providing "notes" in 47 percent of the perfumes made globally in the last 200 years. Thanaka is a traditional cosmetic used mostly in Myanmar and by Burmese people abroad: it is estimated that 90 percent of women in Myanmar use thanaka on a daily basis. Thanaka cultivation is a strongly established industry in Myanmar, with well-developed market and distribution systems.

Sources: Loboda and Lopaciuk (2013); Sahota (2014).

- The market for health-and-beauty products based on natural products is expanding rapidly, and investors and entrepreneurs will develop certain non-wood forest products to supply this potentially highly lucrative market (Box 3.12).

BOX 3.13

Cultural ecosystem services

Forest cultural services are a key set of values provided or facilitated by forest ecosystems. They include nonmaterial benefits to humans, relate to changes in human welfare (Smart, 2010), and are highly dependent on the provision of other ecosystem services. The cultural services that humans derive from forests may include cognitive development, recreation, reflection, spiritual enrichment, and other values gained by viewing aesthetically pleasing vistas (Grebner and Siry, 2013). Forest ecosystems worldwide have played important roles in defining cultural identities and diversity across landscapes. Indigenous peoples who live in tropical regions have traditionally manipulated forested ecosystems to suit their cultural needs and, in general, human interactions with forests have led to the development of human value systems. Generations of people create and express stories of their lives within the environment that surrounds them; over space and time, these memories and associations become embedded in the language and history of cultures. The spiritual and religious values offered by forest ecosystems have long played important and sometimes complicated roles in human civilizations.

The South Asian Himalayan area offers several examples of ecosystems vested with religious values, which in turn help in protecting those ecosystems. Nepal's Forest Act (1993) identifies "religious forest" as one of six forest ownership categories in the country. According to the Act, religious forest is that part of the national forest managed by a religious body, group or community near a religious site. In the Kumaon region of India, the community belief that Golu Devta, a famous deity in the region, resides in forests ensures that treecutting inside those forests is prohibited (Dhaila-Adhikari and Adhikari, 2007). In India's Uttarakhand state, villagers offer their forests to the deity for a given period when faced with difficulties in conserving forests due to encroachment and the uncontrolled extraction of forest resources (Negi, 2010). There is evidence to suggest that, in these sacred forests and landscapes, certain sociocultural and management guidelines decided on by the communities are still operational and have provided conservation value (Pandey and Negi, 2004). These examples show that people in the Himalayas confer on ecosystems a religious value that helps in their conservation and sustainable management.

Value chains for ecosystem services

Interventions to improve – and pay for – ecosystem services are emerging

Several countries in the Asia-Pacific region have developed payment schemes aimed at rewarding landowners who adopt practices to sustain or increase the provision of ecosystem services such as water and soil protection, biodiversity conservation, and climate-change mitigation. Chapter 6 addresses in detail the rise of payment schemes for ecosystem services as potential means for adding value to forests and creating value chains that benefit forest owners and managers. Cultural ecosystem services are gaining prominence in several countries (Box 3.13), and considerable emphasis is now being given to conserving cultural and linguistic diversity, which is linked to natural diversity (e.g. biodiversity).

PART II Drivers of change

Quang Nguyen Vinh

Key points

- Although covering less than one-quarter of the global land area, the Asia-Pacific region accounted for more than half (55 percent) of the world's population in 2015.
- The region's average forest area per capita is the lowest worldwide and declining. Pressure is likely to increase on forest resources, with the population projected to grow by 16 percent by 2050 (an additional 666 million people).
- The region's lower-middle-income and low-income countries face the greatest challenges in population growth to 2050. Many already have low per-capita natural capital as well as low human capital, posing immense difficulties for sustainable forest use.
- As resource pressure accelerates, low-population-density forest-rich countries have emerged as deforestation frontiers, essentially to cater to demand from resource-scarce countries.

4 The region's population is growing and people are on the move

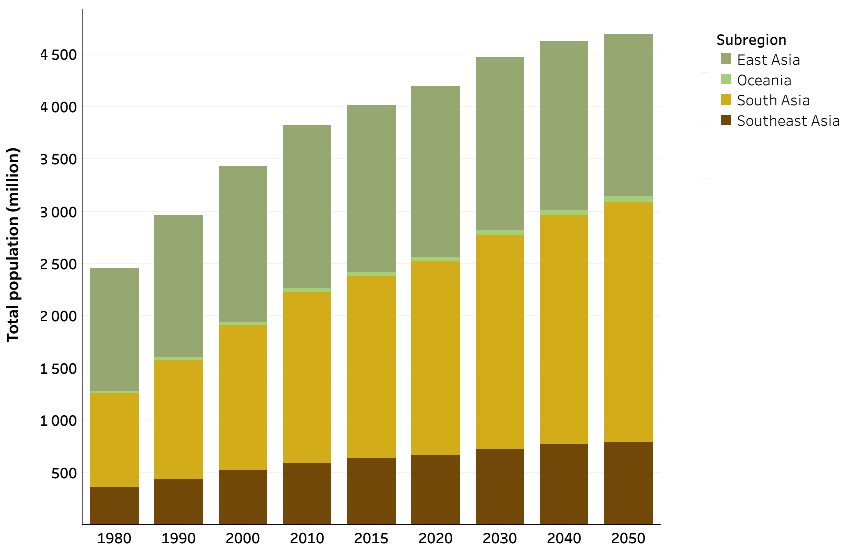
- The Asia-Pacific region is urbanizing rapidly, with the proportion living in cities increasing from 30 percent in 1990 to 46 percent in 2015, increasing demand for forest products and ecosystem services. The need for urban green spaces is also rising, but urban-planning capacity is limited in some countries, leading to disorganized urban development.
- In some countries, especially in South Asia, the migration of men away from rural settings means that older people and women are increasingly responsible for forest and landscape management. Combined with international remittances, this is reducing land-use intensity in some areas and thereby increasing forest growth.
- Migration due to climate-change-related factors – such as water stress, declining land productivity and increased disaster severity and frequency – will increasingly affect land use, including forestry.

Demographic change refers to changes in population–resource ratios over time and space; population growth and changes in density; changes in spatial distribution, especially urbanization and rural–rural and international migration; and changing age structures. It is a key underlying factor driving changes in forests and the forest sector: for example, increasing urbanization can increase wood demand for housing and furniture but reduce it for woodfuel. This chapter provides an overview of how demographic changes have affected forests and the forest sector in the Asia-Pacific region in recent decades and their potential impacts in the future.

More people, more demand on forests

The size and growth rates of populations affect demand for food, fibre, fuel and other products and services and thereby how land and other resources are used. In 2015, the Asia-Pacific region accounted for about 55 percent of the world's population but only 22 percent of the total land area: of the world's main regions, it had the lowest per-capita area of arable land and forests. The pressure on land resources is already high and is likely to increase given projected population growth. Figure 4.1 shows the region's population growth between 1990 and 2015, by subregion, and projected growth to 2050.

Figure 4.1. Actual and projected population growth, Asia-Pacific region and subregions, 1980–2050



Notes: Data for China do not include Hong Kong SAR, Taiwan Province of China, and Macau SAR. Data were unavailable for Tuvalu.
Source: United Nations (2017).

Overall, the region's population is projected to grow by about 16 percent (to 4 730 million, up by 666 million) by 2050, with significant differences between and within subregions:

- South Asia is already the most populated subregion (having overtaken East Asia in 2004). Although the growth rate is slowing, populations will continue to increase in the three most populated countries (India, Pakistan and Bangladesh, in order of decreasing size), increasing the already significant pressure on land and other resources.

- East Asia is the second-most populated subregion, due mainly to China and Japan. China's population is projected to peak in 2029 (at about 1 440 million people); Japan's population size has a downward trajectory.

- The developed economies of Australia, New Zealand and the Republic of Korea are projected to have very low population growth to 2050.

The region's low-income and lower-middle-income countries face the greatest challenges in population growth to 2050. Many already have low per-capita natural capital as well as low human capital (Lange, Wodon and Carey, 2018), posing immense difficulties for the sustainable use of land resources, including forests (Box 4.1). Figure 4.2 shows that many high-population-density countries also have relatively low forest cover.

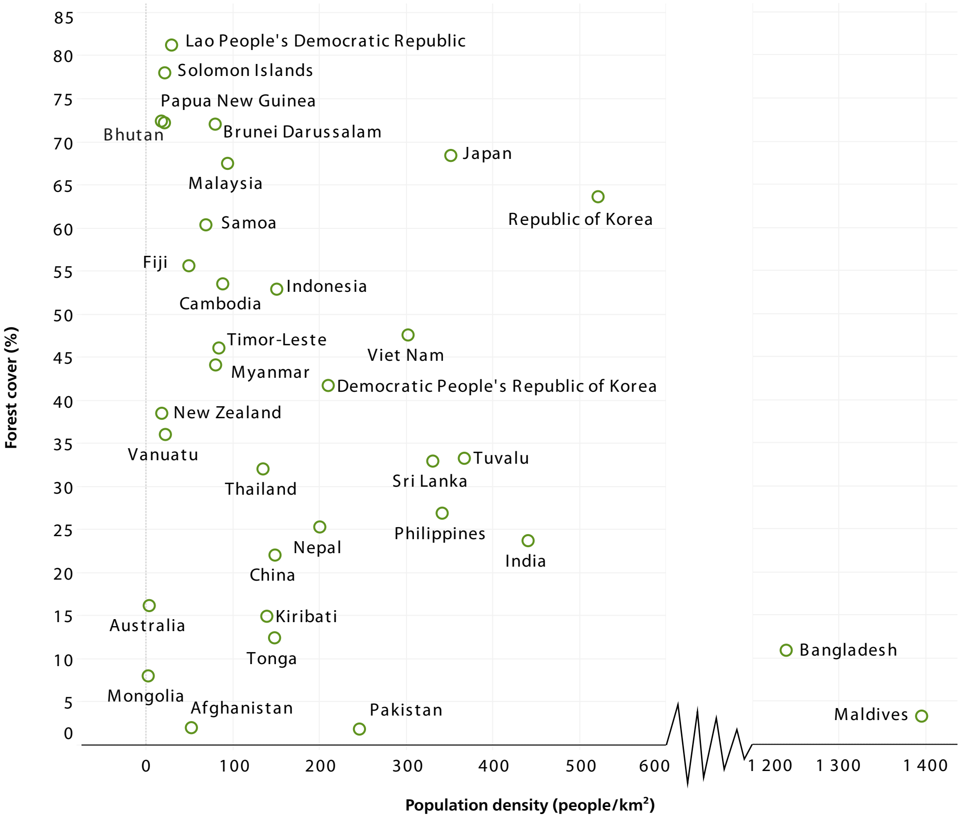
Countries with large forest areas and low incomes have historically faced strong external resource-extraction pressure. Today, for example, Cambodia, the Lao People's Democratic Republic, Myanmar,

BOX 4.1

Demographics and the environment: South Tarawa, Kiribati

Even in small Pacific Island countries, population pressure can be extreme. South Tarawa is Kiribati's capital and main economic hub. More than 50 000 people inhabit the city, which has an area of 16 km^2; population density in its habitable parts exceeds 4 900 people per km^2. This is comparable with major global cities like Tokyo and London, but most families in South Tarawa live in single-storey dwellings. Major environmental challenges include sanitation, pollution, coastal erosion, sea-level rise, inundation and very limited freshwater resources. Trees and forests can play roles in ameliorating the effects of some of these challenges. For example, mangrove replanting at some sites is helping protect against coastal erosion and providing a buffer from storm surges. Multiple-use tree plantings could also provide future sources of food, construction timber, shade, shelter and fuel as well as formal and informal employment opportunities in an economy where unemployment exceeds 30 percent.

Figure 4.2. Population density and forest cover, by country, Asia-Pacific region, 2015



Note: Singapore is not shown (forest cover = 23.4%; population density = 8 227 people per km²).
Sources: FAO (2015a); United Nations (2017).

Papua New Guinea and the Solomon Islands are all major sources of tropical timber for high-population-density, low-forest-cover countries.

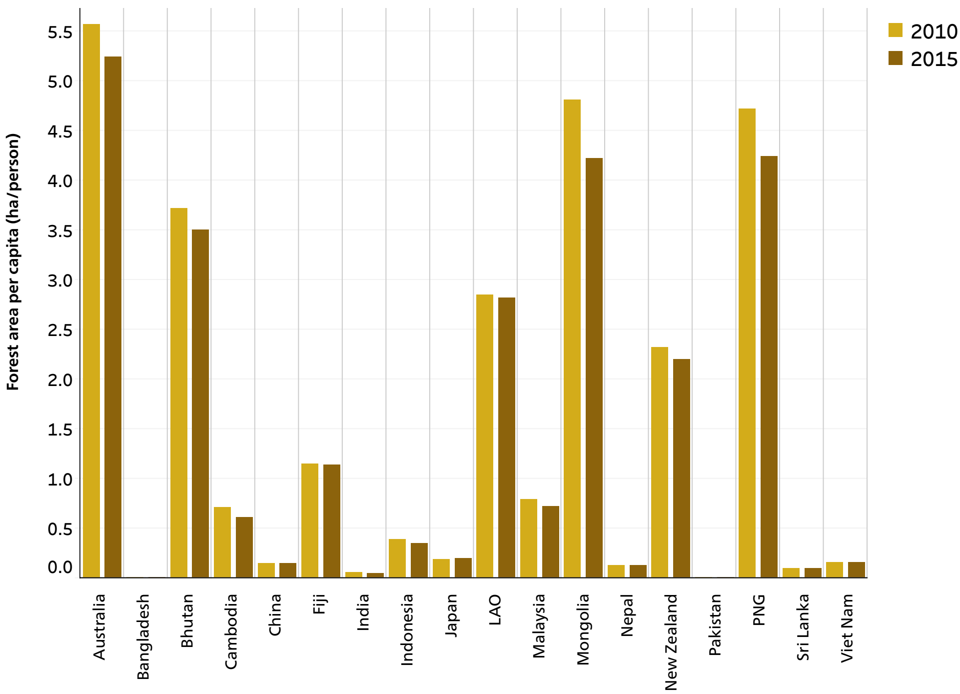
Population density also varies within countries for diverse socio-economic, environmental and historical reasons; for example, hilly and forested regions tend to have lower population densities than fertile plains in river valleys and coastal areas. China has a population-density gradient from west to east, with 2 people per km^2 in the Tibet (Xi'zang) Autonomous Region in the west and 767 people per km^2 in Jiangsu Province in the east. The population density in Indian states varies from 17 people per km^2 in Arunachal Pradesh to more than 1 100 people per km^2 in Bihar. The average population density in Indonesia is 134 people per km^2, but the lion's share lives on Java, where population density is more than 1 100 people per km^2; in contrast, the population density in West Papua is 10 people per km^2. The skewed distribution of people and resources within and between countries has important implications for the use of natural resources, including forests. Many of the region's low-population-density, resource-rich areas are frontiers for commercial plantations, mining and other developments that are leading to rapid changes in population density.

High population density means low per-capita natural resource availability and, usually, a strain on available resources. The area of forest per capita has declined in almost all countries in recent decades (Figure 4.3; Box 4.2 describes the situation in Bangladesh). The pressure on forest and tree resources is especially apparent in low-productivity ecosystems (e.g. in arid lands) and where governance is weak or there is a lack of clarity on land tenure.

Swelling cities

Increased mobility has brought about significant changes in the distribution of populations through urbanization, rural–rural migration and, increasingly, international migration. This has had

Figure 4.3. Per-capita forest area, selected Asia-Pacific countries, 2000 and 2015



Note: LAO = Lao People's Democratic Republic; PNG = Papua New Guinea.
Sources: FAO (2015a); United Nations (2017).

BOX 4.2

Population density, deforestation and forest degradation in Bangladesh

With a population density exceeding 1 100 people per km², Bangladesh faces enormous challenges in conserving its forests. As part of the UN-REDD programme, an assessment was made of the direct and indirect drivers of deforestation and degradation in Bangladesh and their relative importance. A model (created using a geographic information system) of the relationship between population density, transportation corridors and forest change found a negative correlation between population density and percent tree cover: nearly three-quarters (72.6 percent) of forests with a canopy cover exceeding 30 percent was located at least 10 km from townships and 1 km from major roads. Other important drivers of forest loss and degradation include low economic status (especially household income) and a lack of good governance.

Source: Thomson *et al*. (2017).

wide-ranging impacts on land use, including forests (Hecht *et al*., 2015).

People are increasingly living in urban settings

Urbanization has been a key feature of recent demographic change, especially in the context of industrial development. Urbanization processes have significant impacts on the use of natural resources such as arable land, forests, water and energy sources. Figure 4.4 shows broad trends in urbanization in the Asia-Pacific region.

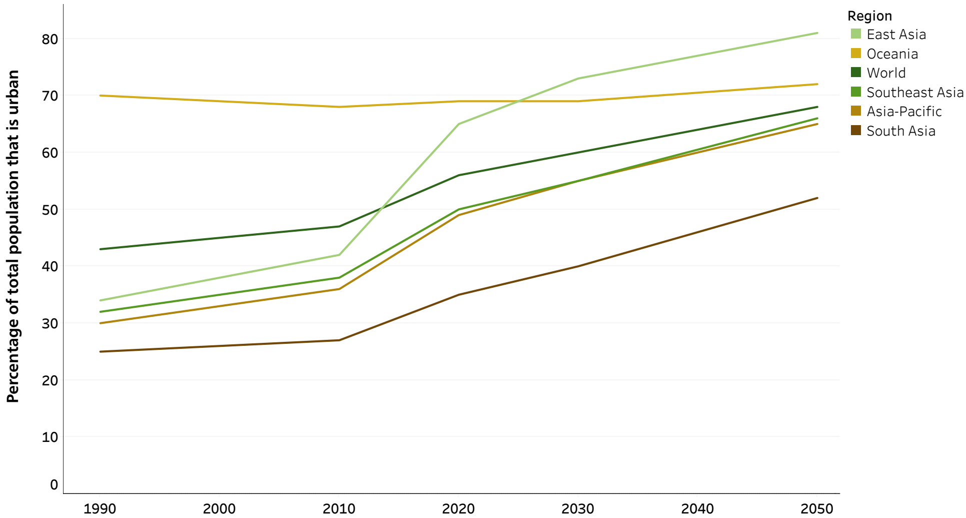
In 1990, about 30 percent of the total population in the Asia-Pacific region was urban, but this had grown to 46 percent by 2015 – a faster rate of growth than that seen globally (the world's urban population grew from 43 percent of the total population in 1990 to 54 percent in 2015).

There are significant differences within the region. For example:

- The most rapid pace of urbanization has been in East Asia, where the urban population as a proportion of the total population increased from 34 percent in 1990 to 60 percent in 2015 (the fastest rate of increase of any world region or subregion); there was an absolute increase of 306 million people.

- South Asia and Southeast Asia are also urbanizing rapidly, with the number of urban dwellers increasing by 284 million in South Asia between 1990 and 2015 and by 159 million in Southeast Asia. On the other hand, there was little change in the percentage of the population living in urban areas in Oceania between 1990 and 2015 – mainly because the most rapid

Figure 4.4. Actual and projected change in urban populations, world and the Asia-Pacific region and subregions, 1990–2050



Source: United Nations (2017).

population growth in the subregion has occurred in less-developed rural economies.

Urbanization will continue for decades. Rapid urbanization is projected to continue in the Asia-Pacific region as a whole and in East and South Asia in particular for the next three decades. Beyond 2030, the urbanization rate is projected to ease in East Asia (largely determined by China) and to continue in South Asia. By 2050, the urban population is projected to increase by 314 million people (to 1 290 million) in East Asia, by 630 million (to 1 200 million) in South Asia, by 228 million (to 527 million) in Southeast Asia and by 14 million (to 41 million) in Oceania.

Urbanization usually implies an expansion in the urban land footprint, achieved mostly at the expense of local agricultural and forest landscapes, with potential impacts on land use, local and regional climates, pollution, the availability and quality of water, and the livelihoods and vulnerabilities of communities. In East and Southeast Asia combined, the area of urban land increased from 155 000 km^2 in 2000 to 189 000 km^2 in 2010; the urban population increased from 738 million to 969 million over the same period (Schneider *et al*., 2015).[13] Urban population density is increasing in the Asia-Pacific region (although it is declining in certain urban areas); nevertheless, it is likely that urbanization will continue to increase its land footprint in coming decades, both through the expansion of existing cities and by the creation of new urban centres: for example, major infrastructure investments are expected

13 These data encompass 14 countries in East and Southeast Asia.

to lead to the development of new urban agglomerations.

The impacts of continued urbanization on land and other resources will depend largely on how well the process is planned and managed. In several countries in the region, rural people are moving spontaneously into urban areas to escape poverty and because of a lack of opportunities in rural areas. Many such people find employment only in low-paid jobs, mostly in the informal sector, inevitably leading to the growth of sprawling slums with poor amenities. Making urban environments more liveable, especially through urban greening, is an important challenge for urban planners.

Urban areas need green spaces, including forests. Urbanization ultimately leads to increases in demand for amenity values, particularly those created by urban green spaces. Urban forests and other green spaces have been demonstrated to improve quality of life for urban residents by regulating climate; storing carbon; removing air pollutants; reducing the risk of flooding; assisting in food, energy and water security; and improving the physical and mental health of citizens. Forests also enhance the look of cities and play important roles in social cohesion (FAO, 2018b). The extent of green spaces in cities is becoming an important consideration in attracting investment.

Urbanization often favours migration by people with higher skills and qualifications. This relatively better-paid segment of the urban population tends to demand better amenities and may also encourage larger investments in, for example, urban forestry. The policies and strategies of many urban centres in the Asia-Pacific region emphasize quality of life (the competitiveness of an urban centre in attracting such skilled workers may be determined partly on the basis of the quality of life it can offer), providing considerable impetus for greening efforts; nevertheless, the capacity for effective urban planning and management is limited in many countries in the region, resulting in unplanned development. In some cases, powerful groups have appropriated real-estate development and flouted rules and regulations, leading to the large-scale conversion of wetlands, mangroves and agricultural areas, with major negative environmental consequences.

Many municipalities in the Asia-Pacific region are making strong efforts to green their cities as a means of improving quality of life for their citizens and to attract investment. The Chinese city of Fuzhou, for example, has planted more than 200 000 trees to create 100 tree-lined boulevards that connect with parks, mountains, fitness plazas and other green spaces. The city's built-up area has 17 200 ha of green space, which is 43.9 percent of the total area (Xiang and Qing, 2018). In Christchurch, New Zealand, a city devastated by earthquakes in 2010 and 2011, rebuilding plans include the creation of a "green corridor" through the city centre and eastern suburbs, incorporating 600 ha of previously residential land that is now deemed unsuitable for housing (see Box 2.15). Singapore's Garden City Programme has been running for more than 50 years (Box 4.3).

BOX 4.3

Singapore: "a city in a garden"

Singapore's Garden City Programme, initiated in 1963, provides an example of how an urban landscape can be developed in a meticulous manner to integrate greenery in most aspects of urban development. The Parks and Trees Act provides the policy and legal framework for the planting, maintenance and conservation of plants in national parks, nature reserves, tree conservation areas, heritage road green buffers and other specified areas. Singapore has thus transformed from a "garden city" to "a city in a garden", and it is the greenest city in the Asia-Pacific region. The systematic investment in greening has increased the attractiveness of Singapore as a destination for investment. Moreover, although it is already a very green city, the budget for greening is increasing. The reason is simple: the city has benefited immensely from the modest funds invested in greenery and its management. Greening and biodiversity conservation programmes will pay for themselves.

Source: Tan Puay Yok (2018).

Urbanization has various impacts on forests. Urbanization can affect forests in many ways depending on the socio-economic, policy and institutional environment. For example:

- Most urban expansion in the Asia-Pacific region has been at the expense of agricultural and forest lands (Box 4.4 and Box 4.5); in many countries it is one of the main causes of mangrove destruction. The loss of agricultural lands to urbanization may be offset by the creation of new farmlands elsewhere through deforestation.

- Rapid urbanization has resulted in de-agrarianization, especially through feminization (Box 4.6) and geriatrification. As more young people of working age move out of their rural settings, the management of natural assets increasingly becomes the responsibility of women and older people (Hecht *et al*., 2015; Tamang, Paudel and Shrestha, 2014; Wang *et al*., 2016). Low-productivity croplands are often fallowed, paving the way for the regrowth of natural vegetation.

- Off-site effects may be both short- and long-term. Short-term impacts arise from demand for construction materials, especially sand, stone, soil and timber. In several countries in the region, sand and stone mining have become major problems affecting forests near new urban centres. Long-term impacts on forests include

BOX 4.4

Urban expansion and cropland loss

Forty-six million hectares of croplands that existed globally in 2000 are in areas where urbanization is expected to occur by 2030. Accounting for the potential for urban agriculture, it is estimated that the net conversion of these lands to built-up urban areas would be about 30 million ha. Of this, 18 million ha is expected to be in Asia, including 7.6 million ha in China, 3.45 million ha in India, 1.8 million ha in Pakistan, 0.8 million ha in Viet Nam and 0.6 million ha in Indonesia. The total projected reduction in cropland in Asia is 3.2 percent; many of the losses would be in prime agricultural lands, however, and crop production is projected to decline by about 5.6 percent.

Source: Bren d'Amour *et al*. (2017).

BOX 4.5

Impact of urban expansion on forests in China

A recent study analysed the impact of urban expansion on deforestation and forest fragmentation in six megalopolises in China – Beijing–Tianjin–Hebei, Yangtze River Delta, Pearl River Delta, Wuhan, Chengdu–Chongqing and Changsha–Zhuzhou–Xiangtan. The study examined the magnitude and speed of urban expansion in these areas in the period 2000–2010 and used remotely sensed data to analyse forest loss and fragmentation. Its findings include the following:

- Urban expansion has been a key driver of forest loss in all six megalopolises.
- Differences in the extent of forest loss are context-specific. Significant losses were noted in the Pearl River Delta, Chengdu–Chongqing and Changsha–Zhuzhou–Xiangtan megalopolises, where forests are key components of landscapes.
- Prefecture/city-level analyses indicate a reduction in the average size of forest patches and therefore increased forest fragmentation. At the megalopolis level, however, there was an increase in the average size of forest patches, due largely to reforestation efforts under the Grain-for-Green programme.
- The total area of forests increased at the scale of megalopolises because the conversion of croplands to forests under the Grain-for-Green programme more than compensated for forest clearance for urban expansion.

Source: Zhou *et al*. (2017).

BOX 4.6

The feminization of agriculture and its impacts in Nepal

Feminization is a phenomenon stemming from a change in the traditional roles of men and women in households in which women assume a major share of the responsibility for managing farms. In Nepal, the number of female-headed households is increasing as more men emigrate from rural areas, and women are assuming responsibilities for many activities previously performed by men. This process, combined with the inflow of remittances from household members living outside the area (including internationally), has led to a significant reduction in land-use intensity and, in some cases, to the abandonment of agricultural land. A household survey conducted in the Middle Hills districts of Kavre and Lamjung in 2014 found that 74 percent of households had reduced the number of crops they grow each year due to changes in labour availability stemming from migration. The survey suggested the need to redesign agricultural systems and cropping practices to suit the changed circumstances towards low-labour-demanding, high-income agroforestry systems.

Source: Tamang, Paudel and Shrestha (2014).

those caused by increased demand for forest products, potentially accentuating resource-use conflicts. For example, increased demand for water and other ecosystem services in an urban population could increase conflicts with local communities who harvest forests for woodfuel and graze their cattle in them. Conversely, urbanization could open up new income opportunities for local communities, such as ecotourism and payments for ecosystem services.

- Although more research is required, there are indications that urbanization changes the quantity and nature of wood use. In most rural settings, wood production and use take place in the informal domain, with users often collecting products directly in forests. Urbanization reduces this practice, and wood and other products become traded commodities. As informal collection declines to be replaced by more formalized trade, harvested quantities also tend to decrease. Woodfuel consumption may also decline due to substitution with more convenient fuels such as liquefied petroleum gas, kerosene and electricity (e.g. Win Chin *et al*., 2018).

Notwithstanding its initial negative impacts on forests and agricultural lands, urbanization can have positive effects on forests if urban communities take an interest in protecting nearby forests for the ecosystem services (including cultural and amenity services) they provide. This depends, however, on the governance system in place for managing the urbanization process.

Moving for work or fleeing strife

Urbanization is a long-term change in the spatial distribution of people within a country, but other less-permanent movements of people also occur, such as through domestic and international work-related migration and displacements due to conflicts and natural disasters. In most countries in the Asia-Pacific region, internal migration from rural to urban areas is high due to both push and pull effects.

Sending money home is a major economic factor. International migration plays an important role in addressing local, subnational and national shortages of labour and expertise. There are two broad types: long-term permanent migration, in which immigrants opt to stay permanently in a host country; and temporary migration, in which immigrants ultimately return to their home countries (or subnational regions). Work-related migration to host countries within and outside the Asia-Pacific region has escalated, especially due to the post-1970 boom in oil prices and the associated economic growth in Middle Eastern economies.

Globally, the number of migrants increased from 173 million in 2000 to 258 million in 2017; the Asia-Pacific region has become a major source of migrants, increasing from 66 million people in 2000 to 108 million in 2017 (UNDESA, 2017). Remittances by migrant workers to their home countries in the region were estimated at USD 256 billion in 2017, more than the combined value of official development assistance and foreign direct investment in the region. The top recipient countries in the region for remittances in 2017 were India (USD 69 billion), China (USD 64 billion), the Philippines (USD 33 billion), Pakistan (USD 20 billion), Viet Nam (USD 14 billion), Indonesia (USD 9.0 billion), Thailand (USD 6.7 billion) and Malaysia (USD 1.6 billion). In some countries in the region, remittances account for a significant share of national income. For example, they comprised 33 percent of gross domestic product (GDP) in Tonga, 29 percent in Nepal, 10.2 percent in the Philippines, 6.4 percent in Viet Nam and 3.1 percent in Timor-Leste in 2017 (World Bank, undated [a]).

International migration and its associated remittances have multiple direct and indirect impacts on economies at the household, community and national scales. Remittances have helped many households out of poverty, leading to changes in land use and to investments in human and physical capital. In the Middle Hills of Nepal, for example, the abandonment of marginal agricultural lands because of the income obtained via remittances has led to forest regrowth (Jaquet *et al.*, 2016; see also Box 4.6). Higher incomes due to remittances have also enabled households to switch from woodfuel to liquefied petroleum gas, with the effect of reducing harvesting pressure on forests and woodlands; significant declines in violations of forest laws have been recorded due to work-related migration and remittances.

On the other hand, increased income due to the flow of remittances has led to local housing booms, with negative environmental consequences like the conversion (for development) of wetlands. Such conversion may have increased the losses incurred during flooding in the Indian state of Kerala in August 2018, when nearly 500 people died.

There is uncertainty about the future trajectory of migration and remittances. Recent global developments, and a potential trend towards isolationism, could act to restrict work-related migration, especially to Europe and the United States of America. Moreover, the decline in revenues from fossil-fuel reserves has led to the curtailment of spending on construction (a key sector providing employment to migrant workers from the Asia-Pacific region) in some countries in the Middle East and the adoption of policies favouring the employment of nationals in key services. If such trends persist, work-related migration and the associated inflow of remittances may diminish. On the other hand, countries with ageing (or declining) populations (e.g. Japan) may open up for increased migration to meet demand for (for example) elderly care-givers and to boost labour forces.

Millions have fled disasters. Many countries in the Asia-Pacific region are highly vulnerable to natural hazards such as storms, drought, floods and wildfire, the frequency and intensity of which are projected to rise due to climate change. Moreover, increasing population densities and the associated growth in physical capital increase the scale of potential damage caused by disasters. Low-lying coastal areas and small-island countries are particularly at risk to sea-level rise, tsunamis and storms; other natural hazards with potentially devastating impacts in the Asia-Pacific region are drought and wildfire.

Disasters can cause significant losses of life and property and the short-term and long-term displacement of millions of people. According to the 2017 global report of the Internal Displacement Monitoring Centre (IDMC, 2017):

- An estimated 24.2 million people were internally displaced globally in 2016 due to disasters. Of these, about 20 million people (83 percent) were in the Asia-Pacific region.

- In the region, there were especially large existing internal displacements in 2016 in China (7.4 million people), the Philippines (5.9 million), India (2.4 million) and Indonesia (1.2 million).

- Although many internally displaced people eventually return to their homes, some may remain displaced for years. In Japan, for example, 124 000 people displaced by the Tohoku earthquake and tsunami and Fukushima nuclear-plant leak in March 2011 are yet to return to their homes, eight years later.

- In the Pacific Island states of Fiji and Tonga, some 76 000 and 3 000 people, respectively, were internally displaced by cyclones in 2016. These numbers are not especially high on a regional scale, but they represent large proportions of the national populations.

- Flooding is the natural hazard that causes most internal displacement in the Asia-Pacific region, followed by tropical cyclones.

Although disaster-related displacements have received considerable attention because of their visible impacts, much less attention has been paid to the slow and creeping impacts of climate change, especially on agricultural productivity and water availability. Low- and middle-income countries are more prone to climate-change-related disasters because their economies are more dependent on climate-sensitive sectors such as agriculture and livestock raising and have low adaptive capacity in terms of human capital, financial resources, institutional resilience and technical capacities (FAO, 2018c). A study in India found that a 1 percent decline in rice yield resulted in a 2 percent increase in out-migration (Viswanathan and Kumar, 2015). A recent World Bank assessment (Rigaud *et al.*, 2018) predicted that climate-change-induced internal migration in sub-Saharan Africa, South Asia and Latin America would compel millions of people to leave their home areas by 2050. Predictions of the study for South Asia include the following:

- There could be 35.7 million climate migrants by 2050 under a pessimistic climate-change scenario and 11.4–22.3 million under a less-pessimistic scenario.

- Irrigated and rice-growing areas will see population dampening due to outmigration, and rainfed cropping areas will see population increases.

- The southern Indian highlands, especially between Bangalore and Chennai, will be a climate in-migration hotspot. Parts of Nepal, as well as northwestern India, will also see climate in-migration. This would have significant impacts on land uses in these areas, including forests.

The impacts of internal displacement on land use are both direct and indirect, with their severity depending on various factors. Some environmental impacts may be long-term and others may be reversible within a few years. Some of the damage wrought by the 2004 tsunami on agricultural lands in Aceh, Indonesia, and other countries has been long-lasting, with saline-water intrusions, for example, still severely affecting land productivity. Overcoming the environmental damage caused by disasters is especially challenging in densely populated areas, and the resettlement of affected people, either temporarily or permanently, will cause changes in land use.

Many people are fleeing conflicts, too. People may be displaced internally or across national borders by political conflicts. There were 4.2 million refugees and another 2.7 million internally displaced people in the Asia-Pacific region in 2017. The two most critical situations today concern Afghani and Rohingya refugees: 1.4 million Afghanis are taking refuge in Pakistan and another 0.95 million are seeking asylum in Iran (Islamic Republic of). The 932 000 refugees in Bangladesh are almost all Rohingyas from Myanmar; 655 000 of these people arrived in 2017.

In many countries that host large numbers of refugees, woodfuel collection in the vicinity of displacement camps has become a major driver of deforestation and forest degradation. In the absence of other resources, displaced people depend almost entirely on woodfuel for cooking and heating; unchecked, however, intensive wood removals could ultimately lead to the total loss of the resource (Box 4.7). The United Nations High Commissioner for Refugees and FAO are working jointly to address this problem, especially by encouraging the establishment of woodlots and sustainable wood harvesting (FAO and UNHCR, 2018).

It is difficult to predict the number of people likely to be displaced by conflicts (and to estimate the direct and indirect impacts of these displacements on the environment) because it depends largely on the political context and the institutional mechanisms available to resolve the conflicts. Although environmental degradation due to conflict-related displacements may not be a major problem today at the regional level, it could be significant at the subnational and local levels.

Changing age structures and consumption of forest products

Age structure can be a direct and indirect driver of change in the forest sector. Population projections indicate a significant increase in the proportion of elderly people in several countries in the region to 2050 (Figure 4.5). This ageing will be particularly marked in East Asia, where the proportion of people aged 65 years or over will increase from 11.1 percent of the population in 2015 to 27.3 percent in 2050, influenced strongly by an already-older population in Japan and rapidly ageing populations in China and the Republic of Korea. There will also be an ageing trend in South Asia, albeit of lesser

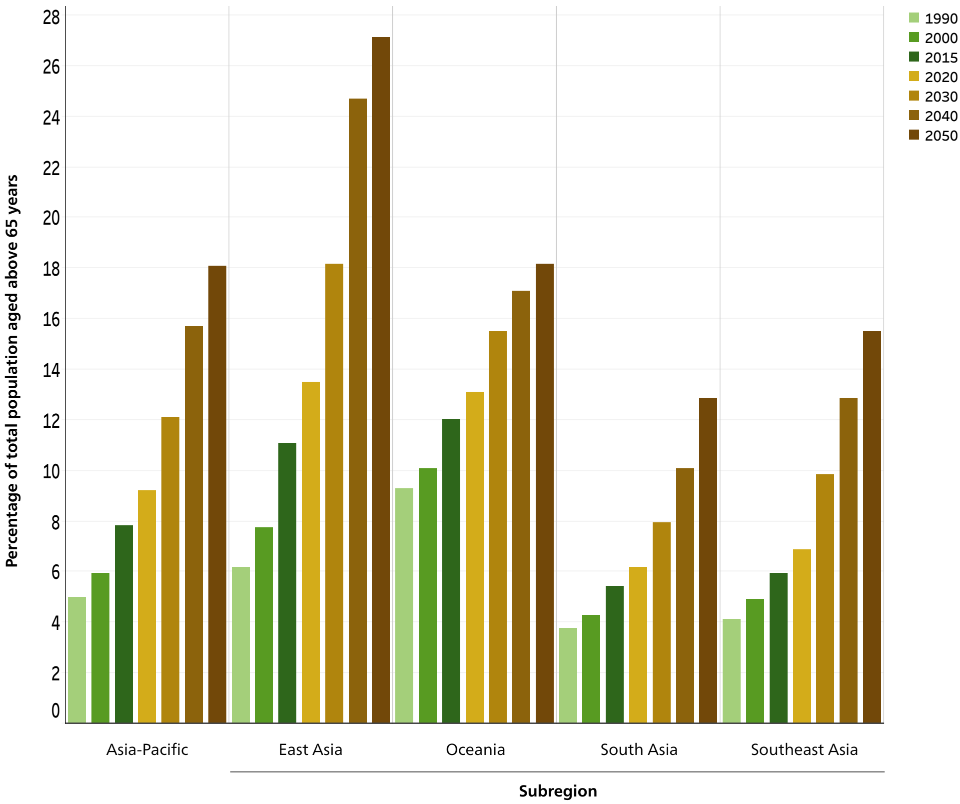
BOX 4.7

Refugees and forest degradation

Sudden influxes of large numbers of people disturb the population–resource balance, potentially causing deforestation and forest degradation. For example, the 700 000 Rohingya people who fled Rakhine state in Myanmar to the Cox's Bazar district in Bangladesh's Ukhia region were welcomed by the local community, but the densely populated region faces many challenges. The arrival of the refugees has increased pressure on the already degraded area: it has been estimated that 700 tonnes of woodfuel is collected per day to meet increased demand, and it could lead to the total loss of forests in Ukhia. Measures are being put in place to reduce this pressure on local resources, including the supply of liquefied petroleum gas and improvements in farming technologies.

Source: Rogers (2018).

Figure 4.5. Actual and projected age structure of populations, Asia-Pacific region and subregions, 1990–2050



Source: United Nations (2017).

magnitude than in East Asia, with the proportion of people over 65 projected to increase from 5.4 percent in 2015 to 13.3 percent in 2050. The situation in Oceania is mixed: the populations in Australia and New Zealand are ageing, but populations in Melanesia have a relatively high proportion of people of working age.

Changing age structures have the following implications for forests and the forest sector:

- Demand for wood and wood products for construction, furniture and many other wood-based consumer goods is expected to increase in countries with high proportions of younger people and people of working age. Such growth in demand is largely linked to higher incomes and urbanization and the associated housing construction boom.

BOX 4.8

Demographics, housing and wood demand in Japan

Japan is facing various challenges as its population ages and declines. The population peaked at 128.6 million in 2010 and has been declining since – it was 128 million in 2015 and is projected to reach 122 million in 2030 and 109 million in 2050. This fall, combined with the population's overall ageing, is already having various economic impacts, such as declining demand for housing and wood. About 1.66 million new houses were constructed in 1988, but annual new-house construction had declined to 708 000 by 2008 (before picking up to 990 000 starts in 2012 due to economic stimulus efforts and reconstruction in the wake of the Tohoku earthquake and tsunami). The Nomura Research Institute projects that housing starts will decline to 540 000 per year by 2030. Increasingly, the Japanese wood industry is exploring export opportunities, such as to China.

Sources: Kobayashi (2015); Nomura Research Institute (2016).

- Conversely, domestic housing markets are shrinking in countries with relatively old (and also, in some cases, declining) populations, reducing demand for industrial wood. Japan's wood industry, for example, is increasingly seeking markets outside the country (e.g. in China) to offset falling domestic demand (Box 4.8). Other consequences of an ageing population for the forest sector include the declining availability of forestry workers and increased demand for the amenity values of forests as older generations seek to improve their quality of life.

- Countries with a relatively large proportion of younger people with high incomes will boost demand for active forest-based recreation.

Demographic changes and forest transitions

Population growth is invariably identified as a fundamental driver of land-use change, including deforestation and forest degradation. Several countries in the Asia-Pacific region have undergone rapid deforestation and forest degradation and then transitioned to phases of forest recovery and, ultimately, to increases in forest area. Japan and the Republic of Korea underwent such forest transitions in the 1960s and 1970s; China, India, the Philippines and Viet Nam went through similar processes after 1990. The following conclusions can be drawn from these transitions:

- The impact of population growth on forests depends largely on the degree of openness of an economy. In relatively closed economies (national, subnational or local), an increase in population implies increased pressure on the land and, almost inevitably, forest clearance. In closed economies, the pressures exerted by increasing populations lead to the opening up of forestlands for cultivation and wood extraction well above sustainable levels because alternatives – such as land redistribution and increased productivity through technological improvement – are economically or politically infeasible.

- The nature of population–resource interactions in closed economies will depend on other factors, too, such as the potential for economic diversification in sectors not reliant on land and other natural resources. In several countries in the region, forest transitions have taken place in parallel with the rapid growth of manufacturing and service sectors, reducing the dependence of people on land. Growth in manufacturing and service sectors also encourages urbanization, the impacts on land of which vary depending on context.

- Forest transitions in more open economies may follow diverse pathways, including increasing trade and investment to tap forest resources in other countries. This has occurred in the forest transitions of several countries in the region, which have invested in the agriculture and forest sectors in other countries where land and forests are abundant. Nevertheless, there is a risk that this approach simply transfers deforestation and forest degradation elsewhere.

Low population density in a country does not guarantee forest stability and low rates of deforestation. Countries with low population densities and large areas of forests may be highly attractive to investments that lead to deforestation. This happened, for example, with the special agricultural business leases offered in Papua New Guinea. Comparable situations exist in Cambodia, the Lao People's Democratic Republic, the Solomon Islands and elsewhere, in which low-population, high-forest-cover countries have become attractive destinations for forest investment, leading to deforestation and forest degradation (albeit helping stabilize and improve forest resources in investing countries).

Forest transitions are possible even in countries where population density is high. Several countries in the region with high population densities are striving to achieve sustainable forest resources by improving governance, especially through better policies, laws and institutions. The experience in Viet Nam demonstrates that forest-tenure reform can be key to improving the forest situation. India and Nepal have also shown how the forest situation can improve with the participation of local communities, even at high population densities.

To a greater or lesser extent, demographic factors such as population growth and density, urbanization, migration and changing age structures will be drivers of change in forests and forest sectors in the Asia-Pacific region for at least the next three decades. Populations in some countries have plateaued, but rapid population growth continues in others. These effects will be moderated or accentuated by other drivers, and the impacts of demographic changes will be highly context-specific. How other drivers affect land use and forests is discussed in following chapters.

Tyler Hendy

Key points

- Asia-Pacific, led by China and India, is the fastest-growing of the world regions, and it now commands more than 40 percent of global gross domestic product. Continued economic growth coupled with a rapidly expanding middle class will increase demand for forest products.

- Housing booms in China, India and Indonesia have increased demand for forest products. In the past, however, the bursting of housing bubbles has had severe impacts on the forest sector.

- There have been dramatic decreases in the number of extremely poor people in the region. In some countries, however, some of the most impoverished people live in forested areas.

- Globalization has brought major changes in the production, processing, trade and consumption of forest products, and global value chains have replaced local value chains.

5 | Economies are booming, with opportunities and threats for forests

A recent backlash against globalization could slow investment, trade and technology transfers in the forest sector.

- The structure of economies in the region is undergoing rapid change. The share of agriculture (including forestry) in value added has dropped sharply in recent decades, although the sector remains a major employer in many countries.
- Increases in bovine and other livestock populations in the region, due in part to changing diets linked to increased incomes, have caused forest degradation and deforestation, including for the production of livestock and poultry feed.
- Investments in infrastructure, mining, urban development and industrial crops are expected to continue growing in the region, with the potential to unleash a new era of deforestation.

The Asia-Pacific region comprises a complex mosaic of people and societies at various stages of economic and social development. Economic change is a prime driver of direct and indirect impacts on land use, including forests and forestry. In many countries in the region, economic development has been fuelled, at least in its early stages, by agricultural expansion and unsustainable forest exploitation. Industrial development and associated urbanization have changed the nature of demands on forests, with an increasing emphasis on the production of industrial raw materials and, more recently, the provision of ecosystem services. In many countries in the region, a rise in economic wealth has led to an increase in investment in conservation and the rebuilding of natural assets through forest restoration.

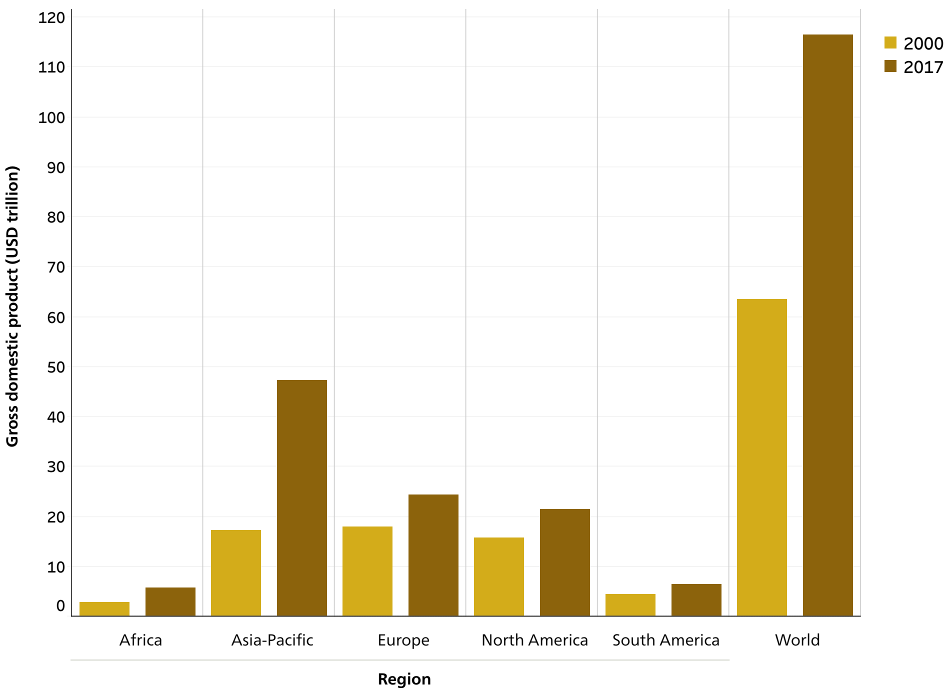
This chapter makes a broad assessment of the implications of key economic changes in the region for the future of forests and the forest sector.

Sustained high growth in incomes

Asia-Pacific is the fastest-growing world region: the economies of many of its countries have been expanding rapidly since the 1980s and especially since the 1990s. Key features of this growth include the following:

- The region's GDP grew from USD 17.3 trillion (in terms of purchasing power parity – PPP) in 2000 to USD 47.2 trillion PPP in 2017 (Figure 5.1),

Figure 5.1. Proportion of global gross domestic product (purchasing power parity), by world region, 2000 and 2017



Source: World Bank (undated [a]).

a compound annual growth rate of 6.1 percent (World Bank, undated [a]). This was significantly higher than the global compound annual growth rate of 3.6 percent over the same period. The region's strong performance was due primarily to rapid growth in some of the most populous countries, especially Bangladesh, China, India and Viet Nam, which mostly grew at rates exceeding 6 percent over the period. Although the region's economic growth declined slightly in the wake of the 2008 global financial crisis, it still accounted for 56 percent of the global increase in GDP from 2010 to 2017, demonstrating the region's vibrancy.

- The region's share of global GDP (in PPP) increased from 27.3 percent in 2000 to 40.5 percent in 2017. Several of the region's economies climbed in the global GDP (PPP) rankings: China is now the world's largest economy by this measure, and India is in third place.[14] Several Asia-Pacific countries – Australia, Pakistan, the Republic of Korea and Thailand – moved into the "trillion dollar club" (i.e. countries with economies generating nominal GDP of more than USD 1 trillion per year) in the period 2010–2017 (China, India, Indonesia and Japan were already in the club). The most remarkable feature of the region's growth has been China's economic expansion, with its GDP growing from USD 4.7 trillion in 2000 to USD 21.2 trillion in 2017.

[14] Note, however, that China was ranked second in 2018 in terms of GDP valued at market exchange rates and India was seventh.

Despite sustained economic growth, per-capita GDP (PPP) was less than USD 10 000 in 19 countries in the Asia-Pacific region (and less than USD 5 000 in nine of those) in 2017 (Figure 5.2).

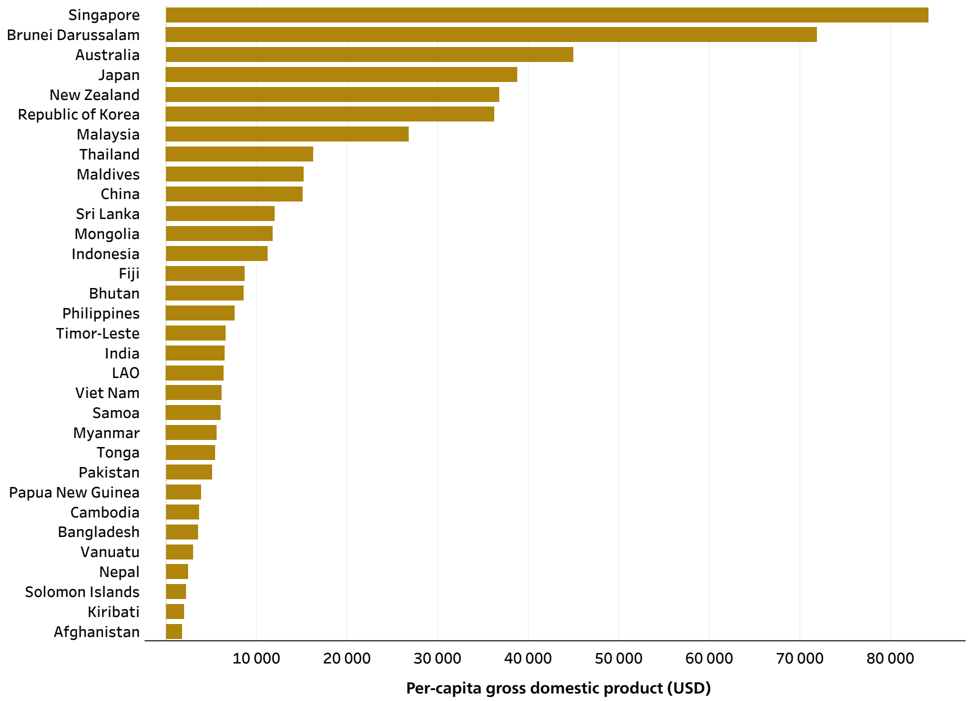
Outlook for economic growth

Notwithstanding the development of various forecasting techniques and models, providing a realistic indication of future economic growth rates in the region beyond the next couple of years is challenging, and many currently unknown factors could alter the course of economic development (IMF, 2018; Box 5.1). Nevertheless, the following broad observations may be made, drawing on PwC (2015):

- There will be major changes in the relative size of economies. In market-exchange terms, China's economy is projected to be worth USD 26.7 trillion per year in 2030, surpassing that of the United States of America. India will have moved into third place in global GDP rankings with an economy worth USD 7.3 trillion.

- Assuming a continuation of current trends, the Asia-Pacific region will grow rapidly to 2050. China will still be the world's largest economy, India will have moved into second position and Indonesia will have become the world's fourth-largest economy.

Figure 5.2. Per-capita gross domestic product (purchasing power parity), countries in the Asia-Pacific region, 2017



Notes: Data were unavailable for the Democratic People's Republic of Korea. LAO = Lao People's Democratic Republic.
Source: World Bank (undated [a]).

BOX 5.1

Challenges to economic growth in the Asia-Pacific region

In a recent assessment of the economic outlook for the Asia-Pacific region, the International Monetary Fund identified the following key challenges in the medium to long term:

- The ageing of populations means that the region faces the risk of "growing old before becoming rich", resulting in a substantial additional fiscal burden. Ageing has the potential to reduce growth rates by 0.5–1.0 percent in China, Japan, the Republic of Korea and Thailand.
- Productivity growth is slowing across all sectors.
- Inequality is growing, requiring policies to foster inclusive growth.
- The region will face significant challenges in harnessing the digital economy and taking advantage of its transformative impacts. The risk of increasing unemployment is high.

Source: IMF (2018).

Figure 5.3 shows the growth in GDP per capita in Asia-Pacific countries between 2000 and 2017. The following conclusions can be drawn:

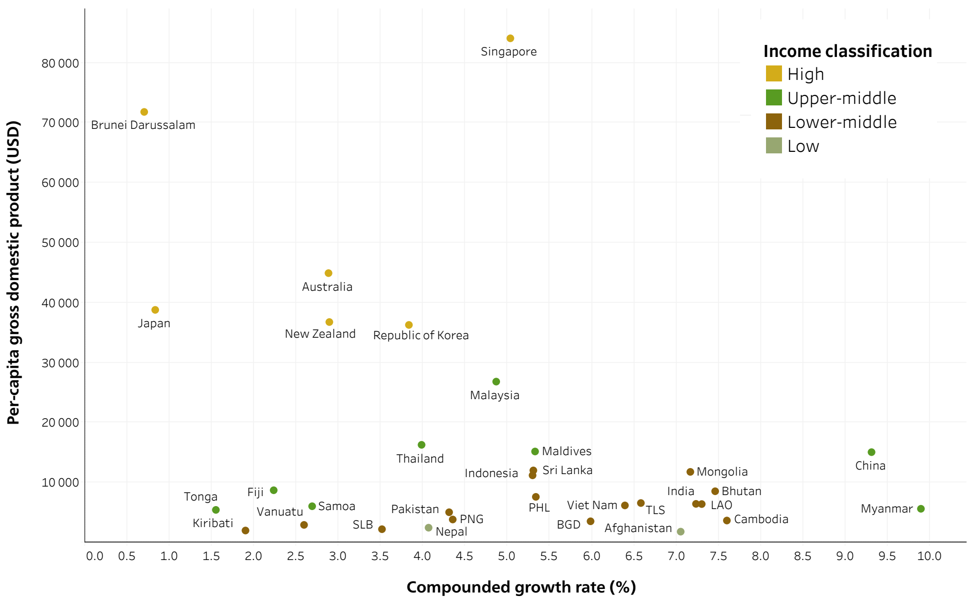
- Most countries are in the lower-middle- or upper-middle-income groups, with economies growing at an annual rate of 5 percent or more.

- Even some low-income countries are growing rapidly, albeit from a low base, and some will soon move into the lower-middle-income group should current trends continue.

- The economies of high-income countries in the region are growing at a much slower pace than those of middle-income countries. Given their much higher base incomes, however, the absolute increase in income in those countries is still substantial.

A fundamental question for this outlook study is whether the regional economy will be able to sustain the growth observed in 2000–2017 to 2030 and 2050. Two key uncertainties, discussed below, are the likelihood of a global recession, and whether there will be a slowdown or reversal of globalization processes; the first in particular would have major consequences for the region's forest sector.

Figure 5.3. Compounded average growth rates of per-capita gross domestic product (purchasing power parity) in 2000–2017, countries in the Asia-Pacific region



Notes: BGD = Bangladesh; LAO = Lao People's Democratic Republic; PNG = Papua New Guinea; PHL = Philippines; SLB = Solomon Islands; TLS = Timor-Leste. Data were unavailable for the Democratic People's Republic of Korea.
Source: World Bank (undated [a]).

Uncertainties and potential disruptions lurk

The Asia-Pacific region has experienced two major economic crises in the last two decades: one in 1997–1998 that primarily affected certain Southeast Asian countries (usually called the Asian economic crisis), and the other in 2008, which affected most countries worldwide (usually called the global financial crisis). Concerted actions in the region by governments and central banks helped minimize the negative impacts of the global financial crisis. Most Asia-Pacific economies have rebounded since, although the consumption of forest

BOX 5.2

Economic crises and forestry: lessons from the past

Economic crises have been a regular feature of the globalized economy: on average, the world has experienced a financial crisis every ten years over the last century (Nilsson, 2009). Various proximal factors have triggered these crises, but the underlying cause has been more or less the same – the failure of regulatory mechanisms to develop checks and balances and to exercise due diligence in investment decisions, especially to control excessively risky behaviour. The impacts of these crises have varied considerably. Those sectors or segments that are highly globalized are particularly affected, while those that cater mostly to local consumption are least affected.

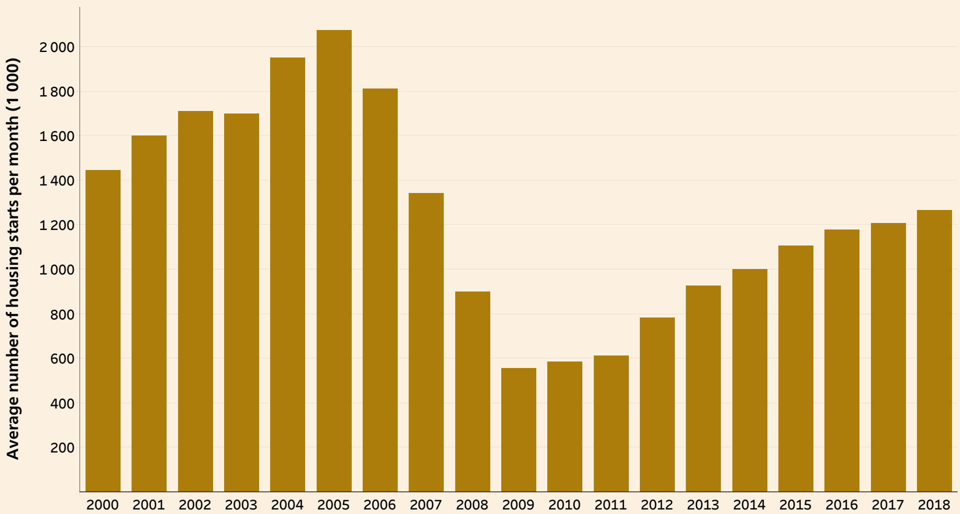
The Asian economic crisis in 1997–1998 stemmed from an exchange-rate crisis centred on fast-growing Southeast Asian countries (especially Indonesia, Malaysia and Thailand), which resulted in the drastic devaluation of currencies and significantly affected trade. One of the few studies on the impacts of this crisis on forests showed that it affected the perceptions of local farmers about their livelihoods and led to increased deforestation (Sunderlin, 2000; Sunderlin *et al.*, 2001).

The epicentre of the 2008 global financial crisis was the sub-prime mortgage crisis in the United States of America's housing sector, the ripples of which affected financial markets, eroded investor confidence and resulted in recessions in many countries. In 2005, at the peak of the housing boom in the United States of America, there were 2.07 million new private housing starts per month, based largely on mortgage finance that, in turn, relied on a continuing boom in house prices. The mortgage repayment crisis led to a cascading decline, which began in 2006 and accelerated in 2007–2009, reaching, at its lowest point in 2009, just 0.55 million starts per month (Figure 5.4). Europe was also affected by a decline in its housing sector, although to a much lesser extent.

products globally remains well below levels achieved before the crisis. The housing construction sector was greatly affected by the global financial crisis, and this had considerable impacts on forestry: the collapse of the housing sector, especially in the United States of America, had a ripple effect on the wood product industries of countries most dependent on that sector. Production was scaled down and there were widespread closures (Box 5.2).

Housing is a key economic sector, and it has important backward linkages with the forest sector; what happens in the

Figure 5.4. Monthly average housing starts in the United States of America, 2000–2018



Source: US Census Bureau (undated).

The repercussions of the rapid fall in housing markets for the forest sector were significant. The gross value added in the North American forest sector plummeted from USD 153 billion in 2005 to USD 120 billion in 2009. Gross value added in Europe's forest sector also fell precipitously, from USD 189 billion in 2007 to USD 155 billion in 2009. The value of global wood product exports declined from USD 446 billion in 2007 to USD 381 billion in 2009 (FAO, undated [a]). Countries such as Canada that exported large volumes of wood products to the United States of America suffered most, and there were large-scale mill closures and considerable unemployment. Asia's export income also declined, from USD 87 billion in 2007 to USD 81.7 billion in 2009. The sharp decline in demand led to major changes in the forest industry, such as the closing down of redundant production capacity and an accentuation of the geographical shift of wood processing to the Asia-Pacific region, especially to China.

housing sector in the Asia-Pacific region, therefore, is of major concern. There are indications that China and India in particular are experiencing housing booms, with a consequent increase in demand for wood products, especially sawnwood, panels and furniture. To a certain extent, however, the booms are linked to speculation and the absence of other investment opportunities, and some analysts suggest that they are bubbles that could burst in the near future. If that were to happen, the region's forest sector would likely contract significantly.

Given the cyclical nature of economic growth, booms and busts will likely continue, and forestry should develop strategies for dealing with them effectively. Careful planning – especially of capacity expansion in wood product industries – will be required. Economic crises also present opportunities for restructuring, especially to reduce redundant processing capacity. More importantly, periodic declines in demand can be used to rebuild natural capital through restoration, thereby also increasing rural employment. Economic stimulus packages could be designed to support employment generation through reforestation and other natural-capital-rebuilding efforts.

Economic development and changing dependence on land

Early phases of economic growth in countries in the region have been (and in some cases are being) driven largely by the agriculture sector (comprising agriculture, livestock, forestry and fisheries). The growth of the industrial and services sectors – coupled with urbanization – has involved major structural change (ADB, 2018), with important implications for land use, including forests. The following overall trends can be observed:

- In almost all countries, the share of agriculture in gross value added declined significantly between 2000 and 2017. Some of the most pronounced declines were in low-income economies such as the Lao People's Democratic Republic and Myanmar.
- In 2017, the share of agriculture in value added was below 10 percent in several countries; it was especially low in Australia (2.8 percent) and Japan (1.1 percent).
- The services sector expanded rapidly between 2000 and 2017 in China, the Lao People's Democratic Republic and Nepal.

Although the share of agriculture in gross value added has declined rapidly in many countries, it is still a major provider of employment, especially in countries with developing economies. In Bangladesh, for example, agriculture's share of gross value added in 2017 was only 14.2 percent but it provided 40.6 percent of employment. In the Lao People's Democratic Republic, agriculture accounted for 18.3 percent of gross value added in 2017 and 72.2 percent of employment (ADB, 2018).

A low share of gross value added and a high share of employment implies relatively low levels of income in agriculture and allied sectors, which has important implications for land use. In almost all countries in the region, farmers are diversifying their incomes (largely through informal activities) to supplement relatively low returns from agriculture (Box 5.3). In some areas, low rural incomes have encouraged rural–urban migration; in forested areas, low incomes mean a high dependence on forests for meeting household needs and generating supplementary income. The growth of the organized industrial and services sectors is far from sufficient in many countries to absorb all rural workers, and a mismatch of skillsets further limits the shift of labour from agriculture to those sectors.

BOX 5.3

The future of farmers and farming in the Asia-Pacific region

The diversification of rural economies has a long history, and even households considered to be agricultural are usually not entirely dependent on agriculture. The trend of diversification has accelerated in recent decades, especially – in some areas – as the size of landholdings and labour productivity have declined. Non-farm income, therefore, has become increasingly important for farming families. Various studies have shown that farm households are increasingly participating in non-agricultural income-generating activities and that, over time, fewer rural households are remaining specialized in agriculture. The rising importance of non-farm income in both urban and rural areas has also increased demand for labour, resulting in increases in rural wages and thereby further reducing the financial viability of farming.

In addition to migration, there are three broad approaches for countering the problems stemming from declining farm size and low labour productivity:

1. produce outputs that are more valuable (e.g. animal source foods, fruits and vegetables, and higher-quality produce);

2. increase productivity (more output and less input, especially labour); and

3. diversify further into the rural non-farm economy.

One of the options pursued in some countries is the planting of tree crops, including industrial crops such as eucalypt and acacia, which is less labour-demanding than most annual crops and gives high returns. Farm operations are being mechanized, and new arrangements for accessing resources are emerging. It is likely that the nature of farming will change dramatically in coming decades in many countries in the region.

The agriculture–forestry dynamic

The Asia-Pacific region hosts a complex mosaic of farming systems that have evolved in various economic, social, cultural and environmental contexts. In almost all countries in the region, food crops such as rice and wheat extended into new areas, including forest areas, in the early phases of economic development. The use of improved varieties, irrigation and chemical fertilizers in the "green revolution" ultimately reduced the need for the horizontal expansion of food crops. Nevertheless, this new form of agriculture brought a host of environmental problems, such as those caused by the overuse of fertilizers and pesticides; increased methane emissions from rice cultivation; and waterlogging associated with irrigation, which led to increases in salinity and consequently to land degradation. Many farmlands became unproductive, and their restoration still poses a major challenge.

In the last three decades there has been a major expansion of perennial commodity crops, especially oil palm and rubber. Indonesia and Malaysia together account for about 85 percent of global palm-oil production. The role of this industry in deforestation – including in peatlands – has attracted considerable attention (Box 5.4), and Papua New Guinea's policy of encouraging oil-palm plantations under special agricultural business leases led to a public outcry there (Box 5.5). An increase in rubber cultivation when the rubber price boomed in 2010–2012 also provided impetus for deforestation (Ahrends *et al*., 2015; Chakraborty *et al*., 2018; Box 5.6). A subsequent decline in the rubber price halted this trend and, in some cases, led to the replacement of rubber with other crops, especially by smallholders; nevertheless, the damage had been done to forests and their associated biodiversity.

Thus, the nature of the agriculture–forest dynamic depends largely on:

- the demand for food and industrial commodities and the profitability of cultivation;
- the governance in place, including policies and strategies designed to minimize social and environmental harm and the willingness and ability of actors to implement these; and
- the impacts of climate change on agriculture – such as sea-level rise (which could make large areas of coastal lands unsuitable for agriculture); increased land degradation and desertification; water shortages; and declining agricultural productivity – with potential ripple effects on other land uses, including forests.

There are instances in the Asia-Pacific region of the reversion of agricultural land to natural or planted forests driven by changes in policies or markets. Low agricultural productivity, coupled with the non-availability of labour (e.g. due to work-related migration) and high wages, has led in some places (such as Nepal's Middle Hills – Jaquet *et al*., 2016; see Box 4.6) to the abandonment of agricultural lands, enabling natural regeneration. On the other hand, strong demand for wood has encouraged the conversion of low-productivity agricultural lands to planted forests of fast-growing species

BOX 5.4

Oil palm, deforestation and societal choices

The production of palm oil through the clearing of biodiversity-rich tropical forests highlights the complex economic, social, cultural and environmental issues that societies must confront in making decisions on natural-resource use. The following key issues are involved:

- Oil-palm plantations are highly productive and extremely profitable. Of all the various oil-yielding crops, oil palm is the most productive, capable of producing 4–5 tonnes of oil per hectare in good growing conditions. Palm oil has become an important export commodity for many countries: for example, it is Indonesia's most valuable export product, earning the country USD 14.4 billion in 2017.
- The global consumption of palm oil quadrupled between 1975 and 2015, from 14.6 million tonnes to 61.1 million tonnes (Byerlee, Falcon and Naylor, 2015). It accounts for a major share of consumption among all cooking oils, especially in China, India and Europe.
- About 75 percent of palm oil is used as food, especially as cooking oil and in processed oils and fats. It is also an important ingredient in the production of soaps, cosmetics and pharmaceuticals. More recently it has been refined as biodiesel.
- The cultivation of oil palm and the processing of palm oil create significant employment and income in rural areas.
- The expansion of oil-palm plantations has resulted in the loss of large areas of biodiversity-rich tropical forests (Vijay *et al*., 2016). In Kalimantan, Indonesia, for example, oil palm is strongly linked to deforestation (The Economist, 2019a). Although it is argued that deforestation would have taken place even without it, the role of oil palm in tropical deforestation cannot be denied.
- Extensive peatlands have been drained and burned in the process of oil-palm cultivation, releasing large volumes of carbon into the atmosphere. Peatland fires are one of the most important sources of greenhouse-gas emissions.
- Natural tropical forests provide local communities with rich, diverse diets. Several studies have indicated that large-scale oil-palm plantations have affected local food security by eliminating locally available foods and thereby increasing dependence on foods brought in from outside.

In many places, the expansion of oil-palm plantations is taking place in an environment of weak governance. Moreover, Gaveau *et al*. (2018) found a close correlation between the international price of palm oil and the expansion of oil-palm plantations. Considerable efforts have been made in the last two decades to ensure that palm-oil production is deforestation neutral through the adoption of certification standards, voluntary pledges by individual companies, national policies, and international commitments. One of the most widely used certification standards is that of the Roundtable on Sustainable Palm Oil, which was established in 2004 to develop and implement global standards for sustainable palm oil (RSPO, undated). Although progress has been made, challenges persist in accomplishing the objective of deforestation-neutral palm-oil production, stemming from the difficulty in finding acceptable trade-offs between economic and environmental objectives and the diverse perceptions of the many stakeholders involved.

BOX 5.5

Oil-palm cultivation in Papua New Guinea

Papua New Guinea implemented a major programme of land leases from 2002 to 2011, especially for the cultivation of oil palm. Seventy-five special agricultural business leases (SABLs) were given to investors over an area of 5 million ha in customary land under community ownership for the cultivation of oil palm and other industrial crops, often under the pretext of agroforestry. Many of these SABLs, however, were a ploy for circumventing the log export ban applicable to normal logging concessions. A public outcry about the large-scale misuse of SABLs for land-grabbing and timber exploitation eventually led to the SABL Commission Inquiry (Global Witness, 2014) and consequently to the cancellation of all SABLs.

BOX 5.6

Rubber expands into conservation areas

An increase in rubber cultivation since 1990 has been a driver of land-use change in the Asia-Pacific region, causing forest conversion and biodiversity loss. Seventy percent of the expansion of rubber plantations in continental Southeast Asia has been in key biodiversity areas and more than 60 percent has been in protected areas (Ahrends *et al*., 2015). Rubber plantations have expanded into natural forests in northeastern India (Chakraborty *et al*., 2018), and there has been a dramatic expansion of rubber plantations in Xishuangbanna in China's Yunnan Province, where the area under rubber increased from 87 000 ha in 1992 to 424 000 ha in 2010. A similar situation exists in most of the Mekong River Basin.

such as eucalypt, acacia and casuarina. Support from governments and industry (especially through the provision of planting materials and technical advice, and buyback arrangements) has provided further impetus to the conversion of farmlands to industrial woodlots. Contract tree-farming in India, Thailand and other countries point to emerging land-use changes driven by industrial demand, although there is growing concern about the social and environmental implications of this.

An example of policy-driven land-use change resulting in the conversion of agricultural land to forests is China's Conversion of Cropland to Forest Programme, which was launched in 1999 in response to widespread flooding in 1998. Under the programme, 32 million farming families receive annual subsidies to plant and manage trees on their (mostly low-productivity) agricultural lands totalling 28 million ha (Zhang *et al*., 2017). The programme has been successful largely because it involves a clear policy directive, the significant allocation of resources, and effective institutional arrangements at all levels to implement and monitor the programme.

The livestock sector and forests

Animal husbandry is an integral component of the rural economies of most countries in the Asia-Pacific region and, in many countries, close linkages exist between forests and livestock management. Changing diets, particularly an increase in the intake of animal protein linked to increasing incomes, has brought about major changes in livestock management systems. The total bovine population (consisting of cow, ox and buffalo) in the world in 2017 was 1 693 million head, of which 430 million (25 percent) were in South Asia. Within South Asia, India alone accounted for 300 million of the bovine population in 2017 (FAO, undated [a]). Asia also had more than 1 billion goats and sheep in 2017, which was 47 percent of the total world population of these livestock types. Of the monogastric livestock species (which have become a main source of animal protein), there were an estimated 558 million pigs in Asia in 2017 and 12.8 billion chickens.

Livestock management systems have changed significantly in the last three decades. In many South Asian countries, bovine populations were previously managed for multiple purposes, including the production of milk and manure and the provision of draught power. With the mechanization of agriculture and the widespread use of commercial fertilizers, however, the draught-power and soil-enhancement functions of cattle have become largely redundant. Nevertheless, the cattle population has continued to increase (exacerbated by recent efforts in India to provide cows with rigid protections), putting enormous pressure on feed sources, including common-property resources. Several studies have highlighted the implications of cattle grazing for forests; in most South Asian countries, intense grazing and browsing is a major cause of forest and land degradation. In India, for example, an estimated 78 percent of forests are exposed to grazing and some 270 million cattle graze in them, although the carrying capacity of these forests is estimated at just 30 million cattle (Nayak, Kohli and Sharma, 2013; Tetra Tech, 2017; Winrock International India, 2011). In addition, an estimated 250 million tonnes of fodder (including that generated through tree-lopping) is collected from common-property resources. Thus, livestock grazing is a key factor in ongoing forest degradation and the preponderance of open forests (i.e. forests with a canopy cover of less than 40 percent), which in 2017 accounted for about 42 percent of all forests in India.

The increase in pressure on forests has been heightened by the diversion of areas previously set aside as common grazing lands for infrastructure, agriculture and mining. Multiple cropping – enabled by irrigation – has also curtailed the availability of land for grazing and led to greater grazing pressure in forests. Increasing demand for other products – such as cashmere (Box 5.7) – has also led to overstocking, resulting in environmental degradation.

Livestock grazing in forests also gives rise to other problems. For example, wildlife populations may act as reservoirs of certain communicable diseases affecting livestock (and vice versa). Competition for fodder and water between livestock and wild animals can be acute in dry seasons, and the predation of domestic animals by wild carnivores has opened up a new front in conflicts between people and wildlife. A significant share of human–wildlife conflicts is linked to the use of forestland for grazing; in many areas, local communities have become antagonistic to conservation, even killing flagship species such as tigers and lions.

Rapid growth in demand for animal protein has led to the development of intensive livestock management systems. Industrial systems that emphasize monogastric animals are dependent on produced feeds – mainly maize and soybean – often transported over long distances (Bai *et al.*, 2018). The expansion of maize production for livestock and poultry feed to meet the explosive demand for livestock, dairy and poultry has brought about major land-use changes in the region.

BOX 5.7

Mongolia: economic liberalization, growth in the livestock population, and environmental degradation

Mongolia hosts one of the world's most extensive and biodiversity-rich grassland ecosystems. Recent studies have shown, however, that this ecosystem is degrading rapidly and that biodiversity is being lost (Hilker *et al.*, 2014). Although climate change is a contributory factor, 70 percent of the degradation of the grasslands has been attributed to overgrazing. Livestock numbers were controlled rigidly during the era of centrally planned, Soviet-style governance, and this helped ensure that grazing remained within the rangelands' carrying capacity. Livestock numbers shot up, however, with the collapse of central planning and its associated control measures. For example, Mongolia's goat population increased from 5 million in 1990 to more than 27 million in 2017 and the number of cattle increased from 2.7 million to 4.4 million (FAO, undated [a]). At least in part, this was due to increasing demand for cashmere, especially in the rapidly growing Chinese market (McLaughlin, 2019). Several measures are underway to arrest land degradation but they face an uphill battle because of continued high demand for cashmere as a high-end fashion product, which enables communities to earn higher incomes , and the important role of livestock in mitigating the risk posed by the high frequency of extreme weather events.

Infrastructure development and forests

Increasing industrialization, rapid urbanization and rising wealth have brought a massive increase in demand for infrastructure in many Asia-Pacific countries. Almost all countries have invested heavily in the development of roads, railways, airports, seaports and residential and commercial buildings. The availability of high-quality infrastructure is considered crucial for ongoing socio-economic development, and almost all governments in the region continue to give it high priority.

Various estimates are available on the investment needs for infrastructure development in the Asia-Pacific region. The United Nations Economic and Social Commission for Asia and the Pacific, for example, estimated that the developing Asia-Pacific region requires annual investments of USD 800–900 billion for the provision of transport infrastructure, information and communication technologies, water supply and sanitation, and electricity (Akhtar, Hahm and Malik, 2017). The Asian Development Bank (ADB, 2017) valued the region's investment requirements for infrastructure development in the period 2016–2030 at USD 26.0 trillion (equivalent to USD 1.7 trillion per year).

The impacts of infrastructure on the environment, which are often much broader than the actual area covered by the installation, have been discussed widely (e.g. Laurence and Arrea, 2017). Large areas of mangroves and other wetlands, especially in coastal areas, have been converted to roads, airports, railways and commercial and residential apartments. In general, the potential impacts of infrastructure development include the following:

- *Immediate onsite impacts* – including deforestation and the disruption of ecosystem processes.
- *Offsite impacts* – especially when large quantities of materials are required, thereby putting pressure on resources. For example, most infrastructure developments involve mining for sand and stone, potentially requiring large-scale offsite mining, with its attendant environmental impacts.
- *Roads, railways and other linear infrastructure* – which fragment ecosystems and habitats – often disrupt wildlife migration routes and have been major causes of increased human–wildlife conflicts.
- *Further cascading changes in land use* – for example, the improved accessibility offered by new roads increases the value of land, favouring land-use options that may have been financially unviable previously. Natural forests adjoining newly created roads are often logged and converted to other more remunerative land uses. Roads also encourage urbanization, which has its own major impacts on forests and ecosystem services.

In the Asia-Pacific region, mega infrastructure projects are likely to have transformative impacts in coming decades on economies, land use, the environment and forests. Often, infrastructure development – especially roads, railway lines and airports – is pursued for strategic reasons (for example in the fragile Himalayan region), and economic and environmental concerns are largely overlooked in favour of geopolitical considerations.

Hydropower and land-use change

Hydropower development has emerged as a major driver of land-use change in several countries in the Asia-Pacific region, with generation capacity expanding rapidly in the last three decades. By 2018, the region had built a capacity of 524 gigawatts (China accounted for 341 gigawatts of this), which was about 41 percent of the installed hydropower capacity globally (International Hydropower Association, 2018). Almost all countries in the Asia-Pacific region have invested in hydropower generation and there are plans for further substantial increases in capacity. Many of the region's large river systems already have multiple hydropower facilities, sometimes totally altering river flows. In the Mekong River Basin, a dam-building spree has been underway since 1990 (Hecht *et al*., 2019): as of June 2017, 64 of 187 proposed dams in the basin had been commissioned with a total generating capacity of more than 25 gigawatts (of which nearly 18 gigawatts is in China). Hydropower could become the Lao People's Democratic Republic's most important source of revenue, potentially generating about USD 4.6 billion per year by 2030 (The Economist Intelligence Unit, 2017).

Intense dam building is also underway to tap hydropower in the ecologically fragile and earthquake-prone Himalayas. In the next few decades, India is planning to build 292 dams in the eastern and western Himalayas to double hydropower generation capacity and as a means for limiting greenhouse-gas emissions. If all these proposed dams are constructed, the Indian Himalayas will have the world's highest dam density, with one dam for every 32 km of river channel (Grumbine and Pandit, 2013). Nearly fourth-fifths of the proposed dams are in biodiversity-rich areas, and half are in areas with dense forests. The dams will result in the submergence of forests and fragmentation of habitats, but the environmental impacts are apparently receiving minimal attention.

Although often an appropriate renewable-energy option, dam building is contentious because it has many potential social and environmental impacts. Almost all hydropower-generation facilities in the Asia-Pacific region are in forested areas and therefore have multiple negative impacts on forests, especially due to the submergence of large tracts of forest, the clearing of forests to build associated infrastructure such as roads, buildings and transmission lines, and the mining of sand, soil and stone as construction materials. Changes in hydrology caused by dam building can affect various ecosystem processes: in the Mekong River Basin, for example, dams have had significant negative impacts on food security, especially due to their effects on fish populations (Hecht *et al*., 2019). The submergence of agricultural land and the consequent displacement of people triggers further land-use changes, including forest conversion and fragmentation. The continued emphasis in the region on hydropower as a strategy for reducing greenhouse-gas emissions means that such impacts are likely to continue.

Mining and other extractive sectors

Industrial development has created huge demand for metals and minerals in the Asia-Pacific region and worldwide, making mining an important economic activity in many countries. Demand for mineral resources is expected to increase, and this will have important implications for land use, including forests (Chatham House, 2015). Mining companies are required to undertake environmental restoration, but this is seldom enforced, especially in countries with limited institutional capacity. The economic situation significantly affects the scale of mining and its environmental impacts. The 2008 global financial crisis, for example, caused a decline in demand for a wide range of metals and minerals. An exception was gold, for which demand surged as investors bought the mineral as a safe asset, and gold mining expanded accordingly.

The boom in infrastructure investments in the Asia-Pacific region has meant a jump in demand for construction materials, especially sand, stone and soil, leading to widespread quarrying. Illegal quarrying has become a major problem in India (for example), exacerbated by inadequate institutional capacity to implement existing rules and regulations. A recent study covering 314 districts in India demonstrated a strong correlation between mining and deforestation (Ranjan, 2019).

In addition to officially approved mining, illegal mining is widespread, with significant economic, social and environmental implications. Mining (both legal and illegal) has exacerbated forest-related conflicts, especially when it affects the livelihoods of local communities. The situation is similar in Indonesia, where coal production has boomed since 2000, mainly in Kalimantan (Ives, 2015).

Globalization and forests

Globalization is a multidimensional economic, social and political process. Table 5.1 shows that it has greatly increased in recent decades, both globally and in the Asia-Pacific region, aided by developments in information and communication technologies, improvements in transportation, and various multilateral and bilateral trade and economic cooperation agreements. Differences exist in the region, however, in the extent to which countries and subregions are globalized, with (for example) South Asia lagging behind East Asia and the Pacific. Most developed economies are highly globalized and low-income countries are least globalized.

The positive and negative impacts of globalization on forests and the forest sector include the following:

- Globalization and the associated increase in cross-border trade, investment and technology transfer have enabled the rapid growth of the forest sector. The wood-panel and pulp-and-paper segments, for example, have expanded in the region in recent decades while capacities have declined in Europe and North America. Relatively low wages enabled increased investment in the wood-furniture industry, especially in China, Indonesia and Viet Nam, catering largely to markets in Europe and the United States of America. There have been intraregional shifts in forest industries, too, especially from Japan to China and more recently from those two countries to Viet Nam, driven by the changing competitiveness of production (and, in the latter case, taking advantage of Viet Nam's favourable investment climate).

- The interregional and intraregional trade of forest products has increased considerably in recent decades. Forest production was previously focused largely on markets at the local, subnational and national scales, but the ability to obtain wood cheaply from distant countries has led to an expansion of imports of unprocessed or primary-processed wood. Forest-deficit countries have been the main beneficiaries; in some cases, they have become major producers of wood products.

- The globalization process has had negative impacts on forest sectors in forest-rich countries with weak forest governance. Many such countries have opened up their economies to enable the rapid exploitation of their forest resources with inadequate efforts to strengthen forest governance, leading to unsustainable – and often illegal – forest exploitation, resource depletion and income leakage. Considerable efforts are underway at the national and international levels to reduce illegal logging and income leakage and to build capacity in such countries for managing their forests sustainably.

Deforestation is increasingly driven by the expansion of industrial crops and mining. Commodity markets have grown considerably in the last couple of decades, especially for industrial crops such as rubber, oil palm, soy, maize and biofuels. Rapid economic growth has also fuelled demand for minerals. Both these phenomena have caused widespread forest loss.

Certain recent developments, especially the escalation of trade disputes between China and the United States of America, have cast doubt on the future of globalization. Some countries that previously were champions of trade liberalization are reversing their positions and putting up trade barriers, potentially curtailing trade and investment and affecting economic development. Sensing the antiglobalization sentiments that followed the 2008 global financial crisis, APFSOS II (FAO, 2010a) identified two scenarios for globalization (Box 5.8); since then, antiglobalization has apparently strengthened, especially in Europe and the United States of America, resulting in the pursuit of relatively inward-looking economic policies. Recent assessments show significant reductions in transborder investment and trade, which may be an indication of "slowbalization" (The Economist, 2019b).

In general, countries in the Asia-Pacific region have embraced globalization because of the role of liberalized trade in

Table 5.1. KOF Globalization Index, selected subregions and countries, 1990–2015

	1990	2015
World	45	61
East Asia and the Pacific	42	58
South Asia	31	48
Australia	67	79
Bangladesh	28	46
Bhutan	27	43
Brunei Darussalam	41	58
China	36	61
Fiji	45	56
India	45	57
Indonesia	44	62
Japan	59	77
Lao People's Democratic Republic	26	44
Malaysia	62	79
Myanmar	24	41
Nepal	29	46
New Zealand	67	78
Papua New Guinea	39	53
Philippines	43	64
Singapore	72	79
Thailand	44	68
Viet Nam	30	62

Notes: The KOF Globalization Index is based on 42 variables aggregated to an index of five sub-dimensions (trade, financial, interpersonal, informational and cultural) and three dimensions (economic, social and political) of globalization compiled in a single index (Gygli *et al.*, 2019). The indicated subregions are constructs of the KOF Globalization Index and do not necessarily align with the subregions used in the present report.
Source: KOF Swiss Economic Institute (undated).

BOX 5.8

Two globalization scenarios

APFSOS II (FAO, 2010a) identified the accelerating pace of globalization as an important factor influencing the Asia-Pacific region to 2020. It noted, however, that, "much of the globalization process was driven by the corporate sector, in particular transnational corporations focused primarily on profit generation. This has led to considerable asymmetries, with most of the benefits accruing to small segments of the population". Such a perception could lead to:

- the strengthening of antiglobalization sentiments driven by a coalition of diverse interests, resulting in protectionist measures and a reversal of certain globalization processes; or
- a more inclusive approach to globalization, involving all stakeholders and fully taking into account the social and environmental implications.

At present, the first of those two scenarios appears more likely, and this would have important implications for the forest sector.

boosting economic growth and reducing poverty. Moreover, the region as a whole is becoming less dependent on markets in Europe and North America, with many economies driven more by domestic consumption than by exports.

On the whole, therefore, it is strongly in the interests of most countries in the Asia-Pacific region to maintain the pace of globalization. Problems may loom with global trade agreements, but the Asia-Pacific region is set to forge ahead with more regional and bilateral trade deals. Some recent mega-investments have tremendous potential to accelerate globalization and shift the balance in favour of the Asia-Pacific region. Any impasse created by the inward-looking policies of some countries is unlikely, therefore, to have a long-lasting impact on the pace of globalization in the region, although there may be short-term negative impacts.

Income inequality, poverty and the future of jobs

A remarkable feature of economic development in the Asia-Pacific region has been the rapid decline in the number of extremely poor people (defined as those with incomes and expenditures of less than USD 1.90 per day). Table 5.2 shows that the number of people living below the poverty line declined dramatically between 2000 and 2016 in the 17 countries in the region for which comparative

Table 5.2. Change in the proportion of people living below the poverty line, selected countries in the Asia-Pacific region, 2000–2016

Country	Proportion of people living on less than USD 1.90/day (purchasing power parity, 2011)	
	2000 (or closest year for which data are available)	2016 (or latest year for which data available)
Bangladesh	34.8	14.8
Bhutan	35.2	2.2
China	31.9	1.4 (2014)
Fiji	4.9	1.4
India	38.2	21.2 (2011)
Indonesia	39.3	6.5
Lao People's Democratic Republic	33.8	22.7
Malaysia	0.4	0.3
Myanmar	-	6.4 (2015)
Nepal	46.1	15.0 (2011)
Pakistan	28.6 (2001)	6.1
Philippines	14.5	8.3 (2015)
Samoa	0.6	-
Solomon Islands	45.6	25.1
Sri Lanka	8.3 (2002)	0.7
Thailand	2.5	0.0
Timor-Leste	42.5 (2001)	30.3 (2014)
Tonga	2.8 (2001)	1.1 (2009)
Tuvalu	-	3.3
Vanuatu	-	13.2
Viet Nam	38.0 (2002)	2.6 (2014)

Source: ADB (2018).

data are available. The most notable changes have been in China (where the proportion fell from 31.9 percent of the population in 2000 to 1.4 percent in 2014), Indonesia (from 39.3 percent in 2000 to 6.5 percent in 2016) and Viet Nam (from 38.0 percent in 2002 to 2.6 percent in 2014); there were also significant declines in Bangladesh, India and Nepal. The proportion of people living below the poverty line exceeded 25 percent in 11 of the 18 countries (for which data are available) in Table 5.2 in 2000 but in only two of those countries by 2016; moreover, the proportion of the population living below the poverty line in 2016 was less than 10 percent in 12 of the 20 countries for which data are available. The situation on the ground may be even better, given that some of the data in Table 5.2 are outdated (and most economies have been growing rapidly in the meantime).

In most countries, poverty has been reduced by a combination of "growth-and-trickle-down" policies and targeted policy and programmatic interventions. Land- and forest-tenure reforms have played a key role in reducing poverty in China, India, Nepal and Viet Nam. If these factors continue to apply, extreme poverty could almost be gone from the Asia-Pacific region by 2030. Most countries will, however, need to deal with persistent pockets of poverty, especially in forested rural areas with low levels of investment in human and physical capital. They will also need to meet the increasing aspirations of people for a standard of living that is well above the poverty line.

In several countries, the most impoverished regions are forested; people living in such areas commonly lack knowledge on, and capacity in, income-generating practices as well as access to finance, markets and the available natural capital. Conserving such forests will be difficult in the absence of efforts to significantly improve the livelihoods of local people.

Industrial development in the second half of the twentieth century has led to a reduction in the dependence on land for employment. The number of people employed in the primary sectors, especially agriculture, has declined drastically, and many people leaving those sectors have been absorbed in the industrial and services sectors, where wages have risen with increasing productivity. Rapid industrialization, therefore, has been considered a prerequisite for growth in both employment and income, especially given high unemployment and underemployment in the agriculture sector.

There is concern, however, that employment is declining in the industrial and services sectors as new technological developments, especially automation and robotics, come increasingly on stream. An assessment by Manyika *et al*. (2017) found that the cost of automation declined by more than 50 percent between 1990 and 2014 but labour costs more than doubled. In most countries in the Asia-Pacific region, the rate of growth in employment is unlikely to increase significantly to 2030 and 2050, and there will be major changes in the nature of jobs. With many of the tasks in the industrial and services sectors once performed by people now the domain of robotics and artificial intelligence, land-based sectors like agriculture and forestry are presented

BOX 5.9

Economic growth and natural resource use in the Asia-Pacific region

Rapid economic growth in the Asia-Pacific region has led to a significant increase in the use of materials – biomass, metals, industrial and construction minerals, and fossil fuels. The aggregate use of these materials in the Asia-Pacific region grew from 5.7 billion tonnes per year in 1970 to 37 billion tonnes in 2010 (half the global consumption of those materials in that year). The annual growth rate of 5 percent in the use of materials in the Asia-Pacific region is the highest of any world region. Moreover, usage is inefficient: on average, the region requires 3 kg of materials to generate USD 1 of gross domestic product (GDP), compared with the average for the rest of the world of 1 kg per USD 1 of GDP. The majority of production in the Asia-Pacific region is consumed within the region, but increasing consumption is turning net exporters of materials into net importers. Increasing reliance on the resources of other countries, and the volatility of those supplies, could have severe consequences for future growth.

Source: UNEP (2015).

with both a challenge and an opportunity. The challenge stems from a possible rise in land dependency as people unable to find employment in cities return to rural areas; ostensibly, this would increase pressure on land and forests. On the other hand, such a trend would be an opportunity to create massive employment in SFM and the restoration of degraded lands, thereby helping rebuild natural capital. Improving the quality of ecosystem services would provide an opportunity for a transition to a green economy and provide meaningful and rewarding jobs (ILO, 2018). Profits generated in the increasingly automated industrial and services sectors could be ploughed into agriculture and forestry to boost employment and thus absorb those workers no longer needed in the industrial and services sectors.

The Asia-Pacific region is paying a high price for its rapid economic growth, if measured by the loss of primary forests and by increases in greenhouse-gas emissions, biodiversity loss, water and air pollution and desertification (UNEP, 2015). There has also been a rapid increase in direct material consumption in the region, led largely by certain fast-growing countries (Box 5.9). On the other hand, high economic growth has enabled millions of people to escape poverty, and efforts are underway to conserve forests and rebuild natural capital through afforestation and reforestation (although not yet at a scale commensurate with the size of the problems).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Key points

- Multiple environmental challenges – including climate change, biodiversity loss, watershed degradation and rising demand for forest amenity – have emerged in recent decades as drivers of the forest agenda in the Asia-Pacific region.

- The proportion of greenhouse-gas emissions in the region contributed by land use, land-use change and forestry declined from 40 percent of total emissions in 1990 to 20 percent in 2014 due largely to a significant increase in the region's fossil-fuel emissions. Forests remain a net source of greenhouse-gas emissions.

- Most of the countries in the Asia-Pacific region involved in the implementation of REDD+ have made progress in REDD+ readiness and a few are moving to the implementation of national REDD+ strategies. The complex economic, social and political environment in which REDD+ must operate poses many challenges in making it an effective results-based payment system.

- The area of forests set aside for biodiversity conservation in the Asia-Pacific region increased from 68 million ha (12.4 percent of all natural forests) in 1990 to 119.2 million ha (16.5 percent) in 2015. The forest sector can play a leading role in biodiversity conservation but, in most of the region, "development first" still dominates policymaking, limiting the scope to prevent further biodiversity losses.

6 Environmental challenges threaten – and countries seek ways to increase ecosystem services

- Countries in the region face acute water deficits, which will be exacerbated by climate change. Twenty-one countries have designated, on average, 35 percent of their forests for soil and water conservation, but little information is available on how these forests are actually managed for stable water supply.
- The number of people living in degraded agricultural lands is increasing in the Asia-Pacific region. Arresting and reversing land degradation through forest and landscape restoration is emerging as a key priority in most countries.
- People's desire to reconnect with nature is rising as urbanization continues and incomes grow. Forestry institutions need to adapt quickly to ensure that increased demand for forest amenity values – which can be viewed as highly positive for environmental awareness – does not jeopardize sustainability.
- Governments continue to seek ways to finance forest and landscape restoration and sustainable forest management for the provision of ecosystem services, including combinations of regulatory and market-based approaches.

The production of food, fibre, energy and minerals has intensified in the Asia-Pacific region in recent decades, increasing pressure on natural resources, including forests. The modification of agricultural and forest landscapes has changed hydrological and nutrient cycles and carbon fluxes, resulting in cascading negative impacts. Heightened awareness of such impacts has triggered responses ranging from local-level protests against deforestation to international action to reduce greenhouse-gas emissions. Ecosystem services (Box 6.1), which previously were taken largely for granted or neglected, are gaining more attention from policymakers. This chapter examines the key forest-related environmental issues in the region – climate change, biodiversity loss, declining water availability, land degradation and desertification, and the growing demand for amenity values – and how governments and other stakeholders are responding.

Key environmental issues

Sustainable management requires trade-offs

Relatively intact forest landscapes produce a wide range of goods (such as food, fibre, materials for construction and biofuels) and ecosystem services such as water regulation, carbon sequestration, biodiversity conservation and aesthetic and cultural values. A major challenge in the management of forests is to identify the optimal level of interventions that could meet the divergent and changing demands of society. Efforts to boost the production of any particular product or service beyond a given limit, however, may negatively affect the production of other goods and services (Figure 6.1).

The management of forests and landscapes involves trade-offs between the many goods and ecosystem services it

BOX 6.1

What are ecosystem services?

The Millennium Ecosystem Assessment (2005) defined ecosystem services as the benefits people obtain from ecosystems, including both goods and services. Thus, this definition encompasses provisioning services (such as food, water, timber, woodfuel, medicines, and a host of other products that contribute to material well-being); regulating services affecting (for example) climate, disease, waste and water quality; cultural services that provide recreational, aesthetic and spiritual benefits; and supporting services such as soil formation, photosynthesis and nutrient cycling.

Most other definitions of ecosystem services distinguish between goods and services. Ecosystem goods are tangible and measurable products (e.g. food, fibre, timber, genetic resources and medicines). Ecosystem services – such as pollination, seed dispersal, temperature moderation, the purification of air and water, the mitigation of droughts and floods, and the control of pests and diseases – are not so easily quantified and mostly are not transacted in markets.

Figure 6.1. Human transformation of natural ecosystems and trade-offs among ecosystem services and biodiversity

Source: Redrawn from IPBES (2018b).

produces. A key issue, therefore, is how decisions on such trade-offs are made and implemented – that is, how forests and landscapes are governed. Aspects that need to be taken into account include the following:

- *The maintenance of ecosystem services has spatial and temporal dimensions* – complexity in managing ecosystem services stems largely from the spatial and temporal separation of cause and effect. Some forest-related issues – such as upland–lowland land-use linkages in a watershed – are relatively local in scale while others may be regional or global. Many environmental challenges, including climate change and biodiversity loss, also have strong intergenerational implications, raising ethical and moral questions on the distribution of costs and benefits between generations.
- *Ensuring the equitable distribution of costs and benefits has global dimensions* – climate change due to increasing atmospheric concentrations of greenhouse gases caused by human activities is a transboundary negative externality requiring global collective action. The setting aside of forests for the provision of ecosystem services (e.g. through the designation of national parks) can have major impacts on people who are dependent on those forests for their livelihoods or who have strong cultural links to them. The provision of ecosystem services offers potential win–win outcomes through payment schemes whereby landholders or countries are rewarded for good environmental stewardship. But achieving this ideal depends largely on the governance systems in place at the global, national and local

levels and the extent to which markets and policies ensure that benefits and costs are distributed justly and equitably.

- *Negative feedback loops degrade ecosystems, undermining their productivity* – environmental change often involves negative feedback loops in which ecosystems become increasingly degraded in a vicious cycle and their productivity declines. For example, climate change is implicated in pest outbreaks, droughts, floods and forest fires of escalating intensity and frequency, reducing the productivity of forests and other land uses and increasing their greenhouse-gas emissions. Climate change may also change the geographical distribution of species. Sea-level rise, and a consequent increase in soil salinity, could reduce the productivity of coastal lands, with the potential for cascading land-use changes affecting forests. Declines in biodiversity, especially through monocultural cropping (including forest plantations), tend to increase the risk of pest outbreaks.

- *Forests have important roles in repairing environmental damage and restoring ecosystem services* – mitigating and adapting to environmental change offer new opportunities for forestry. As more land becomes degraded and loses productivity, rehabilitation and restoration become necessary. Tree-planting and other restoration methods such as assisted natural regeneration using trees have demonstrable positive impacts on soils and a range of other economic, social and environmental benefits.

The future of forests and forestry will be driven increasingly by two overarching needs:

1. to increase productivity, including the provision of ecosystem services; and

2. to ensure the resilience of landscapes in the face of increasing economic and ecological (especially climate-change-related) vulnerabilities.

Governments and other stakeholders are responding to environmental challenges

A wide range of interventions has been deployed in the Asia-Pacific region to address environmental issues. Invariably, the initial emphasis has been on regulatory approaches – primarily centred on policies, rules and regulations, often implemented in a top-down manner. A plethora of policies and laws has been put in place outlining “dos and don’ts”. Realization of the limitations of these, however, is encouraging the pursuit of market-driven approaches, taking advantage of the increasing willingness (and ability) of beneficiaries to pay for ecosystem services. Nevertheless, market-driven approaches also require robust policy frameworks, and increasingly emphasis is being given to mixed regulatory/market-driven efforts. There has been a rapid expansion of policy initiatives, including at the global level. Most notably, the 2030 Agenda for Sustainable Development, incorporating the SDGs, provides a holistic framework for ensuring that development is built on a solid foundation of environmental stability; enabling synergies between goals; and determining trade-offs.

Forests and climate-change mitigation and adaptation

Greenhouse-gas emissions continue to rise

Human activities – including fossil-fuel emissions, deforestation, forest degradation, agricultural practices and land-use change – are estimated to have caused approximately 1.0 °C of global warming above pre-industrial levels, with a likely range of 0.8 °C to 1.2 °C, and global warming is likely to reach 1.5 °C between 2030 and 2052 if the current rate is maintained (IPCC, 2018). Greenhouse-gas emissions are continuing on an upward path: the average of 407 parts per million of carbon dioxide in 2017 was nearly 50 percent higher than the estimated pre-industrial level of 277 parts per million in 1750, and an average concentration of 411.3 parts per million is predicted for 2019. Table 6.1 summarizes the change in the relative share of emissions of the two primary sources, fossil fuels and land use (including forestry). Net carbon emissions from land use have been stable for the last five decades (at about 1.5 gigatonnes per year), but the share of land use in total emissions has declined from 32 percent in 1960–1969 to 12 percent in 2017 (Le Quéré *et al.*, 2018), mainly because of a rise in fossil-fuel emissions.

In the Asia-Pacific region, the share of emissions caused by land use, including forestry, declined from 40 percent of total emissions in 1990 to just over 20 percent in 2014. The decline is consistent with the rapid rise in greenhouse-gas emissions due to increased industrial outputs, urbanization and structural change in the region in recent decades. The region's annual emissions due to land use varied in the last decade in the range of 0.18–0.36 gigatonnes of carbon.

Table 6.1. Global greenhouse-gas emissions, by source, 1960–1969, 2006–2017 and 2017

Emissions source	1960–1969	2006–2017	2017
	(gigatonnes carbon/year)		
Fossil fuels	3.1 (66%)	9.4 (87%)	9.9 (88%)
Land use	1.5 (32%)	1.5 (14%)	1.4 (12%)
Total	**4.7**	**10.8**	**11.3**

Notes: Figures in parentheses indicate the proportion of the total accounted for by the two sources. Totals may not sum due to rounding.
Source: Le Quéré *et al*. (2018).

Forests are still a net source of emissions

Data from FAO (2015a) show a significant decline in annual global forest emissions between the ten-year period of 2001–2010 and the five-year period of 2011–2015, but forest-based sequestration dipped marginally (Table 6.2). Forests are still a net source of emissions, despite the decline.

Overall, forest carbon stocks appear to have declined only slightly in the Asia-Pacific region between 1990 and 2015, although data are incomplete (FAO, 2015b). Of the 26 APFSOS countries for which data are available, carbon stock declined from 5.1 gigatonnes in 1990 to 5.0 gigatonnes in 2015. The following countries achieved significant gains in forest carbon stock over the period: the Republic of Korea (+187 percent), China (+52 percent), Japan (+42 percent), Viet Nam (+32 percent), India (+19 percent), New Zealand (+11 percent) and the Philippines (+5 percent) (Figure 6.2). Almost all the other 26 countries registered declines in carbon stock, led by Indonesia with a net loss of about 0.5 gigatonnes per year between 1990 and 2015. A large proportion of the gains in carbon stock were in countries that had invested significantly in afforestation and reforestation; most of the losses were in countries with significant deforestation and forest degradation.

Forests in climate-change negotiations

The United Nations Framework Convention on Climate Change (UNFCCC) is a landmark international agreement that aims to address one of the most critical challenges facing humanity through mitigation actions to reduce greenhouse-gas emissions and adaptation to increase the ability of countries to adapt to the impacts of climate change. The Kyoto Protocol was agreed by the Conference of the Parties (COP) to the UNFCCC in 1997 and entered into force in 2005; this tied industrialized countries to achieving quantified emission reductions in the period 2008–2012.

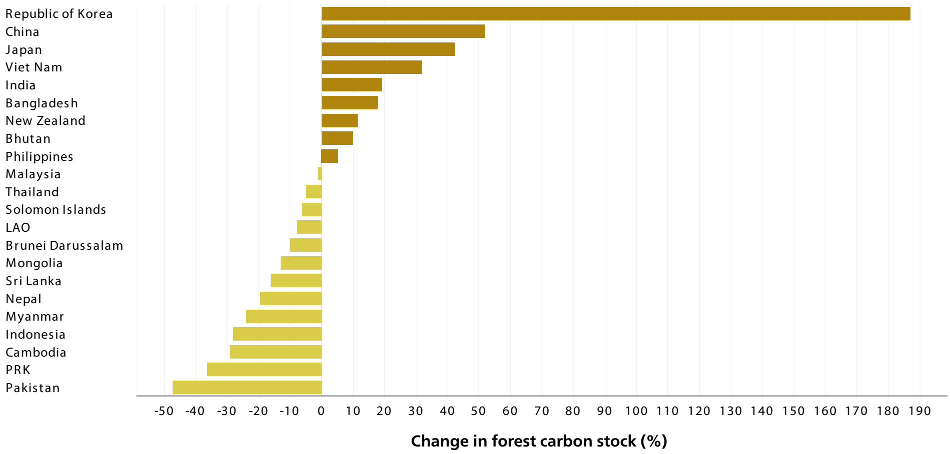
The Clean Development Mechanism (CDM), a key instrument under the Kyoto Protocol, allowed countries to purchase

Table 6.2. Global net emissions from forests, 2001–2010 and 2011–2015

Emissions source	2001–2010	2011–2015
	(gigatonnes carbon/year)	
Emissions	3.9	2.9
Sequestration	2.2	2.1
Total	**4.7**	**0.8**

Source: FAO (2015a).

Figure 6.2. Change in forest carbon stock, selected countries in the Asia-Pacific region, 1990–2015



Notes: LAO = Lao People's Democratic Republic; PRK = Democratic People's Republic of Korea. For Japan and Mongolia, data for 2010 are used as proxies for 2015.
Source: FAO (2015b).

certified emission reductions (CERs) from projects that reduced greenhouse-gas emissions and use these to offset their own emissions to achieve their reduction commitments. Forestry had only a limited role in this system; afforestation or reforestation projects were permitted, but the European Union Emissions Trading System, which was the largest platform for trading CERs, did not allow forest credits. Consequently, the CDM had no significant impact on reducing emissions from forestry, especially considering the very small number of registered afforestation/reforestation CDM projects.[15] Reducing emissions from forests (i.e. "avoided deforestation") was considered ineligible because of inadequacies of technologies for measuring and monitoring emissions; concerns about market flooding; the challenges of proving additionality; and leakage.

UNFCCC negotiations continued over time towards a more comprehensive and ambitious global agreement – one that obligated all countries (not just industrialized countries) to contribute to the mitigation of climate change. This new approach was based on the recognition that emissions from emerging economies were increasing rapidly, and avoiding climate change therefore requires the engagement of all countries. As part of these negotiations, some highly forested tropical countries, led by Costa Rica and Papua New Guinea under the banner of the Coalition of Rainforest Nations, tabled a proposal at COP 11 in 2005 to accommodate efforts in developing countries to reduce emissions

15 Of the 7 805 CDM projects registered globally as of 31 December 2018, only 66 were for afforestation and reforestation. Of these, Asia-Pacific accounted for 27: 19 in India, five in China and one each in the Lao People's Democratic Republic, the Republic of Korea and Viet Nam.

from deforestation and degradation. Further negotiations led to the inclusion of REDD+ in the Bali Action Plan in 2007.[16]

According to UNFCCC decisions taken in COPs in Cancun (Mexico) and Warsaw (Poland), REDD+ involves three phases – *readiness*, consisting of strategy and capacity development; *implementation*, during which actions in the strategy are carried out and monitored; and *results-based actions*, when the impact of these actions on greenhouse-gas emissions is fully measured, reported and verified and potentially used to access results-based payments or finance, which may come from several sources (FAO, 2018e). The objective of the readiness phase of REDD+ in a country is to have four elements in place: 1) a national forest monitoring system; 2) a national REDD+ strategy; 3) a forest reference level or forest reference emission level; and 4) a safeguards information system. Table 6.3 summarizes the status of countries in the Asia-Pacific region supported by UN-REDD and Forest Carbon Partnership Facility programmes with respect to these four elements.

REDD+ readiness efforts have added momentum to ongoing efforts to manage forests sustainably. The majority of forested countries in the Asia-Pacific region now have benchmarks against which their forest-sector greenhouse-gas emissions can be measured and reported. For example, Bangladesh, Bhutan, Mongolia and Papua New Guinea have all carried out their first full cycles of national forest inventories, driven in large part by the need for more-accurate information on forest extent and forest-related greenhouse-gas emissions.

The Paris Agreement on climate change provided REDD+ with a considerable boost, making it the forest-sector's most important global initiative on climate-change mitigation (Box 6.2). REDD+ readiness efforts are supported by various multilateral and bilateral organizations, and the Forest Carbon Partnership Facility and the UN-REDD programme are the leading multilateral support systems. In addition to these multilateral initiatives, several bilateral support programmes have contributed to the development of REDD+ readiness in the region.

The progress made by REDD+ in the last decade could be compromised unless complex economic, social, political and institutional challenges are addressed, especially in countries where deforestation and forest degradation are high (Agarwal *et al*., 2018; Milne *et al*., 2019; Angelsen *et al*., 2018). On a programmatic level, for example, concerns have been raised on the effectiveness and sustainability of REDD+ if various institutional, market and policy barriers are not addressed (e.g. Frechette, de Bresser and Hofstede, 2014).

By the end of 2020, the programmes of UN-REDD and the Forest Carbon Partnership Facility will have mobilized a combined total of close to USD 750 million in 65 countries worldwide, 19 of which are

[16] The full definition of REDD+, as set out in the Bali Action Plan, is: "policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks".

Table 6.3. Status of the components of the Warsaw Framework for REDD+, as of February 2019, selected countries in the Asia-Pacific region

Country	Status of REDD+ readiness components			
	NRS	NFMS	FRL	SIS
Bangladesh	Yellow	Green	Green *	Red
Bhutan	Green	Green	Green	Yellow
Cambodia	Green *	Green *	Green *	Green
Fiji	Green	Yellow	Yellow	Yellow
India	Green	Green	Green *	Red
Indonesia	Green	Green	Green *	Green
Lao People's Democratic Republic	Green	Yellow	Green *	Red
Malaysia	Green	Green	Green *	Green *
Mongolia	Green	Green	Green *	Yellow
Myanmar	Yellow	Yellow	Green *	Yellow
Nepal	Green *	Yellow	Green *	Yellow
Pakistan	Yellow	Yellow	Yellow	Yellow
Papua New Guinea	Green *	Green	Green *	Green
Philippines	Yellow	Yellow	Red	Yellow
Solomon Islands	Yellow	Yellow	Green *	Yellow
Sri Lanka	Green	Green	Green *	Green
Thailand	Yellow	Yellow	Yellow	Red
Vanuatu	Yellow	Yellow	Red	Red
Viet Nam	Green	Green	Green *	Green *

Notes: Green = completed, endorsed at the national level, and publicly available; yellow = in development or drafted but not yet endorsed; and red = not yet formally initiated. * Based on documentation available on the United Nations Framework Convention on Climate Change REDD+ platform (as of February 2019). NRS = national REDD+ strategy; NFMS = national forest monitoring system; FRL = forest reference level/forest reference emission level; SIS = safeguards information system.

in the Asia-Pacific region. International finance has begun to flow into the implementation phase of REDD+. The two main sources of finance for this phase are the Green Climate Fund and bilateral finance, and the majority of this is directed towards subnational or jurisdictional initiatives. A final source of potential finance for forests could be through carbon markets. At the time of publication, the potential for such markets was unclear, and the rulebook for Article 6 of the Paris Agreement, which covers the use of market mechanisms in the context of compliance with the agreement's mitigation targets, was yet to be negotiated.

In many countries, the development of national REDD+ strategies, which are designed to address the root causes of forest loss and degradation, promise even more significant long-term impacts on the forest sector. For example, Viet Nam's National REDD+ Action Programme (NRAP) specifies improved forest governance and strengthened law enforcement as two of the main work packages, with several detailed policies and measures identified up to 2030. MARD (2017) indicates which elements of the NRAP can be implemented through the domestic budget and which require official development assistance or private-sector investment.

Sri Lanka's National REDD+ Investment Framework and Action Plan lists 13 key policies and measures (Sri Lanka UN-REDD Programme, 2017), each of which recognizes the role of government departments, specific numeric targets and estimated investment needs from public and external sources. In both Sri Lanka and Viet Nam, the mobilization has begun of investment finance to implement the strategies. In India, where a national REDD+ strategy has also been

BOX 6.2

Forests and the Paris Agreement on climate change

To support the various emissions goals, the Paris Agreement on climate change refers to the importance of conserving and enhancing carbon sinks and reservoirs and highlights the special role of forests. In particular, Article 5 refers directly to REDD+. Parties are also encouraged to implement and support alternative approaches such as joint mitigation and adaptation approaches for the sustainable management of forests while reaffirming the importance of incentivizing the non-carbon benefits[17] associated with such approaches.

The Paris Agreement on climate change was based on the submission of intended nationally determined contributions (INDCs) from all parties to the United Nations Framework Convention on Climate Change before the final negotiations at the 21st Conference of the Parties, setting out how each country intended to work towards the global goals under the agreement. After the Paris Agreement was signed, in most cases the INDCs became nationally determined contributions (NDCs) to the agreement. In the Asia-Pacific region, more than 80 percent of countries have explicitly included the forest sector in their NDC commitments, clearly suggesting that developing countries are committing resources to the forest and land-use sectors to reduce greenhouse-gas emissions and increase sequestration.

Source: FAO (2019).

[17] Non-carbon benefits are those benefits other than carbon sequestration stemming from REDD+. They include social, environmental and governance benefits such as biodiversity conservation, watershed protection and amenity values.

released, a new fiscal transfer mechanism has been developed that includes forest cover as a criterion in the allocation of funds to the constituent states (Box 6.3), thus directing public investment towards relevant actions and reducing the need for additional finance. REDD+ strategies may be developed at the national level, but reducing emissions requires an integrated approach involving all sectors and all levels, especially given the long-term objective of low-emissions development (Fishbein and Lee, 2015; Box 6.4).

Climate change poses risks to forests. Forests – and the goods and services they provide – will be affected by climate change, both directly and indirectly (Box 6.5). Forests are vulnerable to climate change in numerous ways, including the following:

- The risk of pest damage is likely to increase as climatic conditions change, potentially increasing the virulence of insect pests and pathogens, the susceptibility of trees to pest attacks, and the suitability of certain forest areas for invasive species. Nevertheless, it is

BOX 6.3

India's ecological fiscal transfer system to incentivize forest conservation by state governments

In 2014, India initiated the world's first ecological fiscal transfer mechanism to support forest conservation through the implementation of recommendations by the 14th Finance Commission. Every five years, constitutionally established finance commissions determine the criteria for allocating central tax revenues to states based on measurable criteria such as population, poverty, geographical area and fiscal discipline. The 14th Finance Commission introduced forest area as a criterion (giving it a weight of 7.5 percent) on the justification that states needed to be compensated for foregoing income due to forest conservation (i.e. the income lost due to refraining from forest conversion). The Forest Survey of India's 2013 forest-cover assessment (taking into account only very dense and moderately dense forests and excluding forests with a canopy cover of less than 40 percent) was used as the basis for determining the share that would be allocated to each state. States that conserve forests get a higher share of resource allocation, thus incentivizing sustainable management, including afforestation and reforestation. The annual resource transfer to the states in the period 2015–2020 under this arrangement is estimated at USD 6.9–12 billion (about USD 174–303 per hectare per year). No systematic assessment has been made of the impact of this on forest conservation, but a 2017 resource assessment indicated certain improvements in the forest situation. The 15th Finance Commission is now determining the fiscal transfer framework for 2020–2025; given the Indian Government's emphasis on combating climate change, the fiscal transfer for forest conservation is expected to continue.

Source: Busch and Mukherjee (2017).

difficult to quantify the impacts of this increased risk.

- Increasing droughts could have significant impacts on, for example, tree regeneration and growth, species composition (e.g. declines in drought-intolerant plant species) and susceptibility to pests.
- The natural range of individual species could change as climatic conditions change.
- The frequency and severity of forest fire are likely to increase. This has already been observed in large areas of the region due to lower rainfall and prolonged dry seasons. Forest fires can cause the release of large quantities of carbon to the atmosphere, thereby contributing to climate change, and they can have major impacts on ecosystem services such as watershed protection, biodiversity conservation, amenity values and overall forest health.

The impacts of climate change on other land uses could have cascading effects on forests. For example, the boundaries of the various land uses could change as

BOX 6.4

Jurisdictional approach under the Forest Carbon Partnership Facility

The Forest Carbon Partnership Facility's Carbon Fund was developed to pilot the third phase – that is, providing finance for REDD+ results. Under the Carbon Fund, five Asia-Pacific countries have prepared emission reduction programme documents (ER-PDs). The ER-PDs of the Lao People's Democratic Republic, Nepal and Viet Nam have been accepted into the Carbon Fund portfolio, with Fiji and Indonesia in the pipeline. By 2024, these five programmes are projected to result in net greenhouse-gas emission reductions of up to 140 million tonnes of carbon dioxide equivalent, resulting in claims of approximately USD 360 million from the Carbon Fund.[18] Each of these programmes covers a defined jurisdictional area of the country and a specific set of practical interventions that must be implemented to generate the anticipated emission reductions. For example, Nepal's ER-PD describes a plan to "localise forest governance through transfer of national forests to community and collaborative forest user groups", covering over 200 000 ha of forestland, as a central part of the approach to reduce greenhouse-gas emissions across 13 lowland Terai districts (MoFE, 2018).

[18] The Carbon Fund has a fixed price of USD 5 per tonne of carbon dioxide equivalent. Each country signs an "emission reductions payment agreement", which recalculates the amount of greenhouse-gas emission reductions eligible for claiming from the Carbon Fund according to a formula that takes into account the level of accuracy, environmental risk and other factors, resulting in a discount of 18–60 percent of the emission reductions estimated in the ER-PD.

BOX 6.5

Hindu Kush forests under threat from climate change

Mountain forests provide local highland and lowland people with many goods and services, such as freshwater, biodiversity, wood and non-wood forest products, cultural values and protection against natural hazards. In Asia, where subsistence farming is widely practised, communities upstream and downstream depend on mountain forests for their water to irrigate crops, as well as for wood and non-wood forest products to support their livelihoods. In Uttarakhand, India, for example, more than 75 percent of people work in areas directly or indirectly related to agriculture, especially subsistence cereal farming. Mountain forests play key roles in mitigating the negative effects of climate change, with mountain environments highly susceptible to climate change due to their geographies and fragile ecosystems. Mountain forests are sensitive to changes in temperature and precipitation, with warmer climates causing tree lines to move to higher altitudes and changing forest composition.

The Hindu Kush Himalaya (HKH) stretches for 3 500 km across eight countries – Afghanistan, Bangladesh, Bhutan, China, India, Nepal, Myanmar and Pakistan. Ten of Asia's largest rivers originate in these mountains: the Amu Darya, Brahmaputra (Yarlung Tsanpo), Ganges, Indus, Irrawaddy, Mekong (Lancang), Salween (Nu), Tarim (Dayan), Yangtze and Yellow (Huang He). These are fed by the world's third-largest expanse of ice and snow (after the North and South poles), often referred to as the "Third Pole". The rivers originating in the HKH are the main sources of freshwater in South Asia: they provide drinking water for more than 240 million people in the HKH itself and a total of 1.9 billion people living in the river basins, and they also support vast agriculture and many industries.

According to a study by the International Centre for Integrated Mountain Development (Wester *et al*., 2019), major services provided by ecosystems in the HKH, including water supply, agricultural production and biodiversity, are already being affected by changes in temperature and precipitation. There has also been an increase in the number and magnitude of natural hazards such as avalanches, landslides, wildfires, floods and droughts. Although mountain forests serve a protective function to mitigate these hazards, the fast rate of change and the increased occurrence and magnitude of natural hazards in mountain areas is pushing beyond the capacities and resilience thresholds of forests, which could in turn exacerbate the vulnerability of mountain communities.

Sources: Alfthan *et al*. (2018a); Alfthan *et al*. (2018b); Kotru *et al*. (2015); Sati (2005); Wester *et al*. (2019).

currently cultivated land becomes unproductive and new land is sought to maintain agricultural production. Sea-level rise and salinity intrusions would reduce the productivity of coastal lands, triggering migration inland, including into forested uplands.

Biodiversity conservation and forests

With four of the world's eight main biogeographical regions (Australasian, Indo-Malaysian, Oceanic and Palearctic), the Asia-Pacific region hosts exceptional biodiversity, much of it in highly diverse forest ecosystems, ranging from coastal mangroves to alpine meadows and from tropical rainforests to dry scrub forests. Of the 34 biodiversity hotspots worldwide, 14 are in the Asia-Pacific region. Many of the region's plants, mammals, reptiles, fish, amphibians, birds and insects are threatened, with several factors implicated (Box 6.6). The fate of threatened biodiversity will depend largely on the extent to which negative drivers can be addressed and biodiversity-friendly interventions encouraged.

Biodiversity conservation involves a wide array of actors, and numerous approaches exist (Table 6.4); global concerns are increasingly driving national and local efforts.

Local communities have long conserved biodiversity

Many traditional societies have long conserved biodiversity as part of economic systems based on sustainable wildlife use and the maintenance of spiritual and cultural values. For example, sacred groves still form an integral part of rural

BOX 6.6

Biodiversity loss in the Asia-Pacific region

Biodiversity loss in the Asia-Pacific region is caused by a combination of human-induced factors, including the following:

- ongoing deforestation and forest degradation;
- economic growth causing increased demand for wildlife products, fuelling unsustainable trade;
- the spread of alien invasive species, often facilitated by the increased movement of people and products;
- climate-change-related events, which are particularly affecting certain species and ecosystems; and
- an increase in human–wildlife conflicts, with negative impacts on conservation efforts.

Source: Adapted from UNEP-WCMC (2016).

Table 6.4. Biodiversity conservation at the local, national and global levels

Level	Key players	Approaches	Remarks
Local	Local communities and households Private sector	▪ Locally managed conservation areas ▪ Sacred groves ▪ Private protected areas	▪ Supporting organizations may facilitate and encourage action. Civil-society organizations are playing key roles in supporting environmental action at the local, subnational and national levels ▪ Many international conservation organizations are playing leading roles in strengthening the conservation agenda at the global, national and local levels. Their involvement includes shaping global and national policies, developing strategies and action plans, undertaking or facilitating research and studies, and supporting local action
National	Governments	▪ Establishment and management of protected areas ▪ Development and implementation of regulatory frameworks	
Global	International organizations	▪ International conventions and agreements and monitoring of their implementation	

landscapes in many Asian countries (Box 6.7), and spiritual and religious beliefs have provided a solid base for wildlife conservation in the Bishnoi community in Rajasthan, India. Larger changes to economic and social systems are negatively affecting many traditional conservation efforts, however, and initiatives are underway in some places to revive and support these. The Nagoya Protocol provides a global policy framework for the fair and equitable sharing of benefits arising from the use of genetic resources, with the aim, among other things, of contributing to the conservation and sustainable use of biodiversity.

The expansion of protected areas might be slowing

Conservation efforts at the national level, spearheaded primarily by governments (often at the prompting of environmental non-governmental organizations), have focused largely on the establishment of protected areas such as wildlife sanctuaries, game reserves and national parks and, in some cases, on protecting keystone species. The extent of forests earmarked for biodiversity conservation in the Asia-Pacific region increased from 68 million ha (12.4 percent of the forest area) in 1990 to 119.2 million ha (16.5 percent) in

BOX 6.7

Sacred groves in Asia

Traditional cultural, spiritual and religious beliefs and practices encourage reverence for nature throughout the Asia-Pacific region, resulting, in many places, in the conservation of natural vegetation in sacred groves. Today, such sacred groves often constitute the last remnants of original vegetation existing in an area (Dudley *et al*., 2010). Although no aggregate data are available, the concept of sacred groves is well entrenched in traditional cultures in most countries, and the conservation of biodiversity by local communities in sacred groves thus has a much longer history than modern conservation efforts by governments and other organizations. Sacred groves are reported to exist in 19 of the 28 states in India, with the total number of sacred groves in that country estimated at 100 000–150 000 (Ray, Subash Chandran and Ramachandran, 2014); they are also integral parts of landscapes in Nepal, where they are afforded strict protection from woodcutting. In Japan, only the premises of Shinto temples retain relics of lowland forests.

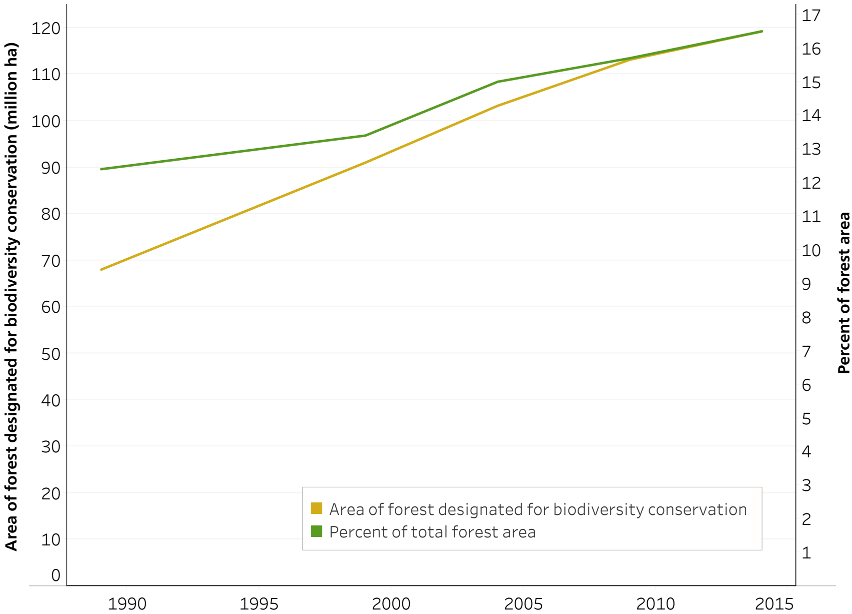
Increasing pressure on land is causing the degradation and destruction of sacred groves. Recognizing the importance of these areas for biodiversity conservation, some governments are providing local communities with technical and financial support to conserve their sacred groves.

2015 (FAO, 2015a; Figure 6.3). Five countries – Australia, China, India, Indonesia and Thailand – accounted for 71 percent of these forests in 2015. Overall, there was a rapid expansion in the area earmarked for biodiversity conservation between 1990 and 2005 and slower growth more recently. The scope for further expansion in the area designated for biodiversity conservation is limited in most countries. On the other hand, even protected areas are being opened up in some countries for the cultivation of commercial crops, mining, infrastructure and even urban development, notwithstanding policies and laws designed to protect biodiversity (see, for example, Bindra, 2018).

Globally agreed biodiversity targets remain distant

The Convention on Biological Diversity (adopted in June 1992 and entering into force in December 1993) provides a global framework for biodiversity conservation, including the sustainable use of its components and the fair and equitable sharing of benefits. A key to the implementation of the convention is the preparation and implementation of national biodiversity strategies and action plans. Almost all countries in the Asia-Pacific region have prepared these, taking into account the Aichi Biodiversity Targets. Some larger countries also have subnational strategies and action plans, and regional and

Figure 6.3. Change in extent of forests designated for biodiversity conservation, Asia-Pacific region, 1990–2015



Note: The term "forests designated for the conservation of biodiversity" does not equate to "forests in protected areas", and these data differ from those provided by UNEP-WCMC.
Source: FAO (2015a).

subregional plans have been prepared to encourage collective action by countries. The aim of the Aichi Biodiversity Targets, among other things, is to mainstream biodiversity conservation into economic and social development. A recent assessment of their implementation, however, suggested that progress has been far from satisfactory (Box 6.8).

Biodiversity conservation faces persistent challenges

Countries in the Asia-Pacific region will need to confront a number of challenges in their ongoing efforts to conserve biodiversity, including the following:

- Many past conservation efforts, especially the creation of protected areas, adopted an exclusionary approach that kept people out of protected areas. In many areas, villages were relocated, causing huge social problems, creating antagonism towards conservation and ultimately severely undermining protected-area management. Although remnants of this rigid conservation philosophy linger, there is more emphasis now on inclusionary approaches that also aim to mainstream local livelihoods into conservation efforts.

BOX 6.8

The Aichi Biodiversity Targets

The tenth meeting of the Conference of Parties to the Convention on Biological Diversity, held in October 2010 in Nagoya, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including specific targets – generally referred to as the Aichi Biodiversity Targets – to be achieved during 2011–2020. The Aichi Biodiversity Targets comprise five strategic goals and 20 targets encompassing all aspects of biodiversity conservation. The five strategic goals are:

1. Address the underlying cause of biodiversity loss by mainstreaming biodiversity across governments and society.
2. Reduce the direct pressures on biodiversity and promote sustainable use.
3. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.
4. Enhance the benefits to all from biodiversity and ecosystem services.
5. Enhance implementation through participatory planning, knowledge management and capacity building.

Through a system of regular reporting, member countries are to indicate progress in accomplishing the strategic goals and targets. A recent global assessment, however, found the following:

1. For most of the Aichi Biodiversity Targets, there has been limited progress and, for some targets, no overall progress.
2. Only a limited number of Parties have adopted their national biodiversity strategies and action plans as whole-of-government policy instruments.
3. Only a limited number of national biodiversity strategies and action plans contain resource mobilization strategies, communication and public awareness strategies, or capacity development strategies, as suggested in the guidance on national biodiversity strategies and action plans.
4. Only a limited number of national biodiversity strategies and action plans demonstrate that biodiversity is being mainstreamed significantly into cross-sectoral plans and policies, poverty eradication policies, and sustainable development plans.

Source: CBD (2018).

- Human–wildlife conflicts – in which wildlife species damage crops and livestock systems and, in extreme cases, cause human injuries and death – have become a major challenge affecting conservation. Such conflicts have created negative sentiments towards conservation among some local communities, especially when new protected areas are established or existing protected areas expanded. People whose livelihoods have been affected negatively by human–wildlife conflicts are unlikely to support conservation efforts.

- The continued growth of illegal trade of wildlife and wildlife products is a major conservation challenge in the Asia-Pacific region, despite efforts to implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Governments, non-governmental organizations such as Traffic, the World Wide Fund for Nature and the International Union for Conservation of Nature, and various other organizations are pursuing multipronged approaches involving efforts to prevent poaching, regulate the trade of plants and wildlife (and their products), and create consumer awareness to reduce demand for illegally obtained wildlife products. Nevertheless, illegal wildlife trade persists, often controlled by transnational criminal groups: it has been estimated that, globally, the value of illegally traded wildlife products is about USD 20 billion annually (Interpol, 2018). The Asia-Pacific region has become a major market for illegally traded products.

The long-term outlook for biodiversity conservation in the Asia-Pacific region will depend primarily on the effectiveness of measures to address these challenges. Two broad trends in biodiversity conservation are evident:

1. There is increasing emphasis on the participation of stakeholders, especially local communities. This inclusionary conservation paradigm is being extended to encompass land outside formal conservation areas with the aim of integrating conservation into all forms of land use. The widespread uptake of this approach requires major changes in governance arrangements, posing another challenge given that established institutions tend to pursue "business as usual" approaches and to resist change that could undermine their rationale for existence.

2. Persistent high levels of poverty in and around protected areas have drawn attention to the need to mainstream livelihoods in conservation efforts. Although examples exist of win–win interventions in protected-area management, many challenges persist in achieving biodiversity conservation outcomes in contexts in which economic development is needed to cater to the aspirations of local people for higher living standards.

Given the enormous biodiversity contained in forests, the forest sector must necessarily play a leading role in the region's conservation efforts, but achieving positive outcomes on the ground depends largely on attitudes in governments and among stakeholders. In most of the region, "development first" still dominates policymaking, with the risk of limiting action to reverse biodiversity losses as agricultural expansion, urbanization and mining and infrastructure development continue. At the same time, there is increasing awareness in most countries of the need for urgent action on conservation and the environment. The inherent contradiction in these two trends will become increasingly stark in coming decades.

The water challenge and forests

Water has become a scarce resource

An increasing water deficit has been identified as a major environmental issue in the Asia-Pacific region, with huge economic implications. In some of the region's most populated countries, the per-capita availability of renewable internal freshwater resources is well below the global average (Figure 6.4). Population growth and the continued degradation of watersheds will inevitably result in further declines in per-capita water availability. Several countries are in the grip of water shortages, stimulating initiatives to install expensive infrastructure to bring water from distant sources, extract groundwater (which is being depleted) and construct desalinization plants. Most countries in the region face the following two challenges:

1. major seasonal changes in flow – most precipitation is concentrated in a few months, and land-use and climatic changes have significantly reduced lean-season flows; and
2. water pollution due to the discharge of untreated effluents.

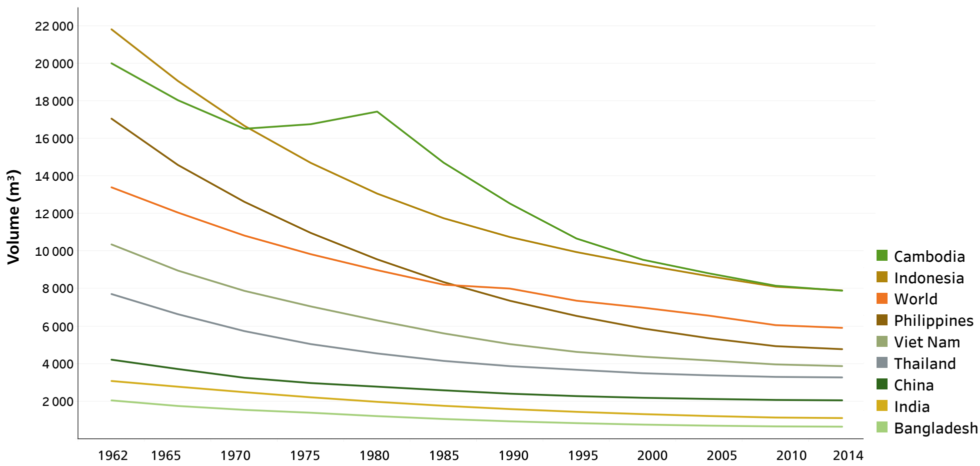
Climate change could reduce the supply of freshwater in many countries. In addition to changes in annual precipitation, most countries in the region are experiencing rainfall extremes, causing floods, droughts and significant declines in lean-season flows. Climate-change-related increases in sea level are affecting coastal regions. For example, the increased intrusion of brackish water and saltwater into aquifers and upstream into rivers reduces freshwater availability, an effect that will become increasingly apparent as lean-season river flows decline further.

Forests are a main means for protecting soil and water

There is widespread recognition in the Asia-Pacific region of the waterflow-regulating functions of forests. Twenty-one countries have designated, on average, 35 percent of their forests for soil and water conservation (Figure 6.5), with most of those countries significantly increasing this area between 1990 and 2015. In China, for example, the area designated for soil and water conservation more than tripled between 1990 and 2015, from 18.4 million ha to 58.3 million ha. Three of the 21 countries – Cambodia, Timor-Leste and, surprisingly given its overall increase in forest area, Viet Nam – reported declines in the area designated for soil and water conservation over the period.

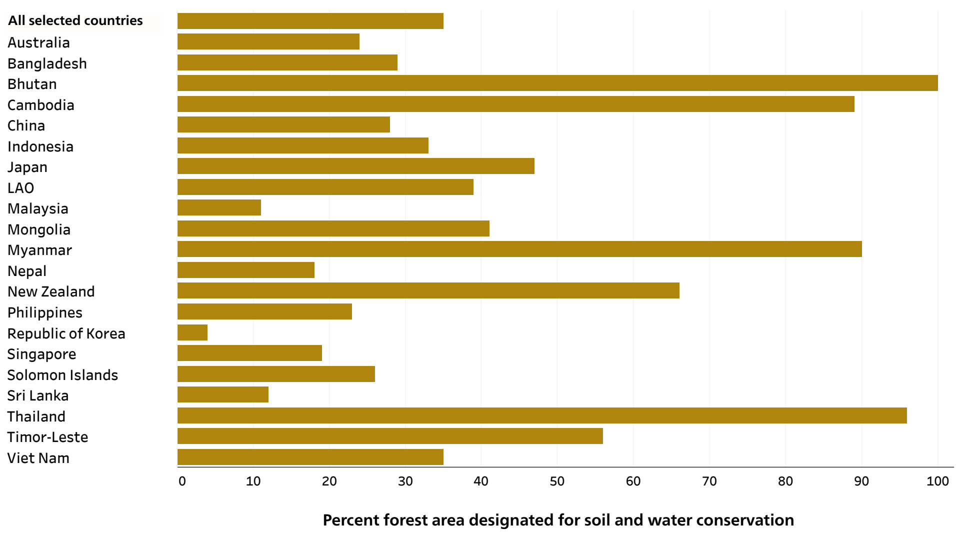
Broadly, the overall increase in the area of forest designated for soil and water conservation can be attributed to the earmarking of natural forests, especially with

Figure 6.4. Per-capita availability of freshwater, world and selected countries in the Asia-Pacific region, 1962–2014



Source: FAO (undated [a]).

Figure 6.5. Percent of forest area designated for soil and water conservation, selected Asia-Pacific countries, 2015



Note: LAO = Lao People's Democratic Republic.
Source: FAO (2015a).

the discontinuation of logging in natural forests, and to afforestation and reforestation aimed at restoring watersheds.

Some countries (e.g. Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, Papua New Guinea and the Solomon Islands) continue to rely on natural forests for wood production and income; most countries in the region, however, have discontinued or reduced logging in natural forests with a view to increasing the provision of ecosystem services. In most cases, forests in the watersheds of reservoirs serving urban areas are protected and their conversion to other uses is prohibited. Regulations are also in place to protect natural vegetation along rivers and streams.

In some countries, disasters such as landslides and floods triggered blanket bans on logging in natural forests, including in Thailand in January 1989 following devastating floods in Nakhorn Si Thammarat Province; in the Philippines in 1992 in response to flooding; and in China in 1998 in response to flooding in the Yangtze River valley (FAO, 2001). These logging bans were driven largely by the perception that deforestation exacerbates flooding by reducing the infiltration of water into soils and thereby increasing surface runoff, although studies have questioned the extent to which forests are able to mitigate major floods (e.g. FAO and CIFOR, 2005). A key challenge is determining the ways in which forests affect hydrological processes in diverse conditions and how they can best be managed to deliver optimal hydrological outcomes.

Little information is available on the forest management practices in place in the region to regulate water yields and seasonal flows, although maintaining forests intact appears to be the main approach applied in forests designated for soil and water conservation. Changes in forest structure – for example when monocultural plantations replace natural forests – may affect runoff and base flows (Tarigan *et al*., 2018; Creed and van Noordwijk, 2018).

Few countries in the region apply forest management regimes aimed specifically at water supply, but there is a widespread assumption that forests in any form will have a positive impact on the quantity, seasonality and quality of water. To some extent, the widely held belief in the "sponge" effect of forests has undermined systematic efforts to assess the ways in which different forest management regimes affect water yields. A multitude of factors affects water supply, however, and the impacts of different management regimes are likely to vary considerably.

Governments seek mechanisms to pay for watershed protection

Urbanization has led to increased reliance on "grey" infrastructure such as large-scale dams, embankments and concrete causeways for delivering water to consumers. Nevertheless, there is increasing interest in nature-based solutions (i.e. approaches that mimic natural processes) to improve water management (UNESCO, 2018), including improving the management of soils, vegetation, wetlands and natural water bodies. Nature-based solutions usually offer more co-benefits – such as biodiversity conservation, carbon sequestration and amenity values – than grey-infrastructure approaches.

Nature-based hydrological services can be encouraged through regulatory or market measures or a combination of the two (in which regulation creates favourable conditions for market measures). In forestry, the predominant approach has been to regulate the intensity of use with a view to maintaining critical watersheds in a relatively undisturbed state. Market interventions – in the form of payments for watershed services – have been adopted more commonly in small watersheds, where it is relatively easy to identify the providers and beneficiaries of the services and to establish institutional mechanisms to mediate their provision.

Market-based approaches are more challenging in large watersheds because there may be many potential providers and users. In such cases, non-market regulatory interventions – including taxes – may be needed. Government interventions, therefore, remain the primary means for ensuring the provision of watershed services in the Asia-Pacific region. For example, China's Sloping Land Conversion Programme is one of the world's largest publicly funded watershed improvement programmes (Box 6.9). Although this programme is sometimes referred to as a system of payments for ecosystem services, it is more a policy and regulatory approach using public funds. Upland farmers are paid to rehabilitate the watersheds, but an inability to determine the precise quantity and value of the ecosystem services provided means that the government pays standard amounts and no effort is made to charge users for the services they receive.

Viet Nam's payment scheme for forest ecosystem services addresses both supply and demand, with users of hydropower and water required to pay a surcharge that is distributed to upland communities through the Viet Nam Forest Protection and Development Fund (Box 6.10). Japan hosted possibly the earliest payment scheme for ecosystem services, and the City of Yokohama's successful scheme

BOX 6.9

China's Sloping Land Conversion Programme

Under China's Sloping Land Conversion Programme, which began in 1999, farmers and rural families are encouraged to convert their sloping and degraded farmlands into forests and, in return, they receive cash and grain subsidies from the government. More than 32 million rural households have received direct payments under the programme (Dayne, 2017). The objective is to halt soil and water erosion on sloping farmlands and to restore ecosystems through large-scale reforestation. The programme has promoted local economic development and poverty-reduction processes in rural areas, achieved agricultural restructuring and increased farmer incomes; it has facilitated a shift from agricultural production to tree-crop production, stockbreeding and other secondary and tertiary industries (FAO, 2004).

BOX 6.10

Payments for forest ecosystem services in Viet Nam

Viet Nam has been a pioneer in the development of payment schemes for ecosystem services, primarily to provide upland communities with incentives to protect forests and thereby ensure the supply of clean water for power generation and domestic and industrial use. The Payment for Forest Ecosystem Services scheme (PFES) was initiated on a pilot scale in 2008 in Lam Dang and Son La provinces; in light of the experience gained, the pilot was extended to the entire country in 2010 through Decree No. 99. Under the scheme, users of hydroelectric power and drinking water are charged for watershed services at a rate of VND 36 per kilowatt hour for hydropower and VND 52 per m^3 for drinking water (97 percent of payments are derived from hydropower). These fees are added to the utility bills of consumers, and the collected monies are transferred to the Viet Nam Forest Protection and Development Fund, which pays upland households in accordance with an agreed formula. As of 2017, 601 contracts had been signed with utility companies mandating the collection of payments for forest ecosystem services from consumers of electricity and water. The PFES covers about 5 million ha, which is more than one-third of the country's total forest area (14.4 million ha). In 2017, the value of the PFES was about USD 77 million. Income from ecotourism has also been brought under the purview of the PFES to be managed by the Viet Nam Forest Protection and Development Fund, and there is a proposal to expand the PFES to cover payments for carbon sequestration.

Source: Hoang Lien Son (2017).

is now being replicated in many other municipalities; a national environmental tax to help pay for improved forest management will come into effect in 2024 (Box 6.11).

Table 6.5 gives an indication of the scale of investments in watershed services globally and in the Asia-Pacific region and the area covered by projects. The global value was USD 24.6 billion in 2015, of which the Asia-Pacific region accounted for USD 14.2 billion. About 88 percent (426.6 million ha) of the 486.7 million ha covered by investments in watershed services globally in 2015 was in the Asia-Pacific region (Bennet and Ruef, 2016). The dominance of the Asia-Pacific region in such investments is due largely to the efforts of China and Viet Nam, and subsidies provided by governments accounted for 96 percent of investment in the region. The predominance of public subsidies is noteworthy: to be effective, market mechanisms must be underpinned by a clear understanding of context-specific hydrological processes and effective systems of governance.

BOX 6.11

Financing watershed protection in Japan: from local-level payments to a national environmental tax

Japan has long had payment schemes for ecosystem services based on the concepts of "compensatory payments" and "beneficiaries pay". The oldest such scheme in Japan (and probably the oldest worldwide) involved compensatory payments by downstream villages to an upstream village in Echigo (Niigata Prefecture) in 1784. The village of Mizuno planned to produce charcoal using its community forest, but 24 downstream villages opposed this because they feared water shortages caused by earlier snowmelt and the discharge of sediments during rain events. Mizuno village cancelled its plan when downstream villages agreed to provide a lump sum of 50 ryo (equivalent to the value of one oval gold coin) and 4 koku (equivalent to 180 litres) of rice per year as compensation.

Another early example was the purchase of upstream watershed forests in Doshi village by Yokohama City in 1916 to ensure the city's ongoing access to clean water. Each citizen in Yokohama (which now has a population of 3.7 million people) pays USD 0.68 per year as part of their water bills, generating an annual income of USD 2.5 million that is used to ensure the sustainable management of the city's forests.

Several other upstream–downstream partnerships and watershed funds were established in Japan after the 1970s. For example, the Toyota Tap Water Watershed Conservation Fund was established in 1994 to provide "safe and tasty tap water", thereby enabling watershed conservation efforts through a surcharge on water bills. By 2009, more than 44 municipalities had established watershed funds to support upland watershed management.

The idea of levying a national-level watershed tax was mooted in the 1980s but dropped after protests from industry. Nevertheless, the need to reduce carbon emissions under the Kyoto Protocol revived interest in forest management, with Japan targeting an overall reduction in greenhouse-gas emissions of 6 percent. It was decided that 3.8 percent of this target would be achieved through improved forest management – especially the thinning of 550 000 ha of forest per year over the period 2007–2012.[19] To support this, a prefectural forest and environmental tax was established, starting with Kochi prefecture in 2003. Similar forest and environmental tax systems were introduced in other prefectures and, by January 2018, 37 prefectures and one municipality had such systems.

In 2018 it was decided to impose a nationwide forest environment tax at the rate of JPY 1 000 per person, the main aim of which was to improve the management of existing (especially privately owned) forests. This will come into effect from 2024 at the cessation of the current surcharge of JPY 1 000 on taxpayers to support reconstruction after the 2011 earthquake and tsunami.

Source: S. Shibata, personal communication, December 2018.

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[19] Large areas of planted forests in Japan, especially under private ownership, have been unmanaged for a long time and the resulting overstocking has led to very low increments and low carbon sequestration. Thinning is considered to be positive because it would open up forests, thereby enabling faster growth and carbon sequestration; moreover, the wood harvested in thinning could be used for energy production, thereby reducing emissions through substitution for fossil fuels. The 2009 Basic Act for Promotion of Biomass Utilization has encouraged the rapid expansion of wood-based power generation.

Table 6.5. Overview of investments in watershed services, 2015, world and the Asia-Pacific region

Indicator	World	Asia-Pacific
Number of operational programmes	419	175
Area covered (million ha)	486.7	426.3
Value (USD billion)	24.6	14.25
Of which:		
▪ Public subsidies for watershed protection	23.5	12.99
▪ User-driven watershed investments	0.657	0.555

Source: Bennet and Ruef (2016).

Land degradation

Land degradation, defined by UNCCD (2017) as "the reduction or loss of biological or economic productivity and complexity of crop lands, range, pasture, forest and other woodlands resulting from land uses or from a process or a combination of processes arising from human activities", has emerged as a major problem in vast tracts of land in the Asia-Pacific region. In some cases, reversing this degradation at a reasonable cost may be impossible. Factors in land degradation include practices to increase the production of certain goods by severely reducing ecosystem complexity, and the overuse of fertilizers, pesticides and water.

Approximately 20 percent of the Earth's vegetated land surface suffered from persistent declines in productivity in the period 1998–2013. Land degradation is both a cause and effect of poverty, with more than 1.3 billion people living in areas affected by degradation. In 2000, 50.8 percent of rural people in East Asia and the Pacific, and 26.2 percent in South Asia, were living in degraded agricultural lands (UNCCD, 2017). The situation is worsening: the number of rural people living in degraded agricultural lands increased by 8.4 percent in East Asia and the Pacific between 2000 and 2010 and by 17.8 percent in South Asia (UNCCD, 2017).

Global initiatives have emerged to address land degradation

Land degradation is an outcome of multiple anthropogenic and natural factors, and addressing it effectively requires highly site-specific interventions. In general, however, achieving land degradation neutrality involves:

- avoiding degradation by addressing the drivers and preventing adverse changes in the quality of non-degraded lands;
- reducing land degradation through the application of sustainable management practices; and

- reversing degradation and restoring the capacity of land to produce goods and services sustainably through appropriate interventions (UNCCD, 2017).

A number of global initiatives aim to address land degradation. One of these is the Bonn Challenge, launched in 2011, the aim of which is to restore productivity on 150 million ha of degraded and deforested land by 2020 and on 350 million ha of degraded land by 2030 using landscape approaches (Bonn Challenge, undated). The Bonn Challenge is a voluntary non-binding initiative to advance restoration efforts and provide a platform for collaboration. Depending on land use and the nature of degradation, forest and landscape restoration may be a suitable approach involving participatory processes and applying strategies such as natural restocking, assisted natural regeneration, seeding, planting, agroforestry and improved fallow, as appropriate, at a landscape scale.

The New York Declaration on Forests includes goals for halving the loss of natural forests by 2020 and ending it by 2030 and for restoring 350 million ha of degraded landscapes and forestlands by 2030. The declaration integrates goals formulated under key international agreements, including the SDGs, the Paris Agreement on climate change and the Bonn Challenge. There are also various initiatives at the regional level. For example, the Sydney Declaration on Climate Change, Energy Security and Clean Development, adopted at the 15th meeting of leaders at the Asia-Pacific Economic Cooperation forum in 2007, set an aspirational goal of increasing the region's forest cover by at least 20 million ha by 2020. Regional networks like the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) and the Asian Forest Cooperation Organization are investing substantial resources in capacity building and knowledge sharing to support the rehabilitation of degraded lands. FAO and APFNet have jointly developed the Asia-Pacific Regional Strategy and Action Plan for Forest Landscape Restoration to 2030 (FAO, 2018f).

Most countries in the Asia-Pacific region have long histories of restoring degraded forestlands with the aim, for example, of producing wood and other products and improving ecosystem services. The rapid growth of planted forests in China, India, the Philippines, Thailand, Viet Nam and other countries has largely been an outcome of the imperative to restore degraded lands. The Green India Mission, under India's National Action Plan on Climate Change, envisages an increase in forest cover to one-third of the country's land area, including through the afforestation of 6 million ha of degraded lands. Considerable emphasis has been given to public participation, taking advantage of experience gained through the joint forest management programme. In the Philippines, a massive national greening programme was launched in 2011 to plant 1.5 million ha over a six-year period. By the end of the programme in 2016, 1.7 million ha had been planted; a follow-up programme, the Enhanced National Greening Programme, was launched with the aim of reforesting 1.2 million ha in 2017–2022.

Landscape-scale restoration is a major challenge

Given the widespread degradation of agricultural and forest lands, forest and landscape restoration and achieving land degradation neutrality will remain focus areas for almost all countries in the Asia-Pacific region. Challenges include the following:

- The approach to addressing land degradation has been broadened considerably, and emphasis has shifted to landscape approaches that go beyond – and attempt to break down – conventional sectoral boundaries.

- The emphasis of restoration efforts is shifting away from a focus on narrow objectives to wider aims such as biodiversity conservation, carbon sequestration, watershed protection, food security and the improvement of livelihoods.

- Governance is the most challenging issue in forest and landscape restoration, with the focus on creating favourable conditions for wider stakeholder participation.

- Funding for forest and landscape restoration remains challenging, especially in low-income countries. Many of the benefits of such restoration are difficult to quantify and monetize, reducing its attractiveness to private investors. Payment schemes for ecosystem services offer a means for valorizing restoration, but most current initiatives rely heavily on public funding.

- Many countries have only low capacity to pay the direct and indirect costs (including the foregone benefits of unsustainable use) of restoration.

Amenity values of forests and trees

Natural landscapes and their constituents – such as forests, trees, water bodies, mountains, valleys and sea coasts – are increasingly seen as valuable beyond the goods they provide; in some cases, their amenity values are becoming more important than the tradition production of material goods. As populations urbanize, people are increasingly seeking to reconnect with nature as a way of enhancing physical, mental and spiritual well-being (see, for example, Box 8.1). In many places in the region, productive forests have been allocated for non-extractive uses, such as ecotourism, often generating income far higher than would have been possible from production.

Several factors contribute to the growing demand for amenity

Travel and tourism in general, and nature-based tourism (or "ecotourism"), have grown rapidly in the Asia-Pacific region in the last couple of decades for several reasons, including the following:

- Transportation costs have fallen drastically, enabling more people to travel. The International Air Travel Association estimated that there were 3.8 billion air travellers globally in 2016, and this is projected to increase to a staggering 7.2 billion passengers by 2035.

- Rapid growth in incomes and the region's burgeoning middle class mean that people have more disposable income and more leisure time and therefore more capacity for tourism. There are indications that Millennials (i.e. those people born between the early 1980s and the early 2000s) will be a dominant segment of tourism to distant locations in the future.

- Increased access to information, facilitated by the rapid penetration of information and communication technologies, means that people are better informed about tourism options.

- People are seeking diverse experiences (depending on age, income, educational level and occupation, among other things).

It is likely that the number of people wanting forest-related tourism and nature-based experiences will continue increasing, and the provision of amenity values will provide new income opportunities for forest owners and managers. There is also a need, however, to consider the social and environmental impacts of forest-based tourism: examples abound of surging visitor numbers causing the loss of the amenity values that attracted tourists in the first place. Managing the expected rise in interest will require careful assessment of carrying capacity and the regulation of visitor numbers through various measures. This has already happened in Bhutan, which strictly regulates visitor numbers through a "high-value, low-impact" approach aimed at ensuring that tourism does not diminish the value of its critical tourism assets – nature and culture.

What needs to be done?

There are strong indications that demand for amenity values will soar in coming decades, with the potential to increase pressure on forests if the sector is unprepared. The following measures would help reduce negative impacts:

- develop strategic plans to capitalize on forest amenity values, taking into account the diversity of market demand;

- regulate visitor numbers through appropriate tools so that amenity values are not degraded; and

- fully involve local people in the management of amenity forests to ensure they benefit from this form of forest use. Considerable experience has been gained in several countries in community-managed ecotourism, providing a basis for institutional and policy interventions to enhance sustainability and equity.

Forests and disasters

Forests in the region are exposed to multiple disaster risks due to natural hazards (such as storms, floods, droughts, fires, earthquakes and pests and diseases), conflicts and other crises; the Pacific Island countries are particularly vulnerable to natural hazards (Box 6.12). An FAO analysis (FAO, 2017b) of post-disaster needs

BOX 6.12

Natural hazards in the Pacific

Climate change and associated extreme weather events will potentially be the most significant factor affecting forests and forestry in the Pacific subregion in the next decade. The World Risk Index indicates that the Pacific has probably the greatest disaster risk (exposure to disasters multiplied by vulnerability to disasters) of any region worldwide. Five countries in the Asia-Pacific region – Vanuatu, assessed as having the greatest disaster risk of any country worldwide, followed by Tonga (second), the Solomon Islands (fourth), Papua New Guinea (sixth), Fiji (tenth) and Kiribati (15th) – are in the top 15 countries globally for disaster risk. The subregion's very high exposure to risk is due mainly to the location of many countries in the South Pacific Basin tropical cyclone pathway. Many Pacific countries also lie on or near the Pacific Ring of Fire (the series of tectonic plate boundaries that border the Pacific Ocean) and are therefore vulnerable to earthquakes and tsunamis. Severe weather events have always been common in the Pacific, but the increasing frequency and severity of typhoons, floods and droughts are exacerbating disaster risk in the subregion and in, some instances, already driving changes in forest management to mitigate the effects of disaster events.

Other countries in the Asia-Pacific region also have very high disaster risk: for example, the Philippines is ranked third in the World Risk Index, Brunei Darussalam eighth, Bangladesh ninth and Timor-Leste 13th.

Source: Bündnis Entwicklung Hilft (2018).

assessments[20] of 30 large-scale disasters that hit the Asia-Pacific region in 2006–2016 found that, excluding the earthquake in Nepal in 2015, storm was the region's most devastating disaster type for forestry, causing 77 percent of total damage and loss. The Nepal earthquake caused USD 308 million in economic losses in forestry, twice the total losses due to all other disasters over the period (Table 6.6; Box 6.13).

Globally, severe weather affects almost 40 million ha of forests per year and fire about 70 million ha; insect pests can annually ravage up to 85 million ha; and diseases annually affect 12.5 million ha (FAO, 2017b). Information on the impacts of forest fires, pests and diseases in the region is scarce, however; Table 6.7 shows

20 Post-disaster needs assessments are conducted under the leadership of affected country governments with the assistance of the Global Facility for Disaster Reduction and Recovery.

Table 6.6. Disasters with the biggest impacts on forestry, countries in the Asia-Pacific region, 2003–2016

Country	Disaster type	Year	Total number of people affected (1 000)	Share of total population affected (%)	Total damage and loss to agriculture (USD million)	Total damage and loss to forestry (USD million)
Nepal	Earthquake	2015	8 000	28.1	588	308
Myanmar	Cyclone	2008	2 400	4.7	686	54.9
Pakistan	Flood	2011	9 600	5.5	1 940	32.0
Samoa	Cyclone	2012	4.76	2.5	64.3	31.7
Indonesia	Tsunami	2004	2 800	1.3	849	22.8
Fiji	Cyclone	2016	540	60.6	252	13.6
Vanuatu	Cyclone	2015	65	24.6	56.1	8.80
Philippines	Cyclone	2009	9 300	10.1	845	7.74

Source: FAO (2017b).

BOX 6.13

The impacts of Nepal's 2015 earthquake on forestry

The devastating earthquake that struck Nepal in April 2015 caused landslides, mudflows and other large-scale dislocations of hillsides that inflicted immense damage in forest areas. There was considerable destruction of nature-based tourism infrastructure in protected areas, such as trails, trekking routes and sites, and the capacity of ecosystems to deliver ecosystem services was severely compromised. The earthquake also had negative impacts on the local governance and administration of natural resources. Many community forest user group members were affected directly, and the capacity of such groups to perform their governance functions was drastically diminished. Another major impact was to increase the risk of future environmental hazards such as landslides and glacial lake outburst flood events, which would have devastating consequences for lives and livelihoods in remote mountain areas. Landslide debris can also cause flooding and sedimentation downstream.

Source: Government of Nepal (2015).

Table 6.7. Forest fires in selected countries, Asia-Pacific region

Country	Period	Number of fires	Total deaths	Total affected population (1 000)	Total damage (USD 1 000)
China	1981–2003	5	243	56.6	110 000
India	1984–2018	4	30	-	2 000
Indonesia	1991–2015	10	319	3 440	10 300
Myanmar	1979–1981	2	8	78.6	11 000

Source: CRED (undated).

data on the extent of forest fires in some countries in the region.

The cost of damage to forestry due to disasters is underappreciated. For example, an analysis of Indonesia's 2015 fire crisis found that almost 1.2 million ha of natural forests, forest concession land, swamp forests and oil-palm concession lands were burned, causing damage estimated at USD 16.1 billion – more than twice the reconstruction cost of the 2004 Aceh tsunami (Dogra *et al*., 2018).

FAO (2017b) found a general lack of information on damage and losses due to disaster in agriculture (including forestry) and therefore a poor understanding of the long-term consequences of disasters for the sector. This is challenging for forestry, which is on the fringes of damage and loss assessment and is at risk, therefore, of underestimations of the impacts the sector bears. Moreover, post-disaster national assessments are designed to evaluate immediate needs for recovery and restoration and to estimate socio-economic impacts; they do not take into account the longer-term damage and losses sustained in forestry (FAO, 2017b).

The impacts of climate change, land-use conversion, unsustainable land-use practices and conflicts will interact increasingly in the future (FAO, 2017b), creating a high-risk environment for forests and forestry. For example, trees damaged in extreme weather events are more susceptible to secondary agents such as fire and pests, with the potential to create cascading disasters.

The role of forests in reducing the risk of disasters and protecting people from climatic extremes is well recognized. Mountain forests, for example, reduce the risk of avalanches and landslides. Healthy ecosystems reduce people's vulnerability to disasters by supporting livelihoods and meeting basic needs for food, water, fuel and shelter. This role, however, can only be fulfilled if forests themselves and their ecosystem services are resilient. Understanding the vulnerabilities of forests, forest-dependent communities and the forest sector is crucial for the development of policies and investments aimed at reducing risks, adapting to climate change and increasing resilience. A growing set of methodologies – involving geospatial tools, satellite imagery and biophysical and open-source climate data – is available for modelling the impacts of climate change on forests and assessing adaptation options. Nevertheless, rigorous multihazard forestry-specific assessments require a base level of data and information, which must be obtained through monitoring and research.

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Key **points**

- Technological advances in, for example, remote sensing and data analysis are revolutionizing forest management and environmental monitoring, but the rate of uptake is far from uniform in the Asia-Pacific region.
- There is greater uptake of technologies to increase forest productivity and industrial efficiency in the planted-forest sector than in the management of natural forests.
- Governments are beginning to leverage new technologies to improve land mapping, the management of land-ownership information, and forest governance.
- Increasing access to the Internet has the potential to enable forest-dependent communities, including those in remote areas, to participate more in forest-related monitoring and decision-making.
- Huge volumes of forest data will be generated and collected in the future, requiring increased human-resource capacity in data processing and analysis.

7 | New technologies are transforming forestry – but uptake is patchy

- Product innovations, such as engineered wood, are enabling new uses of wood; among other things, these will assist the quest to achieve low-carbon economies.
- Enabling conditions for accelerating technological uptake in the region's forest sector, especially in countries that are lagging behind, include conducive policies and laws; agile governance; improvements in communication infrastructure; public investment in technology transfer; the strengthening of forest research, development and education institutions; and strategic partnerships.
- Young people consulted for this study indicated that the uptake of new technologies in the forest sector has been too slow. They called for more opportunities for young people to learn and apply these new technologies.

This chapter discusses technological developments in forests and forestry in the Asia-Pacific region. It provides an overview of the forest-related impacts of established technologies and examines new and emerging technologies, advances in existing technologies, risks, and key research areas. The chapter identifies enabling conditions for the wide adoption of emerging technologies and innovation in the region and canvasses youth perspectives on science, technology and innovation in forestry.

The influence of technology on forestry

Key technological developments with major impacts on forestry globally and in the region include the following:

- The use of chainsaws has transformed and dominated logging practice (and even, in some places, primary processing) for many decades. For example, the pervasive use of chainsaws has greatly increased the productivity and economic efficiency of logging operations, with major savings in labour; on the other hand, it has enabled the acceleration of unsustainable exploitation, degradation and loss of natural forests.

- Technologies such as spindleless lathes enabling the processing of wood irrespective of its natural qualities and size have helped shift wood production away from primary natural forests towards planted forests (FAO, 2009).

- Intense competition for wood fibre in paper manufacturing, coupled with improved resource efficiency and processing, is increasing the proportion of recovered paper in the composition of total fibre furnish. The global consumption of recovered paper increased from 193 million tonnes (50 percent of the total) in 2007 (FAO, 2011b) to 229 million tonnes (56 percent of the total) in 2016 (FAO, 2016c).

- Research on biological aspects of forestry, including ecosystem processes, has improved the tools and techniques available for the sustainable management of both planted and natural forests. Genetic selection, tree breeding and rapid planting-stock multiplication techniques, combined with refined site management practices, have helped increase the productivity of planted forests. Innovations in wood science are enabling many new products; engineered wood, for example, is helping make tall mass timber buildings a reality.

- New information and communication technologies are unleashing unprecedented changes worldwide, including in the forest sector. The widespread use of digital media and e-commerce, for example, is changing demand for paper and paperboard. Global demand for newsprint declined from 31 million tonnes in 2012 to 24 million tonnes in 2016, and demand for printing and writing paper declined from 106 million tonnes to 100 million tonnes over the same period. On the other hand, the production of wrapping and packaging paper increased by 10 percent between 2012 and 2016, from 214 million to 235 million tonnes (FAO, 2016c). Electronic communication technologies are empowering communities and purpose-oriented networks to engage in decision-making and to challenge vertically structured organizations.

- Advances in earth observation technologies, high-resolution satellite imagery, remote sensing and mobile electronic devices are revolutionizing forest management and the environmental monitoring of forests and landscapes. Public-sector agencies, indigenous communities, civil-society organizations and other stakeholders are using these digital technologies in wide-ranging applications to conserve forest resources, improve forest governance and provide greater transparency.

- The combination of advances in data management, remote sensing and open-source technologies has greatly increased the accuracy and transparency of information available for forest administrations to develop responsive and responsible policies and plans and to monitor their impacts. This, in turn, has led to a rapid increase in the number of countries in the region that have institutionalized cyclical national forest inventories and the capacity to report on international commitments such as the Paris Agreement on climate change. It has also increased the ability of third parties to verify forest-related information.

Technologies now on the horizon involving artificial intelligence, machine learning, robotics and genetic engineering could bring further changes to the forest sector. Some are already being applied in forestry, mostly in developed economies. There is potential for wider uptake of such technologies, which has not been uniform across the region: for example, some countries and subnational regions are yet to harness the power of certain digital technologies, and some are yet to fully benefit even from older technologies such as electricity.

Technological development is a key mechanism for the implementation of the SDGs: for example, SDG 17.7 is to "promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms …". Table 7.1 presents some of the major developments in digital technologies with implications for sustainable forest development in the Asia-Pacific region.

Technological developments and innovation in the forest sector relate broadly to the following two primary areas (FAO, 2009):

1. the assessment, monitoring and management of forest and tree resources for the sustainable production of goods and the provision of ecosystem services; and

2. the harvesting, transport, processing, marketing and use of wood and non-wood products.

Table 7.1. Digital technologies with implications for the future of forestry in the Asia-Pacific region

Development stage	Examples of technologies	Potential uses
Digital technologies already deployed in forestry in many countries in the region	Personal computers, smart phones, the Internet, information and communication technologies, remote sensing, geographic information systems	▪ National forest inventory and forest assessment ▪ Data collection and analysis ▪ Improved communication
Digital technologies already deployed or being tested in forestry in some countries in the region	Smartphone- and tablet-based forest management applications, cloud computing, genetic sequencing, semi-autonomous vehicles, nanotechnology	▪ Real-time monitoring of deforestation ▪ Biosensors and biomaterials ▪ DNA-based timber tracking
Digital technologies on the horizon that may bring changes to forestry in the region	Artificial intelligence, robotics, autonomous vehicles, three-dimensional printing, blockchain, fifth-generation wireless technology, big-data analytics	▪ Automation of routine jobs ▪ Enhanced decision-making support systems ▪ Agile governance

Within these two areas, forest science and technology are focused primarily on the following (FAO, 2009):

- reducing costs and increasing productivity;
- developing new products and services;
- conserving resources and reducing adverse environmental impacts; and
- improving energy efficiency.

Forest science and research

Forest research in the Asia-Pacific region has a long history. In most countries, national forestry departments have forest research units within their organizational structures; some countries also have fully fledged public research institutes and some have dedicated research institutes in various subnational regions. Some institutions – such as the New Zealand Forest Research Institute – are corporatized as private entities. In addition, many universities have forest-related faculties or centres addressing various aspects of forest research (in addition to teaching). Multidisciplinary approaches to forest research are increasingly needed to address issues such as climate change, water, the livelihoods of forest-dependent indigenous peoples and local communities, and biodiversity conservation.

Forest research has made significant contributions to forest-related industries. For example, the many research institutes established under the Chinese Academy of Forestry have played key roles in the development of China's eucalypt and bamboo plantations and related industries. Multidisciplinary research in New Zealand has supported the development of that country's large radiata pine forest estate and its associated industries. In the tropics, several governments have backed research into the development of planted forests.

Two major foci of future scientific research in the region are likely to be ecosystem resilience and the bioeconomy (M. Kleine, personal communication, February 2019). The conservation and sustainable use of forest genetic resources is a crucial factor in ensuring the resilience and productivity of forests and trees. Pressures and stressors such as population growth, land-use and climate change, unsustainable forest use, wildfire and pests are causing deforestation, forest degradation and associated losses of forest biodiversity, both among and within species (FAO, 2014b). Modern biotechnology tools are helping increase understanding of genetic variation within and between populations of species in natural forests, thereby increasing knowledge of genetic diversity in tree species. Better vegetative propagation techniques and marker-assisted tree selection are helping improve the quality of planted forests (FAO, 2014b), and the use of tree genetic modification is growing in the planted-forest industry (Box 7.1). Such technologies can help increase tree productivity and reduce costs – incentivizing industries to shift away from natural forestry (Hong, Bhatnagar and Chandrasekharan, 2016), but many promising species still need more research to be domesticated and fully used. Biotechnologies are being applied to help track timber movements as a means for curbing illegal forest harvesting (see Box 7.8 later in the chapter).

Forest management

The management of natural forests is increasingly focused on integrating economic, social and environmental objectives according to the principles of SFM (FAO, 2009) and through landscape approaches. SFM is a multidimensional and multipurpose concept (FAO, 2018d): its implementation is becoming increasingly complex, often entailing trade-offs between objectives through informed planning and management, which, in turn, requires a strong scientific and technological base. There are limits to the application of new technologies in natural forest management due to the dominant role of natural processes, especially in the case of complex ecosystems such as tropical forests. Nevertheless, technologies in common use in the Asia-Pacific region with the aim of improving forest management include remote sensing and geographic information systems and some of those used in reduced impact logging (Box 7.2).

Advanced technologies to increase productivity and improve tree growth are

BOX 7.1

The genetic modification of trees

Although some countries in the Asia-Pacific region are pursuing programmes to genetically modify trees with the aim of increasing wood production and quality, no commercial planting has yet been reported (FAO, 2014b). China (FAO, 2012b) and India (FAO, 2012c) have reported the development of large-scale clonal plantations of some economically important species (e.g. *Eucalyptus* spp., *Tectona grandis* and *Populus* spp.) using biotechnology (FAO, 2014b). Biotechnologies could potentially be used to introduce desirable traits not present in natural gene pools, such as resistance to certain pests, the bioremediation of polluted water and lands, and tolerance to abiotic stresses such as drought and salinity. There are concerns about the safety of genetically modified trees, particularly the potential long-term environmental impacts due to changes in gene flow, although the development of transgene containment strategies may be a means for addressing this issue (Hong, Bhatnagar and Chandrasekharan, 2016).

The limitations to commercializing genetically modified trees are more legal and social than technical (Hong, Bhatnagar and Chandrasekharan, 2016). Countries that lack adequate institutional and policy frameworks for the conservation, sustainable use and development of forest genetic resources will need to address these limitations before moving towards transgenic tree production.

BOX 7.2

Reduced impact logging

Reduced-impact logging (RIL) is the careful planning and control of timber harvesting operations to minimize the environmental impact and waste that result from conventional forms of logging. It is implemented through codes of practice and guidelines designed to improve forest management planning, road construction, tree felling, bucking, log yarding and post-harvest interventions (FAO and USAID, 2012). Benefits derived from RIL include reductions in the damage caused by tree harvesting to forest soils, hydrology, forest growth and biodiversity, as well as improved worker safety, increased wood recovery, and improvements in the livelihoods of rural communities. The introduction of RIL in Southeast Asia is an example of technology transfer from temperate to tropical forests. RIL has been promoted widely in the tropics, and many countries have made good progress in the development of codes of practice and guidelines. But the wide application of RIL has been limited by factors such as weak institutional capacity, low political commitment, the perceived financial costs of RIL (although efficiencies can provide net financial benefits), and a lack of incentives (FAO and USAID, 2012). RIL is also a way of reducing greenhouse-gas emissions resulting from harvesting practices in natural production forests (Ruslandi, 2018).

increasingly being applied in planted forests, including through tree improvement programmes and tree genetic modification (see above). Precision forestry is another approach using modern tools and technologies to improve forest management and decision-making (Box 7.3).

A new technological wave is breaking

Artificial intelligence, virtual-reality technologies and autonomous vehicles are part of an oncoming technological wave enabling the development of new, sophisticated approaches and models

BOX 7.3

Precision forestry and continuous improvement

Precision forestry is the use of modern tools and technologies such as remote sensing, navigation systems and geographic information systems to improve forest management and decision-making, and it holds considerable promise for reducing the delivered cost of wood, increasing yields in a given area of forest, and maintaining ecosystem services. Precision forestry involves a transition from highly manual, broad-based management systems to systems characterized by site-specific management, digitization and automation. It is especially gaining interest among planted-forest companies focused on continuous improvements in productivity. For example, mechanized harvesting such as cut-to-length systems are being adopted in planted forests in some developed parts of the Asia-Pacific region.

Precision forestry makes use of a wide range of technologies, such as drones, laser scanners, environmental sensors and decision-support tools such as big-data analytics.[21] It has the potential to improve forest management by enabling:

- full oversight of operations with improved data collection;
- increased genetic selection of tree seeds, as per production requirements;
- the automation of operations, from nurseries to wood logistics; and
- optimized decision-making.

Precision forestry has been adopted in many developed economies, including Australia and New Zealand, where labour is expensive and the financial capacity exists to invest in modern technologies. It is yet to flourish in most developing and least-developed economies in the region – where labour is cheap and the capacity to adopt modern technologies is generally low.

Source: Choudhry and O'Kelly (2018).

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[21] Big-data analytics is a field involving the use of predictive analytics, user-behaviour analytics and other advanced analytics methods to analyse very large and diverse datasets.

in forestry; for example, an information technology company in New Zealand is testing the use of unmanned aerial vehicles (usually called drones) to replace conventional methods for transporting tree seedlings to planting sites. The drones not only deliver tree seedlings but also food and water to planters throughout the day (Herries, 2018). Such sophisticated technologies have pros and cons, and their roles will differ among countries in the region. Automation may cause some jobs to become obsolete, generate new kinds of job, and magnify income disparities between skilled and semi-skilled labour (Schwab, 2016), potentially exacerbating social tensions. It is important, therefore, that the coming technological wave is accompanied by opportunities for workers to learn new skills. New infrastructure and adequate investment will also be required.

Environmental monitoring

New technologies promise vast improvements in environmental monitoring

The accurate measurement and real-time monitoring of natural resources is a necessary precondition for their effective and efficient management. The prominence of the forest sector in climate-change negotiations under the UNFCCC, particularly in relation to REDD+ (Article 5) and the Enhanced Transparency Framework (Article 13) of the Paris Agreement on climate change, has further emphasized the importance of monitoring forests and changes in forest cover over time. Forest monitoring enables measurement of the contributions of forests to emissions or removals of greenhouse gases, and it also increases knowledge on resilience in the face of climate change through indicators on, for example, biodiversity and water services at the national and subnational levels (Dattaro, 2016; UNFCCC, 2015).

Recent international developments have revolutionized the field of earth observation. Copernicus, an earth observation programme coordinated and managed by the European Commission in partnership with the European Space Agency, has launched a constellation of satellites for measuring planetary features at various spatial and temporal resolutions, providing freely available, continuous, accurate, timely and high-quality data. The United States Geological Survey's free-and-open data policy has also greatly increased the use of earth observation data in forest research and applications. Future missions, such as Landsat 9 and the NASA-ISRO Synthetic Aperture Radar, will further assist forest monitoring. Recent advances in cloud-based remote-sensing technology and open-source forest monitoring tools (Box 7.4 and Box 7.5) have led to an increase in open scientific data for use by policymakers and practitioners beyond academia. Such technologies, the use of which requires less advanced technical expertise than in the past, are enabling scientists to provide policymakers, international donors, non-governmental organizations and other development partners with customized products for monitoring and evaluating forest resources. Operational examples include near-real-time water-quality (Markert *et al*., 2018) and vegetation monitoring platforms (Poortinga *et al*., 2018) that can be

BOX 7.4

FAO-hosted open-source forest monitoring tools

FAO hosts a suite of free, open-source software tools to facilitate flexible and efficient data collection, analysis and reporting, including the System for Earth Observations, Data Access, Processing and Analysis for Land Monitoring (SEPAL) and the Open Foris toolkit.

SEPAL is an easy-to-use platform that offers developing countries unparalleled access to spatial data and supercomputing power, thereby enabling countries to improve the accuracy and transparency of national plans aimed at mitigating climate change and fine-tuning land-use policies and their implementation.

Open Foris comprises five tools – Collect, Collect Mobile, Calc, Collect Earth, and Collect Earth Online – with functions useful for the rapid assessment of forests and continuous forest monitoring. Forest stakeholders such as governments, research institutions and non-governmental organizations are using these tools for forest inventories, climate-change reporting, biodiversity assessments, deforestation monitoring, the detection of desertification, assessments of trees outside forests, and assessments related to greenhouse-gas emissions due to land-use change and forestry.

The continuous development of these tools is made possible by a collaborative effort between FAO and numerous public and private institutions. Collect Earth Online, for example, brings together the National Aeronautics and Space Administration (NASA), the United States Forest Service and Google. Based in the cloud, it promotes consistency in the location and interpretation of data for monitoring land-cover and land-use change and supports simultaneous data entry by multiple users, who require only an Internet connection.

In the Asia-Pacific region, these tools have been used widely by forest administrations, including in Bangladesh, Bhutan, Mongolia, Myanmar and Papua New Guinea, to assist in the development of national forest inventories (NFIs) and in the interpretation and analysis of NFI data. The application of these open-source tools and platforms is further explored through the Global Forest Observation Initiative, bringing together FAO, academic and research institutions, governments and private bodies with a shared interest in improving the quality of, access to, and use of, data related to forests. For example, SERVIR, a partnership between the United States Agency for International Development and NASA, aims to build on SEPAL's existing capabilities to coordinate the interpretation of forest data by environmental decision-makers in developing countries at a regional level, working, for example, in the Himalayan and Lower Mekong subregions.

used for the analysis and quantification of many environmental and ecological indicators.

Leveraging advanced geospatial technologies, some countries (including Bangladesh, Papua New Guinea, Sri Lanka and Viet Nam) are deploying national forest monitoring system web portals (FAO, undated [b]). National portals bring together information from satellite land monitoring systems, which collect and assess data on change in land cover and land use related to forest areas; information from national forest inventories relevant for estimating biomass and stock changes in different categories of forest; and greenhouse-gas inventory data. The development of these portals was initiated as part of efforts in these countries to measure and report on greenhouse-gas emissions from their forest sectors as part

BOX 7.5

Other open-source forest monitoring tools

The JICA-JAXA Forest Early Warning System

Launched in November 2016, The JICA-JAXA Forest Early Warning System in the Tropics was created through a partnership between the Japan International Cooperation Agency (JICA) and the Japan Aerospace Exploration Agency (JAXA) to enable the early detection of deforestation. The system has three key features: 1) it is based on the ALOS-2 system, which can transmit and receive microwaves without being affected by cloud cover or rain; 2) it provides coverage of tropical forests in 77 countries every 1.5 months; and 3) it allows free access from personal computers and mobile devices anywhere in the world.

Source: JICA (2017).

Global Forest Watch Fires

Global Forest Watch Fires is an online monitoring tool to provide users with real-time information on forest and land fires. It combines real-time satellite data from the National Aeronautics and Space Administration's Active Fires System, high-resolution satellite imagery, detailed maps of land cover and concessions of key commodities such as palm oil and wood pulp, and information on weather conditions and air quality to track fire activity and related impacts in Southeast Asia. It also provides a rapid analysis of fire occurrence and can help quicken fire response times, step up action against illegal fires and increase understanding of who might be responsible for fires. Global Forest Watch Fire is available free of charge, and it involves an open-data approach to enable quick decision-making.

Source: Global Forest Watch Fires (undated).

of REDD+ strategies or as their nationally determined contributions to the Paris Agreement on climate change. The transparent and open access to forest data that these portals provide have the potential to improve timely and objective decision-making in forest policy and management in general and to help reduce threats to forest areas (BFD, FAO and SilvaCarbon, 2018).

Open-data platforms such as these create transparency, give local communities and other non-governmental and private stakeholders greater access to information, and facilitate participation in environmental monitoring and reporting. Conversely, the wide availability of data on forest resources carries the risk of making illegal logging and encroachment easier and more profitable. Adequate

Terra-i

Terra-i is a real-time monitoring system for detecting land-cover change resulting from human activities; it produces updates every 16 days. The system is based on the premise that natural vegetation follows a predictable pattern of change in greenness due to changing land and climatic conditions. The system employs artificial intelligence to learn how the greenness of a given pixel responds to rainfall. It then applies the model to identify anomalies (e.g. non-natural fluctuations in greenness) in the time series that could be attributed to human activities. Terra-i data are free to download, and the system has been used to study deforestation risk areas, protected-area effectiveness, and road impacts. A unique feature of the tool is that countries can calibrate it according to their specific contexts. The tool has been deployed in Cambodia and Viet Nam to support conservation efforts.

Source: International Center for Tropical Agriculture (2017).

The Spatial Monitoring and Reporting Tool

The Spatial Monitoring and Reporting Tool (SMART) is a protected-area management tool brought about by a collaborative partnership of nine global conservation agencies. It is open source, non-proprietary and freely available. The SMART software and a mobile application allow users to collect, store, communicate and analyse ranger-collected data on illegal activities, wildlife, patrol routes and management actions to understand where efforts should focus and to evaluate ranger performance. SMART Connect is a new cloud-based extension of SMART. It allows rangers to manage and respond to real-time threats with ease and speed. SMART is already in use in many countries in the Asia-Pacific region, including Bhutan, Cambodia, Indonesia, Malaysia, Nepal, Pakistan, the Philippines, Thailand and Viet Nam.

Source: SMART (undated).

laws, regulations and enforcement measures are required, therefore, to close legal loopholes and prevent the misuse of data.

White *et al*. (2016) identified four advanced remote-sensing technologies with the biggest implications for forest inventories and monitoring: laser scanning (also known as lidar), in both 1) airborne and 2) terrestrial applications; 3) digital aerial photogrammetry; and 4) high-spatial-resolution/very-high-spatial-resolution satellite optical imagery.

Among these, airborne lidar is a transformative technology because of its capacity to provide considerable spatial detail and accuracy across large areas and a diverse range of forest types. Airborne lidar is an active form of remote sensing that can measure the three-dimensional distribution of vegetation within forest canopies and is suitable for studying vertical forest structure. It has the potential to generate measurements that otherwise would require traditional in-the-field geodesic surveys at considerable effort and cost (although the cost-effectiveness of lidar is yet to be determined). Combinations of lidar and digital aerial photogrammetry have considerable potential for the monitoring of a broad range of forest attributes over time (White *et al*., 2016). Nevertheless, although remote-sensing technologies have advanced tremendously in recent years, they have limited application in the assessment of parameters such as species richness, species diversity and species density (Joseph, Murthy and Thomas, 2011).

Product innovation

Economic, social, political and technological changes are influencing consumer needs and purchasing behaviours. Major drivers of innovation in wood-processing technologies and wood-based materials include consumer demand for low-cost end products; intense market competition with non-wood-based materials; a changing forest resource base towards fast-grown, small-diameter trees; and ongoing discourses on climate change and low-carbon circular economies.[21]

Industries are discovering new uses for wood

Advances in biotechnology and nanotechnology are enabling the production of new-generation wood-based materials such as bioplastics, natural chemicals, bioenergy and pharmaceuticals (FAO, 2010a).

Cellulosic technologies can use a wide range of woody biomass, including agricultural and forest waste and residues and municipal solid waste. Lignocellulose can also be obtained from planted trees and shrubs (e.g. willows and eucalypts) and dedicated short-rotation grasses (e.g. switch grass) (USAID, 2009). Biofuels are being considered as a substitute for

[21] A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals that impair reuse and can return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models (World Economic Forum, undated).

BOX 7.6

Biofuel from jatropha in India

India has been promoting biofuel production and use to meet growing energy demand, reduce oil imports and improve energy security. In the last decade, India has launched major national policies to promote a sustainable biofuel industry and mandated the use of 20 percent renewable fuels by 2017. The production of biodiesel from jatropha (*Jatropha curcas*) was a major means for meeting this target, but jatropha biodiesel production could not be sustained due to insufficient yields and revenues. Governments offered a minimum purchase price and provided fiscal incentives to farmers to cultivate jatropha and other non-edible oilseeds. The seed yield is assumed to be 2.5 tonnes per hectare, with a biodiesel recovery rate of 30 percent; thus, an estimated 25 million ha and 40 million ha of jatropha crops would be needed to meet the 20 percent blending target by 2020–21 and 2030–31, respectively. Prospects for an ambitious biofuel pathway have been hindered by a lack of good-quality planting stock, disputes over the ownership of degraded lands targeted for planting, suboptimal processing and marketing infrastructure, and underdeveloped distribution channels. The most recent (2018) national policy on biofuels emphasizes the application of advanced technologies for biofuel generation, the establishment of second-generation biorefineries, and an increased role for village panchayats and communities in augmenting domestic feedstock supply for biofuel production.

Sources: Government of India (2018); Purohit and Dhar (2015).

fossil fuels in the transportation and energy sectors, with potential to reduce a country's greenhouse-gas emissions and dependence on oil imports (Box 7.6). Many countries have (or are formulating) national policies to promote biofuel production and use, and substantial investments are being made to develop and commercialize technologies for producing biofuels from cellulose. Sixty-seven second-generation biofuel facilities are in operation worldwide, one-third of them at a commercial scale (Nguyen *et al*., 2017); of those, 13 are in the Asia-Pacific region (four of which are operating at a commercial scale), mostly producing cellulosic ethanol. Australia, China, India, the Philippines and Thailand are all producing significant quantities of wood-based biofuels.[22]

Biofuel production can boost rural economies because most cellulosic biofuel production facilities are located in rural

[22] Biofuel production in Indonesia and Malaysia is based almost exclusively on palm oil.

areas where feedstock is abundant; globally, biofuel production is providing an estimated 2.5 million direct and indirect jobs (Nguyen *et al*., 2017). The wider adoption and commercialization of cellulosic biofuel technology faces a range of challenges, however: for example, it is capital intensive; many investors are yet to be convinced of the economic feasibility of conversion technologies without subsidies; and relatively low prices for fossil fuels reduce the competiveness of biofuels (Nguyen *et al*., 2017).

Nanotechnology has the potential to produce new biobased composites and nanomaterials and to achieve improvements in the performance-to-weight ratios of paper and packaging products. Cellulose nanomaterials are still in the research-and-development phase, but there are potential applications in paper and packaging, food, health, construction, sensors and electronics (Bowyer, 2016). Biosensors (made from cellulose nanocrystals) could be used in wood products to detect high-moisture-content zones vulnerable to decay, thus helping produce high-quality wood products. Nevertheless, the scaling up of nanotechnology processes in the forest sector is uncertain, despite investments by some developed economies, including Japan.

Green buildings are going up

Commitments made by countries in the SDGs, the Paris Agreement on climate change and other international processes are helping drive a push towards low-carbon economies with minimal greenhouse-gas emissions. This, in turn, has helped stimulate interest in green buildings and the use of renewable materials such as wood in construction. China, for example, is pursuing green wood construction in its 13th five-year plan (2016–2020) to achieve emission reduction targets (RAFT, 2019). Innovations in wood science such as cross-laminated timber (Box 7.7)

BOX 7.7

New engineered wood – cross-laminated timber

Cross-laminated timber (CLT), an engineered wood product developed in Europe in the early 1990s (Muszynski *et al*., 2017), is revolutionizing the use of timber in construction. It comprises large solid-timber panels made from layers of boards glued together on their wide faces, with each layer oriented perpendicularly to adjacent layers. With its relatively low weight and easy-to-attach characteristics, CLT can be assembled quickly on site, and it can also be prefabricated off-site. CLT markets in Australia and New Zealand, although small now, are expected to grow strongly in the next five years as demand increases in residential and non-residential construction (Anonymous, 2018). CLT is also gaining popularity in Singapore for its cost-effective and low-carbon benefits; the Singapore Civil Defence Force revised its fire codes to allow the use of CLT in structural building components (Lim, 2014).

and new construction techniques and fire-proofing technologies are enabling the construction of tall mass timber buildings. An 18-storey wood-hybrid high-rise was completed in Vancouver, Canada, in 2017 (UNECE and FAO, 2017), and construction of the world's tallest wooden building – 70 stories high – is planned in Tokyo (UNECE and FAO, 2018). The International Code Council's recent approval of tall mass timber codes (to be included in the 2021 International Building Code) could help increase the market for tall mass timber buildings (Fabris, 2019).

Three-dimensional (3D) printing using wood waste (e.g. from construction and furniture) is another technology under exploration in the forest sector, although there is considerable uncertainty about its future role. Most existing 3D printing technology is being deployed in the automotive, aerospace and medical industries (Schwab, 2016).

Forest governance

Forest governance can benefit from new technologies

Legality and good governance are essential elements of SFM. In many parts of the region, improving forest governance requires better forest monitoring and law enforcement; increased cross-border collaboration and information-sharing; and providing forest users with adequate access to information on how to comply with legal requirements (FAO, undated [c]).

The increased international discourse on forest governance and technological developments (especially the proliferation of information and communication technologies) in recent years has transformed the supply and management of forest-related information. Timber verification is increasing in importance, driven by consumer demand and policy change. Several timber-tracking technologies are being developed, tested and deployed to track the movement of logs and timber through supply chains, including radio-frequency identification tags, barcodes, and luminescent nanoparticles. Data generated through such means are aggregated and analysed to verify timber authenticity. DNA technologies are also emerging in which cutting-edge genetics and chemical testing are used to detect illegal timber entering global supply chains (Box 7.8). Box 7.9 describes how a non-governmental organization is making innovative use of acoustic technologies to monitor illegal logging in Sumatra.

Disputes over land tenure and ownership are common in many parts of the Asia-Pacific region, exacerbated by missing or poorly managed records. A lack of clarity on land tenure handicaps local forest-dependent communities in claiming rights over land controlled by the private sector or governments and is a major cause of conflict. To address the problem, governments are leveraging technologies to improve land mapping and the management of land-ownership information. The aim of Indonesia's One Map geoportal initiative, for example, is to reconcile conflicting land-rights claims (Box 7.10).

Technologies have increased public access to information, and agile governments are harnessing new-generation technologies

BOX 7.8

Securing Myanmar teak supply chains with DNA

In Myanmar, teak logs are stamped to identify the forest of origin, yet overharvesting and the mixing of logs from different forest areas has been a historical problem. In a move to facilitate trade flows for teak exporters in Myanmar, an Australian university and a technology company collaborated to develop a genetic reference dataset for Myanmar teak. The system is designed to support the Myanmar timber trade in meeting increasingly strict import regulations in Australia, the European Union and the United States of America. DNA tests will be applied to help validate the stated origin of harvest described in government documentation. The project seeks to remove doubt about timber origin, create certainty for industry and consumers, open markets for Myanmar timber, and increase revenue for legal timber traders and the government by providing a mechanism by which suppliers can demonstrate transparency. Work is underway to integrate DNA verification with the national Myanmar Forest Certification Standards (now under development). Independent scientific verification, combined with other initiatives to improve forest management and governance, could provide Myanmar teak with a market advantage. By selecting certified teak with additional DNA verification, buyers sourcing teak under their respective timber regulations will be able to demonstrate best-practice due diligence and risk mitigation.

Sources: Lin (2017); MFCC (2018).

BOX 7.9

Acoustic monitoring of illegal logging in Indonesia

In the Kalaweit Supayang Gibbons Reserve in northern Sumatra, Indonesia, a non-governmental organization has developed an acoustic monitoring system to provide real-time alerts on illegal logging. The system uses old mobile phones, cloud computing and solar panels to record and detect chainsaw noise within a 1-km radius. The mobile phones are placed strategically, and the system immediately alerts local authorities when chainsaw noise is detected. The system has potential to improve forest law enforcement if deployed to monitor larger areas and adopted widely by forest stakeholders.

Source: Nunez (2017).

BOX 7.10

Indonesia's One Map

Indonesia's One Map initiative is consolidating land-use data from disparate sources in a single database and making it accessible to the public via a geoportal. The objective is to resolve overlapping land claims, eliminate disparities between the maps used by different levels of government, ensure consistency and provide clarity. One Map also seeks to resolve disputes over the issuing of permits for mining, plantations and forest conservation. To date, 83 thematic maps have been integrated, and the integration of two more maps is underway.

Source: Gokkon (2018).

BOX 7.11

India's Forest Protection Management Information System

The Forest Protection Management Information System (FPMIS) is an e-governance initiative by the state of Andhra Pradesh, India, in which the state forestry department uses information and communication technologies to simplify and facilitate the exchange of information between different levels of government and enable quick decision-making. The FPMIS integrates management information, a geographic information system and remote sensing to streamline the management process and increase accountability, transparency and efficiency. The FPMIS is helping the forestry department manage both human and forest resources and report and monitor violations of forest laws. Challenges in shifting to an e-governance platform included a shortage of computer skills, low funding, and a lack of motivation among some staff to embrace transformative change to the conventional system.

to assist administration and pursue e-governance initiatives to improve efficiency, transparency and interactions between governments and citizens. The Government of Andhra Pradesh, India, for example, used information and communication technologies to develop the Forest Protection Management Information System (Box 7.11), and it has deployed blockchain[23] to make land records tamper-proof and ensure transparency and accountability.

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[23] A blockchain is a decentralized, distributed and public digital ledger used to record transactions across many computers so that any involved record cannot be altered retroactively without the alteration of all subsequent blocks. This enables participants to verify and audit transactions independently and relatively inexpensively (Wikipedia contributors, undated).

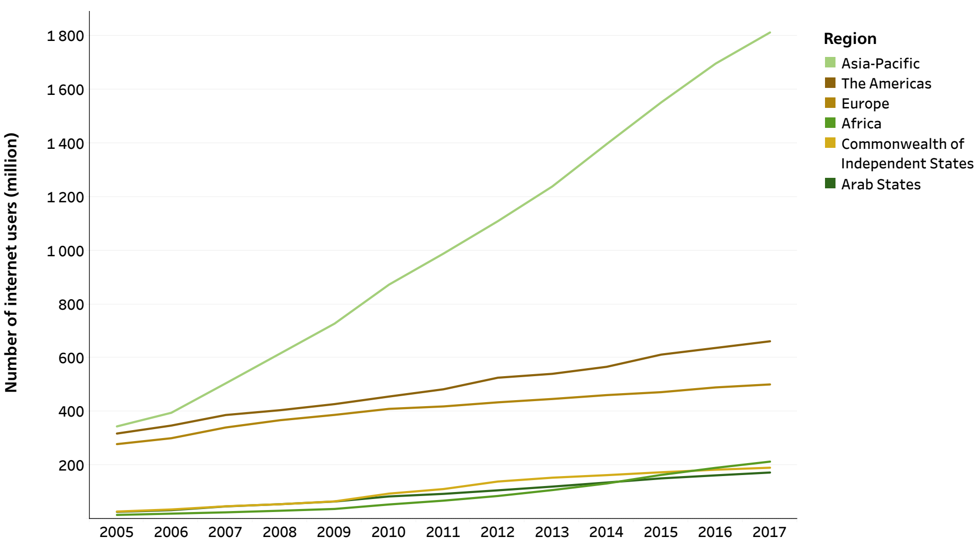
Greater Internet access could empower forest communities

Information and communication technologies have transformed how and when people connect, engage, communicate and even learn. Today, Internet access is empowering individuals to, for example, participate in civic debates, create or join interest groups, obtain and disseminate information, encourage innovation and democracy, educate the public and acquire new knowledge and skills. Figure 7.1 shows the rise in the number of individual Internet users in the main world regions; the Asia-Pacific region contains almost half the world's Internet users. Figure 7.2 shows that, of countries in the Asia-Pacific region, the highest percentages of Internet use (more than 90 percent of the population) are in Japan and the Republic of Korea. Figure 7.3 shows that the number of users accessing the Internet through mobile devices is rising quickly in the region.

Many forest-dependent communities in remote areas have no or limited electricity and Internet services. Such communities serve as on-the-ground forest custodians but may be highly vulnerable to forest-related fire, illegal encroachment and evictions. Access to information and communication technologies, including the Internet, however, is empowering them to participate in the community-based monitoring of forest crimes and forest resource management (Box 7.12) and to obtain forest-related benefits such as increased access to information on timber markets.

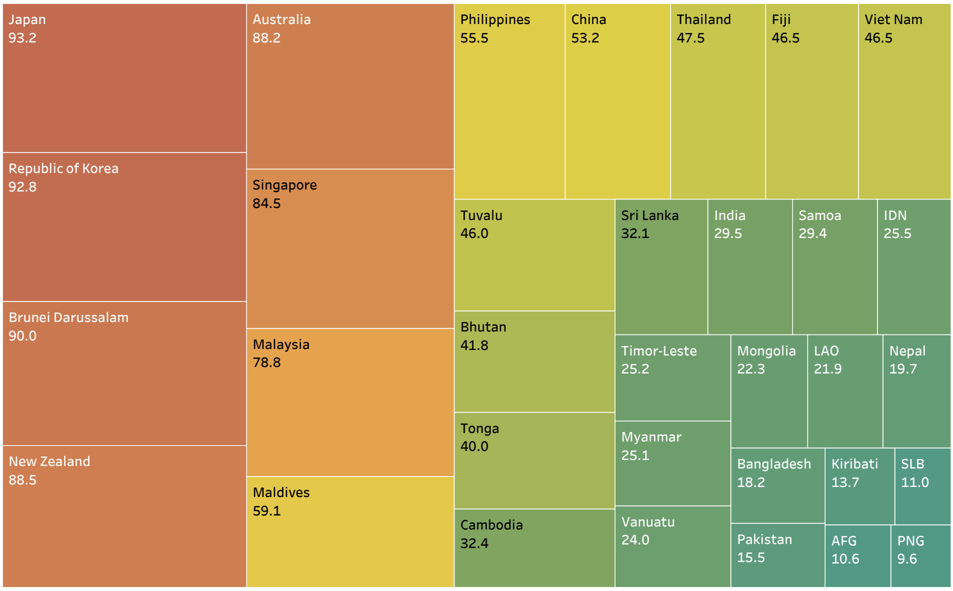
The widespread use of social-media platforms such as Facebook and Twitter is having profound economic, social,

Figure 7.1. Number of individual Internet users, by world region, 2005–2017



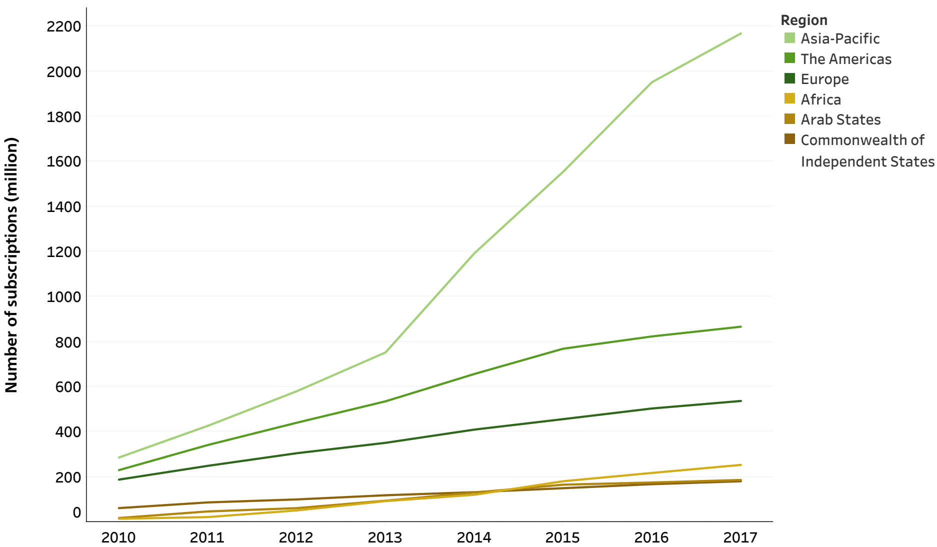
Note: Data for Asia-Pacific include non-APFSOS countries.
Source: ITU (2019).

Figure 7.2. Internet users as a percentage of the total population, countries in the Asia-Pacific region, 2016



Notes: Numbers represent percentage of total population. AFG = Afghanistan; IDN = Indonesia; LAO = Lao People's Democratic Republic; PNG = Papua New Guinea; SLB = Solomon Islands.
Source: ITU (2019).

Figure 7.3. Number of active mobile broadband subscriptions, by world region, 2010–2017



Note: Data for Asia-Pacific include non-APFSOS countries.
Source: ITU (2019).

BOX 7.12

Community-based forest management using information and communication technologies in Cambodia

Recent research in Prey Lang, Cambodia, has demonstrated the capacity of local communities to initiate, design and implement programmes to monitor and report forest crimes using information and communication technologies. More than 200 000 people live in Prey Lang, the largest lowland evergreen forest in the Indo-Burma region, including Kuy indigenous communities and Khmers. The Prey Lang Community Network (PLCN) is a network of local forest activists created to monitor and report illegal logging associated with economic land concessions in forests. PLCN members undertake forest patrols to intercept illegal loggers and seize chainsaws and other logging equipment. In collaboration with the PLCN, scientists at the University of Copenhagen developed a smartphone application based on the Sapelli Platform to collect data generated by the monitoring programme, and workshops were held to train the patrollers in the use of the smartphone app. PLCN members with minimal formal education proved able to collect large amounts of validated data, irrespective of age and gender. Increasing the complexity of the app had no impact on the quality of data collected, although patrollers faced challenges with uploading data and obtaining strong mobile service signals.

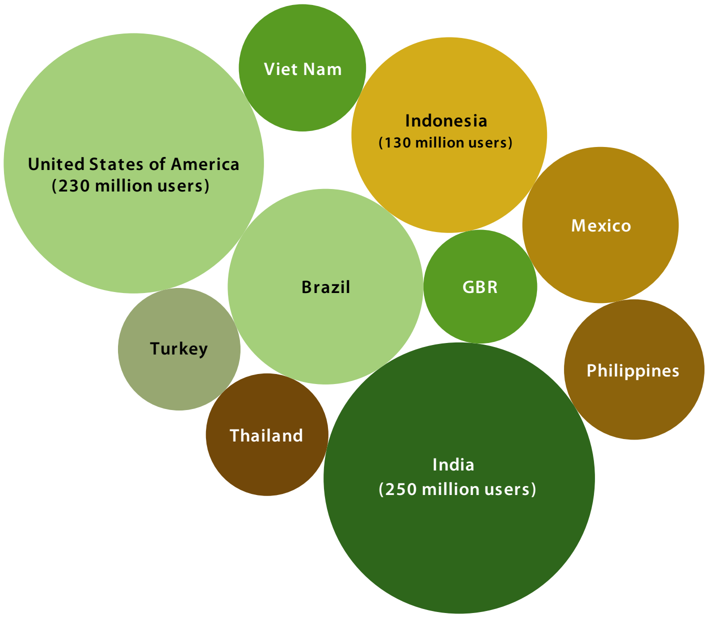
The PLCN requires external support to maintain software and hardware and the digital validation process. Nevertheless, the limited phone service in remote areas was found to be a greater challenge than the capacity of community members to use the technology correctly.

Source: Brofeldt *et al*. (2018).

political and cultural impacts worldwide. The Asia-Pacific region accounted for 947 million monthly active Facebook users in December 2018 (Facebook, Inc., 2019) and is that platform's largest and fastest-growing region. Of the top ten countries worldwide for active Facebook users in 2017, five (led by India) were in the Asia-Pacific region (Figure 7.4).

Today, 43 percent of the world's population has regular access to the Internet; this is projected to rise to 90 percent by 2025 (Schwab, 2016), and the creation of Internet-based content and its dissemination will become increasingly easy and widespread. Some commentators consider that access to the Internet will become a basic right in the future:

Figure 7.4. Top ten countries in the world for active Facebook users, 2017



Note: GBR = United Kingdom of Great Britain and Northern Ireland.
Source: We Are Social (2017).

for example, the United Nations Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression stated that, "Given that the Internet has become an indispensable tool for realizing a range of human rights, combating inequality, and accelerating development and human progress, ensuring universal access to the Internet should be a priority for all States" (La Rue, 2011).

On the other hand, the increasing use of social media could pose significant challenges for the forest sector and forest-dependent communities. Social-media platforms have become major sources of news and information for billions of people, but these are vulnerable to manipulation, including for spreading misinformation and distorting public opinion. For example, social media tend to promote "confirmation bias" by developing communities of like-minded individuals who share information that reinforces their commonly held opinions. Similarly, social-media platforms use algorithms to select and personalize the information that users receive based on assessments of their interests and opinions. Another challenge is the oversimplification of information, such as in social-media platforms that restrict the length of messages. Understanding how social media works, therefore, is crucial if the forest sector is to communicate its messages effectively and increase its transparency.

Markets and finance

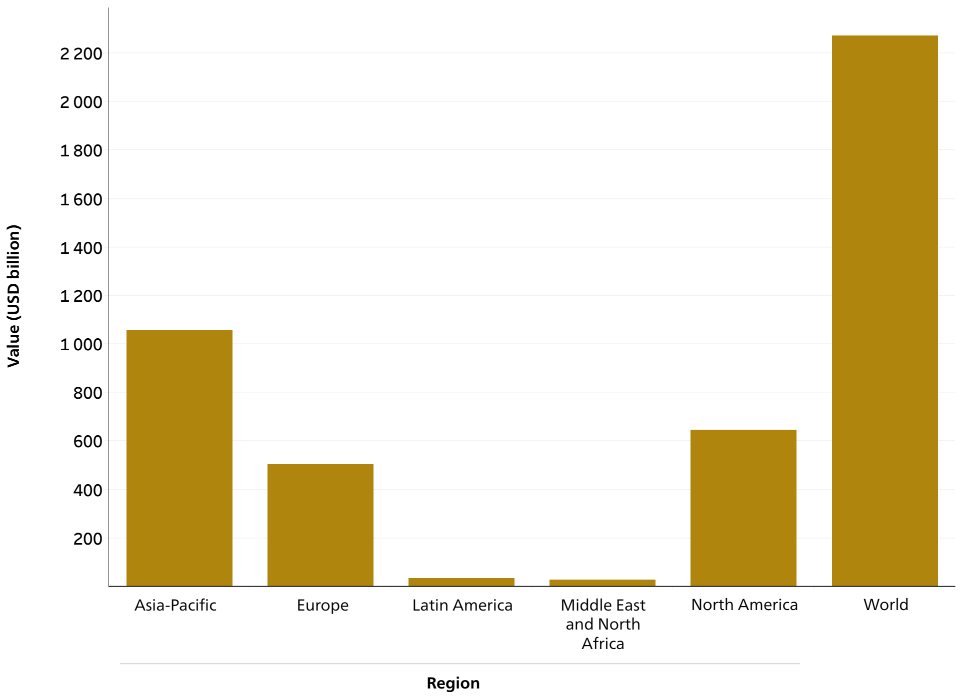
Digital technologies are transforming markets and finance

E-commerce (commercial transactions conducted electronically on the Internet) and developments in financial services technologies are transforming the way in which businesses operate and access finance. Of the world regions, Asia-Pacific had the largest share of the business-to-consumer e-commerce market in 2015 (Figure 7.5), and it is also the fastest-growing region in this field; cross-border e-commerce is expected to rise rapidly in the region (Figure 7.6).

There are advantages in embracing e-commerce: for example, e-commerce enables companies to gain access to global markets, compete on an international scale, improve economic efficiency and create jobs. It also offers the prospect of narrowing the gap in economic development and the rural–urban divide and increasing inclusiveness (ADB and ESCAP, 2018).

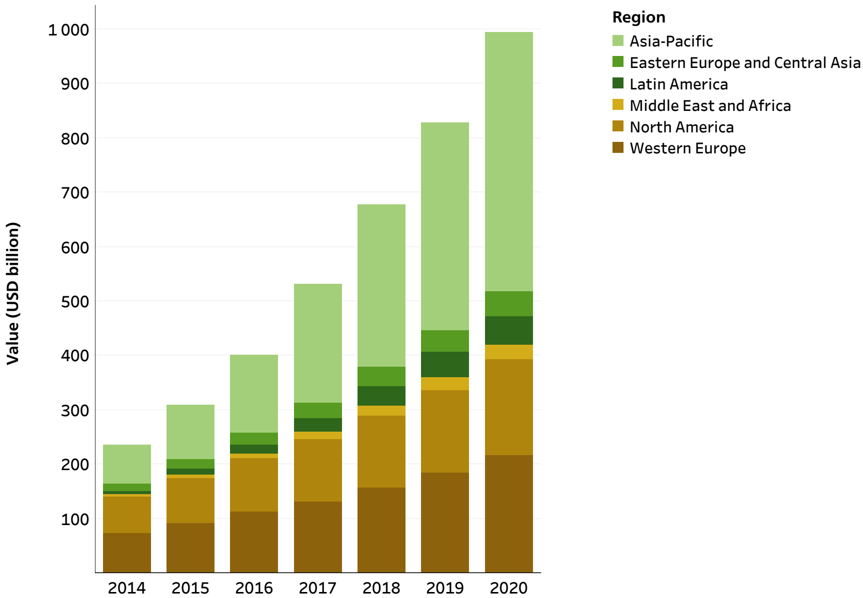
The development of e-commerce in the Asia-Pacific region varies widely. According to the E-commerce Index, the Republic of Korea ranked fifth globally in participation in e-commerce (with a score of 95.5) in 2017, and Afghanistan

Figure 7.5. Value of business-to-consumer e-commerce, by world region, 2015



Note: Data for Asia-Pacific include non-APFSOS countries.
Source: ADB (2018).

Figure 7.6. Actual and forecast value of cross-border business-to-consumer e-commerce market, by world region, 2014–2020



Note: Data for Asia-Pacific include non-APFSOS countries.
Source: ADB (2018).

ranked 132nd (with a score of 17) (UNCTAD, 2017). The variation in the region stems from differences in the extent to which economies engage across borders and how they access the Internet (ADB and ESCAP, 2018); Australia, China, New Zealand, the Republic of Korea and Singapore are among the region's biggest users of cross-border e-commerce. Emerging technologies such as blockchain, machine learning, artificial intelligence, the Internet of Things and fifth-generation wireless systems, which are being adopted in various countries in the Asia-Pacific region (e.g. Australia, China, Japan and the Republic of Korea), are beginning to influence the online business environment, lowering transaction costs, improving the targeting of advertising and increasing data collection.

Such technological developments and trends could be immensely significant for the forest sector, potentially enabling small and medium-sized enterprises (SMEs) in particular to overcome long-standing barriers to expansion and innovation. SMEs play crucial roles in the processing, transport and marketing of wood and non-wood products in many parts of the region, but they are often isolated from markets and key services and dependent on locally sourced, low-value raw materials and unskilled labour (Nair, 2007); they may also be operated by socio-economically weaker segments of society (including indigenous peoples). Faced with such barriers, many SMEs lack the means to invest in improvements in management and product quality and in scaling up production. E-commerce holds promise for linking SMEs to global value chains and niche markets and thereby increasing revenues and profitability.

Developments in microfinancing and financial technology may also increase the access of SMEs, women's groups and entrepreneurs to finance through, for example, crowdfunding (Box 7.13) and the use of branchless banking technologies such as Internet banking. Another emerging financial service, mobile payments, could be used to disburse payments in certain payment schemes for ecosystem services.

Key enablers for accelerating technological development and innovation

Technological advances will continue to provide opportunities and novel solutions to challenges in the region's forest sector, but there are also risks – such as job losses for unskilled labour, invasions of privacy and the spread of misinformation. Moreover, there is considerable disparity between and within countries in access to some new technologies. For example, Australia, New Zealand and Japan are already using drones and advanced remote sensing in forest management, while other countries are yet to reap the benefits of these technologies. Perversely, the uptake of technologies is generally most constrained (by, among other things, a lack of financing and capacity) in less-developed countries, where new technologies could make the biggest differences to economic, social and environmental outcomes. A major challenge, therefore, is to expedite technology transfer to these countries, including through training and upskilling. The wider uptake of technological innovations in the region's forest sector will also depend on a number of key factors or enablers, including those discussed below.

Policies and laws must be catalytic and governments agile

Policies on technology transfer and the financing of environmentally friendly technologies will play a determining role in catalysing uptake in less-developed economies in the region. At the same time, effective policies and laws are needed to address the risks associated with modern technologies, such as the potential for surveillance and the loss of privacy and control over data; identity theft; breaches of ethics; misinformation; political fragmentation; and a decline in job opportunities, especially for unskilled workers.

BOX 7.13

Crowdfunding to plant trees

Tree Planet is a startup in the Republic of Korea that raises funds through mobile games and a crowdfunding platform to plant trees around the world (Ramirez, 2015). Tree Planet (undated) reported that the platform has enabled the planting of 1.5 million trees in 116 forests in 16 countries.

The public-sector institutions governing forests need to adapt to rapid technological change, requiring agility in their administration and management. With changing forest policy discourses and an increasing emphasis on participatory management, forest governance systems must become transparent, decentralized, accountable and efficient. E-governance initiatives that minimize bureaucracy, streamline benefit-transfer processes, enable greater participation in decision-making and provide mechanisms for resolving conflicts over land could be applied to help improve forest governance.

Some countries need vastly improved communication infrastructure

Inadequate infrastructure is a hindrance to the adoption of information and communication technologies such as remote sensing, the Internet of Things and geographic information systems. Although many countries in the region continue to upgrade access to the Internet and mobile broadband, very high penetration (e.g. more than 90 percent) is confined mainly to developed economies, and many less-developed economies are lagging well behind (ADB, 2015). Robust infrastructure is necessary to fully harness the potential of digital transformation and thereby narrow the digital and economic gaps.

The transfer of capital-intensive technologies may need public investment

Innovations such as nanotechnology, biotechnology and robotics are capital-intensive (although the price of hardware is expected to decline in the future; Schwab, 2016). The private sector is playing an important role in the uptake of some such technologies, mostly in the planted-forest sector, but not all countries are attracting investors. Major obstacles to technology transfer in forestry include financing; the capacity of the recipients; and intellectual property rights (Hetemäki and Nilsson, 2005). Innovations are often confined to large forest companies with the capacity and finance to administer intellectual property rights, which, on the other hand, hinder innovation in SMEs. Public-sector involvement and investment may be needed, therefore, especially to enable SMEs – which constitute major parts of the forest sectors of many countries – to take advantage of technological innovations.

Research and development institutions need strengthening

With the scope of forest research expanding to address issues such as climate change, landscapes, water, livelihoods and biodiversity conservation, new ways of working collaboratively and using multidisciplinary approaches are needed. Many forest research institutions still depend heavily on outside funding and technical knowhow, and strengthening their capacity is crucial if all countries in the region are to attain the necessary access to new technologies and approaches.

Forest education and training must ensure technological knowhow

Productivity-enhancing technologies such as automation, robotics and biotechnology could make many existing jobs obsolete and create new jobs that require specialized knowledge and skills in science and technology. Providing such training is largely beyond the current scope of education in forestry and natural resource management. Educational and research institutions imparting specialized forest-related knowledge will need to be creative in the courses and curricula they offer to help build skills in the use of emerging technologies.

Strategic partnerships will be most effective

Partnerships involving, for example, governments, non-governmental organizations, communities, forest enterprises, grower associations and organizations pioneering cutting-edge technologies will need to be forged to enable collaborative work in areas such as environmental monitoring, product innovation, landscape approaches and climate-change mitigation and adaptation. Such partnerships would help bring the capacity, knowledge, buy-in, information sharing and investment required to accelerate technological applications in forestry. For example, FAO is collaborating with Google to advance data access for sustainable forest and landscape management.

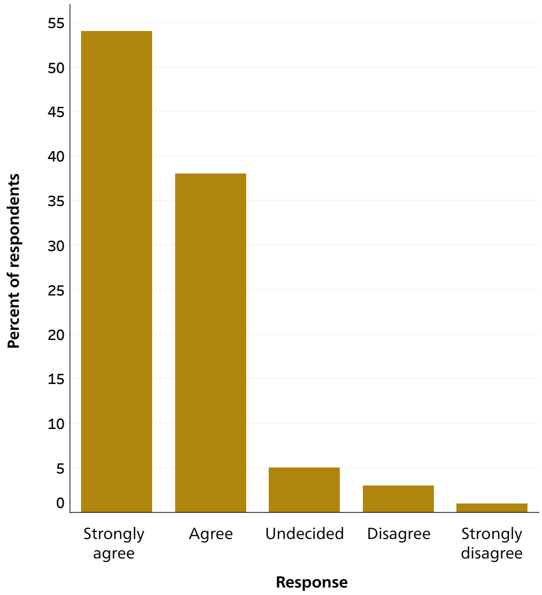
Youth perspectives on science, technology and innovation in forestry

There is a commonality between youth on the one hand and technology, science and innovation on the other – both wield immense power to change existing discourses and create new pathways for a sustainable future. Young people are the most technologically integrated generation and are generally first in line to embrace new technologies. A powerful combination of young people and technology is already creating path-breaking ways to demand action from governments on climate change. For example, using the power of social-media communication, School Strike for Climate led by Greta Thunberg – a young climate activist – motivated 1.4 million children in 125 countries to skip school in March 2019 in protest at the business-as-usual attitude of governments to climate change (Carrington, 2019).

A youth survey and regional youth consultative workshop was organized for APFSOS III to (among other things) probe the synergies between youth and technology, science and innovation in the context of forests and forestry and to gather the views of young people on the potential role of new technologies and innovation in forestry. Some 262 women and men aged 18–35 years from 32 countries took part in the survey.[24]

[24] The youth survey was conducted in February 2019 using an online platform and was open to any interested people aged 18–35 years from countries in the Asia-Pacific region. A call for participation was distributed through various email lists, organizations and youth networks. Therefore, respondents were self-selected and selection was not random. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals) and the other half came from other sectors (e.g. agriculture, environmental management and urban planning). Survey results should be interpreted carefully; the survey does not contain a representative sample and was unavailable to youth who lacked access to the Internet.

Figure 7.7. Responses of survey respondents to the statement, "Adaptation to new technologies and innovation in forestry has been slow and needs to accelerate its uptake in the Asia-Pacific region"



Notes: n = 217. The survey, which was conducted online in February 2019, was open to women and men aged 18–35 years from forestry and non-forestry backgrounds. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals). Not all respondents answered all questions.

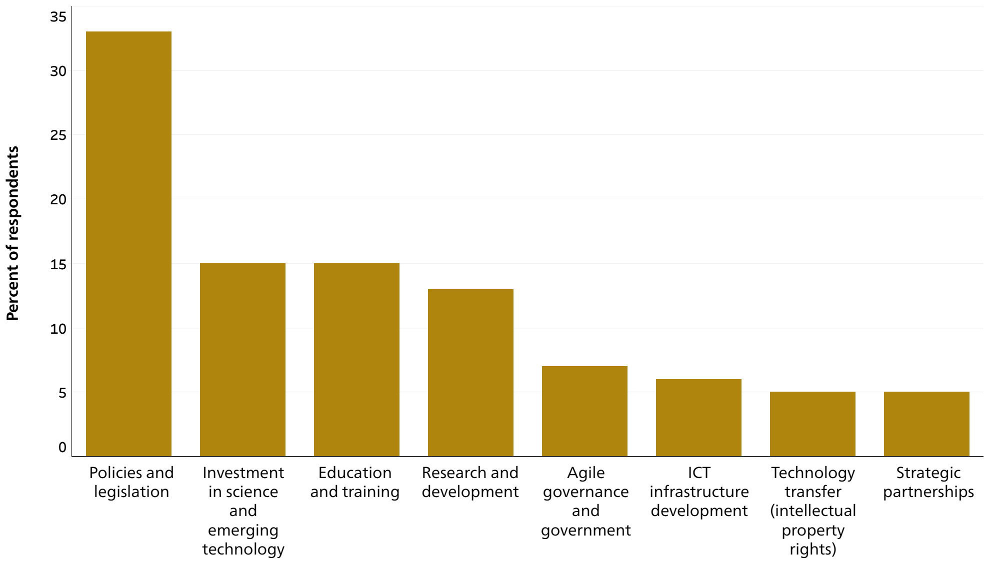
Nearly 54 percent of respondents strongly agreed that the uptake of new technologies and innovation in forestry in the Asia-Pacific region has been slow and needs to accelerate (Figure 7.7).

Figure 7.8 shows the factors considered by survey respondents to be key enablers of greater technological uptake in the forest sector. About 33 percent of respondents considered "policies and legislation" to be the biggest enabler. Education and training (15 percent) and investment in science and emerging technology (15 percent) were second-ranked, followed by research and development (13 percent). In the youth consultation, which involved 25 young people from 12 countries,[25] a participant queried whether governments have the capacity to maintain policies and legislation in line with the rapid pace of technological development.

The results of the youth survey and the outcomes of the consultative workshop showed that young people want opportunities – through training and other learning – to acquire new technology-based skills relevant to forestry and foresters (Figure 7.9). Some survey respondents

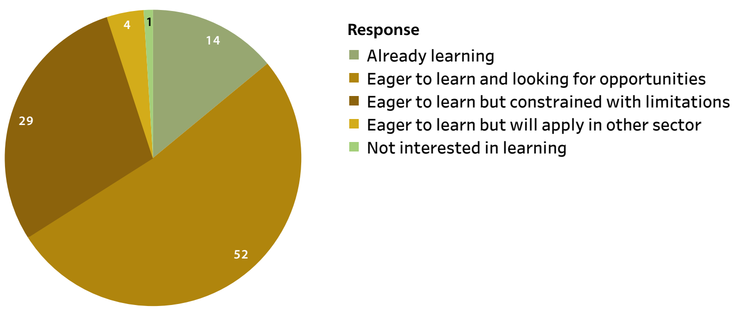
[25] Australia, Canada, China, India, Indonesia, Kazakhstan, Malaysia, Myanmar, Nepal, the Philippines, the Republic of Korea and Thailand.

Figure 7.8. Responses of survey respondents on what is the most important necessary condition for accelerating the uptake of new technologies and innovation in forestry in the Asia-Pacific region



Notes: n = 217. Respondents were asked to rank each condition in order of importance. The survey, which was conducted online in February 2019, was open to women and men aged 18–35 years from forestry and non-forestry backgrounds. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals). Not all respondents answered all questions. ICT = information and communication technology.

Figure 7.9. Responses of survey respondents to the question, "Would you like to gain skills and education in relevant technologies and science to apply in forests and forestry in the future?"



Notes: n = 217. Numbers represent percentages. Indicative technologies were remote sensing, robotics and data analytics. The survey, which was conducted online in February 2019, was open to women and men aged 18–35 years from forestry and non-forestry backgrounds. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals).

(41 percent) and workshop participants indicated that they were already either studying new technologies or using them at work, including remote sensing, lidar, drones (for assessing forest health), artificial-intelligence-based spatial models for ecosystem services, tree genetics and precision forestry. Obstacles to the greater study and use of technologies in forestry may include a lack of adequate funding and scholarships; a lack of access to education programmes; a lack of awareness of the availability of education programmes; and a lack of promotion of such training in forestry institutions and universities. The people involved in the consultative workshop called on governments and stakeholders to invest more in the education and skilling of youth – especially rural youth, who are on the frontline of forests.

Key **points**

- Four broad governance discourses have helped shape the region's forest landscapes and governance institutions – 1) forestry for timber; 2) participatory forestry; 3) multiple benefits; and 4) climate change and sustainable development.
- Efforts to strengthen forest governance in the region include increasing stakeholder participation, market-based approaches, forest-related conflict resolution, and institutional reform.
- In 16 countries in the region, the area designated for or owned by indigenous peoples and local communities grew by about 17 million ha between 2002 and 2017 as governments started to recognize their rights. Nevertheless, many indigenous peoples and local communities still face tremendous challenges, including marginalization, the loss of lands and conflict.
- Most government officials in charge of forestry in the region perceive that forest governance has improved since 2010, especially in terms of stakeholder participation.
- The commitments made by governments as part of global policy processes will influence national forest-related priorities to 2030, but a lack of adequate finance is a major challenge.

8 Participation in forest governance grows, but conflicts loom

- An increasing number of importer countries are putting in place laws and regulations to prevent illegal timber imports. In 2017, Indonesia became the first country to export legality-verified timber to the European Union under a voluntary partnership agreement.
- Conflicts related to protected areas, land-grabbing, tenure and benefit sharing, among other things, are prevalent in the region. Climate change may exacerbate such conflicts in the future.
- Despite a shift in the role of forest agencies from dominant players to facilitators of participatory approaches, many countries lack effective mechanisms for resolving forest-related conflicts.
- Young people have shown capacity to mobilize transnationally on environmental causes, especially climate change. A survey and consultation of young people conducted for this study found a strong expectation among youth of greater participation and transparency in the region's forest governance.

The state of forests and forestry in the Asia-Pacific region in 2030 and 2050 will largely be shaped by the quality of forest governance. With good governance – predicated on mutually supportive and cooperative relationships among government, the private sector[26] and civil society – forests will be better managed; the economic and environmental benefits derived from forests will be shared equitably among stakeholders; and forests will be integral to solutions to challenges such as climate change, hunger and malnutrition, poverty and threatened water supplies. On the other hand, a failure to improve forest governance may bring dire consequences, such as continued forest loss, the further marginalization of forest-dependent communities, and conflict.

This chapter provides an overview of forest governance trends in the region. It outlines four forest policy discourses and their influence on governance; examines governance at various scales, from global to local; reviews recent efforts to assess and strengthen forest governance; and provides a youth perspective.

[26] The "private sector" is generally understood to encompass for-profit business entities not owned or operated by the government. "Civil society" comprises those groups acting voluntarily in their capacities as citizens to advance common goals and agendas (FAO, 2011; Mungiu-Pippidi, 2015).

Changing governance and policy discourses

Four major policy discourses can be identified

Patterns of policy discourse can be discerned amid the dynamic changes to forest policy and governance that have occurred in recent decades. Policy development is not a linear process, and it also varies between countries.[27] Nevertheless, the following four key policy discourses have gained prominence at various times – and often concurrently – in most countries in the region:

1. *Forestry for timber* – this discourse focuses on timber exploitation in natural forests. Timber concessions – whereby private companies obtain licences from governments to manage forests for timber production – were predominant in Southeast Asian countries such as Cambodia, Indonesia, Malaysia and the Philippines from as early as the 1970s. As timber resources declined in Southeast Asia but strong demand for tropical timber continued, countries in the Pacific – such as Papua New Guinea and the Solomon Islands – also adopted concession systems to facilitate timber exploitation.

2. *Participatory forestry* – this discourse focuses on livelihoods and social justice for local communities

[27] Brown and Durst (2014) described numerous changes in international and development assistance in forestry, from the colonial era to recently.

and indigenous peoples whose livelihoods depend heavily on forests. Programmes have been implemented in many countries to increase the participation of local people, formalize their land tenure and resource rights, support livelihoods, enhance the role of non-wood forest products, and acknowledge the cultural and spiritual importance of forests and indigenous knowledge. Such programmes have included collective forestry in China, village forestry in the Lao People's Democratic Republic, joint forest management in India, community forestry and leasehold forestry in Nepal, and social forestry in Indonesia. Some countries – such as China, India and Nepal – adopted their approaches before 1990; others have turned in this direction more recently.

3. *Multiple benefits* – this discourse emerged in recognition of the multiple roles of forests beyond timber production, such as in biodiversity conservation, water regulation, recreation, land conservation and ecotourism (see also Chapter 6, and Box 8.1 provides an example of how a society's view can change about the benefits to be obtained from forests). The multiple-benefits discourse has triggered payment schemes to ensure the provision of forest ecosystem services and initiatives to improve forest health and conservation and promote ecotourism. The discourse has been important in moving away from the conventional paradigm of natural forests as primarily sources of timber, and it recognizes the multifunctionality of forests.

4. *Climate change and sustainable development* – this discourse has been predominant in recent years, with the role of forests in tackling climate change, increasing resilience and abating disasters receiving significant attention in global, regional and national dialogues. Forests and land-use change are important elements of the Paris Agreement on climate change, which countries adopted in 2015, and they also feature prominently in other forums and commitments, such as the Bonn Challenge and the SDGs.

The forest policy discourse has shifted over time

Shifts among the four main forest discourses described above have occurred at different times in different countries and brought changes in forest management and practices; certain discourses have been more prominent in some countries than in others. Figure 8.1 illustrates the changing nature of the forest policy discourse in the Republic of Korea since the 1960s, identifying five major stages. The forest-industry stage (1988–1997) was similar to the forestry-for-timber discourse described above. Subsequently, a major paradigm shift – similar to the multiple-benefits discourse – took place focusing on resource diversification and enhancement, with much greater attention on environmental functions and other forest benefits; the forest public welfare and ecosystem services phase (2008–2017) continued this focus. More recently, the Republic of Korea has addressed the importance of forests in climate change and sustainable

BOX 8.1

Forests for health in Japan and the Republic of Korea

In Japan in the early 1980s, people began a practice called *shinrin-yoku*, or "forest bathing". Tomohide Akiyama, the Director General of the Agency of Agriculture, Forestry and Fisheries of Japan, coined the term in 1982 to encourage people to visit forests as part of a campaign to protect them. The Forest Therapy Study Group, comprising Japanese government agencies and academic organizations, conducted research on the practice in the city of Iiyama in 2005. The group took 12 healthy middle-aged men on a three-day forest-bathing trip and found that forest bathing boosted the immune systems of the subjects; increased their energy; decreased their anxiety, depression and anger; reduced their stress; and helped them relax. After this experiment, Iiyama received a "forest-therapy" certificate – the first in Japan – certifying that the forest had particular health-inducing properties. Since then, many other studies have been carried out in Japan on the therapeutic role of forests. For example, it has been shown that walking in forests improves moods and the quality of sleep and enhances the activity of natural killer cells (important for the body's immune system). Japan now has 62 certified forest-therapy bases, and 2.5–5 million people walk on forest trails each year to help manage their stress and take care of their health. *Shinrin-yoku* has become a cornerstone of alternative medicine and forest therapy.

Forest bathing has also become popular in the Republic of Korea. The Korea Forest Service has facilitated the use of forests for healing and enhancing health and quality of life; it has plans to establish 34 national healing forests and to train 500 forest-healing instructors to provide specialized healing services to the public. The Korea Forest Service has also invested in multidisciplinary research to systematically assess the benefits of forest healing.

Sources: Li (2018); Shin (2015).

development. Although not depicted in Figure 8.1, a participatory discourse on forests has been ongoing in the country since the 1960s.

A common change in the policy discourse from forestry for timber to multiple benefits, especially conservation, is reflected in policies on logging bans adopted in several countries in the region (Box 8.2). Such policies, which have been triggered by various factors, have achieved mixed results and sometimes had unintended consequences.

Figure 8.1. Forest discourses in the Republic of Korea since the 1960s

Source: AFoCO Secretariat (2018).

Understanding trends in policy discourses can help decision-makers and development partners devise strategic interventions. Countries engaged in a forestry-for-timber discourse would benefit from support for SFM and responsible timber trade (as well as learnings from other discourses). Countries focusing more on climate-change mitigation through forestry are likely to require the redesign of land-use planning processes to ensure, for example, sustainable agricultural production and environmentally friendly infrastructure development. Policy dialogues and the prioritization of forestry would benefit from a deeper understanding of historical shifts in governance discourses. Likewise, the clear communication of ongoing forest discourses would assist the forest sector in engaging with other sectors.

From global to local forest governance

Forest and landscape governance processes at the local, subnational, national, regional and global levels operate in parallel, with top-down and bottom-up influences intertwined (IUFRO, 2010). Global governance is shaped by concerns over, for example, resource availability, climate change, human rights, biodiversity conservation and trade, while local governance focuses predominantly on site-specific issues such as livelihoods, employment, social issues such as participation, gender and indigenous peoples, and poverty alleviation. Decisions made at the international level through, for example, the United Nations Forum on Forests, the UNFCCC and the Association of South East Asian Countries are supposed to be adopted nationally for implementation, while experiences at the local level should feed into higher-level processes.

Forest and landscape governance is not a linear process, therefore, but a complex relationship between the various levels of decision-making structures (Agrawal, Chhatre and Hardin, 2008). Major challenges for multilevel governance include a lack of coordination among levels; mismatches between what is needed locally and what can be agreed globally; an inability to bring the full aspirations of stakeholders to negotiating tables; and a lack of capacity and resources at the various levels to implement or enforce policies and laws.

BOX 8.2

Logging bans: a common policy with mixed results

Many Asia-Pacific countries have imposed partial or complete logging bans over the years – typically restricting the logging of natural forests in specified areas or across entire nations. The stated objectives in prohibiting timber harvesting have mostly been conservation-related. Some countries experienced a "forestry crisis", in which forest exploitation was seen as ineffectively regulated or out of control. In other countries, the decision to close forests to loggers was triggered by disasters (e.g. devastating floods and landslides, which took the lives of 400 people in southern Thailand in 1988; catastrophic floods that killed 7 000 people in Ormoc City, the Philippines, in 1992; and flooding in the Yangtze River valley that affected hundreds of millions of people in China in 1998) attributed – incorrectly, in some cases – to poor forest management.

In most instances, logging bans were imposed as political reactions to public pressure or criticism of perceived poor forestry practices without clearly defining the goals or objectives of the bans. This has made it difficult or impossible to definitively determine the success or failure of these actions. Nevertheless, FAO assessments of logging bans over the years have revealed various impacts – including several unintended consequences.

The ineffective or inconsistent implementation of logging bans has led to job losses and reduced government revenues in almost every instance. In economic terms, logging bans reduced the financial value of forests and it is unsurprising, therefore, that, in some countries, economic land concessions took over forests that were to be protected after the cessation of logging. Initially at least, deforestation rates rose in many countries in the vacuum created by departing logging operations as logging bans were imposed. Where management controls were weak, legal logging was often replaced by "illegal logging" – sometimes at a pace exceeding authorized harvesting before the bans. And, in countries where the primary cause of deforestation was agricultural expansion, logging bans were the wrong tool for addressing actual forest threats. Several countries without significant alternative domestic wood sources (e.g. planted forests and trees outside forests) began importing timber to meet domestic needs or to supply established wood-processing capacity. Often, imported timber was sourced from countries with weaker environmental regulations than the country that had banned its own logging.

One of the hoped-for results of logging bans was to give forests a "rest" from overharvesting and to buy time for drafting better policies and regulations and improving forest law enforcement capacity. Although some countries used such timeouts constructively, others did not. The reduction of available timber from natural forests resulted in major transformations of the wood-processing sectors in some countries. For example, Thailand's wood industry has shifted from the use of large-diameter hardwood logs sourced from natural forests to small-diameter plantation-grown wood such as rubber and eucalypt. At the same time, the country has largely refocused the management of its natural forests from timber production to ecotourism, watershed management and biodiversity conservation.

Although the results of logging bans in the Asia-Pacific region have been mixed, it is safe to say that harvesting bans have rarely fully achieved their intended forest conservation goals and, in some cases, they have resulted in significant unintended negative socio-economic consequences (domestically and abroad). A key lesson is that policy actions such as logging bans with major potential impacts require careful analysis before execution as well as effective governance to keep implementation on track.

Source: P. Durst, personal communication, March 2018.

Major developments in global governance in the past decade include the following:

- *Strategic Plan for Biodiversity 2011–2020* (October 2010) – a framework for the establishment of national and regional targets on biodiversity, including the 20 Aichi Biodiversity Targets.

- *New York Declaration on Forests* (September 2014) – a political declaration of diverse stakeholders to halve deforestation by 2020 and bring it to an end by 2030.

- *Sendai Framework for Disaster Risk Reduction* (March 2015) – aims to reduce disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

- *United Nations Forum on Forests Resolution on the International Arrangement on Forests beyond 2015* (May 2015) – aims to enhance the contributions of all types of forests and TOF to the post-2015 development agenda.

- *Addis Ababa Action Agenda on Financing for Development* (July 2015) – supports the implementation of the 2030 Agenda for Sustainable Development.

- *2030 Agenda for Sustainable Development* (September 2015) – a plan of action for peace and prosperity, including the 17 SDGs.

- *Paris Agreement on climate change* (December 2015) – an agreement for combating climate change and adapting to its effects.

- *United Nations Strategic Plan for Forests 2017–2030* (April 2017) – builds on the vision of the 2030 Sustainable Development Agenda and sets out six Global Forest Goals and 26 associated targets to be achieved by 2030.

- *United Nations Decade on Ecosystem Restoration* (March 2019) – declared by the United Nations General Assembly with the aim of massively scaling up the restoration of degraded and destroyed ecosystems to fight the climate crisis and enhance food security, water supply and biodiversity.

Achieving these global objectives will be a priority for countries towards 2030. The availability of adequate financial resources is a major challenge, however, especially in developing countries, despite a diversity of development-assistance financing streams, such as the Green Climate Fund (Box 8.3), the Global Environment Facility and other multilateral, bilateral and private funding. It has been estimated that USD 70 billion–160 billion is required per year to achieve SFM globally, but current official development assistance for forestry amounts to only about 1 percent of this and other available public-sector financing sources to barely another 2 percent (Tuukka *et al.*, 2014). Domestic politics in donor countries constrains investment in SFM in developing

BOX 8.3

The Green Climate Fund

The Green Climate Fund (GCF) was established in 2010 as a financial mechanism under the United Nations Framework Convention on Climate Change (UNFCCC) as a global fund to support the efforts of developing countries to reduce their greenhouse-gas emissions and adapt to climate change. As of March 2019, the GCF had 102 approved projects globally valued at USD 5 billion, 36 of which (USD 1.4 billion) were in the Asia-Pacific region. Fifteen of the approved projects worldwide (valued at USD 835 million) address the "forests and land use" results area; most are cross-cutting and combine mitigation and adaptation measures. Of the 15, four (valued at USD 139 million) are in the Asia-Pacific region, comprising a protected-area network in Bhutan; agroforestry in Cambodia; the community-based conservation and restoration of coastal ecosystems in India; and mangrove regeneration in Viet Nam. Combined, the four projects are expected to have a mitigation impact of 40.1 million tonnes of carbon dioxide equivalent. The GCF's first REDD+ results-based payments project was approved recently (at the 22nd board meeting) for Brazil – a milestone in the fund's history and the history of the UNFCCC. A total payment of USD 96.5 million was made for Brazil's achieved results in reducing deforestation in the Brazilian Amazon in 2014–2015, for a total emission reductions volume of 18.8 million tonnes of carbon dioxide equivalent. The GCF continues to engage with countries in the Asia-Pacific region to support REDD+ implementation and the financing of future REDD+ results-based payments projects.

The GCF intends to continue promoting a paradigm shift in the context of forest and land use, looking beyond the forest sector and considering forests as part of wider landscapes. GCF investments will require a change in approach related to the role of forests and wider land use to meet development needs and achieve environmental sustainability. Interventions should encourage a shift to low-emissions, sustainable-development pathways and the slowing, halting and reversing of losses of forest cover and forest carbon.

Source: Green Climate Fund (undated).

countries, yet pressure on the latter to implement SFM will likely continue. Given the need for economic growth in developing countries as a means for alleviating poverty, short-term economic gains may overshadow long-term sustainability objectives. Local examples of sustainable landscape management exist in developing countries in the region (see Chapter 2), but scaling up to the national level has proved difficult to date.

Strengthening forest governance

There is a lack of systematic evaluation

Forest governance is influenced by and part of wider governance systems, and understanding the overall governance effectiveness of countries, therefore, is an important part of addressing forest governance. The World Bank's Worldwide Governance Indicators measure governance indicators for more than 200 countries and territories for the period 1996–2017 (World Bank, undated [b]).[28] As measured by the Worldwide Governance Indicators, Australia, Bhutan, Japan and New Zealand are highly ranked in their effectiveness in controlling corruption. Several countries improved their rankings significantly over the period, with Indonesia, the Lao People's Democratic Republic and Myanmar all moving to higher percentile ranges, but Nepal slid back. There was no change in the rankings brackets of other countries in the region between 2010 and 2017.

The assessment of forest governance (e.g. FAO, 2011b; Davis *et al*., 2013; Cowling, DeValue and Rosenbaum, 2014) has been inconsistent in the region, and time-series assessments at the national level are lacking. Most countries performed relatively poorly (with all scores below 3.5 on a scale of 0–5) in a recent assessment of forest governance in the Greater Mekong Subregion (RECOFTC, 2018a) using the framework set out in FAO (2011b); the performance of countries varied (Figure 8.2).[29]

Forest governance has been assessed in other countries in the region for various purposes, such as programme development, project implementation, policy reform and conflict management. Indonesia, for example, assessed forest and land governance in 2012 and 2014 in the context of its REDD+ programme. A score above 60 on a scale of 1–100 was considered acceptable performance; none of the 12 assessed provinces achieved this standard, however (their scores ranged from 26 to 42) (Situmorang *et al*., 2014).

A lack of consensus on a forest-governance framework and the absence of time-series data prevent forest-governance comparisons between countries in the region – a critical gap that needs to be addressed for monitoring progress over time. Greater understanding of forest governance trends would help decision-makers design and prioritize interventions, programmes and resources and better enable stakeholders to know where support is most needed, thus increasing the potential for collaboration. Forest governance is likely to become increasingly complex, and monitoring and assessment will be crucial tools for ensuring the capacity of governance processes to deal with such complexity.

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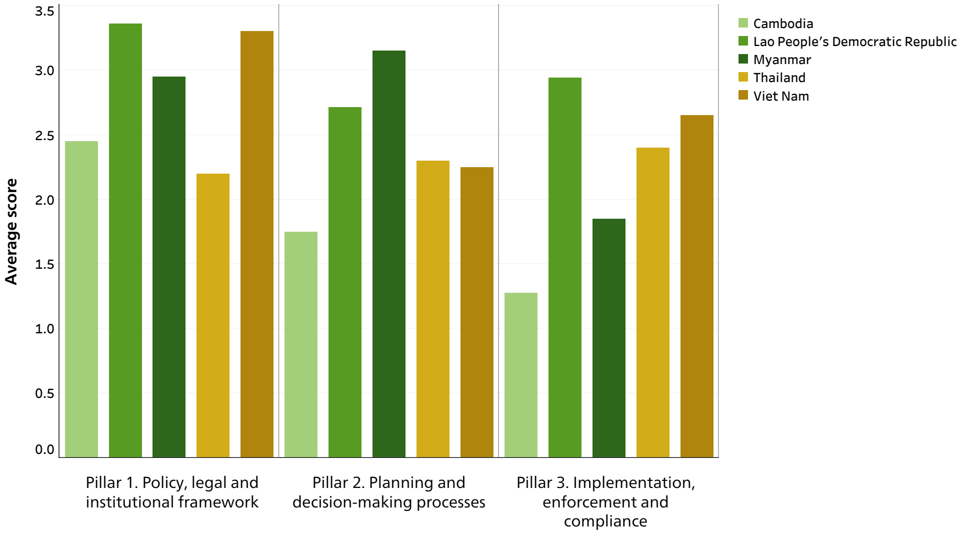
[28] The World Governance Indicators assess six dimensions of governance: 1) voice and accountability; 2) political stability and absence of violence; 3) government effectiveness; 4) regulatory quality; 5) rule of law; and 6) control of corruption.

[29] Three pillars were assessed (policy, planning/decision-making, and enforcement), along with six cross-cutting principles: 1) accountability; 2) effectiveness; 3) efficiency; 4) fairness; 5) participation; and 6) transparency. Over 1 000 people in five Greater Mekong Subregion countries participated in the assessment (RECOFTC, 2018; Gritten *et al*., 2019).

Figure 8.2. Forest governance assessment in five countries in the Greater Mekong Subregion, 2018



Notes: The assessment was made through a participatory process involving various stakeholders at the national and subnational levels. Scores were on a scale of 0–5.
Sources: Gritten *et al.* (2019); RECOFTC (2018a).

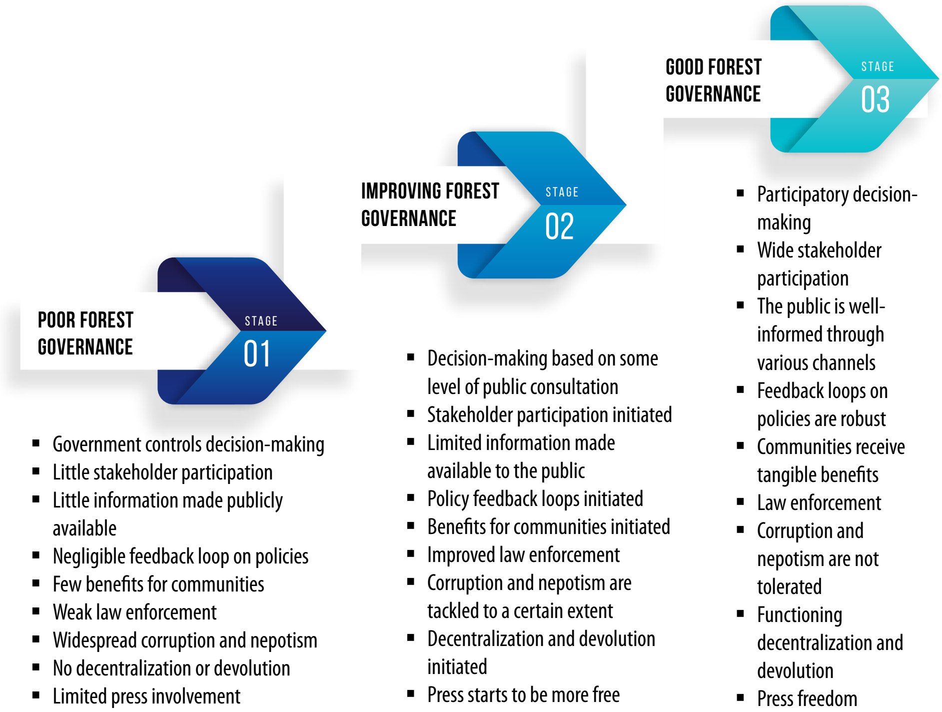
Some countries are improving forest governance

Figure 8.3 provides a generic overview of a possible transition from weak, through moderate, to strong forest governance. Countries in the region have progressed differently in this transition, with some taking their first steps in the 1990s or earlier by transferring certain forest-use and ownership rights to individuals, households, community groups and indigenous peoples.

Countries that have strengthened forest governance by increasing participation include China, Nepal and Viet Nam, where the involvement of communities in forest management has increased significantly since the 1990s. Many countries in the region – such as Bangladesh, Indonesia, India and the Philippines – may be considered to be at stage 2, but others are still at stage 1. Pacific Island countries are a special case in governance reform: local communities already mostly own their forests, but national decision-making processes require huge improvement and the aspirations of communities need to be taken more fully into account to ensure that tangible benefits accrue to forest owners. In several Pacific Island countries, weak governance, both in forestry and more broadly, remains a significant issue that contributes to ongoing serious forest degradation.

Moving to stage 3 in the forest-governance reform process will be difficult for some countries in the region given unfavourable political situations and a lack of interest among elites in changing the status quo.

Figure 8.3. The three common stages of forest governance and policy change

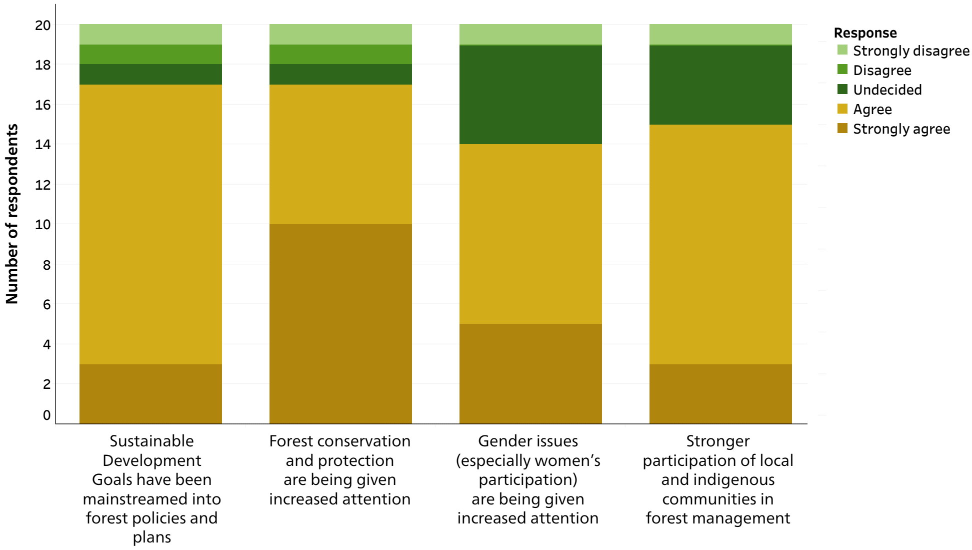


A survey was conducted in late 2018 with the heads of forestry[30] in the region to help understand key changes in forest governance since the publication of APFSOS II (FAO, 2010a), with 20 of the 34 heads of forestry responding (Figure 8.4). Three-quarters (15 of 20) perceived that the participation of local and indigenous communities in forest governance had improved in the last decade in their countries. Nearly as many (14 of 20) indicated that gender issues and the participation of women had received greater attention, and 17 respondents reported that forest conservation and protection had been given more consideration (implying a shift towards the multiple-benefits paradigm). Seventeen respondents also reported that the SDGs – a new governance objective since APFSOS II – had been mainstreamed into forest policies (i.e. embracing the sustainable-development discourse). Thus, the overall perception of heads of forestry in the region is that forest governance has improved based on these four areas of assessment. Building on these positive changes is key to making progress towards SFM and sustainable landscapes.

Below, efforts in the region to address forest governance are reviewed in four

[30] "Heads of forestry" – a term used in the APFC – comprise those people in charge of forest ministries or departments in APFC member countries. In most countries, the heads of forestry are the heads of forestry departments.

Figure 8.4. Perceptions of heads of forestry in the Asia-Pacific region on forest-governance change since 2010



key areas: 1) stakeholder participation; 2) market approaches; 3) addressing forest-related conflicts; and 4) institutional reform.

Increasing stakeholder participation

Participation is necessary to ensure that the views and interests of all stakeholders are taken into account in decision-making processes and the distribution of costs and benefits. Participation works when there are clear benefits for stakeholders, such as in terms of income, livelihoods and ecosystem services. Three important areas of forest-related participation – tenure reform, community-based forestry (CBF) and women's engagement (FAO, 2012d) – are discussed below.

Countries are attempting forest-tenure reforms

Twenty-seven percent of the estimated 450 million forest-dependent people worldwide still live on less than USD 1.25 per day. Forest tenure and tenure reform (defined in Box 8.4) are crucial for enabling forest-dependent people to pursue sustainable livelihoods and move out of poverty, but tenure is contested in large areas of forest in the region. The impetus for tenure reform has come from domestic sources as well as international processes such as REDD+, the EU Forest Law Enforcement, Governance and Trade (FLEGT) initiative, the Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security, and the Land 2030 Global Initiative.

BOX 8.4

Forest tenure and tenure reform

Forest tenure may be defined as a bundle of the following five rights for the use of forestland:

1. access – the right to enter the forest;
2. withdrawal – the right to obtain products from the forest (including harvesting timber, non-timber forest products and woodfuel);
3. management – the right to regulate internal use and transform the forest resource through, for example, silvicultural treatments;
4. exclusion – the right to determine who has access to the forest; and
5. alienation – the right to sell or lease management or exclusion rights and use them as collateral.

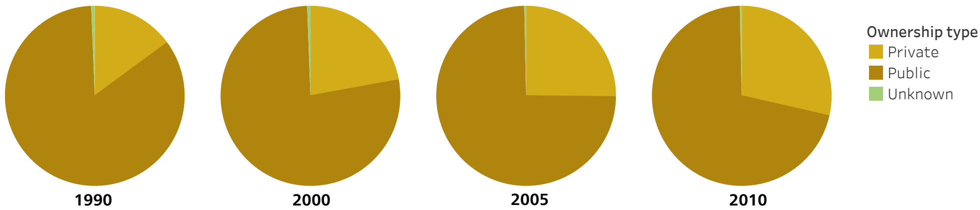
Rights-holders may hold one or more right simultaneously. Tenure reform involves the strengthening of these rights for certain stakeholders by adding to the bundle of rights they hold.

A significant proportion – 71 percent – of forests in the Asia-Pacific region is owned publicly (i.e. by government; Figure 8.5) although the area of forest in the region under private (individual, communal or collective) ownership has increased since 1990. Within the region, public ownership accounts for 87 percent of forests in South Asia, 91 percent in Southeast Asia, 58 percent in East Asia and 57 percent in Oceania. There are considerable differences within Oceania, with local communities in Pacific Island countries owning, on average, 97 percent of forests.

Indigenous peoples and local communities make substantial contributions to forest management in the region (Box 8.5), and recently there has been a steady increase in recognition by government of their forest tenure. In the 16 countries shown in Table 8.1, the area designated for indigenous peoples and local communities grew by just under 2 million ha between 2002 and 2017, and the area owned by this category grew by just over 15 million ha, from 154.2 million ha to 169.5 million ha. For forests designated for indigenous peoples and local communities, there were notable increases (from zero) over the period in Thailand and Viet Nam. The most substantial increase in ownership by indigenous peoples and local communities was in China (up by nearly 21 million ha over the period); on the other hand, there was a decrease of more than 8 million ha in Australia.[31]

[31] The decrease in Australia was likely due to improvements in data resolution rather than to real change on the ground (Rights and Resources Initiative, 2018).

Figure 8.5. Forest ownership in the Asia-Pacific region, 1990, 2000, 2005 and 2010



Notes: FAO (2012a) defined forest ownership as the legal right to freely and exclusively use, control, transfer, or otherwise benefit from a forest. Public ownership is forest owned by the state; administrative units of the public administration; or institutions or corporations owned by the public administration. Private ownership is forest owned by individuals, families, communities, private cooperatives, corporations and other business entities, private religious and educational institutions, pension or investment funds, non-governmental organizations, nature conservation associations and other private institutions.
Source: FAO (2015a).

Box 8.6 explores China's efforts to reform the tenure of collective forests.

Although the increase in tenure recognition shown in Table 8.1 is positive, many indigenous peoples and local communities continue to face serious tenure-related problems. Rights to land are often denied due to the absence of evidence for formalizing claims. Some indigenous peoples have had to leave their lands due to the influx of land-based concessions (Yasmi, Kelley and Enters, 2013) and, in other situations, they have needed to fight for their rights in prolonged conflicts over land-grabbing (Dhiaulhaq, Yasmi and Gritten, 2014). Moreover, the formal recognition of tenure rights is very slow, and indigenous peoples and local communities, therefore, continue their decades-long struggle for lands and resources. A major challenge for policymakers in many countries in the region is to further improve the ways in which they deal with this vexed and crucial issue.

Reform processes in various countries have precipitated shifts in forest ownership in recent decades, especially in East Asia and to some extent in Oceania. An increase in private and community ownership is possible in coming decades as reform processes continue and demands increase for greater participation and social justice in forest and land management.

Push continues to strengthen community-based forestry

The term CBF is applied to a range of situations in which communities have varying degrees of control and rights over forest management (FAO, 2016d; Figure 8.6). Increasing environmental awareness and concern has been one of the main motivators for the development of CBF, partly in recognition of the challenges faced by governments in managing forests sustainably. Over time, the objectives of CBF have matured and increased in diversity, encompassing economic development at

BOX 8.5

The crucial role of indigenous peoples in forest management

The Asia-Pacific region is home to more than 260 million indigenous peoples, which is about 70 percent of the total indigenous population worldwide (International Labour Organization, 2017). Forest-dependent indigenous communities pursue various livelihoods that may include shifting cultivation, pastoralism, hunting and gathering, farming, intercropping, fishing and the collection of forest products. Their deep cultural attachment to ancestral territories and natural resources makes them primary actors in the maintenance and protection of ecologically significant areas and therefore crucial in sustainable forest management. The food systems of indigenous peoples are locally and climatically adapted and resilient to climate threats.

Indigenous knowledge constitutes an invaluable resource for developing adaptation and mitigation strategies in response to climate change. Indigenous women, for example, have developed methods for the sustainable management of natural resources over millennia as a basis for the survival of their families and communities (AIPP, 2013). As guardians of ancestral knowledge related to plants, seeds, medicinal herbs and species, indigenous women play significant roles in the protection of biodiversity and other natural resources. Through their practices and knowledge, they contribute to the sustainable use, conservation and improvement of forests for food, biodiversity, health and livelihoods.

Despite the relevance of indigenous knowledge to sustainable forest management and biodiversity, indigenous peoples are among the most marginalized groups in the Asia-Pacific region. A lack of respect for their basic human rights, cultures, spirituality and traditions and the encroachment of their traditional lands and natural resources undermine their livelihoods, shelters, cultures and identities and thereby increase their vulnerability. Recognizing the customary collective and individual rights of indigenous peoples to communal lands and natural resources is key to comprehensive and cost-effective biodiversity conservation and management (International Labour Organization, 2017). Some countries in the region have increased recognition of the forest tenure of indigenous peoples and local communities; nevertheless, large areas of forest remain in dispute.

Source: C. Park and B. Gatt, personal communication, December 2018.

Table 8.1. Forest ownership in the Asia-Pacific region, selected countries, 2002 and 2017

Country	Government-administered		Designated for indigenous peoples and local communities		Owned by indigenous peoples and local communities		Owned by individuals and firms	
	(million ha)							
	2002	2017	2002	2017	2002	2017	2002	2017
Australia	89.9	83.3	0	9.1	20.9	12.1	18.1	20.2
Bhutan	2.6	2.65	0	0.08	0	0	0	0
Cambodia	11.2	7.73	0	0.46	0	0	0	0
China	76.1	75.2	0	0	103.1	124.3	0	0
India	56.0	59.3	14.1		0	1.11	9.37	9.77
Indonesia	97.7	85.4	0.22	0.79	0	0.01	1.49	4.86
Japan	10.4	11.1	0	0	1.05	0.28	13.4	13.1
Lao People's Democratic Republic	16.5	18.7	0	0.02	0	0	0	0
Mongolia	12.9	8.94		3.35				
Myanmar	34.2	28.9	0.02	0.16	0	0	0	
Nepal	4.63	4.54	1.02	2.07	0	0	0	0
Papua New Guinea	0.9	0.84	0	0	29.2	27.0	0.03	0.03
Philippines	13.8	9.46	1.97	1.64	0.04	4.71	0	0
Republic of Korea	1.89	2.08	0.03	0	0	0	4.5	4.25
Thailand	17.0	15.9	0	0.48	0	0	0	0
Viet Nam	11.8	13.2	0	1.13	0	0	0	0
Total	**457**	**427**	**17.4**	**19.3**	**154**	**170**	**46.8**	**52.2**

Notes: Rights and Resources Initiative (2018) defined "designation" in this context as situations in which national law recognizes the rights of indigenous peoples and local communities to access and withdrawal, as well as to participate in the management of forests and to exclude outsiders. "Ownership", on the other hand, refers to situations in which the forest rights of access, withdrawal, management, exclusion and due process and compensation are legally recognized for an unlimited duration. The right of alienation (whether through sale, lease or use as collateral) is not required for communities to be classified as forest owners in this framework. Totals may not sum due to rounding.
Source: Rights and Resources Initiative (2018).

BOX 8.6

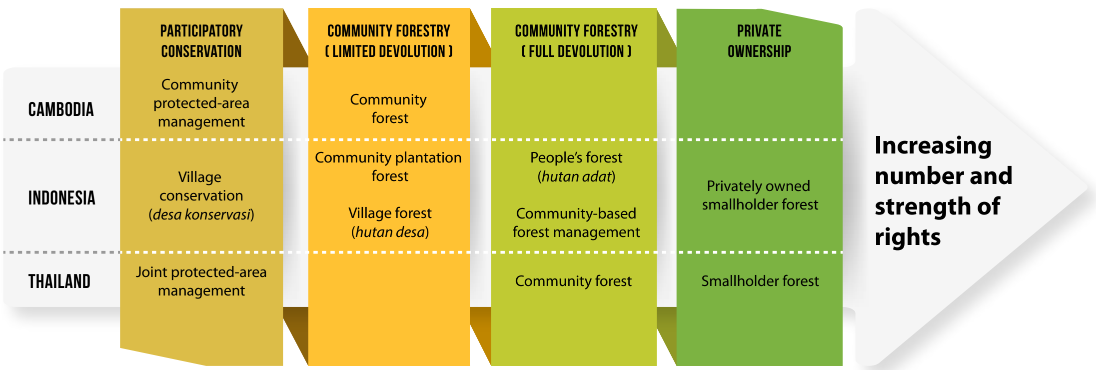
Reform of China's collective forests: a key policy intervention

Since 1949, China has implemented a series of land- and forest-tenure reforms aimed at strengthening the rural economy and increasing land-use efficiency. The reform of collective forests, which account for 60 percent of China's forest area (state forests account for the remaining 40 percent), has been a far-reaching effort to provide stability and security of tenure, improve efficiency, enhance the sustainability of forest land use and increase investment in the sector. The reform began on a pilot scale in 2003 and has been adopted nationally since 2008. By 2013, the transfer of user rights had been accomplished in almost 99 percent of the country's collective forests, with 89.7 million farmers receiving forest tenure certificates.

The reform has given legal entitlement to households to benefit from the land, and these rights can be transferred by way of subcontracts, sale, mortgages and joint ventures over the tenure period, which is 70 years (renewable for another 70 years). The impacts of the reform have been studied extensively: it has brought some stability of tenure, enabled rural households to increase income, and improved the condition of the forests. Forest fragmentation, and limitations on future policy interventions, are among the challenges for the management of these forests.

Sources: Jiang *et al.* (2014); Jintao *et al*. (2012); Liu and Ravenscroft, 2016; Ren *et al.* (2018).

Figure 8.6. Examples of community-based forestry regimes and the strength of rights in three countries in the Asia-Pacific region



Source: Based on FAO (2016d).

the household-to-national levels, social justice, gender equality and environmental (e.g. forest protection) needs.

Many countries in the region, particularly in Southeast Asia, have set targets for the area of forestland under CBF (Table 8.2). They face immense challenges in achieving these targets, however, due to weak legal frameworks; limited scope for sharing learning within government agencies and between communities; limited awareness and understanding of the rationale of, and requirements for, CBF; and the limited capacity and resources of key stakeholders, including the ability of communities to obtain tenure certificates for their forests (Feurer, Gritten and Than, 2018).

Indonesia's target in the period 2010–2014 for the area of forestland under CBF was 500 000 ha, jumping to 12.7 million ha in 2015–2019. There is concern, however, that certain fundamental conditions are lacking for meeting the 2019 target, including clear incentives for local communities to engage in the process (Box 8.7). For example, the tenure on offer is a transfer of usage rights rather than ownership rights (Myers *et al*., 2017).

Increasing the forest area designated for CBF in the region will require a concerted effort by governments and non-governmental organizations. Setting targets is undoubtedly an important step, but improvements in policies, governance and institutional capacity are needed to achieve these.

Attention to gender is patchy

Despite increasing recognition of women's roles in the forest sector, there is still a lack of gender-disaggregated data and limited understanding of the overall contributions of forests to gender equality at the national, regional and global levels (FAO, 2018g). Nepal and the Philippines are among the few countries in the region with gender-responsive forest policies.[32] Table 8.3 summarizes the results of recent country-level gender assessments in some countries in the region.

Existing gender-disaggregated data in forestry mainly pertain to the formal employment of women and men, particularly in the wood-processing industry; they show that the participation of women in forestry is low compared with many other sectors. In the informal forest sector, existing data indicate that, in addition to performing a number of other functions, women collect about 60 percent of woodfuel globally, taking (on average in Asia and Oceania) 139 hours to collect 1 m^3. Even in countries with only moderate woodfuel scarcity, women have been reported to walk up to 10 km to gather woodfuel for cooking. The time burden on rural women due to the collection of woodfuel, non-wood forest products and water is increasing due to deforestation, with women having to walk longer distances and deeper into forest areas.

[32] Gender-responsive policies are policies that reflect understanding of the realities of women's lives and address the issues associated with these.

BOX 8.7

Indonesia's efforts on community-based forestry

The Government of Indonesia launched the Social Forestry (*Perhutanan Sosial*) programme in 2014 for implementation under the 2015–2019 five-year plan. The primary objective was to improve the welfare of citizens and enable them to increase productivity and secure income. The programme seeks to achieve this by allocating 12.7 million ha of forest to communities by 2019 through the distribution of social-forestry permits. The government is offering legal access to communities living in and around forests to manage forest resources through the following five management schemes: 1) Community Forests; 2) Village Forests; 3) Community Plantation Forests; 4) Partnerships; and 5) Customary Forests. The programme grants legal access rights to people managing forest resources with the aim of ensuring the long-term sustainability of community-based forest resource management. As of July 2018, however, only 1.75 million ha – less than 15 percent of the overall target – had been allocated under the programme, involving 395 000 households. Two main causes of the delay were detected: the complicated process of obtaining permits; and, for those who already hold permits, a lack of capacity to obtain benefits and improve livelihoods. Researchers identified three factors for overcoming these obstacles: 1) coherent institutional arrangements and organization among major stakeholders; 2) the increased participation of local communities through the provision of better incentives; and 3) strengthening capacity for business development and entrepreneurship in social-forestry groups. These factors were reflected in the implementation of the programme in the Sumatran province of Lampung, which generated positive outcomes by improving forest management and increasing local incomes. In the assessed villages, average annual income increased from IDR 2.5 million to more than IDR 40 million within a year of the start of the programme due to the development of livelihood activities involving crabs, honey, coconut shells and charcoal. Dedicated and continued stakeholder support from the provincial government, social-forestry groups, public agencies and non-governmental organizations has led to the rapid uptake of the programme in the province.

Source: Shahab (2018).

Table 8.2. Target area for community-based forestry, selected countries in the Asia-Pacific region

Country	Existing area of community-based forestry (2017) (1 000 ha)	Target		Target as proportion of total forest area (%)
		Area (1 000 ha)	Year	
Cambodia	460	2 000	2029	23.0
Indonesia	800	12 700	2019	6.3
Myanmar	160	919	2030	17.4
Philippines	6 350	9 000	2008	70.6
Thailand	480	1 600	2025	30.0
Viet Nam	1 130	4 000	2020	28.3

Table 8.3. Examples of women's roles in forestry based on recent country gender assessments, selected countries in the Asia-Pacific region

Country	Gender assessment result
Cambodia	Women account for just over one-quarter of the total workforce in agriculture-related administrations, including 10 percent in forestry, 17 percent in fisheries, 28 percent in rubber, 29 percent in livestock and 34 percent in agricultural extension services. There is only one woman in a senior decision-making position, however
Lao People's Democratic Republic	Women comprise 51.3 percent of the workforce in agriculture, forestry and fishing
Papua New Guinea	Women comprise almost 35 percent of the economically active population in agriculture, engaging mainly in subsistence agriculture
Philippines	The community-based forest management (CBFM) policy of the Department of Environment and Natural Resources mandates 30 percent representation of women in CBFM; today, women comprise more than 30 percent of the leadership in CBFM committees
Vanuatu	Women account for 11 percent of staff in the Forestry Department, and 5 of the 48 pemanent and contract staff are women

Sources: Unpublished FAO country assessments except for Lao People's Democratic Republic, for which the assessment has been published (FAO, 2018g).

Gender-responsive policies are more likely to ensure that clear benefits materialize for women; a lack of gender-responsiveness, on the other hand, may lead to perverse outcomes, even from well-intentioned policies. For example, a gender-responsiveness approach ensured that measures were taken to increase the participation of women in China's forest-tenure reforms (Box 8.8), which had previously been hampered by biases in policy design towards male heads of household, a lack of gender perspectives in the transfer of forest rights, the lower literacy of many rural women, and other cultural barriers. As a result, rural livelihoods improved, forests were better protected and managed, and women were able to increase their skills, gain access to jobs and increase awareness of their rights (APFNet and ACWF, 2015).

There is evidence that the greater participation of women in CBF and forest enterprises has positive impacts on the socio-economic empowerment of women, the well-being of their households and the environment. In an analysis of community forestry institutions in Nepal, for example, Agarwal (2015) reported a 51 percent higher likelihood of improved forest conditions in community forest user groups with all-women executive committees compared with groups with mixed executive committees.

Market approaches aimed at addressing sustainability and legality

Governance challenges in the forest sector include corruption, elite capture and illegal trade, and various market mechanisms have been deployed to help tackle these. APFSOS II (FAO, 2010a) identified the absence of strong market mechanisms – especially consumer pressure for sustainably and legally produced timber – as a key challenge in increasing the uptake of SFM and reducing forest illegality in the Asia-Pacific region (FAO, 2010a). Both supply-side (producer) and demand-side (consumer) measures are needed. Two key supply-side measures, voluntary forest certification and legality verification, are discussed below.

Certification has triggered participation in forestry to tackle bad governance

SDG indicator 15.2.1 measures progress towards SFM through five subindicators, one of which is "forest area under an independently verified forest management certification scheme".[33] The initial driving force behind certification was consumer demand for sustainably produced wood products, including through corporate and public procurement policies and national-level import regulations. Forest certification, which emerged in the early 1990s, addresses poor governance – especially illegal logging – as part of its overall remit to encourage best-practice forest management. The two main globally active forest-certification systems are those of the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC).[34]

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[33] Forest certification involves the issuance of certificates to operators able to meet specified forest management and chain-of-custody standards, as assessed by independent third-party auditors.

[34] The latter functions by recognizing national-level certification schemes.

BOX 8.8

Women and forests in China

In China, the Law on the Contracting of Rural Land envisages two methods for allocating collective forestland: household-based contracts; and allocation through bidding, auction or open negotiation. To qualify for the allocation of forestland, individuals must be permanent residents registered in a village and members of the village's economic organization. The principle of "equal rights within the village" is observed, giving rural women equal rights to men in the contracting and management of forestland. Most of the 350 surveyed villages were found to have allocated forestland based on the number of people in the village (headcount-based allocation), and the others had allocated forestland by household (household-based allocation).

Women were found to have generally enjoyed equal rights to men in the first stage of the reform, but in some cases their rights were compromised. The land-distribution system is such that women's legal rights to forestland are affected when there is a change in their civil status – that is, when they marry or divorce or are widowed. Some rural women who married men from other villages but kept their residence registration in the village of their parents may be denied allocation by that village because they "married out". Moreover, the villages to which they moved after marriage may also refuse to allocate them land, claiming that they are not really members of the village because their permanent residence is elsewhere. Other women were found to have lost out, even if their registration was changed to their husband's village. Because most villages allocated their forestlands in the first stage of the reform, women who married after or during the first stage must wait until the contract ends (in 20–70 years).

Eighty-four percent of the 350 surveyed villages from the first stage of reform did not reclaim the distributed forestland, regardless of the women's change in civil status, as long as they remained in the village. When women leave their original village after marriage but registration remains there, however, they could lose their individual rights, even when the village does not reclaim those rights.

Source: World Bank (2016b).

The most recent data indicate that 12 percent of the global timber market volume, and 6 percent of all productive tropical forests, are certified. The FSC had certified about 11 million ha of forest in the Asia-Pacific region as of March 2019, with the largest shares in Indonesia (2.5 million ha), Australia and New Zealand

(1.2 million ha each), China (1 million ha) and Malaysia (0.8 million ha) (FSC, 2019). The PEFC had certified 28.6 million ha of forests in the region as of December 2018, with the largest shares in Australia (11.4 million ha), China (6.6 million ha) and Indonesia (3.9 million ha) (PEFC, 2018).

Although the area of certified forests is relatively small in the region, much progress has been made. The forest area certified under the PEFC system grew from 15 million ha in 2013 to 28.6 million ha in December 2018 – an increase of about 14 million ha in five years. The area certified by the FSC in the region grew from 8 million ha in 2012 to 11 million ha in early 2019.

One of the barriers to the greater uptake of certification is its high cost. In most cases, certification is financially unviable without a price premium for certified products or other additional revenues or benefits. Another challenge is engaging small-scale operations: typically, CBF operations and smallholder farmers find it difficult to meet the complex and costly requirements of certification and lack the marketing capacity to maximize their revenues from it. Various efforts have been made to address these challenges, but more work is needed to bring certification within reach of all forest operators in the region.

Countries are taking measures to combat illegal timber

Governments are increasingly acting to control illegal timber imports as consumer countries assume more responsibility for addressing cross-border forest illegality. Import regulations typically prohibit or criminalize the importation of illegal timber and impose due-diligence requirements on operators placing wood products on the market. Australia, the EU and the United States of America (Box 8.9) have comprehensive regulations and laws aimed at preventing illegal wood imports, and several countries in Asia are also contributing to the fight against illegal logging and associated trade through voluntary or regulatory measures (Table 8.4). Some countries involved in negotiations on voluntary partnership agreements (VPAs) with the EU have developed or are developing import regulations as part of their national timber legality assurance systems (TLASs). Thirty of the 34 APFSOS III countries are members of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which uses trade-related measures as a means to ensure that wildlife – both animals and plants – is not exploited unsustainably through international trade (Stahl and De Meulenaer, 2017).

Five countries in the region – Indonesia, the Lao People’s Democratic Republic, Malaysia, Thailand and Viet Nam – are engaged (at varying stages) with the EU in VPA processes. To date, only Indonesia has initiated FLEGT licensing, thereby indicating the successful negotiation and implementation of its VPA with the EU. Other countries either are negotiating VPA texts or are at the system development stage.

Indonesia started issuing FLEGT licences on 15 November 2016; in the first year it dispensed more than 39 000 such licences for exports to all 28 EU member states at a value of more than EUR 1 billion.

Table 8.4. Import regulations in selected consumer countries or blocs to tackle illegal timber trade

Country	Import regulations
The Lacey Act (United States of America)	The Government of the United States of America introduced the Lacey Act in 1900 to ban the trade of illegally obtained animals and wildlife products. A 2008 amendment to the Lacey Act makes it illegal to import plants and plant products that have been harvested in violation of laws in their country of origin, extending its scope to include timber, paper and other forest products
The European Union (EU) Timber Regulation	The EU adopted legislation in October 2010 prohibiting the sale in EU markets of timber logged illegally according to the laws of the country of harvest. The EU Timber Regulation (EU 995/2010), which came into force on 3 March 2013, requires companies placing wood products in EU markets to implement due-diligence systems
The Illegal Logging Prohibition Act (Australia)	The Australian Illegal Logging Prohibition Act (2012), which took effect in November 2014, bans all Australian businesses from importing illegally logged timber and illegal timber products into Australia; it treats all timber equally, regardless of its origin. Like the EU Timber Regulation, the Australian law requires companies to use due diligence to assess the risk of illegality
China	China imports more timber than any other country. China's State Forestry Administration (now renamed the National Forest and Grassland Administration – NFGA) and the Chinese Ministry of Commerce released the Guide on Sustainable Overseas Forests Management and Utilization by Chinese Enterprises in 2009, and the China National Forest Products Industry Association also adopted a voluntary timber legality verification standard. The NFGA is considering issuing measures to manage the legality of imported timber and timber products as an interim step that might lead to a wider legal framework for addressing the legality of timber trade
Japan	Japan is also one of the largest importers of tropical timber, sourcing imports mainly from Asia. Japan has introduced a voluntary system called goho-wood ("legal-wood") to promote trade in legally sourced wood products. In 2006, Japan added goho-wood to the list of environmentally friendly goods subject to its Act on Promoting Green Purchasing. Japan is in the process of putting its Clean Wood Act (2016) into operation
Indonesia	A new system to control imports of timber products entered into force in Indonesia on 1 January 2016. This system completes Indonesia's timber legality assurance system, the backbone of its voluntary partnership agreement (VPA) with the EU. Businesses that import certain regulated timber products are now required to register with the Ministry of Trade and to undertake due-diligence checks to demonstrate compliance with legality requirements in countries of origin

Country	Import regulations
Malaysia	VPA negotiations between Malaysia and the EU have been on hold since 2014, but Peninsular Malaysia, Sabah and Sarawak have continued developing their respective timber legality assurance systems. Peninsular Malaysia introduced a new regulation on 1 January 2016 obliging importers to demonstrate the legality of imports of roundwood, plywood and some types of sawnwood, based on the legal frameworks of the countries of origin
Republic of Korea	The Act on the Sustainable Use of Timbers, which entered into force on 1 October 2018, requires importers in the country to submit documents (e.g. harvesting permits) to Korean customs authorities to show that their timber and timber products are legal. The legality standard issued by the Korea Forest Service recognizes timber licensed under VPAs as legally harvested. It covers lumber, plywood, pallets and anti-decay, fire-retardant and laminated wood, which account for a large portion of the Republic of Korea's imports of timber and timber products

BOX 8.9

Australia's illegal logging prohibition law

The Illegal Logging Prohibition Act (2012), which came into effect in November 2014, was the result of five years of consultation and engagement across governmental, industry and non-governmental sectors. The Act prohibits the trade (importation or processing) of illegally harvested timber in Australia and is equipped with strong financial penalties and jail time. The law requires all importers and domestic processors to conduct due diligence on certain timber and related products. Australia imports more than AUD 8 billion of wood and secondary wood products per year from more than 130 countries.

The Australian Government has worked closely with importers and domestic processors, as well as trading-partner countries, to promote understanding of the law. Efforts include facilitating compliance, working with international supply chains, negotiating country-specific guidelines (CSGs), and regional capacity development. Australia has negotiated nine CSGs to date with trading partners, including, in the Asia-Pacific region, Indonesia, the Republic of Korea, Malaysia, New Zealand, Papua New Guinea and the Solomon Islands. The Australian Government continues to work with other countries to increase coverage and build the trade in legal timber and wood products.

Source: Forestry Branch, Department of Agriculture and Water Resources of Australia, personal communication, September 2018.

Indonesia also issued more than 190 000 legality documents ("V-legal documents") for exports to other markets worth more than EUR 10 billion. Nevertheless, it is too early to measure the full impact of VPA implementation on market access for Indonesian wood products.

Many new trends have emerged since the original design of the VPA approach in 2003, affecting the potential effectiveness of supply-side measures. For example, forest conversion for the development of mining, roads, dams and commodity crops such as palm oil, rubber and soy has become a major source of tropical timber. The timber legality or VPA approach cannot eliminate legal forest conversion, although it may help trigger internal policy and legal reforms and ultimately to eliminate or contain illegal forest conversion.

The 2008 global financial crisis reduced EU demand for tropical timber, which had not recovered to previous levels by early 2019. Meanwhile, demand has risen fast in China, India and other regional markets. The decreasing importance of trade with the EU could affect the trade incentive provided by VPAs and their FLEGT licensing schemes involving EU markets. VPA TLASs usually cover all export markets, however, and producer countries may therefore continue to value VPA partnerships with the EU and the governance and reputational gains these provide. VPAs also cover domestic markets, which often face significant legality challenges. Producer countries could use FLEGT-related support to address such domestic challenges and to boost smallholder and community wood production.

Dealing with forest-related conflicts

Conflict is one of the biggest challenges facing natural resource management in the region, with the potential for causing or exacerbating resource degradation, the marginalization of vulnerable groups, losses of revenue and income, and even loss of life (Yasmi, Kelley and Enters, 2010). APFSOS II (FAO, 2010a) attributed forest-related conflicts in the region to a failure of governance and weak institutions dealing with resource management, and this still holds true. Forest-related conflicts have changed in nature as the policy discourse has changed:

- *Conflicts over timber* – logging concessions generated many conflicts before and during the 1990s, with governments, logging companies and local communities the primary actors. In some cases, local communities vigorously opposed the operations of logging companies because they overlapped with community forests but few benefits flowed to the communities. Conflicts are common where tenure is unclear among customary groups; where elites have made agreements with foreign logging companies on behalf of their communities (but without their agreement); and where the benefits of logging are not distributed equitably among members.

- *Conflicts over conservation and the multiple benefits of forests* – conflicts over measures to increase the area of protected forests have been ongoing since at least the 1980s. The establishment of national parks and a logging ban in natural forests were responses to domestic pressures to halt deforestation and address severe flooding (see Box 8.2). Conflicts over protected areas typically involve conservation agencies (e.g. forest and protected-area authorities and national-parks officials) and local and indigenous communities. In many cases, the establishment of national parks means that the extraction of forest resources is prohibited, with potentially major impacts on the livelihoods of local people, who may have lived in the affected area for many generations. The creation of protected areas may also lead to the eviction of indigenous peoples and local communities from their ancestral lands. The failure to recognize the importance of local people in protecting forests and landscapes in many countries has often resulted in decades-long conflicts.

- *Conflicts in community participation* – where participatory forestry has emerged as an alternative to state-controlled forestry, many conflicts have arisen over the boundaries between community forests and other types of forests, between neighbouring community forests, and within communities over the ways in which benefits are allocated to community members. Elite capture has been reported in numerous cases, resulting in dissatisfaction and resentment among other community members.

- *Conflicts over large-scale land acquisitions and global markets* – forest conflicts became more transnational in character after 2000 as globalization brought a dramatic increase in demand for forest products and agricultural commodities such as palm oil, pulpwood, rubber, sugarcane and coffee, leading to the large-scale acquisition of land for the production of these (Hall, Hirsch and Li, 2011). Such acquisitions, also called land-grabbing, led to competition with existing land uses and often to conflicts involving local communities, private-sector actors and the state. The production of agricultural commodities in Southeast Asia involves the massive conversion of forests, often by dispossessing marginalized rural communities of their land because they lack statutory tenure.

- *Conflicts linked to climate change and sustainable development* – emerging initiatives on climate-change mitigation and adaptation have the potential to both reduce and increase forest conflicts; moreover, forest conflicts could undermine the success of such initiatives. Climatic changes are also likely to be increasingly important factors in forest conflicts to 2030 and beyond. Blondel (2012), for example, considered it likely that changes to ecosystems and livelihoods as a result of climate change would act as "threat multipliers" to resource conflict, especially in areas already facing development and security challenges and where the direct physical effects of climate change will be greatest. It is essential, therefore, that potential conflicts are taken into account when designing and implementing programmes such as REDD+ (Box 8.10).

BOX 8.10

The Cancun REDD+ safeguards

REDD+ has the potential to positively affect forest governance discourses and policies. Concerns have been raised, however, that, if poorly implemented, some REDD+ interventions could lead to conflict (Patel *et al*., 2013). A study in South and Southeast Asia described a range of issues raised by local stakeholders in connection with REDD+, such as restricted access to forest resources; competing demands; benefit sharing; and unclear tenure (RECOFTC, 2016). Ever since the Bali Action Plan was drafted in 2007, these concerns have been at the heart of the international discourse on REDD+ in the context of negotiations in the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC Conference of the Parties in Cancun, Mexico, in 2010 agreed on a list of safeguards that must be "addressed and respected" by any countries applying for results-based payments for REDD+ performance (UNFCCC, 2010). The safeguards include provisions for transparent and effective forest governance structures; respect for the knowledge and rights of indigenous peoples and local communities; and the full and effective participation of relevant stakeholders in the design of REDD+ policies and measures. Several countries in the Asia-Pacific region, including Cambodia, Malaysia and Sri Lanka, have prepared summaries of information on safeguards, as well as safeguard information systems. The Cancun safeguards provide a framework for recognizing and addressing the root causes of conflicts over forest resources and incorporating these lessons into forest governance reforms, policies and laws, not just in the context of REDD+. The issue of poor design and implementation of forestry projects is as relevant to REDD+ as it is to any other forest financing mechanism.

There was massive forest loss in Kalimantan, Indonesia, between 1973 and 2010 (Gaveau *et al.,* 2014) associated with logging, agricultural expansion, mining and the establishment of industrial-scale tree-crop plantations. All these activities gave rise to major conflicts that involved local communities, government and private companies. The livelihoods and territories of local communities were squeezed, resulting in a loss of control over land communities called theirs, disruptions to their cultures, and the degradation of the forests and landscapes on which they depended for subsistence and cultural identity; conflicts largely overlapped with land-use changes (Abram *et al*., 2017).

Forest-related conflicts may arise in the future over the extent to which various land-use systems contribute to carbon emissions and sequestration. As countries increasingly experience the impacts of climate change, national climate-related policies will become major shapers of landscape and resource management. Difficult trade-offs may be needed, such as between economic activities and resource conservation. More conflicts over land use may be anticipated towards 2030 as countries strive to achieve commitments made in the Paris Agreement on climate change, especially if they are lagging behind in meeting their nationally determined contributions and feel obliged to shift dramatically towards a greener development paradigm (or else revise their nationally determined contributions).

Many developing countries in the region lack reliable data on forest conflict, and they also lack mechanisms for coordinating between sectors and levels of governance in responding to conflicts. There are few indications that these problems are being addressed, with many developing countries allocating insufficient human and financial resources to achieve effective institutional development capable of managing conflict.

Changing discourses, changing institutions

Changes in forest governance and policies may require appropriate reforms to public, market and community institutions to ensure they can deliver the services expected of them. For example, the participatory-forestry discourse requires a different institutional structure compared with that needed under the forestry-for-timber discourse. Table 8.5 characterizes the institutional changes that may need to take place to meet the requirements of the four major forestry discourses.[35]

Public forestry institutions (i.e. government agencies) and logging companies generally dominated under the forestry-for-timber discourse. Forestry departments were responsible for forest management, which operated in a command-and-control fashion with little or no involvement of community institutions. The main culture was conformity, and there was little scope for questioning established structures and norms. This situation was evident in Southeast Asian countries such as Cambodia, Indonesia, Malaysia and Myanmar in the 1990s and early 2000s. In Fiji, Papua New Guinea and the Solomon Islands, on the other hand, community forest ownership means that communities have more say in logging than in countries where governments own the forests. In the past at least, many communities wanted logging because of the royalties they would earn and were frustrated if they were constrained by governments from doing so.

Forest institutions have transformed in response to a change in forestry discourse towards participatory forestry. To enable the participation of local communities, government agencies have been required to perform in new ways, such

35 Each of these institutional arrangements is capable of delivering wood and non-wood products, ecosystem services (e.g. carbon sequestration and water quality), and economic benefits for the forest poor. The extent to which they can do so is a matter of emphasis and degree.

Table 8.5. Possible institutional changes according to the four major forestry discourses

Policy discourse	Major institution	Style and approach
Forests for timber	Government; private sector	Command and control; culture of conformity
Participatory forestry	Community institutions; non-governmental organizations; markets	Facilitative; regulative; partnership-based
Multiple benefits of forests	Government; markets; private sector	Market-based
Climate change and sustainable development	Government; markets; private sector	Compliance with international commitments

as by working with community organizations and facilitating site-level CBF. There are increasing moves to include the free, prior and informed consent of indigenous peoples and local communities in programme development (FAO, 2016). The role of community institutions – such as forest-user groups, farmer unions and cooperatives – has become more important, as has that of non-governmental organizations, which act to support communities and at the same time have brought the aspirations of communities to the attention of governments. The role of governmental institutions has shifted from command-and-control to facilitative and regulative. Market-linked institutions such as certification bodies have also emerged as stronger players in this discourse.

The roles of the various institutions in participatory forestry have varied across countries. For example, village institutions and local governments have been central in China's massive collective forestry programme. In Nepal, community forest user groups and non-governmental organizations such as the Federation of the Community Forestry Users Nepal have been crucial for the implementation of community forestry (constitutional change in Nepal also has major implications for the country's forest governance – Box 8.11). In Viet Nam, the role of individual households and of household and community groups has become more prominent under the country's forestland allocation programme.

Further institutional reform has taken place as part of the multiple-benefits discourse. Forestry agencies have been required to perform new functions to ensure the positive role of forests in biodiversity conservation, water regulation, recreation, land conservation, ecotourism and payments for ecosystem services. New sections have been created in forestry departments and new skillsets acquired. The strengthening of market-based institutions is evident, especially with the

BOX 8.11

Recent governance and institutional changes in Nepal

Under its 2015 constitution, Nepal has transformed into a federal, democratic, republican, inclusive and socialism-oriented state. As part of federalization, state powers, responsibilities, functions, resources and accountability have been transferred to subnational and local governments to deliver public goods and services. The federal government, seven state (subnational) governments and 753 local-level governments are functioning within their territories and jurisdictions. Rapid economic development has become a central focus for achieving national development goals. Forests and forestry are integral to the lives of rural people in Nepal – many of whom depend on them for subsistence, livelihoods, employment and income generation – and to the sustainability of mountain landscapes. Although forests have considerable potential to contribute to the national economy, they have been used in the past mainly for subsistence due to a lack of active management. The promulgation and implementation of the federal, democratic and republican constitution has helped resolve ethnic conflicts and ensure a political transition. The three-tier government system is functioning well and delivering public goods and ecosystem services to the people. Now, the paradigm has shifted from a push for political transition to one of stability – a fundamental requirement for the country's overall development. The national development vision has been articulated as "prosperous Nepal and happy Nepali", and the following economic targets have been set: double-digit economic growth; a doubling of per-capita income; and the attainment of developing-country status by 2022 and middle-income-country status by 2030 through the appropriate mobilization of natural and human resources.

Source: P.N. Kandel, personal communication, October 2018.

emergence of payment schemes for ecosystem services, certification, and FLEGT initiatives.

The discourse on climate change, forest and landscape restoration, and sustainable development requires the further reinvention of forestry institutions, with expertise required in, for example, the negotiation of climate-related agreements, carbon accounting, forest monitoring, forest reference (emission) levels and the mechanisms for implementing REDD+. Many forestry departments now have dedicated sections on climate change. Changes have also been required in non-governmental and community organizations to take advantage of policy developments in this discourse, and the role of market institutions has become crucial.

Thus, forest institutions have evolved over time under the influence of the changing forestry discourse. There has been a shift in the role of government agencies in forestry, from dominant players to facilitators of inclusive and participatory approaches as community, non-governmental and market institutions have become increasingly important. Those countries that have made most progress in the past two decades are those that have advanced institutional reforms, especially related to tenure, and increased the area of forest available for community forestry and forestry on private lands.

Youth views on forest governance

As part of the development of APFSOS III, a youth consultative workshop was convened in Bangkok, Thailand, in March 2019, attended by 25 women and men aged 18–30 years from 12 countries. According to various participants:

- "Forests provide a wide range of benefits to society and environment (e.g. food, timber, clean water and air, and medicine)."
- "Forests are important for local and indigenous peoples. They are like a convenience store where people can get all they need and, for many indigenous peoples, they are the main source of their foods."
- "Forests are important for liveable cities because they provide green space and ensure clean air."
- "Forest is life, and without forests there will be no life."

The views of young people on the role of forests are shaped by their backgrounds, education, cultures and life experiences. Even though about half the participants in the youth consultative workshop came from non-forestry backgrounds (i.e. they were not studying or working in forestry), they articulated a good understanding of the importance of forests for society and the planet. Participants cited various issues and challenges for forests in the region, including deforestation, development threats, fire and the destruction of primary forests, and they expressed serious concerns about these. Other quotes from the workshop include the following:

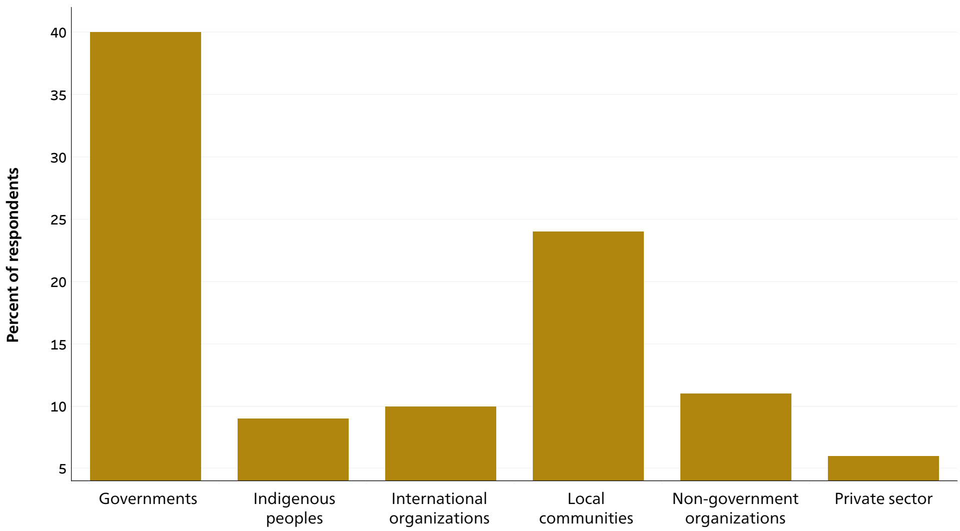
- "I know forests are important, but forests are under threat from infrastructure development, especially in Borneo, where I work now. There are threats at a massive scale."
- "Forest fires are frequent in Australia. It takes a long time for forest to recover. In the future we expect more of these events in view of the changing climate."
- "We are not doing enough to tackle environmental issues."

Forest governance is key for changing the status quo and setting new directions. In a survey of young people conducted for APFSOS III (262 respondents from 32 countries – see Chapter 7), 40 percent of respondents considered that governments need to take the lead role in forest governance. On the other hand, 24 percent of respondents believed that local communities should play the pivotal role, and 11 percent thought this should fall to non-governmental organizations (Figure 8.7).

The survey results suggest that young people expect forest governance in the future to be more participatory and to embrace the aspirations of all stakeholders, especially those living in or near forests. Most survey respondents indicated that decision-making would need to be decentralized and the transparency of forest governance increased, and that this was likely in the region in the future (Figure 8.8). Participants in the consultative workshop warned, however, that decentralization and transparency can only be achieved if the status quo is removed and new policies implemented.

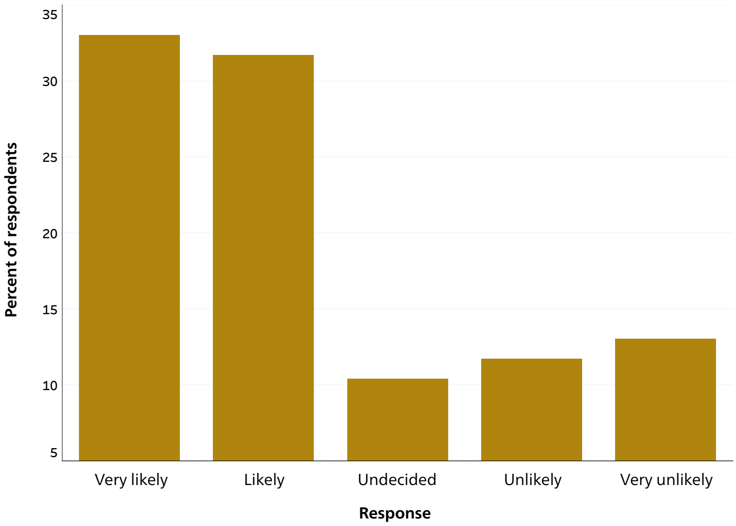
Ensuring good governance requires an ability and willingness among decision-makers to change. Many young people want to be leaders in their countries and to thereby lead such change from within. With the evident capacity of young people to mobilize in large numbers on causes in which they believe, today's leaders would be prudent to listen to their aspirations.

Figure 8.7. Responses of survey respondents to the question, "Who will be the leaders and decision-makers in forest management in the future?"



Notes: n = 262. The survey, which was conducted online in February 2019, was open to women and men aged 18–35 years from forestry and non-forestry backgrounds. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals).

Figure 8.8. Responses of survey respondents to the question, "How likely is it that decentralization and transparency will be implemented in the future?"



Notes: n = 262. The survey, which was conducted online in February 2019, was open to women and men aged 18–35 years from forestry and non-forestry backgrounds. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals).

PART III

Scenarios for 2030 and 2050

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Key **points**

- Scenario building provides an opportunity for stakeholders to discuss possible futures, identify robust actions and develop strategies for steering the future along desirable pathways.

- Three scenarios – business-as-usual, destructive and aspirational – are discussed here for 2030 and 2050, assuming differing outcomes from the drivers of forest change.

- In the business-as-usual scenario to 2030, the role of forests and the forest sector in addressing global challenges and achieving global targets such as the Sustainable Development Goals, the Paris Agreement on climate change, the Bonn Challenge and the Global Forest Goals will be suboptimal.

- In the aspirational scenario to 2030 and in line with the Global Forest Goals, forest area in the region will increase by 22 million ha. With the current pace of establishment of new forests, the region could even aspire to more than this (e.g. an additional 50 million ha by 2030). Additionally, the forest-related SDGs and other targets agreed in global processes will be achieved, although this will require transformational changes in forest and landscape management.

9 | Forests face divergent futures to 2030 and 2050

- In the disruptive scenario for 2030, deforestation and forest degradation will accelerate, few countries will achieve forest restoration targets, forest-based livelihoods and ecosystem services will deteriorate, forest-related tensions will escalate, and forest-based industries will fail to ensure resource sustainability. This could have major ramifications for food and water production, human well-being and overall ecological stability well beyond forests.

- The business-as-usual, aspirational and disruptive scenarios for 2050 involve similar outcomes to those for 2030, driven to further extremes. Building the resilience of forests, landscapes and people would help ensure that the region has the capacity to respond to future shocks and uncertainties.

- Nearly 300 forestry students and young professionals from more than 30 countries consulted for this study considered that they can shape a sustainable future by taking leadership roles, generating momentum through collaboration and social media, and changing rigid institutions from within by shaking them up.

This chapter presents scenarios for forests and the forest sector in light of the drivers and other factors outlined in chapters 4–8. It begins by addressing the question of why scenarios are useful, touches on some of the projections of the previous outlook study, and examines three broad scenarios for 2030 and 2050: 1) business-as-usual (BAU); 2) aspirational; and 3) disruptive. It concludes by canvassing the views of young people on the future.

Why develop scenarios?

> “With a set of possible future scenarios as the starting point, our preparedness to meet tomorrow's challenges is likely to increase” (Öborn *et al*., 2013).

The future is not only to be responded to, but by understanding drivers and visualizing both desirable outcomes and those to be avoided, such as through scenario building, the future can in part be created or planned for (de Bruin, Kok and Hoogstra-Klein, 2017). The process of scenario building is itself fraught with uncertainty, however, due to the complexities of the drivers that will shape the future (Hoogstra-Klein, Hengeveld and de Jong, 2017). Certain drivers with implications for the outlook for forests in the Asia-Pacific region in 2030 and 2050, such as demographic change, can be predicted with high confidence, and sophisticated models enable the analysis of future rates of economic growth for countries, regions and the world. But forests and forestry have multiple dimensions and are influenced by complex factors (Hurmekoski and Hetemäki, 2013); moreover, a wide range of unpredictable events is possible, especially in a timeframe of up to 30 years.

The task of policymaking and decision-making in the forest sector is to optimize beneficial outcomes amid uncertainty. Scenario building provides an opportunity for stakeholders to discuss and exchange perspectives on possible futures. Scenarios can help actors address uncertainty by stimulating adaptive thinking, and they can inform strategic decision-making processes aimed at steering the future along desirable pathways. Scenario building in the forest sector can facilitate planning and thereby assist in the task of making decisions that will best enable the sector to embrace positive change and show resilience in the face of shocks.

In this study, scenario building has three main objectives:

1. To provide an opportunity for decision-makers and other stakeholders to discuss potential changes that could occur in forests and the forest sector by 2030 and 2050, taking into account broader drivers of change.

2. To discuss and propose robust actions that could be taken under various scenarios to increase the likelihood of achieving preferred outcomes and avoiding undesirable consequences.

3. To better position the forest sector to contribute to solutions to challenges faced by communities, countries, the region and the planet.

The scenario-building process used in this study combines quantitative and qualitative approaches. Using quantitative data on trends in key forest indicators in recent decades (e.g. forest area and forest-area change), the analysis extrapolates to 2030 and 2050, taking into account the drivers of change likely to shape forestry over those periods. The qualitative approach obtains information from the literature, expert opinion, and the views of various stakeholders, including the region's heads of forestry.[36]

The Asia-Pacific region is highly diverse in its economics, demographics, natural resources, governance and uptake of technological innovation. Developed and developing countries, and even countries at similar stages of economic development, diverge significantly in their approaches to forest management and in a wide range of forest-related parameters. For example, forest ownership in small-island countries in the Pacific is largely communal, in contrast with most other countries in the region, where large proportions of the forest estate are state-owned. The pace of technological adoption also differs among countries: for example, New Zealand and Japan tend to use mechanized logging systems, in contrast to most other countries in the region in which felling using chainsaws predominates. Readers should bear in mind, therefore, that the regional scenarios presented here are about the big picture and are not necessarily applicable uniformly to all countries in the region.

[36] The scenario-development expert group formed for this outlook study advised the building of scenarios for two time horizons, one to 2030 (a similar time span to previous forest-sector outlook studies), providing planners with insights into the policy, business and environmental situations in the next decade or more, and the other to 2050, offering greater scope for influencing outcomes with robust actions taken now.

Scenarios in the previous outlook study

APFSOS II, published in 2010, provided scenarios for how forests and forestry might look in 2020 (FAO, 2010a). Table 9.1 summarizes some of the key projections set out in APFSOS II and briefly assesses their validity today. It shows that APFSOS II was relatively accurate in projecting the regional situation in 2020 but less accurate at the subregional level.

Scenarios for 2030

What will the Asia-Pacific region look like in 2030? Based on available data and expert opinion, the following predictions are reasonably likely:

- The region will be home to 4.5 billion people (53 percent of the world population), up by 276 million people (almost equivalent to the entire population of Indonesia) compared with 2017. Most (82 percent) of the region's population will live in East and South Asia.

- About 55 percent (2.5 billion people) of the region's population will live in cities, compared with only 36 percent in 2010. This represents an additional 390 million urban residents compared with 2010.

Table 9.1 Forests and forestry in the Asia-Pacific region in 2020: selected predictions from APFSOS II

Predicted regional situation in 2020 (FAO, 2010a)	**Remarks**
Forest area in the Asia-Pacific region will increase or stabilize	At an aggregate level, forest area in the region has increased, although the rate of increase has slowed
The loss of natural forests through clearing to meet growing demand for food and biofuel will continue	Deforestation has been an issue in many countries, although the overall rate of deforestation has slowed. The loss of natural forests has been largely due to the expansion of agriculture to meet growing demand for food and commodities
Forest degradation will continue	The area of primary forests has declined. About 76 percent of natural forest has suffered from various level of degradation, and forest growing stock has declined in many countries
The implementation of sustainable forest management will be constrained in many countries by weak policies and institutional arrangements	Many countries have seen only slow improvements in forest governance. On the other hand, producer and consumer countries have made strong efforts towards sustainability through, for example, certification, legality measures, and improvements in forest policies
Planted forests and trees outside forests will be an increasingly important source of wood	Almost all countries in the region registered increases in planted-forest area. Trees outside forests have increased and become important sources of timber in many parts of the region
Subregional situation in 2020	
Continued overall increase in forest area in East Asia (FAO, 2010b)	There was an expansion in forest area in the subregion, due mainly to increases of planted forests in China
For Australia and New Zealand, net forest cover will remain relatively stable (FAO, 2010c)	Australia has experienced forest loss, mainly due to clearing for livestock grazing, but New Zealand's forest area has not changed significantly
Low probability of a forest transition (i.e. a net increase in forest area) in South Asia (FAO, 2010d)	According to recent data, Bhutan and India have experienced net positive forest-area change. Overall, South Asia has more forests now
REDD+ will play an increasing role as a means of funding for protected areas and community forestry in Southeast Asia (FAO, 2010e)	REDD+ has been initiated and piloted in countries across the region, including in protected areas and community forests. However, significant funding for protected areas and community forestry has not materialized

- The region will have more elderly people – 12 percent of the population will be aged 65 years or older, double the percentage in 2000.
- Overall regional economic growth will remain strong – the growth rates of some countries in the region will plateau as their economies reach natural limits to rapid growth, but others will undergo growth spurts. Despite variations between countries, the region could be free of poverty by 2030.
- New technologies will have transformed some countries, but their uptake in others will lag severely behind.

Business-as-usual will be less than ideal

The BAU scenario to 2030 assumes that the major drivers of change – demographic factors, economic growth, environmental and governance factors, and technological innovation – will continue to develop in line with historical trends. Although countries may make progress in addressing certain challenges, there will be no significant change in the direction of these trends. For example, the BAU scenario does not take into account newly announced forest-related programmes, and it sets a baseline according to current trajectories of key indicators. On the other hand, it assumes there will be no dramatic changes in governance or economic growth. Nevertheless, disasters such as cyclones, earthquakes, forest fires and typhoons will likely occur.

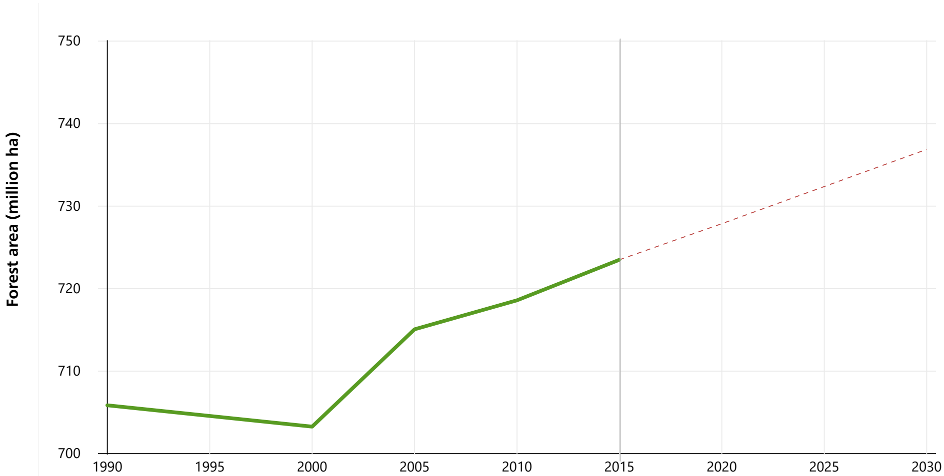
Forest area will increase. In the BAU scenario, there will be a continued increase in forest area to 2030 – at an average of 1.2 million ha per year – as efforts to establish new forests in China, India, the Philippines, Viet Nam and other countries continue (Figure 9.1). In 2030, the total forest area in the region will be around 737 million ha, up by 14 million ha (an area almost equivalent to Nepal's total land area). D'Annunzio *et al*. (2015) also projected a continued increase in forest area in the Asia-Pacific region to 2030, most of it in China.

Subregionally, East Asia will continue to dominate the overall regional increase in forest area in the BAU scenario (Figure 9.2), due mainly to China's afforestation programme. Some 32 million ha of additional forests (compared with 2015) is expected in the subregion by 2030, an average annual increase of about 2 million ha per year. This projection assumes no economic slowdown in China and that the government continues its afforestation programme at the current pace.

In contrast, there will be a decline in forest area in Southeast Asia and some Pacific countries, although at a reduced rate. Cambodia, Indonesia, the Lao People's Democratic Republic, Myanmar, Papua New Guinea and the Solomon Islands will probably continue to experience forest loss to 2030, but the rate of deforestation will decline in some countries.

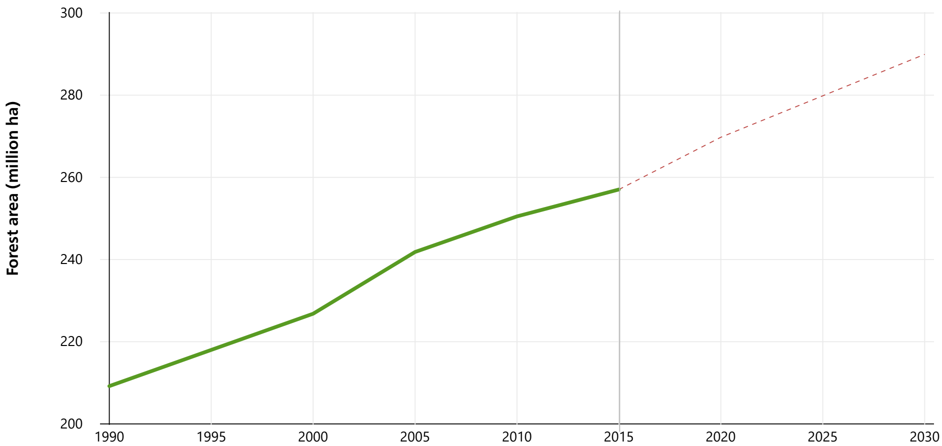
Some countries in Oceania will see increases in forest cover, although this will not markedly affect the regional picture. Forest area has been increasing in South Asia since 2000 and this trend

Figure 9.1. Projected forest area to 2030, Asia-Pacific region, business-as-usual scenario



Note: The green line indicates measured forest-area change; the red dashes indicate the business-as-usual scenario for change in forest area in the region to 2030.

Figure 9.2. Projected forest area to 2030, East Asia subregion, business-as-usual scenario



Note: The green line indicates measured forest-area change; the red dashes indicate the business-as-usual scenario for change in forest area in the subregion to 2030.

will continue, but the rate of growth will be less than that in East Asia. More trees will be planted in agricultural areas in Bangladesh, India and Sri Lanka to meet increased domestic demand. Box 9.1 sets out the expectations of surveyed forest stakeholders regarding forest-area change by 2030.

Planted forests will expand, but primary forests will decline. The area of planted forest in the Asia-Pacific region will continue to increase in the BAU scenario, from 126 million ha in 2015 to about 165 million ha in 2030. The area of primary forests will decrease and stabilize in a number of countries. The region's additional forest area, therefore, will mostly comprise planted forests (some natural forests will regenerate, but the area will be relatively small). This finding coincides with the expectations of the region's heads of forestry, as expressed in a survey conducted for this study (Box 9.2).

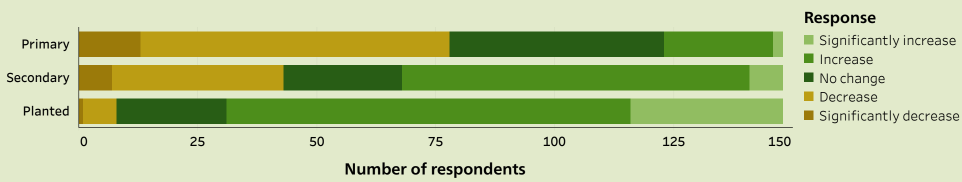
Demand for forest products will be strong. In line with continued economic growth and increased purchasing power, demand for various forest products – such as industrial roundwood, sawnwood, wood-based panels, pulp for paper, paper and paperboard, and wood furniture – will

BOX 9.1

Stakeholder expectations of forest area in 2030

A stakeholder survey conducted for this study (n = 180) showed that a large majority of respondents expected the area of planted forests to increase to 2030 (Figure 9.3). Significantly more than half the respondents expected the area of secondary forests to expand and the area of primary forests to decline. These are two sides of the same coin: usually, a reduction in primary forest will result in an increase in secondary forest (i.e. the same forest area changing from primary to secondary forest, for example after logging). Primary forest is only rarely converted directly to non-forest.

Figure 9.3. Stakeholder expectations of forest area in 2030, by forest type, Asia-Pacific region



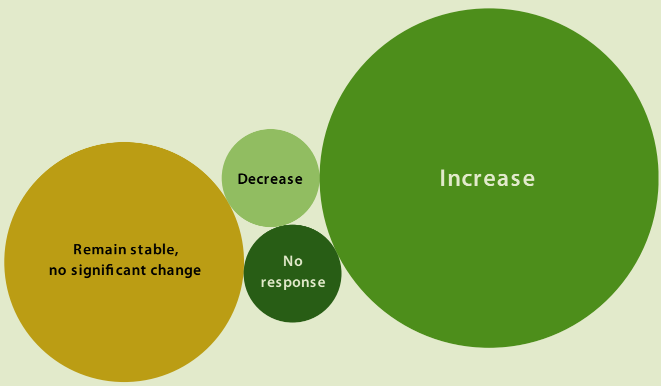
Note: n = 148.
Source: Online survey conducted in late 2018 and early 2019 involving 180 respondents from 24 countries. The survey was open to the public, and responses were voluntary. Not all respondents answered all questions.

BOX 9.2

Perception of heads of forestry on the state of forests in the Asia-Pacific region in 2030

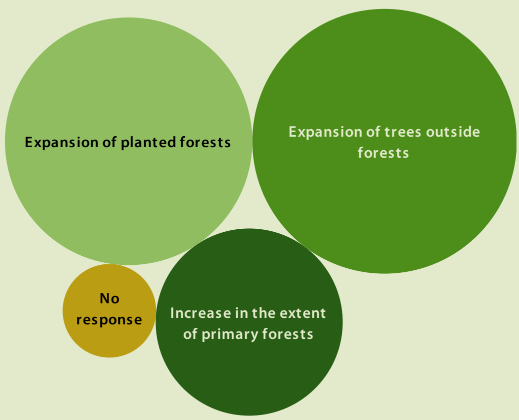
Twenty of the region's 34 heads of forestry responded to a survey in 2018 to determine their views on a range of topics. Figure 9.4 shows that 12 respondents (60 percent) believed that forest area will increase in their countries between 2018 and 2030, and six (30 percent) expected forest area to be unchanged. Figure 9.5 shows that eight respondents (40 percent) expected the increase in forest and tree resources to be due mainly to the expansion of trees outside forests, seven (35 percent) expected it to be due mainly to an expansion of planted forests, and four (20 percent) thought it would be due to an increase in the extent of primary forests (although this seems unlikely given that the definition of primary forests is "largely unmodified by humans").

Figure 9.4. Responses of heads of forestry in the Asia-Pacific region to the statement, "Forest area in my country will increase/decrease/remain stable in 2030"



Note: n = 20.
Source: Online survey of heads of forestry in the Asia-Pacific region, 2019.

Figure 9.5. Responses of heads of forestry in the Asia-Pacific region to the statement, "Increases in forest and tree resources in my country in 2030 will be due mainly to …"



Note: n = 20.
Source: Online survey of heads of forestry in the Asia-Pacific region, 2019.

increase to 2030 in the BAU scenario. The production of industrial roundwood has been growing rapidly in the region since 1990. This trend will continue, with industrial roundwood increasingly sourced from planted forests, TOF and smallholder plantations (and increasingly less from natural forests). Technological improvements will enable greater recycling as well as an increase in the products that can be produced from increasingly small-dimension roundwood.

Demand will rise relatively slowly for sawnwood under the BAU scenario but more strongly for wood-based panels. The Asia-Pacific region has accounted for 79 percent of the global increase of wood-based panel production since 1990, and the region's production of pulp for paper has doubled; these trends will continue to 2030 in the BAU scenario. The production of wood furniture will grow strongly to 2030 and the market for non-wood forest products will also increase in the BAU scenario, with the health-and-beauty industries pushing up demand for certain products.

Governance will improve marginally. Efforts to improve forest governance will continue in many countries in the Asia-Pacific region in the BAU scenario, including strengthening efforts to combat the illegal trade of wildlife and wildlife products. Stakeholders will increasingly participate in decision-making and benefit sharing in light of continued domestic and international pressure. New technologies will enable stakeholders to participate more in forest-related decision-making and monitoring. Nevertheless, most countries will fail to achieve adequate tenure reforms or fulfil forest-area targets for CBF (as presented in Chapter 8) because of a widespread lack of an enabling environment, which, in most countries, will fail to fully materialize in the BAU scenario.

Overall, on the positive side, there will be an increase in forest cover in the region by 2030 in the BAU scenario, mainly from monocultural planted forests (with some efforts to increase the multifunctionality of planted forests). Meaningful (but insufficient) progress will be made in forest conservation, due largely to increasing appreciation of the important roles of forests in providing ecosystem services, growing demand for wood fibre, and the knowledge that biodiversity loss poses a long-term threat to environmental stability and the well-being of human communities.

On the other hand, forest conversion for agriculture, mining, infrastructure and plantation estates will be unabated in the BAU scenario. National, regional and global dialogues aimed at reducing deforestation, improving forest management and increasing the trade of sustainably and legally produced forest products will continue, but with frustratingly little impact on the ground. Employment in forestry will decline as rural people migrate to cities and other sectors offer better opportunities. There will be no significant change in the absolute contribution of the forest sector to GDP, although the relative contribution will continue to decline as other economic sectors outpace forestry; nevertheless, the forest sector will remain an important contributor to the economies of several countries in the region.

In the BAU scenario, the role of forests and the forest sector in addressing global challenges and achieving global targets embedded in the SDGs, the Paris Agreement on climate change, the Bonn Challenge and the Global Forest Goals will be suboptimal. Most worryingly, forest degradation is likely to continue, with the ongoing loss of biodiversity and declines in the quality of crucial ecosystem services. To ensure a positive trajectory toward 2030, therefore, the region will need a more aspirational approach.

Forest-related goals will be achieved in the aspirational scenario

Four globally agreed sets of targets are all highly relevant to forests in the Asia-Pacific region in 2030: 1) the SDGs; 2) the Paris Agreement on climate change; 3) the Bonn Challenge;[37] and 4) the Global Forest Goals. These set the framework for the 2030 aspirational scenario.

The forest-related SDGs will be achieved. The aspirational scenario involves meeting the forest-related SDGs – and optimizing the role of forests in other SDGs – in the Asia-Pacific region. FAO (2018a) reviewed the various contributions that forests could make to achieving ten of the SDGs, including 28 SDG targets, finding, among other things, an overall absence of data and methodologies for collecting information on targets and indicators. In the same vein, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP, 2017a) indicated that data availability is an issue for environment-related SDG targets.

UNESCAP (2017a) found that the region is on track to achieve only one SDG by 2030 – SDG 4 (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all). On the other hand, progress to 2017 was very slow for two SDGs that make specific reference to forests: SDG 6 (clean water and sanitation) and SDG 15 (life on land) (UNESCAP, 2017b). This is concerning.

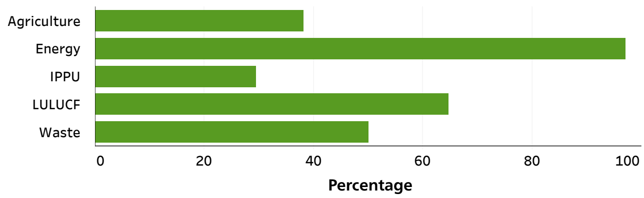
FAO is the custodian agency[38] for five forest-related indicators – two for SDG 6 and three for SDG 15. Time-series data for three of the five indicators – those related to forest area, SFM and mountain green cover – are available from FRAs conducted every five years. In terms of indicator 15.1.1 (forest area as a percentage of total land area), 25 percent of the total land area in the Asia-Pacific region is forest, which is lower than the global average (31 percent). Nevertheless, more data and improved methodologies are needed to fully track progress in SDG 15's 14 indicators.

Countries will meet their forest-related nationally determined commitments on climate change. The Paris Agreement establishes a collective commitment by Parties to the UNFCCC to take action to limit the increase in global average temperature to well below 2 °C above

[37] The recent declaration of the United Nations Decade of Ecosystem Restoration is also in line with the Bonn Challenge.

[38] FAO is the custodian United Nations agency for 21 SDG indicators and a contributing agency for a further four. In this capacity, FAO is supporting the efforts of countries to monitor the 2030 Sustainable Development Agenda.

Figure 9.6. Percentage of nationally determined contributions in Asia-Pacific countries that include land use, land-use change and forestry and other sectors in economy-wide mitigation contributions



Note: LULUCF = land use, land-use change and forestry; IPPU = industrial processes and product use.
Source: FAO (undated [a]).

pre-industrial levels and to pursue further efforts to limit the increase to 1.5 °C. The Paris Agreement refers to the importance of conserving and enhancing carbon sinks and reservoirs and highlights the special role of forests in this regard. Actions under the agreement will be based on nationally determined contributions (NDCs) aimed at achieving the agreement's long-term goals (see Chapter 6).

A review of NDCs in the 34 APFSOS III countries showed that land use, land-use change and forestry (LULUCF) is a key priority in both mitigation and adaptation policies and measures. Sixty-five percent of countries in the region have included the LULUCF sectors as part of their economy-wide mitigation contributions, second only to the energy sector (Figure 9.6).

Grassi *et al*. (2017) quantified the greenhouse-gas emission reductions from forest-related NDCs in eight countries in the region – Australia, Cambodia, China, India, Indonesia, Japan, the Lao People's Democratic Republic and New Zealand – as part of a global assessment. The approach included re-creating historical emissions from LULUCF in selected years and the calculation of unconditional (i.e. self-effort of countries) and conditional (i.e. with external assistance) emission reductions and sinks for 2030 by drawing on a wide range of nationally prepared data sources.[39] The authors found that, by 2030, independent action by each country to reduce emissions in line with their NDCs would result in the maintenance of LULUCF sinks in China, India and Japan and in emission reductions in Indonesia.

The analysis by Grassi *et al.* (2017) showed that achieving significant emission reductions at the regional level depends on management in a few forest-rich countries. With their unconditional and conditional targets, most of the assessed countries will not deviate much from

[39] The key national sources used in the analysis prepared by Grassi *et al.* (2017) were NDCs; 2015 greenhouse-gas inventories; national communications; biennial reports (for developed countries) and biennial update reports (for developing countries); forest reference emission levels; FRA 2015 country reports; and other country-specific sources. See Grassi *et al.* (2017) for supplementary information.

their current LULUCF emission pathways. On the other hand, Indonesia could reduce its national sector emissions by 37 percent and 52 percent, respectively, if it meets its unconditional and conditional targets for LULUCF. This potential action is significant at the regional level because Indonesia accounts for around 90 percent of the total cumulative potential emission reductions from LULUCF in the countries assessed.[40] In the aspirational scenario, all countries in the Asia-Pacific region will meet their NDCs.

Although, globally, the potential for emission reductions in LULUCF based on country actions is substantial, the estimated cumulative effect of these will be insufficient to keep the global temperature below the 2.0 °C target by the end of the century. IPCC (2018) indicated that human activities have already caused an increase in average global temperatures of around 1.0 °C above pre-industrial levels, and this is likely to reach 1.5 °C between 2030 and 2052 if greenhouse-gas emissions continue to increase at the current rate. Based on current NDC pledges, the planet is projected to warm by 2.9 °C by 2100; if countries do not act, the increase could be as high as 4.5 °C (Stylianou *et al*., 2018). Thus, the collective targets set by countries in their NDCs is far short of that required to reduce greenhouse-gas emissions sufficiently to keep global warming below 2 °C. Future iterations of the NDCs – including in the region – need to be much more ambitious, and the search for rapid mitigation strategies will assume greater importance in coming years (UNESCAP, 2017c).

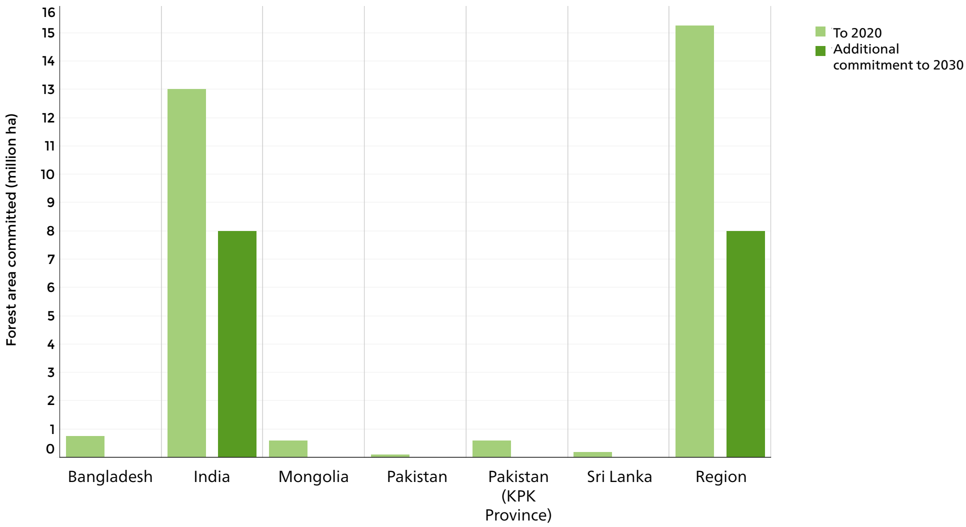
Increasing the ambition of NDCs will not be easy for many countries in the Asia-Pacific region, which also seek economic growth to alleviate poverty and increase the well-being of citizens. In the aspirational scenario, incentives will be made available to encourage developing countries in particular to pursue low-carbon development pathways.

Countries will meet their forest restoration targets. Launched in 2011, the Bonn Challenge is a global initiative to restore 150 million ha of deforested area by 2020 and 350 million ha by 2030. As part of the initiative, countries have made pledges to contribute to these goals. In the Asia-Pacific region, countries have committed to restoring 15.25 million ha of deforested land by 2020, and a private company in Indonesia has pledged an additional 1 million ha, with the total amounting to 10.1 percent of the global target (Figure 9.7). India's pledge to 2020 is 13 million ha, which constitutes 75 percent of the region's total pledge, and it has also pledged to reforest an additional 8 million ha by 2030.

Overall, the commitments made to the Bonn Challenge are low in the Asia-Pacific region, with only a few countries making pledges, mostly in South Asia. In comparison, 27 countries in Africa have pledged to restore 100 million ha by 2030 (World Resources Institute, undated). In Latin

[40] These projections of potential future sector emissions are based on the targets formulated by countries and the best available knowledge at the time of preparation. The full impact of the implementation of SFM practices consistent with policies and measures that have not been quantified or incorporated into the calculation of the current NDC targets is unknown.

Figure 9.7. The Bonn Challenge pledges to 2020 and 2030, Asia-Pacific region



Note: Pledges were current as of February 2019.
Source: Bonn Challenge (undated).

America, Brazil has committed to restoring 12 million ha by 2030.

Nevertheless, the Asia-Pacific region has several existing regional goals and commitments. For example, the aspirational goal of Asia-Pacific Economic Cooperation is to increase forest cover in the region by 20 million ha by 2020. A recent evaluation indicated that the region is on track to achieve this target. There has been considerable success in the region in restoring degraded lands, with China, India, the Philippines, the Republic of Korea, Thailand and Viet Nam (among others) achieving upward trends in forest area in recent decades. Such success is expected to continue. Table 9.2 summarizes the commitments (not pledged through the Bonn Challenge) of certain countries in the region to increase forest area and restore degraded land.

Achieving pledges and targets on forest area and the restoration of degraded land such as those in Table 9.2 will involve a number of robust actions and strategies, including to improve forest and landscape governance. Restoring degraded landscapes is more than a technical tree-planting exercise: it requires sufficient financial and human resources, local participation and benefit sharing – deciding where to restore and who should be involved is crucial for success. The political will to manage restored landscapes sustainably is another important factor: many restoration programmes focus on the number of trees planted, but success depends on how many of those trees reach maturity and the ongoing ecological and utilitarian functions they are able to perform and the extent to which they contribute to sustainable livelihoods. Thus, forest restoration requires considerable planning and

Table 9.2. Forest-cover targets not pledged through the Bonn Challenge, selected countries in the Asia-Pacific region

Country	Forest area as a proportion of total land area, 2015 (%)	Forest cover/restoration target
Australia	16.0	Establish 400 000 ha of new planted forests by 2030
Bangladesh	11.0	Restore 750 000 ha of forests by 2020
Cambodia	53.6	Increase forest cover to 60 percent by 2030
China	22.1	Increase forest cover to 23 percent by 2020
Indonesia	53.0	Restore 8 million ha of forests (2.5 million ha on peatland and 5.5 million ha on critical lands)
Lao People's Democratic Republic	81.3*	Increase forest cover to 70% by 2020
Myanmar	44.2	Maintain forest cover through reforestation and by slowing deforestation
New Zealand	38.6	Establish 500 000 ha of new forests by 2040
Philippines	27.0	Increase forest cover to 30% by 2028
Thailand	32.1	Increase forest cover to 40% by 2036
Viet Nam	47.6	Increase forest cover to 47% by 2020

Note: * The Lao People's Democratic Republic had a forest cover of 57.4 percent in 2015, according to the national forest definition (Government of the Lao People's Democratic Republic, 2018). The figure given in the table is from FAO (2015a).
Sources: FAO (2015a); IUCN (2018); RECOFTC (2018b); SFA (2016).

resources, which, in the aspirational scenario, are put in place in the region. The declaration in March 2019 of the United Nations Decade on Ecosystem Restoration is expected to boost efforts on forest and landscape restoration by mobilizing resources, expanding research and developing capacity.

Countries will submit and achieve their voluntary national contributions to the Global Forest Goals. The United Nations Strategic Plan for Forests 2017–2030 places strong emphasis on SFM. The aim of its Global Forest Goal 1 is to reverse the loss of forest cover worldwide through SFM and to increase forest cover globally by 3 percent in 2030. In the aspirational scenario, this goal is achieved in the Asia-Pacific region, requiring an increase in forest area of about 22 million ha. Achieving this increase is possible given the region's success in the past two decades in growing its forest cover, assuming that countries commit sufficient resources. In the aspirational scenario, the region will continue and expand its efforts to halt deforestation and to increase forest cover through afforestation and forest and landscape restoration; potentially, the region could have an additional 50 million ha of forest by 2030.

At the time of writing, New Zealand was the only country in the region to have submitted a voluntary national contribution to Global Forest Goal 1 by committing to plant 1 billion trees in the ten years to 2027 (New Zealand Permanent Mission, 2018), although some other countries are implementing afforestation programmes (Box 9.3). It is expected that more countries

BOX 9.3

"Billion trees" programmes in New Zealand and Pakistan

The New Zealand Government has set a goal of planting 1 billion trees in the ten-year period to 2027. This will require a doubling of New Zealand's current rate of tree planting, with the target including both replacement planting of harvested planted-forest areas and new planting for both commercial and amenity purposes. The government has announced NZD 240 million in new incentive funding to support the programme. It includes grants to landowners for the cost of planting and establishing trees and indigenous forest regeneration; and a partnership fund to create closer working relationships among local governments, non-government organizations, researchers, training providers, Maori (indigenous) landowners and community groups.

Source: New Zealand Ministry of Primary Industries (2018).

The government of the Pakistan province of Khyber Pakhtunkhwa enabled an increase in the province's forest area of 5.6 percent through its Billion Tree Tsunami Afforestation Project. About 293 000 ha of barren land was afforested under the project between 2014 and 2017 with the active involvement of local communities and the private sector. An additional 307 000 ha of degraded forest was restored and 160 million seedlings were added to farming systems. The World Wide Fund for Nature Pakistan validated these outcomes. The project's success encouraged the federal government to recently launch an afforestation programme to establish 10 billion trees throughout the country as part of the "Clean and Green Pakistan" campaign.

Source: F. Bari, personal communication, April 2019.

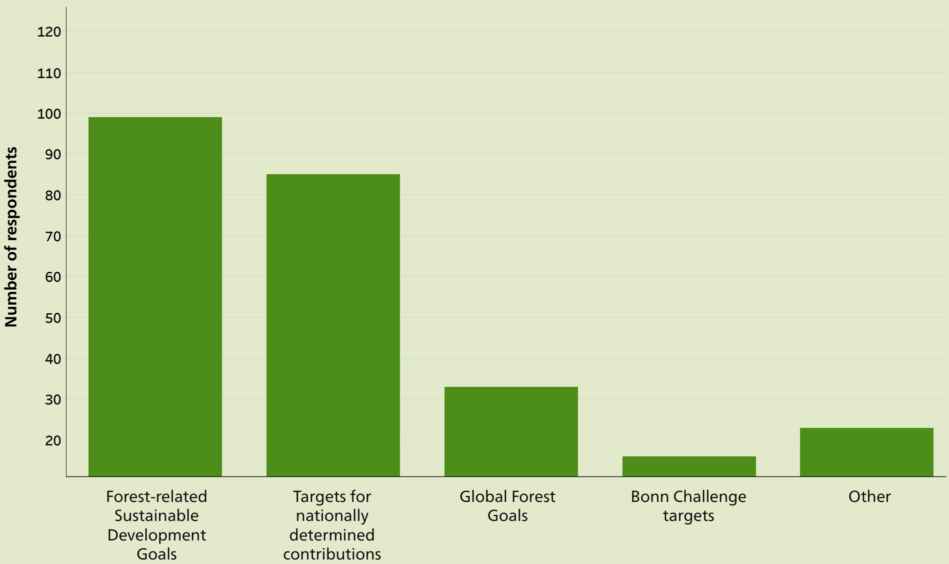
will follow suit in coming years. Ensuring good governance and adequate resources will be crucial in determining whether the region can achieve the 3 percent target by 2030. A survey conducted for this outlook study canvassed the aspirations of stakeholders for forests in the region by 2030 (Box 9.4).

BOX 9.4

Stakeholder aspirations for 2030

Figure 9.8 depicts the aspirations of forest stakeholders in the Asia-Pacific region for 2030, as determined in an online survey conducted in late 2018 and early 2019. The majority of respondents considered that achieving the Sustainable Development Goals (SDGs) related to forestry and nationally determined contributions (NDCs) towards the goals of the Paris Agreement on climate change were the two most important aspirations; achieving the Global Forest Goals and the Bonn Challenge received relatively low responses. Governments have taken various actions to support the SDGs and the NDCs, such as passing rules and regulations and allocating budgets through programmes. The low emphasis of stakeholders on the Bonn Challenge may be related to the low number of pledges made so far by countries in the region.

Figure 9.8. Responses of survey respondents when asked to nominate their two most important aspirations for forests in 2030

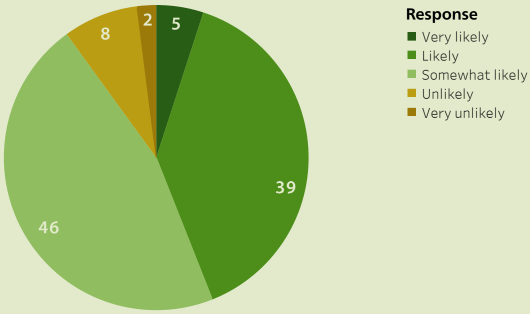


Notes: n = 128. The survey was conducted in late 2018 and early 2019 involving 180 respondents from 24 countries. The survey was open to the public and responses were voluntary. Not all respondents answered all questions.

BOX 9.4 (continued)

Figure 9.9 shows that less than half the respondents considered it likely (i.e. either very likely, likely or somewhat likely) that the forest-related aspirations would be achieved in their countries by 2030 (only 5 percent considered it very likely). Ten percent considered it unlikely or very unlikely.

Figure 9.9. Responses of survey respondents when asked to indicate the likelihood of their countries achieving the nominated forest-related aspirations by 2030



Notes: n = 128. Numbers represent percentages. The survey was conducted in late 2018 and early 2019 involving 180 respondents from 24 countries. The survey was open to the public and responses were voluntary. Not all respondents answered all questions.

Many factors will determine whether the aspirational scenario will be achieved in the Asia-Pacific region by 2030. Most countries will strive for strong economic growth, and whether and how this is obtained will strongly influence the ability to reduce greenhouse-gas emissions, achieve SFM and meet environmental challenges. For example, economic strategies that ensure the fair and equitable sharing of benefits are likely to significantly reduce poverty and therefore poverty-related forest degradation.

The progress of countries will be determined at least in part by institutional capacity and domestic political situations. Positive actions that could be taken include encouraging the emergence of "change leadership" (in which companies, businesses and initiatives act as transformational champions) and the creation of institutions dedicated to enabling integrated landscape-scale governance and the reform of poor land-use policies. On the other hand, a rise in nationalism, for example, could change the development trajectory of some countries in ways not conducive to achieving the aspirational scenario; continued corruption and a lack of participation would likely exacerbate illegal forest practices.

The global aspirations articulated in commitments such as the SDGs and the Paris Agreement have provided countries with a common direction, but actions are required now to ensure they are achieved. Identifying the nature of these actions, and finding the means to adopt them, will determine whether the aspirational scenario will be realized.

There are reasons for optimism. Collaboration among a wide range of forest stakeholders, including some who have been antagonistic towards each other in the past, has emerged at various levels and is likely to grow in coming years. Knowledge of how to tackle key challenges is increasing. New technologies will help countries make faster progress toward certain goals (see Chapter 7), and the rise of well-educated young innovators will provide further impetus. Table 9.3 presents potential initiatives that would further support the realization of the aspirational scenario.

The disruptive scenario would mean a downward spiral

The disruptive scenario assumes that significant negative events and trends occur beyond business as usual, such as a global or regional financial crisis, a war between countries, major environmental disasters, or unprecedented migration,[41] the impacts of which would have major consequences for societies, forests and landscapes. It also assumes that few countries in the region take adequate precautionary measures designed to mitigate the impacts of such negative events and trends.

Figure 9.10 presents the results of a survey of forest stakeholders in which respondents were asked to indicate the major disruptions they considered most likely in the region to 2030. The biggest concern expressed by respondents was for a weakening of governance, with increased corruption or a failure of the rule of law all likely to exacerbate resource degradation. Many respondents were also worried about political tensions between countries or blocs in the region: the worst-case scenario – a war between countries – could have major ramifications for forests and forest sectors, including by inhibiting trade, reducing the quality of forest management, increasing the displacement of communities, and causing the excessive logging of forests to generate funds for war-related activities. Political tensions do exist in the region, but it is unclear whether these will escalate or subside over time.

Survey respondents were also concerned about the potential for environmental catastrophe. For example, a prolonged, widespread drought in the region could exacerbate forest wildfires and the outbreak of forest diseases, inflicting widespread damage on human communities, ecosystem functions and forest productivity. A major pest outbreak in planted forests could jeopardize wood production and force wood-users to seek increased resources from outside the region. For those countries with major planted-forest resources, the economic losses of a major pest outbreak could be immense.

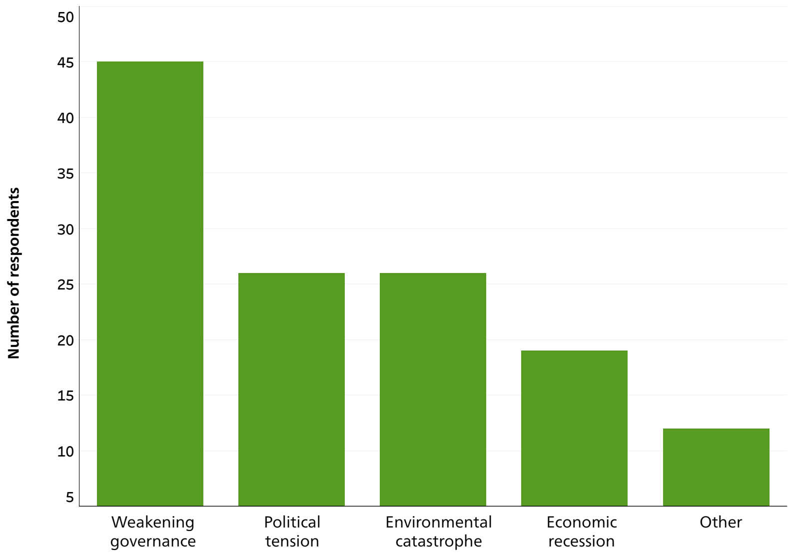
[41] The disruptive scenario does not address "normal" disruptions that might occur in any of the scenarios, such as changes in governance, conflicts over landscape management or the invention of new technologies.

Table 9.3. Potential initiatives in the Asia-Pacific region that may support the achievement of an aspirational scenario

Initiative	Probability of occurrence by 2030	Probability of occurrence by 2050	Potential impact on forests and forestry	Potential of forests and forestry to mitigate/ engage/ respond
New regional economic trading blocks, such as the Regional Comprehensive Economic Partnership (Iwamoto, 2018) and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership spur a regional economic boom	Low	Medium	Medium	Medium
Donors and national governments make major new commitments on forest and landscape restoration	Medium	High	High	High
Breakthroughs in agricultural research and technology drive a doubling of yields in key commodity crops	Low	Low	High	Medium
There is widespread acceptance of mass timber/cross-laminated timber and other engineered wood products as construction materials in high-rise buildings	Medium	High	Medium	High
A new post-Paris climate agreement is reached with increased ambitions for curbing greenhouse-gas emissions	Low	Medium	Medium	High
A youth-led, new-generation environmental movement brings about major lifestyle changes	Medium	High	High	High
New technologies lead to major advances in forest governance and the uptake of sustainable forest management	Low	Medium	High	High
Moves towards a bioeconomy provide significant impetus for sustainable forest management, forest and landscape restoration, and the sustainable harvesting of forest products in both planted and natural forests	Low	Medium	High	High
Declining environmental health brings heightened awareness of the importance of forest ecosystem services, leading to the widespread introduction of payment schemes for the provision of ecosystem services that make sustainable forest management viable and profitable	Low	Medium	High	High

Note: The probabilities indicated are subjective, albeit informed by information contained in this report and other sources.
Sources: Based on P. Durst and A. Sarre, personal communications, March 2019.

Figure 9.10. Responses of survey respondents to the question, "What major disruption do you fear most for your country in 2030?"



Notes: n = 128. The survey was conducted in late 2018 and early 2019 involving 180 respondents from 24 countries. The survey was open to the public and responses were voluntary. Not all respondents answered all questions.

Survey respondents identified another economic recession as a significant possibility by 2030. Overall, the region has recovered successfully from the 1997 Asian economic crisis and the 2008 global financial crisis, but another economic shock could have significant impacts on forests: for example, forest-rich countries may overexploit their forests to generate income and provide jobs. Given China's dominant influence on the forest sector in the region, an economic crisis there could cause a reduction in its afforestation programme and a decrease in wood imports.

Table 9.4 presents possible disruptive events with major implications for forests toward 2030 and 2050, including a subjective judgement on their likelihood. It is of course uncertain whether any of these (or other unforeseen) events will eventuate; nevertheless, the list in Table 9.4 shows that the region's forest sector should be prepared for a wide range of potential shocks.

Countries in the Asia-Pacific region have learned useful lessons from previous recessions, and many have addressed fiscal policies and strengthened their economic foundations. Nevertheless, any major economic shock, including a trade war between large economies, would have regional impacts and a range of implications for forests.

In the disruptive scenario to 2030, therefore, forest loss and degradation will

Table 9.4. Potential major future disruptions with implications for forests and forestry in the Asia-Pacific region

Potential major disruption	Probability of occurrence by 2030	Probability of occurrence by 2050	Potential impact on forests and forestry	Potential for forests and forestry to mitigate/ engage/ respond
Another global financial crisis hits	Medium	High	High	Low
Global/regional trade disputes disrupt current trade regimes	Medium	Medium	High	Low
Regional economic or political blocs break down or fragment	Low	Low	Medium	Low
The Greenland and Antarctic ice packs melt at a pace exceeding current estimates	Medium	Medium	High	Medium
Multiple major natural disasters occur in the region within a two-year span	Medium	High	Medium	Medium
Regional armed conflict occurs involving multiple countries in the region	Low	Medium	High	Low
A major disease pandemic occurs	Low	Medium	Low	Low
There is mass migration due to ethnic strife, war, economic turmoil and disasters	Medium	High	Medium	Medium
Terrorism activities increase	Low	Low	Low	Low
A major dieback/disease/pest outbreak occurs in key planted tree species	Medium	High	High	High
There is major climate-related dieback of natural forests due to changes in temperature gradients and water cycles	Medium	High	High	Medium
Nationalism, populism and authoritarian governance increase	Medium	Medium	Medium	Low
Frustration with the slow pace of international forestry processes leads to withdrawal from and abandonment of international forestry-related agreements	Low	Low	High	High

Note: The probabilities indicated are subjective, albeit informed by information contained in this report and other sources.
Source: Based on P. Durst, personal communication, March 2019.

accelerate, few countries will achieve forest restoration targets, the livelihoods of forest-dependent people will deteriorate, forest-related tensions will escalate, and forest-based industries will fail to ensure the sustainability of their resources.

Much can be done to prevent a weakening of forest governance, including by continually encouraging greater transparency in decision-making and by adopting landscape approaches that require the inclusion of a broad range of stakeholders and the creation of participatory mechanisms. The abatement of political tensions between countries is a task beyond the forest sector, but undoubtedly it will require ongoing diplomacy, partnership building and constructive dialogue.

Climate change is increasing the likelihood of environmental catastrophes in the region, and its mitigation, therefore, must be a priority of policymakers. Sustainably managed forests can, within limits, confer resilience against climate change and disasters. The diversification of livelihoods and incomes, including those based on the wide range of goods and services offered by forests, can help increase the resilience of communities to shocks such as those precipitated by climate change and economic crises.

Scenarios for 2050

Major economic shifts will have occurred by 2050

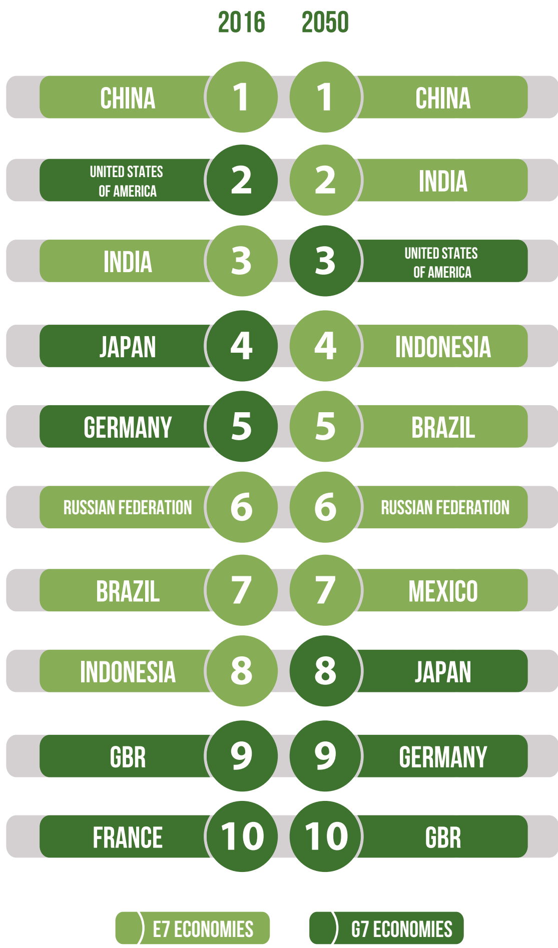
In this era of rapid change it is impossible to predict with certainty the state of the region's forests and forest sector in 2050, but major environmental and political shifts are likely. Various studies and analyses exist, mostly on the economic outlook. The professional services company PricewaterhouseCooper (PwC, 2017), for example, has projected the following in 2050:

- The world economy could more than double in size, far outstripping population growth, due to continued technology-driven productivity improvements.
- On average, emerging economies (i.e. Brazil, China, India, Indonesia, Mexico, the Russian Federation and Turkey – also known as the E7) could grow around twice as fast as advanced economies (Canada, France, Germany, Italy, Japan, the United Kingdom of Great Britain and Northern Ireland, and the United States of America).
- As a result, six of the seven largest economies in the world in 2050 could be from the E7, led by China (first), India (second) and Indonesia (fourth).
- The United States of America may have declined to third place in global GDP rankings by 2050, and the EU's share of world GDP may have fallen below 10 percent.[42]
- For emerging economies to realize their long-term growth potential, however, they will need to significantly improve their institutions and infrastructure.

[42] PwC (2017) refers to the EU27, comprising all current member states of the EU except the United Kingdom of Great Britain and Northern Ireland.

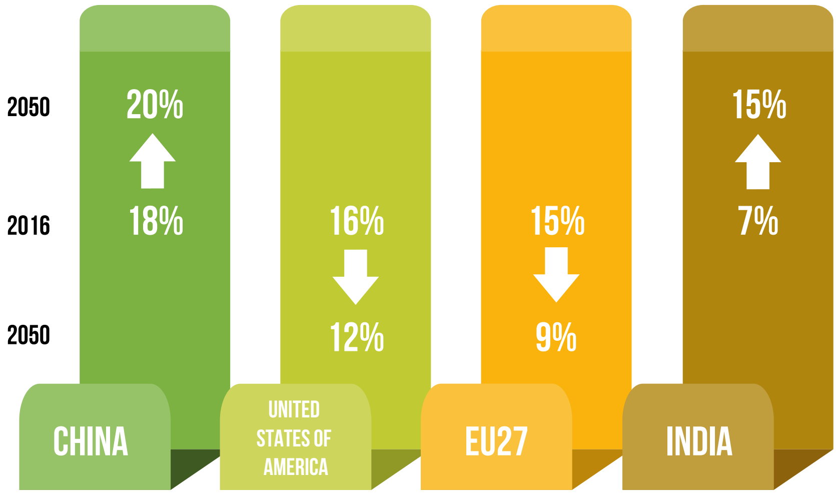
As Deloitte (2017) pointed out, the "global economic centre of gravity has shifted towards Asia. The Asian region is the fastest-growing in the world and has been a significant driver of global economic growth". The Asia-Pacific region could be home to three of the top five economies by 2050, and the E7 countries are likely to be major players (Figure 9.11). Global production and consumption will largely be shaped by Asia, with the United States of America and Europe steadily losing ground to China and India. About 35 percent of the world's economy could be in the hands of China and India in 2050; the United States of America and Europe, on the other hand, might command just 21 percent (Figure 9.12). Increasingly, the focus of global businesses will be in Asia.

Figure 9.11. The world's top ten economies in 2016 and 2050, as forecast by PricewaterhouseCooper in 2050



Note: GBR = United Kingdom of Great Britain and Northern Ireland.
Source: PwC (2017).

Figure 9.12. Actual and projected share of world gross domestic product (purchasing power parity), selected countries and blocs, 2016 and 2050



Note: EU27 = the European Union minus the United Kingdom of Great Britain and Northern Ireland.
Source: PwC (2017).

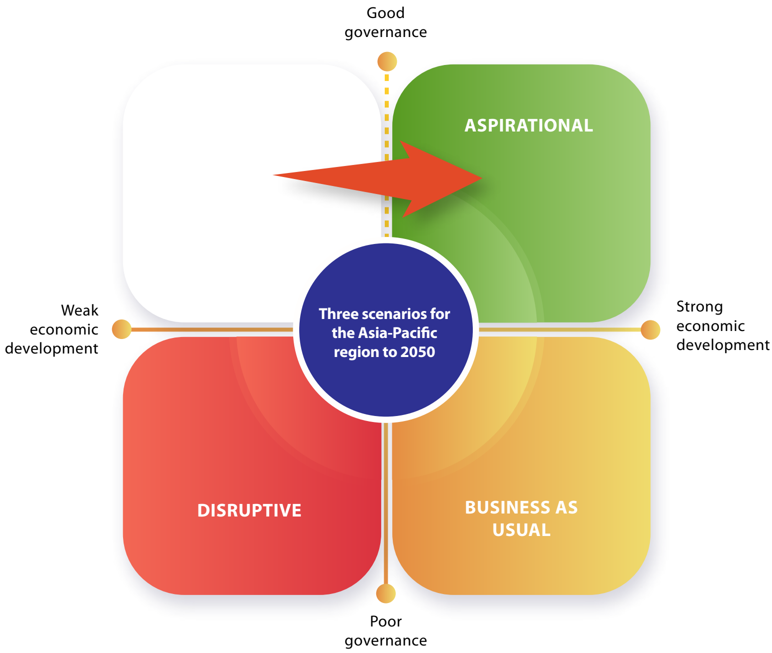
The Asia-Pacific region's population is projected to be 4.7 billion in 2050. Two-thirds of the region's people will be living in cities; there will an additional 696 million urban residents in China (+292 million) and India (+404 million) combined. The region today is home to 17 megacities (cities exceeding 10 million inhabitants), including the world's three largest (Tokyo, Delhi and Shanghai), and this number is projected to increase to 22 by 2050 (UNESCAP, 2015). Cities in the region are already dominant hubs of economic growth and wealth creation; they will be playing an even bigger role in 2050. On the other hand, the region's population is ageing, and how this change is handled will be crucial for determining the nature of cities in 2050.

Economic and population growth are projected to increase demand for biomass, fossil fuels, metals and non-metallic minerals to 2050 and beyond (OECD, 2018). Demand for forest products and services is also likely to escalate in the region to 2050 as populations and economies grow; sociocultural shifts (such as the worldwide movement to reduce the use of plastics) and changes in technology (such as the increased suitability of wood products for the construction of tall buildings) will also affect demand for forest products.

Three scenarios are presented for forests in 2050

As for 2030, three scenarios are proposed for forests in 2050: BAU; aspirational; and

Figure 9.13. Three scenarios for the Asia-Pacific region to 2050 based on economic development and governance

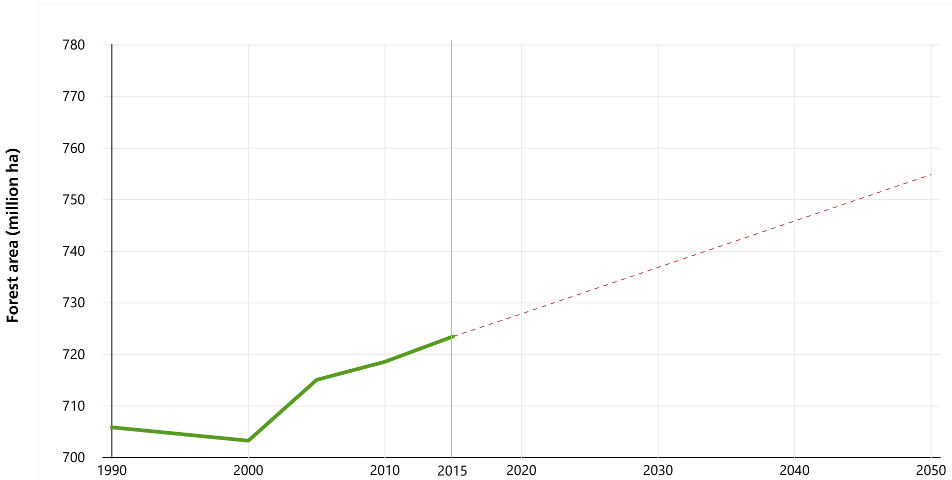


disruptive. They are based on two important but uncertain drivers of change in forests and landscapes – economic development and governance (Figure 9.13). Under the BAU scenario, economic development will continue to be strong and governance will be poor or problematic. The aspirational scenario assumes good governance, but the nature of economic development may vary: for example, it may involve (and require) strong economic growth in some countries, but in others it might mean a shift towards a greener economy. There is an expectation under the aspirational scenario that technological breakthroughs and rapid adoption will help the world address pressing challenges, such as climate change. The disruptive scenario presents a bleak picture in which poor governance and a lack of economic development lead to highly negative outcomes.

Business as usual will mean deteriorating forests

Under the BAU scenario, economic growth is strong but governance is poor. There is no major deviation in the historical trends of drivers of change, and the region's forest area continues to increase at the current pace. By 2050, therefore, the forest area will have reached 755 million ha (Figure 9.14), with most of the increase comprising planted forests. In reality, the increase in forest area is unlikely to be

Figure 9.14. Projected forest area in the Asia-Pacific region to 2050, business-as-usual scenario



Note: The green line indicates measured forest-area change; the red dashes indicate the business-as-usual scenario for change in forest area in the region to 2050.

linear, with fluctuations over the years; Figure 9.14, therefore, represents the projected average increase. Given the continued strong economic growth assumed in this scenario, countries such as China, India and Indonesia are likely to continue expanding their planted-forest estates to meet growing demand for timber.

In the BAU scenario, natural forests will continue to be logged and cleared; remaining areas will be increasingly fragmented and remote. Pressure is likely to remain high to clear forests for agricultural production, infrastructure, urban development and mining. Efforts will be made to conserve primary forests to protect biodiversity and ecosystems and also due to international pressure. The decline in the area of primary forests, therefore, may be slow; there may be 130–140 million ha of primary forests in 2050 – moderately less than the region has now.

Demand for almost all wood and non-wood forest products will rise in the region as the population grows and incomes increase. Demand from countries outside the region, especially the United States of America and those in Europe, will focus increasingly on verified legal and sustainably produced products; although this will be somewhat less important within the region, there will be a long-term shift in the region towards certified timber. The demand for woodfuel will decrease (substituted by alternative energy sources, such as liquefied petroleum gas and electricity) as incomes rise and the population becomes more urban.

Efforts to tackle poor forest governance will continue but with limited success, especially in developing countries; therefore, ongoing forest degradation and loss is likely. Corruption in the timber business will remain a problem, especially in natural forests. Work will continue to reform forest tenure in favour of indigenous peoples and local communities, but progress will be slow. Pressure from civil-society organizations and the international community will continue for increased participation in forest management, but action on the ground will fall short. Landscape approaches will not be adopted widely.

The disruptive scenario paints a bleak picture

In the disruptive scenario, weak economic growth and poor governance will combine to drive resource exploitation at unprecedented rates and without heed to environmental sustainability. Increasing demand for resource-intensive foods (especially meat) and commodities will increase pressure to clear forests to expand production. Corruption, collusion and a lack of participation will be commonplace in the forest sector. The "voice" of local communities will be suppressed and ignored. Countries will need to grapple with increasing poverty, inequality and social conflict due to ongoing economic recession, but poor governance will mean these issues cannot be resolved. The consequences for forest resources are bleak: widespread deforestation and degradation, illegal forest practices and trade, and corruption.

Many of the potential disruptions presented in Table 9.4 will occur. One or more global financial crisis will hit, and the profound consequences of this for the region's economic performance will put forests under immense pressure as countries seek ways of generating revenue. In the disruptive scenario, resilience has not been build, reducing capacity to ride out such hard times.

Other disruptions may come in the form of a greatly increased incidence of disasters with large-scale impacts, especially climate-related events such as cyclones, droughts and wildfires. In the absence of proper planning and adequate resources, ongoing exposure to such disasters will take their toll on communities and prosperity. Previous experience shows that recovery from major disasters takes time: in the wake of the 2004 Indian Ocean tsunami, for example, communities – especially in Aceh, Indonesia – took many years to regain normality. On the other hand, the recovery process involved the use of a huge amount of timber for reconstruction, providing a boost to the forest sector but leading, in some cases, to unsustainable extraction to meet demand. Nevertheless, withstanding and rebounding from future disasters will require major investment and potentially considerable international assistance.

Governments, civil society and the private sector need to face the possibility that a disruptive future of escalating disasters may arise and to prepare by building resilience. There are many ways to do this, some of which are addressed in Chapter 10.

The importance of building nature-based resilience is increasingly clear, including through forest-related measures. Mangroves, for example, help protect coastal communities and lands in the face of storms and other extreme events and thereby reduce vulnerability to climate change; they can also make important contributions to local livelihoods, biodiversity conservation and carbon sequestration.

Realizing the aspirational scenario would mean a region transformed

Good governance will prevail in the aspirational scenario (Figure 9.15). Among other things, economic development will take into account environmental sustainability and will be fuelled by innovation; the involvement of people and markets in development will be the norm; the rule of law will apply; transparency and checks and balances will be in place; and corruption will be punished appropriately. Agricultural productivity will increase due to innovative farming approaches, technological improvements and land-tenure reforms. Demand for food and energy will increase much less than in other scenarios, and there will be no need to convert forests to meet this demand.

Consumer awareness of the need for environmental protection will be high in the aspirational scenario, and biodiversity conservation and forest and landscape restoration will be political priorities. Most governments will have put landscape approaches in place for the management of natural resources, including well-structured intersectoral coordination. Trade-offs will be decided through participatory processes.

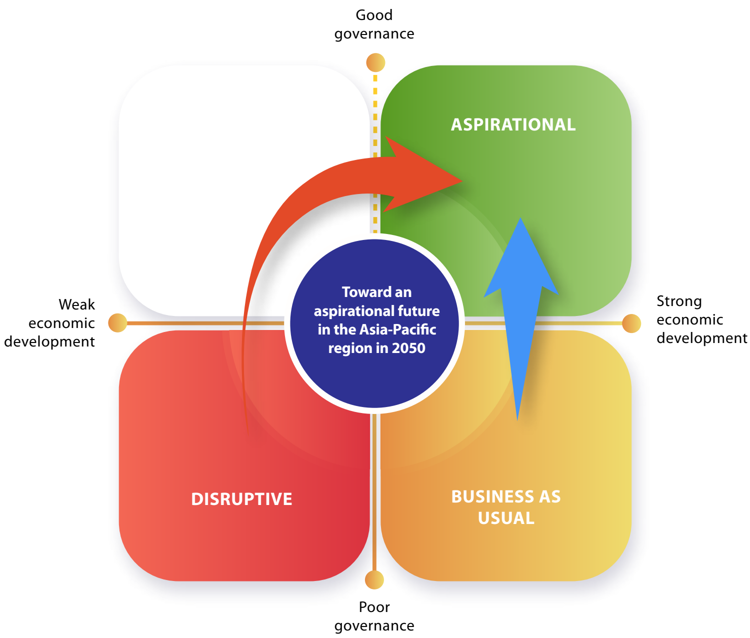
Technological advances will play major roles in addressing pressing challenges, including climate change. There will be major transformations in the transport and energy sectors towards low-carbon alternatives, significantly reducing the use of fossil fuels. Significant improvements in the efficiency of production and the reuse of materials will reduce the need to mine virgin ores. Breakthroughs in alternatives to meat will have major positive implications for forests and landscapes.

The important role of forest landscapes in the provision of ecosystem services will be recognized and rewarded by market mechanisms invoking the user-pays principle. A range of incentive and disincentive mechanisms will be deployed in the region to encourage good environmental stewardship and ensure that responsible forest users are able to earn appropriate incomes. There will be little environmental destruction. Disasters such as wildfires and disease outbreaks will still occur, but good forest governance will ensure they are managed appropriately. Countries will invest strongly in capacity development, green spaces and improving urban environments.

Most countries in the Asia-Pacific region have the potential to realize the aspirational scenario for 2050, in which good governance coupled with appropriate economic development will produce positive outcomes for forests and the forest sector.

Appropriate economic development will help in achieving the aspirational scenario in 2050 if it is derived at least partly through innovation and is subject to good

Figure 9.15. Toward an aspirational future in the Asia-Pacific region in 2050



governance aimed at achieving sustainable economic, social and environmental outcomes. New forest products with high returns could assist with this.

The following actions would help speed up improvements in forest governance in the region:

- *Address corruption in the forest sector* – this will be especially important in emerging and developing economies, where corruption levels are often high. Nevertheless, all countries will need to guard against corruption in the allocation of forest and landscape resources, given that these are likely to increase in value in the future.
- *Increase participation* – the involvement of citizens in the strategic direction of any country is crucial. In the forest sector, this may require tenure reforms, new participatory institutions and technologies and, ultimately, the equitable sharing of benefits and costs.
- *Ensure law enforcement* – the capacity to enforce forest-related laws needs strengthening in many countries, including through appropriate penalties for transgressions. Citizen-based forest monitoring could greatly increase real-time scrutiny of forest-based activities. Fair and efficient forest law enforcement is key for credibility and trust.

- *Improve transparency* – all stakeholders must be accountable for the decisions they make and actions they take. Citizens must have sufficient information about the direction of development and have the opportunity to provide inputs to decision-making.

Realizing the 2050 aspirational scenario will no doubt be difficult, especially for countries with existing poor governance, but it is possible given the adoption of certain robust actions, as described in Chapter 10.

Youth views on the future

Bright or bleak? It is our choice

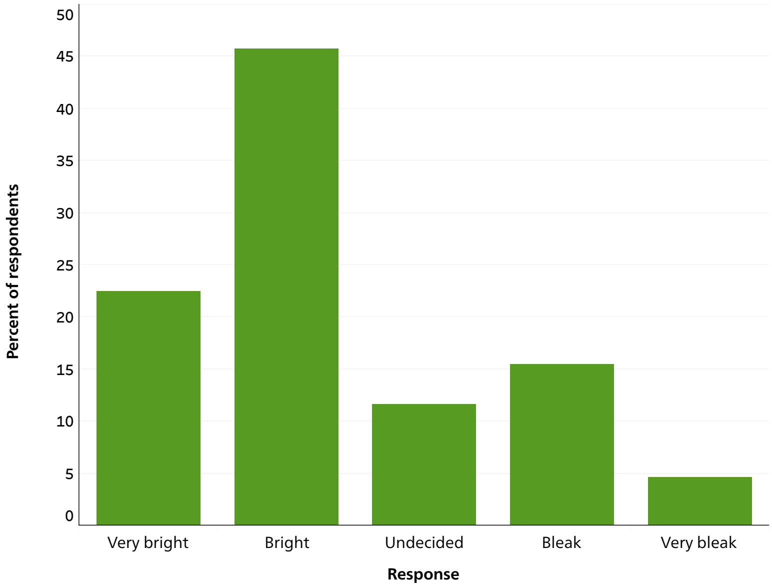
Young people have a high stake in the future, which they will inherit from the generation that today makes most of the major decisions on forest and landscape management. Young people clearly care about the quality of forests and landscapes that will be handed down.

In a survey of 262 young people (aged between 18 and 30 years) from 32 countries in the region, 46 percent of respondents considered the future of forests to be "bright" and an additional 22 percent considered it to be "very bright" (Figure 9.16). There were two main reasons for this optimism. First, respondents considered that, because forests are important landscape systems with various roles in society, there is an imperative to manage them sustainably and to restore degraded landscapes. Second, young people have observed, been encouraged by, and even participated in, recent global efforts to create shared visions, such as those expressed in the SDGs and the Paris Agreement on climate change.

This overall sense of optimism was confirmed at a youth workshop held for APFSOS III in Bangkok, Thailand, in March 2019, in which 25 women and men aged 18–30 years from various backgrounds participated from seven countries. When asked how they saw forests in 2050, participants generally responded positively (Box 9.5). There was considerable hope that natural forests would be conserved and sustainably managed; urban forests would increase; investments and technological breakthroughs (e.g. in artificial intelligence) would prevail; and future generations would be able to make efficient use of resources. Technologies would also transform agriculture: for example, drones and other technological advancements would empower people in sustainable production and food security. Electric cars and green transport options (already available in some cities) would expand greatly towards 2050. Information and education would be accessible to all, thus enabling rapid knowledge generation and analytical thinking. The availability of green jobs and employment would increase.

Although many young people appear positive about the future for forests, some have reservations and doubts. Figure 9.16 shows that 16 percent of survey respondents considered the future to be bleak and a further 5 percent considered it to be very bleak. A bleak future would be characterized by poor quality of life due to unregulated urbanization and continued consumerism and by the deterioration of

Figure 9.16. Responses of survey respondents to the question, "The future of forests is …"



Notes: n = 258. The survey, which was conducted online in February 2019, was open to women and men aged 18–35 years from forestry and non-forestry backgrounds. Of the 262 respondents from 32 countries, about half had a forestry background (e.g. forestry students and professionals). Respondents were requested to select only one of the options. Not all respondents answered all questions.

BOX 9.5

Youth views on forests in 2050

The following are direct quotes from participants in a workshop held in Bangkok, Thailand, in March 2019 as part of APFSOS III involving 25 people aged 18–35 years:

- "The power of the people will determine the future. I want to be a prime minister of my country so that I can decide the fate of forests."
- "The choice of the future in 2050 is ours. We will shape and determine how it will look like. We can make a green future."
- "Youth can make change from within – we can influence our work and our institutions."
- "I expect every home in cities will have a green space, even how small it is."

forests and the environment. The survival of individuals would require the rationing of canned or bottled food and water. The rise in global temperature would make survival a challenge, and people would need to adapt to living underground to escape the unbearable heat. Most life forms would perish due to pollution and climate change, and previously "natural" resources such as trees would increasingly need to be artificial. Energy from nuclear power would be in high demand. A tremendous amount of information would be available, but it would not be used for the betterment of society. Nations would continually fight and blame each other.

An important concept that emerged during the youth workshop was that the future could be shaped in either direction – towards bright or bleak. Workshop participants considered that the following factors would be important for ensuring that the future they inherit will be bright:

- *Big movements to save the planet* – most young people are technologically savvy. They can use their social-media and other technology-related skills to organize at a large scale to, for example, bring about environmental protection, reduce the use of plastics, and fight climate change.

- *Being the leader* – workshop participants considered that they must obtain strategic political positions (e.g. city mayor or prime minister) to obtain sufficient power to ensure sustainable development.

- *Social media* – young people can and will use social media to counter the existing development narrative and provide alternative views for a greener future.

- *Collaboration and networking* – young people need to build networks and collaborate with key stakeholders to ensure that their views are heard and aspirations met.

- *Education and awareness raising* – prioritizing education about forests and the environment is crucial for the creation of a global movement.

Change from within – young people can influence the institutions in which they work.

Shaking rigid institutions: how young people are taking the lead

In recent years, young people have made their mark in international forums, policymaking bodies and other platforms. The youth agenda has entered centre stage and gained considerable attention. Various international and intergovernmental platforms now provide spaces in which youth groups and networks can raise their voices, including the UNFCCC and the United Nations Forum on Forests.

Beyond the international arena, young people are coordinating with growing enthusiasm and taking to the streets to call for action on climate change. For example, at least 1.4 million school children and other young people in more than 125 countries recently staged a strike. They were led by Greta Thunberg, a 16-year old Swede who had been striking from school every Friday to demand more action on climate change. She has received worldwide attention and inspired a worldwide movement of young people linked via social media. Among other things, this movement has shown that young people today have the capacity and desire to mobilize in large numbers on causes in which they believe, and they can potentially wield considerable power.

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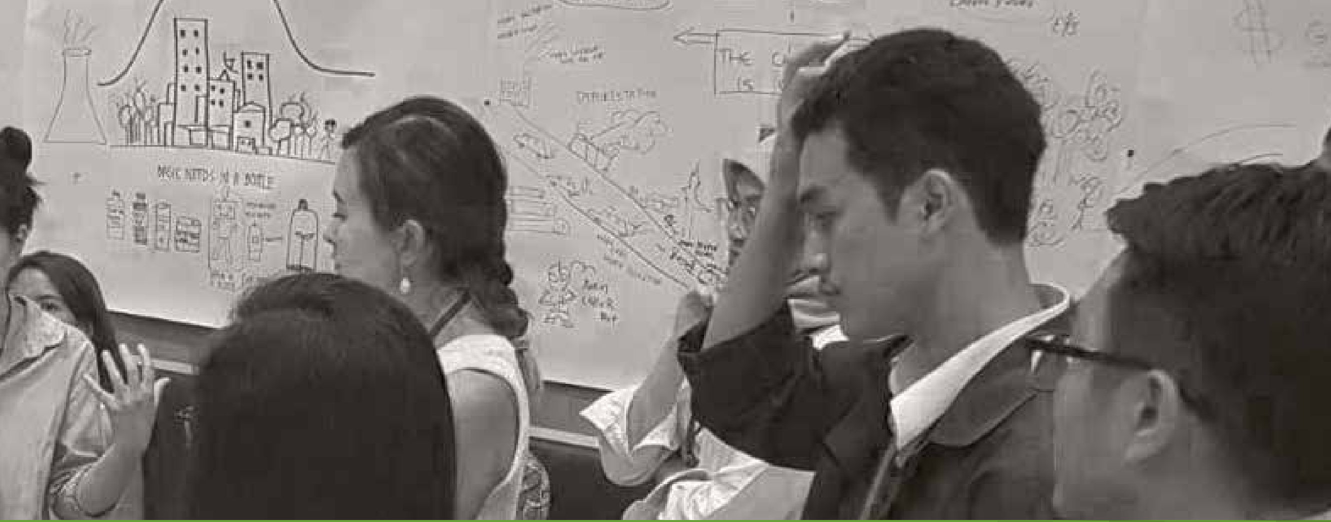
Key **points**

- Sustainable forest and landscape management poses a "wicked problem" because of its many intertwined challenges at various scales.
- Alternatives to the prevailing economic development model may be needed to achieve a sustainable future. Counter-narratives to the "growth first" model are yet to gain traction, but an increasingly vocal youth may help bring about change.
- New approaches to forest and landscape governance are also needed, involving greater transparency, the increased participation of women, indigenous peoples, youth and other marginalized groups, equitable tenure, and effective conflict-resolution mechanisms, among other elements.
- Forest-sector actors in the region could use this outlook study as an entry point for obtaining buy-in from diverse actors and bringing about rapid positive change at the national level.



10 Forestry can lead the region towards a sustainable future

- The Asia-Pacific region has the capacity to achieve a sustainable future. To do so, the following seven robust actions should be taken now or in the near future:

  1. Promote and institutionalize a learning culture and adaptive landscape management.
  2. Consolidate efforts to make global visions work nationally by increasing coordination and cooperation among stakeholders.
  3. Put much more emphasis on maintaining and improving forest quality and restoring degraded landscapes.
  4. Explore and invest in alternative economic development models that consider progress beyond growth.
  5. Put more effort into achieving good forest and landscape governance at all levels, and institute effective conflict-management mechanisms.
  6. Build the resilience of forests, landscapes and people in coping with climate change, shocks and uncertainties.
  7. Commit sufficient resources and effort to make landscape approaches work.

The preceding chapters have painted a mixed picture for forests, landscapes and people in the region. Commendable progress has been made on several fronts but, at the same time, pressure is increasing due to climate change, demographic shifts, conflicts over tenure and land use, and other stressors, and landscape management is proving increasing complex and challenging. Action is needed now and in the near future to avoid potentially catastrophic outcomes.

This chapter distils some of the key lessons learned in the preceding analysis, provides recommendations based on these lessons for five sets of stakeholders, and draws final conclusions.

Lessons learned

Sustainable forest and landscape management is a wicked problem, requiring adaptive management

The challenges and peculiarities of forest and landscape management vary widely among countries. Some countries have reversed forest loss, but deforestation remains a serious issue in others. Some countries have improved forest governance by increasing stakeholder participation, but illegal logging and forest conflicts continue. As described in preceding chapters, the forest sector faces multiple and often-interlinked challenges, many of which are outside the sector's control. Addressing a small set of these challenges will not solve the overall trajectory, but trying to solve all challenges at once is infeasible. Thus, bringing about sustainable forest and landscape management could be characterized as a "wicked problem" that requires continuous adaptive and coordinated actions by all stakeholders.

Simple solutions to any wicked problem tend to be ineffective. For example, logging bans in the region have rarely solved the problems they were designed to address; on the contrary, they have often had perverse results – such as increased illegal logging due to a breakdown in forest governance, and total forest loss by causing a land-use vacuum that attracted other economic sectors. Logging bans without good governance can result in negative impacts. Moreover, even when effective, logging bans in one country have led to increased (unsustainable) logging in others as wood imports rose to meet demand. Addressing deforestation and other forest-related problems, therefore, requires a comprehensive and coordinated effort, and there are no quick fixes.

On the other hand, overly complex solutions are also likely to be ineffective. Thus, the way forward for policymakers is to create policy conditions that encourage improvement and adaptive management over time. Many examples and best practices exist in the region, and these can be drawn on in the formulation of innovative approaches to suit given sets of circumstances. The key is to take a landscape-scale approach involving collaboration among actors, the capacity to learn from experiences, and a willingness to engage in participatory decision-making processes. Institutions responsible for forest and landscape management will need to foster a learning culture that enables innovation to thrive.

Governments should play a facilitative role in bringing about landscape approaches: they often have a constitutional responsibility for forest and landscape management, they can make policy decisions to create an enabling environment, and they can allocate financial resources to help make landscape approaches work. A facilitative role implies the sharing of decision-making: other actors, including youth, women, marginalized groups, the private sector and civil-society organizations, must be brought on board. In most cases, this will require changes in institutional culture from one that manages competition and trade-offs and involves hierarchical relationships to one that seeks synergies and partnerships, thereby enabling learning and innovation.

A rigid, blueprint approach to forest and landscape management will not build resilience and is unlikely to produce sustainable outcomes. Adaptive management will be necessary – requiring adaptability among institutions and stakeholders and the capability to respond with the best possible actions in the face of emerging challenges; this will be nurtured in a learning culture.

Such change is easier said than done, but there seems little choice: approaches involving collaboration, coordination and partnership are imperative for solving this wicked problem. The region's economic, cultural, environmental, policy and political diversity presents a challenge for building consensus on forest and landscape management. Nevertheless, acting together on, for example, climate change, deforestation, conflict and illegal logging has already yielded promising results. Cooperation through subregional bodies such as ASEAN (Box 10.1), the Mekong River Commission, the South Asian Association for Regional Cooperation and the Pacific Community (Box 10.2) is important because many of the issues are transboundary in nature. Many examples of effective transboundary resource management and cross-sectoral cooperation exist, and approaches have been tested in wide-ranging contexts. The lessons learned from these are likely to be valuable in other situations and can contribute to the development of adaptive management solutions.

Making global visions work requires local action

In recent years, global visions and commitments have been embodied in (for example) the SDGs, the Paris Agreement on climate change and the United Nations Decade on Ecosystem Restoration. There is, therefore, broad consensus on what a sustainable future might look like. In the Asia-Pacific region, Asia-Pacific Economic Cooperation has set a restoration target for 2020 and ASEAN has an agreement for addressing transboundary haze. Bilateral agreements such as those between the EU and countries in the region to combat illegal timber trade point to a desire to build synergies between consumer and producer countries. Nationally, many countries have established forest-related targets and visions on, for example, forest restoration, forest area, changes in tenure in favour of local communities, and the contributions of forests to climate-change mitigation; some of these are linked to global visions.

BOX 10.1

Regional cooperation on forestry in Southeast Asia

The Association of South East Asian Nations (ASEAN) Cooperation on Forestry, which began in 1997, brings together ASEAN member states to promote dialogue on the forest sector. Historically, the Hanoi Action Plan (1997–2004) and the Vientiane Action Programme (2004–2010) guided ASEAN cooperation in forestry with a mandate to enhance the global competitiveness of ASEAN's forestry products and to promote intra- and extra-ASEAN trade and greater private-sector investment in the forest sector. In 2016, ASEAN Senior Officials on Forestry established a vision of cooperation for 2025, in which "forest resources are sustainably managed at the landscape level to meet societal needs, both socio-economically and culturally, of the present and future generations, and to contribute positively to sustainable development".

Relevant regional policies and guidelines to improve forest management in the region include the following: *Manual for Assessing FLEG Implementation in ASEAN*; *ASEAN Guidelines for Agroforestry Development*; *ASEAN Criteria and Indicators for Sustainable Management of Tropical Forest*; *ASEAN Guidelines on Phased Approach to Forest Certification*; *ASEAN Guidelines on Chain of Custody for Legal Timber and Sustainable Timber*; and *ASEAN Criteria and Indicator for Legality Timber*.

ASEAN has also been active in international forums, including the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Forum on Forests (UNFF). It expressed the common views of its members through submission of the "ASEAN Common Position on Reducing Emission from Deforestation and Forest Degradation (REDD+)" to the UNFCCC and of the "ASEAN Input Paper" to the UNFF.

Source: D. Sukmajaya, personal communication, March 2019.

BOX 10.2

Regional forestry cooperation in the Pacific

For more than 70 years, the Pacific Community has been assisting Pacific countries and territories in the development of their human and natural resources. The Land Resources Division (LRD) is now a core part of this, empowering Pacific countries to bring solutions for endangered forests and landscapes as well as for their vulnerable communities. The LRD has helped Pacific communities develop and improve regulatory frameworks (i.e. policies, plans, laws and strategies) and strengthen capacity for the widespread application of sustainable forest and landscape management.

Bridging the divide between lofty aspirational goals and their implementation looms as a massive governance challenge in many countries, however. For example, SDG 15 requires the cessation of deforestation by 2020, but how do governments translate this into action? It is especially difficult to do so in countries at a stage of development in which forest conversion is seen as a means for providing state revenues, enabling the development of industries based on agricultural commodities, and providing access for mining and other economic activities. In such situations, halting deforestation in the absence of development alternatives risks major political fallout and potential declines in economic prosperity.

All governance decisions involve pros and cons, and risks, and they can give rise to heated debates and potentially to conflicts. This is certainly true in forest and landscape management, which involves a wide range of stakeholders, interest groups and sectors. In bringing about positive change, governments will need to be creative, build consensus, and develop alternatives to the economic benefits foregone (had deforestation proceeded). Financial assistance and compensation from developed countries, such as through REDD+ payments, would help, especially in the short to medium term. Nevertheless, each country will ultimately need to seek its own sustainable domestic solutions.

The good news is that countries are increasingly recognizing the importance of sustainable forest and landscape management and the need to plan for the future. Forests are appreciated more for their multifunctional roles, and the perception is decreasing that forests are simply sources of capital or a hindrance to development. Environmental awareness more generally is growing in the region.

Many countries are shifting their management objectives for natural forests away from timber production towards soil, water and biodiversity conservation. More wood is being produced on farms and in dedicated planted forests, and there is potential (and, indeed, an imperative) for these plantings to also perform multifunctional roles. New technologies have huge potential for increasing the sustainability of forest and landscape management, and today's technologically savvy youth offer hope that innovative approaches to sustainable forest and landscape governance and management will gather momentum.

Market changes will play a role. The traditional use of wood as a source of domestic energy is declining rapidly. Although the share of wood in the region's production of modern biofuels is low, the use of solid biomass in electricity generation is increasing and regional demand for wood pellets is on the rise. Industrial roundwood consumption has grown only modestly in the region in recent decades, despite rapid economic and population growth. Nevertheless, new wood-based products such as bioplastics are emerging that could accelerate wood consumption. A shift towards a bioeconomy would also likely stimulate growth in demand for sustainably produced wood.

Much more attention is needed on forest quality and restoring degraded landscapes

There has been an overall gain in forest area in the region since 2000, due mainly to massive reforestation and afforestation efforts, especially in China but also in several other countries. Nevertheless, there is concern that overall forest quality is declining, diminishing the capacity of forests to provide essential ecosystem services.

Forests are home to an estimated 80 percent of terrestrial biodiversity, and the ongoing loss of this biodiversity is alarming. Although biologists are divided on whether the planet is undergoing a sixth (Anthropocene) mass-extinction event, there is no doubt that forests in the Asia-Pacific region have experienced huge biodiversity losses in the past 50 years. This has included reductions in the area and quality of most forest types and the extinction of genes, species and ecosystems. Many of the species have become extinct even before scientists have had the chance to understand comprehensively their role in food chains. Broad forest data might capture certain forest-related megatrends, but a great deal of unmonitored change is occurring at the local and biological levels, including microbial levels, that could pose enormous threats to forests and, ultimately, to the resilience of ecosystems and human societies. Major declines in pollinator species such as bees, for example, are a huge cause for concern. Most of the species that are thriving in today's modified landscapes are those adapted to human-dominated ecosystems. For many species dependent on primary-forest ecosystems, however, the story is bleak and an indictment of recent human stewardship.

Maintaining the health and vitality of forests is important for ensuring they can continue to perform their many ecological functions, but three-quarters of the region's forests suffer from at least some level of degradation. Important lessons include the following: overharvesting may provide short-term economic benefits but, in the longer term, the degradation it causes can have dire consequences for landscapes and people; conflicts over forests, and land appropriations, have often resulted in the eviction and marginalization of local and indigenous people, which, in turn, has reduced local forest management capacity; degraded forests have less capacity to deliver ecosystem services vital for society's survival; and the adoption of SFM in secondary forests can help restore forest health and the provision of ecosystem services and improve outcomes for biodiversity.

The economic development model requires rethinking

Although the region has performed extremely well economically, there may be a need to reconsider the "growth first" paradigm adopted by most countries in the region, in which rapid economic development is pursued at substantial cost to the environment (and, arguably, social cohesion). Is this development model adequate for charting the highly uncertain future that lies ahead? The prima facie evidence suggests that it is not. Alternative narratives exist, such as "gross national happiness", adopted in Bhutan (Ura *et al.*, 2012), the "steady state" economy (Lawn, undated), and the "doughnut economy" (Raworth, 2018). These and other new narratives (including the circular economy and the bioeconomy, as discussed in previous chapters) consider and measure progress more broadly than just through economic growth, but their acceptance to date is limited. It may take time for new development narratives to prevail and strong political support to emerge, but the increasingly alarming adverse impacts of the current model suggest that a move towards sustainable alternatives is urgent. The SDGs have set a broad vision for a sustainable future beyond economic development and constitute, therefore, a collective move in that direction.

The emergence of young leaders could speed the move. Youth campaigns for greater action on climate change are gathering momentum globally, with some involving young people in more than 100 countries. Given that today's youth will inherit tomorrow's planet, listening to their voices, and involving them in decision-making, is a moral obligation.

Improving forest governance is crucial

Good forest and landscape governance will be crucial in this era of rapid change. It could be the single most important factor in determining whether the region achieves "the future we want"[43] or continues along a more problematic path. Therefore, the continued development of robust, equitable systems of forest and landscape governance is an urgent task in many countries in the Asia-Pacific region, despite some successes. In particular, ensuring the rights of women, indigenous peoples and other marginalized groups is a huge challenge.

Processes to reform forest and landscape governance will vary enormously depending on the overall political context in countries. Nevertheless, those that increase social inclusion and benefit sharing are likely to produce more sustainable outcomes and reduce the potential for tensions and conflicts. Experience has shown that reforms achieved through mass uprisings against the status quo often lead to losses of life and even the breakdown of entire governance structures. Ideally, therefore, reforms to forest and landscape governance will be achieved incrementally.

Ultimately, the expectation for forest and landscape governance is that stakeholders can participate in decision-making and thereby ensure that their voices are heard. The key is to ensure that all stakeholders are able to share the benefits and costs of resource management equitably and justly; meaningful involvement in decision-making will make this possible.

The Asia-Pacific region boasts many inspiring examples of positive change in forests, forestry and landscapes, including the restoration of degraded lands, expansions of forest area, reductions in deforestation, and the adoption of participatory processes. Regionally, there have been major decreases in the number of very poor people (although highly impoverished

[43] "The Future We Want" is the title of the outcome document of the United Nations Conference on Sustainable Development, held in Rio de Janeiro, Brazil, in September 2012.

people still live in some forested areas). Positive changes in forests, forestry and landscapes have arisen in diverse political and economic contexts, but underlying them has been an imperative to change because existing governance approaches were proving inadequate. Experiences in the region in recent decades indicate that prerequisites for good forest and landscape governance usually include transparency, the participation of women, indigenous peoples and other marginalized groups, equitable tenure, and effective conflict-management mechanisms. Good forest and landscape governance will enable planning and implementation through collaboration and partnerships among all stakeholders to achieve common visions. It will also feature the fair and equitable delineation of roles, responsibilities and benefit sharing, the joint monitoring and evaluation of outcomes, and the adaptive management of forests and landscapes.

Technologies are emerging that can help bring about new approaches to forest and landscape governance, such as by assisting in forest monitoring and the tracking of forest products. On the other hand, effective policies and laws are needed to address the governance risks associated with modern technologies, such as the potential for covert surveillance against legitimate forest actors, the loss of privacy and control over data, identity theft, misinformation and political fragmentation.

The region should expect surprises – and build resilience

Shocks will undoubtedly occur in the Asia-Pacific region in the years ahead to 2030 and 2050. Change can be unpredictable: five years ago, for example, few people would have considered it likely that nationalist movements would decisively swing policies away from free trade and globalization. No one can be certain about what will unfold in the years ahead, and surprises at the local, national, regional and global levels are inevitable.

Disasters and crises tend to undermine efforts to achieve sustainable development, and rural people are often the most affected. Many people, communities and landscapes in the Asia-Pacific region are highly vulnerable to the impacts of climate change and other environmental (as well as geopolitical, economic and demographic) stressors. It is crucial, therefore, that forest and landscape management encompasses holistic approaches to maximize the resilience of livelihoods, communities, institutions and ecosystems.

Resilience involves the ability to prepare for predictable change; the capacity to absorb negative shocks and take advantage of positive opportunities; and the means for coping with whatever surprises the future has in store. A major challenge in coming decades will be the increasing frequency and severity of climate-change-induced disasters such as wildfires, floods, landslides, droughts and hurricanes. Forests could play crucial roles as both vectors for the impacts of disasters, as in the case of forest wildfires, and in mitigating some of the worst effects, for example by providing buffers against winds, storm surges and flooding. More attention is needed on the roles of trees and forests in building resilience against climate change.

Resilience can be built in many of the same broad spheres as the drivers of change. For example, economic resilience can be built by "saving for a rainy day" and by developing livelihoods that encompass diverse income streams rather than rely on single products or services. The maintenance of strong cooperative social structures that encourage community members to help and support each other will build social resilience, although this could be challenging given the many factors apparently working against stronger social cohesion. A spread of technologies and robust infrastructure can help build resilience in communities.

Equally, there is a need to ensure that the forests on which communities depend are resilient to change. Maintaining the ecological integrity of forests and therefore their resilience will involve safeguarding biodiversity, avoiding the overexploitation of forest products and ecosystem services, staying vigilant against wildfires and pests, and monitoring forest health – in effect, managing forests sustainably and adaptively. The institutional framework – the policies and laws that govern forests and forestry – must adequately safeguard forests against rapid change and promote rather than undermine the resilience of forests to change.

Landscape approaches must be made to work

There are clear advantages in – and an imperative for – taking landscape approaches to governance and management: water, fire and forest pests, for example, don't recognize administrative or sectoral boundaries, and trees outside forests receive little attention from regulators because they are considered neither part of agriculture nor within the jurisdiction of forest authorities. Meanwhile, demand for forest products and ecosystem services stretches beyond national boundaries. The Asia-Pacific region imports large quantities of industrial roundwood and sawnwood. The region is also now the world's largest producer of wood-based panels, with significant exports to markets outside the region. To avoid situations in which resource-hungry, forest-poor countries overexploit forests in other less-developed (forest-rich) countries, more attention needs to be paid to the "leakage" of environmental degradation that might arise when countries become large net importers of forest products. Other transboundary issues, such as those involved in wildlife management, water resource management and allocation, and fire and haze management, will require increasing cooperation on landscape management between governments and other stakeholders at the regional level.

As populations continue to grow in most countries and more people live in urban environments, the ecosystem services of forests – such as those related to water, air quality, human health and well-being, and disaster risk mitigation – will assume increasing importance and economic value. Similarly, awareness will grow of the connections between the urban, peri-urban and rural environments. Increasingly, planted forests will be the region's main source of wood production, with most natural (especially remaining primary) forests reserved for the provision of ecosystem services and amenity values. Nevertheless, many natural (especially secondary) forests could continue to supply wood and non-wood products under sustainable management regimes: "locking up" natural forests to protect them is not always an efficient or effective strategy. It can also lead to perverse outcomes, including the further marginalization of local people accustomed to using forests for a wide range of purposes and for whom forests are often an important source of livelihoods.

Governments once dominated the planted-forest sectors of most countries in the region, but this is changing. Corporate investors, wood companies, institutional investors, smallholders and local communities are increasingly growing and supplying wood, and new arrangements are emerging to link farm foresters and wood product companies, with potential to increase wood supply and generate local incomes. Managing these many interests – often in landscapes featuring diverse land uses – to ensure sustainability, legality, the provision of essential ecosystem services and equitable economic outcomes is an important challenge that can best be met through landscape approaches.

In recent decades there has been a major expansion of perennial commodity crops, especially oil palm and rubber, often at the expense of forests and forest-dependent people. Certain infrastructure projects could have transformative impacts in coming decades on economies, land use, the environment and forests. Although tools exist to enable informed decisions that fully take into account the economic, social and environmental impacts of infrastructure and agricultural development, in practice these are rarely used optimally in most countries in the region. Well-implemented landscape approaches are most likely to enable informed decisions on land uses that minimize negative impacts and seek synergistic outcomes.

Despite increasing awareness of the benefits of landscape approaches, however, there are few examples in the region of their effective adoption: barriers to their uptake include a lack of political will for institutional reform due to entrenched sectoral interests and the difficulty of quantifying the benefits of landscape approaches. The administrative task of coordinating and finding consensus among diverse interests – with varying levels of power – can be daunting, too, although the emergence of various new information and communication technologies will help. Nevertheless, there is vast potential for synergies in landscape management that can simultaneously increase agricultural and forest productivity, human well-being, biodiversity conservation and other positive outcomes.

Landscape governance does not necessarily require that countries break up their sectoral institutions to form single entities responsible for governing all aspects of landscapes, but it points to the need to plan and work jointly among sectors. Coordinated, integrated approaches are needed to planning, budgeting, resource mobilization, monitoring and evaluation. Bringing sectoral expertise together to address landscape-scale issues is the characteristic and strength of a landscape approach. It requires that priorities are defined jointly, actions are coordinated, and resources are invested at scale, which, in turn, means changing the way that sectoral institutions and stakeholders work. Who would lead such a process, and what would be the incentive for sectoral institutions to participate? Answering these questions is crucial for making progress towards landscape approaches.

Robust actions to shape a sustainable future

Five broad groups of stakeholders will be crucial for taking the region forward by working in a coordinated manner to address the challenges of forest and landscape management: governments; the private sector; civil-society, local community and indigenous groups; research institutions; and intergovernmental and development assistance agencies. Box 10.3 lists seven robust actions that all these stakeholder groups could take now and in the next decade. Moreover, specific options are proposed (at the end of this chapter) that stakeholders may adapt to specific situations and contexts and use as a starting point for operationalizing the robust actions. The intention is not to be exhaustive, and some options may be more relevant to some countries than others. The options are targeted mostly at national-level stakeholders.

All stakeholders will need to coordinate their actions with others to ensure maximum impact and synergies and optimum outcomes. Actions taken in isolation will be less effective in achieving a sustainable future for people, forests and landscapes.

BOX 10.3

Seven robust actions

1. Promote and institutionalize a learning culture and adaptive landscape management.
2. Consolidate efforts to make global visions work nationally by increasing coordination and cooperation among stakeholders.
3. Put much more emphasis on maintaining and improving forest quality and restoring degraded landscapes.
4. Explore and invest in alternative economic development models that consider progress beyond growth.
5. Put more effort into achieving good forest and landscape governance at all levels, and institute effective conflict-management mechanisms.
6. Build the resilience of forests, landscapes and people in coping with climate change, shocks and uncertainties.
7. Commit sufficient resources and effort to make landscape approaches work.

Options for operationalizing these robust actions, organized by stakeholder group, are provided at the end of the chapter.

Ensuring the effectiveness of the robust actions set out in Box 10.3 will involve a number of cross-cutting strategies, such as those described below.

Policy and institutions require reform

Policies and laws that enable mainstream forest and landscape management are needed, but these are lacking in most countries in the region. Without significant reforms to policies and laws, therefore, it will be difficult to fully implement integrated, coordinated landscape management approaches. Policies should empower stakeholders in landscapes to collaborate and build synergies; land-use planning should involve all sectors, with the strong participation of all stakeholders; and resources should be made available to ensure cross-sectoral planning. All this requires policy support and may involve the significant reform of strongly rooted sectoral institutions.

Intersectoral and multidisciplinary approaches are needed

Forest and landscape management involves many sectors and stakeholders and often-complex relationships. Stakeholders have widely varying interests, aspirations and motivations, which need to be taken into account. To ensure sustainability at the landscape scale, intersectoral approaches offer opportunities to increase synergies, efficiencies and impacts. Bringing together diverse types of expertise and skills in joint work will likely yield better outcomes for landscapes and people.

Ensure inclusive education and knowledge building

The ability to work cross-sectorally may require inclusive education processes that are made available to all stakeholders and which aim to build knowledge on the role of all sectors in landscapes and on the practices of sustainable forest and landscape management. Such education processes should encompass all sources of knowledge, including that held by indigenous peoples and other traditional communities, governments, civil-society organizations and scientists, and they should make use of experiences and lessons learned in other countries and subnational regions. Educating people on sustainable forest and landscape management is a key for its acceptance and implementation.

Use collaborative and joint decision-making processes

Landscape management can work where decision-making processes are participatory and the aspirations of all stakeholders, including youth, are heard. Participatory processes will ensure the buy-in of all stakeholders and in turn build commitment for change. A conscious effort is needed for those more-powerful stakeholders to collaborate with others. Transparency in such processes is crucial.

Build capacity for sustainable forest and landscape management

The success of forest and landscape management depends on the capacity to implement it, but existing capacity is weak in the region, and few land managers and practitioners are trained to interact successfully beyond their own areas of expertise. Building capacity for landscape management will require a long-term effort and investment, and it needs to be afforded high priority. A key to making sustainable forest and landscape management work is demonstrating its value and advantages. Thus, building entrepreneurship will be crucial to ensure that forest and landscape management produces tangible economic results.

Conclusion: the forestry response

It is often written that "forestry is at the crossroads" as if the sector faces a single decisive choice. The reality is, however, that forestry in the Asia-Pacific region has already passed through many crossroads, and no doubt many more lie ahead. Largely, this is because the choices made to date in the region have not led to sufficient improvement. Sometimes the decision has been to do (or has achieved) little to change the status quo; sometimes, decisions have made things worse and occasionally they have been outright destructive to the environment, social fabrics and local, national and regional economies.

As we enter the third decade of the twenty-first century, a handful of key indicators in the region – such as an increase in the region's total forest area, reductions in poverty, increases in protected areas and increases in the efficiency of wood use – give some cause for optimism that a corner is being turned. But a great many other measures – including the loss of primary forests (among the last frontiers of terrestrial biodiversity) and ongoing forest degradation – reinforce the view that the state of forestry, and indeed of the broader global environment, is worsening. The 2019 global environmental outlook report concluded that, "the overall condition of the global environment has continued to deteriorate … despite environmental policy efforts across all countries and regions … Unsustainable human activities globally have degraded the Earth's ecosystems, endangering the ecological foundations of society" (UN Environment, 2019). In general, rare and threatened species should be accorded far greater attention and support than they are receiving today because once they are gone they are gone forever – and a source of wonder will have been removed from the world.

For forestry professionals working in the region, the technical requirements for improving forest management and directing it towards sustainability are well understood. The greatest challenges lie in the political and philosophical spheres; fundamentally, they relate to the decisions surrounding the balancing of economic, social and environmental objectives for forests, which are often made beyond the forest sector. Forests play multidimensional roles and it is imperative, therefore, that forestry sits at the decision-making high table, nationally, regionally and globally.

In many countries, the prevailing political wisdom of the past 50 years has been weighted heavily towards economic development, in which the majority of benefits have been captured by a relative few and the many social and environmental costs have largely been externalized and are being borne by the many. That economic considerations have taken precedence in political decision-making is unsurprising – political timeframes are usually short and dictated by election cycles, and decisions that shut down industry, hamper economic development and cost people's jobs and livelihoods are rarely popular vote-winners. True leadership, however, requires hard decisions: with climate change and other stressors threatening the safety and well-being of entire societies, the time has come for political leaders to tackle environmental imperatives as a priority. On the other hand, greater funding for forests and the environment is simply part of a broader need to demonstrate political will. And, as with every challenge confronting forestry, the fundamental problems are not technical but socio-political. Necessary change will occur when forests and forestry are accorded sufficient priority in societal and political decision-making. To date, in many countries, this prioritization is yet to be made.

Among those who believe strongly in anthropogenic climate change, there is increasing scepticism at the lack of progress in moving from talking about climate change to concerted action on the ground. The pace of tangible political action fails to reflect the peril we face.

So, what should advocates and policymakers do? A major task is to instil a sense of urgency to ensure that climate change is accorded priority in government decision-making now, rather than deferring the potential costs to future times and generations. The emergence of a strong youth voice in many countries in the region, inspired especially by concerns about climate change, offers hope for change.

Forestry has often been at the forefront of social change: it was the progenitor of the contemporary guiding principle of sustainability (Schmithüsen, 2013) and could be said to have been a leader in the development of participatory models of natural resource management (Sarre and Sabogal, 2013). It has the opportunity to lead again today by responding urgently to the clear danger that lies ahead.

Forestry won't achieve an aspirational future on its own; all landscape actors must play their parts. But the forest community can start the process by scaling up its ambition. The first step in the forestry response, therefore, could be to immediately and vocally advocate approaches that draw landscape participants together in a spirit of collaboration to seek synergistic outcomes.

A groundswell in the regional forestry community can bring this about. Forestry leaders in the Asia-Pacific region have the opportunity to form a united front in this advocacy at the level of national governments. They can obtain buy-in from diverse national actors by presenting a persuasive case that landscape approaches are in everyone's best interest – or, rather, that a failure to take a more coherent, inclusive and collaborative approach risks allowing countries and the Asia-Pacific region to drift towards a disruptive future. Forest-sector actors in the region are invited to collaborate more strongly than ever before, using this outlook study as an entry point for bringing about rapid positive change. In so doing, they would inspire other regions to follow suit, thereby helping stir a global, forestry-led response to the threats we all face. Where there is political will, there is a way.

Options for operationalizing the robust actions

1. Promote and institutionalize a learning culture and adaptive landscape management

Governments

- Formulate or strengthen policies in support of institutional learning and adaptive management in land and natural-resource-based sectors.
- Develop and implement institutional (or system-wide) incentives to promote stability, flexibility and creativity in policymaking and implementation.
- Make space for genuine policy feedback through various means, such as public consultation, policy dialogues, the press and social media, with the aim of improving policies so they support adaptive management.
- Actively create an environment that supports innovation and innovative policies, including through internal policies to facilitate such innovation.

Private sector

- Participate in landscape-level planning, implementation, monitoring and evaluation and promote dialogues and information sharing with other stakeholders to increase transparency.
- Create opportunities for other stakeholders to voice their concerns about business operations and respond to such concerns appropriately.
- Look for opportunities to develop corporate social responsibility policies.

Civil-society, local community and indigenous peoples' groups

- Proactively engage in the adaptive management of forests and landscapes and with other stakeholders.
- Build the capacities of local communities and indigenous peoples in relation to landscape management, collaborative management and adaptive management.
- Advocate for full access to information on the management of forest landscapes, benefit sharing, and the roles and responsibilities of various actors.
- Assist local communities to negotiate fair and equitable shares in forest management responsibilities, rights and revenues.

Research institutions

- Conduct action-oriented research on adaptive landscape management and social learning involving key stakeholders.
- Provide recommendations on how key stakeholders can engage in adaptive management based on empirical research findings.
- Help governments and other stakeholders address barriers to the implementation of adaptive forest and landscape management.

Intergovernmental and development assistance agencies

- Support governments in the promotion of adaptive forest and landscape management, in collaboration with key stakeholders.
- Support knowledge sharing and capacity building on adaptive management, including intergenerational knowledge sharing.
- Support landscape-scale projects to demonstrate how collaborative and adaptive management can yield better outcomes for people, landscapes and forests.

2. Consolidate efforts to make global visions work nationally by increasing coordination and cooperation among stakeholders

Governments

- Revise and implement national policies to deliver on forest-related targets, such as those in the SDGs and the Paris Agreement on climate change, taking into account the interests, voices and aspirations of all stakeholders, and mobilize resources to implement such policies.
- Link global visions and national and local aspirations, and translate global visions to national and subnational actions that take into account the local context.
- Engage stakeholders across sectors and levels of government to increase understanding of the role of forests in sustainable development and addressing global challenges.
- Increase significantly the engagement of youth, women and indigenous peoples in formulating and implementing programmes on sustainable forest and landscape management in the broader context of sustainable development.

Private sector

- Demand engagement from government on sustainable forest and landscape management to support the achievement of the forest-related SDGs.
- Engage in initiatives on the forest-related SDGs in collaboration with governments and other key stakeholders.

- Implement sustainable business models through the adoption of environmentally friendly approaches that increase benefits for people, forests and landscapes.

Civil-society, local community and indigenous peoples' groups

- Strengthen the engagement of indigenous peoples and local communities in the implementation of the forest-related SDGs and other global visions and commitments.
- Raise awareness at the subnational level of the SDGs and other global visions and commitments, in collaboration with governments and other key actors.
- Hold governments accountable on policy development and implementation.

Research institutions

- Conduct research on the forest-related SDGs, including gaps in methodologies for data collection and monitoring.
- Demonstrate through evidence that SFM can support national sustainability goals.

Intergovernmental and development assistance agencies

- Increase regional collaboration and financial support aimed at achieving the forest-related SDGs cohesively, including by assisting countries where necessary to ensure progress.
- Encourage the development of incentives for developing countries to pursue low-carbon development pathways, including payments for regionally and globally significant ecosystem services.
- Mainstream methodologies and guidelines for reporting and assessing progress towards the forest-related SDGs, including by adopting new technologies and participatory approaches in forest-related monitoring and evaluation.

3. Put much more emphasis on maintaining and improving forest quality and restoring degraded landscapes

Governments

- Devise and implement fiscal mechanisms – such as payment schemes for ecosystem services, incentive schemes and other measures – for increasing remuneration for SFM.
- Formulate or strengthen policies to protect ecologically sensitive watersheds and restore degraded landscapes.

- Support locally based enterprises to develop business models that maximize the economic potential of forest and landscape restoration and thereby stimulate its uptake at scale.
- Bring together technology companies, forest companies, researchers, entrepreneurs, communities and governments with a view to encouraging appropriate technologies in forest and other land-use sectors.
- Develop new and additional mechanisms to enable the provision and transfer of financial, technical and technological resources to support improved forest and landscape management in less-developed countries.
- Enact laws to encourage sustainable supply chains and discourage illegal trade.
- Reward change agents and innovators for their efforts to implement SFM.

Private sector

- Adopt best practices in forest and landscape management and corporate social responsibility.
- Work with governments, civil-society organizations and other actors on the development of payment schemes for ecosystem services that provide fair remuneration for the multifunctionality of forests, including privately owned or managed forests.
- Foster sustainable supply chains for forest products that encourage SFM and provide fair reward for responsible practices.
- Engage in processes to develop sustainable forest-related supply chains, including by assisting local-level suppliers to obtain forest certification or otherwise improve production processes and verify legality and sustainability.
- In cooperation with civil-society organizations to provide credibility and transparency, develop and implement policies aimed at eliminating illegal wood from supply chains.

Civil-society, local community and indigenous peoples' groups

- Play effective advocacy and watchdog roles to ensure the implementation of policies to protect intact forests, maintain and improve forest quality, and restore degraded landscapes.
- Work with governments, the private sector and other actors on the development of payment schemes for ecosystem services that provide fair remuneration for the multifunctionality of forests and ensure equitable outcomes for local communities and smallholders.

Research institutions

- Develop adaptive forest restoration and management approaches aimed at increasing the structural and biological diversity of forests over time.

- Assist policymakers to develop indicators for monitoring forest-quality change.
- Encourage multidisciplinary research aimed at increasing the health, productivity and multifunctionality of planted forests, including wood production and the provision of ecosystem services.
- Encourage multidisciplinary research aimed at increasing the resilience of forests in the face of climate change.
- Design and undertake research aimed at understanding and maximizing the roles of forests and trees for the adaptation of agriculture, livelihoods and landscapes.

Intergovernmental and development assistance agencies

- Support countries to implement indicators for monitoring forest-quality change.
- Build on and improve a platform for sharing best practices in forest management aimed at maintaining and improving forest quality and for sharing experiences in payment schemes for ecosystem services.
- Build the capacities of all stakeholders to facilitate forest and landscape restoration.
- Foster sustainable supply chains for forest products that encourage SFM and fair reward for responsible practices.

4. Explore and invest in alternative economic development models that consider progress beyond growth

Governments

- Promote balanced policies beyond the “growth first” economic model that consider the importance of sustainable forest and landscape management.
- Learn lessons from other countries that have adopted alternative approaches to development and consider piloting these based on the national context.
- Enact laws to encourage sustainable supply chains and discourage illegal trade in forest products and wildlife.
- Reward change agents and innovators for their efforts to implement sustainable development.

Private sector

- Invest in green growth by creating business opportunities in, for example, renewable energy, the use of recovered woods, and green building.
- Engage young entrepreneurs in green business development.
- Promote science-based approaches to sustainable value chains through smallholder certification systems, training, and corporate social responsibility for fair trade.

Civil-society, local community and indigenous peoples' groups

- Advocate for sustainable development pathways and campaign for consumer awareness programmes.
- Share best practices in sustainable development models.
- Raise awareness of the need for transformational change to achieve sustainable development.

Research institutions

- Investigate the economic, social and environmental implications of moving towards a more circular economy and a bioeconomy.
- Provide governments and decision-makers with empirical findings on economic, social and environmental synergies and trade-offs towards sustainable value chains.

Intergovernmental and development assistance agencies

- Assist governments to effect a transition to sustainable development and a more circular economy.
- Assist in transferring technologies to developing countries to support sustainable value chains for more efficient production and consumption.
- Build up capacities in all stakeholders for transitioning towards a more circular economy and a bioeconomy.

5. Put more effort into achieving good forest and landscape governance at all levels, and institute effective conflict-management mechanisms

Governments

- Take advantage of new technologies for implementing more efficient, accountable and transparent institutional mechanisms.
- Formulate or strengthen policies that enable the significant participation of all stakeholders – including indigenous peoples, local communities, women and youth – in decision-making and which minimize conflict.
- Formulate policies that make free, prior and informed consent mandatory before any interventions in landscapes that may affect indigenous peoples and local communities.
- Screen policies for transboundary cooperation, the potential for overlapping claims and needs over natural resources, climate-change objectives, and the transboundary nature of ecosystem services.
- In reforming forest and land tenure, apply the principles embodied in the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security.

Private sector

- Compensate local communities for the adverse impacts of forest operations as a means for resolving conflicts.
- Employ local people in forest operations and provide employees with a safe work environment, fair and equitable remuneration and ongoing personal development.
- Engage in regular communication with local communities to understand their aspirations, interests and concerns.

Civil-society, local community and indigenous peoples' groups

- Build the capacity of indigenous peoples and local communities in dealing with outsiders that have operations in or near their territories.
- Help bridge the communication gap between indigenous peoples and local communities and the government and private sector.
- Facilitate dialogue among stakeholders to ensure that the aspirations, voices and concerns of indigenous peoples and local communities are heard.

Research institutions

- Investigate the underlying causes of land-based conflicts and propose policy solutions and clear actions for resolving these.
- Communicate the results of research on land-based conflicts to policymakers in simple ways.
- Promote action research oriented towards resolving forest-related conflicts.

Intergovernmental and development assistance agencies

- Invest in building the capacity of governments and other key actors in conflict management.
- Support exchanges and learning on best practices in conflict management.

6. Build the resilience of forests, landscapes and people in coping with climate change, shocks and uncertainties

Governments

- Ensure that national strategies and action plans on climate change are implemented in an inclusive and cross-sectoral way.
- Implement an efficient system to monitor, alert and deliver timely interventions for coping with extreme climatic events.
- Increase financial allocations for building the resilience of forests, landscapes and people.

- Seek regional and international cooperation and mobilize external financial resources and technical gaps to adequately respond to climate change and disasters.

Private sector

- Engage in subnational, national and international negotiations and forums on climate change to ensure that the voice of responsible business is heard.
- Continually adapt management in light of changing climatic regimes.
- Work closely with governments and other key actors to build resilience at the national and subnational levels.

Civil-society, local community and indigenous peoples' groups

- Engage in subnational, national and international negotiations and forums on climate change to ensure that local voices are heard.
- Build local capacity, especially among vulnerable communities, and promote alternative livelihood options.
- Raise awareness among local people of the threats posed by climate change and climate-related disasters and about the potential role of forests in mitigating these.

Research institutions

- Investigate methods for using trees and forests most effectively to mitigate the impacts of climate change and disasters.
- Develop measures for minimizing the harmful effects of trees and forests, especially in urban and peri-urban communities.
- Monitor the direct impacts of climate change on forests and landscapes and develop measures to increase the resilience of forests and conserve vulnerable species.
- Test local-scale interventions and approaches to forest and landscape management as means for reducing the risks posed by climate change.

Intergovernmental and development assistance agencies

- Promote investment in disaster risk management and climate-change mitigation and adaptation.
- Invest in capacity building for disaster risk management and support governments in developing national capacity and know-how, including by mobilizing resources and appropriate technologies.
- Invest in regional cooperation and exchanges of knowledge and best practices on disaster risk management and climate-change mitigation and adaptation.

7. Commit sufficient resources and effort to make landscape approaches work

Governments

- Promote integrated landscape-scale governance and land-use policies by increasing coordination across sectors and among competing land uses.
- Allocate budgets based on landscape-scale planning – in which sectoral agencies receive allocations based on joint planning involving all land-based sectors.
- Improve the management of trees outside forests in urban and rural landscapes because of their multiple benefits and growing role in wood supply.
- In urban and peri-urban environments, develop planning processes that make adequate provisions for forests and other green spaces to meet the recreational and well-being needs of growing urban populations and provide other ecosystem services.
- Work with secondary and tertiary training and education institutions to develop transdisciplinary programmes aimed at facilitating the adoption of landscape approaches to land management and policy.

Private sector

- Work with governments and other actors to encourage landscape approaches.
- Encourage the development of supply chains for forest goods produced by smallholders, local communities and collectives under fair and equitable contractual arrangements.
- Develop sustainable supply chains.

Civil-society, local community and indigenous peoples' groups

- Work with governments and other actors to demonstrate the value and benefits of landscape approaches, and play an active role in the development of landscape-focused institutions.
- Advocate for the full involvement of indigenous peoples and local communities in forest and landscape management, the appropriate use of traditional knowledge, and equitable benefit sharing.

Research institutions

- Develop understanding of forest and landscape resilience and create case studies of whether the landscape approach is producing better outcomes.
- Generate evidence on the usefulness, advantages and disadvantages of landscape approaches and propose clear recommendations on their application.
- Develop means for monitoring change in the multiple functions of forests and landscapes over time and for valuing these functions.

Intergovernmental and development assistance agencies

- Work with financial institutions and governments to deploy new and emerging technologies aimed at increasing the availability of microfinance for enterprises based on the outputs of sustainable forest and landscape management.
- Shift investment to projects that apply landscape approaches and significantly reduce or cease funding for sectoral projects.

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Forests and landscapes in the Asia-Pacific region are under increasing pressure from economic development, climate change, demographic shifts, conflicts over tenure and land use, and other stressors. This, the third Asia-Pacific Forest Sector Outlook Study, presents scenarios and a strategic analysis to help policymakers and other actors understand the implications of these stressors for forests and forestry in the Asia-Pacific region and how best to address the challenges ahead.

The product of outstanding collaboration among institutions, networks and more than 800 individuals across the region, the study examines the drivers of change in the region's forest sector and explores three scenarios – business-as-usual, aspirational and disruptive – to 2030 and 2050. It shows that "more of the same" will likely lead to highly negative outcomes over both time horizons.

On the other hand, the adoption of landscape approaches and other key measures could help realize the enormous potential of forests – with their capacity to simultaneously perform multiple economic, social and environmental functions – to help achieve development goals in and beyond the forest sector. A key message of the report is that the region must respond now to ensure the resilience of forests, landscapes and communities and thereby avoid catastrophic outcomes. The report sets out seven "robust actions" for operationalizing this response.

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