

2012

State of the World's Forests



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State of the World's Forests

2012

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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Foreword

This tenth edition of *State of the World's Forests* elaborates on a fundamental truth: forests, forestry and forest products play a critical role in sustainable development. *State of the World's Forests* is published every two years.

The first chapter in this edition provides an overview of the main issues raised in the first ten editions of *State of the World's Forests*. One interesting trend observed is the growing recognition that forests and their use lie at the centre of any serious discussion of a sustainable future for planet earth. Forests play an essential role in mitigating climate change and providing products and ecosystem services that are essential to the prosperity of humankind. Forests and forestry played a central role in the development of modern civilization.

Chapter two, “Forests and the evolution of the modern world”, looks back at the successes and failures of past societies. Understanding ecological and economic history is an essential first step towards building a sustainable future.

Throughout history, deforestation has accompanied economic development. It was primarily in response to deforestation that the concept of sustainable development originated and evolved within forest science. The good news is that deforestation ceases to be a serious problem in most of the countries where economic development has progressed and sound forest practices, backed by political commitment, have been implemented. However, it must be clear that including forests at the core of a strategy for a sustainable future is not an option – it is mandatory.

Chapter three, “Forests, forestry and forest products for a sustainable future”, describes a world where economic output has more than doubled in the 20 years since the Rio Earth Summit; but this growth has been achieved at the expense of natural resources, including forests.

The world now needs to change its thinking about “progress” and develop new approaches for future economic success.

Photosynthesis – nature’s way of capturing solar energy and storing carbon – is necessary for the survival and prosperity of planet earth. Wood is produced by photosynthesis, and wood products continue to store carbon throughout their lifetimes. A sustainable global economy will use more wood for energy, shelter and an increasing array of products. To understand why “wood is good”, it is necessary to understand the entire life cycle of a forest. The same could be said of other forest products, such as bamboo and cork.

However, if wood products are produced from non-sustainable sources, the result will be deforestation or forest degradation, impeding sustainable development. In addition, not all forest products are positive in themselves. The forest practices that are collectively known as “sustainable forest management” must be used throughout the world for the global economy to become greener. At the core of sustainable forest management is the simple idea that as trees are used, they are replaced by new trees.

To the extent that “good wood” is used in the manufacture of higher percentages of buildings, infrastructure and other consumer products, the economy will become greener and more sustainable. Wood and charcoal are already the dominant form of renewable energy worldwide. In a greener economy, more wood will be used for energy as the use of fossil fuels declines. Net carbon dioxide in the atmosphere will decline as new trees are planted and nurtured to replace those that are used. Dealing with the increased demand for food, fodder, fibre, fuel and wood requires optimizing energy use, ambitious landscape restoration, intensive plantations where appropriate, imaginative agroforestry

activities, and coordination among all the activities present at the landscape level (such as agriculture, livestock, forestry, hunting, fisheries and biodiversity preservation).

A challenge for the forestry profession is to communicate the simple idea that the best way of saving a forest is to manage it sustainably and to benefit from its products and ecosystem services. If the principles of sustainable forest management are applied and forest products and ecosystem services play an increasing role, the global economy will become greener.

State of the World's Forests 2012, like its nine predecessors, is intended to serve as a reference source to support policy and research related to forests.

In addition, I hope that some of the ideas it advances will stimulate debate and lead to innovative approaches that help move the global economy in a greener direction.



José Graziano da Silva
FAO Director-General

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Acronyms and abbreviations

BCE	Before the Common Era
CIFOR	Center for International Forestry Research
CO ₂	carbon dioxide
COFO	Committee on Forestry
EU	European Union
FRA	Global Forest Resources Assessment
GDP	gross domestic product
GHG	greenhouse gas
HDI	Human Development Index
IFF	Intergovernmental Forum on Forests
IPF	Intergovernmental Panel on Forests
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
MEA	Millennium Ecosystem Assessment
NWFP	non-wood forest product
REDD	Reducing Emissions from Deforestation and Forest Degradation
SOFO	<i>State of the World's Forests</i>
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme

Executive summary

The 2012 edition of *State of the World's Forests* focuses on the critical role that forests play in sustainable production and consumption systems. In this milestone tenth edition, it is appropriate to take a look back to understand the important role that forests and forestry have played in shaping the world as it is today.

Chapter 1: *State of the World's Forests*: the first ten editions

This is the tenth edition of FAO's flagship forestry publication, which has informed readers about the status and changes in the world's forests, forest products and ecosystem services, and forest policies since the series was introduced in 1995.

This chapter provides a brief overview of the key issues and events covered in each of the ten editions of *State of the World's Forests*, highlighting the major global trends over this period.

In the 1990s, there were serious divisions among the countries of the world regarding forest policies. These differences were starkly revealed at the first Earth Summit in Rio de Janeiro, Brazil, in 1992, when countries were sharply divided over the issue of a global forest convention. In an effort to address this division, an international forest policy dialogue was launched in 1995, starting with the Intergovernmental Panel on Forests, which was followed by the Intergovernmental Forum on Forests and, since 2000, the United Nations Forum on Forests. *State of the World's Forests* has followed the progress made at these venues.

Today, there is widespread agreement on the importance and key elements of sustainable forest management as an organizing principle for the world's forests. *State of the World's Forests* continues to monitor and report on progress towards sustainable forest management at the national, regional and global levels.

In addition, it analyses major economic trends, focusing on the critical role that forests play in the modern global economy and the global environment.

Chapter 2: Forests and the evolution of the modern world

The history of humans is a story of forests and their use. Trees have provided the principal fuel and building material of human societies since prehistoric times. However, few societies have succeeded in managing their forests sustainably. As well as being a history of using forests to improve the quality of human life, the history of human civilization is also a history of deforestation.

This chapter traces the history of forests in the human era. In virtually every region of the world, wood has been the primary material used in economic development. Time and again, forest areas have declined as populations and economies have grown. Rapid economic development is often accompanied by high rates of deforestation. Fortunately, history suggests that as countries reach a certain level of economic development, they are generally able to stabilize or increase the area of their forests. There is reason for optimism in the longer term.

As human populations have expanded, forests have changed and evolved in different ways in different regions of the world. This chapter explores this evolution and considers both the impacts of forests on people and the impacts of people on forests.

The science and practice of forestry have evolved over the centuries. One of the most important contributions that forestry has made to human enlightenment is the concept of sustainability. Over a period of about 300 years, this concept has expanded, from focusing on the preservation of forest capital while ensuring the sustainable production of wood, to including a deeper understanding of sustainable development in a broad global context.

Chapter 3: Forests, forestry and forest products for a sustainable future

In the two decades following the United Nations Conference on Environment and Development, the world economy has increased from USD 24 trillion to 70 trillion of annual production and consumption. This economic explosion has been led by developing countries. However, unprecedented growth has been achieved at the expense of natural resource sustainability, and economic benefits are unequally distributed.

There is growing awareness that an economy based on the continuously increasing depletion of natural resources is not sustainable. New ways of thinking about progress are needed, and agriculture and forestry will play central roles in this transition. The economy will become greener as more and more of the products consumed in mass quantities are based on photosynthesis. When plants are harvested for food, they are replaced by a new crop to grow more food for the next cycle. The same principle applies to forests. Production systems, including energy, must be based on sustainable processes, especially photosynthesis, if the world is to have a sustainable future.

Most people understand that forests could play a role in a green economy, but not many people realize that this role is not optional – for a sustainable world, it is mandatory. Without forests, the global ecosystem would collapse. The good news is that the global economy can be sustained indefinitely through the widespread use of renewable energy, including wood-based energy.

Forests provide resources for people, including a renewable source of energy. If the global economy is to be sustainable, the land-use principles, policies and practices that are collectively known as sustainable forest management must be used all over the world. Net carbon dioxide in the atmosphere will decline as long as new trees are planted to replace those that are used.

This chapter considers an important but often ignored segment of developing economies – the use of wood as the basic material for furniture, woodcarving, handicrafts and other small or medium enterprises. Increased investment in wood-based enterprises will generate additional employment, create real and durable assets, and help revitalize the lives of millions of poor people in rural areas. At a broader scale, this green economy approach (low-carbon, resource-efficient and socially inclusive) can expand the possibilities for disadvantaged segments of the global economy. Opportunities for rural people in emerging economies are especially high.

The chapter concludes with four broad strategies for a sustainable future:

- Plant trees and invest in ecosystem services.
- Promote small and medium forest-based enterprises, and gender equity.
- Use wood for energy; reuse and recycle wood products.
- Enhance communication, and coordinate development.



Chapter 1

State of the World's Forests: the first ten issues



State of the World's Forests 2012 is the tenth edition of SOFO. It was launched at the twenty-first session of the FAO Committee on Forestry (COFO).

The first edition was launched in 1995, to coincide with the twelfth session of COFO. SOFO has been published every two years since then. Traditionally, one of the main agenda items at COFO is a review of the state of the world's forests, including a debate on topical issues in the forest sector.

Beginning in 2012, SOFO will be published in even-numbered years to coincide with the new COFO schedule, which changed from odd- to even-numbered years in 2010, to align with the new FAO Conference schedule.

This chapter provides a guide for readers who are interested in drawing on the knowledge encompassed in the first ten issues of SOFO, available online.¹ It provides a review of topical issues that were important when each edition of SOFO was prepared.

The most striking observation of this review is that every edition of SOFO remains relevant today. SOFO is an important resource for those seeking wisdom about forests, forestry and forest products.



SOFO 1995

In 1995, the international forest community was struggling to reach consensus on how to move forward after the United Nations Conference on Environment and Development (UNCED). The Tropical Forestry Action Plan was clearly out of date,

and many countries were trying to find ways of halting increasing deforestation rates. The world was seeking to develop more effective forest policies. Consequently, forest policies were the focus of the first issue of SOFO in 1995 (FAO, 1995b).

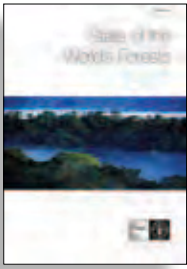
SOFO 1995 traces the evolution of forest policies from when forests were viewed mainly as resources to be exploited: in the 1970s, there was increasing awareness of the need to involve communities in forest management; in the 1980s, forests' role in stabilizing the

global environment was recognized; and by the 1990s, forests were widely regarded as having an important role in sustainable development.

By the mid-1990s, there was consensus on the need for each country to determine its own forest policies based on its unique culture, its forest ecosystems, and its stage of economic development; these country plans became known as "national forest programmes".

In addition to reviewing the state of forest policies, the first issue of SOFO presents statistics collected by FAO on the production, consumption and trade of forest products, and data on forest area in different regions of the world, based mainly on the results of the 1990 Global Forest Resources Assessment (FRA) (FAO, 1993; 1994). Subsequent editions of SOFO have included similar tables, updated to reflect the results of the most recent national surveys of forest products and the latest global assessment.

¹ www.fao.org/forestry/sofo/en/.



SOFO 1997

SOFO 1997 (FAO, 1997) reports in detail on deforestation in tropical countries, drawing heavily on the results of FRA 1990, updated to 1995 (FAO, 1995a). SOFO 1997 reports an estimated deforestation rate of

13.7 million hectares per annum between 1990 and 1995 in natural forests in developing countries. The net global deforestation rate, taking into account increases as well as decreases in forest area, was estimated at 11.3 million hectares per annum.

SOFO 1997 also contains detailed reports on trends in forest management, forest utilization and forest products. Projections for consumption and trade of forest products until 2010 are summarized. SOFO notes that FAO had already lowered the projected consumption levels compared with the projections made in 1996.

A chapter on policy issues reflects major global concerns of the time, including the large number of national economies that were undergoing the transition to a free market system, and the impact of structural adjustment programmes. Many countries were experimenting with decentralization of the forest sector.

In commenting on trends in national forest planning, SOFO 1997 notes that many countries were placing more emphasis on iterative processes involving stakeholders, rather than trying to impose “one-size-fits-all” planning blueprints within a country.



SOFO 1999

SOFO 1999 (FAO, 1999) reports on the initiatives of other organizations that assess global forest resources, including the European Union (EU) Joint Research Centre, the International Geosphere-Biosphere

Programme, the World Conservation Monitoring Centre and the World Resources Institute.

This edition also includes an extensive report on the status of and trends in forest management worldwide. It reports an increase in national initiatives to manage forests according to scientific principles and management plans that consider economic, social and environmental dimensions.

SOFO 1999 reports on the consensus achieved at the Intergovernmental Panel on Forests (IPF) that “national forest programme” is a generic term referring to a country-specific approach to forest planning and policies. This was a breakthrough in that many organizations (including FAO) had previously focused on global “best practices” for use in all countries. The new approach recognized that decentralization can work at the global level as well as within a country.

Regarding forest policy, SOFO 1999 makes an interesting observation: “National policy-makers have become more aware of the complex nature of policy reforms and the uncertainty of their effects. The interrelationships between forests and other sectors of the economy are better understood. Finally, there is a greater recognition that policy statements mean little in practice without strong institutional capacity to implement them.”



SOFO 2001

SOFO 2001 (FAO, 2001) opens by noting two seemingly opposite trends in the forest sector: localization and globalization. Many countries were decentralizing the responsibility for forest planning and management

while facing the impacts of expanding global trade and globalization.

SOFO 2001 reports on the results of FRA 2000 (FAO, 2000), the most comprehensive global forest assessment ever undertaken, at the time. SOFO also includes the new global forest map displaying the world’s forests in 2000. Important results include estimated annual losses of natural forest area of 15.2 million hectares in the tropics and 16.1 million hectares worldwide; and net deforestation (taking into account expansion of natural and planted forests) of 12.3 million hectares in the tropics and 9.4 million hectares worldwide.

SOFO 2001 provides a wealth of information about forest resources, including area of forests under protection, area of forest available for wood supply, and forest growth rates.

SOFO 2001 includes a major report on climate change and forests. Based on FRA 2000 and other FAO studies, estimates are given for carbon stocks in forest ecosystems, carbon density in different ecosystems and

regions, carbon emissions from land-use changes, and the potential contribution of reforestation and agroforestry to global carbon sequestration. This SOFO report is one of several that eventually led to global recognition of the key role that forests play in climate change mitigation.

SOFO 2001 also contains a report on illegal activities and corruption in the forest sector. This subject had been taboo in international organizations for many years, and SOFO is one of the first respected international publications to confront the problem openly. (In subsequent years, the softer term “governance” has become an acceptable replacement for the more inflammatory reference to “corruption”.)



SOFO 2003

The theme of SOFO 2003 (FAO, 2003) was “partnerships in action”, and entire chapters were contributed by partner organizations, including the Center for International Forestry Research (CIFOR), the

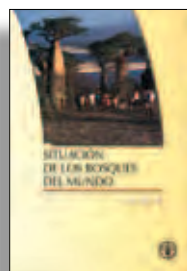
International Union for Conservation of Nature (IUCN) and the International Union of Forest Research Organizations (IUFRO). SOFO 2003 stresses that effective partnerships are the key to making progress toward sustainable development.

CIFOR contributed a chapter addressing the critical issue of forests and poverty alleviation in developing countries. Six strategies with potential for contributing to poverty alleviation are identified:

- people-centred forestry;
- removal of tenure and regulatory restrictions, and return of public forests to local control;
- improved marketing arrangements for forest products (a “level playing field”);
- partnerships;
- redesign of transfer payments;
- integration of forestry into rural development and poverty reduction strategies.

SOFO 2003 addresses several other important issues in depth, including chapters on:

- the role of forests in sustainable use and management of freshwater resources;
- how the sustainable use of forests can contribute to conserving biological diversity;
- science and technology in the forest sector;
- fiscal policies in the forest sector in Africa.



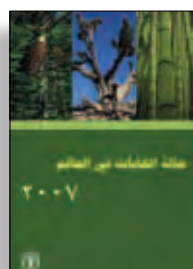
SOFO 2005

With the theme “realizing the economic benefits of forests”, SOFO 2005 (FAO, 2005b) recognizes that the forest sector is not a high priority in most countries, partly owing to the perception that it makes a relatively small contribution to national economies. Many people in the forestry profession are convinced that the rest of the world does not understand the full value of forests.

SOFO 2005 describes ways in which communities, governments and the private sector are enhancing the economic benefits from forests. It also identifies issues that must be addressed to make sustainable forest management economically viable.

SOFO 2005 includes a comprehensive report on the economics of wood energy, identifying core considerations for the development of future programmes and policies that must take complex economic issues into consideration.

An interesting chapter on “Forests and war, forests and peace”, contributed by CIFOR, concludes this issue of SOFO, and a strategy for action is outlined for countries where there is a tradition of conflict in forest areas. The chapter suggests that governments should implement policies that integrate forest-dependent people into the wider economy, without forcing them to abandon their homes or cultures.



SOFO 2007

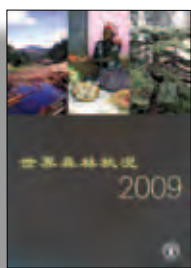
In the early 2000s, international consensus was reached on seven categories that can be applied to the various processes for identifying criteria and indicators for sustainable forest management:

- extent of forest resources;
- biological diversity;
- forest health and vitality;
- productive functions of forest resources;
- protective functions of forest resources;
- socio-economic functions of forests;
- legal, policy and institutional framework.

FRA 2005 was organized around these seven categories (FAO, 2005a). Core information from FRA 2005 was used to prepare reports on progress towards sustainable forest management in six major regions of the world. In 2006, each draft regional report was reviewed by its respective regional forestry commission and revised to reflect regional inputs; the final reports are included in SOFO 2007 (FAO, 2007).

The conclusions of the regional reports are mixed. Some regions had made more progress towards sustainable forest management than others. There were at least some encouraging signs and positive developments in each region. A striking result of FRA 2005 was that about 12 percent of the world's forest area had been set aside for protection, even though ten years earlier a global goal of 10 percent had seemed almost impossible to reach. However, in 2007 there was also widespread acknowledgement of the difficulties that many countries faced in effectively monitoring and enforcing their protected forests.

SOFO 2007 also includes short updates on several issues in the forest sector, such as climate change, desertification, poverty reduction, forest tenure, harvesting, invasive species, mountain development, planted forests, trade in forest products, water, wildlife and wood energy.



SOFO 2009

Continuing the regional approach that was used in 2007, the theme for SOFO 2009 (FAO, 2009) was the outlook for the forest sector.

The results of FAO's regional forest sector outlook studies are

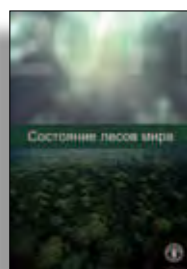
summarized and compared with an updated analysis of global and regional economic trends.

SOFO 2007 emphasizes the supply side by reviewing the state of each region's forest resources and institutions. SOFO 2009 looks at the demand side, by asking: what impacts on the forest sector will future changes in population, economic development and globalization have? Is the explosion in global trade having positive or negative effects on the world's forests?

SOFO 2009 finds a strong correlation between economic development and forests. Countries undergoing rapid

economic development must deal with immense pressures on their forests. Regions that have already achieved a high level of economic development are usually able to stabilize or increase their forest resources. However, the factors affecting forests are very complex, and it is not possible to draw simple conclusions that apply to all countries.

The second part of SOFO 2009 looks at how countries will have to adapt for the future. This analysis includes future scenarios for forest products, ecosystem services and forest institutions.



SOFO 2011

SOFO 2011 (FAO, 2011c) continues the approach of the two previous issues by leading with an analysis of regional trends, focusing on five categories of criteria and indicators for sustainable forest management

based on the results of FRA 2010 (FAO, 2010b): extent of forest resources, biological diversity, protective functions of forests, productive functions of forests and socio-economic functions.

SOFO 2011 reports that global forest area continues to decline. A positive sign is that the estimated loss of forest area at the global level declined from 16 million hectares per year in the 1990s to an estimated 13 million hectares per year between 2000 and 2010. The annual net decrease in forest area, after accounting for regeneration and planted forests, declined from about 6 million hectares to 5 million hectares over the same period.

SOFO 2011 includes a comprehensive report on the development of sustainable forest industries.

This analysis focuses on factors affecting profitability and sustainability in the forest sector over the past 15 years, and reviews the efforts of forest industries to respond to these challenges. Companies in the forest sector face strategic choices that are similar to those faced in other manufacturing sectors.

The report concludes that the overall outlook for the forest industry is one of continued growth, but that the existing structure and location of the industry are not in line with the main economic driving forces. In particular, most of the growth is expected in emerging economies, while much of the existing infrastructure is in developed countries.

SOFO 2011 also includes a major report on the role of forests in climate change adaptation and mitigation; and a new look at the local value of forests, including the importance of traditional knowledge.



SOFO 2012

This tenth edition of SOFO focuses on the critical role of forests, forestry and forest products in the transition to a sustainable global economy.

A review of the history of forests suggests that many lessons from the past can inform decisions today. Notably, virtually every country or region that has undergone economic development has experienced high rates of deforestation during the economic transition.

Fortunately, once a national economy reaches a certain level of economic development, most countries have been successful in halting or reversing deforestation.

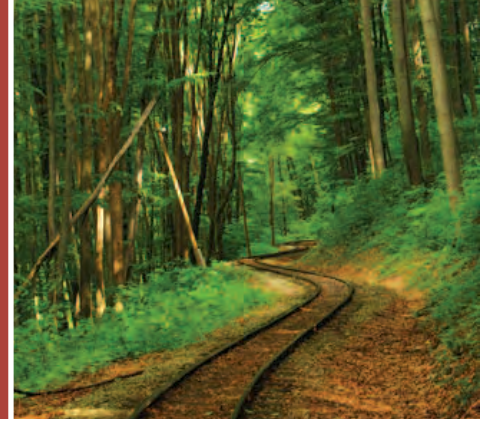
The concept of sustainability originated as a way of managing forests sustainably to provide a steady supply of wood, and evolved as foresters increasingly understood the importance and value of the wide range of ecosystem services provided by forests. Today, sustainable development is a widely accepted human goal.

As the world looks for ways to ensure a sustainable future, it is increasingly apparent that forests, forestry and forest products must play a central role in this transition. SOFO 2012 concludes with a comprehensive analysis of this process, including suggestions for future strategies for consideration by leaders inside and outside the forest sector at the local, national and global levels.



Chapter 2

Forests and the evolution of the modern world



Forests in a historical context

Forests have played a major role in human history, and periodic deforestation has accompanied population growth and development for thousands of years, throughout the world. Climate, culture, technology and trade have had an important influence on speeding up or slowing down – in some cases even reversing – the pace of deforestation. Over time, the interaction between humans and forests has changed in response to social and economic changes. Among the lessons of history is that there are strong links between forest use (including deforestation) and economic and social development, and between the destruction of forests (with irreversible environmental damage) and economic decline. Policy-makers must confront the paradox that although forests, forest products and forest-based ecosystem services are essential, in some circumstances there are more pressing demands for the land that forests occupy. A historical perspective reveals both the importance and the challenge of sustaining forests and striking a balance between conservation and use – practising sustainable forest management – to ensure the full range of forests’ economic, social and environmental contributions.

Forests

The thinning, changing, and elimination of forests – deforestation, no less – is not a recent phenomenon; it is as old as the human occupation of the earth, and one of the key processes in the history of our transformation of its surface.

◆ Williams, 2002

Human history is a story of how the earth’s diverse forests and their many products have been used. Forests have been a source of raw material for buildings, transportation and communication; a source of food, and the fuel for cooking it; and – when forests are cleared – a source of land for farms and cities. Although the need to manage forests and forest-based commodities gave rise to some of the earliest laws, most societies found it extremely challenging to manage forests sustainably. The search for new supplies of scarce forest products was a motivation for trade; and

unremitting scarcity eventually spurred migration. Human history is also a story of deforestation and the severe environmental consequences that can result – at times contributing to the collapse of societies.

As an aid to developing the long-term perspective needed for sustainable forest management, this chapter looks at the history of humans and forests. It provides a brief survey of several thorough and detailed studies, foremost among which is Williams’ (2002) exhaustive survey of the interaction between human history and forests. The survey also draws on other sources, including Perlin (1989) and Winters (1974), who document the importance of forests and wood to a wide variety of societies over thousands of years.²

² Additional historical material is available in Tucker and Richards (1983) and Richards and Tucker (1988).

Forests: looking back

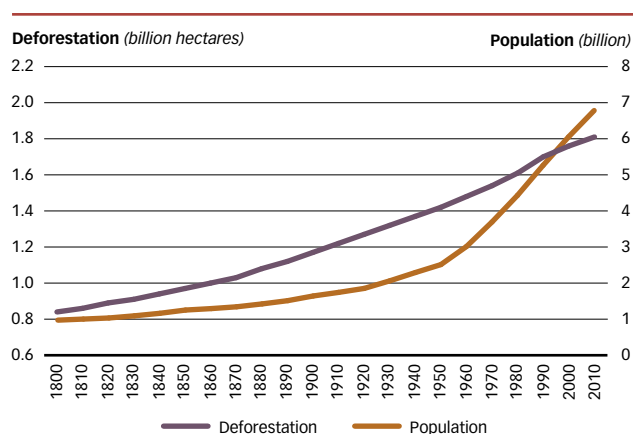
History clearly shows that in countries with abundant natural resources and sparse population there is no thought of the future, and all energy is directed to the exploitation and reckless use of what nature has abundantly provided. The waste under such conditions is naturally very great and a more economic utilization does not pay. As the population increases and industry grows, the demand for raw material of all kinds increases, and there is a gradual awakening of public opinion for the need for a more careful husbanding of natural resources. Practically all nations have travelled the same road. Some reach this point sooner than others, but everyone is inevitably bound to face the same situation.

◆ Zon, 1910

The forests of today have evolved over millions of years and have been profoundly shaped by swings between warm and cold climates. Glacial periods usually lasted 80 000 to 100 000 years, interspersed with warmer interglacial periods of 10 000 to 15 000 years. The last great ice age ended about 10 000 years ago, leaving forests on nearly 6 billion hectares, about 45 percent of the earth's land area. During the last 10 000 years, cycles of changing climate and temperature have continued to influence the world's forests, while human activity has also had an increasing impact.

Forests currently cover about 4 billion hectares, about 31 percent of the earth's land surface (FAO, 2010b). As human population and economic activity have increased, so too has humans' ability to manipulate the natural world. This manipulation is most evident in the clearing of forests.

Figure 1: World population and cumulative deforestation, 1800 to 2010



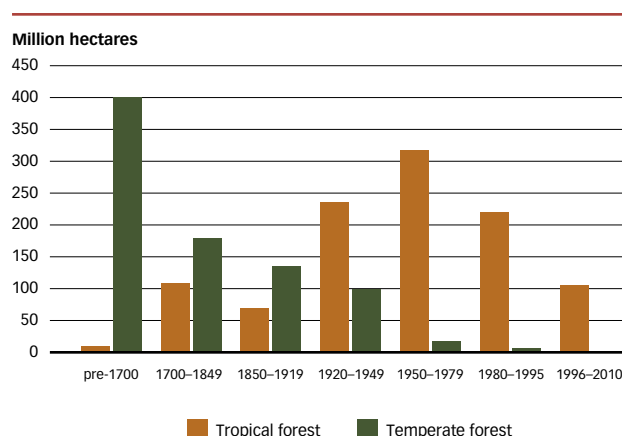
Sources: Williams, 2002; FAO, 2010b; UN, 1999.

Deforestation – the clearing of forests to use the land for other purposes, or to leave it as unused wasteland – is one of the most widespread and important changes that people have made to the surface of the earth. Over a period of 5 000 years, the cumulative loss of forest land worldwide is estimated at 1.8 billion hectares – an average net loss of 360 000 hectares per year (Williams, 2002). Population growth and the burgeoning demand for food, fibre and fuel have accelerated the pace of forest clearance, and the average annual net loss of forest has reached about 5.2 million hectares in the past ten years (FAO, 2010b). The trajectory of global deforestation has more or less followed the global growth rate of the human population, although the pace of deforestation was more rapid than population growth prior to 1950, and has been slower since then (Figure 1).

Deforestation and population growth rates have several other aspects in common: both tend to vary among different regions of the world; and both tend to increase during periods of economic development, while stabilizing or even falling after a society has reached a certain level of wealth.

Until the early twentieth century, the highest rates of deforestation occurred in temperate forests in Asia, Europe and North America. The expansion of agricultural production accounted for most forest clearing, but economic development and the related, often unsustainable, use of forests for raw material and fuel was another contributing factor. This pattern changed during the twentieth century (and even earlier in Europe) and, by mid-century, deforestation had essentially come to a halt in the world's temperate forests (Figure 2). As deforestation slowed in the temperate zone, it rapidly

Figure 2: Estimated deforestation, by type of forest and time period



Source: Estimates based on Williams, 2002; FAO, 2010b.

increased in the world's tropical forests and remains high, largely because of dependence on land-based economic activities.³

Historically, there is a strong correlation between large societal changes and how forests are used. Pre-agrarian societies (including hunter-gatherer communities) are highly dependent on forests for their livelihood. As agrarian societies emerge and expand, the nature of this dependence changes. The demand for agricultural land and the products required in an agricultural economy becomes a main concern, while provision of ecosystem services, particularly water for irrigation, becomes a high-priority objective. Industrialization brings major shifts in the use of forests, with production of raw materials (including wood, industrial crops, energy and minerals) gaining priority, and demand shifting from hardwood species (for fuel and animal fodder) to softwood species (for construction and paper manufacture). Developing agrarian societies have often been under pressure to supply raw materials to support the industrial development of other countries. Development of a post-industrial economy based on the service sector brings further changes in priorities for forest management, with provision of ecosystem services, including amenity values, gaining increased attention. Conflicts related to the use of forests tend to be severe in situations where diverse segments of society – pre-agrarian, agrarian, industrial and post-industrial – use the same forests to meet divergent needs.

The Near East and Mediterranean regions

The Fertile Crescent, spanning the region from the Persian Gulf to the Mediterranean, was covered by vast tracts of forests 5 000 years ago. Humans had long used fire to clear forests for crops and to facilitate hunting and gathering. Technological advances in the Bronze Age (starting about 3 300 BCE), and the Iron Age (starting about 1 200 BCE) provided new tools for felling trees and utilizing the wood. Almost without exception, the rise of ancient kingdoms was driven by the exploitation of forests and their conversion to agriculture. The exhaustion of forest resources was usually accompanied by a decline in the power of these kingdoms.

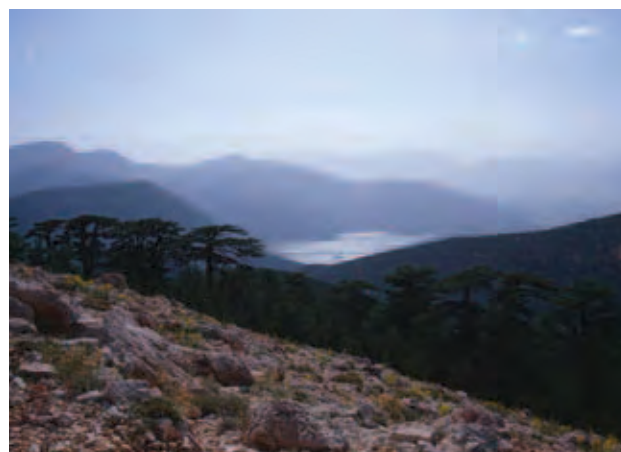
This same trend continued as the locus of power in the ancient world shifted westwards. As Crete, Cyprus, Greece and Rome rose to dominance, their economies

were based on the exploitation of abundant forest resources found in northern Africa and the Mediterranean basin. For example, Alexander the Great used Cyprus as a strategic site for shipbuilding by exploiting the abundant oak forests on the island. Today Cyprus is left with no oak forests.

Long, straight timber was essential for building ships, the main form of transport in the Mediterranean basin; wood was also needed for heating, cooking, construction, fuelling ceramic and metal kilns, and making containers. However, deforestation for agriculture had the unwanted side-effect of reducing the supply of wood, and the price of wood rose to rival the prices of precious metals. The quest for wood drove expansion to the west and north, while the wealth and power of one civilization after another rose and fell with the exploitation of its forests. This was not simply a matter of overusing forests for timber: forest clearing was often the first step in a process of land degradation. Poor agricultural practices and uncontrolled grazing on former forest land frequently resulted in soil erosion, loss of fertility and eventual desertification.

This pattern was repeated with the rise and fall of Rome. The expansion of the Roman Empire throughout western Europe was partly related to the need for access to forests on the Italian peninsula and around the Mediterranean rim. Deforestation was increased by the Romans' habit of clearing trees for a considerable distance from the sides of their roads, to reduce the possibility of ambush. After the fall of Rome in the fifth century, some forests in the region recovered for several centuries.

- Misty mountains, lake and cedar forest in foreground, Turkey. In northern Africa and the Mediterranean basin, wood was needed for building ships, heating, cooking, construction, fuelling ceramic and metal kilns, and making containers



FAO/ILRI, Baturhan Guneser/IC-2021

³ Population density and the accompanying perceptions of space – or its lack – may be a factor in the different patterns of deforestation that can be observed.

Box 1: The Agdal system of traditional resource management in Morocco

The term “Agdal” is widely used among northern African pastoral societies to refer to an area, a resource, and the rules laid down for managing this resource space. In Agdal forests, local communities establish rules governing the permitted periods, quantities and species for harvesting; violators have to pay a hefty fine to the local community. This ancient practice is found in all Berber-speaking regions in northern Africa and the Sahara. It shares common features with other

traditional land management systems, such as “Hema” in the Near East. Agdal provides a holistic conceptual framework for integrating a territory’s ecosystems and resources, knowledge and practices, rules and institutions, and representations and beliefs.

Source: Auclair *et al.*, 2011.

The Arab conquest of the Mediterranean area between 700 and 900 was driven by the expanding demand for cropland and enabled by the use of wood to build ships. Over several centuries, the forests of the Mediterranean were gradually depleted, and people in northern Africa lacked wood for shipbuilding. The power centres shifted back to the northern side of the Mediterranean; by the fifteenth century, the Venetians in Italy were battling the Ottoman Turks for control of the region. Venice had access to timber from central Europe, while the Ottoman Turks had access to forests on the Black Sea. In northern Africa, most of the scarce forest resources had been lost during the Roman period and the early Middle Ages. Today, the few remaining forests are well protected, and afforestation schemes are increasing the forest area in several countries. Traditional community management of natural resources has helped to protect forests; some of these systems, such as the Agdal system in Morocco, have proved to be resilient in accommodating external and internal changes (Auclair *et al.*, 2011) (Box 1).

Although widespread deforestation coincided with the rise and fall of Mediterranean powers, it would be an oversimplification to conclude that deforestation was the sole or even the primary cause of the fall of the great Mediterranean empires. Deforestation, land degradation and loss of access to wood were factors in many cases, but wars, epidemics and failures in governance were also important in the decline of cultures, in both the Mediterranean and other parts of the world.

Europe

Two thousand years ago, forests covered an estimated 80 percent of the land in Europe; today they cover 34 percent, excluding the Russian Federation.⁴

Over these 2 000 years, different parts of Europe have experienced high rates of deforestation at different times, depending on population growth, migration and the spread of technology. The clearing of trees to plant cereals began when Neolithic people occupied the land as the last ice age receded. These early human activities brought changes in tree composition as well as in the extent of forest land as in the extent of forest land.

Deforestation in Europe increased gradually but steadily during the Middle Ages, as forests were cleared to make space for arable land to feed the expanding population. About half of western Europe’s forests are estimated to have been cleared prior to the Middle Ages. The collapse of Europe’s population due to the bubonic plague in the mid-fourteenth century resulted in the abandonment of up to 25 percent of all croplands, and forests returned in many areas. However, population growth resumed within a generation, and the pace of deforestation had returned to its previous levels within a hundred years.

The European Renaissance of the fifteenth and sixteenth centuries triggered another boom in Europe’s population and economy. The rate of deforestation remained high during the early decades of the industrial revolution in the eighteenth and nineteenth centuries; wood was the principle source of industrial energy until it was gradually replaced by fossil fuels.

The highest rates of deforestation were on the land best suited for farming, especially in France, Germany and the United Kingdom of Great Britain and Northern Ireland. Periods of more intense deforestation coincided with periods of high economic activity. Trees were felled when grain prices rose and forest lands were converted to cropland. The use of wood for construction and shipbuilding also contributed to forest degradation and eventual deforestation in France, Portugal and Spain.

⁴ Forests cover 49 percent of the Russian Federation, but most of this forest land is in the Asian part of the country.

By 1700, Europe had an estimated 100 million hectares of cropland, about one-third of it in what was then Russia. By the turn of the twentieth century, cropland had increased by another 145 million hectares in Russia and 80 million hectares in the rest of Europe, mostly on land that had previously been forest (Williams, 2002).

The coniferous forests of Finland, Norway and Sweden were an exception to the pattern of deforestation in Europe as a whole. While deforestation occurred in these countries, especially near cities, it was not as extensive as it was further south, where population pressure was higher. In addition, shorter growing seasons and rocky soils set a natural limit on the clearing of forests for farming, although shifting cultivation was practised in some areas. Eventually, shortages of arable land contributed to emigration, especially to North America in the nineteenth century.

The landscape of Germany – the birthplace of modern forestry – was transformed by deforestation from the Middle Ages until the nineteenth century. Not only were forests cleared for agricultural land, but there was also a need for wood to fuel foundries and smelters in the early industrial revolution, resulting in further forest degradation and deforestation, even on land not suitable for agriculture.

In central Europe, deforestation was not reversed until the early twentieth century, when changes in agricultural practices improved productivity and slowed the clearing of forests for crops, and fossil fuels replaced wood as the main source of industrial energy. During the nineteenth

■ Dolomite Mountains, Italy. Two thousand years ago, forests covered an estimated 80 percent of the land in Europe



FAO/J. Bailey/FO-6875

century, forests, which had once covered more than 90 percent of the total land area, shrank to a low of about 10 percent. Old-growth, primary forests essentially disappeared from central Europe; today the region's forests are shaped by humans through extensive planting and tending (Plochmann, 1992). In the last 150 years, the expansion of planted forests has brought dramatic recovery in Germany, where forests now cover about 32 percent of the total land area.

Throughout western Europe, the rate of deforestation started to decline in the late nineteenth century: little of the remaining forest land was suitable for farming; farm productivity was rapidly improving; Europe was relying increasingly on imported food and wood from other regions; and coal was replacing wood as a source of fuel. Throughout Europe, investments in the reforestation and regeneration of former farmlands were rising, encouraged and supported by national and regional policies. By the end of the twentieth century, forest areas in all of Europe were stable or increasing; deforestation was a problem of the past.

Asia

Asia is the world's largest continent and has a wide diversity of forest ecosystems. At the region's geographic extremes, these ecosystems include extensive boreal forests in Siberia, moist tropical forests in southeastern Asia, subtropical forests in the mountains of southern Asia, and juniper forests on the Arabian Peninsula. Asia is also home to more than half of the world's human population and, as in other regions, population growth and development have been accompanied by widespread deforestation.

China experienced increasing population and declining forest area for many centuries. Four thousand years ago, China's population was about 1.4 million people, and forests covered more than 60 percent of the land area (Fan and Dong, 2001). At the beginning of the first feudal dynasty (the Qin Dynasty in 221 BCE), the population had increased to about 20 million, and forests covered nearly half of the land. When the Ming Dynasty started in 1368, China's population had increased to about 65 million, and forest cover had declined to 26 percent. In 1840, China's population reached 413 million, and forest cover was 17 percent. At the foundation of the People's Republic of China (1949), forest cover had decreased to its historically lowest point – less than 10 percent of the land area – and population had increased to more than 541 million.

- Lotus blossoms and mountain forests, Republic of Korea. Asia is the world's largest continent and has a wide diversity of forest ecosystems



FAO/SeoFO7391

Wars and colonial exploitation were significant factors in historical patterns of deforestation in China. In the nineteenth and early twentieth centuries, regional and global conflicts contributed to overexploitation of timber resources, forest destruction and degradation, widespread soil erosion, and enduring shortages of fuel and building materials. In the last 60 years, investments in planted forests, for both the production of wood and protection against desertification, have added roughly 80 million hectares, effectively replacing the forest area that was lost in the eighteenth and nineteenth centuries. Even with these successes, however, forests currently account for only 22 percent of China's total land area, compared with the global average of 31 percent (FAO, 2010b). In addition, China's dependence on imported timber has increased significantly.

Japan also experienced periods of rapid population growth accompanied by the expansion of agricultural land and inevitable deforestation. Although this pattern was similar to that in many other countries, Japan developed an affinity for forests as part of the managed landscape, and for wood as an essential material for traditional construction. Extensive deforestation and the expansion of timber harvesting on to higher elevations on steep slopes, which took place in the seventeenth and eighteenth centuries, were eventually modified by recognition of the benefits of forest management and conservation. In the nineteenth and twentieth centuries, planting expanded the forest area by millions of hectares, to nearly 70 percent of Japan's total land area. This situation was aided by the emergence of an industrial economy in which agriculture accounts for very small shares of income and employment, and by the ability to import raw materials, including timber resources,

from other countries. Forest conservation is integrated into Japanese culture and customs, particularly through the traditional *satoyama* approach to managing the landscape as a mosaic of forests, rice fields, grasslands, streams, ponds and reservoirs, thus meeting food, forest, water and energy needs harmoniously.

The forests of southern Asia, including those in Afghanistan, Bangladesh, Bhutan, India, Nepal and Pakistan, were cleared to provide cropland to support a rapidly expanding human population. In 1500, India's population of 100 million – more than twice that of Europe – required a steady expansion of the agricultural frontier. Deforestation accelerated during European colonization in the nineteenth and early twentieth centuries. During the most intense colonial exploitation of timber resources, from 1850 to 1920, as much as 33 million hectares of forest was cleared in India (Williams, 2002); today 68 million hectares of forest remains. When these losses are added to the deforestation to expand farming that occurred prior to colonization by the United Kingdom of Great Britain and Northern Ireland, it is probable that more than half of southern Asia's historic forest area has been lost in the last 500 years. Recent assessments suggest that the extent of forests is increasing in India, largely because of afforestation and reforestation and the expansion of tree planting on farms.

In most of southeastern Asia, shifting cultivation was the primary driver of forest clearing until the late eighteenth and early nineteenth centuries. Under colonization, commercial development, trade and population increased and the pace of deforestation increased steadily. Forests were exploited for selected tropical timbers, and cleared to plant a variety of crops such as oil-palm and rubber; between the late nineteenth and early twentieth centuries, nearly 40 million hectares of forest was cleared, mostly for commercial agriculture (Williams, 2002). Deforestation and forest degradation are continuing problems for many countries in southeastern Asia.

The Americas

In many parts of the Americas, including the eastern United States of America, Mexico, Central America, Peru and the coastal regions of Venezuela and Brazil, there is evidence that native cultures systematically used fire to clear forest or to create openings for growing crops or managing game. Archaeological evidence of pre-historic construction and charcoal remains in the Plurinational State of Bolivia and Brazil suggest that vast areas of the Amazon basin may have been cleared for

farming. The extensive forests of the western Amazon may have been significantly smaller than they are at present. Elsewhere in the Americas, there is abundant evidence of the extent to which the size and composition of forested landscapes have changed (Williams, 2002).

The Americas had an estimated population of 65 to 100 million people at the time of initial European contact in the late fifteenth century. Over 150 years, starting around 1500, the native populations were reduced to about 1 million in North America and 4 million in Central and South America (Williams, 2002). This unprecedented demographic collapse was largely the result of introduced pandemic diseases for which the native people had developed no immunity, including smallpox, measles, influenza, cholera, dysentery and yellow fever.

Initially, the population collapse in the Americas had the effect of allowing an increase in forest area, through natural regeneration in interior regions. This increase partly offset the clearing of forests that was taking place as European settlers increased the population in coastal areas. The European population in the Americas did not approach the levels reached by native populations prior to their collapse until the mid-eighteenth century. Latin America was probably about 75 percent forested before European settlement, although some studies suggest that it may have been less (see, for example, Sponsel, Headland and Bailey, 1996; Steen and Tucker, 1992). Today it is about 50 percent forested. Although some deforestation occurred in the eighteenth and nineteenth centuries, the pace more than doubled in the twentieth century (Williams, 2002).

In North America, as population increased and settlers pushed westwards in the nineteenth century, the rate of forest clearance increased rapidly. The immigrant population jumped from 2 million in 1750 to 23 million in 1850 and 75 million in 1900; the forest area of the United States of America fell from 450 million to less than 300 million hectares, with about half of total deforestation occurring between 1850 and 1900. By 1920, however, deforestation had largely stopped; today forests cover about 300 million hectares, roughly 33 percent of the land in the United States of America (McCleery, 1992). Canada also underwent a period of deforestation in the eighteenth and nineteenth centuries and has also been able to stabilize its forest area since the early twentieth century.

Africa

Forests in Africa are extremely diverse, ranging from the dry forests of the Sahel and eastern, southern and northern Africa, to the humid tropical forests of western and central Africa. Over the centuries, forests and wildlife in many parts of the continent were protected through rituals and sacred activities. Most of these attitudes were gradually abandoned during the period of European colonization, but many small, sacred forests have survived in western Africa and are still used for various rituals.

Sub-Saharan Africa consists largely of agrarian societies, primarily dependent on low-input agriculture and animal husbandry. Unlike Asia – where agricultural intensification through the green revolution helped to reduce the horizontal expansion of agriculture while assuring adequate food supplies for a growing population –

■ View of the Amazon forest, Brazil. Latin America was probably about 75 percent forested before European settlement



FAO/R. Faidutti/CFU000111

in sub-Saharan Africa, deforestation and population have gradually increased together, with the heaviest forest losses coming in areas where wood is needed for fuel or where forest land is needed for growing crops. The production of industrial crops for external markets – such as cotton, cocoa, coffee and tobacco – has also contributed to deforestation; large-scale land acquisitions by foreign investors have recently accelerated this process in some countries (Cotula *et al.*, 2009).

■ Springbok in Etosha Park, Namibia. Forests and wildlife in many parts of Africa were traditionally protected through rituals and sacred activities



FAO/M. France-Lanord/FO-5557

Agroforestry has been practised in Africa for centuries, and is the key to survival for many local communities throughout the continent. *Acacia albida*, for example, is known for its regenerative capacities on agricultural lands and as a livestock feed. The Senegalese Serer people combined cattle grazing on farmland and protection of young natural seedlings growing in cattle dunks. In the Niger, the Sultan of Zinder enacted laws punishing *A. albida* pruners with the amputation of limbs, and people convicted of felling the trees with decapitation.

In a few locations, deforestation in Africa increased during the colonial period, when trees were harvested and shipped to Europe. Forests were exploited to fuel steamboats and trains during the nineteenth century, opening up large areas of the continent for resource exploitation and agricultural development.

Agricultural technology was slow to develop in Africa, perpetuating systems that relied on slash-and-burn cultivation. Fallow periods became shorter as the human population increased, and forests were harvested for fuelwood and charcoal as cities grew. In some areas, industrial agriculture was introduced to supply export

markets, resulting in the clearing of large areas of forest and the introduction of intensive, often non-sustainable agricultural practices.

Is deforestation inevitable?

“The tragedy of deforestation in Amazonia as well as elsewhere in the tropics is that its costs, in both economic, social, cultural, and aesthetic terms, far outweigh its benefits.”

◆ Anderson, 1990

“Companies do not clear-cut forests out of wanton destructiveness or stupidity. On the whole, they do so because market signals – influenced by subsidies, taxation, pricing and state regulation, as well as land tenure and use rights – make it a logical and profitable thing to do. It is often profitable and logical because the costs of deforestation are generally not borne by companies clearing the land for agriculture or by companies logging and selling the timber. Rather, these costs tend to fall on society, on future generations, and often, on poor households in rural areas who frequently depend on the resources and services of the forest for their daily survival and security.”

◆ TEEB, 2010

As illustrated in the historical survey, although deforestation is a common pattern, about half of the world’s countries have halted or reversed forest loss. So the answer to the question of whether deforestation is inevitable must be “no”. Perhaps a more relevant, and in many ways more challenging, question would be: Are there circumstances under which deforestation is tolerable, or even desirable? Most deforestation is intentional and is not irrational. Rather, it represents a deliberate decision to convert land to a use that is perceived as having a higher value than retaining the land as forest would have. Forests have been cleared to make room for cities and farms and to produce timber, food and fuel for domestic and export markets, with the goal – if not always the result – of producing a higher standard of living for humans.

FAO’s Global Forest Resources Assessment 2010 (FRA 2010) (FAO, 2010b) estimated that the global forest area was 4.033 billion hectares, almost exactly the same as FAO’s first global estimate in 1948 (FAO, 1948; 2010b). However, the two reports are not directly comparable. Countries did not agree on a

standardized global definition of forest until 2000, so comparisons with previous assessments – many of which used a narrower definition of forest – require adjustments. Working backwards from deforestation rates found in recent assessments suggests that the global forest area in 1948 was about 4.4 billion hectares according to today's definition of forest.

FRA 2010 concludes that net deforestation at the global level occurred at the rate of 0.14 percent per year between 2005 and 2010. This compares with estimated net annual global deforestation rates of 0.20 percent between 1990 and 2000, and 0.12 percent between 2000 and 2005. The net rate is calculated by estimating the total forest area converted to other land uses, and adding back the area that is afforested plus any natural expansion of forests, for example on abandoned agricultural land.

If the world's net forest area continues to decline by 5.2 million hectares per year (the average net annual loss between 2000 and 2010), it will take 775 years to lose all of the world's forests. This would seem to provide enough time for actions to slow or stop global deforestation.

FRA reports make an important distinction between the total forest area lost in a given period and changes in net forest area. Between 2000 and 2010, the world lost about 130 million hectares of forest (about 3.2 percent of the total forest area in 2000), but gained back about 78 million hectares, mainly as planted forests and natural forest expansion. The net loss of forest area was 1.3 percent over the ten-year period.

It is not easy to generalize about the differences between losses and gains in forest area: there are many differences between a mature forest and a young forest; and the term "plantation" generates confusion and dispute, with some observers considering that planted forests do not compensate for the loss of natural or primary forests, especially considering the impact on biodiversity. However, planted forests vary widely, in both objectives and composition, while only a relatively small portion of the world's plantations are managed intensively for timber production. It must also be noted that primary forests account for only a share of current deforestation; in some regions, semi-natural and degraded forests account for the majority of forest loss. In addition, most forest loss now takes place in the tropics, while most net gains in forest area occur in the temperate and boreal zones, in very different types of forests.

Factors affecting deforestation vary widely, within and among countries; deforestation phenomena are therefore always local – deforestation has never taken place at the same rate in all parts of the world. Between 100 and 200 years ago, deforestation was a significant process in Europe and North America, but not in the tropics; today this pattern is reversed.

At the United Nations Intergovernmental Forum on Forests (IFF, 1998 to 2000), countries debated the underlying causes of deforestation (Box 2). It was agreed that the deforestation problem cannot be solved within the forest sector alone. As the underlying causes are spread throughout the economy, the solutions must be too.

A comprehensive study of the history of forests in the United States of America confirms the suggestion that macroeconomic forces often hold the key to halting deforestation. From 1700 to 1900, about half the forest area in the United States of America was converted to agricultural use. However, in the last 100 years, forest area has increased, even though population growth and urban development have continued, and have even accelerated. The explanation is that advances in agriculture – including fertilizers, intensified grazing, and technical innovations such as refrigeration and freezing – have made it possible to grow more food on less land. As a result, farms in marginal growing areas have been abandoned, and the farmland has been replaced by forest through natural regeneration or programmes for planting trees (McCleery, 1992).

At the other end of the spectrum, nine countries are currently experiencing net deforestation rates of more than 2 percent per year. This trajectory would result in the loss of most – if not all – of their forests within this century. Most of these countries or territories have low forest cover (so a small change in absolute value can produce a large percentage change). Twenty more countries or territories have net deforestation rates exceeding 1 percent per year, and another 30 have rates of more than 0.5 percent. All of these countries will face serious ecological and economic challenges if they do not slow or reverse these trends.

In Latin America, there was a net loss of 88 million hectares of forest (9 percent of the total forest area) during the 20 years from 1990 to 2010 (FAO, 2010b). This is an understatement of the actual deforestation over this period because it takes afforestation into account. The leading cause of deforestation was conversion of

forests to grazing and cropland. For the first time in history, the region's forest area fell to less than 50 percent of the total land area. If this rate of forest loss were to continue, Latin America would be without forest in about 220 years.

In Africa, forests currently cover about 23 percent of the land; African countries reported that 75 million hectares of forest land (10 percent of the total forest area) was converted to other uses between 1990 and 2010. As in Latin America, deforestation in Africa is driven by the demand for land for growing a variety of crops and for grazing. An added pressure on forest resources in Africa is that wood is the main source of fuel; about 80 percent of all wood used in the region is for fuel. An acute fuelwood shortage affects large areas of eastern Africa.

Modern tropical deforestation has been the subject of considerable academic study, much of it concluding that "policy failure is usually a more important driver of tropical deforestation than market failure" (Folmer and van Kooten, 2007). Many governments encourage deforestation by providing direct or indirect subsidies and incentives for agriculture and by failing to recognize the importance of the non-timber benefits of forests and the external costs associated with forest clearing. Folmer and van Kooten (2007) suggest that deforestation is justified when there are important opportunities for agriculture and ecosystem values are low: "Countries with tropical forests might well be reducing their stocks of forest because they are going through development stages similar to

those experienced by developed countries". A recent statistical analysis of deforestation in 59 developing countries from 1972 to 1994 confirmed that the failure of political institutions plays a significant role in deforestation, but found no conclusive evidence – in the sample – to suggest that progress in development is associated with a slowing of the rate of deforestation (Van and Azomahou, 2007).⁵

However, from a global perspective, the good news is that many countries have been able to stabilize their forest areas. During the period 2005–2010, about 80 countries reported either an increase or no change in forest area. Countries reporting increased forest area include several of the world's largest forested countries: the Russian Federation, the United States of America, China and India. In Europe, 27 countries reported increases in forest area, led by Spain, Italy, Norway, Bulgaria and France; Asian countries with significant increases, in addition to China and India, include Viet Nam, the Philippines and Turkey; Latin American countries posting increases include Uruguay, Chile, Cuba and Costa Rica; and in Africa, Tunisia, Morocco and Rwanda report the largest increases in forest area.

Although there are many underlying causes (Box 2), deforestation and forest degradation are fundamentally driven by two realities:

⁵ However, using a sample that included developed countries, Kauppi *et al.* (2006) conclude that forest area and density are positively related to economic development.

Box 2: Underlying causes of deforestation and forest degradation

During the deliberations of the United Nations Intergovernmental Forum on Forests, the global community agreed that the underlying causes of deforestation and forest degradation are interrelated and are often socio-economic in nature. Both the causes and the approaches to dealing with them are often country-specific and therefore vary among countries. The underlying causes include:

- poverty;
- lack of secure land tenure patterns;
- inadequate recognition within national laws and jurisdiction of the rights and needs of forest-dependent indigenous and local communities;
- inadequate cross-sectoral policies;
- undervaluation of forest products and ecosystem services;
- lack of participation;
- lack of good governance;
- absence of a supportive economic climate that facilitates sustainable forest management;
- illegal trade;
- lack of capacity;
- lack of an enabling environment, at both the national and international levels;
- national policies that distort markets and encourage the conversion of forest land to other uses.

Source: IFF, 2000.

- Natural forest cleared for agriculture in Aceh Province, Indonesia. Tropical deforestation has been the subject of considerable academic study



FAO/H. Hiraoka/FO-5618

- It takes many years to grow trees. In many parts of the world, fertile land is scarce and, compared with long-term forest management, more money can be made from growing and harvesting crops that mature more quickly and require another land use, such as farming, grazing or orchards. It is a widely observed – and ethically debated – tendency of human beings to give higher value to the needs of the current generation than to those of future generations.
- Many forest benefits are not valued by markets. There are no markets – places to sell or buy – for most of the ecosystem services provided by forests, such as sequestering carbon and helping to provide clean water. In addition, many of the negative consequences (or costs) of deforestation, such as greenhouse gas (GHG) emissions and soil erosion, are not assigned financial values or paid for through markets or other mechanisms. These positive and negative market externalities play a significant part in decisions about forests, but they are notoriously

difficult to quantify, and people seldom agree on their values.

Although oversimplifying the problem can make the solutions appear to be easier than they really are, simplification can also help clarify the type and focus of appropriate policy responses.

In the first comprehensive book on forest economics, written in 1902, Bernhard Fernow observed that “the exploitation of the forest resource for private gain is apt to lead to its deterioration or eventual destruction” because “the private individual can hardly be expected to appreciate distant interests of his own motion in the management of his forest property, hence the state must guard them” (Fernow, 1902). These arguments gained considerable attention, leading to the establishment of national forests in Europe and North America and the development of public regulation of private forest practices.

In 1976, Nobel laureate economist Paul Samuelson noted that “applying what is sound commercial practice to government’s own utilization of public forests ... is a sure prescription for future chopping down of trees”. He observed that “everybody loves a tree and hates a businessman”, and “indeed, if the externalities involved could be shown to be sufficiently important, I am naïve enough to believe that all economists would be found on the side of the angels, sitting thigh next to thigh with the foresters” (Samuelson, 1976).

There is, however, a counterpoint to these observations of the tendency towards, and consequences of, narrow, short-term thinking: in several countries, privately owned forests are among the best-managed and most productive. In many major timber-producing countries – including those in Scandinavia and central Europe, and Australia, Brazil, Chile, Japan, New Zealand and the United States of America – privately owned and, in some cases, intensively managed forests provide timber raw material for competitive forest industries. The motivation of ensuring a reliable supply of timber has been a basis for maintaining or even expanding the area of forests.

Forestry

“Planting a tree is one of the very few human actions which can really be called altruistic. A person plants a tree for his children, his grandchildren, or even for their children, but not for himself.”

◆ Seymour, 1983

↳ *Multi-purpose plantations, designed to meet a wide variety of social, economic, and environmental objectives, can provide key ecosystem services, help preserve the world's remaining primary forests, and sequester an important proportion of the atmospheric carbon released by humans over the past 300 years.*

◆ Paquette and Messier, 2010

For hundreds if not thousands of years, humans have practised forestry with the main goal of providing a steady, reliable supply of wood and other forest products and ecosystem services. Although forestry has been recognized as a science and a profession in only the last 300 years, methods for allocating and attempting to conserve forest resources have been implemented in one society after another and in different regions of the world for far longer.

Forestry: looking back

Forest policies have evolved since the Bronze Age. The Code of Hammurabi in Babylon included government regulations for felling and distributing timber. The Han Dynasty in China had similar laws about 2 000 years ago. Conservation of forests formed an integral part of the Vedic tradition of India: as early as 300 BCE, the Maurya kingdom recognized the importance of forests, and the first emperor of the dynasty, Chandragupta, appointed an officer to look after the forests. The concept of sacred groves is deeply ingrained in Indian religious beliefs, and thousands of such protected areas still conserve trees and biodiversity. There is evidence that during the Middle Ages in Europe, many kingdoms had local laws to govern the allocation and use of wood, which was recognized as a valuable resource. The objective of such laws was usually to stop harvesting rather than to encourage reforestation. In general, however, laws had little effect against the inexorable demand for land and timber.⁶ In Africa, where oral culture is strong, most clans or tribes developed codes that were handed down through the generations as tales and legends.

By the seventeenth century, forests were becoming so scarce in populated areas of France and Germany that they were eventually perceived as having a value that justified their conservation and replenishment. Human intervention was required to ensure that not all the wood was used by current generations, and that there would be sufficient wood for the future; communities in central Europe began to plant trees as well as felling

them. This simple step marks the advent of modern scientific forestry.

Hans Carl von Carlowitz published the first comprehensive book about forestry, in Germany in 1713; he became known as the father of sustained-yield forestry. His particular concern was to ensure a steady supply of timber for the mining industry where he was employed. Forestry evolved as the science and practice of managing forests and trees, and by the eighteenth century the deforestation of Europe was increasingly viewed as an economic crisis. The teaching of forestry as an applied science spread through universities in France and Germany, and systematic reforestation programmes were started in both countries.

By the late nineteenth century, the practice of forestry as a scientific discipline and a profession was spreading to all corners of the world. Colonizers from the United Kingdom of Great Britain and Northern Ireland recognized the need to conserve forests in southern Asia, where they hired a German forester, Dietrich Brandis, who became known as the father of tropical forestry for his work in what was then known as Burma and in India. Future forestry leaders travelled from North America to France and Germany to study forestry; among these future leaders was Gifford Pinchot, who established the United States Forest Service in the early twentieth century.

In Chile, laws to protect forests date back to 1872, and the first national forest reserves were established in 1907. All over South America – in Argentina, Brazil and Peru – the economic value of forests gained increased attention. Throughout the twentieth century, forestry schools were established, and new policies and laws for conserving and managing forest resources were enacted in countries across Latin America.

In Japan, a complex series of forest customs and laws evolved over several centuries, exerting effective controls on the harvesting of trees and resulting in the protection of forests and a system for allocating forest products. Private citizens did not own the forest but had rights to controlled harvesting, which were similar to the concessions in modern public forests in Western countries. The result was the conservation of a much higher percentage of forest than in other densely populated societies.

By the end of the First World War, widespread deforestation was coming to a halt in eastern Asia,

⁶ A similar failure can be noted in efforts to repress forest fires.

- Native forest of *Araucaria spp.* in the Andes Mountains, Chile. In Chile, laws to protect forests date back to 1872, and the first national forest reserves were established in 1907



FAO/C.A. Dinamarca Garrido/ FO-7407

Europe and North America. The most important reasons were economic, as discussed earlier, but an important complementary factor was the spread of forestry as a science and profession, resulting in new laws, policies and government agencies in countries around the world.

In most countries, the majority of timber was harvested from natural forests, and the primary thrust of forest management was to regulate the pattern and rate of exploitation. However, as forests were cleared for use in agriculture, and timber stocks declined, it became necessary to make deliberate efforts to restore and rebuild forests through afforestation and reforestation, sometimes using methods that closely followed natural systems of disturbance and regrowth. Nevertheless, the transition from a hunter-gatherer approach to systematic cultivation is more recent for forestry than for agriculture. The hunter-gatherer approach to forestry still persists in many countries, even though planted and managed forests account for more than half of the world's timber production, and supply all of the timber raw material in several important timber-producing countries.

Forestry today

By the middle of the twentieth century, many countries recognized that forests need to be managed for more than timber. Laws were enacted mandating multiple uses of forests for recreation, wildlife and water, in addition to timber. Forest management practices, including sustained yields of timber, were codified as public policy throughout Europe and North America, and in colonial territories. In Europe, the multi-functionality of forests gained prominence in the late twentieth century.

Forests were increasingly valued for soil protection, watershed management, protection against avalanches and provision of biodiversity. When combined with economic forces that reduced the incentive to convert forest land to other uses, changes in policy helped to bring deforestation to a halt in most of the temperate world.

In many developing countries that used to be European colonies, attempts were made to duplicate the forest laws and practices of the colonizing power. Towards the end of the colonial period, several European countries made efforts to introduce good forest practices in their colonies, such as the United Kingdom of Great Britain and Northern Ireland in southern Asia, and France in western Africa and the Maghreb countries.

However, the end of colonial rule often left a country without the technology, human capacity and financial resources to manage its forest resources effectively. Governments of newly independent countries had to pay increased attention to economic and social development, and forests were often seen – and used – as a resource and asset to support these efforts. In many instances, poor governance and corruption resulted in the rapid depletion of forests, without any concomitant benefits to society. FAO and a number of bilateral aid organizations have focused energy and resources on capacity building in developing countries in all regions, enhancing institutions and technical capacity, including by supporting education, research, extension and local community involvement.

During the 1970s, advances in the study of ecology influenced forestry practitioners in expanding their focus from the sustainable management of forests primarily for a single product (timber) to a broader emphasis on ecosystem and social services in addition to wood and non-wood products. Education and practice gave increasing attention to the importance of forests in providing clean water and biodiversity. By the 1990s, concepts of “ecosystem management” were replacing “sustained-yield forestry” as organizing principles, especially in developed countries.⁷

At the same time, the idea of “putting people first” was coming to the forefront in many developing countries.

⁷ It has been argued that the recognition of forests as complex systems with broad, tangible and intangible benefits has precursors in the beliefs and practices of ancient societies and indigenous peoples (see, for example, Banuri and Appfel-Marglin, 1993).

It was increasingly clear that top-down solutions were not very effective. The theme of the World Forestry Congress in Indonesia in 1978 was “Forests for People”; the congress helped to provide impetus to a movement variously known as “social forestry”, “community forestry” and “participatory forestry”. The basic idea is summed up in the name of a field-oriented programme coordinated by FAO in the 1980s and 1990s: “forests, trees and people”.

- Primary forest of the Tailândia region of Brazil, site of a sustainable forest harvesting project. Sustainable forest management is understood as being the cornerstone of good forest policy



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As recently as the late twentieth century, there were heated debates within and among countries regarding the meaning and wisdom of sustainable forest management. Today, the concept is broadly accepted and understood as being the cornerstone of good forest policy. Sustainable forest management has evolved to recognize the importance of adopting a broad, multidisciplinary approach to managing forests in ways that sustain a variety of forest goods and ecosystem services, while explicitly taking into account the role of forests in relation to other sectors, based on the three interdependent pillars of sustainable development: economy, society and environment.

In the past ten years, the importance of forests in mitigating climate change through carbon sequestration has become widely understood and accepted. By the 2000s, it was increasingly clear that deforestation and forest degradation were major contributors to global climate change. In response, and to halt the conversion of primary forests to other land uses, several developing countries have pioneered new approaches to forest management, including the use of payments for ecosystem services as a financial tool.

An emerging challenge is reaching consensus on how to use the concepts and methods of sustainable forest management to integrate forest products and services into a green economy for the future, in which economic growth is based on sustainably managed natural systems. Important and immediate consequences would be to stabilize, or in some circumstances increase, the area of forests, and to increase the quality of forests – their ability to provide goods and ecosystem services sustainably. The net loss of forests would be reversed. However, forest management, science and policy face challenges in reaching this result, not the least being the need for a broader and deeper knowledge of the importance of forests and forest products. For years, foresters and forest policy-makers have recognized the need to deal more effectively with forces outside the forest sector – that is, forces outside their own sphere of influence. As this chapter has shown, deforestation is almost always the result of such forces.

Unfortunately, in contemporary discussions of the green economy, foresters may find themselves on the periphery, apparently with limited relevant experience and therefore little influence. Climate change, globalization and unknown future changes in technology are among the factors that complicate the already complex interactions of forests and forest management with other sectors, giving rise to daunting policy problems. One of the biggest challenges for forestry professionals is therefore building on and extending their expertise to demonstrate their ability to help solve these problems; find ways of ensuring that the full range of forest functions is recognized and valued by society and reflected in the global political economy; and ensure that forests play an integral role in the future green economy.

Sustainability: an enduring value

“Sustainable management is a beguiling term and open to many interpretations. It contains many uncertainties and ambiguities.”

◆ Poore, 2003

Sustainability requires the making of decisions that take into consideration the needs of future generations as well as present needs. Although the future, including the needs of future generations, cannot be known, the lessons of history and of contemporary earth sciences and ecology underscore the importance of forests and the need to ensure that future generations

- Baskets for sale at a market, Plurinational State of Bolivia. On balance, the demand for goods and services from forests has contributed to forest conservation by sustaining the perception of forests as valuable assets



FAO/R. Farduti/CFU000719

can enjoy and use forests' many benefits. The resilience and productivity of well-managed forests provide an opportunity for meeting the needs of many generations.

The idea of sustainable output, which is a core concept of scientific forestry, dates back about 300 years. In the past 40 years, this concept, and forestry itself, have deepened and broadened to encompass the ecosystem services provided by forests and their critical role in sustaining life on earth. As a consequence, the social and economic functions of forests are better understood, and the role of people and communities that directly depend on these ecosystem services is increasingly appreciated and used in the management of forests.

Transformation of the environment has been a feature of human history for thousands of years, and can be expected to continue. When applied to forests or other resources, the concept of sustainability links consideration of the interests of future generations to actions for meeting the needs of today. Inevitably, perspectives on environmental transformation, including deforestation, are influenced by people's direct experience of the costs

or benefits of these changes; perspectives can also be expected to change over time: sustainability is a dynamic rather than an absolute concept.

This diversity of perspectives should not lead to the conclusion that there are no bad choices or bad outcomes – an environmental equivalent of moral relativism. Instead, it argues for the need to understand the lessons of history, including the lesson that not all deforestation is bad, but some deforestation is catastrophic. Another lesson is that the long-term effects of forest use, including deforestation, are typically determined by a combination of factors, such as subsequent patterns of land use and accompanying patterns of weather and climate. In the past, where population pressure continued unabated and soils were degraded, forests did not return; however, there are also examples from many continents and cultures where – given the opportunity, including the right policies – forests have recovered.

On balance, the demand for goods and ecosystem services from forests (including wood products) has contributed to forest conservation by sustaining the perception of forests as valuable assets. The science of sustainable forest management will play an important supporting role, but it is the perception of forests' role – immediate or potential – that is the critical element. When considering the importance of forests and their role in a sustainable future, discussed in detail elsewhere in this volume, it is important to understand the central role that forests and their products have played in the economy in the past. Looking ahead, forests should be seen as an increasingly valuable asset – for example, as a source of renewable energy and as a natural system providing multiple services, including the capture and storage of carbon created by the use of fossil fuels. Forestry must therefore continue to evolve and, in doing so, will have a profound impact on the future global economy and environment.



Chapter 3

Forests, forestry and forest products for a sustainable future



Forestry and agriculture in the mainstream of a sustainable future

For the past two decades, expansion of the global economy has provided benefits to many countries, helping many developing countries advance towards middle-income country status. However, too much of this economic growth comes at the expense of natural resource sustainability and relies heavily on fossil fuels, while too little provides benefits to large segments of the world's population, especially people living in rural areas. With world population expected to reach 9 billion by 2050, continuing reliance on increasingly scarce fossil fuels and the degradation and depletion of natural resources is not sustainable. Agriculture and forestry can assist in both expanding economic growth into rural areas and increasing reliance on renewable resources. Agriculture and forestry can be building blocks for an economically and environmentally sustainable future because both are natural production systems based on photosynthesis and, when sustainably managed, both can provide a steady flow of readily adaptable products and services. Strategies for realizing forests' potential contribution to a sustainable future include improving the quality and quantity of forests by planting trees and investing in ecosystem services; promoting small and medium forest-based enterprises to reduce rural poverty and improve equity; increasing the long-term value of wood products by reusing and recycling them and using wood for energy; and enhancing communications and linkages across the physical and institutional landscape.

Forests and forest industries in a global economy

Sustainable development is not an option! It is the only path that allows all of humanity to share a decent life on this, one planet.

◆ Zukang, 2011

The idea of sustainable development – a vision in which prosperity is increased and shared without exceeding the carrying capacity of the earth's ecosystems – stimulated unprecedented excitement and hope at the historic Earth Summit held in Rio de Janeiro in 1992. Two decades later, an assessment of progress in sustainable development reports mixed results (UNCSD, 2010). In these two decades, the world economy has almost tripled, growing from USD 24 trillion to 70 trillion between 1992 and 2011 and benefiting hundreds

of millions of people in many ways. However, global economic growth continues to place unsustainable pressure on the earth's forests and other natural systems.

Economic context: growth but little gain

Economic growth in the past two decades has relied on technological change, trade, increased productivity, and greater utilization of renewable and non-renewable resources. Looking back, too much of this growth has had negative impacts on the health of natural resources and ecosystems. According to the Millennium Ecosystem Assessment (MEA, 2005), more than 60 percent of the world's major ecosystems are now degraded or used unsustainably. More than 50 percent of all types of forest, agricultural land and wetlands surrounding urban and semi-urban areas have been lost through conversion to other land uses. In the past decade alone, about 130 million hectares of forest were lost, of which

40 million hectares were primary forests (FAO, 2010b). This forest loss and degradation are estimated to cost the global economy between USD 2 trillion and 4.5 trillion a year (Sukhdev, 2010). Unfortunately, such costs are not captured in traditional measures of economic progress such as gross domestic product (GDP) (World Bank, 2011c).

In addition, the benefits of economic progress have not been equitably shared. The absolute number of people living in extreme poverty rose by 36 million between 1990 and 2005.⁸ The number of undernourished people increased from 817 million in 1990 to 830 million in 2007 (UN, 2010) and has continued to climb (FAO, 2010b). A fifth of the population in the developing world still lacks access to sufficient clean water (UNICEF/WHO, 2012) and a quarter lack modern energy services (IEA, 2010). Non-inclusive, rapid economic growth that undermines people's livelihoods through resource depletion has become a major cause of political and social unrest in many parts of the world. The need to feed a growing population and the effects of global climate change are expected to put further pressure on natural resources (FAO, 2011b). The promise of a sustainable future – where economic prosperity is shared broadly and achieved without compromising natural capital – is still to be realized.

Solving old and new challenges will require human ingenuity and creativity. It will also need an approach that makes better and greater use of renewable resources, increases the resilience and diversity of production systems, and provides for broader sharing of economic wealth. Although most of the world's population now lives in urban areas, most of the world's poor people live in rural areas, so a greater focus on rural inclusion and rural development is essential. Forests, forestry and forest products are uniquely positioned to complement other agricultural activities in contributing to a sustainable future that will address the needs for both sustainable economic growth and economic and social justice.

Globalization and other factors

The forest sector, including forest management, timber harvesting and industries manufacturing timber-based products, represents a small component of most national economies. At the global level, the sector contributes about 1.0 percent of GDP and employs about 0.4 percent of the total labour force (FAO, 2008).

⁸ Excluding data from China, where there have been significant gains in poverty reduction.

- Mangrove forest destroyed by tin mining activities, Thailand. More than 60 percent of the world's major ecosystems are now degraded or used unsustainably



FAO/M. Kashi/FO-6392

However, the aggregate data mask considerable differences among regions and among countries in each region; in some developed as well as developing countries, the forest sector accounts for a larger share of the national economy,⁹ and in rural areas in several countries it accounts for significant shares of economic activity and employment. Unfortunately, these data do not take into account the provision of ecosystem services such as watershed protection and erosion prevention, or the contribution of informal activities such as the production of woodfuel and non-wood forest products (NWFPs). At least ten million people are employed in forest management and conservation (FAO, 2010b), and an estimated 1 billion people depend on forests for subsistence, as an economic safety net or as a direct source of income (Scherr, White and Kaimowitz, 2004).

Forest industries face a variety of significant challenges arising from the lingering effects of the global economic crisis and the slow recovery in demand for construction materials, packaging material and furniture.¹⁰ Many of these challenges reflect long-term, broad-scale trends in the sector, in addition to the issues that face all industries, such as increasingly integrated and competitive international markets (globalization), excess production capacity and competition for resources. Although the environmental attributes of wood products present opportunities to produce and market environmentally

⁹ For example, the contribution of the forest sector to GDP in Canada is 2.7 percent, in Malaysia 3.0 percent, in Finland 5.7 percent, in Papua New Guinea 6.7 percent, and in Liberia 17.7 percent.

¹⁰ There is an extended discussion of these issues in SOFO 2011 (FAO, 2011d).

friendly products, firms in many countries have been slow to adapt, as have public policies (FAO, 2011c).

Regions of the world interact more frequently and intensively than ever before. Increased interaction and integration among people, companies and governments are driven by international trade, cross-border investment and the rapid pace at which information moves around the world. Markets respond quickly, leading to rapid expansions (or contractions) in associated flows of capital, goods and services. Although external forces – such as broad trends in the economy, and demographic and social change – have always had a far greater impact on the forest sector than have changes within the sector itself, the current speed and complexity of these externally driven changes are unprecedented. Increasingly, the businesses that benefit from globalization are those that understand the dynamics of global markets and learn to use their basic communication tools.

Turning the corner on how progress is perceived

↳ *Many poor countries possess natural capital in their farms, forests, and ecosystems that can be a primary source of their prosperity. Capitalizing on those riches while, at the same time protecting or enhancing the environment, is not mutually exclusive.*

◆ World Bank, 2011a

Economic success is typically measured by calculating the value and quantity of outputs, regardless of the waste that is generated, the impact on the environment, or the non-renewable resources that are exploited. The World Bank is among those calling for a new way of thinking about economic development (Box 3).

Jeffrey Sachs, special adviser to the United Nations Secretary-General, also argues for new approaches and identifies six sectors that require a “fundamental, technological overhaul” for achieving global sustainability: forests, agriculture, power, transport, buildings and industries. He stresses that reliance on unregulated markets alone is not enough to solve global problems; more effective public–private partnerships must be implemented. Sachs emphasizes the importance of regulatory systems, research and development, public awareness and education, and calls on world leaders to develop a long-term strategy for achieving global sustainability (Sachs, 2011).

The economist Herman Daly argues for pursuit of a steady-state economy rather than a growth economy, noting that infinite economic growth is incompatible with a finite biosphere. He suggests that recurring “bubbles” in the global economy are the result of exceeding the steady-state capability of the planet. Daly concludes by observing that policies intended to re-establish the growth economy are self-destructive (Daly, 2011).

The late Buckminster Fuller provocatively argued that humans will be able to solve all the physical problems of existence because the real wealth of the world is information and energy, both of which are increasing without limits. He pointed to continual technological changes that allow people to do more with less. Fuller argued that exponential improvements in technology could outpace the physical constraints of the world’s limited resources. The real obstacle to human progress is therefore people’s inability to solve political and distribution problems, resulting in unnecessary poverty and inequality, which in turn lead to riots and wars (Fuller, 1969).

Sachs, Daly and Fuller all underscore the need for public policies and private decisions that steer global production and consumption systems towards a more sustainable economic path. Such a path will necessarily be more protective of nature and more equitable. Transition to this path is likely to be stimulated by the rising economic and environmental costs of using fossil fuels and other resources that are limited in supply and increasingly scarce.

Photosynthesis captures solar energy and carbon dioxide (CO₂), converting them into stored carbon and releasing water and oxygen; despite the world’s current reliance on fossil fuels, photosynthesis is the basis for the survival and prosperity of humans on earth. According to global estimates, photosynthesis still captures energy six times as rapidly as human civilization consumes it in the form of power. The human economy will become stronger and more resilient when the “engines” of photosynthesis (plants) are sustainably managed and when renewable, photosynthesis-based products (such as wood products) have a more prominent role in production and consumption. When crops are harvested, they are replaced by new crops to grow food for the future. The same principle applies to forests. Forests “are unique because they are a potentially sustainable source of resource rents – truly a gift of nature” (World Bank, 2006).

Box 3: Alternative ways of measuring wealth and human well-being

Traditional measures of economic success focus on aggregate outputs such as growth in GDP. Alternative measures include the following:

- The Human Development Index (HDI) was first developed by the United Nations Development Programme (UNDP) in 1990 as a comparative measure of life expectancy, literacy and education, and standard of living. The related Human Poverty Index concentrates on deprivation in the three essential elements of human life reflected in the HDI.
- A measure of total wealth developed by the World Bank includes the value of natural capital – minerals, timber assets, non-timber forest assets, cropland wealth, pastureland and protected areas – in estimates of a country's wealth. Total wealth includes produced capital (infrastructure), natural capital (forests, fish stocks, etc.) and human resources (World Bank, 2011b).
- “Adjusted net saving”, also developed by the World Bank, is an indicator of an economy's sustainability; it measures changes in wealth from year to year by comparing changes in produced capital, depletion of natural resources, investments in human capital, and damages to health caused by pollution (World Bank, 2011c).
- Although income inequality is not typically reported in official national or global statistics, there are several ways of estimating it, such as by comparing the wealthiest and poorest 10 percent (the R/P 10 ratio), or through the Gini index, which measures the extent to which income distribution varies from an equal distribution. In Bhutan, the official government policy is to promote “gross national happiness” ahead of “gross national product”. This is more than a slogan; emphasis is placed on maintaining traditional culture and promoting social goals, rather than on simply trying to maximize production or consumption.

This chapter illustrates four fundamental ways in which forests and forest-based industries can contribute to a sustainable future: i) as a source of energy; ii) as ecosystems that provide people with goods, services, resilience and ecosystem health; iii) as rural economic activities that benefit local development through increased employment and income; and iv) as the source of products that contribute to economic growth, livelihoods and well-being. Forests could make a significant contribution to a more sustainable future, but realizing this potential requires better strategies and communication. The last section of this chapter highlights selected strategies to help achieve that future.

Forests as renewable sources of energy

The development of civilization has been powered by wood energy. Today wood is still the most important single source of renewable energy, providing more than 9 percent of the global total primary energy supply. Energy derived from wood is estimated to represent more than 1 100 million tonnes of oil equivalent each year. Wood energy is as important as all the other renewable energy sources put together (hydro, geothermal, waste, biogas, wind, solar and liquid biofuels) (Figure 3).

More than 2 billion people depend on wood energy for cooking and/or heating, predominantly in households in developing countries. Household cooking and heating with woodfuels accounts for one-third of global consumption of renewable energy sources. Woodfuel is not only a globally

important source of renewable energy, it is also the most decentralized source of energy in the world.

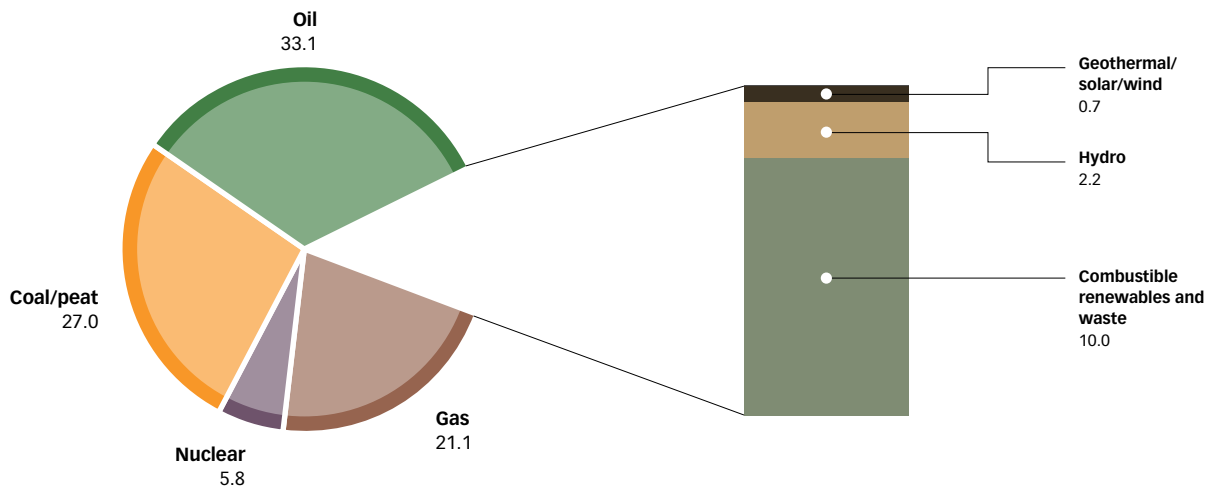
As the attention on climate change and energy security has increased, wood energy has become far more important and visible. Wood energy is considered a climate-neutral and socially viable source of renewable energy when:

- it is harvested from sustainably managed forests and trees outside forests;
- it is burned using appropriate technologies to maximize efficiency and minimize indoor and outdoor emissions.

Forests providing for people

About 350 million of the world's poorest people, including 60 million indigenous people, use forests intensively for their subsistence and survival. These populations include the most disadvantaged and vulnerable, and often the politically weakest parts of society; forests are their main means of meeting contingencies and mitigating risks from unforeseen events. These populations are extremely talented, creative and innovative in their use of forests and their products and ecosystem services. Many forest users have rich traditions and knowledge. For example, hundreds of millions of people rely on traditional medicines harvested from forests, and in 60 developing countries, hunting and fishing on forested land supply more than a fifth of the population's protein requirements. A further 1 billion people depend on woodlands, homestead trees and agroforestry for many of their day-to-day needs. For more than 2 billion

Figure 3: Shares of total primary energy supply in 2008 (percent)



Notes: Share of total primary energy supply – 12 267 million tonnes of oil equivalent – excludes the electricity trade. Woodfuels constitute 90 percent of combustible renewables and waste (FAO estimate). Shares under 0.1 percent are not included; the total may not add up to 100 percent. Source: IEA, 2010.

people, wood energy is critical for cooking, heating and food preservation (FAO, 2010a).

At the same time, forests are important components of ecosystems at all scales, providing a wide range of services and functions: regulating water supplies, buffering floods and droughts, mitigating the adverse effects of GHG emissions, and harbouring biodiversity. Forests are estimated to store about 289 gigatonnes of carbon in their biomass alone; they therefore play a central role in the earth’s carbon balance and hold significant potential to mitigate climate change (FAO, 2010b). Because forests contain more than 80 percent of the world’s terrestrial biodiversity (plants, animals,

- Wood charcoal production, Liberia. For more than 2 billion people, wood energy is critical for cooking, heating and food preservation



FAO/A. Lebedevs/FC-6968

birds and insects), they will be an important resource in the development of new medicines, improved plant varieties and countless other products.

An increased emphasis on forests, forestry and forest products is therefore not simply for meeting the world’s increasing demand for timber and fibre but also for providing ecosystem services and sustaining livelihoods. Managing forests sustainably and enhancing their contribution to people and the planet lie at the heart of a sustainable future.

Realizing the value of forests

Many of the products and most of the ecosystem services provided by forests are not bought and sold through formal markets. As a consequence, forests are frequently undervalued and too readily destroyed, inadequately managed or abandoned. Trees can be sold for fibre or energy, but markets do not exist (yet) for the carbon stored in forests, the ability to conserve diverse flora and fauna, or the ability to provide clean water.

Major efforts are being made to focus attention on this issue. For example, the motto of the Prince’s Rainforest Project, led by Prince Charles in the United Kingdom of Great Britain and Northern Ireland, is “Working to make the forests worth more alive than dead”.¹¹ Considerable progress has been made in developing markets, including international ones, for a wide variety of

¹¹ Additional information at www.rainforestsos.org.

renewable NWFPs (such as nuts and fruits), with resulting benefits for forest-dependent communities.

A resilient and durable economy will incorporate a broader range of forest values in decision-making processes. Where markets are non-existent or underdeveloped, public policies can play an essential role in identifying and promoting recognition of these forest values. Current actions by governments, civil society and the private sector to ensure greater attention to forest values include efforts to create markets that underpin Reducing Emissions from Deforestation and Forest Degradation (REDD) (Box 4). As a consequence, there is broad consensus that sustainable management of forests is an important goal for all countries, and that it should include a greater emphasis on conserving and enhancing forest-based carbon stocks. In moving to a sustainable economy, deforestation and forest degradation must be significantly reduced and net global forest area increased.

Forestry in a sustainable future

Forestry is the art and science of creating, using and conserving forests. The forestry profession was a pioneer in developing techniques for sustainable management and, later, techniques for the multiple use of forests. More recently, broad holistic concepts such as ecosystem management and landscape management have been developed, tested and applied. These are all elements of the sustainability and sustainable management of a wide variety of renewable resources. However, forestry is embedded in a changing, predominantly urban society that has limited direct experience of nature and is frequently sceptical of resource managers. Although the term “sustainable

forest management” is synonymous with “good forestry”, forestry and forest management are sometimes viewed as potentially damaging to the environment. This fear is justified where unscientific or illegal forest practices are used, but the argument that there is a need to “green the forest sector” appears to give too little credit to forestry’s core concepts (see, for example, UNEP, 2011). Nevertheless, if forestry is to contribute effectively, it must continue to evolve.

Forestry is “sandwiched” between two extreme and conflicting views: on one side are the superficial, mainly urban, perceptions of the felling of a tree or the hunting of forest wildlife as environmental offences; and on the other side are the poor practices and negative impacts on forests that generally come from outside forestry (fires, pollution, etc.) or from mining and other interests that perceive forest lands as reservoirs of land for mineral extraction, agriculture, etc. The tools for dealing with these extremes are effective communication for the first and land-use planning and enforcement for the second.

A significant challenge for the forestry profession is to communicate and demonstrate the simple idea that one of the best ways of saving a forest is to use it. When looking for ways to stimulate economic development, politicians and planners seldom see all the dimensions and potential of the forest sector. Forests are viewed as either a feature of the environment to be preserved or, in stark contrast, a source of land to aid the expansion of agriculture. A balance should be found in which forests contribute to achieving all of these goals: sustainable forest management adds value to a forest by using

Box 4: Is REDD a “game changer”?

In *The Future of the World's Forests*, Jim Douglas and Markku Simula suggest that the opportunity to receive payments for reduced deforestation through carbon emission trading is a “game changer” because it represents the international community’s first attempt to develop a global mechanism that recognizes non-market values from forests – in this instance the contribution to mitigating climate change through carbon sequestration.

The authors acknowledge that carbon storage is only one of several forest ecosystem services that are not valued by markets, but it is the first such value that people are

addressing formally by seeking to create a global market. Noting that deforestation is caused mainly by economic forces outside the forest sector, the authors conclude that “it will not be easy to use broad based economic reform as a primary means of implementing a revaluation of existing rainforests: it is simply too blunt an instrument.”

The authors therefore describe themselves as “REDD optimists” in their hope that payments for reducing deforestation will be a significant accomplishment in efforts both to mitigate climate change and to finance sustainable forest management adequately (Douglas and Simula, 2010).

forest products for energy, construction materials, packaging and a wide variety of other consumer products while preserving the pieces and functions of a healthy forested ecosystem. When sustainable forest management is practised, the values of the natural forest can largely be maintained.

The global economy is driven by many forces. Frequently cited large-scale trends include population growth, unsustainable production and consumption systems, and climate change. Internet-based communication and consumer products, digital devices and technological advances have changed the ways in which information is read and obtained. Social networking has changed the dynamics of information exchange and facilitated new forms of social interaction, protest and political change. These changes and trends around the world have a massive impact on forests and the forest sector.

Although forestry offers significant potential for investment, many people hesitate to enter the business because of inherent risks, including the long gestation period involved in establishing, tending and ultimately harvesting forest products. Other challenges include market uncertainty (the forecasting of prices for forest products and forest land in the short or long term), environmental risks (forest fires, insects, disease) and policy risks (unclear forest tenure, an unstable political environment, unpredictable changes in policies). Promotion of investments in forestry thus requires improved institutions and governance, and policies and market-based tools that help mitigate some of these risks.

The world is large enough to allow different forests to be managed for different values and outputs: some forests can be protected; others can be intensively managed for wood; and others can be managed for multiple uses. Decisions about the type of management appropriate for each forest should be made through participatory processes that engage all levels of society. Both developed and developing countries now understand the importance of involving local people and forest-dependent communities in decisions about forest management and use. It is essential to construct a decision framework for forests that incorporates the best science, local experience and traditional knowledge.

Forestry already plays a significant role in sustainable local economies. This contribution to a sustainable future

will increase if the principles, policies and practices of sustainable forest management are applied and if forest products and ecosystem services assume more importance in the global economy.

Carving out a better future

International debate about forests looks at the big picture from the top down; while governments argue about multi-billion-dollar investments to reduce tropical deforestation, bottom-up solutions are often overlooked. Too little attention is paid to important segments of developing economies that already use wood to make a significant contribution to social, economic and environmental well-being: through furniture making, woodcarving, handicrafts, and other small or medium-scale enterprises.

Hand-crafted products made primarily of wood and other forest products are the source of livelihoods for at least 100 million artisans and their families in rural communities (Scherr, White and Kaimowitz, 2004). More effective development of these businesses and marketing of their products could help ensure more stable and sustainable rural development. For example, woodcarving generates more money and jobs per unit of wood than does any other part of the forest products industry. In many areas, woodcarving also serves as a safety net when other opportunities are limited, and is particularly helpful to women and other economically marginalized sections of society.

Despite growing economic opportunities in many countries, severe inequalities persist, and poverty remains widespread in rural areas. Because forests are in the poorest regions of many developing countries, including in countries with rapidly emerging economies, stimulating investment in local eco-entrepreneurship and green enterprises can serve as an engine of rural economic development (Matta, 2009).

Wood as an integral part of culture and tradition

Throughout human history, woodcarvings and handicrafts have played an important role in art and aesthetics that goes well beyond function and extends into the realm of happiness and fulfilment. Through creative designs, intricate ornamentation and expert craftwork that appeals to the senses, woodwork became an integral part of culture and tradition in many societies. Patronized by monarchs and commoners, scholars and religious leaders, these art forms were integrated into virtually every aspect of life throughout the world.

A beautifully carved main door inlaid with wood is a sign of welcome in many parts of India, where carved wooden lintels, brackets and balconies are found in many traditional homes. While features such as intricately carved furniture, architectural features and decorative elements served to enhance the aesthetic appeal of the places where people lived, they also demonstrated a person's relative socio-economic status and well-being.

In many cultures, the most talented woodcarvers and artisans enjoyed special status. In certain stratified societies, the right to create wooden art was considered a privilege of specific families or ethnic groups, and the necessary skills were imparted through hereditary channels (Jha, 2009).

Even amid poverty, there is more to life than acquiring basic necessities or producing objects solely for their utilitarian value. People of all cultures admire art and aesthetics – those things that appeal to the eye, the ear, the heart, the touch and the taste. These feelings stimulate emotions and happiness and generate imagination and creativity.

In modern life, however, consumer goods are typically based on mass production, and woodworking artisans have gradually lost social importance in many countries. Competition from inexpensive, easily mass-produced products made of steel and plastic has undermined appreciation of the artistic and aesthetic values of wood.

Artisans and craftsmen have been relegated to the status of a “backward” community.

A challenge for the proponents of a green economy is to find ways of equitably rewarding the skills and creativity of rural people who carve wood and make handicrafts. These often informal industries provide full or partial employment to an estimated 100 million artisans and semi-skilled labourers. Although the figures vary from country to country, many of these craft producers and artisans are women and ethnic minorities, residing in remote areas where they are disproportionately affected by poverty (Scherr, White and Kaimowitz, 2004).

The collection and processing of raw material and the production of wooden items and handicrafts constitute the most important sources of income for many rural families. In some societies, farmers carry out this work during the agricultural off-season; the additional income derived from wood handicrafts often decides whether or not an artisan family can rise above the national poverty line (World Bank, 2006). In recent years, the plight of these families has worsened in countries that have restricted the collection of wood and other raw materials from forests.

Winds of change

There is some basis for optimism that the situation is changing for the better. Emerging economies could become the world's leading economies and the trend-setters for transformation in the twenty-first century.

- Wooden choir stalls in the church of Paramaribo, Suriname. Through creative designs, intricate ornamentation and expert craftwork, woodwork is an integral part of culture and tradition in many societies



FAOM, Neuberger/FO-0781

Included in this economic group are countries that are major producers and consumers of handmade wood products: Brazil, China, Egypt, India, Indonesia, the Islamic Republic of Iran, Mexico, Pakistan, Turkey and Viet Nam. These countries account for more than half of the world's population and most of its recent economic growth.

The rapidly expanding urban middle classes in these emerging economies will have growing incomes, more disposable money and higher aspirations. They constitute a huge potential market for new and innovative products, including those made of wood. People who acquire new wealth often develop an interest in art and aesthetics, and the demand for higher-value niche wood products is likely to increase accordingly. The increasing popularity of wooden toys is a notable example, which connects children to nature. Toy manufacturers have started to realize this potential.

Although urbanization is accelerating, large populations in emerging economies will continue to live in rural areas. This mix of rural and urban populations will be conducive to an optimal supply and demand balance for promoting woodcarving and handicrafts.

With increasing wealth and leisure, people in many cultures look fondly on the past and develop an interest in reviving old traditions. With longer life expectancies and ageing populations in many countries, the proportion of people with such feelings will continue to increase. Intricately carved, light and durable wooden items and traditional artefacts with deep cultural significance are becoming increasingly sought after

- Traditional wooden toys from Channapatna, Karnataka, India. The demand for higher-value niche wood products is likely to increase with the rapidly expanding urban middle classes in emerging economies



FACOL/Animon

as gifts and decorative items for the home. The revival of cultural festivals, performances and rural markets can be interpreted as a search for the continuity of tradition in a rapidly changing world. Hand-crafted wood products can play an important role in meeting demands stimulated by nostalgia for the past. Wooden art and decorative forms of wood define the cultural identity of many countries, and woodcraft entrepreneurs can learn from the people who have generated new income streams from other local and regionally branded products such as wines and cheeses. Moreover, sustainable forest management and, in particular, the jobs generated by small and medium forest enterprises, offer a viable way of retaining rural youth in their local communities and harnessing their energy, ambitions and capacity to innovate in the sector.

Hurdles to overcome

Despite the potential for helping to transform rural areas, small wood-based industries face significant challenges. Many of these businesses are characterized by low productivity, inadequate processing, poorly integrated markets and high vulnerability to external shocks. Most artisans and craft producers draw on local resources and cater primarily to local markets.

The woodcarving industry typically consists of small production facilities – households and small enterprises – many of which are informal (not registered with the State) and in the unorganized part of the sector (Jha, 2009). Although the production of goods for sale requires a great deal of skill, creativity and artistry, artisans frequently lack business skills, so may not get their fair share of profits. Most of the value is captured by those at the top of the market chain; this raises concerns regarding equity and may also act as a disincentive for sustainable management.

Rural entrepreneurs have limited access to credit, external markets and technology, leaving them with limited capital and capacity for upgrading technology or improving production efficiency (Macqueen, 2008). Access to raw material is frequently another major constraint. In many countries, rural entrepreneurs also lack an enabling environment for organizing, networking and improving their entrepreneurial skills, although modern communication technology is helping to change this situation. Faced with these challenges, the prospect of industry decline is ever present, bringing with it the risk of losing livelihoods, indigenous knowledge and traditional beliefs associated with the production and use of these materials.

Realizing the benefits of small wood product enterprises

Wood and wood products will make increasingly important contributions to a greener economy and more sustainable development. As societies grow and prosper, they increasingly value goods and services that contribute to health, education, culture, heritage and tradition. Particularly in emerging economies, markets for traditional wooden works of art, woodcrafts, home décor and furnishings show signs of resurgence and offer excellent potential for growth. Recognizing these trends and acting on them as development and business opportunities could be productive and profitable.

Increased investment in wood-based enterprises will generate additional employment, create real and durable assets, and help revitalize the lives of millions of poor people in rural areas. At a broader scale, this green economy approach (low-carbon, resource-efficient and socially inclusive) can open up new possibilities for disadvantaged segments of the global economy. There are especially good opportunities for rural people in emerging economies.

Realizing this potential requires overcoming several hurdles:

- Misinformation about the destruction of tropical forests caused by the increased use of wood must be overcome.
- Local entrepreneurs need to learn how to obtain access to global markets. There must be more involvement further up the value chain, with greater production of quality wood materials for niche markets. It may be necessary to organize this highly decentralized industry on a country-by-country basis, through such approaches as product standardization, segmentation and market development.
- There is a need for policies that support and encourage improved marketing, including the development of cooperatives.
- Proactive policies that promote tree growing on private lands and sustainable forest management practices on all lands are also necessary.

Forest products in a sustainable future

Projections of future population foresee a world of 9 billion people by 2050; much of this population growth is expected to occur in cities in the developing world. If current practices continue, the building of these cities will produce millions of tonnes of GHGs; however, increasing

the use of sustainably managed wood products in construction will store carbon and offset some of the emissions from manufacturing concrete and steel. This is just one aspect of the compelling case for making greater use of wood products as part of a sustainable future.

Connecting consumption and production in a closed cycle is another important aspect of a sustainable future. In an effectively integrated cycle of production and consumption, positive economic, environmental and social benefits can be sought and negative consequences avoided. Products and services from productive natural ecosystems, such as forests, grasslands, agriculture and aquatic systems, are ultimately based on photosynthesis, so their production and consumption can be repeated in a cycle. When managed under thoughtful stewardship, forest ecosystems generate a host of products and services that can be perpetuated. Forest products will therefore play an important role in a sustainable future in which sustainable consumption and production are linked in a closed cycle.

Wood products

Wood products are manufactured from renewable raw material; they are reusable and biodegradable, and they continue to store carbon throughout their lifetime. These characteristics make wood an excellent alternative to many of the materials that are now widely used in construction and consumer goods, which leave a much larger “carbon footprint” and include concrete, steel, aluminium and plastic. Increasing production and consumption of wood products will therefore be part of a sustainable future. However, a sustainable future will also require greatly improved efficiency and reduced waste

- Sawmill converting tropical hardwoods into parquet flooring, Lao People’s Democratic Republic. Wood products are manufactured from renewable raw material; they are reusable and biodegradable, and they continue to store carbon throughout their lifetime



J. Broadhead/IC-5938

in timber harvesting, manufacturing and consumption. There is already evidence of considerable progress in wood product industries. Examples include:

- use of small-scale equipment and low-impact practices in logging operations;
- wood-saving manufacturing equipment (thin blades) and technologies (laser guides), and complete utilization of wood raw materials, including through the use of waste to generate heat and power;
- product developments that utilize smaller, lower-quality trees while improving the performance of engineered wood products, such as laminated beams and flooring;
- use of recovered and recycled paper, paperboard and wood.

Wood product manufacturers face many challenges, including changes in consumer preferences and global demographics, competition for resources, competing materials, and changes in the ownership of the forests that provide raw material. Forest industries typically require large capital investments and it is difficult for them to adjust rapidly to changing economic conditions. Nevertheless, the overall outlook for the forest industry is generally good. Production and consumption are expected to grow, while new investment and production are expected to continue shifting towards the more rapidly growing emerging economies. In developed country markets, wood products will benefit from a greater focus on meeting high environmental performance standards, and new wood-based products such as bioenergy, biochemicals and biomaterials will be a basis for overall industry growth (FAO, 2011c).

Innovations in forest products

The rate of innovation in global telecommunications is widely known. However, too few people are aware that manufactured forest products are also undergoing a transformation, which is leading the transition of the forest sector in the green economy (Tissari, Nilsson and Oinonen, in press). Innovations in forest products tend to fall into two broad groups: subtle, evolutionary innovations involving gradual changes to processes that are well established; and abrupt, revolutionary innovations creating new products and processes that have never been seen before, such as using wood in the manufacture of electronics.

Composite or “engineered” wood products are changing rapidly. Among the engineered wood products that are substitutes for solid wood are glulam beams, laminated veneer lumber, parallel strand lumber, I-beams with oriented strand-board webs, and edge-glued, solid wood

panels. One of the most recent innovations, cross-laminated timber, is producing wood products with superior strength and dimensional stability, enabling the development of new construction techniques for high-rise buildings.

Production technology in the plywood sector is also changing rapidly – especially in Asia – enabling the use of smaller logs, including from planted forests. New manufacturing processes are faster, more fully automated and capable of greater quality control. Innovations include laminated veneer board and long-stick board. The most recent type of plywood contains a flexible core layer, creating a wood-based panel that can easily be bent into a variety of shapes and used in new processes and products.

- Wood technology laboratory. Innovations in forest products fall into two broad groups: subtle, evolutionary innovations involving gradual changes to well-established processes; and abrupt, revolutionary innovations creating new products and processes



FAO/IFLOR/IFU/0002/15

Indonesia, the world’s largest exporter of hardwood plywood, has invested in improved processing that adds value to end products, for example by using direct coating to produce “colour-tone plywood” and moulded or curved plywood products. Plywood is also being used for large-scale structures such as tank supports on the large commercial vessels that transport liquefied natural gas.

Many advances are being made in reconstituted panels, especially oriented strand board in North America and medium-density fibreboard in Europe. Improvements include increased strength, a wider range of densities, improved packaging, and greater product diversification through a larger variety of surface treatments.

One of the more interesting technological developments is the increased manufacture of products that mix wood fibres with other materials, including flax, cotton, straw, paper and plastics, to produce wood composite boards. Wood-polymer composites are beginning to penetrate markets owing to their ease of use and durability. Research in this area focuses on using wood resources more efficiently, optimizing the physical properties of raw materials, making products with special properties such as resistance to fire or fungi, reducing manufacturing costs, and recovering waste when products are no longer useful.

Technology and core products in sawmilling are not changing as rapidly as they are in composite products. The most important transition is that more timber comes from planted forests, and a higher percentage of logs are small by traditional standards. There have been improvements in log sorting, sawing yields, the speed of processing, the speed and quality of drying, and surface treatment and non-toxic preservation. Many of the natural defects of sawnwood can be removed by means of optical scanners, automated off-cutting and finger-jointing. Relatively new “hew-saw” technology is well suited to the rapid processing of small logs into bulk grades of lumber, simultaneously hewing slabs into chips that are suited for pulp.

Forest industries are also at the forefront of innovation in the use of renewable sources of energy. Combined heat and power units are the norm at forest product manufacturing sites in Europe and North America, and are becoming more common in developing countries. Pulp and paper plants derive most of their energy from wood bark and the black liquor that is produced in the pulping process. Energy consumption per unit of output is declining throughout the pulp and paper industry.

Non-wood forest products

As well as being a source of essential food, NWFPs are also an economic foundation for millions of families (CIFOR, 2012). Worldwide, the estimated value of NWFP removals in 2005 was USD 18.5 billion (FAO, 2010c), but this estimate is conservative because NWFPs are rarely reflected in official national economic statistics. NWFPs are an important complement to agricultural income, and they serve as safety nets during calamities such as drought and civil unrest (Scherr, White and Kaimowitz, 2004).

Forests and trees on farms represent a vital source of food for many of the world’s poorest people, providing

both staple foods and supplemental foods such as fruits, edible leaves and nuts; fodder and browse for livestock; and fuel for cooking and food processing. It is often the poorest people who depend the most on forests. Households living on the margins of poverty are exposed to food insecurity at certain times of the year, when income levels drop. This may be during the lean season (when crops are still growing in the fields and stocks from the previous harvest are exhausted) or in times of famine or food shortage. Forest foods are particularly important during these periods. Plants and animals found in forests provide a critical source of protein and important vitamin- and nutrient-rich supplements for rural households, adding variety to diets and improving the taste and palatability of staples. NWFPs often form a small but critical part of otherwise bland and nutritionally poor diets (FAO, 2011a).

There are significant challenges to the continued use of NWFPs as a source of rural income and employment. Most of the livelihoods supported by NWFPs are characterized by low productivity, inadequate processing and value addition, and poorly integrated markets. NWFPs’ potential value to local people is hindered by factors such as the remoteness of forests, poor infrastructure, unclear tenure rights, and limited access to financial and market services. Low returns and unfavourable market conditions often lead to unsustainable exploitation of NWFPs. To enhance the many benefits that NWFPs provide, there is need to raise awareness of the contributions that forests and trees make to nutrition and food security strategies and policies; increase support for adequate and locally controlled forest management and use; give greater attention to pro-poor forestry measures; and support the development of economically, socially and environmentally sustainable small and medium forest enterprises.

Investing in NWFPs provides an opportunity to strengthen the livelihoods of forest-dependent people, contribute to their nutrition and food security, and help conserve their resource base. Enhancing the entrepreneurial capacities of people engaged in NWFP collection would result in increased income and provide an incentive for better forest protection and management. Areas for investment include improving technical knowledge and information on sustainable harvesting, collection, storage, processing and value addition; overcoming the isolation of small and medium forest enterprises by connecting them to each other and to markets, service providers and

- Intermediary who links producers and processors of shea nut (*Butyrospermum parkii*), Central African Republic. Investing in non-wood forest products provides an opportunity to strengthen the livelihoods of forest-dependent people, contribute to their nutrition and food security, and help conserve their resource base



FAO/J. Masuich/FO-7233

decision-makers; and providing policy and institutional support to ensure clear commercial use and/or tenure rights, a fair and simple regulatory environment, cost reductions, and the promotion of collective action and partnerships among NWFP entrepreneurs.

Forest-based enterprises

The livelihoods of millions of rural people, including a high percentage of rural women, can be enhanced through investments in small and medium forest-based enterprises that use wood and NWFPs to meet demand from local and non-local markets. For example, the value of woodcraft exports (primarily from developing countries) increased from an estimated USD 500 million in 2002 to USD 1.5 billion in 2010.

As another example, in recent decades shea butter and argan oil – both derived from tree nuts grown in the arid regions of northern and western Africa – have demonstrated the economic potential of NWFPs and their integration into global as well as lucrative niche markets.

In Burkina Faso, exports of shea butter and unprocessed shea kernels generated USD 7 million in 2000, making these products the country's third most important export, after cotton and livestock (Ferris *et al.*, 2001). Forest-based tourism is another increasingly important source of revenue for many developing countries.

Increased investments in sustainable forest-based enterprises will result in economic growth and higher employment while meeting the demand for forest products of an expanding global population. It will also contribute to the achievement of social development objectives by building capacities, particularly of rural women, through increased income opportunities, a stronger voice in communities, and the reinvestment of profits in communal infrastructure and services.

Investments in small and medium forest enterprises should take into account the entire value chain, by including the suppliers, producers, processors and buyers of a product, and the technical, business and financial service providers that support them. Such a system will create sustainable self-dynamism and independence from external support mechanisms.

Green buildings and infrastructure

Wood is an important material for ensuring a sustainable future; it has a neutral carbon footprint, it is renewable, and the manufacture of wood products has a smaller environmental impact than that of competing building materials. Wood is versatile and can be used both in new housing and in upgrading old buildings. Although wooden buildings have traditionally been limited to only one or two storeys, innovative and engineered wood products are increasingly recognized as having potential for buildings of up to 20 or 30 storeys.

It is very difficult to produce evidence of the direct environmental and GHG-mitigation benefits of using wood in building and construction. However, focusing on specific building products enables comparisons of the environmental impacts of wood and competing materials. This “material life cycle” approach measures the environmental impacts of building products at four stages:

1. extraction, refining and transportation of the raw material;
2. manufacture of the product;
3. utilization and maintenance of the finished product throughout its service life;
4. recycling, reuse and disposal of the product after use.

Using broad-scale indicators and the life cycle assessment approach, a comparison of wood and other construction materials can be summarized as follows:

- *Global warming potential, measured in CO₂ emissions:* Wood is CO₂-neutral and has a negative global warming effect – wood products provide net storage, rather than release, of CO₂. The precise score depends on the boundaries of life cycle analysis, but wood easily outperforms concrete, brick, stone and metal, all of which are sourced from extractive industries and require intensive energy use throughout their mining and processing chains.
- *Photochemical ozone creation potential (ethane emissions):* Wood products emit far less ethane than aluminium, and significantly outperform PVC plastics.
- *Acidification potential (sulphur dioxide emissions):* The sulphur dioxide emissions associated with wood products are only 40 to 50 percent as large as those associated with aluminium and PVC.
- *Eutrophication potential (enrichment of dissolved phosphate):* Wood products are associated with approximately two-thirds of the eutrophication potential associated with aluminium and PVC.

Globally, existing buildings account for more than 40 percent of total primary energy consumption and 24 percent of CO₂ emissions (IEA, 2006). The rapidly expanding construction sector that is needed to meet the needs of an ever-increasing population is likely to exacerbate this energy and climate impact. Energy savings from buildings that are resource- and energy-efficient throughout their life cycles will therefore

- Kooraste hunting house, southeast Estonia. Although wooden buildings have traditionally been limited to only one or two storeys, innovative and engineered wood products are increasingly recognized as having potential for buildings of up to 20 or 30 storeys



J. Pere

be critically important. This situation presents an opportunity for increasing the use of wood products: wood's lower carbon footprint makes it a rational and natural choice for a greener building sector.

Strategies for the future

Strategies for realizing forests' potential contribution to a sustainable future include improving the quality and quantity of forests by planting trees and investing in ecosystem services, promoting small and medium forest-based enterprises to reduce rural poverty and improve equity, increasing the long-term value of wood products by reusing and recycling them and using wood for energy, and enhancing communication and linkages across the physical and institutional landscape.

Planting trees and investing in ecosystem services

Planting trees is often the quickest and most effective way of producing new biomass, thus helping to offset the loss of carbon resulting from deforestation or forest degradation on another plot of land. Investing in new carbon stocks has great potential to make a significant, fast and measurable impact on climate change without requiring sweeping changes in policies, cultures or national economies. Several developing countries, notably in Asia, have demonstrated that major investments in planted forests can reverse the trend towards deforestation and result in a net increase in forest area.

The UNEP report *Towards a green economy: pathways to sustainable development and poverty eradication* (the Green Economy Report; UNEP, 2011) calls for investments in reforestation of USD 22 billion per annum over the next 40 years. This level of reforestation would certainly increase the sequestration of carbon in woody biomass, and may be large enough to have an impact on climate change. However, considerable hurdles would need to be overcome: it is not clear where the funds would originate, where the trees would be planted, or how a global programme of this magnitude would be administered. Planted forests must be designed for local conditions; the trees must be appropriate, ideally native species; and planting programmes must take local cultures and economic conditions into account. Planted forests are not a simple one-time investment; they must be properly nourished and managed to ensure their long-term success. Nevertheless, the planting of new forests on a massive scale could result in zero net deforestation on the global scale, with or without REDD.

- Teak (*Tectona grandis*) plantation in limestone zone, Thailand. Major investments in planted forests can reverse the trend towards deforestation and result in a net increase in forest area



FAO/M. Kasahor/FO-6628

The challenge lies in working at the local level, but with large enough investments to make a difference at the global level.

Trees sequester carbon, regardless of their location, so they may be planted on farmland and rangeland and in cities: outside the “forest” as officially defined by FAO. Agroforestry – incorporating trees into farms – is an essential component of global efforts both to enhance rural livelihoods and to mitigate climate change. A total of more than 1 billion hectares of agricultural land – half of the world’s farmland – currently has tree cover of more than 10 percent. Farm forestry contributes up to 40 percent of farm income through the harvesting of wood, fruits, oils and medicines from trees. Trees can also provide fodder for livestock, help enhance soil fertility, and provide environmental benefits such as clean water, soil health, carbon sequestration and biodiversity. Trees add both market and non-market value to rangelands. In cities, they provide ecosystem services: shade from heat, shelter from wind, absorption of pollution, and creation of urban biodiversity. Urban trees also have aesthetic benefits and add value to property.

Successful programmes for increased tree planting require realistic goals established at the local and national levels, effective partnerships between the public and private sectors, and a business environment in which planted forests represent a good financial investment.

Protecting and enhancing ecosystem services from existing forests can be a powerful complement to establishing new forests and planting trees outside forests. Forest landholders can be rewarded for maintaining healthy forests and encouraged to restore other forests through payments for forest-based ecosystem services, such as carbon sequestration, providing clean water or conserving biodiversity. Several countries have implemented small-scale programmes that demonstrate the effectiveness of such efforts. In one example, forest owners receive payments for managing forested watersheds in ways that reduce the cost of generating electricity from hydropower. Payments for the ecosystem services of forests can be used to create new forests and enhance the quality of existing forests.

REDD is one of the most widely discussed and promising examples of such payments. It is well known that sustainable forest management can reduce emissions of GHGs by reducing deforestation and forest degradation. However, before REDD or other payments for the ecosystem services of forests can have a significant impact, many practical problems need to be overcome, including establishing a clear, stable policy environment; clarifying tenure for forest land and forest carbon; ensuring that payments are linked to the services provided; ensuring sustainable sources of funding; and addressing governance issues where institutions are weak.

Promoting small and medium forest-based enterprises and gender equity

Forest-dependent people and communities continue to be among the poorest in the world; however, small-scale projects that help to promote small and medium forest enterprises have been successful in reducing poverty, improving equity and helping to protect forests and other natural resources. Undertaking these approaches on a larger scale could therefore contribute to national efforts to stimulate employment and strengthen livelihoods; at the regional and global scales, these efforts could play an important role in combating deforestation and forest degradation and slowing the pace of climate change.

Many countries will require policy, legal and institutional reforms to create an enabling environment that ensures access to forest resources, equitable distribution of benefits and support to innovation and entrepreneurship. A policy and institutional environment that is “friendly” to

the rural poor will provide these important stakeholders with the opportunity, knowledge and capacity to participate actively in the decisions that affect their lives; national forest programmes have proved to be effective mechanisms for achieving this objective in countries with limited institutional capabilities. Sustainable forest management and the successful enterprises that rely on it require long-term investments, which in turn require transparent, fair and stable rules, starting with clear tenure arrangements.

Across many regions and countries, women make significant contributions to rural economies but, compared with men, they have consistently less access to resources and fewer opportunities for enhancing productivity. Increasing women's access to land, livestock, education, financial services, extension, technology and rural employment would boost their productivity and generate gains for agricultural production, food security, economic growth and social welfare. Closing the gender gap in agricultural inputs alone could lift 100 million to 150 million people out of hunger (FAO, 2011d). Similar gains are possible in the forest sector.

Although there is no blueprint for closing the gender gap, some basic principles are universal: eliminate discrimination under the law; promote equal access to

resources and opportunities; ensure that agricultural, forestry and rural development policies and programmes are gender-aware; and allow women to be equal partners in sustainable development. Obtaining these results will require cooperation among governments at all levels, the international community and civil society. Achieving gender equality and empowering women in agriculture and forestry is not only the right thing to do, it is crucial for a sustainable future.

Using wood for energy and reusing and recycling wood products

The energy sector is responsible for more than half of anthropogenic GHG emissions; however, when managed properly, the production of electricity by burning wood instead of coal can reduce GHG emissions by up to 98 percent when the entire life cycle is taken into consideration. Increasing the use of renewable energy, including wood-based fuels, relative to fossil fuels may therefore be one of the most important components of a global transition to a sustainable economy. To be fully successful, this will require careful attention to existing patterns of wood energy dependence, the use of sustainable forest management practices in the harvesting and planting of trees, and the adoption of efficient technologies for converting biomass into heat and electricity.

- Meeting inaugurating project activities for capacity building in marketing of non-wood forest products among village communities of southern Cameroon. Small-scale projects that help to promote small and medium forest enterprises have been successful in reducing poverty, improving equity, and helping to protect forests and other natural resources



FAO/I. Tokou Saliam/PO-7154

Combustible renewables and waste currently account for about 10 percent of the world's energy production. This includes the wood energy used by households in developing countries, and the wood used in developed countries in efforts to meet ambitious energy policy targets, such as in Europe. The 10 percent share could be increased through the application of carefully targeted policies and programmes. In developing countries, these policies and programmes will include promoting the use of efficient and clean burning devices and providing training in efficient, sustainable and legal charcoal production, to improve energy efficiency and reduce pressure on natural resources. Sustainable energy production from wood will create local employment and can be used to redirect expenditures from imported fossil fuels to investments in domestic sources of energy, with employment and income benefits.

- Wood briquettes packed for delivery to customers in a local market, Lithuania. Combustible renewables and waste currently account for about 10 percent of the world's energy production, including the wood used in developed countries in efforts to meet ambitious energy policy targets, such as in Europe



FAO/A. Lebedys/FO-7295

In developed countries, woodfuel technologies enable some of the highest levels of energy and carbon efficiency, particularly in generating heat or combined heat and electricity. Wood is increasingly recognized as a core component of national strategies for making the transition from an economy based on fossil fuels to one based on renewable energy. However, the increased use of wood for energy will also present challenges to existing users of forests and forest resources. Policies for increasing the demand for woodfuels must therefore be accompanied by good forest policies and effective institutions to implement them.

Governments can also pursue climate- and forest-friendly policies by encouraging greater recycling of wood-based products. Wood products, notably paper and paperboard, have been recycled for decades; every year more than 200 million tonnes of paper is recovered and recycled, accounting for roughly half of total consumption. These efforts have been fostered by government policies and consumer preferences. Additional progress is possible, including through the reuse and recycling of solid wood products such as in the restoration of old houses and antique furniture. In some circumstances, solid wood products can be used for energy. When wood and paper products are recycled, they continue to store carbon. Every improvement in the percentage of wood that is used and not wasted in production processes reduces GHG emissions.

Enhancing communication and coordinating development

Sustainable forest management is first and foremost a local and national responsibility. Nevertheless, there is much to be gained from international cooperation, and many developing countries continue to rely on foreign assistance, including in supporting the sustainable management of forests and other natural resources. However, forests (and other development objectives) often suffer from competing and overlapping priorities both among donors and between donors and national governments. Ensuring effective collaboration among donors and government agencies in developing countries is a prerequisite for improving the governance, monitoring, assessment and management of forests. Developed countries also face challenges associated with competing domestic policy goals that undermine efforts to achieve sustainable forest management. Therefore, more effective communication and coordination across sectors and countries is needed for a sustainable future.

To maximize forests' contributions to a sustainable future, policies, programmes and investments in forests must take into account – and be taken into account by – actions in other sectors. Better communication and greater use of partnerships will also be required, including partnerships among government agencies, between government agencies and the private sector, and among private-sector stakeholders (civil society and commercial interests). Notable areas for better communication and partnerships include the following:

- *Finance:* For the banking sector, pension funds, endowments, foundations and insurance companies, forests and forestry are increasingly attractive assets in which to invest. In many countries, the number and diversity of timberland owners and investor-managers have grown rapidly in recent years; new institutional owners include sovereign wealth funds, pension funds and endowment funds. A recent FAO-sponsored survey (Glauner, Rinehart and D'Anieri, 2011) concludes that the outlook for forestry investments in emerging markets is positive. Hence, dialogue with the investment community should be expanded and cultivated. Increasing access to credit is considered one of the most effective ways of improving productivity in the agriculture sector (FAO, 2011b). Dialogue with the banking sector should therefore also be improved to increase access to credit for forest economic activities by communities and smallholders.
- *Other sectors within the landscape:* Traditionally, foresters have focused on sustainable management

of the forest estate. However, there is increasing recognition that forests must be managed as part of the broad mosaic of land uses in the social, environmental and economic landscape. For example, in an integrated landscape approach, forests, water and energy would be considered holistically, rather than being treated as discreet economic sectors. Integrated landscape approaches are needed not only to meet the emerging challenges of food insecurity and climate change, but also to address the long-standing challenges of using the natural environment as an engine of growth rather than simply as a fuel.

- *Research and education:* Agricultural research in low-income economies continues to be the most productive investment in support of the agriculture sector, followed by education, infrastructure and input credits (FAO, 2011b). Public and private investment in forestry research is also needed, and will also yield high returns.

To achieve wider recognition and acceptance of the role of forests in building a sustainable future, much needs to be done to spur changes in the ways in which policy-makers and the general public view forests and forest-dependent people. Advocating for and guiding these transformations effectively will require strong local, national and international leadership and concerted action on several fronts, including communication, knowledge sharing, networking and capacity building.

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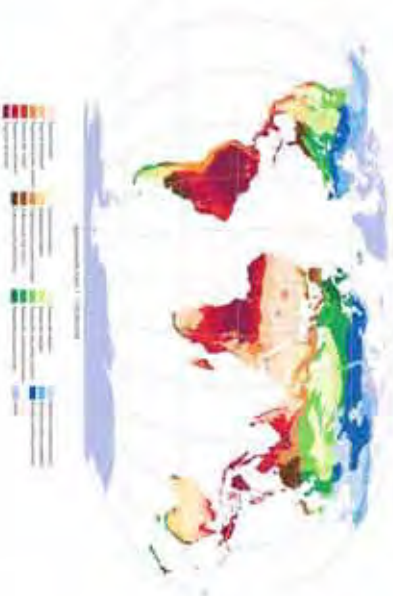
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The world's forests 2010



The FAO global ecological zones



The forest cover map was generated with:

- Forest cover data from the Vegetation Continuous Fields project (VCF) through the Remote Sensing Global Ecosystem Dynamics (RESED) system, updated the 'New and Old-World' (NOW) Global Ecosystem Dynamics (GED) system from the Global Forest Resources Assessment (FAO, 2011), MODIS Forest Biome (2010) in spatial resolution at combination with the MODIS global forest maps (Canard et al., 2008)
- Timber data from the 1970s at 1 km resolution, from compiled by the FAO (FAO, 2008)
- Country boundaries data obtained from the Global Administrative Boundaries (GADM, 2008) of the FAO.

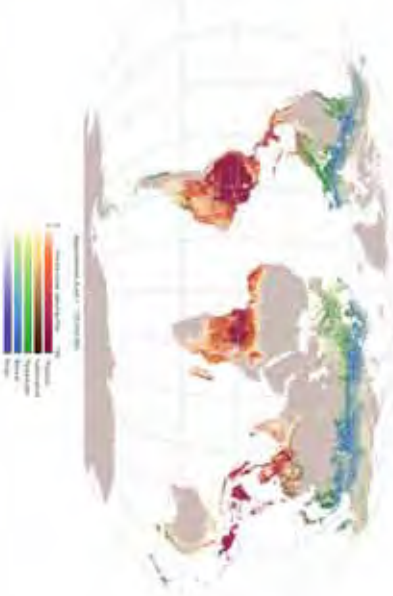
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 • FAO, 2008 - Forest Resources Assessment
 • FAO, 2011 - Global Forest Resources Assessment
 • FAO, 2008 - Forest Resources Assessment
 • FAO, 2008 - Forest Resources Assessment
 • FAO, 2008 - Forest Resources Assessment

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The world's forests 2010 by climatic domain





As the global community looks for ways to move to a greener economy, it is increasingly clear that forests, forestry and forest products must play a central role.

This tenth edition of *State of the World's Forests* explores the role of forests in human history, finding strong links between forest use and economic and social development and between unabated forest destruction and economic decline. It suggests that forest production has an important role to play in a sustainable future in which consumption and production are connected in a closed cycle. It points out the importance of striking a balance between forest conservation and use, and proposes four strategies for ensuring that forests make their vital contribution to a greener, more sustainable world.

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