Indufor ...forest intelligence

Forest Stewardship Council (FSC)

Strategic Review on the Future of Forest Plantations

October 4, 2012
Helsinki, Finland

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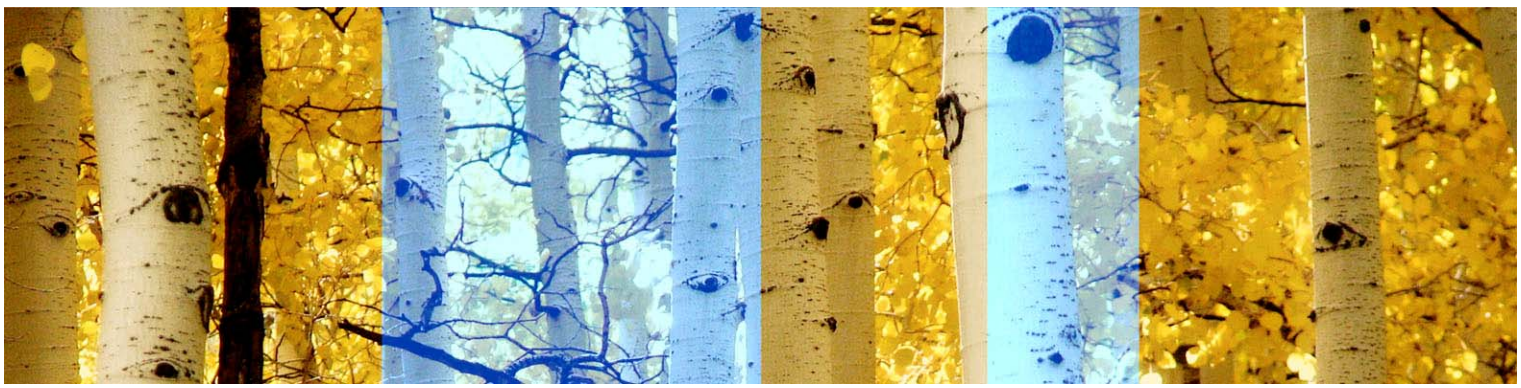

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ABBREVIATIONS

AAC	annual allowable cut
BRL	Brazilian real
CBD	Convention on Biodiversity
CDM	Clean Development Mechanism
CIFOR	Center for International Forestry Research
CMPC	cellulose riograndense
CO_2	carbon dioxide
CPF	Collaborative Partnership on Forests
EKC	Environmental Kuznets Curve
ERS	Economic Research Service of USA
EU	European Union
EU ETS	EU Emissions Trading Scheme
EUR	euro
EUTR	European Union Timber Regulation
FAO	Food and Agriculture Organisation of the United Nations
FGHY	fast growing high yielding
FLEGT	Forest Law Enforcement, Governance and Trade
FSC	Forest Stewardship Standards
GDP	gross domestic product
GEF	Global Environment Facility
GFRA	Global Forest Resources Assessment
GHG	greenhouse gas
GMO	genetically modified organisms
ha	hectare(s)
ICRAF	World Agroforestry Centre
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organization
m^3	cubic metre
MAI	mean annual increment
MST	Movimento dos Trabalhadores Sem Terra
NFC	New Forests Company
NGO	non-governmental organization
NWFP	non-wood forest product
NZ ETS	New Zealand Emissions Trading Scheme
NZU	New Zealand Units
PEFC	Programme for the Endorsement of Forest Certification Schemes
REDD+	Reducing Emissions from Deforestation and Forest Degradation plus
SME	Small and Mediums-sized Enterprise
TIMO	Timber Investment Management Organization
ToR	terms of reference
UK	United Kingdom
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nation's Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
US	United States
USD	United States dollar
VPA	voluntary partnership agreement
WB	World Bank

PREFACE

This report was prepared at the request of the Forest Stewardship Council, **FSC** (the Client) by Indufor Oy. The intended user of this report is the Client. No other third party shall have any right to use or rely upon the report for any purpose.

The project involved a strategic review on the future of forest plantations in the world. The report contains the opinions of Indufor and material based on other sources. This report covers the issues mentioned in Chapter 3 (Scope).

This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

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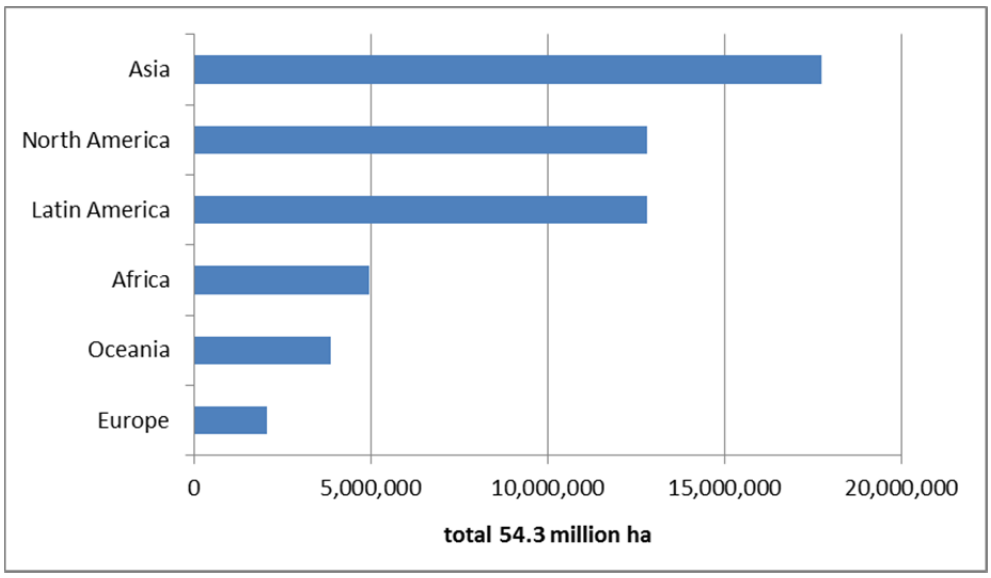
KEY RESULTS AND SUMMARIZED FINDINGS

Present Extent of the World's Fast-growing Industrial Forest Plantations

The world's total area of industrial fast-growing forest plantations[1] is 54.3 million ha (ha), based on Indufor's survey. The countries with the largest area of the plantations are the United States (US), China and Brazil, each having over 5 million ha of industrial plantations. India and Indonesia are the next largest plantation growers with over 2.5 million ha of industrial plantations.

Asia has the largest industrial forest plantations (17.7 million ha), followed by North America (12.8 million ha) and Latin America (12.8 million ha). In Africa there are almost 5 million ha, in Oceania 3.7 million ha and in Europe 2.0 million ha of industrial forest plantations.

Figure 1 Industrial Forest Plantations by Region, 2012



Land Ownership

The majority of the world's forest plantations are still government-owned with 50% of the assets while corporates hold about 20% and private landowners about 30%. However, there are significant differences depending on the region.

Land is mainly owned by the state in Asian plantation countries (China, Indonesia, India and Malaysia) as well as in African plantation countries (Mozambique, Tanzania, Uganda, Rwanda, Zambia, Angola, Ghana and Liberia). The states have in some cases leased the land to private companies or other entities or allocated land to private farmers or villages with land titles that resemble freehold land.

In the US, Oceania and Europe the dominant land ownership mode is private freehold land. In the US and Oceania assets are mainly owned by corporates and in Europe by families or individuals.

[1] The definition of industrial fast-growing plantations covers intensively managed productive plantations i.e. semi-natural planted forests, protection plantations and scattered planted woodlots are excluded.

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The land ownership structure can be a barrier to entry for many plantation developers, although leasehold arrangements eliminate high upfront investment and speculation on land prices. All in all, it is expected that conventional state management will be replaced with outsourced private management and leasehold arrangements in the future in many countries.

In Latin America the pressure arising from the dissatisfaction of local smallholders, rural landless people and some civil society groups will undoubtedly impact on land ownership structure. While large-scale industrial ownership will remain dominant in the future there will be a growing number of small and medium-scale tree farmers. In some Asian and African countries small-scale tree growers are expected to play an important role in future plantation development.

Land Use Competition

Global land use competition is mainly demand-driven due to increasing needs, on the one hand, of food and agricultural commodities, and bioenergy on the other.

The demand for arable land for food production is mainly driven by population growth and increased livestock production in developing regions, as well as by highly developed and populated countries suffering from shortages of farm land (e.g. South Korea, Qatar, United Arab Emirates). These countries have started to lease large areas of arable land, mainly from Africa, to grow food for their own citizens. The demand for bioenergy has not yet clearly materialised but it is likely that the decisions concerning renewable and bioenergy in Europe, the US and elsewhere will increase the competition for plantation land aimed at biomass production purposes.

Land use competition will put pressure on land prices, pushing them up and shift in forest plantations towards new frontiers. It will also be a strong future driver for more intensive management and for the development of technology aimed at higher productivity of trees and agricultural crops.

However, it is important to note that fast-growing forest plantations represent only 1.3% of the global forest area. It is anticipated that the share will grow to 2-4% by 2050. In other words, forest plantations as such are seldom the main form of land use even at the local level.

National Laws and Policies

The key plantation countries have had and may continue to have incentive schemes supporting forest plantations. Such incentives include tax exemptions and direct or indirect plantation subsidies. Strong national policies promoting plantations have been seen in South America (Brazil, Chile and Uruguay), Asia (China and Vietnam) and Europe (the United Kingdom (UK), Spain and Portugal). There are very few incentives for plantation development in Africa – South Africa and recently Uganda are exceptions. In North America the state has traditionally neither limited nor supported forest plantation development.

Oceania, North America and Europe have well-established and enforced environmental legislation. In Latin American plantation countries environmental legislation and particularly law enforcement has recently tightened with strict permit processes and environmental liabilities. In practise this will guide plantation development and most likely lead to improved environmental performance. In many Asian and African countries insufficient law enforcement is, however, a serious problem.

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Technology

Oceania as well as Latin American and North American countries will continue to be the leaders in plantation technology with plant breeding, advanced silvicultural genetic improvement, advanced silvicultural regimes and logistics. Plantation technology will also play an important role in adaptation to climate change.

The best available technology will, over time, spread to all global regions along with the international plantation companies and investors.

Genetically modified organisms (GMOs) are and will remain a contentious issue. However, most likely genetic modification will be applied in plantation forestry in the future to improve specific characteristics of planted trees.

Environmental Issues

In countries and regions where the administration and society is strong enough to fulfil its role in legislation and law enforcement, the environmental issues are usually dealt with appropriately. Plantations can be part of rehabilitation of endemic forests and the growing wood source from plantations diminishes the pressure on native forests.

From a climatic point of view plantations can have both a positive as well as a negative impact. Plantations can be established for climate mitigation reasons as they can act as carbon sinks and store more carbon than, for instance, grasslands. On the other hand there is concern, mainly in Asia (Indonesia and Malaysia) regarding thick peat lands storing vast amounts of CO_2 as the draining of peat lands accelerates carbon emissions from soil.

Biotic and abiotic damage is a concern on existing monoculture plantations, as natural damage control is missing. In some areas the frequency of disease is higher in next generations of a plantation. More and more measures will be needed to mitigate such threats as wind, insects and fungi in changing climatic conditions.

Water shortage is a source of environmental concern in many regions. There is particularly a concern of plantation development with highly evaporating species will worsen the existing drought-proneness in vulnerable regions.

The environmental value of forest plantation depends largely upon the type and condition of the area replaced by a plantation. Inappropriate plantation expansion, with conversion of native vegetation to forest plantations and neglect of soil and water conservation, has given a bad reputation to forest plantations in some countries. Forest plantations, when properly managed, can, however, serve a number of purposes that reflect numerous societal values, including environmental ones.

Social Issues

Plantation development naturally creates changes – both positive and negative – to the lives of local people. Social impacts are manifold and highly complex. In addition, they are dynamic, while being very time and place specific. In many regions the environmental and social issues are very much interlinked.

Population growth causes tension, mainly in Asia and Africa. As the population grows, more people will end up competing for the same piece of land, and as a consequence competition for land will become tougher.

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The ambiguous situation regarding statutory and customary land use rights is another difficult issue in parts of Africa, Asia and South America. Indigenous people and other local communities often rely on customary rights, whereas plantation companies are committed to following the statutory licensing and tenure statutes. The statutory system does not always recognize or respect customary land rights, which can mean loss of land use rights for local people. In some countries the state does not allow plantation developers to take local people's wishes into consideration even if the plantation company would like to do so. The situation creates a serious challenge for foreign companies working in developing countries– not least since sometimes plantation companies end up as stakeholders in local conflicts that were initiated long before they entered the area.

Timberland Investments

The value of the global timberland area available for institutional investors is estimated to be USD600-700 billion, of which forest plantations have a significant share. The total value of the professionally managed timberland assets is USD70-100 billion[2]. This corresponds to only around one tenth of the value of global forestland available for investors worldwide, leaving major opportunities for institutional investors to access the asset class in the years to come. It is likely that timberland investments will grow in the future.

The majority of timberland investment funds are located in the US, with only a small share of the assets of the US funds being located outside the country (mainly in Australia, New Zealand and South America). More international focus has brought about new, non-US-based funds, especially in Europe. Currently, over 50 established timber funds exist globally.

In the future a shift of focus by investors from mature areas (North America, Oceania and parts of South America) to new regions and countries is expected. Investors are, in addition to the direct financial result, conscious of their reputation. As the global competition for arable land will most likely intensify, investors will tolerate higher risks and move to new, more demanding areas in the future. Investors from Asia, mainly China and India, are already active in the land markets in Africa and South America. Africa will become a more desired location and new areas will be explored in South America. Asia will continue to be an attractive target for investors, in spite of concerns regarding quite challenging land lease processes and concerns for environmental performance.

Global Plantation Supply Development

Indufor estimates that the annual increase in forest plantation area from 2012 to 2022 is 2.28% and respectively from 2022 to 2050 it is 1.30%; i.e. the area will expand from the current 54 million ha up to 67 million ha in 2022 and finally up to 91 million ha in 2050.

[2] Indufor estimate based on information of several Timberland Investment Management Organizations in 2012.

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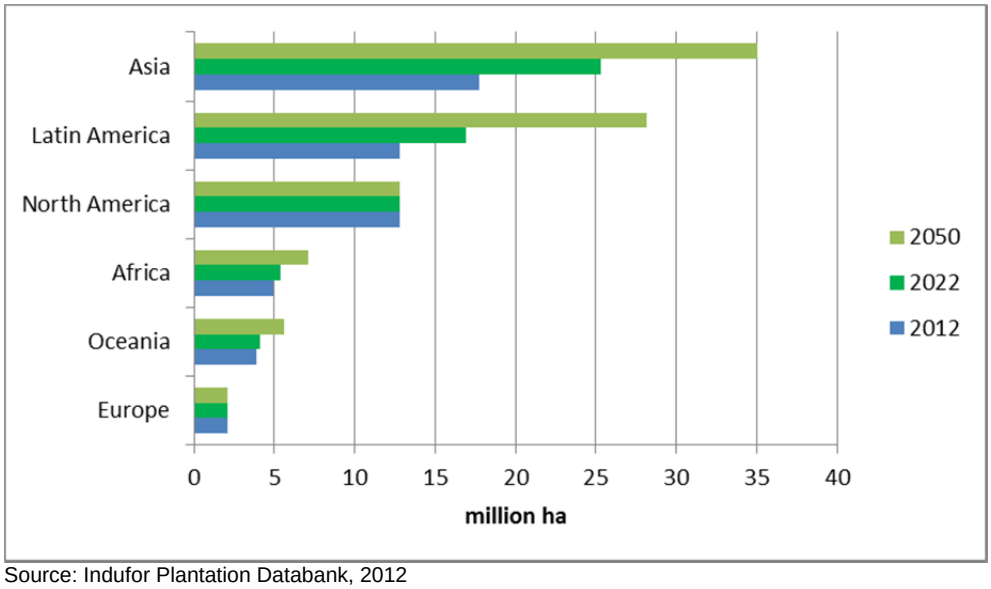
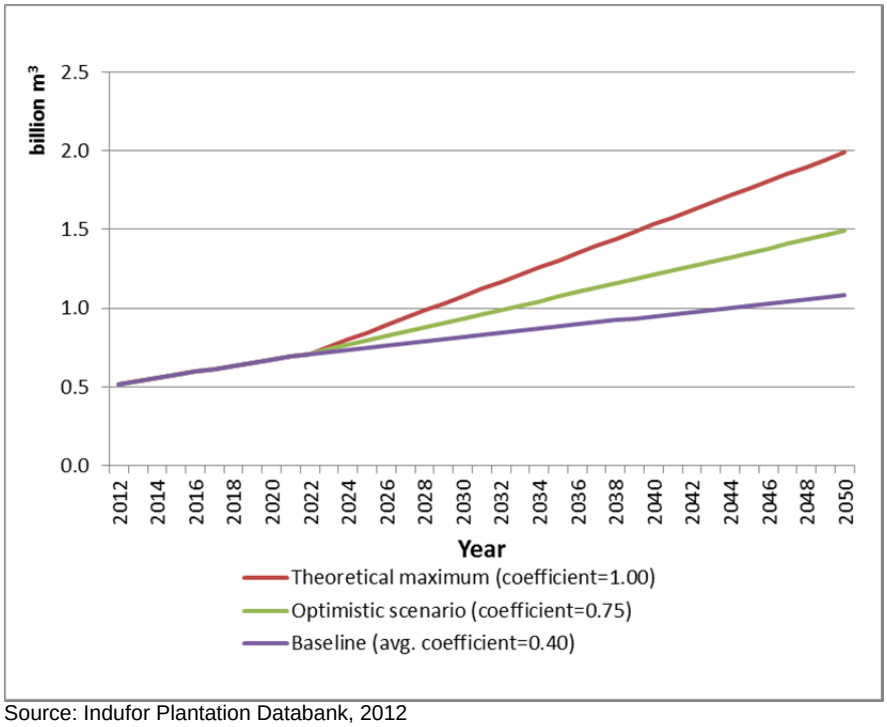
Figure 2 Global Plantation Area in 2012 and Forecast for 2022 and 2050



Source: Indufor Plantation Databank, 2012

The level of overall annual supply of plantation based roundwood is 520 million m^3 in 2012. Indufor estimates it will grow to 711 million m^3 by 2022. Under the baseline scenario the overall supply is estimated at 1 billion m^3 while the theoretical maximum scenario would imply an overall supply of 2 billion m^3 in 2050. Based on the optimistic scenario, and in Indufor's opinion the most likely scenario, the plantation wood supply will be 1.5 billion m^3 by 2050. The factors differentiating the supply scenarios are productivity, intensity of management and logistics.

Figure 3 Global Plantation Supply Scenarios, 2012-2050



Source: Indufor Plantation Databank, 2012

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Global Industrial Roundwood Demand

Global demand for industrial roundwood was just over 1.5 billion m^3 in 2012. North America, Europe and Asia are the largest demand regions, corresponding to 73% of global consumption.

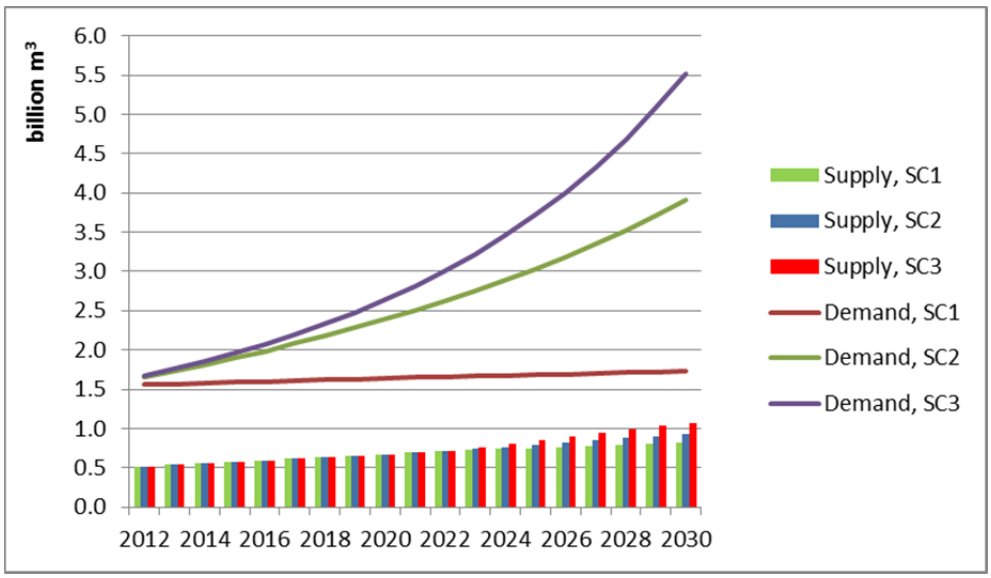
Scenario I of this study forecasts that globally the industrial roundwood demand will reach over 1.7 billion m^3 in 2030, and just under 2 billion m^3 in 2050. This trend reflects the expectation that the world population in coming decades will still increase but at a slower pace. **Scenario II** forecasts that demand for such roundwood will exceed the 2 billion m^3 mark by the beginning of the next decade and reach just over 6 billion m^3 in 2050. Under **Scenario III** demand will reach just over 3 billion m^3 in 2030 and over 8 billion m^3 in 2050.

Supply Demand Balance

At present, plantation based wood satisfies about one third of the total global industrial roundwood demand although with significant regional differences. Indufor estimates that by 2050 plantation based wood will satisfy between 25 and 35% of the industrial wood requirements, depending on the development of supply and demand.

Demand for industrial roundwood is forecast to grow faster than supply of plantation wood under all other scenarios except the most pessimistic demand scenario. Currently the share of plantation wood of all demand is some 33% and the share will decrease under all other scenarios except the pessimistic demand scenario.

Figure 4 Global Demand and Supply Scenarios, 2012-2030



Source: Indufor Plantation Databank, 2012

Demand Scenario II is slightly optimistic and considered the most realistic outlook. Under this scenario supply of plantation wood cannot match the demand increase, and its share of all supply will decrease from 33% in 2012 to 24% in 2050. This means 76% of all global roundwood demand will be satisfied with harvesting from natural and semi-natural forests. This greatly increases the pressure on existing natural forests,

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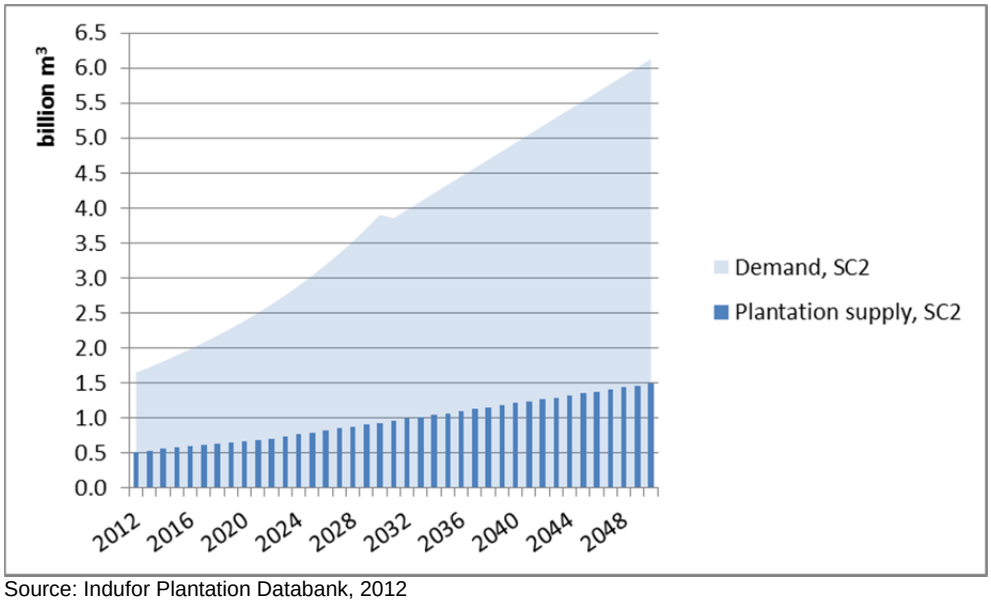
both tropical and boreal. As the access to existing underutilized boreal forests is limited, the pressure will mount first on areas with easier access.

Only under supply Scenario III does the share of plantation wood of total supply remain stable at 32-34% towards 2050. This means plantation forestry is promoted, land tenure issues are actively resolved and land is made available for plantations, management is intensified, efficiency of wood production is improved and average growth, either through GMO or other effective means, is significantly increased. This would help to keep the utilization of natural forest at the current share, but in volume terms the use would increase substantially.

Figure 5 Supply Scenario II and Demand Scenario II, 2012-2050



Source: Indufor Plantation Databank, 2012

Strategic Highlights of the Study

Due to the forecast demographic and economic development Indufor anticipates that:

1) Global fast-growing plantation area will most likely almost double by 2050.
2) Ownership and tenure structure of plantations will be more diversified, giving a more important stake in the future for: (i) financial investors, (ii) private small- and medium sized tree growers; (iii) lease arrangements between states and companies; and (iv) partnerships between strategic and financial investors as well as between companies and local landowners.
3) Land use competition will elevate land prices.
4) Growing industrial wood demand will continue most likely well beyond the volumes that the fast growing tree plantations can supply even if plantation development is accelerated.

This means that the Forest Stewardship Standards (FSC) has to consider carefully the following environmental and social challenges:

1) The pressure to use natural forests, particularly in frontier areas, will continue and cause deforestation and degradation.

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2) Climate change increases risks related to wind, insects, drought, fire and other damage.
3) Incompatibility of statutory and customary law regarding land ownership, tenure and use will cause more tension at the local level in new frontier regions.
4) Due to the increased number of small-size tree growers in many regions technology, logistics and market access will require new innovations.
5) Genetically modified organisms (GMOs) applied in tree breeding will continue to be developed.

The FSC should capitalize on the following opportunities:

1) Fast growing forest plantations can be an attractive investment target for financial and strategic investors as well as for local landowners.
2) Plantation development can improve the overall environmental performance and increase ecosystem services related to biodiversity, carbon stocks and landscape planning.
3) Forest plantations that involve local stakeholders provide positive social impacts: improved land management, employment, income, infrastructure, and social services (e.g. education, health).
4) New innovations in plantation technology can increase future wood supply and adaptation to climate change.
5) National and local level policies can accelerate plantation development e.g. with direct and indirect incentives as well as by improving the operational environment.
6) Forest plantation development has an important role in climate change mitigation and adaptation: releasing pressure from tropical natural forests, increasing carbon stocks, and improving resistance to changing climatic conditions.

Indufor recommends that FSC take into account the following issues in future strategic work:

1) Plantations will be very significant for wood sourcing in the future and it is important that FSC have clear guidelines both for certification in plantations and in natural or semi-natural forests.
2) FSC has to remain abreast of the changing ownership of plantations and develop and diversify its approaches to reach different types of owners (institutional, timber investment management organizations (TIMOs), industrial, smallholders) of plantations.
3) FSC has to be active in new frontier areas e.g. in Africa where the area of forest plantations is expected to grow rapidly.
4) FSC has to develop a strategy regarding carbon issues and plantations to meet the expectations in the future and to be able to benefit from finance in carbon trading.
5) FSC should pay attention to the development of GMOs. As a first step FSC could develop a policy regarding research on GMOs. FSC could also formulate a policy promoting openness and the need for monitoring in relation to the use of GMOs.

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1. INTRODUCTION

FSC announced that it will engage an external consultancy to conduct a high-level, strategic analysis of the current status of forest plantations and develop a view of their future for the next ten years and longer term-projections.

The FSC sent Indufor the Terms of Reference (ToR) for the assignment on March 26, 2012, based on which the analysis in this report includes a wide variety of themes related to forest plantations, including

- Basic data on plantations (area, geographic and species distribution, use of plantation wood)
- Plantation development from land use viewpoint
- Social and environmental issues and challenges (including plantations carbon sink component)
- Forest industry markets and consumption patterns
- Expected development of new forest product markets (e.g. biofuels, biochemicals)
- Development of forest plantation technology

The final outcome of the study is an in-depth scenario-based analysis. The scenarios will give insight to FSC for elaborating future strategies under different possible circumstances.

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2. OBJECTIVE

The objective of the assignment is to provide FSC with key insights on the current status and future development of the world's forest plantations.

The purpose of the analysis is to inform FSC's long-term strategic deliberations and positioning.

The work will focus on:

- Making a high-level analysis
- Identifying major trends
- Identifying expected impacts on development in the forest sector.

The horizon for the data, trends and estimates is the next ten years. In addition, Indufor also provides longer term projections (to 2050) on the role of plantations in supplying forest products.

3. SCOPE

The scope of the assignment is presented in Figure 3.1 and Figure 3.2.

Figure 3.1 Scope - Supply

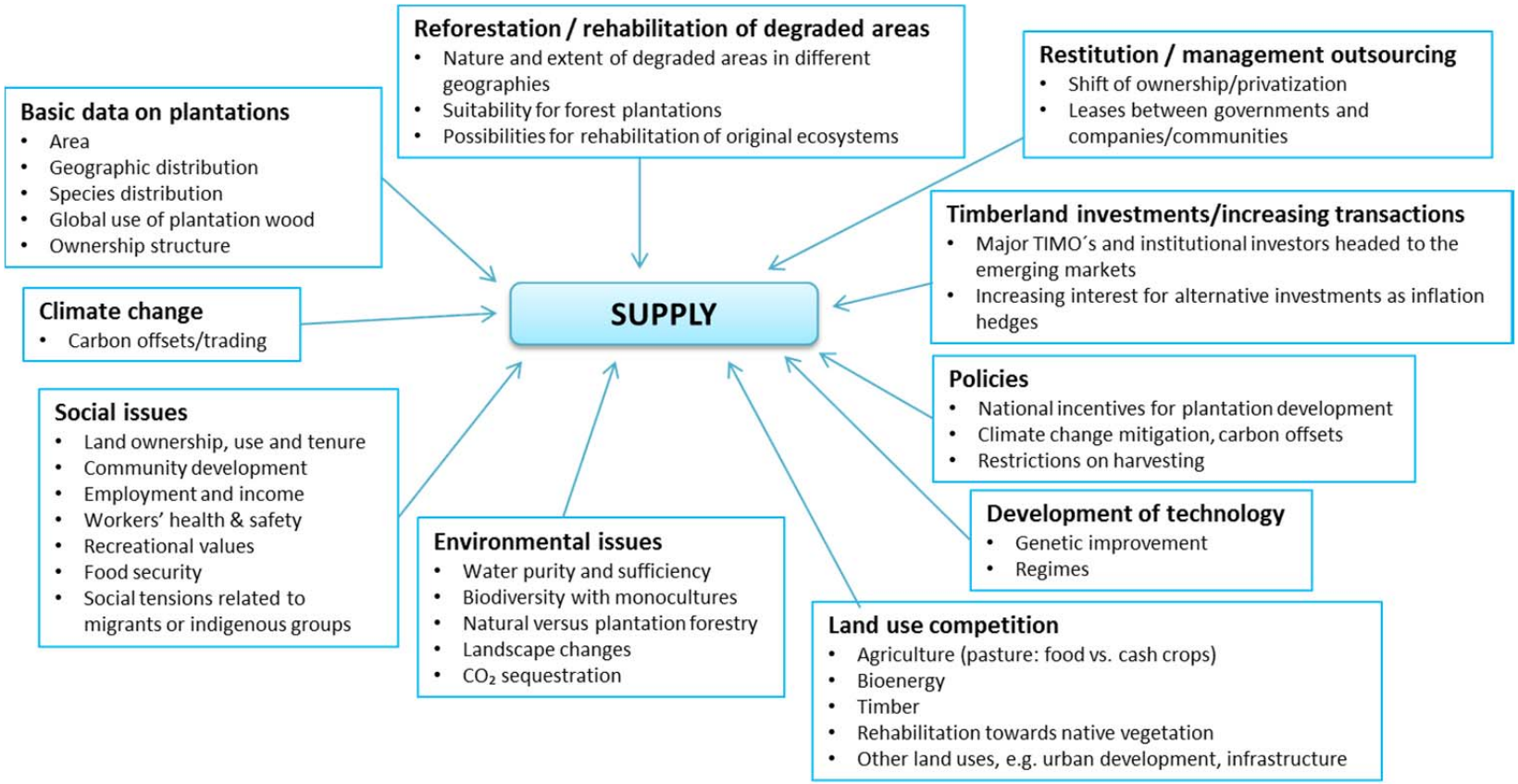
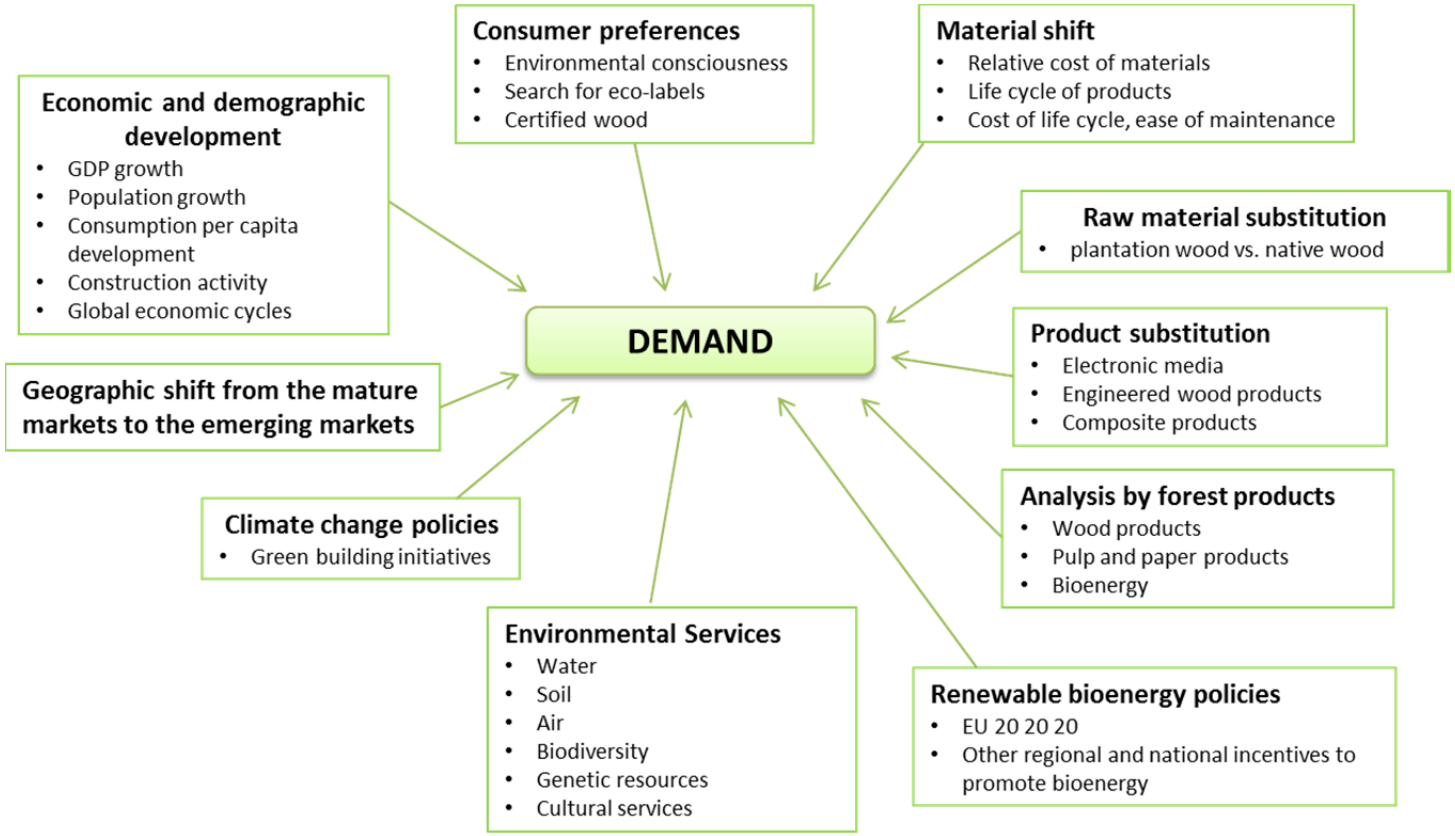


Figure 3.2 Scope - Demand



4. METHODOLOGY

4.1 Supply

Plantation roundwood supply forecast was extended until 2050. Annual allowable cut (AAC) for the countries and regions was calculated based on the Indufor plantation databank data on areas and mean annual increments (MAIs). Supply coefficients, based on real world data, were used to calculate the share of plantation wood that comes to the markets annually. The baseline coefficient was used from 2012 to 2022 as a static figure as the trees to be harvested in the next 10 years are mostly already planted.

In order to create scenarios from 2022 onwards to 2050 Indufor has varied the coefficient for the optimistic and pessimistic scenarios. The baseline scenario after 2022 leaves the coefficient untouched and the 2050 level is therefore based on the estimate of the plantation area growth by 2050. For the optimistic scenario a coefficient of 0.75 was predicted from 2022 onwards until 2050. This estimate of coefficient is based on technological improvements (e.g. harvesting and cloning technology), more efficiently managed forests and higher demand for wood increasing the pressure on forest plantations. Compared to the theoretical maximum scenario Indufor still predicts that 25% of the forest plantation potential will remain unexploited, due to a variety of reasons. With the theoretical maximum scenario the coefficient is 1.00 which means that AAC equals supply. This scenario would indicate that all of the rotations are symmetrical and everything is harvested exactly according to the managed plantation regimes.

4.2 Demand Forecast

The demand for industrial roundwood is forecast to 2050. The forecast to 2030 is made year by year and then the trend is extended to get projections for 2040 and 2050. For the purposes of the forecasting, the world is first divided into seven regions (Table 4.1): (1) Latin America and the Caribbean (2) Asia (3) North America (4) Europe (5) Russia (6) Africa and (7) Oceania. The first two regions are further divided into sub-regions and countries to deepen the analysis. The global demand forecast is then the summation of forecasts of all seven regions. Altogether there are 12 demand forecast (sub-) regions and countries: *Latin America*: (1) Brazil (2) Rest of Latin America; *Asia*: (3) China (4) India (5) Indonesia (6) Japan (7) Rest of Asia; (8) *Europe*; (9) Russia; (10) *North America* (the US and Canada); (11) *Oceania*; and (12) *Africa*.

The forecasts are made under three scenarios: Scenario I, Scenario II and Scenario III. These scenarios incorporate all possible demand drivers (analysed in Section 6.1), and are described with their respective assumptions in Section 6.2. The forecast results are presented in Section 6.3.

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Table 4.1 Regions and Sub-regions for Indufor Forecast

Regions	(Sub)regions/countries
1. Latin America and the Caribbean	Brazil
	Rest of Latin America
2. Asia	China
	India
	Indonesia
	Japan
	Rest of Asia
3. North America	US
	Canada
4. Europe	
5. Russia	
6. Africa	
7. Oceania	

4.3 Geographic Analysis

Chapter 5.3 of this report is constructed so that the world is divided into six global regions. Relevant themes for each region are presented in a table. The global regions are the following:

1. Latin America
2. Asia
3. Africa (sub-Saharan)
4. Oceania
5. North America
6. Europe and Russia

The themes discussed under each global region are:

(i) Land ownership
(ii) Land use competition
(iii) Laws and policies
(iv) Technology
(v) Environmental issues
(vi) Social issues
(vii) Timberland investments

This approach was chosen, because the relevance, nature and extent of the themes (and specific issues under them) differ greatly between regions.

The analysis is presented in a table format in order to keep it clear and consistent. The analysis starts with identifying the relevant issues under the above mentioned broad themes (i)-(vii). The next column lists the countries where the issue is prevalent. The column after that explains why the issue is relevant in today's world or gives background information behind the issue. The next column estimates the trend for the issue and the final column explains the impact of the issue for forest plantation development in the future.

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5. PLANTATIONS

5.1 Plantation Definition

FSC International itself has classified plantations as shown in Box 5.1. It is important to note there are different definitions for plantations, the widest covering areas which have been artificially planted, or are composed of only one or few species, and the most narrow definitions requiring a certain productivity level for plantations.

Box 5.1 Plantation Definition by FSC

> Forest area established by planting or sowing with using either alien or native species, often with one or few species, regular spacing and even ages, and which lacks most of the principal characteristics and key elements of natural forests. The description of plantations may be further defined in FSC, with appropriate descriptions or examples, such as:
>
> Areas which would initially have complied with this definition of 'plantation' but which, after the passage of years, contain many or most of the principal characteristics and key elements of native ecosystems, may be classified as natural forests.
>
> Plantations managed to restore and enhance biological and habitat diversity, structural complexity and ecosystem functionality may, after the passage of years, be classified as natural forests.
>
> Boreal and north temperate forests which are naturally composed of only one or few tree species, in which a combination of natural and artificial regeneration is used to regenerate forest of the same native species, with most of the principal characteristics and key elements of native ecosystems of that site, may be considered as natural forest, and this regeneration is not by itself considered as conversion to plantations.

Source: FSC, 2011

The definition, "planted forests", used by the Food and Agriculture Organisation of United Nations (FAO) is broad and leaves essentially the limitations open. Planted forests are generally defined according to the extent of human intervention in the forest's establishment and/or management, which depends, to a large extent, on the purpose of growing the forest. In many instances, because there is an extensive range of silvicultural practices applied in varying levels of forest management to achieve different objectives, the difference between a semi-natural forest and planted forests is essentially arbitrary – it is in the eye of the classifier (FAO, 2000).

"Planted forests" can resemble natural ecological processes to a greater or lesser extent. There is also a need to distinguish between "Planted Forests" consisting of indigenous species from those consisting of exotic species. There is a trend towards referring to Planted Forests of exotic species as "Plantation Forests" (with single or few species, even age class, uniform planting density). "Planted Forests" of indigenous species are forms of "Semi-natural Forests" or "Modified Natural Forests" (depending on the degree of naturalness, including mixed species and age classes and variable planting density).

"Planted Forests" are often intensively managed for production purposes, but can also be established for protection, conservation or socio-economic purposes in which case the management may be less intensive. This distinction is important in global

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assessments that attempt to capture the extent of both productive and environmental functions of forests.

5.2 Global Overview

5.2.1 FAO Planted Forest Statistics

Statistics concerning plantations are often based on different definitions and there is large variation in data collection methodology also. The majority of plantations are located in emerging market economies where the accuracy of public statistical services is not a priority, and thus, publicly available information is not always reliable. FAO forestry statistics are based on information received from national statistical correspondents and therefore represent the official figures of the countries. For the purposes of this study FAO statistics are not used but are however introduced to show the difference.

According to the FAO Global Forest Resources Assessment (GFRA) 2010 the total area of planted forest was estimated to be 264 million ha, corresponding to 6.6% of the global forest area. East Asia, Europe and North America reported the greatest area of planted forests, together accounting for about 75% of global planted forest area. In East Asia planted forests make up 35% of the total forest area; most of these in China. The second largest area of planted forests is found in Europe where the share of planted forests is 27%, the second highest in the world. North America has the third largest area of planted forests with a share of 5.5% of the total forest area. China, the US, Russia, Japan and India together account for more than half the world's planted forests (53%).

Planted forests are established for different purposes and not all of them are designated for production of wood or for Non-Wood Forest Products (NWFPs). However, no information was solicited on the area of planted forests designated for productive and protective purposes for GFRA 2010. Based on the results of the Global Planted Forests Thematic Study 2005, it is estimated that around 76% of planted forests have production as their primary function. This should be kept in mind when interpreting the findings below, which cover all planted forests irrespective of their designated functions.

At the global level planted forest area has steadily increased since 1990 by an average of 4.3 million ha/year. Given this trend, FAO expects a further rise in the planted forest area up to 300 million ha by 2020. The steadily rising trend in planted forest area varies considerably among regions. China has been a clear leader in plantation expansion during the past 20 years with 1.9 million ha/year expansions, followed by the US (805 000 ha/year), Canada (385 000 ha/year) and India (251 000 ha/year).

FAO statistics clearly do not match with the general understanding of commercial plantations today. Brazil today has some 6 million ha of plantations, while the FAO reports global plantation area would increase by an average of almost 5 million ha every year. The forecast of some 36 million ha of new forest plantations in the next ten years is six times the plantation area in Brazil today. Finding suitable land and investors, willing to spend an estimated EUR36 billion, is challenging given the constraints there are in new plantation establishment.

The largest uncertainties in plantation area are related to China, which claims to have very large plantation areas. The Chinese government has promoted plantation

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establishment programs for decades, although some plantations are designated for protective purposes. Area estimates vary between 28.5 million ha (GFRA 2005) and 81.3 million ha (Chinese 5th forest resources inventory). The establishment of a fast-growing and high-yielding timber plantation base has been incorporated into the China Forestry Tenth Five-year Plan and 2015 Draft Development Plan and it is one of the six Foundations to be developed as a priority. The tentative plan is that by the year 2015 the fast-growing and high-yielding timber plantation base expands to 9.48 million ha, among which the industrial material base covers 7.42 million ha (78% of planted area), while the production base for rare and large timber covers 2.1 million ha (22%).

According to the FAO, and the Chinese authorities who provided this information, the plantations expand at an annual rate of some 2.5 million ha. Rapid expansion of plantations in China cannot be confirmed, and the owners/investors cannot be identified in most cases. Land is largely owned by the Government in China, as are most of the forests and plantations. Foreign enterprise investment in plantations is limited but expanding. Traditionally state forest farms have been in charge of forest plantations but privatization is a growing trend. It is not clear who is responsible for the expanding plantations.

GFRA also has a grouping “use of introduced species in planted forests” which better reflects the realistic level of commercial plantations. The total area of plantations established with the use of introduced species is 52.4 million ha, less than 20% of total area.

5.2.2 Indufor Plantation Databank

Indufor has relied on its own plantation databank in this study due to the lack of reliable and consistent public sources. Indufor’s plantation databank has been constructed to survey the global plantation area and production data. The latest comprehensive update to the databank was completed in May-August 2012.

The databank has been defined to include industrial forest plantations. The definition includes those productive plantations that are fast growing and high yielding (FGHY) as well as intensively managed. The end-product or the end-use is also a considered determinant e.g. non-industrial fuel wood and rubber wood are excluded. FGHY means that the plantation rotation time is notably shorter and that MAI is significantly higher than corresponding semi-natural planted forests. Intensive management in this context means that the forest management has been clearly established and realized according to the appropriate forest management regime.

The databank sources vary greatly. Sources include private companies, organizations, national forest inventories, expert interviews and Indufor’s own estimates based on the field experience. The most significant plantation countries have in many cases well-established forest inventories, which distinguish industrial plantation forests. Some countries, such as China and India, lack these thorough statistics. For such countries an examination of the planted species, management intensity and the ownership structure was carried out in order to estimate the plantation area fit for the definition. Although the FAO definition of plantation forests is much broader, as it includes any tree planted for any production purposes, some of the FAO sources have helped to determine the shares of different species in less significant plantation countries. The accuracy and level of detail is substantially higher in the following major plantation countries: Argentina, Australia, Brazil, Chile, New Zealand, South Africa, Uruguay and several African countries due to the African Forest Forum working paper series and Indufor field experience.

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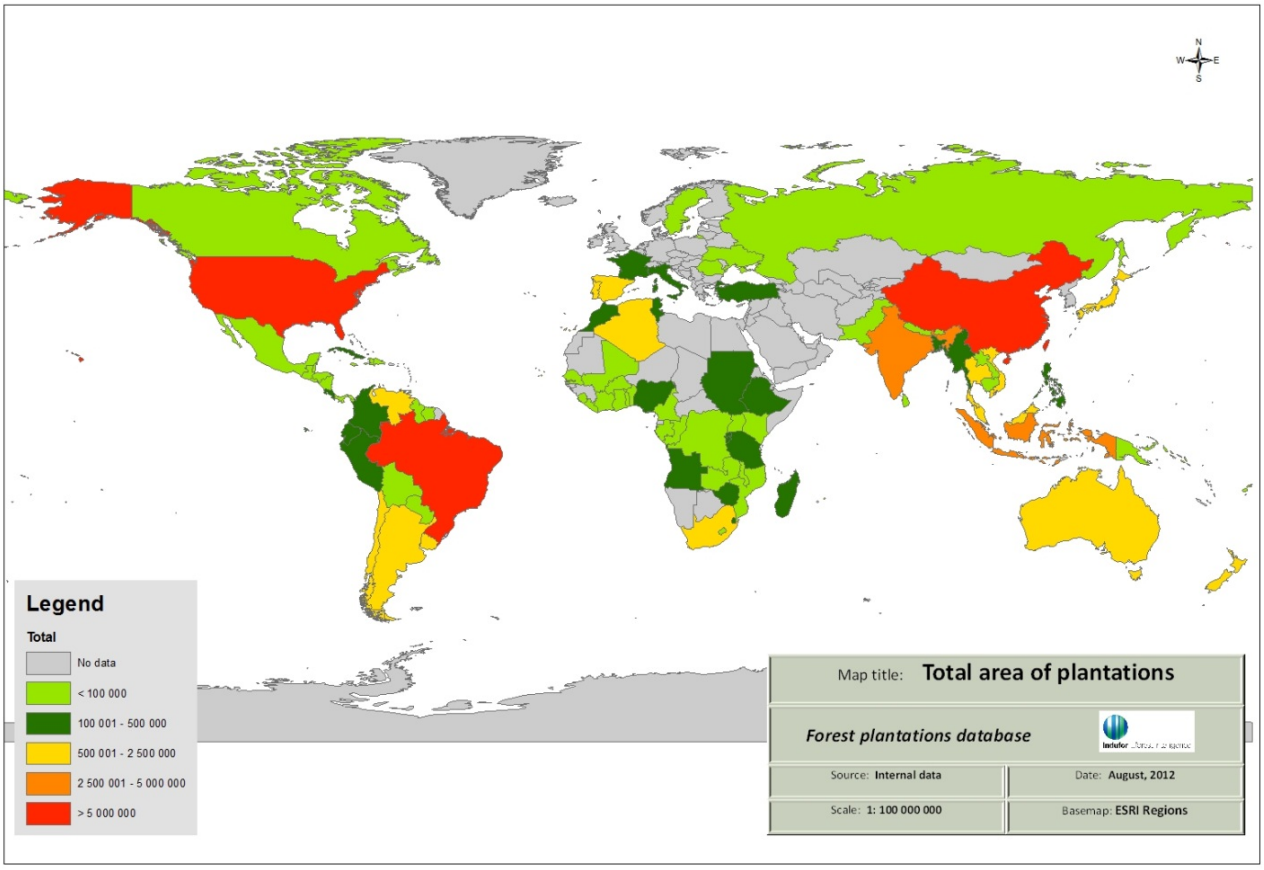
Some of the inconsequential species were labelled under *other hardwoods* or *other softwoods*. In addition in some cases these definitions were used when estimating the plantation areas and this has sometimes been the labelling used in the original data.

5.2.3 Plantation Area and Species Distribution

The total plantation area is 54.3 million ha. The countries with the largest area of plantations, classified as industrial plantations, are the US, China and Brazil, each having over 5 million ha of industrial plantations. India and Indonesia have over 2.5 million ha of industrial plantations. A number of countries globally have over 0.5 million ha of industrial plantations (Figure 5.1).

Figure 5.1 Industrial Forest Plantations Globally, 2012



Source: Indufor Plantation Databank, 2012.

The largest industrial plantations are in Asia (17.7 million ha), followed by North America (12.8 million ha) and Latin America (12.8 million ha). In Africa there are almost 5 million ha of plantations classified as industrial and Oceania has some 3.7 million ha of plantations. Europe has 2.0 million ha of industrial forest plantations (Figure 5.2).

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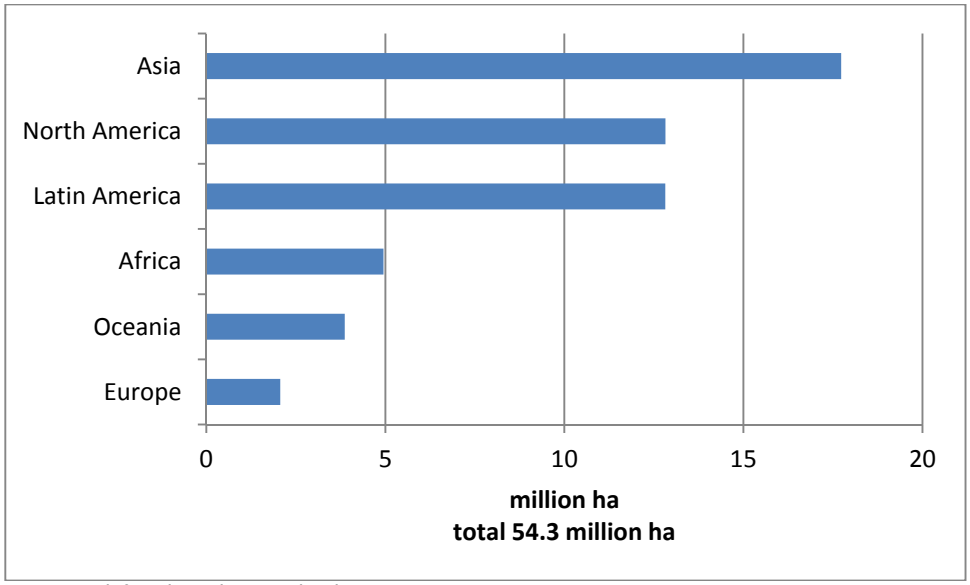
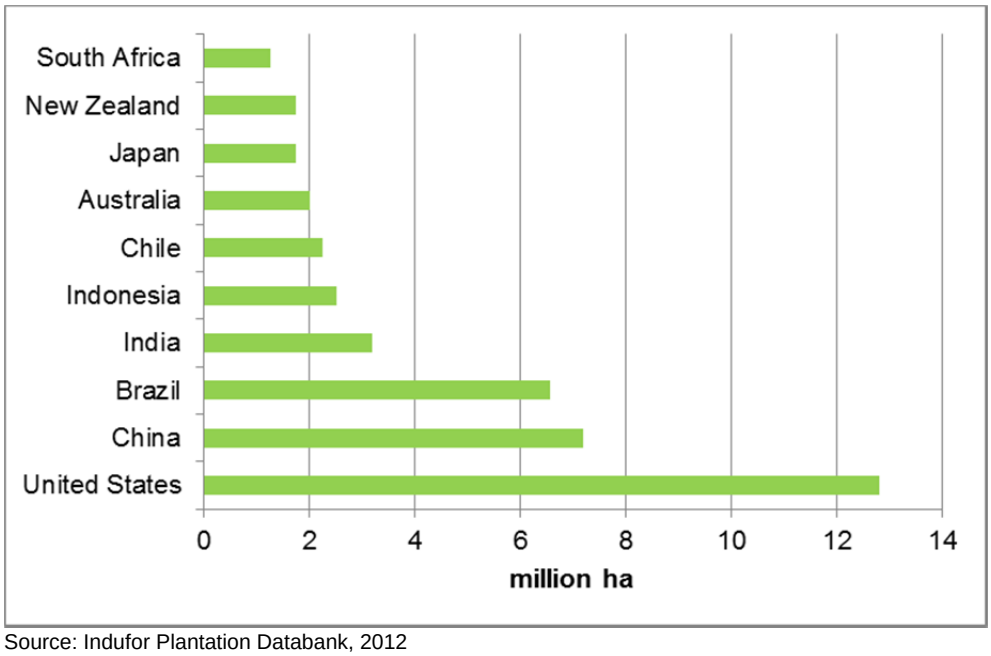
Figure 5.2 Industrial Forest Plantations by Region, 2012



Source: Indufor Plantation Databank, 2012

The largest plantation countries are shown in Figure 5.3. The US has the largest area, followed by Brazil and China. This ranking is subject to classification, and according to FAO China has the largest plantation area. India and Indonesia both have over 2 million ha of industrial plantations, followed by Chile and Australia. Japan, New Zealand and South Africa are also among the ten largest plantation countries. Together these countries account for over 75% of global industrial forest plantation area.

Figure 5.3 Plantation Area in Top 10 countries, 2012



Source: Indufor Plantation Databank, 2012

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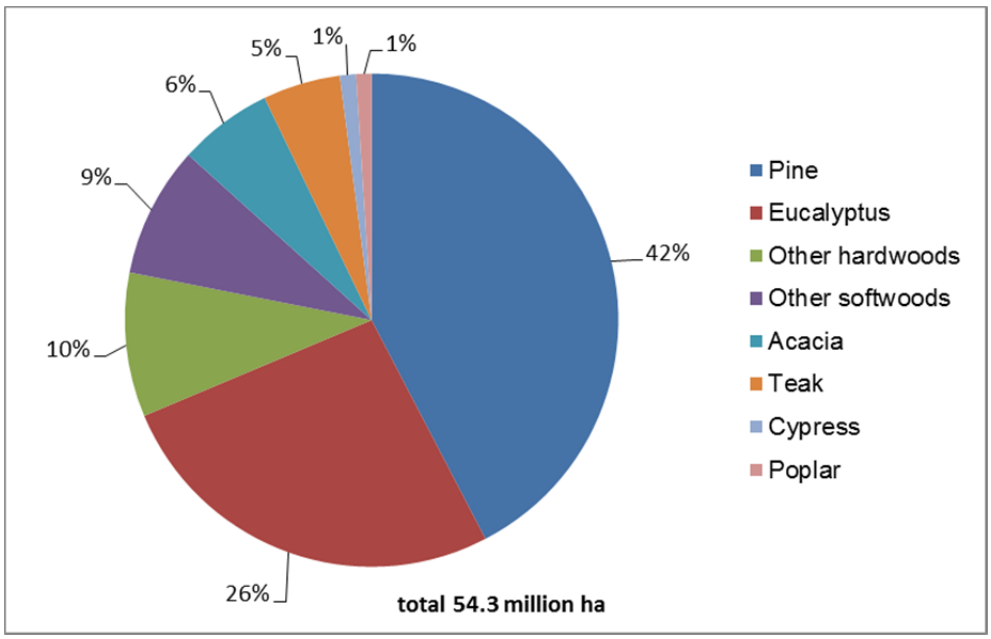
Pinus spp. is the most common species on industrial forest plantations, followed by *Eucalyptus* spp. (Figure 5.4). Unclassified hardwoods and softwoods also cover a large share of global area, these are species used mainly in Asia. On a global scale teak plantations are some 5% of global area and acacia 6%.

Figure 5.4 Industrial Forest Plantations by Species, 2012



Source: Indufor Plantation Databank, 2012

On a regional level North America consists mainly of pine plantations of different species. Latin America and Oceania have also a large share of pine plantations, as well as Africa. Europe has the highest share of eucalyptus plantations, however Asia and Latin America also have a significant proportion of eucalyptus species. Acacia is mainly found in Asia and Africa, and teak plantations are concentrated in Asia, with smaller areas in Africa and Latin America (Figure 5.5).

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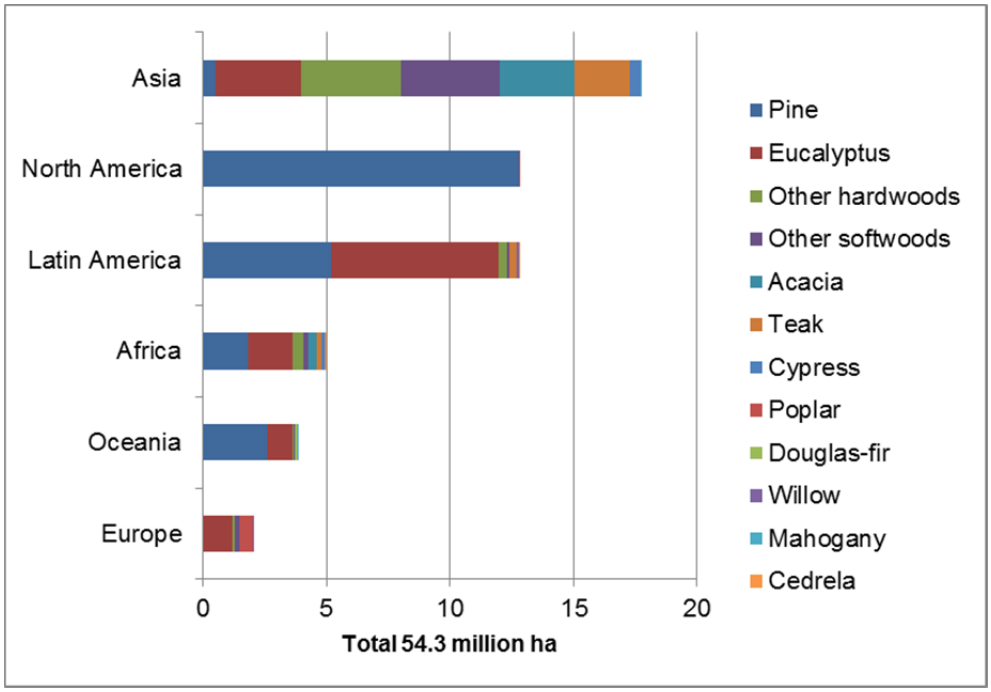
Figure 5.5 Industrial Forest Plantations by Species per Region, 2012



Source: Indufor Plantation Databank, 2012

5.2.4 Plantation Ownership Structure

According to the FAO some 50% of global productive plantations are owned by governments and other public sector bodies (Figure 5.6). This is explained by the land ownership structure of some of the large plantation countries, including China, Indonesia, India and African countries. In some cases the land may be owned by the government (in many countries the constitution defines that land cannot be owned by private individuals) but is managed by a private individual / institution / company. This has been an increasing trend although it has not advanced rapidly. Private smallholders own one third of global productive plantations, and corporate owners own less than one fifth of global plantation area.

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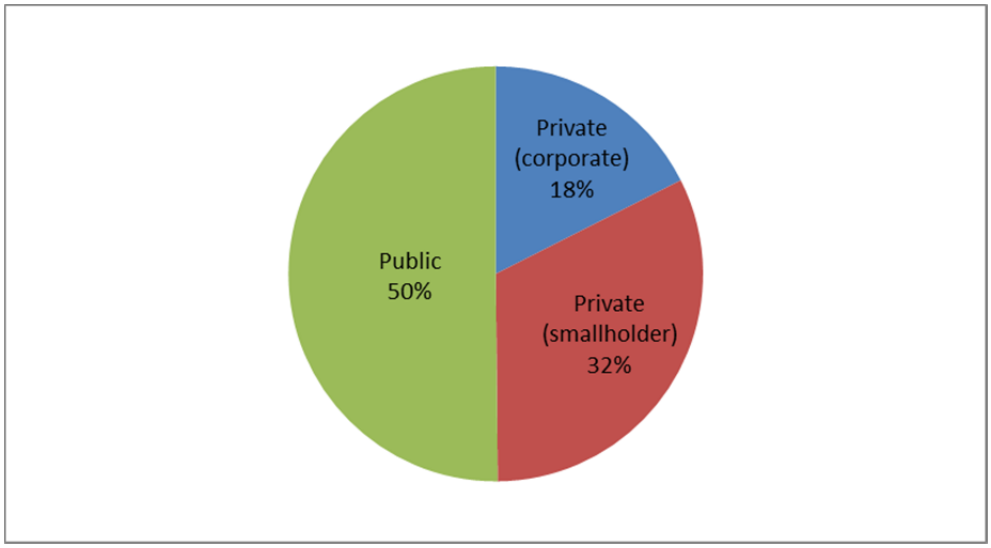
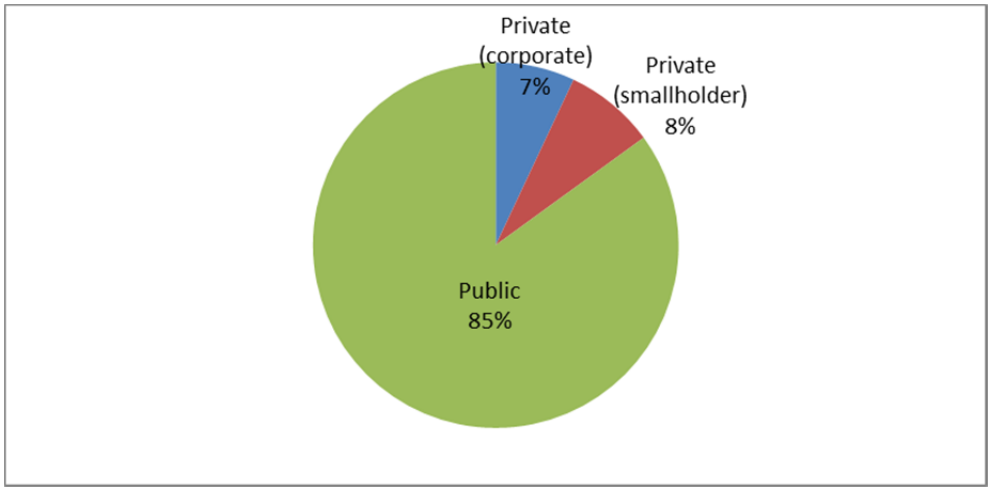
Figure 5.6 Global Ownership of Wood Plantations for Productive Purposes



Source: FAO. Wood from Planted Forests: Global Outlook, 2005-2030.

The majority of protected plantations are owned by governments, and only 15% of global protected plantations are owned by private owners (Figure 5.7). This is quite natural as plantations established for protective purposes produce a public good, and are therefore not attractive from the private player's perspective. It is likely that the productive plantation area includes protected areas as in most plantation countries the law requires a certain proportion of protected parts within the plantation area.

Figure 5.7 Global Ownership of Wood Plantations for Protective Purposes



Source: FAO. Wood from Planted Forests: Global Outlook, 2005-2030.

Since the 1980s there has been a significant rise in the ownership of planted forests around the world by institutional pension and endowment funds. This development commenced in the US, with domestic institutions wanting to diversify their investment portfolios. One such diversified category was North American planted and managed native forests.

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One reason for these phenomena was the frustration of shareholders in listed forest products companies not being able to realize the true value of their planted and managed native forest holdings in the companies' share prices. The only way to gain recognition was to liquidate their forest holdings. At the same time that more companies wanted to sell their forests, more and more institutional funds wanted to buy them - a perfect match. The scale of the ownership change from forest products companies to institutional and other owners has been phenomenal. For instance, in 1981 forest products companies owned 23.5 million ha of managed forests in the US. By the end of 2007, it was estimated to be less than 6.0 million ha. In contrast, the investment by institutional funds in global planted and managed native forests has increased from less than USD1.0 billion in 1985 to perhaps more than USD30 billion in 2007.

5.2.5 Timberland Investments

Timberland investing has its roots in the United States. In the 1980s forest industry companies in the US started to rethink their wood sourcing strategies and to consider the divestment of their forest areas. Many of the companies wanted to concentrate on their core businesses, to improve the return on assets and to generate cash.

Simultaneously, the awareness of forest assets' attractive investment characteristics started to draw professional investors. A number of scientific studies had found timberland returns to be non-correlated with financial asset returns but correlated with inflation. This indicated that forest would not only decrease the overall risk of an investment portfolio but also provide for a natural inflation hedge.

In the 1990s the number of timber investment management organizations (TIMOs) and their assets under management in the US increased significantly from around USD1 billion to USD10-12 billion (Zinkhan et al. 1992). Towards the end of the decade TIMOs also started to expand to certain emerging markets where forest assets with higher risk-return profiles existed. Higher returns were achieved as a consequence of several factors: high growth rates, low costs of wood production, reasonable proximity of the markets and demand, as well as increasing land prices. In the late 20th century Latin America (for example Brazil, Chile) and Oceania (Australia, New Zealand) emerged as attractive timberland investment regions.

During the last ten years, the value of forest investments has continued the rapid growth. Institutional investments in timberland in 2005-2006 were estimated to be USD15-30 billion, of which 91% were in North America, 5% in Oceania and less than 4% in emerging markets (Clutter et al. 2005; Merrill Lynch 2007). By 2008 the estimated allocation of investments had increased to USD50 billion (Neilson 2008). At present, the investor capital placed in timberland is USD70-80 billion, of which over 70% is in the US. The emerging markets' share of the timberland investments has grown as the drivers behind the higher returns, identified during the 1990s, have become stronger. In addition, new rising trends, such as environmental services, climate change mitigation and demand for wood-based energy, have enhanced the attractiveness of emerging markets.

Figure 5.8 presents the development of the timberland investments' products, drivers, ownership structure, and regions over time.

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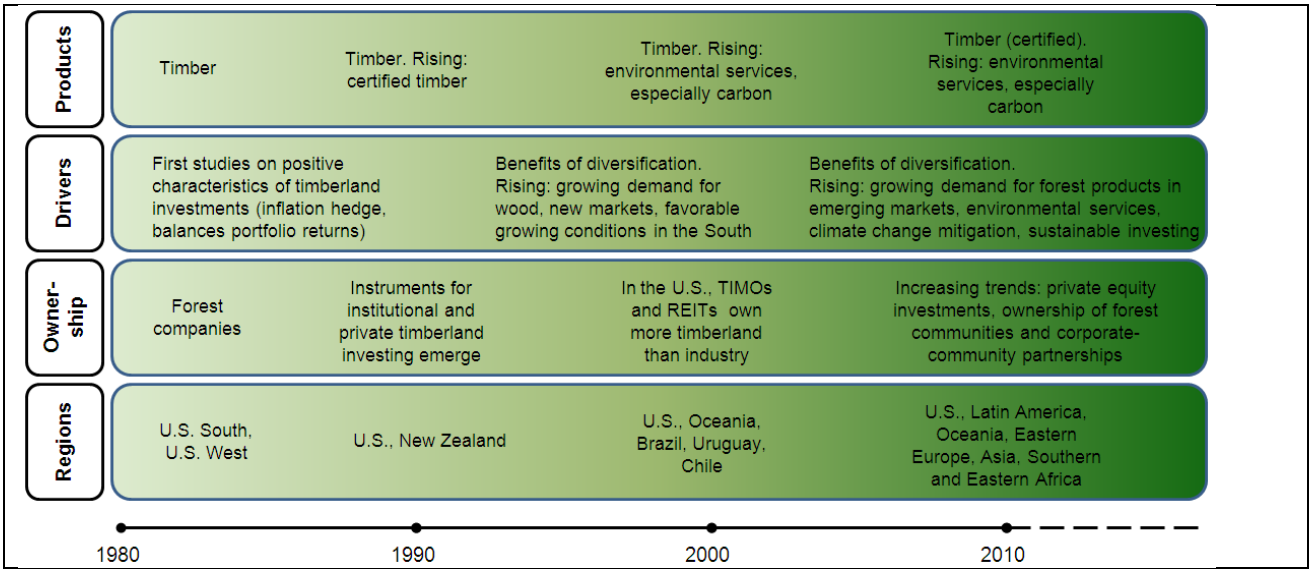
Figure 5.8 Timberland investment Development over Time



5.2.6 Policy Framework

The international policy dialogue concerning forests started before the United Nations Conference on Environment and Development (UNCED), Earth Summit held in Rio de Janeiro in 1992. There was an intention to negotiate a Global Legally Binding Forest Convention on all Types of Forests in line with the Convention on Biodiversity (CBD) and UN Framework Convention on Climate Change (UNFCCC). Consensus was not reached on a forest convention but the Rio-Conference adopted the Forest Principles.

On planted forests the Forest Principles states:

> *The role of planted forests and permanent agricultural crops as sustainable and environmentally sound sources of renewable energy and industrial raw material should be recognized, enhanced and promoted. Their contribution to the maintenance of ecological processes, to off-setting pressure on primary/old-growth forests, and to providing regional employment and development with the adequate involvement of local inhabitants should be recognized and enhanced.*

In the international forest policy framework there is a delicate balance between natural, semi-natural and planted forests. At an earlier stage some countries and stakeholders had tried to promote the use of either one of these regimes as the preferred option and way forward. The discussion was sometimes fairly tense but it led to a better understanding and to a consensus. More important than an overall favoured regime is that the use of the forests is sustainable and adapted to the circumstances. For instance, in the Ministerial declaration and message from the United Nations Forum on Forests to the World Summit on Sustainable Development (2002) this is expressed as follows:

> *Sustainable forest management of both natural and planted forests is essential to achieving sustainable development. Forests affect and are affected by other sectors. Therefore, policies and approaches in all sectors should be developed with consideration of their cross-sectorial impacts.*

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The non-legally binding instrument on all types of forests of the UN[3] from 2007 does not mention or have any preference in this regard. This is a critical point as this document, which has been adopted by the UN General Assembly, can be seen as the current key policy framework document at international level.

A balanced view on forests – in terms of plantation, semi-natural and natural forests – has also been enhanced by the establishment of the Collaborative Partnership on Forests (CPF). CPF has 14 members[4] with global responsibilities and all with a slightly different angle on forests. This cooperation has paved the way for a more holistic view on forests.

In brief the international policy framework does not pose any restrictions or hindrances for developing plantations nor does the dialogue favour plantations. The decisions and policies need to be developed on a country level depending on local circumstances and taking into account the sustainability issues in each particular country.

5.2.7 Experiences of Forest Incentive Schemes

At some points incentives have played a significant role in forest development in the most well-recognized forest and forest industry countries of today e.g. Brazil, Chile, Uruguay, New Zealand, South Africa and Finland. There are also recent examples of plantation incentive schemes e.g. in Uganda, Malaysia, Thailand and Costa Rica that have launched appealing smaller-scale and well-targeted grant schemes.

Interestingly, incentives for forest development in Europe, the US, Australia and New Zealand have far exceeded those provided by developing country governments in Africa, Asia and Latin America. Apparently the subsidies are not driven by development aid such as is being given to emerging economies.

The lowest levels of incentives have probably been in African countries, with the exception of South Africa. Latin American countries with significant plantation interests have used, or continue to use, incentives and subsidies as a means of encouraging plantation development. For example, between 1974 and 1994, the Chilean government spent some USD50 million on afforestation grants. In Brazil, subsidies and taxation incentives were used to encourage the establishment of plantations, and in recent years Ecuador and Colombia have adopted a similar incentives model to that used in Chile. Ecuador currently provides planting and maintenance incentives amounting to USD300/ha. Paraguay provides USD350/ha for planting and USD100/ha for maintenance for the first three years.

The positive impacts of incentive schemes include

- Creating a critical mass of forests (Brazil, Uruguay, Chile, South Africa, New Zealand) leading consequently to the establishment of forest-based industries.
- Catalysing socio-economic development and reducing poverty in rural areas
- Reducing pressure on natural forests
- Strengthening land tenure

[3] Resolution adopted by the General Assembly. Non-legally binding instrument on all types of forests. 74th plenary meeting 17 December 2007. A/RES/62/98.

[4] Center for International Forestry Research (CIFOR), Convention on Biological Diversity (CBD Secretariat), FAO, Global Environment Facility (GEF Secretariat), International Tropical Timber Organization (ITTO), International Union for Conservation of Nature (IUCN), International Union of Forest Research Organization (IUFRO), United Nations Convention to Combat Desertification (UNCCD Secretariat), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Forum on Forests (UNFF Secretariat), United Nations Framework Convention on Climate Change (UNFCCC Secretariat), World Agroforestry Centre (ICRAF), World Bank.

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There are naturally also negative experiences of incentives within forest plantations such as inefficiencies, suboptimal land use, poor quality plantations, and loss of biodiversity, as well as neglect of small-scale growers. In some cases the incentive schemes have been fully concentrated on small-scale growers and not been able to create sufficient scale for significant wood processing (e.g. Mexico).

Some incentive schemes have ended up supporting the planting of high numbers of seedlings with subsequent very low survival rates resulting in few actual plantations. These schemes focused on distributing free seedlings or direct upfront payments without performance based criteria and/or without sufficient technical support. In some cases no consideration was given to the end-products that were to be produced from the plantation products and in others, the profitability of the plantations was not taken into consideration.

In the 1970s and 1980s many countries, such as Brazil, Chile and the UK, as well as other European countries, launched fiscal incentives or tax relief incentives for forestry. Back then these incentive schemes were successful in the sense that large areas of plantations were established mainly by large-scale landowners. The other side of the coin was that medium and small-scale tree growers were practically left out and were not able to benefit from the incentives. In many cases native vegetation was indiscriminately cleared to accommodate the new forest plantations. There are also examples where land areas that were better suited to higher-value land uses were afforested.

In most countries, indirect enabling incentives have normally been well justified – especially with aspects like improved land tenure, infrastructure development, and technical assistance.

The lessons learned from successful afforestation indicate that incentive schemes need to include the following elements:

- Be performance-based – focusing on high survival rates and high productivity
- Combine direct incentives with tactical assistance (indirect enabling incentives)
- Be temporary in nature – finite lifespan and phased out at a certain point of time
- Be inclusive rather than exclusive: supporting small- medium and large-scale tree growers
- Comply with the best environmental and social standards

5.2.8 Land Use Competition

Fast-growing industrial plantations represent only 1.3% of the global forest area. It is anticipated that the share will grow to 2-4% by 2050 i.e. the forest plantations as such are seldom the main form of land use even at the local level.

Industrial forest plantations compete for land with agriculture, cattle-raising and bioenergy in most tropical countries, especially in those with large populations. As populations grow, more people will end up living on the same piece of land and exercising claims on it which inevitably leads to growing competition. Competition for land also affects land prices and thus makes land an increasingly strategic and desired asset in the future.

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Raw material production for bioenergy (like soybean, corn, oil palm) is expanding rapidly and governments in many countries promote this development. Local people choose the land use type that they find to be the most economically profitable. For instance, in Sumatra (Indonesia) the price of plantation timber per cubic metre is about USD20 which is considered barely above the cost of production, while the profitability of oil palm and rubber is at least eight times higher. Such low prices for plantation timber create disincentives for local people to actively support the development of timber plantations.

In most industrial countries land is already in some type of (productive or other) use or at least has a designated use for the future. In developing countries land use planning is often weak or inefficient, and many countries have areas that are not officially in use. Forest plantations that require large areas of land expand to areas where there is available land and where other prerequisites (good growing conditions, inexpensive labour, etc.) for profitable plantation forestry can be met i.e. to Africa, Asia and Latin America. These regions have people living in forest areas that are not officially used, but are often used unofficially by local people for many purposes such as food collection, animal herding, firewood collection, etc. These land use modes are often protected by customary laws that are not respected by all nations (following statutory laws) which create conflicts and competing land claims. Land is thus an asset that is open for competition between different industry sectors (e.g. forestry and agriculture), but also between different societal groups (e.g. industry and local communities). This creates a diverse breeding ground for different and often conflicting interests.

5.2.9 New Bio-based Markets

Many of the bio-products (biomass, textiles, bio-plastics, biofuels, etc.) are already well established in the markets as bio-based versions of fossil products, but based on soya, corn, waste oils, etc. The bio-markets are growing fast (for example, biodiesel has been growing by almost 50%/a on average). Market entry for new companies in the business should thus be comparatively easy.

Not all markets are absorbing all new bio-products as fast as some developed ones (e.g. biodiesel), nevertheless the fossil-based markets are large enough to allow and leave room for the growth of sustainable (bio-based) products. This applies for example to textiles and plastics markets. Various novel wood products are nearly ready for the market as their innovation process is maturing. The slowness to enter the market is due to the long time taken to scale up the production capacity. One important reason for the slow implementation is that there are still several competing technologies to select from, and none of them is superior to the others.
In those cases, where the bio-based products are totally new, for example nanocellulose-based products, the applications and their customers have to be developed before they can start entering the market.

5.2.10 Social Issues

Social issues related to wood plantations encompasses the relationship between plantations and the local populations living inside and around them. Plantation development naturally creates changes – both positive and negative – to the lives of local people. These changes are defined as social impacts and they are manifold and highly complex. In addition they are dynamic and very time and place specific.

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Plantation development can have an impact on community development, employment and income (level and availability), food security, recreational values, sensitivities or tensions related to indigenous groups and migrant workers, and on many other social areas of life.

Community Development

Changes related to community development are often related to the size or structure of the local population (e.g. new migrant workers coming to the area), employment opportunities and availability, land use modes (e.g. traditional land use types being replaced by plantations) and land prices.

Forest plantations, when managed badly, can cause involuntary resettlement, endanger local food and energy security or bring along other socially unwelcome consequences. Being present in many poor and rural areas, forest plantation companies can contribute to the economic and social development of the areas in many ways by investing in: general infrastructure (e.g. roads, bridges, power lines, sewerage systems), social infrastructure (e.g. schools, dormitories, kindergartens, health clinics, dispensaries, village/community halls, etc.), electricity, education and capacity building, health and sanitation, employment, gender equality, small and medium-size enterprise (SME) development, and institutional development (e.g. development of rural banking or granting micro-loans). Wood plantation companies also build infrastructure and facilities that are beneficial not only for the plantation but also for the surrounding community (e.g. fire stations; safety and security systems).

Employment and Income

Wood plantations are mostly established in rural areas where population density is relatively low. The employment benefits brought by a plantation company are beneficial in areas where other employment opportunities are scarce. Employment can be offered at different stages of plantation process (e.g. nursery, planting, management and harvesting stages).

In addition to employing local people directly as workforce, there are many other ways of cooperating with local people and providing them employment and income. Out-grower schemes, tree-grower association models, agroforestry systems and many types of company-community cooperation arrangements are examples of this. When working with a plantation company local tree growers also get many indirect benefits, such as better access to information, services and markets.

Food Security

Food security has become a heated political topic in some countries where land is being allocated for tree (or other industrial) plantations instead of food production or cattle grazing. Tree plantations are not the only cause for such criticism. Oil palm plantations and other non-edible crops cultivated for bioenergy purposes are at the heart of the current critical discussion globally.

Food security is, however, a complex issue. It is not the result of the availability or lack of food as such. It is government action or inaction that often determines its state and severity, and even whether or not a famine will occur. The distribution of food within a country is thus a political issue. Governments with strong tendencies towards cleptocracy can undermine food security even when harvests are good. Wood plantation development on its own can therefore not be seen as improving or undermining food security.

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Non-wood forest products (NWFP)[5] instead are directly linked to local food security. In forest plantations the availability of NWFP is limited when compared to native forests that contain higher levels of biodiversity. The FAO estimates that 80% of the developing world relies on NWFPs for some purpose in their everyday life. NWFP can also be safety nets during seasonal shortfalls and during periods of emergencies. Therefore shortage or lack of NWFPs can be a threat to local food security, subsistence and income earning.

Drinking water is an elementary part of food security. In Australia it has been reported that plantations have a direct impact on groundwater recharge and can extract groundwater in areas where the local water table is shallow. This can pose a threat for local people's ability to acquire clear water.

Recreational Values

In many countries recreational use is an integral element of wood plantations. Plantations provide a wide range of recreational opportunities including; walking, sightseeing, bird and wildlife viewing, picnicking, fishing, horse riding, hunting, jogging, cycling and collecting plants. With the expansion, the use and appreciation of plantations as a recreational resource is increasing, especially near urban populations.

Plantations are usually public access areas which are compatible with many forest operations. Safety considerations mean that at some times during the forest rotation cycle public access to all or part of a plantation is to be restricted. Problems can arise, for instance, when a recreational facility has to be removed for operational reasons, especially if this is done without prior warning. This is a particular problem if a facility has been well used for many years and people believe, incorrectly, that it is theirs to use as a matter of right.

A number of plantation management operations can also have an adverse effect on the recreational use value of plantations. A common example is when tracks used for walking, running and cycling are blocked for harvesting reasons. This is likely to be more common in areas close to towns and cities.

Operational requirements (for safety reasons) also often create a temporary conflict with the public use of plantations, including: use of chemical sprays and aerial sprays in areas where people are engaging in recreational activities; logging trucks using forest roads that are also used by pedestrians, cycles, horses, public cars and motorcycles; and pest control operations (poisoning) in areas where domestic dogs are exercised or where people go hunting.

Sensitivities and Tensions Related to Indigenous Groups

Lack of recognition or unfair treatment of indigenous people is a common problem in many developing countries especially in Africa, Southeast Asia and Latin America. Often the problems relate to land use. Conflicts stemming from land use, tenure and ownership rights are common in countries with an unclear relationship between customary and statutory law. Many countries recognize the existence of customary laws (to which indigenous and other local people adhere), but do not always respect them. Often customary laws are respected as long as they do not contradict statutory law – meaning that where there is conflict statutory laws prevail. This naturally creates

[5] Foods and proteins (e.g. mushrooms, honey, leaves, berries, fruits, nuts, bush meat and other game, snails, acorns), food additives (e.g. spices, herbs, flavorings, sweeteners), fodder for cattle, fibres (furniture, clothing, construction), fragrances for perfumes, ornamental pods and seeds, natural dyes, gums and resins, oils, plant and animal products with medicinal value, firewood.

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dissatisfaction and resentment among local people, and disputes are likely to be ignited.

Social Conflicts

Gerber (2010) analysed social conflicts (until the end of 2009) in the context of industrial tree plantations and identified the five most conflict prone regions, namely:

1. Coastal Brazil
2. Chile (Araucanía region)
3. Thailand (northern and north-eastern provinces)
4. Malaysia (Sarawak)
5. Indonesia (Sumatra and Kalimantan)

According to Gerber's study, 62% of social conflicts in the world were located in Asia (31% in Indonesia) and 22% in Latin American. It must be noted that China is nowadays an increasingly sensitive area for social conflicts and would probably be among the top five regions if a similar analysis was done today (2012).

Agriculturally, the dominant species involved in industrial plantation conflicts were eucalyptus (33% of the cases) and oil palm (40%).

According to Gerber's study smallholder peasants neighbouring industrial tree plantations represented the most important category of protesters involved in social conflicts (70% of the cases) while forest-dependent indigenous populations accounted for almost 30% of the cases. In addition, advocacy non-governmental organizations (NGOs) have played an important role. They have participated in one way or another in about 50% of social conflicts and have been especially active on legal issues.

5.2.11 Environmental Issues

Forest plantations can effectively provide several ecosystem services, such as maintaining water and nutrient cycles, soil protection and the provision of habitats for biodiversity. The main purpose of a plantation is normally wood production, but specific ecosystem services play an equally important secondary role, or they may also be the primary purpose for planted forest. One should recognize that no form of natural resource management, including forest plantations, can provide a maximum of all ecosystem goods and services to all stakeholder groups. New approaches in plantation management should seek a balance of economic, environmental and social objectives at higher spatial scales. With increasing spatial scale, which means moving from one plantation stand or one property to a wider watershed or landscape, it becomes increasingly easier to reconcile conflicting or non-complementary objectives of management (Bauhus et al. 2010). A landscape level approach enables managers to meet the various interests and priorities in different parts of the landscape. Many forest services and forms of forest use depend on ecosystem processes that operate at different spatial and temporal scales, many of which exceed the scale of a single forest estate level.

Plantation development causes drastic changes in ecosystems due to heavy manipulation of both abiotic and biotic factors. Intensive forest plantations are most often single species cultivations that require land clearing, soil scarification and chemical substance use for fertilization and plant protection. Rotation cycles are also short, typically from 7 to 20 years, which prevents forest ecosystems from stabilizing and they follow a succession cycle.

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Holistic planning, however, through balancing the various services forest plantations can produce, may result in management regimes that mitigate many negative impacts of intensive plantation forestry. Region and site adapted planning can integrate social and economic benefits with biotic and abiotic growth factors, native ecosystem types, structures and functions, crop species as well as with dynamics of pests and diseases. Economic benefits and environmental risks are closely interlinked which emphasizes the importance of understanding the environmental impacts of plantation forestry in each specific region.

Landscape Level

The nature and magnitude of environmental impacts depend on the management of individual forest areas and also on the scale and layout of planted forests. The presence of native forest areas in the plantation landscape increases biodiversity in the region and improves ecosystem stability. Native forests host fauna and flora that may also increase biodiversity on planted sites. Studies have shown for example that native habitat proximity correlates strongly with beetle community composition in planted forests (Pawson et al. 2008). Animals, especially insects, bats and birds play an important role in spreading native species and facilitating the colonization of native tree and understory species in plantation areas. These types of dynamics are beneficial especially in catalysing succession on deforested and degraded sites (Parrotta et al. 1995, Carnevale&Montagini 2002) and increasing biodiversity in intensive plantations.

The importance of landscape level planning is recognized in many countries. The legislation in Brazil, for example, requires that native forests shall cover 20–80% of the land titled for plantation development. If an adequate share of native forest does not exist, plantation managers are often required to restore natural forests on deforested sites. In Indonesia plantation managers have used intensive plantations as buffer-zones to prevent uncontrolled burning of native forests. All in all, landscape level planning, when adapted to local ecological and social circumstances, provides a variety of tools to improve the services forest plantations can provide.

Site Level – Loss of Soil Productivity

Soil productivity forms the basis for all biomass production. Soil productivity depends, among other things, on soil structure, availability of nutrients and minerals and on content of organic material. Plantation development affects these factors by changing decomposition rates and increasing leaching of nutrients and organic material. Soil disturbance for planting has been reported to decompose soil carbon at different rates in the soil profile. The losses will be offset by the accumulation of carbon in trees and under vegetation but to reach the original level may take several decades. Therefore there is a high risk that soil carbon decline will continue over subsequent rotations in short rotation forest plantations (rotation cycle <15 years) (Turner & Lambert 2000). Soil organic matter plays an important role in stabilizing chemical and biological processes and increases the soil's ability to hold water. These are all properties that enhance soil productivity. Repeated loss of carbon can gradually lead to soil degradation. Due to the high quantities of organic carbon in soil, even small changes in the content have a significant impact on carbon dioxide emissions to the atmosphere and thus contribute negatively to climate change.

Intensively managed tree plantations generally have a negative nutrient balance without fertilizer application, i.e. within one rotation more nutrients are lost from the system than gained. Constant nutrient exports result in a distinct depletion of soil nutrient storage. Nutrients are lost through leaching, erosion and oxidization. In order

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to maintain a balanced nutrient budget and thus sustain site productivity, it is necessary to compensate nutrient losses (Mackensen & Fölster 2000). Low impact management that avoids heavy soil scarification and harvesting damage as well as burning of residual phytomass can decrease nutrient losses significantly. Given the impacts on soil productivity and the high costs for compensatory fertilization, nutrient losses have great implications for the economic viability of plantations.

Site Level – Disruption of Local Water Cycles

The drinking-water quality of stream water in forests typically exceeds the quality of water in areas with other types of land use. In forest plantation areas water bodies are subject to erosion, nutrient run-off and run-off from used chemicals. Uncontrolled run-offs can be efficiently controlled through an appropriate plantation management regime and proper application of any chemicals in forests.

Although the run-offs to water bodies are small from individual forest stands, the impact will multiply in cases where a watershed area supplying a water body consists exclusively of open land or planted short rotation forests. There is still limited knowledge on the effects of repeated fertilization and chemical use in short rotation forest plantations.

Concerns about the impact of plantations on soil moisture and water yield are mostly related to soil moisture depletion and reduced stream flow (Bowyer 2006). The increased water intake of forest plantations may cut stream flows significantly and thus reduce the water available for domestic use.

Water bodies, such as rivers and brooks, host unique flora and fauna that are adapted to the surrounding vegetation and microclimate. Removal of natural vegetation along water bodies drastically change habitats on land and in the water, resulting in biodiversity impoverishment. Adequate buffer zones with natural vegetation, adapted to the landscape and site conditions, contribute to biodiversity conservation.

In drought prone regions exotic tree species that have deep rooting systems and poorly adapted transpiration systems (e.g. eucalyptus) may lower the water table level. However, in some cases this improves water quality. In Southern Australia and in the African Sahel, for example, plantations are being used successfully to keep saline groundwater below crop rooting zones and in other countries plantations are being used to dry waterlogged soils and alleviate flooding.

On the other hand in the Pampas grasslands of Argentina, the brackish groundwater lies under shallow freshwater lenses that provide drinking water. The researchers' measurements in areas where grasslands have been converted to forest plantations reveal that trees were eliminating the freshwater lenses. It was found that the observed salinization was independent of the tree species planted but rather depended strongly on the soil texture. These kinds of costs associated with plantations need to be taken into account.

Site Level – Impacts on Biodiversity

Intensive forest plantations are managed to develop high homogenous stocking density often of exotic species and with little or no structural diversity of a stand. Such an ecosystem lacks the biodiversity that a native habitat in natural conditions would host. However, forest plantations can provide valuable habitats and contribute to the restoration of native ecosystems on deforested and/or degraded land. When valuing the biodiversity impacts of forest plantation it is important to recognize the biodiversity

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impacts of the previous land use and of the planned plantation management regime. The differences in biodiversity vary considerably across the range of management intensities and the degree to which plantations deviate from the tree species composition and structure of natural forests in the same area (Figure 5.9) (Brockerhoff 2008).

In general most of the measures that benefit biodiversity impact negatively on plantation productivity, both at the stand and landscape level (Bauhus 2010). However, the benefits of biodiversity conservation may be higher at a landscape level than the marginal costs of allocation of land for biodiversity protection. For example, maintaining corridors of native vegetation instead of converting them to plantation stands may reduce productivity at the estate or property level, but there is no likely negative influence on the productivity of the plantation stands (Bauhus 2010). Presence of native forests may increase the ecosystem stability and thus contribute to better production of planted stands. If native forests are on moist or less productive soils, management inputs can be allocated to the most productive sites and the services gained from the set aside area are “free”.

Forest plantations have less habitat diversity and complexity and the richness of species living only in forest habitats is often lower in plantations than in semi-natural forests, whereas the difference is less strong for generalist species. (Magura et al. 2000, Raman 2006). Biodiversity values in forest plantations increase with stand age. Closed forest canopy attracts animals, birds, insects and bats that all play an important role in seed dispersal in tropical countries. Restoration projects have demonstrated that plantations with suitable fast growing tree species facilitate recruitment of a variety of native species (Otsamo 2000). Restoring tree species richness by planting tree monocultures works because a manager can match species to particular site conditions and thus overcome limiting factors that prevent the regeneration of species-rich forests on degraded sites (Lugo 1997).

Proximity of natural forests greatly improves biodiversity in plantation area, by hosting natural species that can also use the habitats of planted forests.

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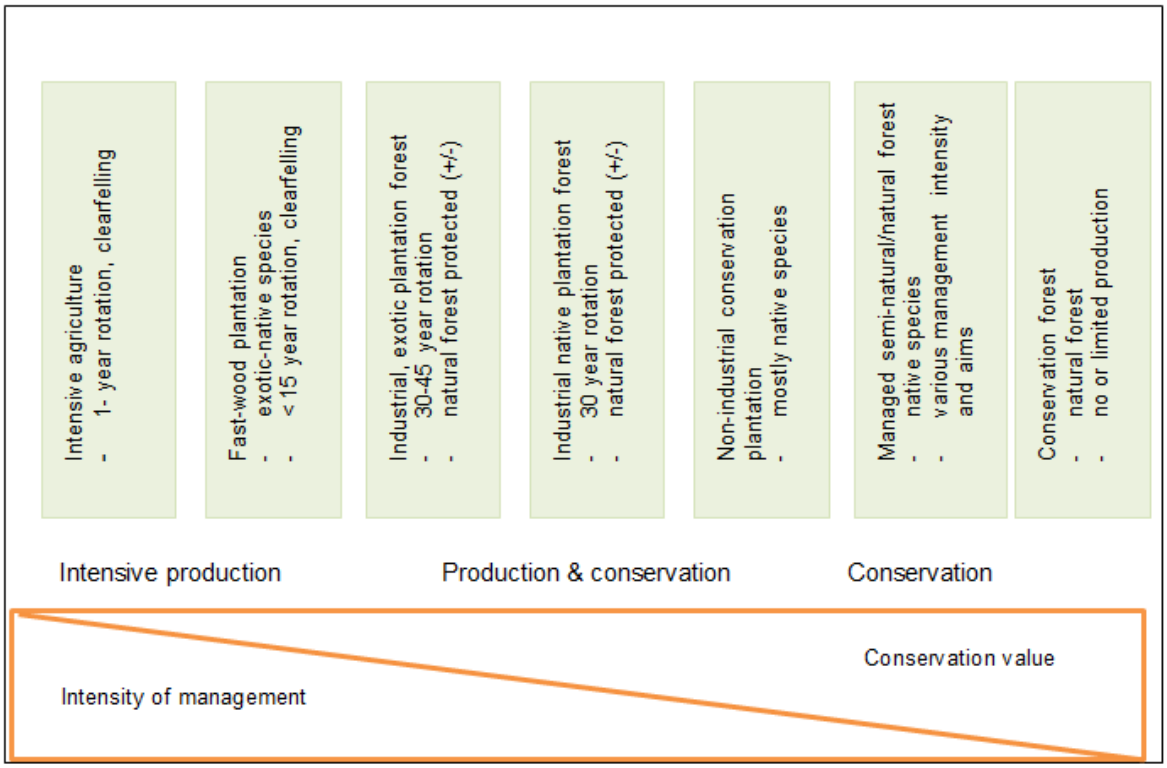
Figure 5.9 Conceptual Model of Various Management Intensities of Plantations



Source: Brockerhoff et al (2008)

Site Level – Risks of Pests and Diseases

Site conditions and climate are key drivers of tree health and productivity. Abiotic and biotic factors should not be considered in isolation as they often both have an impact on plantation health. This emphasizes the importance of proper provenance selection and fertilization regime in plantation management. Cultivation of exotic species may introduce exotic diseases and pests to a region and native insects may feed on planted crop. It is difficult to predict what insects will become problematic in the future and climate change makes this more challenging as the detailed biology of many species is unknown. Often the most serious threat to plantation health comes from the incidence and severity of plant pathogens, particularly fungi.

Monoculture plantations are more vulnerable to insect damage and disease than natural forests. In plantations such damage can cause catastrophic losses. However, the dynamics of pests and disease is complex. It is observed that the introduction of exotic species tends to alter natural balances that serve to keep pathogenic organisms in check in native ecosystems. On the other hand, some researchers have noted that exotics face lower risks than native species, since introduction of a species into a region that is outside of its natural range separates that species from its natural pests and can thus improve health and performance, at least in the short term (Bowyer 2006) .

Genetic diversity of planted trees increases the stand resilience to biological damage. There is evidence that genetic diversity within a single species is a more important factor to safeguard the stand health than the number of species growing. Short

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rotation times also give less time for pests and diseases to develop and allow managers to react promptly to emerging problems. The target of a short rotation conflicts somewhat the objective of increasing biodiversity and forest ecosystem resiliency in the region.

Pathogen and pest infections may become severe gradually, several years after exotic tree plantations have been established. Therefore it is important to screen and improve stand health by maintaining optimal site conditions for well adapted tree proveniences. Consideration should also be given to breeding for resistance to some key pathogens, rather than focussing only on productivity of the stand. Nutrient deficiencies and damage cause substantial losses in wood production even before any symptoms are obvious.

Gene Manipulation in Tree Breeding

Tree breeding and the right provenance selection have always been the underlying elements of fast growing biomass production. There were hopes in the early 1990s that biotechnology and gene manipulation would provide a key to speed up the breeding cycle with trees and thus provide significant increases in the productivity of plantation wood.

Various biotechnological techniques are used to multiply the desired genetic material. Knowledge of techniques to improve different characteristics of trees has improved along with better understanding of gene functions in different tree species.

With gene manipulation tree breeders aim to improve specific traits of trees depending on the purpose of the forest plantation. Gene manipulation has been used to improve, among other factors, the following characteristics:

- resistance to biodegradable herbicides
- altered lignin properties
- resistance to drought and cold
- resistance to selected pests or diseases
- resistance to soil salinity
- altered reproductive mechanisms for faster breeding
- phytoremediation of polluted sites
- production of novel chemicals or pharmaceuticals.

The species groups that are currently most amenable to improvement are likely to remain so in future, including Douglas-fir (*Pseudotsuga menziesii*), *Eucalyptus* spp., loblolly pine (*Pinus taeda*), Monterey pine (*P. radiata*), poplars (*Populus* spp.), and the spruces (*Picea* spp.) (Trevor et al. 2002).

Gene manipulation techniques are expensive to implement on a large scale. The high cost, limited benefits and regulations on spreading gene manipulated organisms (GMO) in nature have restricted the adoption of transgene–based management regimes in forestry. Currently also the major voluntary forest certification schemes, FSC and Programme for the Endorsement of Forest Certification Schemes (PEFC), prohibit the use of gene manipulated plant material in certified forests. However, the recent advancements in knowledge of tree genomes and related biotechnology in forest trees has made biotechnology a feasible plant propagation method in forestry.

Field trials on genetically modified trees have increased during the past years. Information on the number and location and types of field trials is often confidential, which decreases the transparency for evaluating the benefits and risks related to

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GMO use. The US has been the leading country with 64% of the field trials (Valenzuela et al 2006) followed by France, Finland, New Zealand, China, and Brazil (Boyd 2010). The presence of field trials does not necessarily reflect the probability of commercial use of gene modified trees in practice, because some of them are purely research oriented. However, the emergence of large-scale intensive forest plantations provides a feasible platform for intensive tree breeding and the development of domesticated varieties of species with various biotechnology applications.

Bioengineering typically involves the modification of a single gene or gene complex associated with a trait of interest, often in the absence of full and detailed knowledge about its direct role in biochemical pathways or indirect interactions with other genes. The number of possible interactions is therefore too large and too complex to adequately predict, and so demands rigorous field testing. Relatively few experiments have been conducted to determine the effects of genetic modification on long-lived species such as trees (Halpin et al. 2007, Boyd 2010). Understanding the risks of genome modification has been hampered by the time that it takes to conduct lengthy and potentially hazardous field trials. However, without sufficient data it is difficult to characterize with scientific certitude the potential risks associated with the use of genetically modified trees (Campbell and Asante-Owusu 2001).

The main concerns relating to the use of gene modified plants in forests include:

1. Gene escape to wild organisms
    a. manipulated genes transfer into the genome of another organism by non-sexual means e.g. with bacterial vectors (horizontal transfer).
    b. escape of manipulated pollen into wild populations of the same species (vertical transfer) (Walter 2004)
2. Spreading of manipulated tree genotypes into natural vegetation (weeding effect)
3. Negative impacts on forest biodiversity, insects, mammals, fungi and plants that depend on forest ecosystems
4. Risks to health
5. No experience on long term impacts to nature and humans
6. Favours corporative industry that owns and rules the cultivation technology.

Escape of transgenes to the wild ecosystem may cause evolution of undesired properties to wild organisms (e.g. herbicide resistant weeds, reduced fitness or reproduction potential or properties harmful to other organisms). Very little information is available on the probabilities of transgenes escaping into wild ecosystems. Based on the experience gained in agriculture, where GMO crops have been produced on a large scale for a decade, such escape is not common. However, in the past few years, reports of transgene migration from agricultural to wild populations have begun to emerge (Schoen et al. 2008). In forestry, where the use of GMO seedlings has been very limited, any escape of transgenes has not been reported. In theory transgene escape is possible at any stage of forest stand succession including decomposing processes, which means that long term testing of gene manipulated stands is needed in order to understand the risks and appropriate mitigation measures.

It is often claimed that highly improved varieties of cultivated species cannot survive in less fertile natural conditions where the competition of other plant species is high. This theory applies to highly domesticated agricultural crops but forest tree species are still genetically fairly close to the wild varieties. There is a real risk that GMO trees may

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spread into native habitats. However, gene manipulation techniques can prevent normal reproduction of GMO trees in order to prevent their unintended spread.

Plantation forestry has often been criticized for the tendency to reduce biodiversity, and the application of biotechnological tools is seen by some as potentially accelerating that trend. However, this is a matter of decision making in forest management (Walter 2004). The presence of gene manipulated trees is only one element among all the biotic and abiotic elements that contribute to biodiversity development. Use of gene manipulated trees may increase biodiversity if their cultivation allows diminished use of pesticides or if their use assures successful forest vegetation in the area. The gene modified trees used for phytoremediation of polluted lands or waters produce irreplaceable environmental benefits. On the other hand it is important to understand the ecosystem functions on plantation area and assure that gene manipulation does not alter drastically such factors as feeding patterns of species. Introduction of pollen free or non-seed producing trees may deprive food from insects that are essential prey for other animals.

Development of gene technology and manipulated tree provenances is expensive and requires special expertise. This has led to the situation where seed production and related technology is the property of a few companies that control their use. Market dominance tends to increase prices for GMO plant material and exclude some potential users due to the high costs. Corporate development also decreases the transparency of data exchange in the development and use of GMO trees in practice, which hampers the development of good cultivation methods, protective measures and related regulatory framework. Regulations controlling the use of gene manipulated plant material are largely very restrictive when considering the permits to plant transgenic trees, but regulations are not always updated to require and consider the results of appropriate follow up of the use of GMOs in forests.

To conclude, more information on GMO trees in plantation forestry is needed in order to fully understand their potential and required precautionary measures. Gene functions in ecosystems may change over time and biological impacts may emerge gradually, which supports the need for long term testing at a larger scale. Transparency in testing data and sites for the scientific community would contribute to the understanding of GMO potential and related risks and help to develop appropriate management systems for different types of forests.

Forest certification can contribute to the sustainable use of gene manipulated organisms in forestry. In order to do so, it is important that certification requires transparency in the information that is relevant to the sustainable use of transgenic trees in forest ecosystems.

Climate Change Mitigation

Energy from biomass is crucial for countries with developing economies and it plays an important role in the developed countries. When wood from short rotation plantations is used for energy purposes (replacing fossil fuels) the plantations have a high potential for climate change mitigation (Rootzén et al. 2010). However, the current trend in plantation development cannot meet the growing demand if the available technology is not also applied at the local level to improve biomass processing for energy.

Fast growing forest plantations have a high CO_2 potential but little carbon storage in vegetation or soil when compared to natural and older forests. Frequent harvesting and soil disturbance increase the carbon removal from a forest site. With longer

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rotation periods the carbon sequestration rate decreases along with the growth rate but the amount of carbon stored in the stand and soil increases.

The life-cycle of the end products greatly determines the climate impact of a forest plantation. If the products have a long life span and their end use is for energy to compensate fossil fuels the impact can be very positive.

In general, one cannot assess the ultimate effect of plantations on carbon cycling and atmospheric CO_2 within a plantation management system (Bauhus 2010).

Impacts of Climate Change

Climate change increases the vulnerability of natural and planted forests. Variations in precipitation and temperature alter soil conditions, availability of nutrients and the physiology of plants. Climate change will affect the pathogen/pest, the host and the interaction between them. The projected damage from pests will rise as pests encounter more suitable climatic conditions for their establishment and biology, and by host tree species becoming more susceptible to pests due to climate induced stress, such as drought (FAO 2010).

To ensure the sustainable production of plantation wood in the future, existing and future abiotic and biotic threats need to be managed under a prolonged period of climate change. Plantation management regimes should consider strategies to adapt to the changes in growing factors and also to the potential socio-economic implications of climate change in the region.

5.3 Regional Analysis

5.3.1 Latin America

The key issues in Latin America that are relevant for future forest plantation development, in addition to technical potential and demand, are related to changes in land ownership, land use competition, laws and policies, technology development, social and environmental issues and the role of investors[6]. These issues are analysed in a matrix presented in Table 5.1.

[6] Methodology is discussed in Chapter 4.

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Table 5.1 Issues Relevant to Plantation Development in Latin America

Issue	Now	Where?	Why?	Trends	Possible implications
Land ownership	Plantations are established mainly on private freehold land.	- Brazil, Chile, Argentina, Uruguay. - Inthe near future also Colombia and Paraguay.	Investors have few barriers to entry and more secure land tenure with freehold than with leasehold land.	Freehold land ownership is expected to continue.	- Land will continue to be an asset class (at least for local investors) - Land prices will be determined by the market.
	The majority of land is owned by large-scale land owners namely forest industry and mining companies.	Same as above	Forest and mining industries have developed significant forest plantation poles over the past decades.	- Large-scale industrial ownership remains dominant in the future. - There will be a growing number of small and medium-scale tree farms. - New forms of partnerships are increasing – e.g. leasehold agreements between local private and foreign parties.	- Increasing number of small and medium scale tree farms will help to alleviate the dissatisfaction among small-scale farmers and landless people - Remains to be seen whether it will also mitigate conflicts mobilised by civil society groups.
	- The second landowner group is timberland investors and the third group private land owners. - Small-scale land owners remain a minority in terms of the total land area.	Same as above	Timberland investors see Latin America as extremely attractive for new plantation establishment.	- Industrial owners continue to outsource plantation assets to financial investors (TIMOs).	Forest industry will focus on its core business (e.g. producing pulp) and financial investors build up forest portfolios matching their investment strategy. The development pattern can be similar to North America in this respect.
	Foreign investors can own land – however, recently the ownership rights have been limited (or threatened).	Same as above	Fear of foreign invasion on land.	This development expected to continue.	Uncertainty of foreigners rights to own land will make them cautious with land deals.

Issue	Now	Where?	Why?	Trends	Possible implications
Land use competition	Conversion of native vegetation to other uses like pasture, soy bean and other agricultural crops as well as for biofuel production.	Paraguay, some regions in Brazil	High demand for agricultural soft commodities particularly from Asia (China).	Demand for soft commodities will continue and increase competition for land.	- Continuing deforestation in frontier areas e.g. in Paraguay. - New forest plantation development frontiers will evolve: North and Northeast Brazil, Colombia, and at a later stage Paraguay and possibly Venezuela
	Intensification of agricultural soft commodity production (soybean, corn, cotton) and cattle ranching in already deforested or cultivated areas.	Brazil, Argentina, Uruguay, Colombia		Intensification of land use and agricultural productivity as well as increasing land prices expected in the future.	- More production will be possible on a smaller piece of land. - However, small-growers will not gain the benefits from the intensification at the same pace as large-scale growers.
	Increasing bioenergy production	Brazil, Chile, Argentina, Uruguay, Colombia	Increasing demand in Europe and North America	Bioenergy boom will continue for the future.	Positive contribution to forest plantation development – increasing competitiveness for secondary forest products foreseen.
Laws and policies	Incentive schemes are still important in some countries / regions within countries	- Colombia, - Province level in Brazil and Argentina	The critical mass of plantations was established with the support of the incentive schemes.	The political support for economic development favours forest plantation development at local levels.	Positive contribution to forest plantation development
	Strict environmental policies and environmental licensing	Brazil, Uruguay, Argentina	Main concerns behind strict limits are conversion of native vegetation, loss of biodiversity due to monocultures, soil protection and water issues	The environmental licensing will be guiding more and more plantation establishment and improving their performance	Plantation development and expansion will be better controlled and environmental performance more closely audited/followed. However, insufficient law enforcement (especially in Brazil) will pose a challenge in practice.

Issue	Now	Where?	Why?	Trends	Possible implications
	GMO policy – still controversial	Brazil, Argentina, Chile Colombia, Uruguay	GMO has been one important step in improving future productivity, quality requirements and climate change adaptability	GMO development will move forward and it is expected that Latin America has a positive view on GMOs	- Countries accepting GMOs will have technology advantages and higher productivity - Uncertainties, e.g. consumer acceptance of GMO products, will complicate the situation as markets are global (consumers in some markets do not accept GMO products)
	Climate change mitigation, carbon offset policies	Brazil	Awareness of the climate change has led to national policy actions.	- Conversion of native forests to other land uses will become even more difficult.	- Climate change mitigation efforts will not promote plantation expansion.
Technology	Advanced plantation technology	Brazil, Chile, Argentina, Uruguay	Long-lasting and rapid forest plantation development	Technology will continue to play a key role in productivity development.	Commercial plantations will be highly technical and well-controlled industrial cultivations, whose management and mastery is advanced and professional
	GMOs	Brazil	Need to increase productivity and cost-competitiveness	GMO development will move forward	Threat or advantage for plantation development.
	Current dominant regime: short rotation pulpwood – some signs of new regimes appearing	Brazil, Uruguay	From plantation owner viewpoint other products (besides pulpwood and bioenergy) might be more profitable, favouring other regimes with longer rotation periods	New regimes (e.g. sawlog, bioenergy) will develop to complement the currently dominant regime	Alternative regimes foreseen that will diversify forest plantation concept.
	Integrated regimes with sawlog and pulpwood production	Argentina, Chile		Solid wood demand drives the alternative regimes.	

Issue	Now	Where?	Why?	Trends	Possible implications
Environmental issues	Balancing between native vegetation and tree plantations	Brazil, Chile, Uruguay, Paraguay, Colombia	Amazon rainforest deforestation is caused by pasture and agricultural expansion rather than tree plantations. However, deforestation due to forest plantation development does happen in some ecosystems.	The balancing between native vegetation and plantations will intensify, especially due to expansion to new frontier areas	Increased implementation of mosaic (mixed) plantations and stronger protection of endemic forest areas.
	Rehabilitation of original ecosystems	Brazil (Atlantic rainforest)	Increasingly strict environmental requirements for forest players and proactive company policies favour rehabilitation	Rehabilitation is expected to increase since environmental benefits (including carbon) are unquestionable	Significant positive impact on biodiversity conservation as a tested and proven model.
	Monoculture plantations face insect and wind damage	All	Sensitivity to such damages has increased	Climate change will intensify extreme weather events and risk for damage	More and more measures are needed and applied to mitigate wind and insect damage risks
	Large-scale landscape planning is in an initial stage	Brazil	Effective ecosystem conservation requires mosaic plantations with ecological corridors covering large areas (and whole ecosystems).	Landscape level planning will gain more attention in the future	Landscape planning will have more important role in forest plantation development.
Social issues	Unbalanced land ownership structure: the minority of population own the majority of land, benefit sharing is not optimal	Brazil, Argentina, Chile, Uruguay, Colombia, Paraguay	Constant conflicts with local stakeholders and increasing dissatisfaction.	Large-scale land ownership model will start to dissolve (either peacefully or through conflicts)	Foreseen changes in land ownership structure.
	Strong and heterogeneous local stakeholders (e.g. MTS, *Quilombos*, indigenous groups) with their own agendas	Brazil	Due to conflicts plantation companies have faced land claims, loss of significant assets and some of them have a questionable image among their key stakeholders.	Conflicts will become more professional and well-organized as international NGOs participate in them and in their communication to the global public	- Challenging operating environment for wood plantation business. - Professional and locally-tailored cooperation and communication skills are required from plantation companies.

Issue	Now	Where?	Why?	Trends	Possible implications
Timberland investments	Latin America has been the primary target of forest investments over the past decades.	High interest: Brazil, Chile, Uruguay Some interest: Argentina, Colombia, Paraguay	The attractiveness of investments has been high due to excellent growing conditions and availability of freehold land as well as other favourable conditions (e.g. good business climate, political stability).	Latin America will remain a key region for plantation forestry, but changes in focus area inside the continent are expected to happen	- Shift to new frontier areas due to maturity of “old” plantation poles; - New areas: Colombia, Paraguay, Northeast and North Brazil.

Land Ownership

In the continent's main plantation countries – Brazil, Chile, Argentina and Uruguay – large-scale industrial ownership will remain dominant in the future; however, there will be a growing number of small and medium-scale tree farmers. Available freehold land lowers barriers to market entry and security of land tenure makes Latin America attractive to timberland investors. At the same time the pressures arising from the dissatisfaction of local smallholders, rural landless people and some civilian groups will undoubtedly impact on the land ownership structure.

New forms of partnerships are increasing e.g. leasehold agreements between local and foreign parties or financial investors and forest industry or energy companies. Timberland investors see Latin America as an attractive investment target while industrial owners continue to outsource plantation assets. The industry will focus on its core business (e.g. producing pulp) and financial investors build up forest portfolios matching their investment strategies. It is likely that the development pattern will be similar to that in the US in the past in this respect.

Land Use Competition

Land use competition is mainly demand-driven due to increasing needs, on one hand of meat and soft agricultural commodities in Asia and, on the other hand, of bioenergy in Europe. In the new frontier areas such as Paraguay, Northeast and North Brazil, and possibly in other frontier regions adjacent to the Amazon deforestation will continue. In established plantation areas such South, Southeast and Central Brazil, Chile, Argentina and Uruguay it is expected that land use will be more intensive with higher productivity of trees and agricultural crops than before.

Land use competition will drive up land prices and shift forest plantations towards the new frontier areas.

National Laws and Policies

The key plantation countries have had in the past or continue to have incentive schemes supporting forest plantations. Such incentives are tax exemptions and direct or indirect plantation subsidies. The existing critical mass of existing plantations in Brazil, Chile and Uruguay was largely created thanks to these incentives. In general terms, the national policies continue to be favourable towards forest plantation development.

At the same time environmental legislation and particularly law enforcement has tightened, with strict permit processes and environmental liabilities especially in Brazil and apparently in all Latin American plantation countries. In practise this will guide plantation development and most likely lead to improved environmental performance.

Technology

Latin American countries will continue to be the forerunners in plantation technology meaning continuing plant improvement, advanced silvicultural regimes and logistics.

GMOs will remain to be a contentious issue. It is, however, likely that Latin America will see the most advances in genetic improvement programmes and experimentation by high-tech plantation companies.

Technology will also play an important role in adaptation to climate change.

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Environmental Issues

In Latin America well established forest plantations will have mainly positive impacts on the environment at least when the establishment considers the wider landscape and mosaics structures to include rehabilitation of endemic forests.

More and more measures will be needed to mitigate such threats as wind, insects and fungi in changing climatic conditions.

Social Issues

There will be a gradual change in the land ownership structure as discussed in the previous table, from large-scale industrial ownership towards increasing land ownership by financial investors and ordinary medium and small-scale tree growers. The operating environment for forest plantation businesses will be increasingly challenging in a context where well-managed stakeholder relations are fundamental for success.

Timberland Investments

Latin America will continue to be an attractive target for forest investments in the eyes of strategic and financial investors. The first category comprises forest industry, energy and mining companies as well as possibly soft commodity traders and local land owners. The second category includes institutional investors – foreign and local pension funds, and university and other endowment funds – represented also by TIMOs. The investments will be shifting from mature areas such as South and Southeast Brazil, Chile and Uruguay towards new frontiers in Colombia, Paraguay and Northeast and North Brazil, together with other regions adjacent to the Amazon.

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Box 5.2 Case Brazil

Contested new Forest Law

A new (federal) Forest Code was endorsed in the Congress of Brazil in April 2012. The bill has been one of the most controversial ones to pass in the country in recent years. If the bill finally gets approved, it could bring some benefits to the industry sector, especially concerning the size of legal reserves to be protected (that would get diminished). The new Code would allow landowners to count woodland on river margins, hilltops and steep inclines towards the total proportion of forest that must be legally preserved on their land. Before, such land was not allowed in the calculation.

The opposition of civil society to changes in the Code have been very strong. The President of Brazil, Dilma Rousseff, announced a 'partial veto' of the controversial revisions to the law at the end of May 2012 and since then more than 300 amendments have been made to the law. One of the articles the President rejected dealt specifically with riverbanks that she ordered to be protected also in the future. The president's decision needs an approval from the majority of Brazil's Congress before it can be written into law. The Brazilian House of Representatives approved a newly modified text (i.e. new changes made after the President) in mid-September 2012. Environmental organisations have announced their dissatisfaction with the current text since they say that it opens up greater river margins for deforestation than expected (in big properties, or in the case of wide rivers, the minimum requirement for the protected vegetation strips has been reduced from 30 to 20 meters; also replanting and recuperation of vegetation can now be done using commercial fruit trees). Now the Senate's final approval is missing, but could happen any time soon (at the end of September 2012). WWF-Brazil representative has said that the best thing that could happen for Brazilian forests and biodiversity is that the law proposal is allowed to expire on the 8 October 2012 deadline without a Senate vote. All in all, the situation is filled with controversial interests (those of politicians, environmental groups and "ruralistas" i.e. large landholders and agribusinessmen to name a few) and might lead to increased social and environmental tension.

Conflicts around land use

Land is a particularly heated topic in Brazil due to the unfair history of its use, tenure and ownership. There are constant land claims from the strong Landless Workers' Movement (*Movimento dos Trabalhadores Sem Terra*, MST), former slaves' movement (*Quilombos*) and from different indigenous groups. The movements have strong agendas and opposing interests which created conflicts. In 2011, Brazilian pulp producer Veracel, a joint venture between Fibria and Stora Enso, said that it had recorded BRL8.8 million (USD4.8 million) losses due to land invasions by the MST since 2009. In 2006, former Aracruz Gauíba mill (currently CMPC Celulose Riograndense) was invaded by women of the "Via Campesina" movement, also connected to MST, destroying a laboratory, as well its tree nursery and 5 million seedlings. More than 20 years of research was lost, according to Aracruz, and damages were estimated at nearly USD20 million.

5.3.2 Asia

The key issues relevant for the future forest plantation development in Asia are analysed in a matrix presented in Table 5.2.[7]

[7] Methodology is discussed in Chapter 4.

Table 5.2 Issues Relevant to Plantation Development in Asia

Issue	Now	Where?	Why?	Trend	Possible implications
Land ownership	- State land ownership dominates with company land leases and farm land titles or customary rights - Governments have outsourced management of state forests	China, Vietnam, Indonesia, Laos, Myanmar, Cambodia	- Large-scale industrial plantations are mainly established by the state or with leasehold agreements by private companies - Smallholders have land with customary rights or with land titles	Leasehold land will continue to be the dominant land tenure model for industrial forest plantations	New forms of leasehold and partnership agreements will be created.
	Mixture of state and private ownership	Malaysia, India			
	Large amount of small-scale farmers	India, Vietnam, (China)	Densely populated areas	Population growth will continue and a large number of small-scale farmers will exist also in the future	Plantation development will rely more on smallholders in the future. This will cause challenges for industrial wood and biomass sourcing.
	"Land bubble" – unsecure land leases through sometimes dishonest middlemen "representing" communities	China, Indonesia	Land leases are signed without just/transparent stakeholder consultation at local level	As investment activity increases more local players see a personal "business opportunity" in land leasing	Sensitive land issues will be the main burden for foreign investors, especially in China
Land use competition	Oil palm plantation expansion	Indonesia, Malaysia	Oil palm boom for renewable energy	Competition between: 'fibre versus food/feed versus fuel' will continue	Oil palm for energy is searching for substitutes (e.g. animal waste), but use of palm oil for food will remain stable / increase → land competition will be hard
	Existing high population density worsened by immigration of external workforce to oil palm plantations	Indonesia, Malaysia	New employment opportunities seen in oil palm plantations	Social tension between local people living on adjacent or overlapping small areas of land	Social risks will intensify and make plantation development increasingly challenging

Issue	Now	Where?	Why?	Trend	Possible implications
	Rubber, coffee, cocoa and other commodities and biofuels encroach to native forest areas	Vietnam, Laos, Cambodia, Myanmar	High demand for agricultural commodities and biofuels	Deforestation continues regardless of forest plantation development	Agriculture and biofuels will be the main threats for native forests, not forest (pulpwood) plantation development
Laws and policies	- Strong state - State plantation promotion plays a crucial role	China, Vietnam	States and collectives own all land areas and still prioritize economic development	Local level stake in decision making will be more important than before.	Political stability will remain, however, exceptions at the local level.
	- Insufficient law enforcement and surveillance or control; - Impunity of offences and illegalities	All countries but especially Indonesia	- Weak institutional infrastructure - Corruption - Local authorities' alleged participation in illegal activities	Institutional development will be slow due to governments' lack of resources and poverty of local populations	Sustainable forest plantation development will be challenging
	National incentives for plantation development focusing on smallholders	China, Vietnam, Malaysia, Thailand	The incentives have been justified with socio-economic development and protection functions of forests	Incentive schemes will be gradually phased out.	The Asian incentive schemes have a minor impact on large-scale plantation development, with the exception of China
	Environmental policies have focused on logging bans or restrictions in *native* forests and not limiting forest plantation development	All plantation countries to some extent	The main focus of the policies has been on conservation or sustainable use on natural forests	Willingness to protect native forests will stay very high on national and international agendas	Environmental legislation is not expected to impact on plantation development
Technology	Reasonably high level plantation technology among *industrial* plantation managers	Indonesia, Malaysia, China	Industrial plantation managers apply state-of-the-art technology	High-tech industrial plantation management will spread with investors to other Asian countries	Advanced plantation technology will be fundamental for the improvement of productivity

Issue	Now	Where?	Why?	Trend	Possible implications
	Underdeveloped plantation technology with low productivity among *state managed* assets and smallholders	China, Vietnam	- State management has been poor - Smallholders often use seeds or seedlings from unknown origins	- Poor management of state forests will continue - Smallholder / farm plantations have a high development potential if appropriate technology is used	Asian states are increasingly interested in leasing forest lands to foreign investors in order to improve plantation management and technology
	GMOs	China	GMOs are part of the intensive genetic improvement programs	Will be applied in future plantations	Threat or advantage for plantation development.
Environmental issues	- Rich biodiversity - Peat-forests storing large amounts of CO_2	Indonesia, Malaysia	Threat of conversion of native peat lands and forests to oil palm plantation	Peat lands will remain under constant pressure	Large CO_2 emissions and dramatic climate implications if plantations are developed on peat lands
	Soil erosion	China, and all countries to some extent	Plantations have been established in sloping terrain sensitive to soil erosion	As competition for land intensifies, more plantations can be expected to be developed on sensitive areas	- Harvesting of such plantations will be a challenge - Soil erosion impacts on land will become more acute
	Wind / insect / fungi damage	All	Monocultures increase the risks	Climate change impacts are expected to intensify damage	New mitigation measures are needed
	International NGOs (allying with local NGOs) opposing local plantations	All countries	Most of the major industrial plantation projects have faced opposition	Conflicts will get more professional & well-organized as international NGOs participate in them and in their communication to the global public	The pressure by international NGOs and other society will continue and grow

Issue	Now	Where?	Why?	Trend	Possible implications
Social issues	Land ownership, use and tenure is a highly sensitive issue	China, Indonesia and other countries	- Obscurity and conflicts between statutory and customary law - Land acquisition sometimes ends up in illegal overtaking of local people's land ("land-grabbing"), sometimes with local authorities' approval - Involuntary resettlement with little compensation for lost land and livelihood	Social tension is expected to increase	Forest plantation development will be increasingly challenging and risky for social reasons
Timberland investments	There are interesting countries for plantation investments in Asia	Indonesia, China, Vietnam, Malaysia	- Demand is driving plantation development especially in China - Growing conditions are good in most of Southeast Asia	Forest investors will remain interested in Asia	- Plantation development in China will be driven principally by the local economy with limited foreign investments due to social challenges - Southeast Asia – namely Indonesia and Malaysia – will develop forest plantations; however sustainable plantation investment will be challenging

Land Ownership

Land in Asian plantation countries – China, Indonesia, India, Malaysia and other Southeast Asian countries – are mainly state-owned. The state has then further leased the land to private companies or other entities or allocated land to private farmers or villages with land titles that approximate freehold land.

While the landownership structure is a barrier to entry for many plantation developers, leasehold arrangements eliminate high upfront investment and speculation on land prices. Overall it is expected that state management will be replaced with outsourced management incorporating leasehold arrangements when it comes to significant commercial plantations in the region.

Smallholders typically hold a customary right or such land title that resembles freehold land[8]. Problems arise in cases where customary rights are subordinate (secondary) to statutory law or when they are not respected at all. In some countries or regions within countries small-scale tree growers will play an important role in future plantation development e.g. in India, Vietnam, and in some parts of China and Indonesia.

Land Use Competition

Land use competition is extremely fierce simply due to high population density in most Asian countries particularly in the Southeast Asian countries which possess the best sites for plantation development. The demand for agricultural commodities as well as biofuel dramatically increased competition for land and hastened deforestation.

Land use competition will drive up land prices and shift forest plantations towards new frontiers.

National Laws and Policies

China and Vietnam have had strong national policies promoting plantations with concrete results at least in terms of plantation area. Some Southeast Asian countries such as Malaysia and Thailand have implemented incentive schemes targeted at smallholders with marginal impacts on large-scale plantation development.

Insufficient law enforcement is a problem in many Asian countries. Weak surveillance and control worsens the situation, leaving room for offending with impunity and many illegalities. Weak (unskilled) governance and poverty incentivise corruption. Often local authorities, who should be enforcing the law, are found to be participating in illegal activities.

Technology

The extent and level of technology varies from scarce to well-developed, depending on the plantation manager and region.

GMOs will still be a contentious issue, however, most likely they will be implemented increasingly in the future.

Technology will also play an important role in adaptation to climate change.

[8] For example so called Redbooks in Vietnam allow farmers to use the land as collateral and also to shift the “ownership” to next generation. The land title period can be expanded automatically if the land is under productive use. Still, the Government maintains the absolute ownership of land.

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Environmental Issues

Environmental issues are a key challenge especially in Indonesia and Malaysia. In the context of climate change the countries' rich natural biodiversity and thick peat lands (in many places over 3 metres thick and storing vast amounts of CO_2) are especially sensitive issues. The extensive conversion of peat lands to oil palm plantation – causing a massive release of CO_2 in the atmosphere – has been the most worrisome scenario in the recent past, but new forest plantations are also seen as a potential threat to peat lands. This is exacerbated by weak environmental law enforcement and a lack of surveillance (e.g. of plantation companies ongoing compliance with environmental laws and regulation).

Due to the initial high population density being worsened by the influx of migrants looking for work from oil palm plantations, soil in Southeast Asia is under heavy use and new forests (and other areas of native vegetation) are inevitably cleared in order to support the large populace. Forest plantations have also been established in sub-optimal areas e.g. sloping terrains sensitive to soil erosion.

Social Issues

Land ownership use and tenure are complex and conflict-prone issues in Asia. In many Asian countries land is officially owned by the state (and leased to private investors), but the legal rights under a customary system are not being equally respected. Every country has its own way of dealing with indigenous and other traditional land claims, but often customary rights are secondary or subordinate to statutory ones. As customary laws might not be written in any official records, they do not enjoy the same amount of protection as statutory laws. As local people find their land use and tenure rights have narrowed dissatisfaction and a collision of interests is inevitable. The situation creates a serious challenge for foreign companies – not least since often companies end up as stakeholders in conflicts that were initiated long before they entered the area and became involved.

Timberland Investments

Some Asian countries have been attractive targets for forest investment by some strategic and financial investors. In China the problems with land leasing processes have recently discouraged timberland investors. In Indonesia the strategic Asian industrial players remain, however, financial investors avoid the area due to poor environmental performance. In Malaysia the situation is slightly better at least in environmental terms than in Indonesia. However, there significant plantation expansion would mean clearing of remaining native forests.

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Box 5.3 Case Indonesia

Over-optimistic plantation targets

Indonesia's forestry sector is facing a dilemma due to the long-standing disparity between the high processing capacity of forest industries and the limited supply of timber. The supply crunch has led to over-harvesting in order to meet demand and has resulted in a decline of natural forests. The government of Indonesia seeks to revive the forestry sector and secure its long term survival through a massive timber planting effort: 9 million ha of new plantations by 2016. While timber plantations are vital for the future of Indonesia's woodworking sector, the expansion plan relies on overly optimistic assumptions about the current state of Indonesia's timber plantations, their future performance, and associated benefits. It will be very challenging to ensure economic feasibility, social equity, and environmental sustainability with such a growth rate.

Difficult social issues

The expansion of plantations in Indonesia has frequently led to social conflicts over access to land and land rights. In many cases, local communities do not possess official certificates or permits of land ownership, which makes it easy for unscrupulous plantation developers to claim control over the land and establish projects on it. This was particularly the case in Indonesia during Suharto's 'New Order' era when plantation owners were able to "grab land" with the support of the military and police. Although the fall of the Suharto regime since 1998 has brought changes, the formal legal system for land use rights, especially at the community level, remains unclear and weak. This is exemplified especially by the expansion of oil palm and rubber plantations in Kalimantan which has ignored the customary tenure and effectively expropriated local communities' land. This has not only impinged upon local land rights and resulted in violence, but also led to extensive environmental damage.

Legal confusion

The vast areas destined for timber plantation development in Indonesia are fraught with legal uncertainty. While the central government admonishes local administration to honour plantation concession licenses allocated by Jakarta, local government institutions make their own, often contradictory, interpretation of concession allocation laws. While this generates short-term benefits for the local administration, it encourages illegal activities and creates legal confusion.

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Box 5.4 Case China

Controversial land lease deals

The process for getting use right to land in China is sensitive and has caused problems to some foreign investors in the country. The use of middlemen in land rentals is common, especially with foreign investors. It means that land first gets leased from its current user by a middleman who then leases the land again to a foreign company. The Chinese government has established companies, such as Beihai Forestry Investment Company, to act as governmental middleman in forest land leasing cases. The company leases forestland from multiple sources (individual households, collectives, state forest farms, etc.), and then rents the land as a package to a foreign investor. This way the local government exercises its governmental power in helping companies to obtain large amounts of land for forest plantation purposes.

Even though this is a convenient way for foreign companies to obtain large areas of land in one deal (and save significant transaction costs), they must be wary as there are often disputes and uncertainties regarding the rights connected to the land because the lease with the company is dependent upon the previous leases with a number of farmers. A "government middleman" possesses considerable political power and could place significant pressure on citizens, with little bargaining power, to agree to otherwise unacceptable or even illegal deals. There are accusations that small farmers have been coerced to rent their land to the government. It is also said that local governments in various regions of China have set up "commercial" entities, exercising their political power by maximizing their own profit to the disadvantage of local people.

Fraudulent land assets

Sino-Forest Corporation, whose business was to purchase and sell standing timber in China, allegedly recently orchestrated one of the largest frauds in the Canadian stock market's history through a broad-ranging scheme to falsely inflate the company's assets and revenue. However, it has to be noted that investigation is still going on.

Sino-Forest, which was traded on the Toronto Stock Exchange and was once valued at more than USD6 billion, is claimed to have severely violated the law by overstating its financial performance. Between 2006 and 2011, many of Canada's largest bank and brokerage firms helped Sino-Forest raise more than USD3 billion from investors eager to tap in to China's soaring growth through the burgeoning forestry industry. At its peak, Sino-Forest claimed to control more than 800 000 ha of timber assets in China and reported revenues of more than USD1.9 billion in 2010. Lately it has turned out that many of those claims were not true. The company allegedly moved money in a "circular" manner between various corporate entities in a series of complex related-party transactions. The company may have also falsified evidence of ownership for the vast majority of its timber holdings. Currently Sino-Forest has filed for bankruptcy protection from its creditors and its shares have been delisted from the Stock Exchange.

5.3.3 Africa (sub-Saharan)

The key issues relevant for the future forest plantation development in Africa are analysed in a matrix presented in Table 5.3. [9]

[9] The methodology is discussed in Chapter 4.

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Table 5.3 Issues Relevant to Plantation Development in Africa

Issue	Now	Where?	Why?	Trend	Possible implications
Land ownership	Dominant state land ownership with customary/legal village rights	Most sub-Saharan countries excluding South Africa, Zimbabwe and Swaziland	- State management of plantations has resulted in degradation of the forest assets - Village rights are not always clear	Increase in land leases and concessions for private sector - leased land will be the dominant form of new industrial plantations	- Great improvement in plantation management - Incompatible statutory-customary ownership will cause problems for plantation development
	- Dominant freehold land with customary/legal village rights - Large plantation area previously owned by the state and at later stages outsourced to private companies	South Africa	The state promoted plantation development in their own land in order to produce e.g. mining timber.	In South Africa the plantation expansion will be marginal Increase of small-holders and other private tree growers	Plantations will remain with shift in ownership structure.
Land use competition	- Competition for land is location specific (low population density areas also exist); - Demographic growth increases pressure on village and urban land	Most sub-Saharan countries in certain regions	Traditional land areas are not sufficient to feed the populations in certain areas	Drastic population growth expected to continue	In some areas limitations for forest plantation expansion
	Large-scale land leasing by foreign companies mainly for biofuel and agricultural purposes	Tanzania, Mozambique	Eastern Africa is considered a politically stable as well as geographically (sea passage to Asian markets) and ecologically (good growing conditions) attractive area	Development expected to continue	

Issue	Now	Where?	Why?	Trend	Possible implications
	Large-scale arable land lease plans by foreign governments (and companies) to safeguard their own citizens' food supply	Madagascar, Liberia, Sudan, South Sudan	Highly developed and densely populated countries suffering from shortage of farm land (e.g. South Korea, Qatar, UAE) lease large areas of land from Africa to grow food for their own use (ship foodstuff from Africa to Asia)	- Land leasing will continue as Africa warmly welcomes Asian investors - However, the recent political and socio-economic problems of this phenomenon probably halt the speed of such development	- Danger of "neo-colonialism", with poor states producing food for the rich at the expense of their own (hungry) people - The siphoning of water for huge areas of farmland will worsen the already low water levels of rivers in Africa, (e.g. the Niger) - Land will be an increasingly strategic, highly priced and desired asset
Laws and policies	- Very few incentives for plantation development - International development aid / donors role still important even though aid-dependency is decreasing slowly	Most sub-Saharan Africa except South Africa	Policies have not successfully promoted forest plantation development without exceptions and support has been donor rather than market driven	There is room to improve the policies. Mozambique has promoted plantation development by facilitating foreign investments; Uganda has implemented an incentive scheme with donor support, and Tanzania has planned to support plantations.	With slowly declining donor support, Eastern African states' own policies will probably attract forest investors
	Weak governments / heavy corruption		Lack of governments' resources and capacity	Slow improvement	Enabling environment for forest plantation activity in many African countries will remain poor
Technology	Underdeveloped plantation technology with some exceptions	Most sub-Saharan Africa except South Africa	The dominant state managers have neglected development efforts	Technology development will remain very slow	Productivity of plantations with remain low if technology (the cornerstone of new plantations) is not improved
Environmental issues	Conversion of native vegetation (native grass lands) and loss of biodiversity	Most sub-Saharan Africa	The conversion is mainly due to fuel wood collection, pasture and agricultural expansion	Native vegetation (e.g. Miombo woodlands) will continue to be under pressure	- Well established plantation can mitigate environmental challenges - Good lessons to be

Issue	Now	Where?	Why?	Trend	Possible implications
	Water shortage	South Africa; potential problems elsewhere	Potential problems with some evidence when industrial plantations have been mismanaged and poorly implemented	Weak control and punishment mechanisms encourage unsustainable forest plantation operators	learned e.g. from South Africa.
	Wind, insect and other damages threatening monoculture plantations	Existing plantation areas			
	Soil erosion and desertification	Half of the continent	Climate change reasons and poor land management	Expected to continue	Local people moving to more arable lands → population pressure will rise
Social issues	Population growth	All sub-Saharan Africa	High birth rate, poor family planning combined with low standard of living	Population growth will continue	More people living on the same piece of land and presenting claims on it in the future
	Poverty	All sub-Saharan Africa	Low socio-economic development	Poverty continues even though it slowly decreases with economic growth and political stability	Numerous negative repercussions
	Food security and importance of Non-Timber Forest Products (NWFP)	All sub-Saharan Africa	Local forest dwellers depend on forest products for living	Plantation induced land use change will continue to be a threat to forest dependent people	Plantation companies can be held liable for causing malnutrition / starvation in cases where local people's access to NWFPs gets limited or threatened
	Low level of education (illiteracy), concerning especially women	All sub-Saharan Africa	- Low socio-economic development and inequality - Local stakeholders' unawareness of their rights and responsibilities	- Potential confusion between plantation companies and local groups on rights and responsibilities - Unskilled labour	Social conflicts expected
	Health and safety problems (HIV)	All sub-Saharan Africa	High morbidity and mortality	Continuing problem	Negative repercussions and heavy burden for local governments' expenditure
Timberland investments	Investors are cautious and do not rush into Africa. Some pioneer-investor examples, however, already exist.	Eastern Africa	Poverty, political instability, low level of socio-economic development, health problems, etc. have curbed investments	Plantation investors are increasingly interested in Africa since available land in other parts of the world is getting scarce	Africa will become a more desired location and investors will tolerate higher risks

Land Ownership

The land in African plantation countries or potential plantation countries – Mozambique, Tanzania, Uganda, Zambia, Angola, Ghana and Liberia – is mainly state-owned or mastered by villages with customary or in some cases statutory rights[10]. In some cases the state has then further leased the land to private companies or other entities (e.g. in Mozambique, Tanzania, Uganda and Rwanda).

The landownership structure is a barrier to entry for many plantation developers. Leasehold arrangements eliminate high upfront investment and speculation on land prices. Overall, it is expected that state management will be replaced with some form of outsourced management incorporating leasehold land tenure arrangements when it comes to significant commercial plantations in the region.

Smallholders typically hold a customary right or such land title that resembles freehold land8. In some countries or regions within countries small-scale tree growers will play an important role in future plantation development.

Land Use Competition

Land use competition is very location specific as low population density areas also exist.

Land use competition will drive up land prices and shift forest plantations towards new frontier areas.

After the 2007-2008 world food price crisis, highly developed and populated developed countries suffering from a shortage of farm land (e.g. South Korea, Qatar, United Arab Emirates) started leasing large areas of arable land from Africa to grow food for their own citizens, i.e. shipping it out of Africa. As Africans have not benefitted from this development land lease plans have caused social unrest in many countries and even led to overthrow of governments. These incidents strengthen the prognosis that land will be an increasingly strategic, highly priced and desired asset.

National Laws and Policies

There are very few incentives for plantation development in Africa, with South Africa as the exception. Policies and financing have been more donor than market driven during the past decades. Official development aid from industrial countries has been a major component of many African countries' budgets – sometimes the only thing keeping the economy from collapsing. Poor governance and egotistic leaders have also corrupted the political environment as nepotistic rulers have enacted laws and policies that have only favoured themselves and their families. There is much room for improvement in the field of policies in Africa. However, there are some positive signals in Eastern Africa. Mozambique has promoted forest plantation development with facilitating foreign investment. Uganda has implemented an incentive scheme with donor support, and Tanzania has planned to support plantations.

[10] In Ghana village/ethnic groups manage and decide on land issues and village land represents the majority of potential plantation areas.

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Technology

Plantation technology is in an incipient stage in Africa. As most people are poor and livelihoods are still largely based on subsistence farming and gathering, there are no skills, know-how or capacity to adopt modern plantation technologies. However, there are some plantation companies (mainly foreign) that are technologically advanced and South Africa is the exception with much more technological development than the rest of Africa.

GMOs will still be a contentious issue, however, most likely it will be implemented increasingly in the future.

As in Asia, technology will also play an important role in adaptation to climate change.

Environmental Issues

The conversion of native vegetation (savannah) to forest plantations and loss of original biodiversity is a possible negative repercussion of badly managed plantation expansion in Africa. However, the conversion is mainly due to fuel wood collection, pasture land expansion and agricultural expansion (see the discussion on land use expansion above), not because of forest plantation development.

Water shortage is a source of environmental concern in South Africa and a potential problem elsewhere in the future, especially if the rate of desertification stays at the current level.

Wind, insect and other damage are a concern on existing monoculture plantations, as natural/organic damage controls are missing.

Due to a variety of problems, including legislative (especially concerning law enforcement) and administrative weakness of many African countries along with corruption in the business climate, some forest plantations have been badly mismanaged and poorly implemented.

Social Issues

In Africa general social problems are more accentuated than on any other continent. Rapid population growth, extreme to moderate level poverty, low socio-economic development, illiteracy, weak or collapsed states, high dependency on external development aid, food insecurity and health problems (especially HIV) – all have negative repercussions. Africa has become a challenging context for any industrial activity, including for forest plantation development.

As the population grows, more people will end up living on the same piece of land and presenting claims on it, and as a consequence competition for land is predicted to become tougher.

As a significant number of people in Africa depend on forests and NWFPs for living, plantation companies will find it difficult to deprive them of the basic conditions of life. They might be held liable for causing e.g. starvation, if game and other foodstuffs disappear with plantation expansion.

The confusion between statutory and customary land use rights is another difficult issue in Africa. Indigenous people and other rural groups (often illiterate and uneducated) rely on customary rights, whereas plantation companies have to follow

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the statutory licensing and tenure statutes. In addition, in some countries the state does not allow plantation developers to take local people's wishes into consideration even if the company wished to do so.

Timberland Investments

Investing in Africa is a lot riskier than other global plantation areas. Poverty, instability (political turmoil, authoritarian governments, etc.), wars and lack of education make investors cautious. There are, however, some promising areas, especially in Eastern Africa, where investors are involved with plantation forestry.

It is probable that as the global competition for arable land intensifies, Africa will become a more desired location and investors will tolerate higher risks in the future.

Box 5.5 Case Uganda

Land vacation

In 2011 Oxfam published a report accusing a London-based New Forests Company (NFC) of evicting local people from land to make way for NFC's operations in Uganda. Oxfam claims that the now landless people are desperate and driven to poverty. Accusations also include the use of violence and destruction of peoples' property, crops, and livestock. In addition NFC was indicted of not properly consulting local people, as well as not offering them adequate compensation or alternative land.

NFC, however, insists that their process was actually the most consultative in Ugandan history and that consultation, community meetings and awareness raising took place. Regarding compensation, NFC asserts that it offered and was prepared to pay compensation to former encroachers, but was prohibited from doing so by the Ugandan Government, whose responsibility it is. All land claims must be processed and land or monetary compensation provided by the government's Ministry of Lands, Housing and Urban Development and not by private investors.

NFC also defended itself by saying that those vacated by the government were illegal encroachers. According to the government, any person who has moved to the land in question after 1992 is considered an illegal encroacher, with no legitimate right to it. According to NFC the majority of the people affected by the vacation entered the area after 1992. NFC also claims that the vacations took place without any personal injury, reports of violence or reported damages.

As this case shows, with two contradictory views of the course of events, land use is a sensitive matter in Uganda. No matter what the final truth is, plantation companies acquiring land in Uganda are faced with numerous challenges and need to be well prepared when establishing operations in the country.

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Box 5.6 Case Liberia

Wealthy nations acquiring arable land from Africa

In January 2012 two Liberian land campaigners wrote in The New York Times that the government of Liberia, headed by President Ellen Johnson Sirleaf (co-winner of the 2011 Nobel Peace Prize), was likely "sowing the seeds of future conflict by handing over huge tracts of land to foreign investors and dispossessing rural Liberians." They alleged that between 2006 and 2011, the President "granted more than a third of Liberia's land to private investors to use for logging, mining and agro-industrial enterprises."Today, more than 7 million acres have become forestry and agricultural concessions," they said. More than 20 percent of this (1.6 million acres) went to one company, the Sime Darby Corporation of Malaysia and Golden Veroleum, a subsidiary of the New York's Verdant Fund L.P.

Local communities in Liberia, where 150 000 of the 1 million people will be resettled without being consulted or compensated by their government, have temporarily blocked the Malaysian company's plans to plant oil palms on 0,5 million acres of land. The company has reportedly frozen its operations following an appeal to the Roundtable on Sustainable Palm Oil, an international palm oil certification body.

The “land grabs” in Liberia were triggered by the 2007-2008 world food price crisis, with countries like oil-rich Saudi Arabia and South Korea buying or leasing vast tracts of land in Africa, Asia and Latin America. A case similar to Liberia led to a political crisis in Madagascar in 2009. Then a plan to lease large tracts of land to a South Korean company, Daewoo, was followed by a 2009 Malagasy political crisis culminating into a *coup d’état* and at least 130 people being killed. The new president cancelled the contract with Daewoo under which it would have leased 1.3 million ha of land, almost half of Madagascar's arable land for 99 years to grow corn and palm oil for export to South Korea.

5.3.4 Oceania

The key issues relevant for the future forest plantation development in Oceania are analysed in a matrix presented in Table 5.4.

Table 5.4 Issues Relevant to Plantation Development in Oceania

Issue	Now	Where?	Why?	Trend	Possible implications
Land ownership	Private freehold land. Significant areas of plantations are owned by financial investors.	New Zealand, Australia	Both countries have old pasture areas suitable for forest plantation development.	Forest plantation development will continue at a modest pace	Land use changes might favour pasture or forest plantations.
Land use competition	Not significant		Land use patterns are settled and deforestation does not take place		
Laws and policies	Policies are favourable for plantation development		Importance for the rural economy and carbon stocks	Political climate will remain favourable to plantation development	Plantations remain an important part of the landscape (esp. NZ)
	Well established and enforced environmental legislation		Environmental awareness is high in Australia and New Zealand	High environmental performance expected to continue	Regulations and policies control environmental impacts well
	Climate change challenge tackled with a carbon market mechanism – carbon credits traded in NZ ETS* and Australian ETS market		Australian and New Zealand have been proactive in establishing national carbon market schemes	Carbon financing will have positive contribution to plantation development	Plantation land is valued for many purposes (timber, ecosystem services, landscape, carbon storage)
Technology	Advanced state-of-the-art-technology		Australia is one of the development centres of eucalyptus and New Zealand of sub-tropical pines.	Continue to be leaders in plantation technology and know-how	First countries to implement new technologies
Environmental issues	Australia is one of the world's biggest per capita carbon emitters		- Civil society is very sensitive to environmental issues related to plantations particularly in Australia. - Endangered species (flora and fauna) endemic to Tasmania are a core environmental concern for some NGOs	Communication between environmental groups and forest plantation industry now exists (after 30 years of conflict) and continues in a constructive manner	High environmental performance is expected
	Logging/degradation of native forests in Tasmania				
	Concerns of plantation development worsening the existing drought-proneness in Australia				
Social issues	- Social movements are mainly concerned about environmental issues (explained above) - Strong civil society opposition towards plantations especially in Tasmania		Environmental concerns have created two opposing teams: the green groups and the industry that until recently were very far from each other	Social movements are expected to continue	Civil society and NGOs will act as the plantation industry's watchdogs and keep it alert
Timberland investments	The region has been attractive particularly for financial investors who continue to acquire existing assets.		Markets are mature, however, favourable growing conditions and overall security offers good opportunities for investments.	Timberland investing will be the principal driver of green field plantations.	Timberland investing will continue in New Zealand.

* New Zealand Emissions Trading Scheme NZ ETS

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Land Ownership and Land Use Competition

Land in Australia and New Zealand is mostly privately owned freehold land. Significant areas of plantations are owned by financial investors. Both countries have old pasture areas that are suitable and benefit from forest plantation development.

Land use competition is very different from Latin America, Asia and Africa, as it has been quite limited in Oceania.

Land use patterns are settled and deforestation does not take place in a significant manner. Even though there are challenging issues concerning the original inhabitants of Australia (Aborigines), those are mostly not land-related but related to health, employment, education, substance abuse, etc.

National Laws and Policies

The two countries are both favourable to forest plantation development. Forest plantations have been important for the development of the rural economy and an important source of employment in sparsely populated areas.

Both Australia and New Zealand have well-established and enforced environmental legislation. As with most developed countries they are characterized as countries with robust criteria and advanced indicators for the environmental performance of industrial operators.

Both countries also have a well-functioning judiciary system to ensure the equal treatment of all people under the law.

Technology

Eucalyptus is an endemic tree species in Australia. Due to the long experience and in-depth knowledge of the characteristics of the species, Australia is one of the development centres of eucalyptus with advanced, state-of-the-art technology in use.

New Zealand is a similar leading development centre for another species, namely sub-tropical pine (*Pinus radiata*). It is expected that both countries will continue to be leaders in plantation technology and know-how in the future.

Environmental Issues

As discussed earlier, the two countries in Oceania have strict environmental legislation and well-functioning law enforcement.

The main environmental issues in Australia are (i) the concern of plantation development worsening the existing drought-proneness of the country, (ii) logging of native forests in Tasmania and (iii) the high carbon emission levels.

Australia is one of the world's biggest per capita carbon emitters. That has made both Australian and New Zealand proactive in establishing national carbon market schemes for climate change mitigation purposes. At the end of 2011 Australia introduced a fixed-price carbon tax. The tax is expected to proceed to a fully-fledged floating-price emissions trading scheme in 2015 when Australia's price on carbon will be linked to the European Union ETS.

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In New Zealand carbon credits are already sold in the New Zealand Emissions Trading Scheme (NZ ETS). The NZ ETS puts a price on greenhouse gases (GHG) to provide an incentive to reduce emissions and to encourage tree planting. Under the scheme participants earn New Zealand Units (NZUs) from the Government, for example, owners of forests that absorb GHG. Forestry was included in the NZ ETS in 2008 and by 2015 there will be eight sectors[11] participating/included in the scheme.

There are endemic species (flora and fauna) in Tasmania, some of which are in danger of extinction. Logging in environmentally sensitive native forest areas has ignited a so called Tasmanian forest war. Recently the two opposing parties of the "war", the green groups and the industry, have been negotiating peace again. An initial truce was agreed by industry leaders and environmental groups in 2010 after 30 years of protests against native forest logging in Tasmania. It came as the industry collapsed in the face of market rejection of native forest woodchips, and the high dollar. In a recent agreement, signatories accepted that some companies continue native forest logging, with a transition to greater use of plantations, and to legally binding protection of high-conservation-value native forests.

Social Issues

The environmental and social issues are very much interlinked in Oceania. The media has painted a picture of Tasmania as a centre of a polarised debate: green groups on one side fighting for the environment, and industry on the other side fighting for economic growth and jobs. As discussed under Environmental Issues above, the opposing parties have been working hard to find a resolution to the situation and to deliver a strong outcome for nature conservation, so that it delivers a sustainable and durable environment for the industry to prosper and provide employment.

Timberland Investments

The Oceania region has been attractive particularly for financial investors who continue to acquire existing assets. The markets in Australia and New Zealand are mature, however, favourable growing conditions and overall societal and political security offers good opportunities for plantation investments in the future. Timberland investment is expected to be the principal driver of green field plantations.

[11] Forestry, Energy, Fishing, Industry, Liquid fossil fuels, Synthetic gases, Waste and Agriculture.

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Box 5.7 Case New Zealand

Positive environmental impacts of plantations

The importance of some plantation forests as a habitat for indigenous biodiversity is especially well documented in New Zealand. A diverse range of species, including rare and threatened species, have been recorded in the native undergrowth of pines or other exotic plantation tree species. Plantation forests also act as a refuge for indigenous beetle species, especially in areas where indigenous forests are rare. Streams and rivers running through wood plantations provide habitats for native fish. Several endangered fish species have been found in streams running through plantations in New Zealand. Trees improve riverbank stability, help to absorb nutrients from run-off before they reach the stream, and provide shade that controls stream temperature and the growth of nuisance plants.

Plantation landscape values

Plantation forestry is one of the major land-use activities in New Zealand. Plantations cover 6.6% of New Zealand's land area making plantations a significant component of New Zealand's environment and landscape. There has been research done to determine perceptions and attitudes towards exotic tree plantations in the country. Exotic plantations are generally seen by most New Zealanders as a harvestable tree crop or tree farm, but can be viewed differently by overseas visitors, particularly those from North America, Europe and Japan. Visitors often consider New Zealand's plantations more as a natural and scenic resource due to differences in cultural perceptions. Landscape values, including scenic, are commonly addressed in New Zealand's regional and district plans and are also often considered in international certification evaluations.

5.3.5 North America

The key issues relevant for the future forest plantation development in North America – particularly in the southern parts of the US – are analysed in a matrix presented in Table 5.5.

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Table 5.5 Issues Relevant to Plantation Development in the US

Issue	Now	Where?	Why?	Trend	Possible implications
Land ownership	Private freehold land. Industrial owners had started to outsource plantation assets to financial investors by the 1970s - investors are currently the main forest asset managers in the US.	Plantations are concentrated in the Southern states.	The best growing conditions are in the Southern states.	The plantation area is expected to remain stable or grow at a modest pace	No significant implications for the plantation situation
Land use competition	No competition with agricultural land. However, in urban areas some forest land has other, more lucrative uses e.g. real estate or recreation. Some competition between different regimes – e.g. biofuel vs. others		Plantation will play an important role in also supplying biomass for energy purposes. A growing number of renewable energy projects in the Southern US utilizing woody biomass will require the development of short-rotation bioenergy plantations.	Biomass production will continue to grow in forest plantation areas	Biomass plantations will become a new forest plantation class
Laws and policies	The state has traditionally neither limited nor supported plantation development.		Markets and freehold land are and remain the principles	No policies are expected to be developed	No significant implications for the plantation situation
	Environmental legislation – conservation easements in use.		Conservation easement prevents forest land from shifting to urban or other uses and has offered an earning mechanism for some timberland funds.	Plantations will continue to have high environmental performance	US specific, voluntary but legally binding, mechanisms protect forest land for long periods of time

Issue	Now	Where?	Why?	Trend	Possible implications
Technology	GMO technology is starting to be applied with eucalyptus		- Concerns for environmental problems / threats have curbed enthusiasm for GMOs before - Now competition with Brazil is rising interest in the US for GMO eucalyptus	GMOs will impact on future productivity of the fast growing short rotation plantations	It is unlikely that GMO eucalyptus in the US will end up competing with Brazilian eucalyptus, in volume
Environmental issues	Conservation is a well-reflected issue in the legislation		Civil society is active in environmental issues related to land use.	Plantations will continue to have high environmental performance	No significant implications for plantation development
Social issues	Not a significant issue				
Timberland investments	Origin of timberland investments since 1970s – industries outsourcing assets to financial investors.		The forest industry is increasingly concentrating on its core business.	The US will continue to be the main location for timberland investors	Timberland investments are driving the future plantation development

Land Ownership

The dominant land ownership mode in the US is private freehold land. Industrial owners started to outsource plantation assets to financial investors in the 1970s and investors are currently the main forest asset managers in the US.

Plantations are concentrated in the Southern states of the country, where the best growing conditions can be found. In the Southern US, the history of forest plantations is long and successful. It is projected that more than half of the wood harvested for processing is obtained from planted forests in the region.

The plantation area is expected to remain stable or grow at a modest pace in the future.

Land Use Competition

There is basically no competition with agricultural land, but with bioenergy there will probably be more competition in the future. The growing number of renewable energy projects in the Southern US utilizing woody biomass will require the development of short-rotation bioenergy plantations. The increasing scale of forestry biomass for bioenergy will only be possible with developments in forest bioenergy plantations as there will be insufficient feedstock from logging residuals for all announced and planned bioenergy facilities. Relevant technology exists to rapidly establish forest bioenergy plantations and research is already underway to expand these possibilities in the country.

National Laws and Policies

The state has traditionally neither limited nor supported forest plantation development in the US.

A concept called conservation easement has been developed in order to protect ecological values on privately-owned land. A conservation easement is voluntary, but when applied, a legally binding agreement that limits certain uses or prevents development from taking place on a piece of land now and in the future, while protecting the property's ecological or open-space values. In short it is a restriction placed on land to protect its resources (e.g. specific conservation values such as water quality or bird migration routes). It functions so that a landowner voluntarily agrees to sell or donate certain rights associated with the property – often the right to subdivide or develop – and a private organization or public agency agrees to hold the right to enforce the landowner's promise not to exercise those rights.

Conservation easement prevents forest land from shifting to urban or other uses and has offered earning mechanism for some timberland funds. Because the land remains in private ownership (with the remainder of the rights intact) an easement property continues to provide economic benefits in the form of jobs, economic activity and property taxes. Conservation easements contribute to plantations having higher environmental performance in the future.

Technology

Various concerns related to environmental problems and threats have curbed the enthusiasm to apply GMOs in the US in the past. As Brazil has recently become a strong player in plantation forestry with fast growing eucalyptus, eucalyptus is becoming a more interesting option also in the US. Some companies have plans to

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change from pine cultivation to GMO eucalyptus cultivation. In the long run, GMOs will most likely have a role in the fast growing short rotation plantations in the country.

Environmental Issues

Conservation is an issue strongly reflected in the US legislation. Civil society is active in environmental issues related to land use. Therefore plantations are expected to have high environmental performance today as well as in the future.

Timberland Investments

The US is the home and birth place of timberland investments since the 1970s. Industries have been outsourcing assets to financial investors because the forest industry has been and still is concentrating its activities on its core business.

The US will continue to be the most important location for timberland investors and timberland investments are driving the future plantation development.

Box 5.8 Case US

GMO and forestry

Some companies in the US have recently been planning to transform plantation forests of the Southeast part of the country by replacing native pine with genetically modified eucalyptus. The motivation for using eucalyptus instead of pine is to catch up with countries like Brazil that have experienced a boom of vast tree plantations in recent decades. While the Southern US has seen a rise in pine plantations during the same time, pine simply cannot compete with eucalyptus in growth.

The process towards GMO in forestry in the US has been slow mainly because of the fear of bio-engineered eucalyptus turning invasive and overtaking native forests. The existence of concerns about the extent to which transgenic plants could become weed pests is clearly reflected in the US Federal Plant Pest Act. However, along with recent innovations in fertility control technology it might be possible to control the plants' spread. This would open a door to trees and wild plants, including weedy grasses, to be genetically engineered for use in pulp and paper production as well in energy applications like biomass and next-generation biofuels without fear of invasiveness.

In mid-May 2010 the US Department of Agriculture approved large-scale field trials with genetically modified eucalyptus. A gene has been introduced into trees which makes them less sensitive to cold. Before this the cultivation of eucalyptus has only been possible on the southern tip of Florida, but the new frost tolerance could mean that cultivation would be possible in other parts of the US as well.

There are groups and associations that strongly oppose the use of GMO in the US. They claim genetically modified trees to be highly invasive, explosively flammable and causing or worsening droughts. The divergent opinions around GMO are expected to remain opposed and discussion heated.

5.3.6 Europe and Russia

Europe and Russia are less important regions in terms of global forest plantation development as natural and semi-natural forests dominate the continent. According to some definitions there are actually no plantations in Russia. European countries, however, have existing pulpwood plantations and a growing interest in new biomass

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for energy plantations mainly triggered by the need to meet the European Union (EU) 20-20-20 targets[12].

The key issues relevant for the future forest plantation development are analysed in a matrix presented in Table 5.6.

Land Ownership and Land use Competition

Families have traditionally owned forests in Europe and freehold land has been the predominant land ownership model. Some industrial owners and financial investors also own land, but states do play an important role as plantation owners. The main plantation countries in Europe are the UK, France, Spain and Portugal which have pine and eucalyptus plantations, as well as Romania with its poplar plantations.

In the future forest plantation development for pulpwood is expected to be marginal, but for energy generation there can be plantations developed in completely new areas. Bioenergy plantation development depends on the progress of renewable energy policies and commitments (voluntary and legally binding).

In Russia, the State owns land and grants concessions to private companies. As mentioned earlier, plantation development has not taken place in Russia before and is expected to remain so in the future.

There is no significant land use competition between forest and other land use modes in Europe or Russia.

National Laws and Policies

The existing forest plantations in the UK, Ireland, France, Spain and Portugal were largely established with the help of state-level incentive schemes, particularly with tax exemptions. The use of incentives, however, does not continue today and is unlikely to take place in the future.

Europe and especially the EU has been active in formulating climate change policies. The policies have important implications regarding biomass for bioenergy production. The EU 20-20-20 target states that 20% of EU energy consumption shall come from renewable resources by 2020. If this ambitious target is kept, the interest in bioenergy will inevitably rise, meaning that biomass plantations are also expected to arouse interest and to be promoted and developed. Some countries have already developed bioenergy plantations, e.g. Romania. Despite the climate change driven interest on bioenergy, this will most likely have a marginal impact on overall plantation development in Europe.

[12] In 2007 the EU Heads of State and Government set a series of demanding climate and energy targets to be met by 2020, known as the "20-20-20" targets.

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Table 5.6 Issues Relevant to Plantation Development in Europe and Russia

Issue	Now	Where?	Why?	Trend	Possible implications
Land ownership	- Freehold land with traditional family ownership as the predominant model. - Some industrial owners and financial investors. - States do play an important role as plantation owners.	Europe: UK, France, Spain, Portugal with pine and eucalyptus; Romania with poplar	In several countries land had been allocated to private families by the state or Crown centuries ago	The ownership model is expected to stay as it is	Marginal plantation development driven by biomass production for energy production.
	State is the land owner with concessional arrangements with private companies.	Russia	The concession arrangements have been revised along with adjustments to forest policy.	Marginal to zero plantation development	No implications for plantations
Land use competition	Not significant				
Law and policies	Incentive schemes	Europe	Forest plantations in the UK, Ireland, France, Spain and Portugal were largely established with incentives, particularly tax exemptions.	Incentives are no longer significant	Large scale plantation expansion will not take place in Europe.
	Climate change policies (EU 20-20-20) highlighting bioenergy	Europe	Some areas have developed bioenergy plantations e.g. Romania.	Climate change policies are expected to have an impact in the future	Marginal impact on plantation development
	Carbon market mechanism in use – carbon emission allowances traded in the European emission trading system (EU ETS)	Europe	The EU has been proactive in establishing a carbon market schemes	EU ETS is currently facing challenges	Carbon financing will have a positive contribution to plantation development.
Technology	Advance plantation technology when applied	Europe	State-of-the-art techniques available and in use in most plantations countries	High level of technological development will continue	Advanced technology enables sustainable plantation development.
	GMOs not applied on a commercial scale	Europe and Russia	Very strict attitudes towards GMOs; Attention and discussion more focused on crop plants than trees	The use of GMO in forestry is likely to start with pilots and proceed at a slow pace.	GMOs will not play a big role in European plantation development
Environmental issues	Illegal logging	Russia	- Non-transparent business culture - Vested interests - Slack control mechanisms	Scepticism in the market towards Russian wood	As forest plantations (new or old) do not exist in Russia, illegal logging,

Issue	Now	Where?	Why?	Trend	Possible implications
	Pollution	Russia (e.g. Lake Baikal area)	Unique and very sensitive ecosystem	The Soviet legacy (that paid very little attention to environmental problems) is a burden, but the situation is now improving	pollution and forest fires do not have an impact on plantation forests
	Forest fires	Russia	- Heat, drought - decrepit/decaying infrastructure - inadequacy and understaffing of fire-fighting units	Expected to continue with intensifying climate change effects	
		Southern Europe	- Heat, drought - negligence and unmanaged / neglected forest reserves	Use of the large pool of available forest resources for bioenergy would be an environmentally and economically ideal solution (jobs + forest fire mitigation)	Woody biomass availability, especially in Spain, is expected to attract bioenergy producers attention
	Global warming (melting of permafrost)	Russia	Climate change i.e. rising temperatures	Threat of large carbon emissions if melting happens on a large scale	As forest plantations (new or old) do not exist in Russia, global warming, poverty and corruption do not have an impact on plantation forestry
Social issues	Land lease agreements often include social obligations	Russia	Soviet history: social programmes often form part of land lease agreements	Expected to continue	
	Poverty		Highly unequal society	Hinders social development	
	Corruption		- Non-transparent business culture - Vested interests - Slack control mechanisms		
	Structural change of the forest sector from mature markets to the emerging markets (especially pulp and paper)	Northern and Central Europe	Better growing conditions (soil, climate), less expensive labour and land availability drives plantation forestry to the emerging markets	Loss of employment opportunities in Europe and socio-economic problems as a consequence	Less people working for the forest sector (including plantations) in Europe
Timberland investments	Emerging investments after restitution	Baltic Nations, Romania, Slovakia	Affordable land areas available in the market	The development will continue for some years	Institutional investors may have an important stake as forest owners
	Some investments have happened after companies have outsourced the assets	Finland, Sweden	Return on equity percentage	Corporate ownership will not expand.	No significant impact on plantations

Technology

In general the level of technology in Europe has been and continues to be at a very high level.

EU has very strict policies regarding GMOs, especially regarding crop plants, but also for trees. The European Directive concerning the trade on forest reproductive material, for instance, is quite strict with regard to GMOs. In addition, food and feed GMOs can only be placed on the market after having undergone a stringent science-based risk assessment on a case by case basis.

The EU Seventh Framework Programme is currently funding an initiative that aims at evaluating and substantiating the scientific knowledge relevant for genetically modified tree biosafety protocols by putting together already existing information generated in various European countries. Participants from institutions in 26 European countries as well as 18 institutions from Albania, Argentina, Australia, Canada, China, New Zealand, South Africa and the US are already participating in the initiative.

Environmental Issues

The important environmental issues in Russia are illegal logging and melting of permafrost. Forest fires, however, are a very serious concern in both Russia and the Southern part of Europe.

Illegal logging is a major problem in Russia. The volume of illegal logging in Russia is reportedly around 11%, while the unofficial data reveals figures of 20-30%. Melting of permafrost in the north of Russia is a consequence of the rising temperatures and can, at worst, lead to massive emissions of GHG to the atmosphere. That is a serious risk from climate change viewpoint, as the gases, CO_2 being the main culprit, accelerate the GHG effect that is the original cause of global warming.

Forest fires have been the most manifest and, in some regions, catastrophic environmental, economic and social problem emanating from forests in Europe and Russia in recent years. Forest fires are expected to become a permanent phenomenon in the area as climate change effects, i.e. extreme weather conditions, will likely intensify in the future.

Social Issues

In Russia the relevant social issues are the socially-conscious land lease agreements, poverty and corruption. In Europe the most prominent issue has been the structural change of the forest sector from mature markets (developed countries) to the emerging markets (developing countries).

The Russian Soviet history left a legacy where development of social programmes is often part of land lease agreements between the government and companies. Russian regional authorities and local administration can also demand that companies finance existing social programmes e.g. support kindergartens, health clinics, schools, heating and effluent treatment for municipalities, cultural and social events or transportation.

Northern and Central Europe have experienced a permanent structural change of the forest sector in the past years. Pulp and paper companies have established operations and plantations in areas characterised by better growing conditions, more favourable climate, cheaper labour costs and more available land for plantation development than in the traditional European regions. This has caused loss of employment opportunities in Europe and socio-economic problems as a consequence. In the future it is expected that less people will be employed by the forest sector (including plantations) in Europe.

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Investments

After restitution[13] took place in Eastern Europe, timberland investors started to take an interest in the area, especially the Baltic Nations, Romania and Slovakia. This, however, does not have a significant impact on the plantation development in the area in the future.

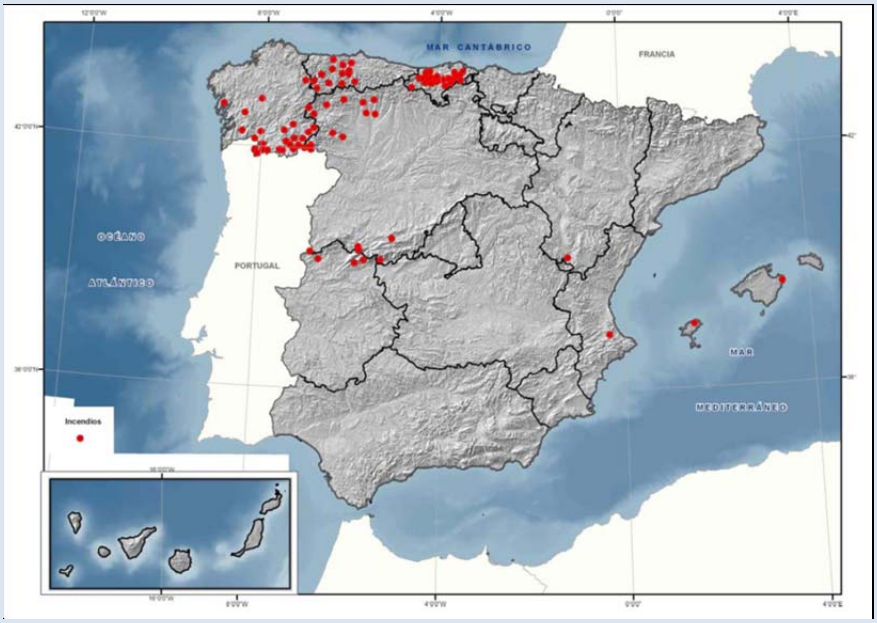
Box 5.9 Case Spain

Forest fires

Forest fires are a major environmental, social and economic problem in Spain. On average approximately 0.5% of the forest area in Spain is burnt every year. It is estimated that there are nearly 20 000 forest fires in the country every year, with up to 60% having been intentionally ignited. Since the reform of the Penal Code in 1995, setting wildfires has been a punishable crime with imprisonment for up to 20 years. However, history reveals that the Penal Code has had problems in its application, and law enforcement is rather low.

Due to the fact that Spanish forests grow in excessive amounts, with deficient forest management practices in place, fires are poorly prevented and controlled. The situation is aggravated by the hot and dry weather, but more so by insufficient forest management on privately owned land.

The map below shows the distribution of forest fires in Spain in 2011. Fires (174 in total) were mostly concentrated in the Galicia region (northwest of the country) which is the region with the highest concentration of plantations in Spain. Thus forest fires are a serious problem to plantations in Spain.



Source: Ministerio de Agricultura, Alimentación y Medio Ambiente. Incendios Forestales en España 1 enero – 31 diciembre 2011. Avance Informativo.

[13] An act of honoring prior interests of property ownership against current, competing claims. In effect, it is a legal procedure for transferring property rights from current owners to former owners because of the injustices of the current situation.

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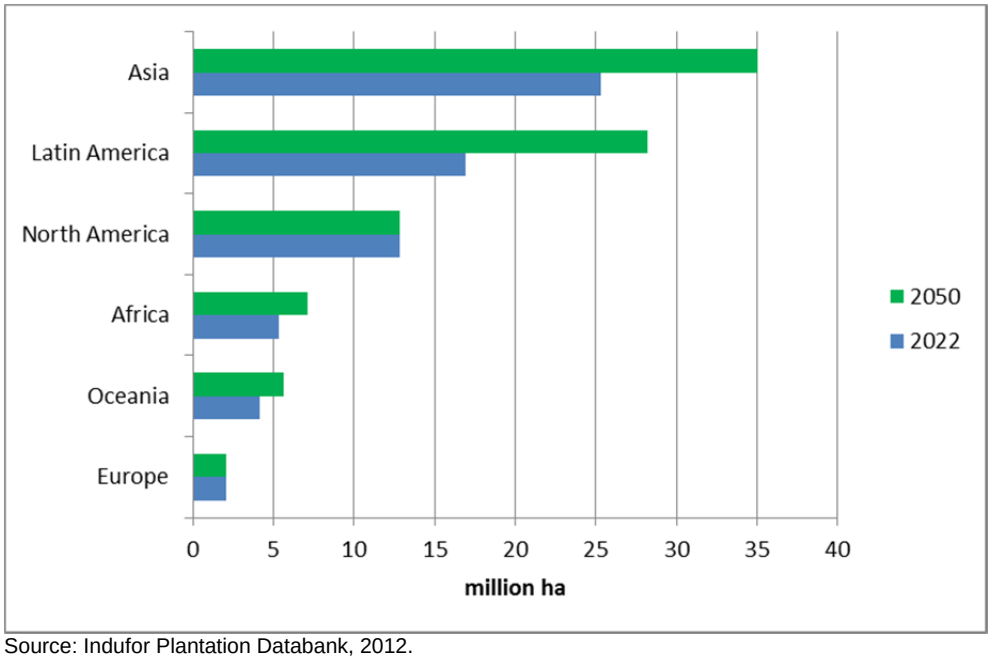
5.4 Global Plantation Supply Development

Forecasts of plantation development in terms of area and supply were prepared using Indufor's plantation databank. Indufor plantation specialists have provided the information, and it is benchmarked to other sources where available.

The first step was to estimate the growth in plantation area by 2022 and 2050 at a country and species level. The plantation area in 2022 represents the area that is likely to be planted and managed as industrial plantation area. The country level forecast took into account land availability and the current investment climate. The forecast for 2050 includes all plantable area and assumes the forestry investment climate has improved and political / bureaucratic obstacles have been cleared.

The global plantation area will expand from the current 54 million ha up to 67 million ha in 2022 and finally up to 91 million in 2050. A regional breakdown shows the 2022 and 2050 situation (Figure 5.10). Plantation area growth is based on the potential plantation area throughout the globe.

Figure 5.10 Global Plantation Area Forecast, 2022 and 2050



Source: Indufor Plantation Databank, 2012.

The global forecast of 2022 was relatively more than the forecast of 2050 due to overall uncertainties in the longer time frame and because of the lack of available land for forest plantations. In the prediction the annual increase in forest plantation area from 2012 to 2022 is 2.28% and from 2022 to 2050 the annual increase is 1.30%.

Based on the plantation databank information on areas and MAIs it is possible to calculate AAC for the countries and regions, and species. The average of the minimum and maximum MAI was determined to be the most reliable variable with which to determine growth potential.

The AAC was then compared to those countries industrial plantation roundwood removals where this information is available. This gives the ratio that determines the baseline for the actual plantation supply. Based on these countries with data available Indufor was able to create default coefficients for every continent. The coefficient shows how large a share of the theoretical production is actually harvested. These

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default coefficients were used for such countries that have not provided information on their industrial plantation roundwood removals.

The baseline coefficient was used from 2012 to 2022 as a static figure as the trees to be harvested in the next ten years are mostly planted already. The global coefficient average was 0.40, and was pushed to this low level mainly by Africa. This indicated an MAI of 9.6 m³/ha in 2012, and 10.7 m³/ha in 2022. The level of overall annual supply is 520 million m³ in 2012 and 711 million m³ in 2022.

In order to create scenarios from 2022 to 2050 Indufor has varied the coefficient. The baseline scenario after 2022 leaves the coefficient untouched and the 2050 level is therefore based on the estimate of the plantation area growth by 2050. Under the baseline scenario the MAI attained is 11.9 m³/ha in 2050 and overall supply reaches 1 082 million m³.

For the optimistic scenario a coefficient of 0.75 was predicted from 2022 to 2050. This estimate of coefficient is based on the improving technology (e.g. harvesting and cloning technology), more efficiently managed forests and higher demand for wood increasing the pressure on existing forest plantations. Compared to the theoretical maximum scenario Indufor still predicts that 25% of the forest plantation potential will remain unexploited, due to a variety of reasons. In countries such as Brazil and Chile, the coefficient is currently at 0.65-0.7. In the optimistic scenario the MAI attained is 16.4 m³/ha/yr in 2050 and overall supply is 1 491 million m^3.

With the theoretical maximum scenario the coefficient is 1.00 which means that AAC equals supply. This scenario would indicate that all of the rotations are symmetrical and everything is harvested exactly in accordance with the managed plantation regimes. This would imply that based on the forecast global plantation area the global average MAI would be as high as 21.9 m³/ha/yr in 2050 and overall supply would reach 1 988 million m³. Doubling the global MAI required very intensive management of plantations and successful application of GMO in forestry.

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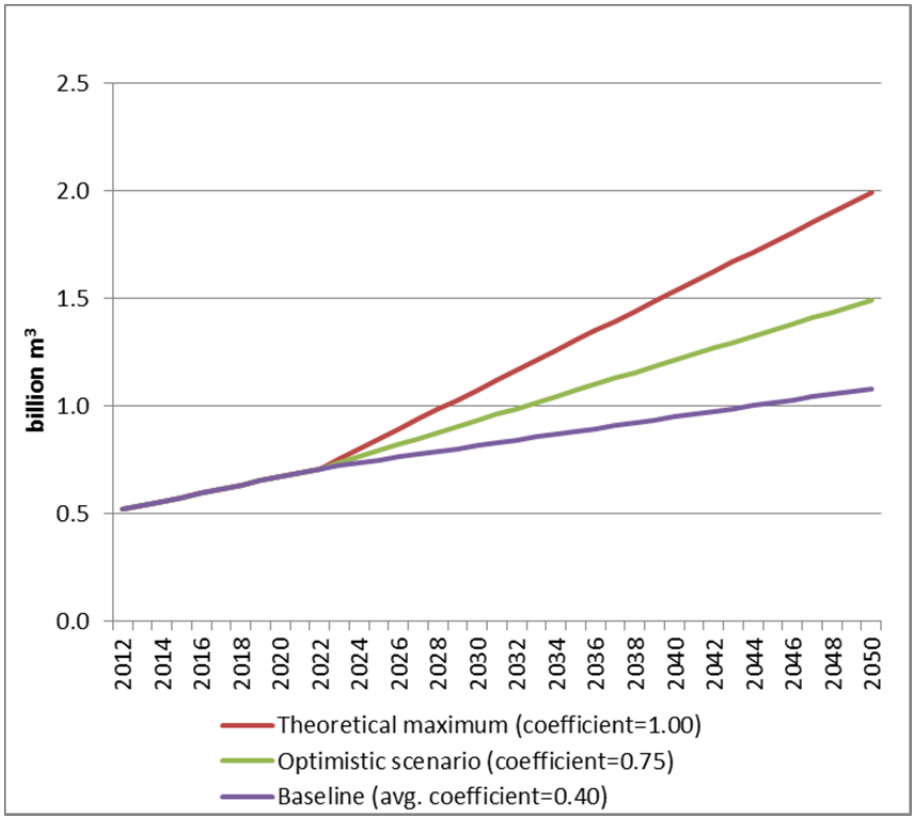
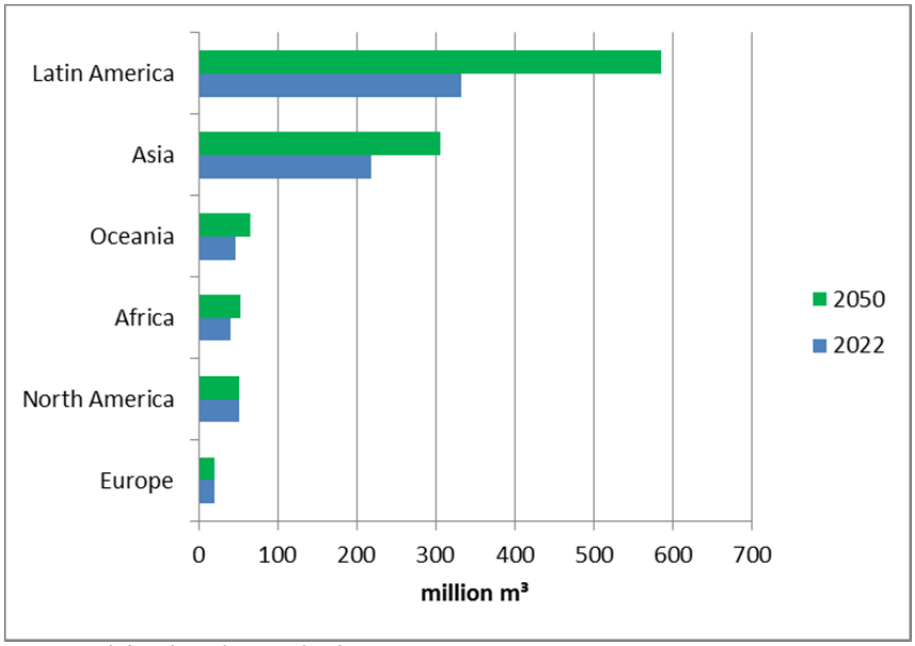
Figure 5.11 Global Plantation Supply Scenarios, 2012-2050



Source: Indufor Plantation Databank, 2012

Figure 5.12 Plantation Supply Scenario I by Region, 2022 and 2050



Source: Indufor Plantation Databank, 2012

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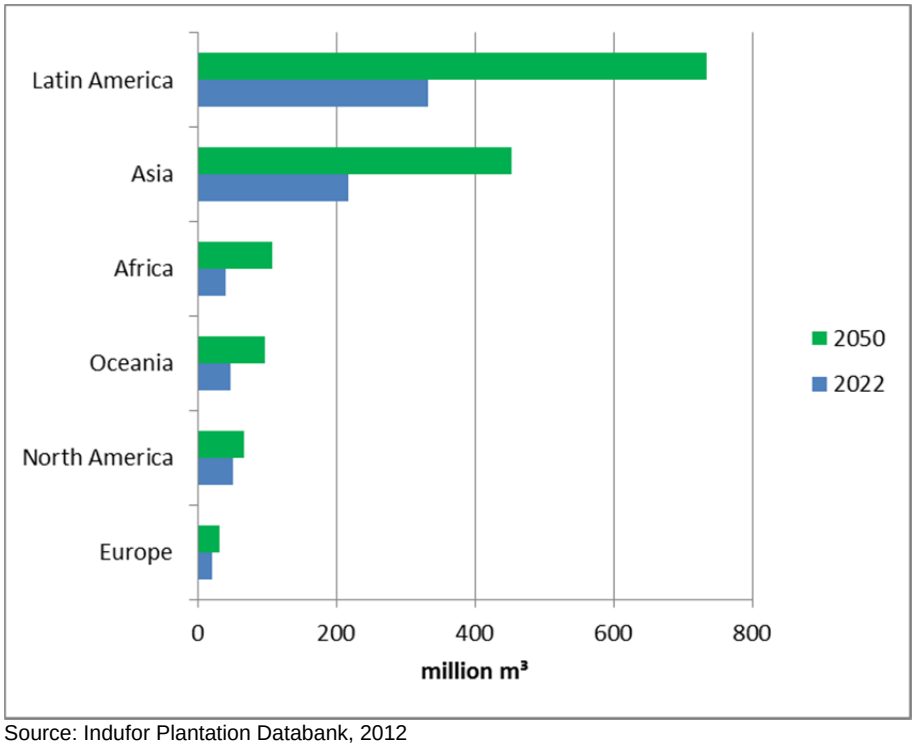
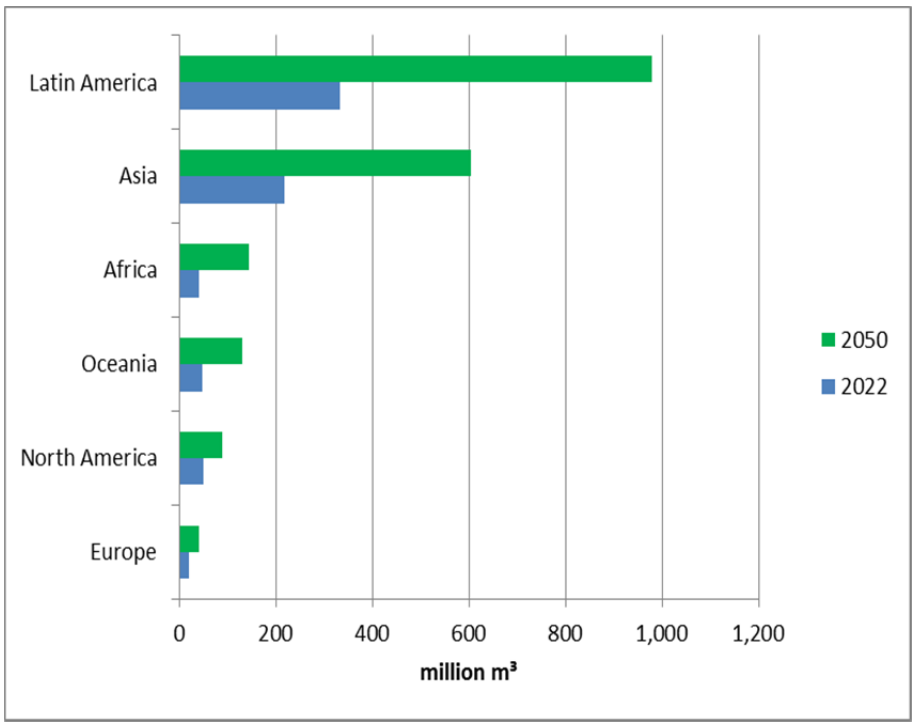
Figure 5.13 Plantation Supply Scenario II by Region, 2022 and 2050



Source: Indufor Plantation Databank, 2012

Figure 5.14 Plantation Supply Scenario III by Region, 2022 and 2050



Source: Indufor Plantation Databank, 2012

The *Eucalyptus spp* were estimated as growing most rapidly *(*Figure 5.15*).* The growth is based both on assumption of plantation area increase in eucalyptus rich countries, such as Brazil, and on a global increase of eucalyptus MAI and intensified management regimes. Other species may yet turn out more productive/profitable, with

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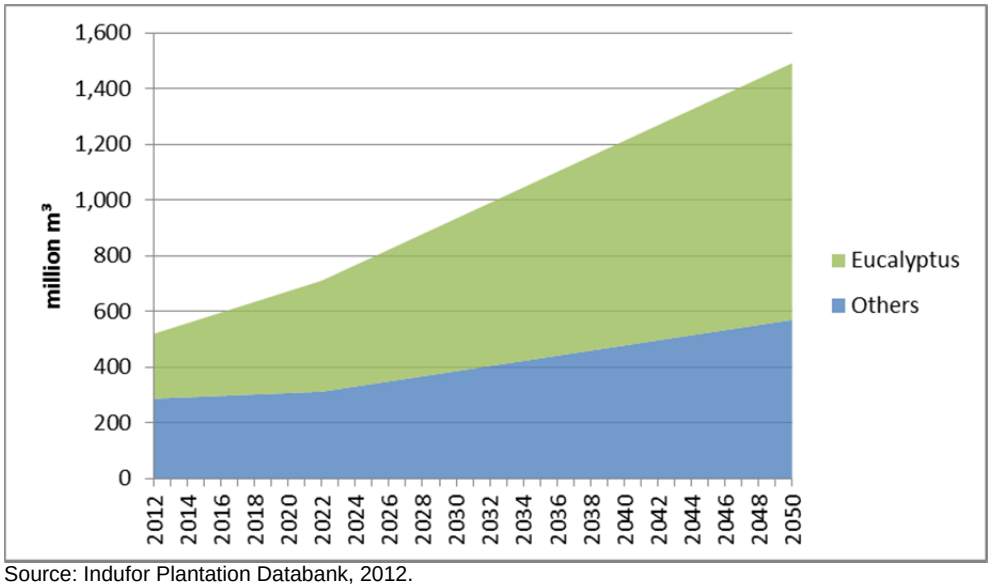
higher pulping yield etc. and more adaptable to changing climatic conditions. Extended plantation areas will be planted on less rich soils in the future.

Figure 5.15 Share of *Eucalyptus spp.* of Total Plantation Supply in Scenario II

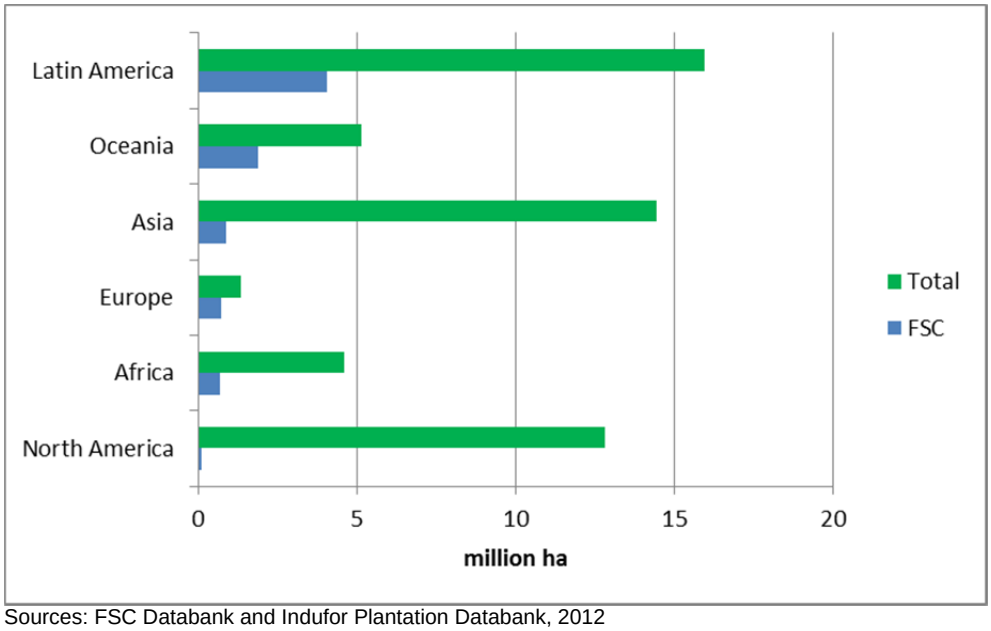


Source: Indufor Plantation Databank, 2012.

5.5 FSC Certified Plantation Wood Supply

The total industrial forest plantation area, as defined by Indufor, covers 54.3 million ha of which 8.4 million ha are FSC certified according to FSC's plantation database (August 2012) when a like definition of plantation forest is applied. This implies a total share of 15.5% of area. The following regional shares of FSC certified plantation area of the total plantation area were found: Europe 55%, Oceania 37%, Latin America 25%, Africa 15%, Asia 6% and North America 1%. Figure 5.16 represents the regional areas from the largest amount of FSC certified forest plantations to the smallest.

Figure 5.16 Total and FSC Certified Plantation Area, 2012



Sources: FSC Databank and Indufor Plantation Databank, 2012

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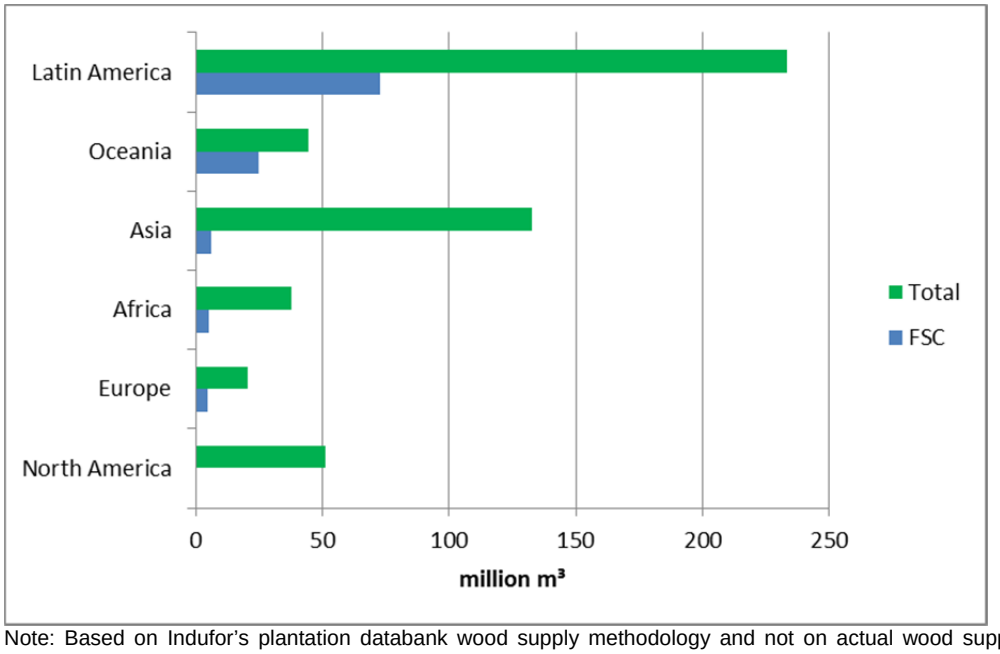
The industrial FSC certified forest plantations are estimated to supply approximately 115 million m^3. The supply was calculated by Indufor using averages of regional MAI obtained from Indufor plantation database in order to create the AAC. Regional coefficients were used to calibrate the supply in order to forecast a realistic supply. The average coefficient for all of the FSC plantations was 53.3%. The average MAI was found to be 4.4% higher in FSC plantations than the average MAI of the Indufor plantation database. The total supply from all of the plantations in the similar baseline scenario is 520 million m^3, which implies a share of 22.1% of FSC certified roundwood from the total supply. Regionally the following shares of FSC certified roundwood were obtained: Oceania 56%, Latin America 31%, Europe 24%, Africa 14%, Asia 5% and North America 1%. Figure 5.17 represents the supply by regions.

Figure 5.17 Total and FSC Certified Plantation Wood Supply, 2012



Note: Based on Indufor's plantation databank wood supply methodology and not on actual wood supply harvested / reported by operators

6. WOOD DEMAND

This chapter presents the industrial roundwood demand estimates used in the study. Information is based both on publicly available statistics and information, and on Indufor research. For the demand forecasts, the background data on key demand drivers are collected from publicly available statistics from the FAO, International Monetary Fund (IMF), World Bank (WB) and United Nations (UN), and a Cobb-Douglas type function is used. The different future scenarios help to understand how large of a share of future demand can and will be satisfied with plantation wood when these are compared to plantation supply estimates.

Scenarios based on forest products were considered but rejected as being impractical given the long forecast period. Product substitution among forest products is common and products have a certain life cycle. This has been apparent especially among wood based panels and also in the paper industry. Roundwood consumption, used in the production of different forest products, best represents the demand for forest products as it is the raw material and the only source of virgin fibre in the production chain.

Sector level break down into wood products and pulp & paper products is undertaken at the end of the demand analysis to highlight expected changes and strategic implications with regards to plantation wood demand. This helps to understand whether plantations will change according to market demand and if management regimes are foreseen to experience significant changes.

6.1 Demand Drivers

6.1.1 Population Growth

Population growth is one of the key drivers of demand for wood and wood products. Between 1960 and 2010, while the world population more than doubled, reaching nearly 7 billion people, global roundwood consumption increased more than 50% (Figure 6.1). This means that the global demand for wood during the past 50 years has more or less followed the trend of population growth. The world population is expected to continue to grow and much of the expansion will occur in emerging market countries such as China, India and other developing Asian countries, Latin America and the Caribbean as well as in Africa. Therefore, a greater share of this increased demand for wood will be in the emerging market countries where the per capita consumption of wood products is lower than in mature markets. Even without increasing standards of living the wood consumption on a global level will continue to increase, following the population growth.

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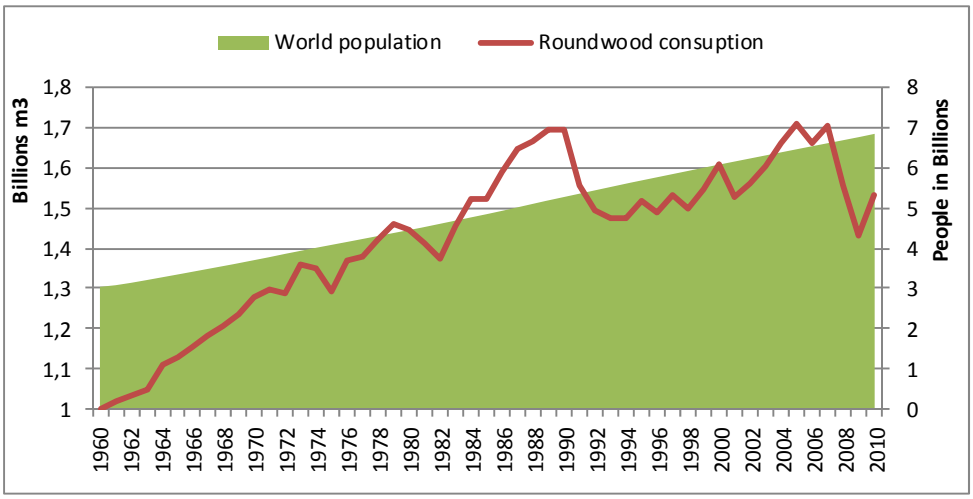
Figure 6.1 World Population and Global Roundwood Consumption, 1960-2010

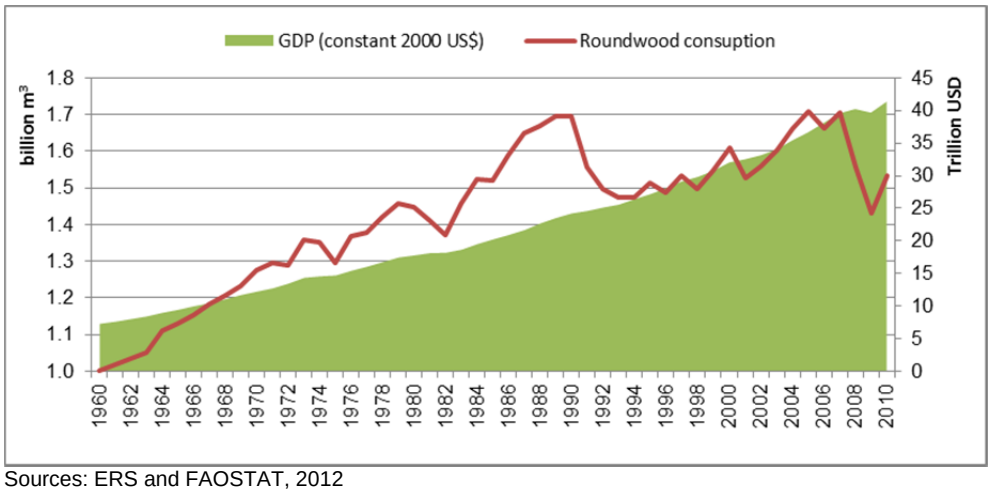


Sources: US Bureau of Census, FAOSTAT, 2012

6.1.2 Economic Growth

The economic growth in a specific country or region, is commonly measured through the growth in gross domestic product (GDP) which reflects overall economic activity and is another key driver of roundwood and wood products demand. Global roundwood consumption followed a similar increasing trend as GDP growth between 1960 and 2010, reflecting a positive relationship between roundwood demand and GDP (Figure 6.2). Therefore, it is realistic to expect that with growth in world GDP the demand for roundwood sourced from natural forests as well as plantations will increase too. This demand is often measured as consumption per capita, and an increase in GDP usually leads to a higher standard of living and thus higher roundwood consumption per capita. However, this relationship is changing as discussed later.

Figure 6.2 World GDP and Global Roundwood Consumption, 1960-2010



Sources: ERS and FAOSTAT, 2012

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6.1.3 Income Per Capita and Product Substitution

The consumption of wood and forest products, except for fuelwood, usually increases with rising incomes (Buongiorno et al. 2003, p. 16), because people can then afford to consume more forest products. However, consumption of forest products and wood per capita starts to fall when the income per capita reaches a certain level. For example, the per capita consumption of printing and writing paper has gone down since 2000 in mature economies such as the US, Europe, Japan, and Oceania where income per capita is amongst the highest in the world.

In emerging economics such China, Russia, and Central and South America where income per capita is much lower, per capita consumption of such paper is increasing. This is probably because in mature economies high income per capita means a high living standard and high rate of internet access. This, coupled with the literacy rate being almost 100%, results in people increasingly substituting traditional paper-based products with electronic products, i.e. people read newspapers online, and all day-to-day services get digitized, reducing per capita consumption of wood and forest products.

In contrast, in emerging economies, with comparatively low living standard and literacy rate still well below 100%, electronic products and services are still out of reach of most people and thus wood and wood product consumption per capita increases as the personal or household income increases. This implies that per capita income and consumption of wood, be it from plantation or natural forests, follows an EKC-type[14] relationship. Likewise, Buongiorno et al. (2003, page 66) used positive income elasticity of demand for emerging economy countries and negative elasticity for mature economy countries when projecting global roundwood demand.

6.1.4 Geographic Shift of Global Forest Industry

Increased environmental concerns, decreased availability of sustainably managed natural forests, higher yield of plantations and limitations of recycled fibre cause the global forest industry to shift to alternative raw material sources and locations. Southern Hemisphere plantation forestry has expanded rapidly in countries like Brazil, Chile, Uruguay, Indonesia and Malaysia, and Australia and New Zealand.

Occasionally land has been available at attractive prices, and productivity is high while production costs are lower and governments have had direct and indirect policy incentives for plantation development. The relocated forest industries produce secondary forest products such as pulp and export much of their production to other countries. This implies that the rise in demand or consumption of wood products outside of emerging market countries actually increases the demand for roundwood in the emerging market countries.

6.1.5 Measures to Ensure Environmental Sustainability

People's concern about the environment has had a major effect on forest and wood products consumption in the world in the past decade (Buongiorno et al. 2003). Such effect continues to prevail and the scale of it is expected to grow in the future as concern about the environment further increases. The following analysis examines how the forestry-related measures, already taken or to be taken, to ensure global environmental sustainability can affect the demand for industrial roundwood in the future.

[14] EKC stands for the Environmental Kuznets Curve. See, for example, Vogel (1999) for more on EKC.

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Initiatives to ensure environmental sustainability have a positive effect on the demand for wood coming from plantations and sustainably managed forests. The scale of such effect is usually bigger in developed countries than in developing countries as noted earlier. These factors are presented below and later form the basis of scenarios for possible future development.

Climate Policies

There are various on-going policy efforts to cut GHG emissions and thus to mitigate climate change. These efforts have both direct and indirect effects on sustainable forest management and forest plantations. Reducing Emissions from Deforestation[15] and Forest Degradation plus (REDD+) is a worldwide initiative by UNREDD to avoid tropical deforestation and forest degradation, and to promote forest restoration, rehabilitation, sustainable forest management and afforestation and reforestation.

The Clean Development Mechanism (CDM) of the Kyoto Protocol incentivizes afforestation and reforestation to offset GHG emissions (see FAO 2011). In addition, there are other policy measures such as imposing carbon tax on polluting industries for mitigation of climate change. If these policies are developed relatively uniformly throughout the world, they may push plantation investment and development as well as efficient use of wasteland to satisfy the increased timber and fibre demands (Barua 2011). Uniform climate policy development will therefore increase the demand for wood especially from plantations as well as from sustainably managed natural forests.

Initiatives to Stop Illegal Logging

Illegal logging of tropical forests has become a serious forestry-related problem in major wood producing regions such as South-East Asia, Central and Western Africa, and South America. This has become a concern for civil society and consumers in wood consuming countries which are mostly developed countries.

Governments, both in producing and consuming countries, international organizations and global forest companies are increasingly reacting to this issue. The European Union Timber Regulation (EUTR) and the Lacey Act prohibit the importation of illegally sourced timber to the EU and the US, the two biggest markets for tropical timber. The Australian government is currently working on a piece of legislation, called Illegal Logging Prohibition Bill to exclude illegally-sourced timber from imports and domestic processing in the country (Brack et al. 2012).[16] Other important consumers of wood such as New Zealand and Japan also have regulations in place banning importation of illegal timber.

There are campaigns to stop illegal logging in producer countries themselves. Six countries, Indonesia, Ghana, Liberia, Cameroon, the Central African Republic, and the Republic of Congo, have already signed voluntary partnership agreements (VPA) with the EU to comply with Forest Law Enforcement, Governance and Trade (FLEGT) regulations. Furthermore, Vietnam, Malaysia, Gabon, Guyana and Honduras, are currently negotiating for such agreements.

China, the world's biggest importer of roundwood, and other big emerging economies such as India, Brazil and Russia have actively participated in initiatives to stop illegal logging in the recent past. For example, the G8 Illegal Logging Dialogue (Sheikh 2008) shows that the countries are committed to fight against illegal logging and ready to pass legislation accordingly. In addition, large global forest products retail and

[15] Deforestation contributes to about one-fifth of world's total anthropogenic GHG emissions (IPCC 2007).

[16] The Illegal Logging Prohibition Bill 2012, the accompanying explanatory memorandum and minor government amendments passed through the Australian Parliament House of Representatives on 20 August 2012. The Bill will still need to pass through the Senate and receive Royal Assent before becoming law.

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consumer companies such as IKEA, Kingfisher, Home Depot, and Lowe's have strict procurement policies in place to ensure that their wood raw material comes from legal and sustainably managed sources. Therefore, initiatives to stop illegal logging are likely to increase the demand for wood coming from sustainably managed natural forests, and plantations which can more easily demonstrate the legality and sustainability of their products.

Green Building Initiatives

Green building initiatives promote environmentally friendly, and resource and energy efficient practices throughout the life-cycle of buildings. The green building programs usually reward the use of wood, especially from certified and sustainably managed sources. Most of the existing green building programs and building environmental assessment tools in use so far are in high income countries and thus much of the demand for wood to meet green building initiatives is from those countries. However, it can be expected that with the rise of income per capita in developing countries, the green building program will become more global, resulting in higher demand for wood in building construction purposes.

Policies to Promote Bioenergy

Because of increasing prices and GHG emissions associated with the use of fossil fuels, the demand for bioenergy is increasing worldwide (IEF Bioenergy, 2007). Policies are being developed globally to promote bioenergy. For example, the EU has set a binding target of 20% renewable energy use in its overall energy consumption for 2020 as a part of its 20-20-20 targets (EU 2010). Since forest biomass, along with agricultural biomass, constitutes 65% of the EU's total renewable energy sources (Summa, 2007), this target cannot be met without substantial input and contribution from the forest sector. If wood becomes the main source of bioenergy, higher demand for bioenergy will mean higher demand for wood.

Payment for Environmental Services

The demand and recognition for environmental services, most of which come from forests, are increasing globally and thus payment for environmental services are becoming more widespread. This calls for conserving and sustainably managing forest resources resulting in a shift to plantations for meeting increasing wood demand.

6.2 Demand Forecast Scenarios

6.2.1 Demand Regions

For the purposes of making the demand forecasts for industrial roundwood, the world is first divided into seven regions: (1) Latin America and the Caribbean, (2) Asia, (3) North America, (4) Europe, (5) Russia (6) Africa and (7) Oceania. The first two regions are further divided into sub-regions and countries to deepen the analysis. The global demand forecast is then the summation of forecasts of all seven regions. Altogether there are 12 demand forecast (sub-) regions and countries:

- *Latin America*: (1) Brazil, and (2) Rest of Latin America
- *Asia*: (3) China (4) India (5) Indonesia (6) Japan and (7) Rest of Asia
- (8) *Europe*
- (9) Russia
- (10) *North America* (the US and Canada)
- (11) *Oceania*
- (12) *Africa*

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6.2.2 Demand Scenarios

Three different scenarios were designed in order to reflect possible future development alternatives. Different factors are treated as variables as indicated later.

Scenario I

The key assumptions for this scenario are:

(i) Population growth will drive the future demand for industrial roundwood in all countries and regions of the world.
(ii) Growth in GDP and income per capita will continue and will drive demand for industrial roundwood.
(iii) Forest products will be substituted by non-forest products reducing the demand for industrial roundwood. This reduction will neutralize the demand growth due to GDP and per capita income growth, and thus per capita wood consumption in all countries and regions of the world will stay the same as current.
(iv) The pace of progress in the formulation and successful implementation of climate policies and environmental regulations will be very slow, eco-friendly initiatives such as green building initiatives will not materialize, and thus there will be no increase of industrial roundwood demand despite measures to ensure environmental sustainability.

According to the above assumptions, Scenario I gives a conservatively realistic estimate of industrial roundwood demand.

Scenario II

Assumptions (i) and (ii) of Scenario I also hold for Scenario II. The other key assumptions for Scenario II are:

(i) Income per capita will increase in all regions of world. The relationship between income and consumption of wood products per capita will follow an EKC-type relationship. More precisely:

- In emerging market countries and regions such as Brazil and the rest of Latin America, China, India, Indonesia and the rest of Asia (excluding Japan), Russia and Africa, where income per capita is comparatively low, per capita consumption of wood products will increase with the increase of income per capita
- In mature market countries and regions, such as Japan, North America, Europe and Oceania, the per capita consumption of wood products will decrease with the increase of income per capita.

(ii) The external demand for secondary wood products such as pulp produced in Latin America (Brazil and the rest) and Indonesia will grow. For all other regions and countries there will be no such demand growth.

(iii) Measures to ensure environmental sustainability will increase the demand for industrial roundwood in mature economies only, *viz.* Japan, North America, Europe and Oceania.

Based on the assumptions presented above, this scenario is mostly likely to give realistic to partially optimistic estimates of demand for industrial roundwood.

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Scenario III

Assumptions (i) and (ii) of Scenario I and assumption (i) of Scenario II also hold in Scenario III. The other key assumptions for Scenario III are:

(i) The external demand for secondary wood products such as pulp produced in Latin America (Brazil and the rest) and Indonesia as well as in Asia, excluding Japan and Indonesia, Russia and Africa will grow. But for the former group of countries/region the growth will be faster than for the latter group. For all other regions and countries there will be no such demand growth.

(iv) Measures to ensure environmental sustainability will increase demand for industrial roundwood in all countries and/regions. In Japan, Northern America, Europe and Oceania, the demand under Scenario III will increase faster than that under Scenario II as well as more than in other countries or regions.

The assumptions suggest that this scenario presents a clearly optimistic picture of industrial roundwood demand in the world.

6.3 Demand Forecast Results

6.3.1 Global

Demand for industrial roundwood was just over 1.5 billion m^3 in the world in 2012. North America, Europe and Asia are the largest demand regions, corresponding to 73% of global consumption (Figure 6.3). Scenario I of this study forecasts that globally the industrial roundwood demand will increase at a decreasing rate over the next 20 years to reach total demand of over 1.7 billion m^3 in 2030, and just under 2 billion m^3 in 2050 (Figure 6.4), following the trend of demand growth between 2012 and 2030. Asia's share is highlighted as it experiences the fastest growth. This trend reflects the expectation that the world population in coming decades will still increase but the growth rate will decline (UN 2011).

Figure 6.3 Global Demand for Industrial Roundwood by Region, 2010

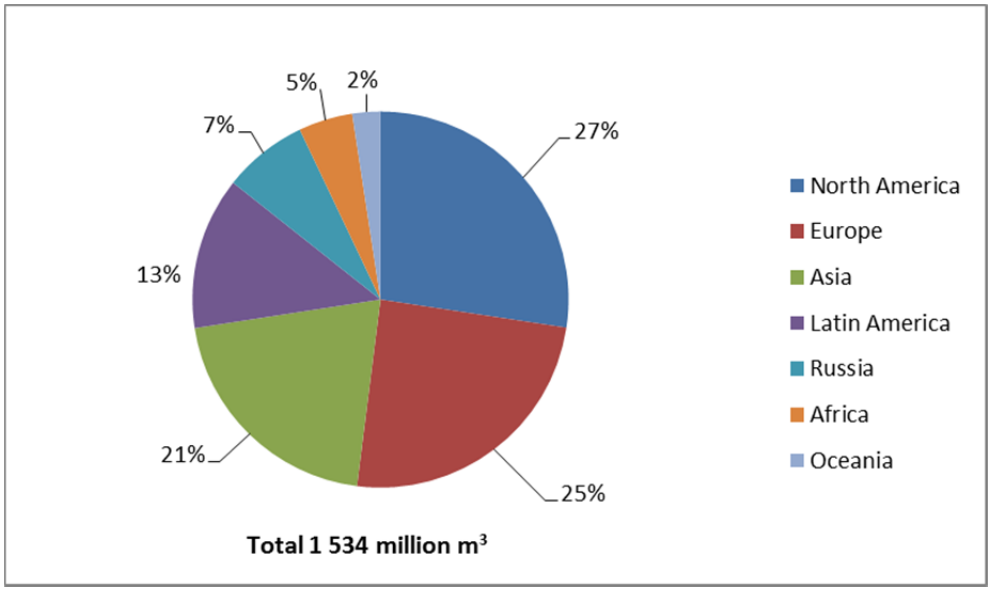

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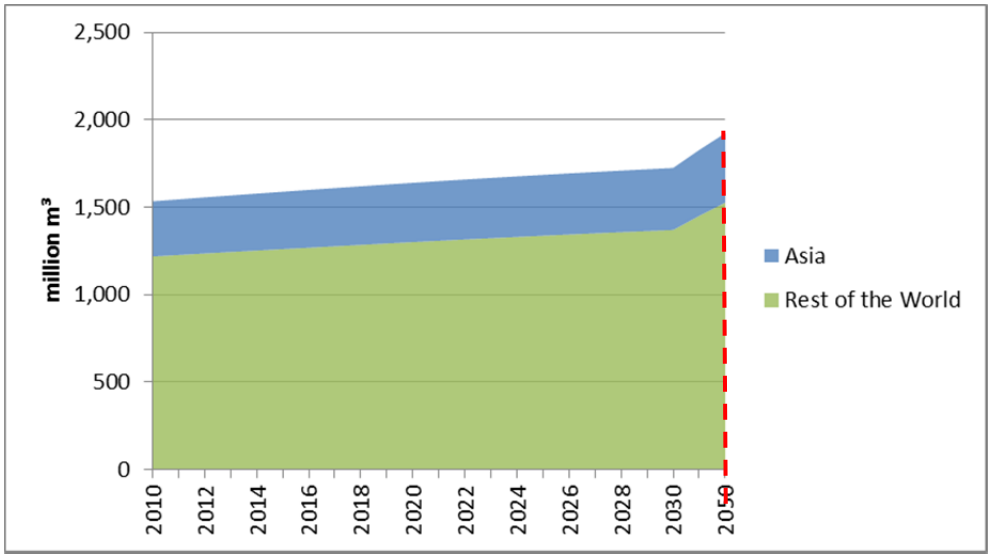
Figure 6.4 Global Demand for Industrial Roundwood under Scenario I



Under Scenarios II and III, the demand for industrial roundwood at the global level is forecast to expand at increasing rates. This is because the effects of a number of interacting factors in these two scenarios are captured. While the world's population is projected to increase at a decreasing rate of around 1% per year until 2018 and below 1% per year after that (UN 2011), world GDP is projected to grow at a slightly increasing rate of over 3.5% per year for the next two decades (ERS 2012). This implies that per capita income will then rise globally[17].

As the majority of the world's population live in developing countries where per capita roundwood consumption is increasing with increasing per capita income, globally per capita consumption of roundwood will increase, despite the per capita consumption in mature economy countries declining. This is because only a small share of the world's population lives in the mature economy countries.

Measures towards ensuring environmental sustainability such as climate policies, steps to stop illegal logging and clearing of native tropical forests, and policies promoting biomass energy will push the wood demand up in both developed and developing countries alike. As a result of these, the demand for industrial roundwood is expected to rise at an increasing rate worldwide.

Scenario II of this study forecasts that the demand for such roundwood will exceed the 2 billion m^3 mark by the beginning of the next decade and reach just over 6 billion m^3 in 2050 (Figure 6.5). The share for Asia is highlighted.

[17] GDP per capita is often used as a proxy for income per capita. Therefore, if the GDP growth rate matches the population growth rate, the growth rate in per capita income is the same as the GDP growth rate. However, if the former rate is bigger than the latter, per capita income growth rate is faster than the GDP growth rate, and *vice versa*.

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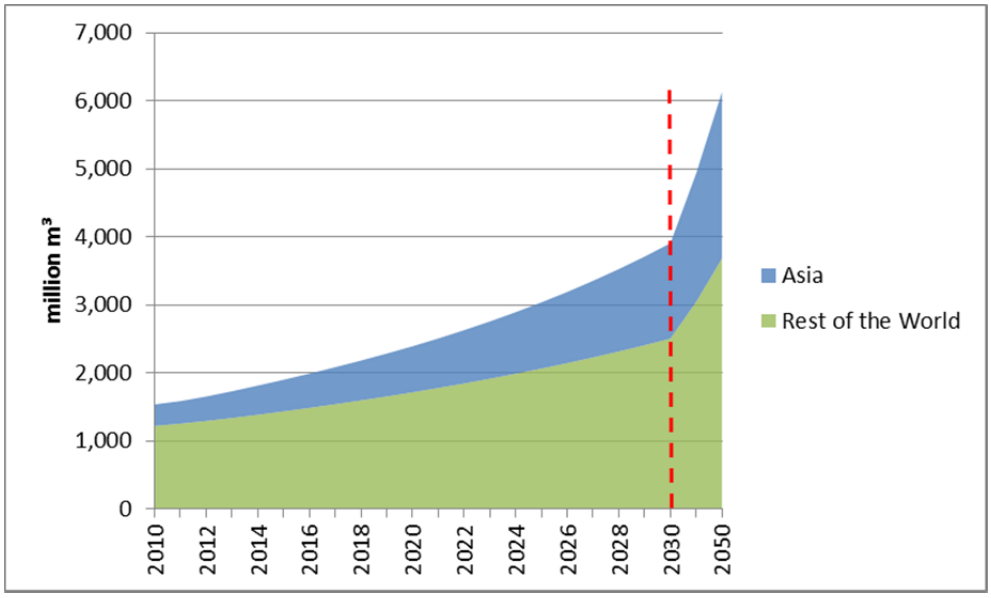
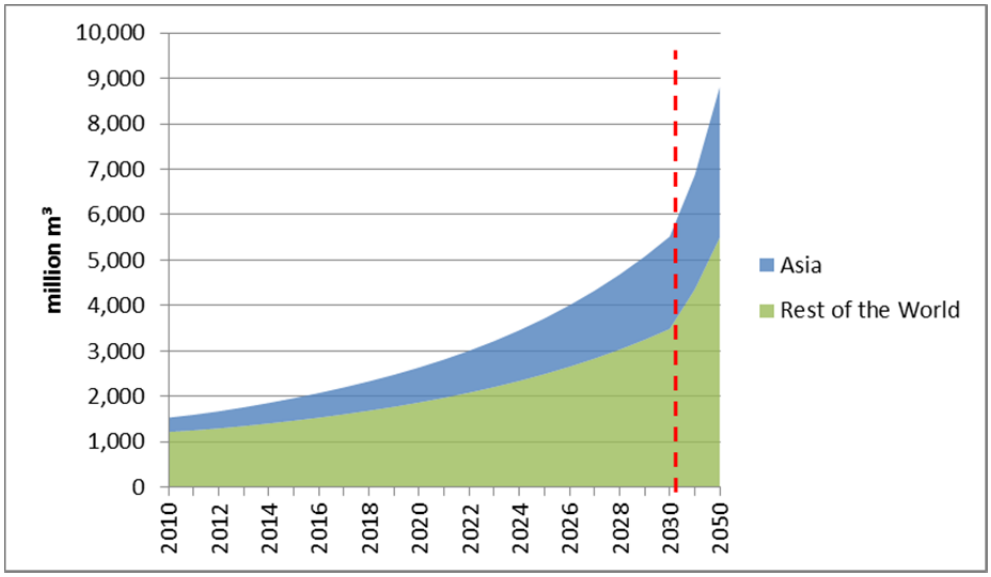
Figure 6.5 Global Demand for Roundwood under Scenario II



Under Scenario III demand will reach over 5 billion m^3 in 2030 and over 8 billion m^3 in 2050 as demonstrated in Figure 6.6.

Appendix 1 presents the demand projections for 2040 and 2050 for all regions and countries under all three demand scenarios of this study.

Figure 6.6 Global Demand for Industrial Roundwood under Scenario III



6.3.2 North America

Currently North America, (the US and Canada), is the world's biggest consumer of industrial roundwood in terms of volume. In 2010, the demand for roundwood in this region was over 400 million m^3. Scenario I of this study forecasts that in North America the demand for industrial roundwood will rise modestly to reach nearly 500 million m^3 in 2030. Even though per capita consumption of wood products is

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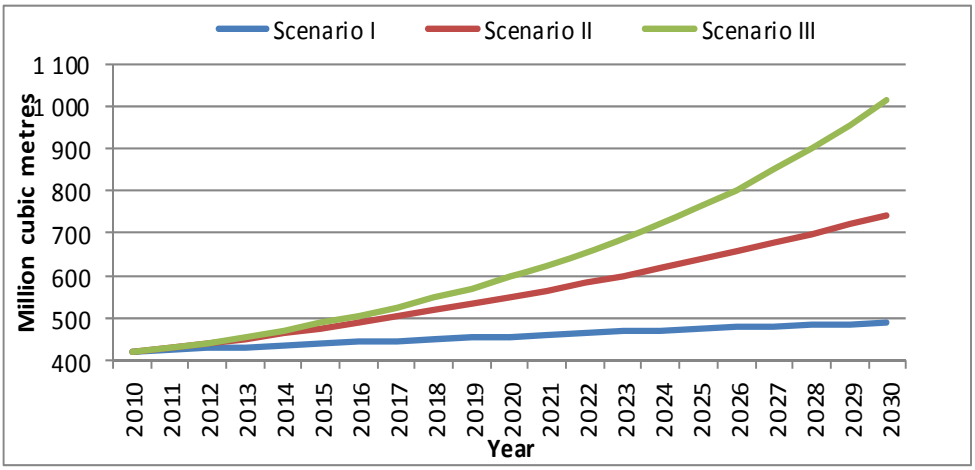
expected to continue its downward slide, because of positive economic and population growth and expected positive development in green policies, under Scenarios II and III, the demand is forecast to grow quite rapidly.

Scenario II forecasts that industrial roundwood demand in the North America region will reach about 750 million m^3 in 2030 (Figure 6.7) and over 1 billion m^3 in 2050 (Appendix1). Under Scenario III the growth in demand for such roundwood will be even faster to surpass 1 billion m^3 in 2030.

Figure 6.7 Demand for Industrial Roundwood in North America



6.3.3 Europe

At present, Europe is the world's second largest consumer of industrial roundwood in terms of volume. In this region the demand for industrial roundwood was approximately 375 million m^3 in 2010. As in Scenario I, the demand for such wood will increase modestly to still remain under 400 million m^3 in 2030.

Scenarios II and III forecast that the growth in demand for industrial roundwood will be faster than that under Scenario I, but much slower than that in Asian countries except for Japan, and Latin America regions under the same two scenarios. This implies that the joint effect of slower economic growth than that in Latin America and Asia, excluding Japan, and downward per capita consumption of wood products will dominate the positive effect on demand of measures ensuring environmental sustainability in this region.

Scenario II forecasts that the demand for industrial roundwood in Europe will reach over 500 million m^3 in 2030. Under Scenario III, the demand will be near 700 million m^3 and 1 billion m^3, respectively, in 2030 and 2050 (Figure 6.8 and Appendix1).

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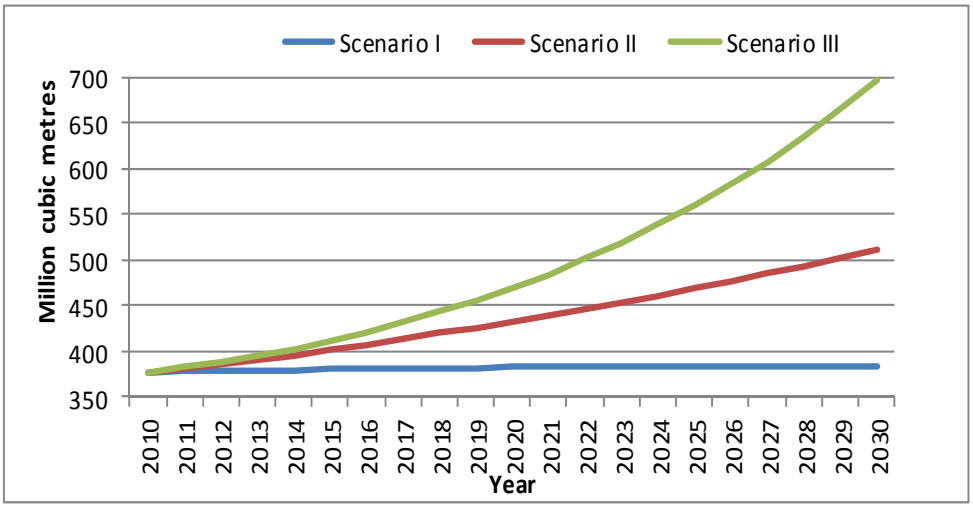
Figure 6.8 Demand for Industrial Roundwood in Europe

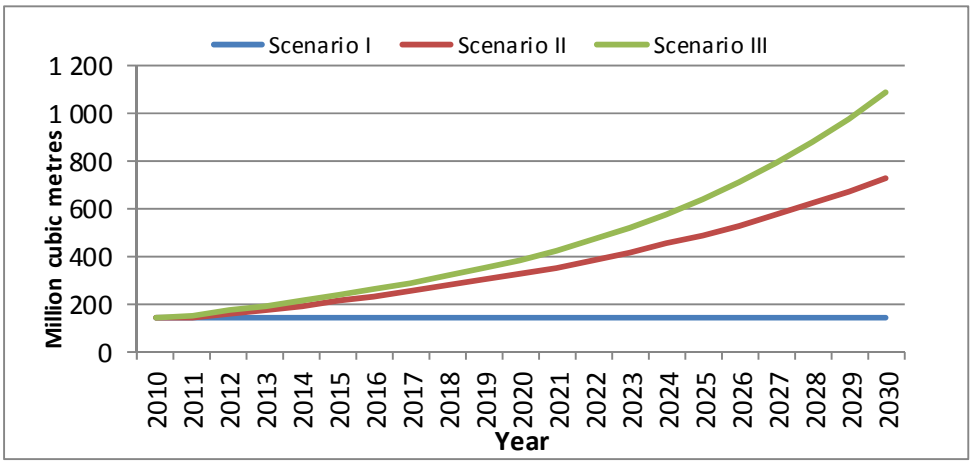


6.3.4 Asia

China

Scenario I predicts that the demand for industrial roundwood in China will remain much below 200 million m^3 until 2050 (Figure 6.9 and Appendix 1) which may not necessarily be realistic. However, under Scenarios II and III, the demand will increase very rapidly mainly because expected strong growth in GDP and income per capita in the future will drive wood consumption up in the country. As in Scenario II, the demand for roundwood for industrial use in China will reach 400 million m^3 in 2022, be nearing 800 million m^3 in 2030, and finally exceed the 1 billion m^3 mark in 2040. Under Scenario III, the demand will exceed 1 billion m^3 by 2030 (Figure 6.9 and Appendix1).

Figure 6.9 Demand for Industrial Roundwood in China



India

Even though India is a big economy with a huge population, its demand for industrial roundwood is relatively low at the moment. The consumption of roundwood in India will still remain under 50 million m^3 in 2030 under Scenario I (Figure 6.10). Scenario II forecasts that the demand for industrial roundwood in India will be 100 million m^3 in next 10 years (Figure 6.10) and over 350 million m^3 by 2050 (Appendix1).

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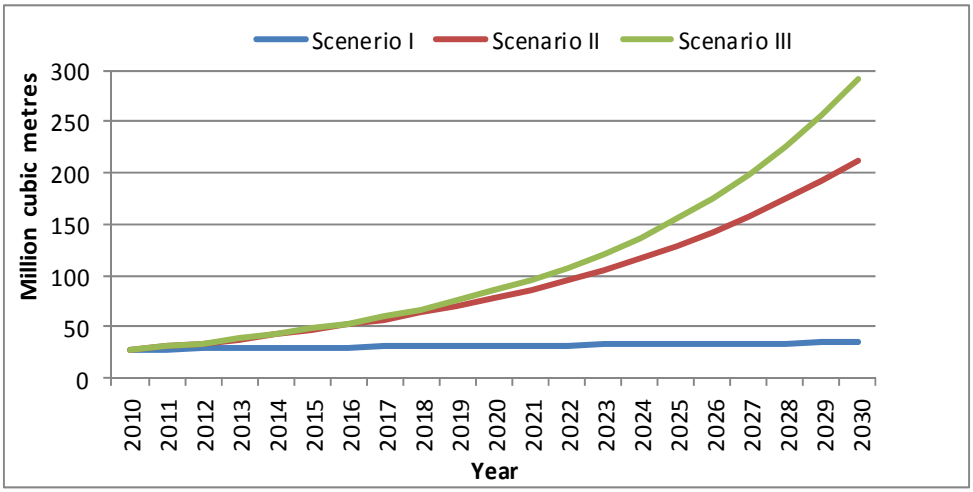
Under Scenario III, the growth in demand for industrial roundwood in India will be even faster than that under Scenario II; the demand is forecast to reach near 300 million m^3 in 2030 and just below 471 million m^3 in 2050 (Appendix1). Even though the demand under both scenarios is not forecast to be higher than that in China, the rate of growth in India is forecast to be faster mainly because of faster predicted growth in GDP (ERS 2012).

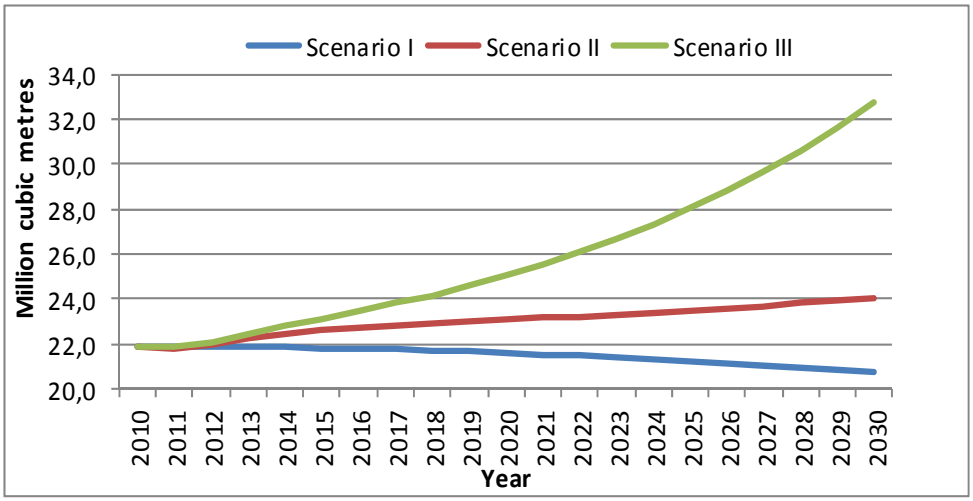
Figure 6.10 Demand for Industrial Roundwood in India



Japan

Under Scenario I, the demand for industrial roundwood in Japan is forecast to follow a steadily declining path to fall below 21 million m^3 in 2030 (Appendix1) as Japan's population is expected to decline over the next two decades (UN 2011). Due mainly to slow economic growth, and declining wood product consumption per capita, the demand, as per Scenario II, will rise very modestly to about 24 million m^3 in 2030. Scenario III forecasts that the demand will be nearly 33 million m^3 in 2030 (Figure 6.11) and over 41 million m^3 in 2050 (Appendix1), mainly due to green drivers assumed in the scenario.

Figure 6.11 Demand for Industrial Roundwood in Japan



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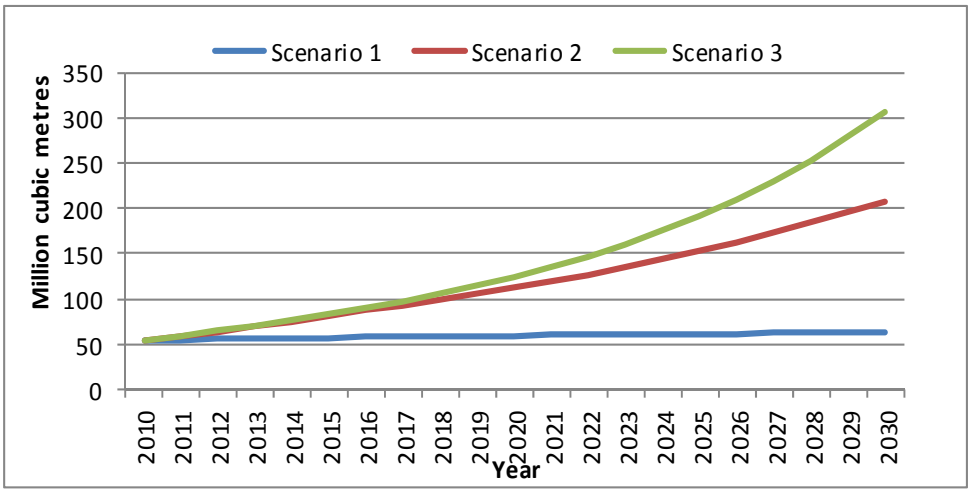
Indonesia

As shown in Figure 6.12, Scenario I forecasts there will be a modest rise in demand for industrial roundwood in Indonesia over the next two decades reaching nearly 60 million m^3 in 2030. Under Scenarios II and III, the demand for such roundwood will reach over 200 million m^3 and over 300 million m^3, respectively (Figure 6.12).

Appendix1 shows that roundwood demand in Indonesia is forecast to reach about 500 million m^3 in 2050 as per Scenario III. The demand drivers for industrial roundwood in Indonesia under Scenarios II and III are growth in GDP, forecast to be around 5%/a for the next two decades (ERS 2012); per capita consumption of wood products induced by growth in income per capita; initiatives to stop tropical deforestation and, the rise in demand for pulp for foreign export.

Figure 6.12 Demand for Industrial Roundwood in Indonesia



Rest of Asia

Demand for industrial roundwood in the rest of Asia, which includes all countries in the continent except China, India, Japan and Indonesia, as per Scenario I, is forecast to reach nearly 100 million m^3 in 2030. Under Scenario II, the demand for roundwood in this region will be over 225 million m^3 in 2030 (Appendix1). Scenario III forecasts demand will reach over 300 million m^3 and 500 million m^3 by 2030 and 2050, respectively (Figure 6.13 and Appendix1)

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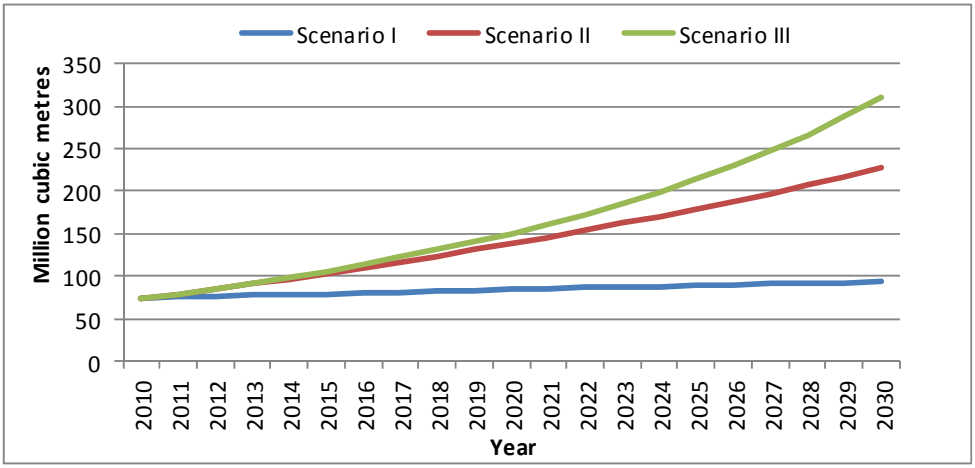
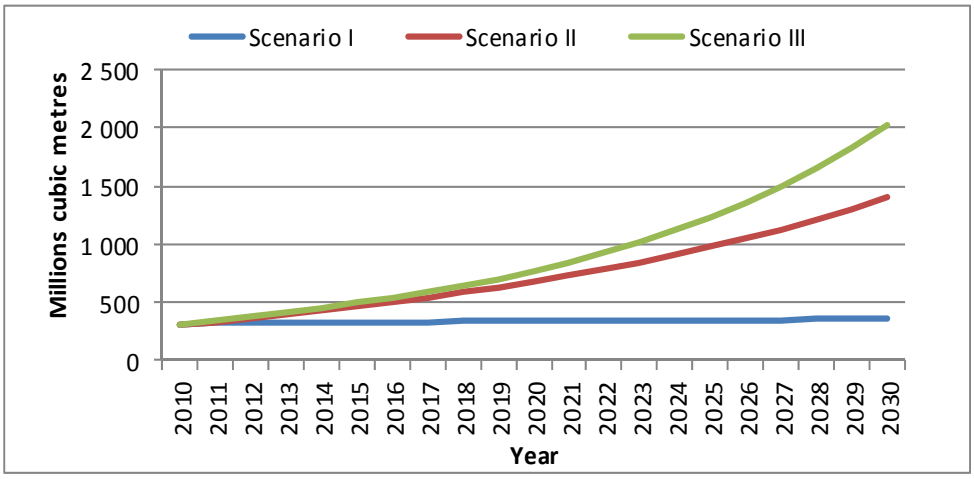
Figure 6.13 Demand for Industrial Roundwood in Asia excluding China, India, Japan and Indonesia



The aggregate demand forecast for the whole of Asia until 2030 is presented in Figure 6.14 and for 2040 and 2050 are presented in Appendix1.

Figure 6.14 Demand for Industrial Roundwood in Asia



6.3.5 Latin America

Brazil

Under Scenario I, the demand for industrial roundwood in Brazil will grow at a decreasing rate to reach just over 145 million m^3 in 2030 (Figure 6.15). The trend under this scenario closely follows the future population growth rates in Brazil. Under Scenarios II and III demand will grow faster, as increased local consumption and also greater trade (exports of forest products) is assumed. In 2030, the demand for industrial roundwood in Brazil will just pass 400 million m^3 under Scenario II and just over 600 million m^3 under Scenario III (Figure 6.15). According to Appendix 1, in 2050 the roundwood demand in Brazil will increase to over 660 million m^3 and 1 billion m^3 under Scenarios II and III, respectively.

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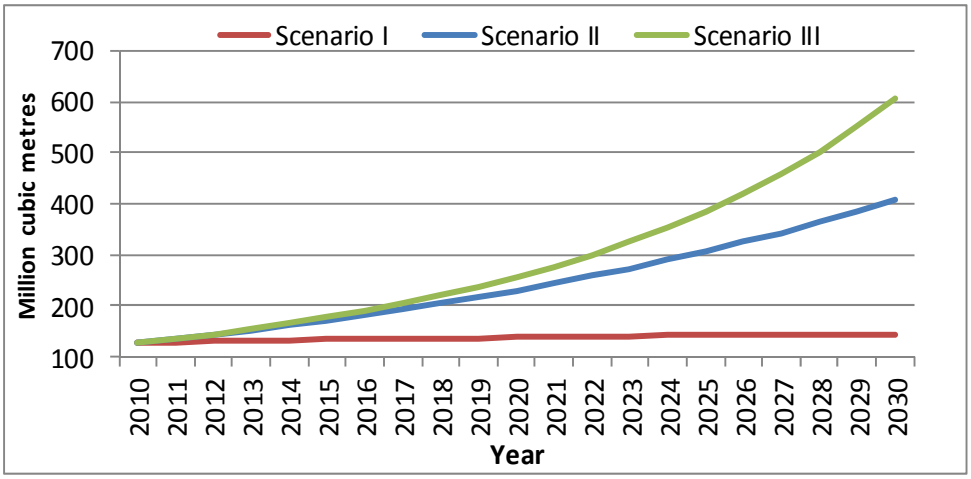
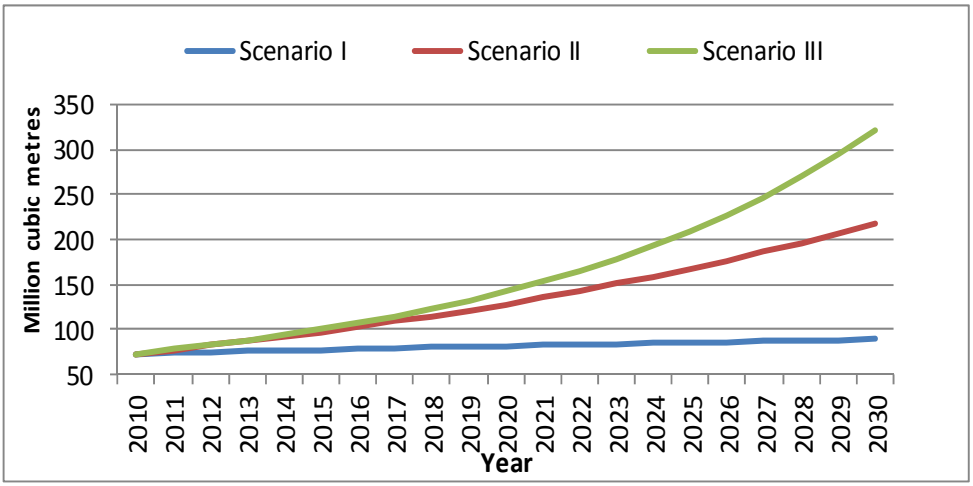
Figure 6.15 Demand for Industrial Roundwood in Brazil



Rest of Latin America

Demand for industrial roundwood in the rest of Latin America, which includes all countries in Latin America and the Caribbean regions excluding Brazil, is far less than that in Brazil alone. In 2010, observed demand for industrial roundwood in these countries was about 73 million m^3 which was just over half the size of Brazil's demand in that year. The demand in these countries, as per Scenario I, will rise to about 90 million m^3 in 2030 (Figure 6.16) and just under 105 million m^3 in 2050. Under Scenario II, the industrial roundwood demand in the rest of Latin America will reach just over 200 million m^3 in 2030 and about 350 million m^3 in 2050. The demand will reach over 300 million m^3 and 500 million m^3 in 2000 and 2050, respectively (see Figure 6.16 and Appendix1).

Figure 6.16 Demand for Iindustrial Roundwood in Latin America excluding Brazil



The aggregate demand forecast for Latin America up to 2030 is presented in (Figure 6.17) and for 2040 and 2050 are presented in Appendix1.

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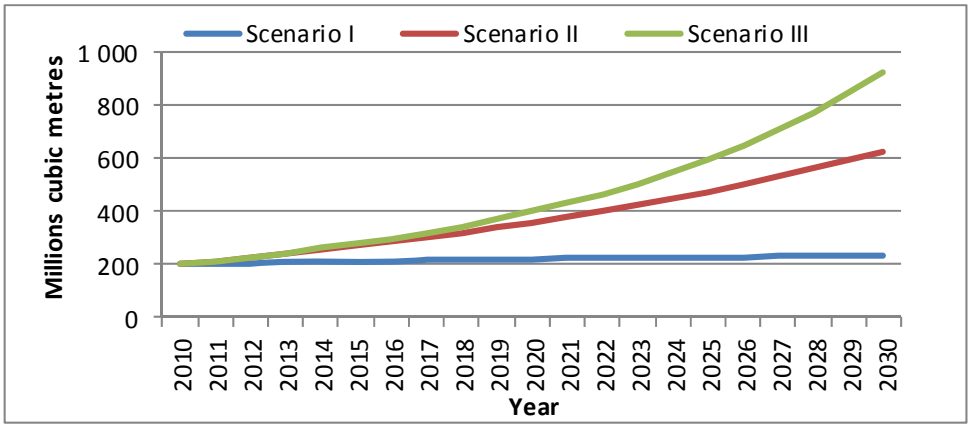
Figure 6.17 Demand for Industrial Roundwood in Latin America

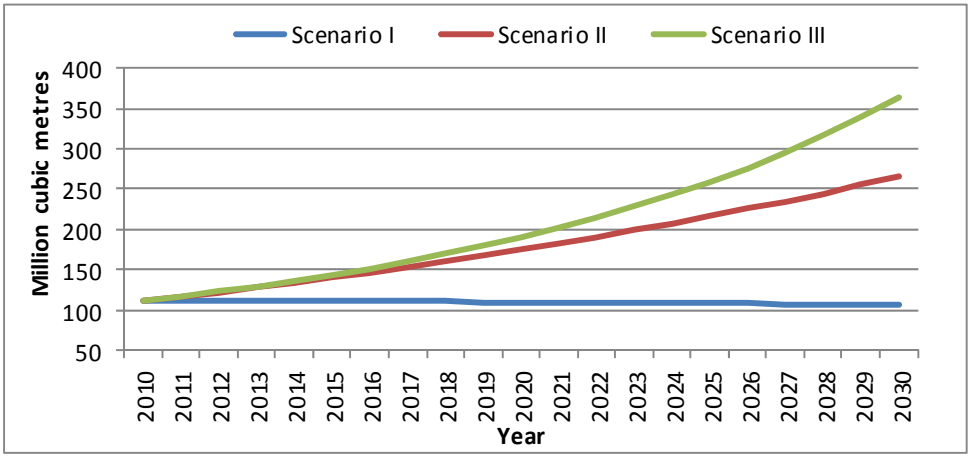


6.3.6 Russia

The demand for industrial roundwood in Russia is forecast by Scenario I to drop slowly to reach just over 100 million m^3 in 2030. This downward slide of demand under Scenario I will be due to the declining population in Russia in future (UN 2011). It is likely that roundwood harvest in Russia will increase however due to exports of forest products.

Under Scenario II and also under Scenario III, the demand for industrial roundwood in Russia will rise at a rapid rate, mirroring mainly rapid economic growth predictions and increasing per capita consumption of wood products in Russia. In 2030 and 2050, the industrial roundwood sourced from Russia will reach over 250 million m^3 and 570 million m^3, respectively, as per the forecast under Scenario II. Under Scenario III, the industrial roundwood demand is projected to reach over 350 million m^3 in Russia in 2030 (Figure 6.18 and Appendix1).

Figure 6.18 Demand for Industrial Roundwood in Russia



6.3.6 Oceania

Under Scenario I of this study, the demand for industrial roundwood in Oceania is forecast to grow to near 40 million m^3 in 2030. Scenario II forecasts that the demand of industrial roundwood in this region will be just under 80 million m^3 in 2030 (Figure 6.19 and over 115 million m^3 in 2050 (Appendix1). Under Scenario III, the industrial roundwood demand in Oceania will be nearly 110 million m^3 by 2030.

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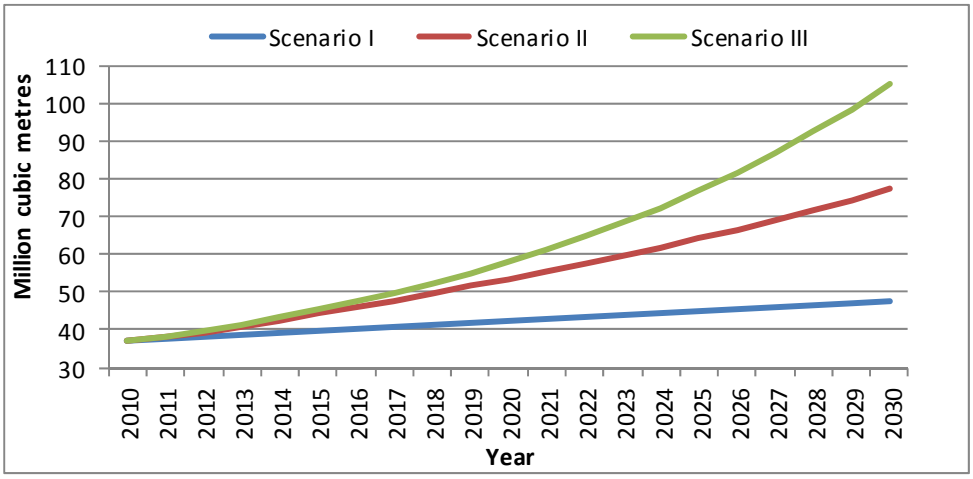
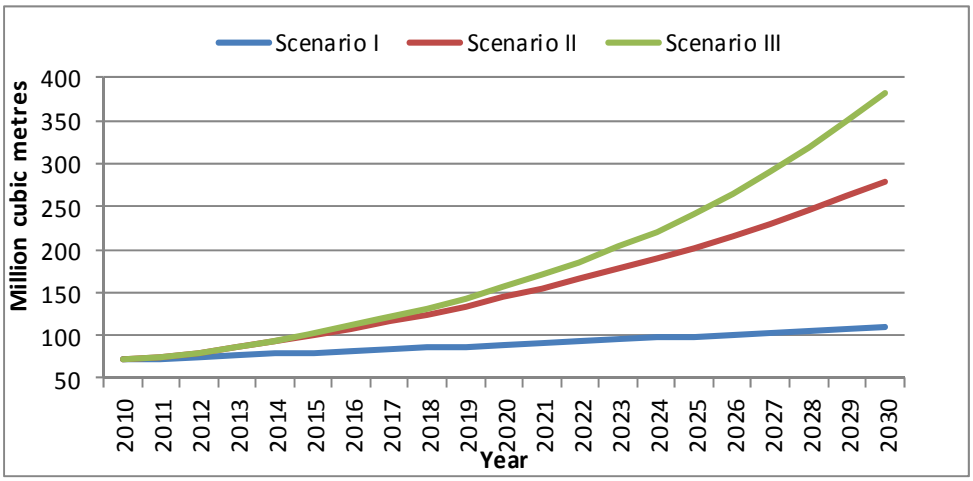
Figure 6.19 Demand for Industrial Roundwood in Oceania



6.3.7 Africa

Africa relies heavily on natural forests for meeting industrial roundwood demand. Scenario I forecasts that the demand for industrial roundwood demand will grow to just exceed 100 million m^3 in 2030. This excludes demand for domestic firewood which is significant in Africa. However, under Scenario II, the demand for industrial roundwood in Africa is forecast to be nearly 300 million m^3 by 2030 and over 465 million in 2050. As per Scenario III, the demand for roundwood for industrial purposes will grow a bit faster to reach almost 400 million m^3 in 2030 (Figure 6.20 and Appendix1).

Figure 6.20 Demand for Industrial Roundwood in Africa



6.4 Demand from Different Product Sectors

Globally, some 35% of roundwood is consumed in the pulp and paper industries and some 65% by the wood working industries. Additionally, the pulp and paper industry uses large amounts of recovered paper and other fibres, and by-products are used both by pulp and paper and wood based panels industries. There is large regional variation in the sector level breakdown (Figure 6.21).

In China up to 90% of domestic roundwood is consumed by the wood working industry, while the pulp and paper industry is more dependent on imported raw

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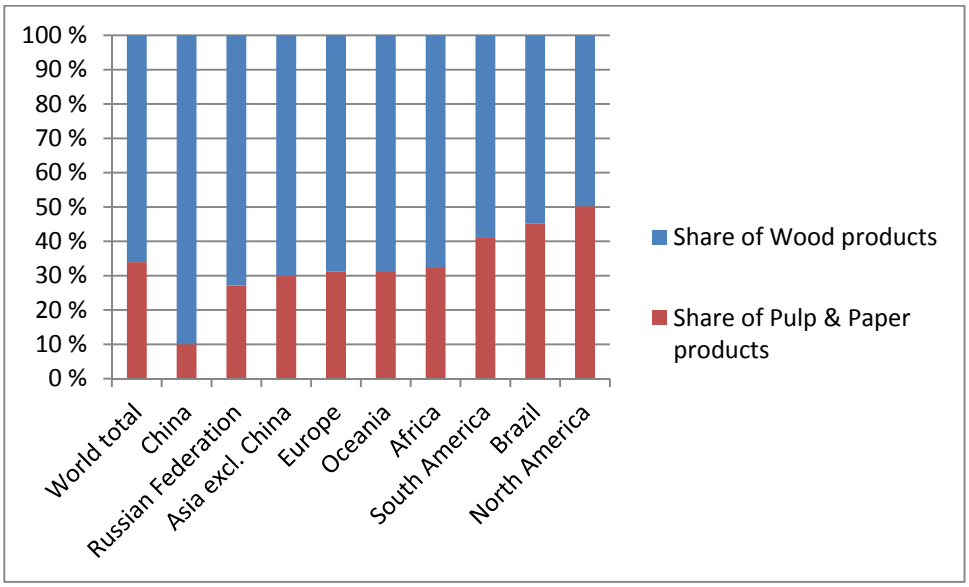
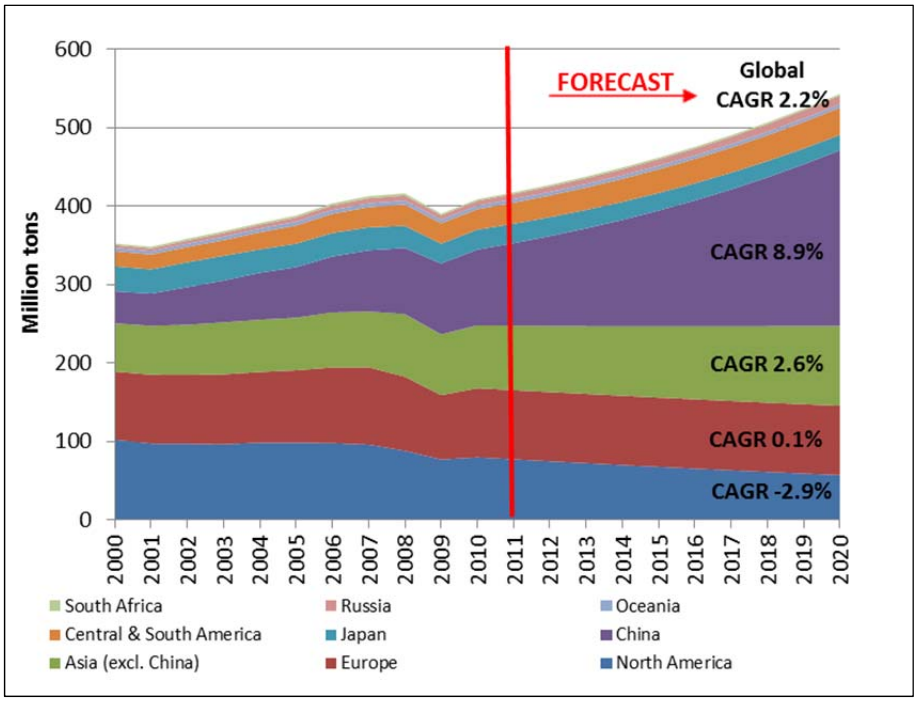
material. At the same time the pulp industry is expanding in other regions. For example, in Brazil up to 45% of all wood is used in the pulp and paper sector. Consumption and production are increasingly diverging globally, leading to higher trade of forest products.

Figure 6.21 Share of Roundwood Consumption by Sectors, 2010



In Asia, and particularly in China, paper and paperboard demand is forecast to grow faster than the global average (Figure 6.22). In North America paper consumption is forecast to decline. This increases the significance of pulp and paper as a demand sector in Asia. In other regions no major changes in the share of sectors is expected. Only under demand Scenario III does the share of wood products increase since an increasing use of wood products is assumed.

Figure 6.22 Global Forecasts for Paper & Board Consumption, 2000-2020



Source: Indufor, 2012

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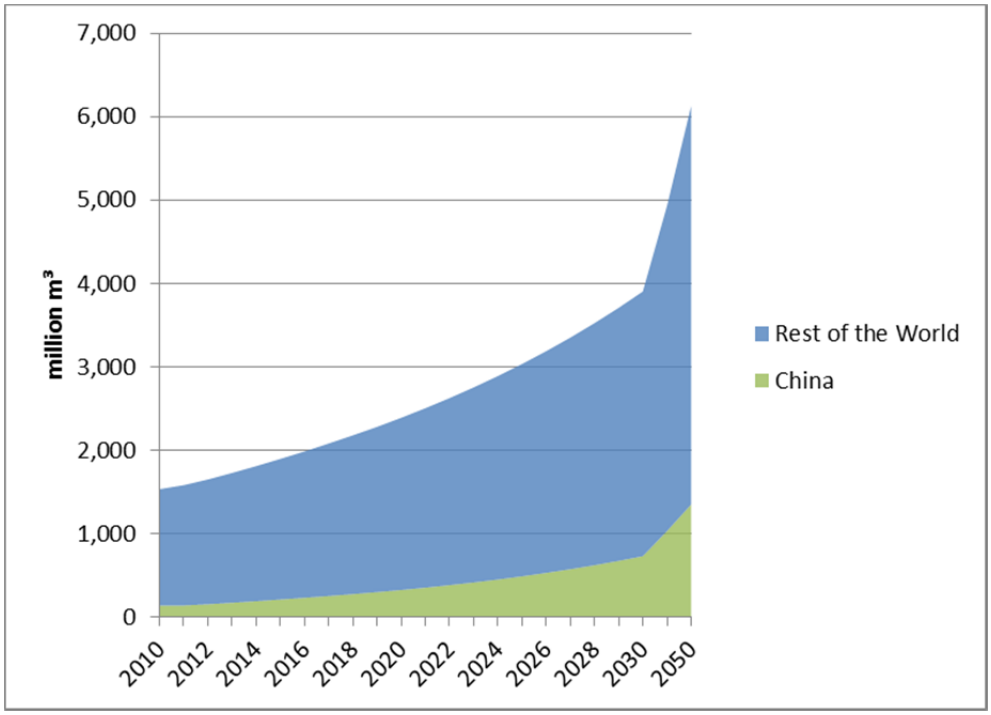
China's share of roundwood demand in 2010 is approximately 9% of total global demand and is estimated to increase to 19% by 2030 and to 22% by 2050 (Figure 6.23). The plantation supply within China, or within Asia, is not able to meet this demand increase and the supply gap will be satisfied with imports from other regions, and partly by increased used of the remaining natural forests in Asia.

Figure 6.23 Roundwood Demand China and Global, 2010-2050



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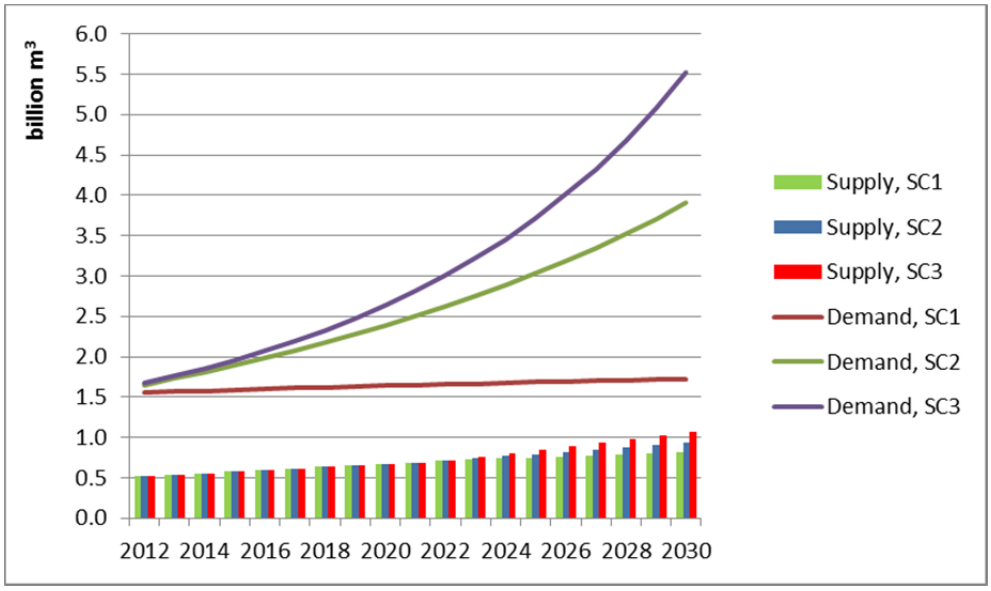
7. SUPPLY & DEMAND BALANCE

Demand for industrial roundwood is forecast to grow faster than supply of plantation wood under all other scenarios except the most pessimistic demand scenario (Figure 7.1). Currently the share of plantation wood of all demand is some 33% and the share will decrease under all other scenarios but the pessimistic demand scenario.

Figure 7.1 Global Demand and Supply Scenarios, 2012-2030



Supply Scenario II is a slightly optimistic scenario and represents the most likely development under circumstances where plantation forestry is seen as acceptable and promoted, or at least not restricted (see Chapter 5 for more detailed description). Increasing wood prices will lead to higher utilization rates of plantation areas, higher yields through species development and more intensive management of plantations.

In Figure 7.2 it can be seen that the increased supply of plantation wood is not able to meet the increase in demand if global demand were to increase any faster than global population growth. Under demand Scenario II it is assumed living standards will improve globally and wood consumption increases also in developing countries (see Chapter 6 for more detailed description).

Under demand scenario III wood use is seen as positive and green drivers will increase the per capita wood consumption. It can be seen that the share of plantation wood of total wood demand will be an estimated 24% under demand Scenario II and mere 17% under demand Scenario III. The balance will be supplied from natural and semi-natural forests.

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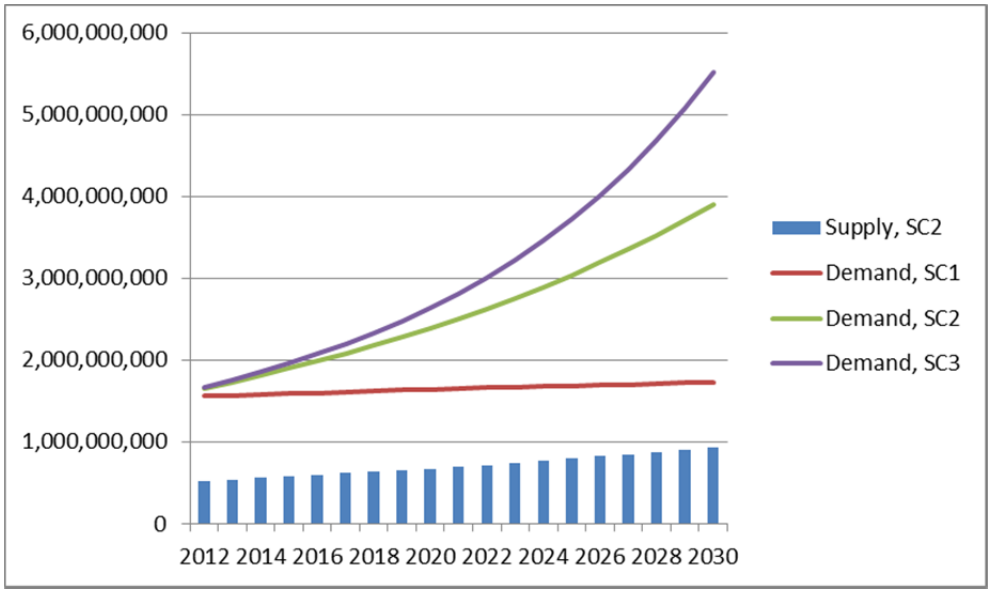
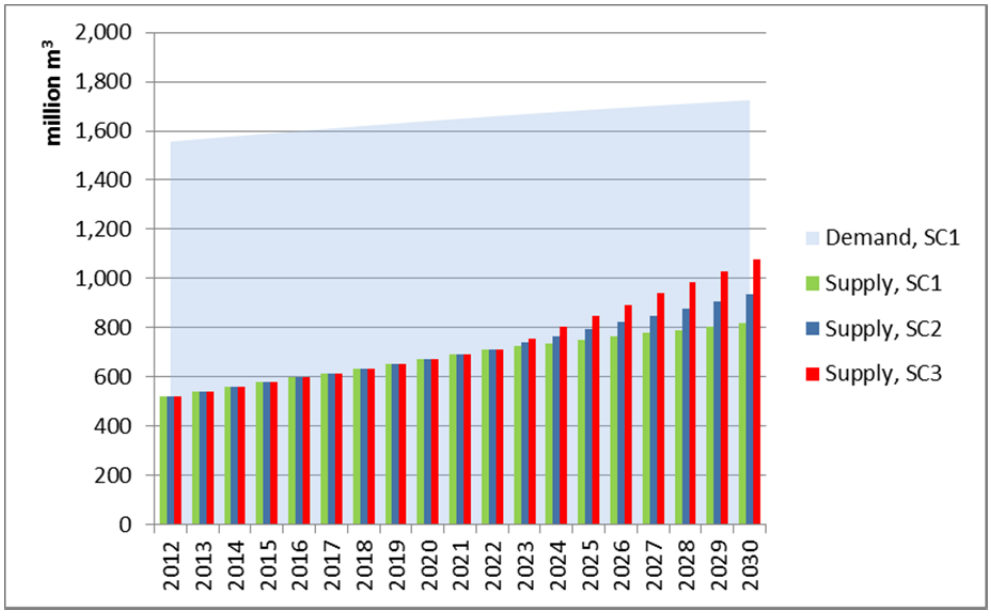
Figure 7.2 Global Demand Scenarios and Supply Scenario 2, 2012-2030



Under the pessimistic demand Scenario I supply of plantation wood can match the demand growth, and under all 3 supply scenarios the growth is faster than demand growth (Figure 7.4). If this were to happen, global living standards would decrease.

Figure 7.3 Global Supply Scenarios and Demand Scenario I, 2012-2030



Demand Scenario II is considered the most realistic, slightly optimistic. In this view development of the supply of plantation wood cannot match the demand increase, and the share of plantation wood of all supply will decrease from 33% in 2012 to 24% in 2050. This means 76% of all global roundwood demand will be satisfied with harvesting of natural and semi-natural forests. This greatly increases the pressure on existing natural forests, both tropical and boreal. As the access to existing

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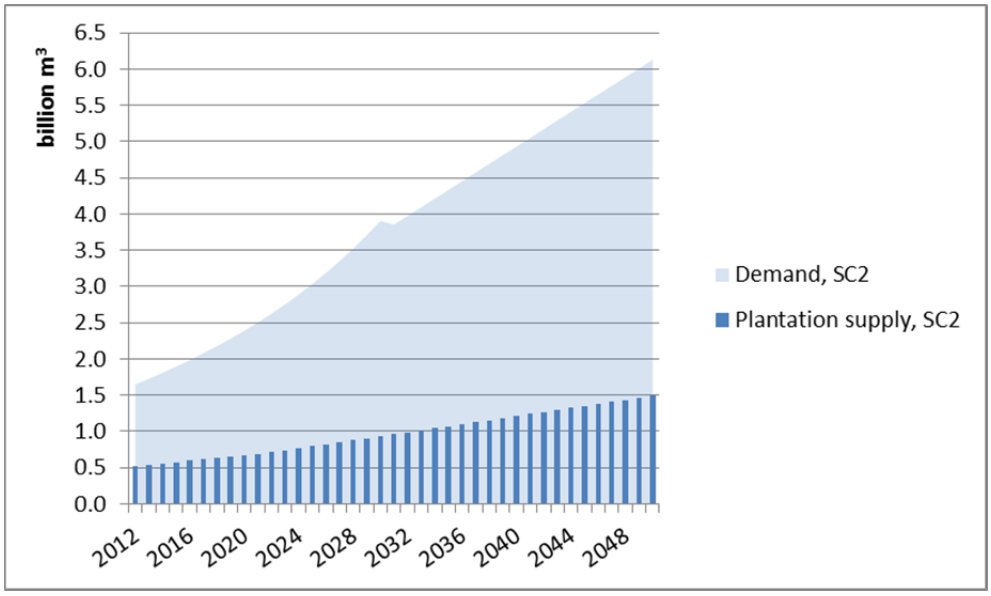
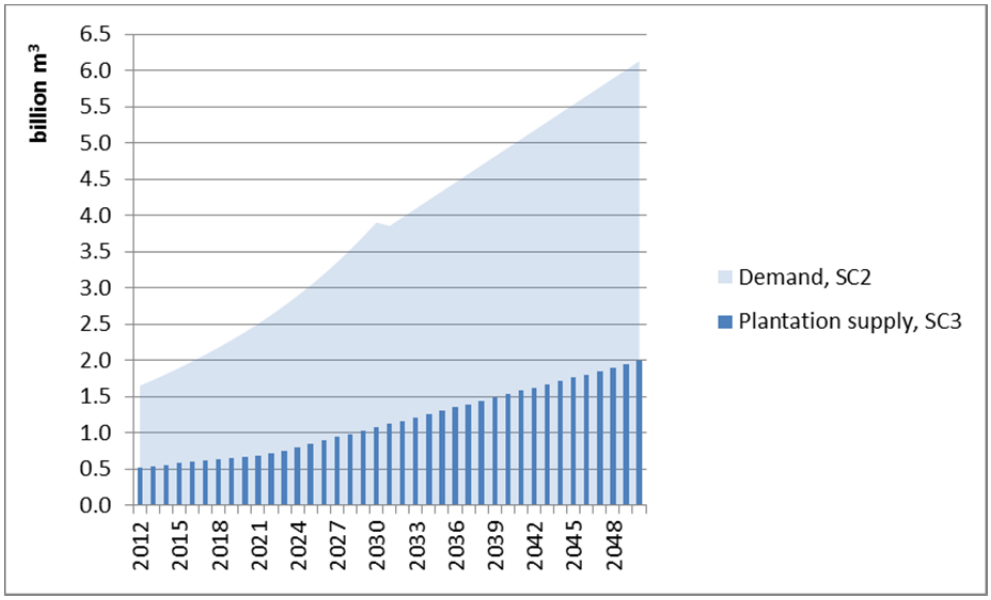
underutilized boreal forests is limited, the pressure will mount first on areas with easier access.

Figure 7.4 Supply Scenario 2 and Demand Scenario II, 2012-2050



Only under supply Scenario 3 will the share of plantation wood of total supply remain stable at 32-34% towards 2050. This means plantation forestry is promoted, land tenure issues are actively resolved and land is provided for plantations, management is intensified, efficiency of wood production is increased and average growth, either through GMO or other effective means, is significantly increased. This would help to keep the utilization of natural forest at the current level, although in volume terms, the use would effectively still increase substantially.

Figure 7.5 Supply Scenario 3 and Demand Scenario II, 2012-2050



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It is apparent that plantation wood supply under the current projected scenarios is not able to fill the supply gap. On a global level there is room to increase the supply of some natural and semi-natural forests, mainly in boreal and temperate zones. However, Indufor does not see it as a realistic scenario that boreal and temperate forest would fill the whole demand gap. There are several limitations in the supply, mainly related to logistics, profitability of the operations, and the ownership structure.

In Russia, for example, the sustainable yield of forests (AAC) is estimated at over 500 million m^3 annually while the average harvest in the past years has been some 125 million m^3 annually. In Scandinavia and Canada there is a significant supply surplus but it is not likely this wood will be available to the markets under current circumstances.

Sustainable management of tropical natural forests will not likely increase the supply of wood but in many cases will instead decrease the current supply. Harvesting of natural forests in the tropics is often related to the land use change, and the real driver behind the harvesting may be agriculture (soy production), palm oil, cotton, or cattle raising. It is difficult to see that sustainable management of tropical natural forests would increasingly help to satisfy the forecast demand.

Large investments are needed to establish new sources of supply, whether they are plantations or sustainably managed natural forests, and financial investors have a key role to play. Institutional investors have invested both in existing forests and green field plantations as long as the projects fulfil sustainability criteria. The existing forests are often semi-natural forests in the temperate and boreal zones, and in very few cases in the tropics.

Indufor sees investors will increasingly move to new frontier areas in forestry to find attractive investment targets. This means more focus will have to be on green field plantation investments in more demanding geographies. This sets new requirements for risk management as this is a precondition for any investment, and also in forestry where the risks may be different. FSC certification is seen as one of the most prominent tools to mitigate these risks and to communicate sustainability.

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8. CONCLUSIONS AND STRATEGIC HIGHLIGHTS

8.1 Underlying Facts

Based on Indufor's analysis it is evident that the expansion of industrial fast growing plantations is driven mainly by the inevitable demographic and economic development and growing wood demand. The principle facts are summarized below.

(1) Global fast-growing plantation area will most likely almost double by 2050

This conclusion is supported by Indufor's on-going survey of the potential available land with technical, socio-environmental and economic feasibility.

(2) Ownership and tenure structure of plantations will be more diversified

There will be a more important role in the future for: (i) financial investors, (ii) private small- and medium sized tree growers; (iii) lease arrangements between states and companies; and (iv) partnerships between strategic and financial investors as well as between companies and local land owners.

Financial investors, particularly institutional investors such as pension and endowment funds, perceive timberland as an attractive long-term asset in their portfolios. Farming families and other individuals see forestry increasingly as an interesting option, often considered better than the previous land use mode such as extensive pasture or unproductive agricultural land.

Lease arrangements with companies have proven to be one way to improve conventionally poor management of state plantations in many emerging market countries. Different types of new partnerships make it possible to overcome barriers related to limited foreign or corporate large-scale landownership.

(3) Land use competition will elevate land prices

History has clearly proven that land will not be left lying empty i.e. it will always find a use. Therefore it is evident that the growing scarcity of land will increase land prices.

(4) Constantly growing industrial wood demand will continue most likely well beyond the volumes that fast growing tree plantations can supply, even if plantation development is accelerated

All the analysed scenarios indicate that plantation wood alone is far from sufficient to replace even tropical timber from natural forests in the future. Increasing global population and increasing standards of living will drive the wood demand continually up, even if wood and fibre products are increasingly substituted with other products.

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8.2 Challenges for FSC

Considering the underlying facts mentioned in Chapter 8.1. Indufor recommends that FSC take into account and focus its strategic work on the following challenges

(1) The pressure to use natural forests particularly in frontier areas will most likely continue and cause deforestation and degradation.

It is quite evident that industrial plantations, even with accelerated expansion and growth rates, will not be able to fully substitute wood sourced from unsustainably managed tropical natural forests.

In the tropics there will be limited opportunities to increase wood production from the current level with sustainable practises. On the other hand, there is room to increase sustainable production in natural and semi-natural boreal and temperate forests.

The FSC needs to have a balanced view of the use of plantations as well as on natural forests and continue promoting sustainable forestry and certification in both these areas.

(2) Climate change increases risks related to wind, insects, drought, fire and other damage.

Wind damage, diseases and forest fires have been frequent phenomena in many plantation countries and thus the main threats to plantations. New innovative means, such as genetic improvement and new management regimes, are needed to face and overcome these threats. For FSC this means an additional challenge to find ways to promote appropriate risk mitigation measures along with certification schemes.

(3) Incompatibility of statutory versus customary law regarding land ownership and tenure will cause more tension and conflicts at the local level in new frontier regions.

Corporates especially, operating in emerging market countries, have already been facing and involved in complex social conflicts. More proactive ways to overcome the conflicts are needed. FSC has to consider whether its certification offers a means to solve these kinds of conflicts.

(4) Due to the increased number of small-size tree growers in many regions technology, logistics and market access will require new innovations.

Scale benefits have been the fundamental driver of improved technology, logistics and financial efficiency in advanced forest plantations. Now we have to face the fact that more and more wood has to be sourced from small-scale tree farmers. Social innovations e.g. in the forms of associations, are needed to address this problem. FSC needs to pay attention to the development of new technologies and formulate positions regarding these.

(5) Genetically modified organisms (GMOs) applied in tree breeding will continue to be developed.

The tight interpretation of precautionary principles has led to a situation where scientific research has been stifled and is very limited. This means that there is little of the necessary information available about the long term impacts to form the basis for sound decisions by FSC. However, it is likely that the technique will be developed regardless and FSC will need to formulate its position.

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8.3 Opportunities for FSC

There are numerous opportunities that the stakeholders of plantation development can capitalize upon in order to lead the well-performing forest plantation development wanted by all parties. The main points are listed below.

(1) Fast growing forest plantations can be an attractive investment target for financial and strategic investors as well as for local landowners.

Financing is always a precondition for plantation investments. It is obvious that plantation development cannot be catalysed only with public investments. Private investment flow is definitely required. In the long run more institutional investors will most likely perceive that timberland investments in the emerging market countries match their long term sustainable investment strategies. FSC needs to position itself with regard to the more diversified ownership structure in plantations.

(2) Plantation development can improve the overall environmental performance and increase ecosystem services related to biodiversity, carbon stocks and landscape planning.

If plantations are established with the best international practises also the environmental benefits are likely to be gained. There are already positive signs of improved environmental performance in the advanced forest plantation countries.

(3) Forest plantations that involve local stakeholders provide positive social impacts: improved land management, employment, income, infrastructure, and social services (e.g. education, health).

Plantation development takes place often in remote areas in the countryside where economic opportunities for local people are limited. When the development is carried out in a responsible way involving local smallholders, service providers and employers the outcome can be a social success.

(4) Forest plantation development has an important role in climate change mitigation and adaptation through releasing pressure from tropical natural forests, increasing carbon stocks, and improving resistance to changing climatic conditions.

Climate change is a serious global concern and forest plantations play an important role in combating its negative effects as well as in adapting to the unavoidable new circumstances. Climate change is, however, also an opportunity for traders of carbon credits and new technologies.

(5) New innovations in plantation technology can increase future wood supply.

Innovations are still needed to increase tree yield, quality as well as resistance to different climatic conditions. Genetic improvement, regimes, silvicultural methods, sanitary systems and harvesting methods are all important for improved technology.

(6) National and local level policies can accelerate plantation development e.g. with direct and indirect incentives as well as through creating an enabling environment for forest plantations.

Improved policies can do a lot for plantation development. These include treatment of foreign investors, incentive policies, donor support, environmental policies and improved processes to lower barriers to entry for investors.

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8.4 Recommendations for FSC

Indufor recommends that FSC take into account the following issues in the future strategic work.

(1) Plantations will be very important for wood sourcing in the future and it is important that FSC have clear guidelines both for certification in plantations and in natural or semi-natural forests.

(2) FSC has to follow the change of ownership for plantations and develop and diversify the approaches to reach different types (institutional owners, TIMOs, industrial owners, smallholders) of owners of plantations.

(3) FSC has to be active on new frontier areas e.g. in Latin America, Africa and Asia where the area of forest plantations is expected to grow rapidly.

(4) FSC has to develop the strategy regarding carbon issues and plantations to meet the expectations in the future and to be able to benefit from finance in carbon trading.

(5) FSC should pay attention to the development of GMOs. As a first step FSC could develop a policy regarding research on GMOs. FSC could also formulate a policy promoting openness and the need for monitoring in relation to the use of GMOs

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Appendix 1

Demand for Industrial Roundwood in 2040 and 2050 per Region

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Appendix 1

Demand for Industrial Roundwood in 2040 and 2050 per Region (in million m^3)

Regions and countries		Scenario I		Scenario II		Scenario III	
		2040	2050	2040	2050	2040	2050
Latin America		**252**	**268**	**799**	**1 009**	**1 289**	**1 690**
	Brazil	155	163	522	660	893	1 176
	Latin America, excluding Brazil	97	105	277	348	396	514
Asia		**377**	**397**	**1 890**	**2 449**	**2 512**	**3 313**
	China	147	149	1 032	1 351	1 352	1 796
	India	38	42	269	357	351	471
	Japan	20	20	25	26	36	42
	Indonesia	68	73	269	344	381	499
	Rest of Asia	104	113	295	371	392	506
Europe		**388**	**391**	**571**	**638**	**803**	**958**
Russia		**105**	**102**	**333**	**410**	**449**	**571**
Africa		**127**	**146**	**362**	**465**	**478**	**626**
Oceania		**53**	**58**	**95**	**115**	**129**	**162**
North America		**526**	**561**	**883**	**1 044**	**1 210**	**1 496**

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