Technical Report

ETHIOPIA FOREST SECTOR REVIEW

Focus on commercial forestry and industrialization

FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

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FOREWORD

Ethiopia's forest resources have been playing significant socioeconomic and environmental roles. It is hardly possible to disentangle the day-to-day life of rural as well as urban people from wood products and services offered by forest landscapes. While still more than 80% of the population relies on woodfuels, due to limited alternatives, the use of modern wood construction and furniture is expected to grow rapidly as part of the transformational change to a green economy. Non-timber forest products (NTFPs) such as coffee, honey or gums and resins support the livelihoods of forest-dependent communities and are economically important export products. The forest sector's significance stretches far beyond its boundaries. The economic return and sustainability of sectors such as agriculture, water, energy (hydroelectric resources), tourism and health strongly depend on well managed and intact forested landscapes. Moreover, the forest sector is essential to mitigate against and adapt to climate change.

The Ethiopian government has a strong focus and places high priority on forests and other natural resources. Hence, the forest sector is recognized as one of the four key sectors prioritized in Ethiopia's Climate-Resilient Green Economy Strategy (CRGE). It is expected to abate about 130 million tons of CO2 equivalent, which is 50% of Ethiopia's national emission reduction goal set forth for 2025. The Ministry of Environment, Forest and Climate Change (MEFCC) was established considering the importance of the sector. The Ministry is responsible for building and developing Ethiopia's forest resource base, focusing on rehabilitation of degraded forest landscapes while ensuring appropriate protection and sustainable management of existing forest resources. MEFCC's responsibility further extends to reduce the forest product supply gaps, as stated in the Forest Development, Conservation and Utilization Policy of 2007.

The analysis of the Forest Sector Review was a key input for the GTP2 (a five-year plan, 2015–2019) preparation, the commercial plantation and forest industry investment plan and the national forest sector programme. The Review has allowed an informed exchange with the Ministry's key stakeholders, including cross-sectoral policy development. The Review is also the basis for a dialogue with the private sector to attract investments in commercial forestry and the related processing industry. It presents valuable information that informs the private sector about the lucrative business opportunities offered by the forest sector.

In summary, this Review is an important knowledge base for the transformation of the forest sector and its contribution to achieve the green growth targets. It will stimulate further research and serves as a springboard for commercial forestry and industry research.

The Government likes to thank all professionals, the private sector and other stakeholders who were involved in the review process. The financial and technical support from the World Bank is highly appreciated.

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Minister, Ministry of Environment, Forest and Climate Change

CONTENT

ACRONYMS

AFE	Amhara Forest Enterprise
ANR	assisted natural regeneration
ATA	Agriculture Transformation Agency
CBO	community-based organization
CIFOR	Center for International Forestry Research
CRGE	Climate-Resilient Green Economy
CSA	Central Statistical Agency
ECCSA	Ethiopian Chamber of Commerce and Sectoral Associations
ECAFCO	Ethiopian Chipwood and Furniture (company)
EEPCO	Ethiopian Electric Power Corporation
EFAP	Ethiopian Forest Action Program
EFSR	Ethiopia Forest Sector Review
EPPCF	Ethiopian Public Private Consultative Forum
ETB	Ethiopian Birr
FAO	UN Forest and Agriculture Organization
FRA	forest resource assessment
FTE	full-time equivalent (employment)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GTP	Growth and Transformation Plan
GVA	gross value added
GVP	gross value of production
IWC	International Woodland Company
MAI	mean annual increment
MEFCC	Ministry of Environment, Forest and Climate Change
MoANR	Ministry of Agriculture and Natural Resources
OFWE	Oromia Forest and Wildlife Enterprise
NTFPs	non-timber forest products
PFM	participatory forest management
PLC	private limited company
PPD	public private dialogue
R&D	research and development
REDD+	Reducing Emissions from Deforestation and forest Degradation, including the role of conservation, sustainable forest management and forest carbon stock enhancement
SDA	supply-demand analysis
SMEs	small and medium enterprises
SMFEs	small and medium forest enterprises
SNNP	Southern Nations, Nationalities and People
TLU	Tropical Livestock Unit
WBISPP	Woody Biomass Inventory and Strategic Planning Project

EXECUTIVE SUMMARY

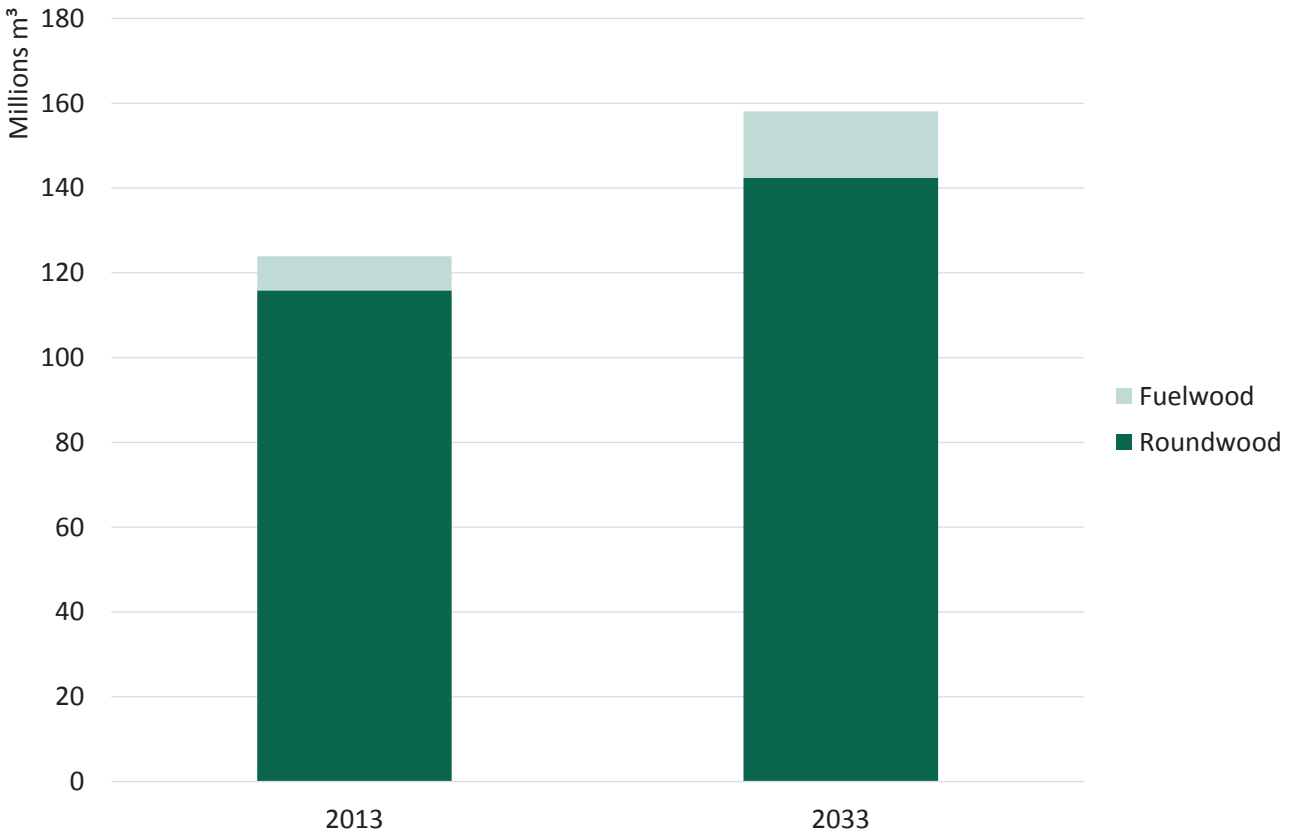
This Forest Sector Review – the first comprehensive analysis in 20 years – broadly aims to provide an update on the status of the forest sector in Ethiopia, and specifically to inform the Government's next Growth and Transformation Plan (GTP2) about the most promising forest and forest industry investment opportunities. This Review focuses on the current and future supply and demand of industrial and small-scale timber production, a strategic component of Ethiopia's transformation towards a more prosperous and industrialized economy. The Government of Ethiopia, specifically the newly created Ministry of Environment, Forest and Climate Change (MEFCC), called for this Forest Sector Review with the objective to improve understanding of the contribution made by Ethiopia's forests and trees in landscapes to sector industrialization, growth and employment. The Review also aims to assist the Government to achieve the Climate-Resilient Green Economy (CRGE) goals, given that investments in forests and accompanying industries support achievement of climate mitigation and rural development goals.

Ethiopia's diverse forest resources, including high forests, woodlands, and trees on farms, provide goods and services of important value to Ethiopia's people, environment and economy. For example, non-timber forest products (NTFPs) play an important role in rural livelihoods and the growing market-based economy. The main commercial NTFPs in Ethiopia are honey, spices, forest coffee, bamboo, gums and resins. There is stable demand on domestic and international markets for many of these products, providing foreign currency earnings. Ethiopia's forests also are important for climate stabilization, contributing to global climate mitigation goals and providing local climate adaptation benefits. In addition, forests are increasingly recognized for their role in mitigating and adapting to global climate change. Land use related activities (agriculture, forestry) are the main source of emissions in Ethiopia. Reducing Emissions from Deforestation and forest Degradation, forest conservation, sustainable forest management and forest carbon stock enhancement through afforestation and reforestation (REDD+) is an important element in Ethiopia's CRGE strategy and must be integrated into a comprehensive sector strategy to ensure these forest goods and services are maintained.

Taking into consideration the multitude of products and benefits Ethiopia's forests provide, the Review focuses on supply, demand and the value of the forestry sector – focusing on timber – as it contributes to economic growth. This aligns with the Government strategic priorities for the GTP2, which are economic development through industrialization, private sector development and commercialization. This Review aims to support growth and transformation by encouraging large and small domestic and foreign investment in forest establishment, sustainable forest management and forestry industry. Experience in eastern and southern Africa demonstrates that there are promising models of forest-based partnerships between communities, smallholders and enterprise to meet economic development goals and create sustainable livelihoods. Thus, this Review's focus is on forest industrialization and does not include a detailed analysis of the broad range of forest benefits, such as ecosystem services related to forests, which include watershed protection, land rehabilitation, food security, ecotourism, and biodiversity conservation.

In 2013, Ethiopia consumed roughly 124 million cubic meters of wood and is consuming more each year. With population growth and economic development projections, total wood product demand will increase by about 27% over the next 20 years, reaching an annual consumption of 158 million cubic meters by 2033. Woodfuel (fuelwood and charcoal) will continue to be the main forest product consumed. However, with rural electrification and urban development, the relative share of fuelwood demand is expected to decrease (see Figure 1 below). The increasing demand is mainly explained by growing needs for industrial roundwood, driven by the expanding construction indus-

Figure 1: Total roundwood and fuelwood demand in 2013 and 2033



try and consumer demands of the growing middle class. Construction (housing and commercial building) is expected to experience steady growth over the coming years in line with urbanization, and the forestry sector must supply this increasing demand with higher quality wood products to meet the requirements of modern construction. Other important drivers of the increasing demand include wood products for furniture, especially for urban households and commercial consumption, as well as utility poles for electrification and pulp and paper.

As shown in Figure 1, woodfuel, which is critical for household heating and cooking, is the most important forest product consumed in Ethiopia. Ethiopia now consumes over 100 million cubic meters of woodfuel each year, with roughly a third of consumption from unsustainable use of forests and woodlands. Current management of the woodfuel situation urgently needs to be improved so that it does not undermine the investments in environmental and social transformation (including food security) at the core of the Government's rural development program. Demand and supply side measures will be needed, including electrification and introduction of efficient stoves. The woodfuel supply interventions are not prioritized in this Review for the following reasons: industrial and urban users are the main consumers with the means to pay for sustainably produced woodfuel and they will be the first switching to cleaner or more convenient alternatives; the value adding potential for woodfuel production is relatively small; and there is limited evidence that the private industrial sector is interested in investing in woodfuel production since most markets operate informally with limited benefits for industrial investors. Thus, this Review focuses mainly on the investments required to close the industrial roundwood gap, demonstrated by the "unspecified sources" supply category below.

To meet the needs of Ethiopia's growing economy, a supply gap of 4.4 million cubic meters industrial roundwood will need to be closed over the next 20 years, as demonstrated by the 2033 "unspecified sources" category in Figure 2. This challenge provides a considerable investment opportunity, as Ethiopia can close this gap through plantation establishment, sustainable management of forest resources and expansion of the forestry sector's industry base. Smallholder woodlots are currently the main source of roundwood – mainly poles – and these are expected to continue to

Commercial forestry value chains Source: UNIQUE




supply an important amount of roundwood. There is significant value adding potential for wood products produced from woodlots, as much of the wood produced from woodlots does not enter the domestic industry. This presents foregone opportunities for downstream processing, including through small and medium forest enterprises, to supply the growing construction and furniture demand. Timber can also be sourced sustainably from natural forests, given safeguards are in place to prevent unsustainable practices. For example, participatory forest management (PFM) arrangements with forest communities could also contribute to closing the projected gap, if capacity is developed and policies are aligned and effectively implemented. Over one million ha are currently under PFM agreements, but the majority is not currently under sustainable forest management. Sustainable forest management could contribute around 2 million m^3.

To ensure the future industrial roundwood gap is closed through sustainable domestic timber production, establishment of 310,000 ha of professionally managed plantations is required. As shown in Table 1 below, this will require investments of about USD 638 million. These investments in plantations and processing should create employment for roughly 51,000 people. If they are realized, the potential GDP contribution (calculated as gross value added) would reach USD 518 million in 2033, and continue annually. Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks, is one of the CRGE's four pillars. Establishing the plantations required to fill this gap will mitigate roughly 89 million tCO2 through forest carbon stock enhancements. Further, closing the industrial roundwood gap through domestic production will reduce imports and support sector development through industrialization and commercialization. Although the volume of current wood product imports is relatively small, it is unclear how many wood products will continue to be imported. It is clearly in Ethiopia's best interest to substitute imports with sustainable domestic production, and thereby strengthen the forest sector's contribution

Figure 1: Total roundwood and fuelwood demand in 2013 and 2033

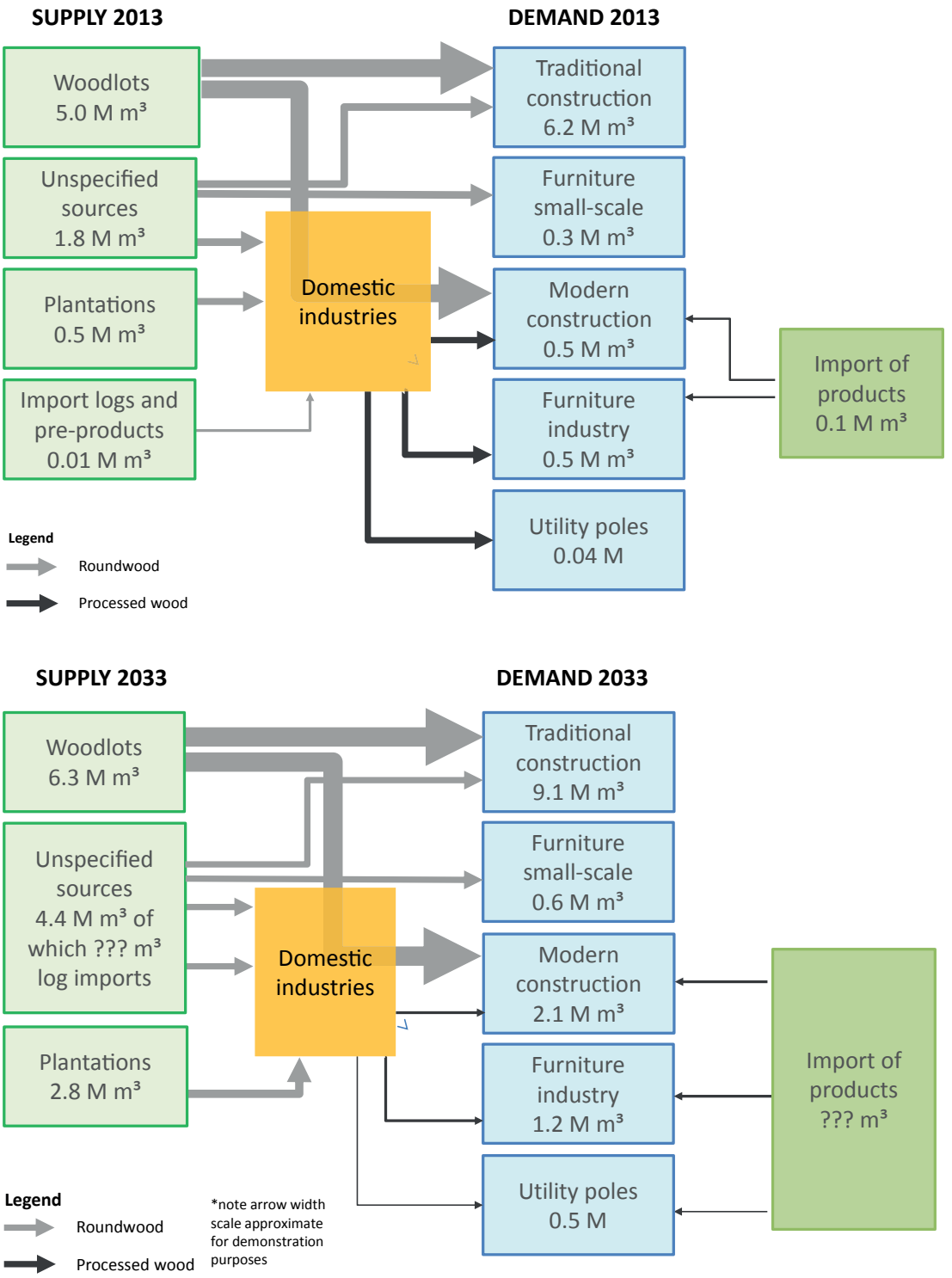


Table 1: Investment requirements and additional economic impacts of sub-sectors in 2033

	Construction	Furniture	Utility poles	Total
Production				
Roundwood gap 2033 (million m^3)	3.4	0.5	0.5	4.4
Area required (x 1,000 ha)	245	35	30	310
Investment in plantations (million USD)	196	28	24	248
Processing				
Investment requirements processing (million USD)	341	24	25	390
Total				
Total investment (million USD)	537	52	49	638
Total additional employment	39,000	7,000	5,000	51,000
Potential additional GDP contribution in 2033 (million USD at current price)	384	90	43	518

to the CRGE goals while generating green jobs and fostering economic growth.

Economic growth is the major driver for certain forest sub-sectors, especially for pulp and paper consumption and industrial wood product consumption (panels, sawnwood) in the construction sector, as commercial construction and infrastructure development increases with growth. Economic growth influences purchasing power, improving the ability to switch fuel sources from wood to electricity or to purchase more and higher value wood furniture. Paper consumption (for commercial and private use) increases with economic growth. Over the last decade, Ethiopia has experienced double digit GDP growth rates. With a view to future development paths, this growth is expected to continue. However, considering a harmonized approach with national strategy planning (i.e. GTP and CRGE), this Review assumes an average long-term GDP growth of 8% until 2033 (corresponding to the CRGE planning data, which indicates an 8% average GDP growth as the low development scenario).

Sub-sector potentials: Construction

Construction timber production is critical for reducing deforestation and achieving industrialization. Industrial roundwood production for construction enables the development of a timber processing industry to sustainably serve the growing timber demand. The construction sector demand of roughly seven million cubic meters is currently supplied mainly from private woodlots (small poles), public plantations, imports, and roughly 20% is delivered informally from unknown sources. Industrialization of the construction sector should be a priority moving forward as – given an enabling investment climate and public policy direction – this has the potential to generate significant employment opportunities and can be a driver of the country's economic growth, including through export diversification and import substitution. This should be combined with a modern wood-based housing construction program. Modern wood-based construction requires higher quality industrial wood products such as panels and sawnwood, providing additional impetus for domestic industrial development. With a total demand of around 0.8-0.9 million housing units annually (new and replacement), additional gross production value amounts to USD 384 million (at current price). Moreover, the use of wood as a major construction material can partly or fully replace high emission construction materials such as aluminum, plastics or cement.

Sub-sector potentials: Furniture

Demand for wooden furniture – a high value adding sub-sector – is expected to grow by nearly 400% over 20 years. Furniture production and consumption can be divided into three groups: (1) furniture produced in rural areas by small carpentries or by households themselves, (2) furniture produced industrially by medium and large com-

Small- and large-scale construction in Addis. Source: UNIQUE

Sawmill and utility pole plantation. Source: UNIQUE

panies sold in urban centers to private consumers, and (3) furniture used to equip public schools and offices. Total furniture demand was estimated at 0.8 million m^3 in 2013. The raw material required for furniture production has a variety of sources, including plantations, natural forests and woodlands. Furniture sector demand is projected to increase to roughly 1.8 million m^3 in 2033. Moving forward, investments to enhance the competitiveness of small and medium companies should be prioritized. In addition, a green and competitive public procurement policy can play an important role in securing demand for high quality and sustainably produced wood products, which could have a direct impact on natural resource protection.

Sub-sector potentials: Utility poles

Utility poles and pulp and paper are two important sub-sectors that are expected to grow in coming years and may represent important investment opportunities. Large **utility poles** are currently sourced almost exclusively from public plantations. However, increasing electricity exports rely on large transmission poles that cannot

be supplied from existing timber resources and require rapid and dedicated investments to substitute increasing imports. Although the pulp and paper sector can play an important role in terms of employment and GDP contribution, it is not yet integrated in the Ethiopian forest cluster and its value chains. Currently there is no wood pulp and paper industry based on domestic supply of raw material in Ethiopia. Considering the predicted growth of 300% by 2033, the potential to develop this sub-sector through domestic sources is huge.

Concluding remarks and recommendations

As Ethiopia continues to experience rapid economic growth, the role of the forest sector becomes increasingly important in achieving the Government's ambitious climate-resilient green growth goals. Given the right interventions and policy adjustments, the forest sector has the potential to expand its contribution to sustainable economic development, creating green jobs, supporting the bio-economy and fostering climate change resilience. Achieving a productive sector that produces high quality timber and wood products requires capacity development, technological advancements, improvements in the investment climate and access to affordable finance. The main barriers to private investment in forestry include: lack of ready-to-invest land; lack of access to affordable long-term finance; weak prioritization of the forestry sector compared to other land use sectors to date; lack of recognition and engagement of private sector in forestry to address technology investment requirements, and ineffective local extension schemes. However, given the planned infrastructure investments and institutional improvements such as the ongoing forest law reform, the ease of doing business in forestry sector is expected to improve, attracting the investments required to transform the sector into one that is more productive and contributes to the country's industrialization goals as laid out in the GTP. Emphasis must be placed on attracting foreign direct investment providing access to new technology (e.g. clonal nurseries, timber processing equipment, transport logistics), related skills and knowledge and capital. These outside inputs require an enabling investment climate and partnerships between the private and public sector and domestic as well as international actors.

Investments in plantation establishment and best practice management are critical to ensure Ethiopia closes the projected industrial roundwood supply gap through sustainable domestic production. In 2013, public plantations officially produced 271,000 m^3 roundwood, 270,000 m3 roundwood for chipwood production and 74,000 m^3 of fuelwood. Plantation establishment must be combined with improved management techniques to increase timber recovery and utilization rate. This can be achieved through private investments in smallholder owned out-grower schemes as already successfully practiced in the agriculture sector. To ensure that plantation establishment is prioritized on suitable and available land, the Government should provide investment-ready forest concessions and tender them on a competitive basis. Related activities require the application of robust social and environmental safeguards to respect people's rights and protect sensitive ecosystems with a high biodiversity value.

The main recommendations for the GTP2 resulting from this Review include a number of supply and demand side interventions, and enabling environment conditions:

Invest first in the forest resource base, including through smallholder engagement:
As Ethiopia's forest resource is limited and continues to decline, the establishment of commercial plantations is a priority and has the potential to address deforestation by reducing pressure on natural forests and woodlands and to provide sustainable sources of wood products to reduce the projected future supply gaps and support implementation of the national REDD+ strategy. Given limited land availability, woodlots should play an important role in transforming the sector to one that produces high-quality industrial timber. Experience in other African countries suggests quality timber production can be achieved through the establishment of a core dedicated commercial plantation combined with out-grower schemes that engage surrounding communities. This approach fosters technology spill-over from commercial plantations to woodlot owners and generates significant local socioeconomic development while meeting the commercial timber production demands of a country increasingly modernizing its construction and housing sectors.

Secondly, invest in forest industry:
From the different sub-sectors identified, the construction sector, the furniture sector and utility pole markets are the priority areas which can contribute substantially to increasing the sector's industrialization. In order to achieve this, substantial investments are required in the resource base and industrial capacity for timber transformation. Private sector engagement, including through public-private and community partnerships will play a crucial role in meeting the sector investment requirements.

Reinforce capacity and extension:
The establishment of peri-urban plantations and private woodlots, combined with a plantation program to produce industrial roundwood and poles, established through a partnership of private investors, government and communities through an out-growers scheme should be technically supported through a functional forest extension system.

Engage private sector:
With limited government financing for the industrialization, the forestry sector would benefit significantly from increased engagement of the private sector to provide additional capital and know-how. Investment-ready land needs to be identified and a tangible incentive system needs to be put in place to encourage investment in the sector taking into account the long-term nature of investments in forests/trees and the need for relatively large areas to make economically viable investments. Continuous efforts should also be made to ensure that the private sector is well informed of investment opportunities existing in the forest sector. Foreign investment can also provide the technology, skills and international best practice required to increase sector productivity, including professional nursery establishment and tree breeding programs for promising species and clones.

Facilitate access to finance:
A national or regional Forest Fund, providing concessional loans, loan guarantees or result-based incentives by partly reimbursing the cost of plantation establishment and maintenance, should be established to channel and attract investments in forestry and mobilize domestic private capital. This fund should also have a dedicated technical assistance facility that can provide capacity building support.

Establishment of sector business associations:
Strengthening existing and establishing new tree growers and timber manufacturer associations is crucial for strengthening the sector's political visibility and allowing the sector to speak in a more united voice.

Research and education:
A forest information and research action plan should be elaborated to harness the potential of research and improved knowledge management to advance sector development through informed and evidence-based policy-making. An applied research agenda needs to be combined with an incentive system to attract and maintain motivated and well-qualified professionals to the sector.

Demand-side policy:
A public procurement policy requiring sustainable and quality certification for key wood products should be considered to encourage investments in sustainable forest management, industrialization and professionalization of the sector. This helps to ensure domestic enterprises contribute a significant share of the country's growing demand for wood products. Public policy should also consider introducing a modern wood-based housing construction program to ensure a sustainable source of demand for higher quality wood products. In parallel, unsustainable fuelwood demand needs to be addressed in the short to medium term by providing affordable electricity as an alternative to unsustainable woodfuel extraction, which is an important driver of forest degradation in natural forests and woodlands.

1 INTRODUCTION

Trees and forests contribute a diversity of products and services generating wealth and well-being for Ethiopia's growing population. Forestry directly contributes to the national economy through employment generation, potential foreign currency earnings through export, and savings through import substitution. Wood and non-wood forest products also contribute significantly to other important sectors, including energy, agriculture, food, industry, and tourism to name only a few.

The 1994 Ethiopian Forest Action Program (EFAP) marks the latest comprehensive review and strategic analysis of the sector. The present Forest Sector Review thus provides a timely update, especially as the Government of Ethiopia is planning to develop a second Growth and Transformation Plan (GTP2) in which the forest sector is one of the priority areas.

Humans have long depended on forests for a remarkable variety of products, services and benefits. With economic growth and technological advancements, the products and benefits forests provide are refined and thereby made more valuable. As Ethiopia continues to experience rapid economic growth, the role of the forest sector becomes increasingly important in achieving the Government's ambitious Climate-Resilient Green Economy (CRGE) growth goals, which aim for Ethiopia to become a middle-income country by 2025, resilient to climate change impacts and with a zero net increase in greenhouse gas (GHG) emissions over 2010 levels. Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks, is one of the four main CRGE pillars. Given the right interventions and policy adjustments, the forest sector has the potential to expand its contribution to sustainable economic development, creating green jobs and fostering climate change adaptation.

Building on the CRGE forestry targets, the strategic GTP2 recommendations proposed in this Review can significantly advance the sector towards one that is more productive and better contributes to Ethiopia's environmental sustainability and equitable socio-economic development. This Review comprises a comprehensive supply and demand analysis to demonstrate current and future gaps in forest production and related value chains, based on population and economic growth trends. Subsequently, it provides sub-sector recommendations for developing the forest resource base and accompanying industries to fill the observed gap.

This Review provides analyses of key forest sub-sectors, including their demand and supply sources, and an institutional analysis of the forest sector investment climate. The objective is to outline the main market and investment barriers to advancing sector growth and thereby provide inputs for decision-making leading up to the country's second Growth and Transformation Plan (2015-2020, GTP2).

Other important forest values related to ecosystem services, such as watershed protection and associated benefits related to energy and soil protection, ecotourism potential and biodiversity conservation, are reviewed based on available literature and case studies. An assessment of the Economic Value of Forest Resources in Ethiopia which is conducted by UNDP/UNEP provides additional empirical data and knowledge related to these aspects, in order to highlight the importance of the forest sector – beyond forestry production – to the health and wealth of Ethiopia. Moving forward, future studies can help to better understand the full range of economic and non-economic values of Ethiopia's forests, including their role in community engagement and poverty reduction, to continue providing policy makers with important information regarding Ethiopia's forest sector development.

The following chapters present the methodology and results of the supply and demand analyses carried out for this report, as well as the projected baseline scenario used to calculate the sector investment requirements. Thereafter, a brief overview of the forest industry is provided, followed by an institutional analysis that focuses on the sector investment climate, highlighting current conditions and constraints faced by the sector and providing suggestions for possible solutions. Finally, the sector Vision 2033 outlines the investment requirements for the specific sub-sectors analyzed and the respective benefits of these investments in terms of employment generation and contribution to GDP.

2 SUPPLY AND DEMAND ANALYSIS

2.1 Methodology and important data sources

The **primary data sources** for the supply-demand analysis (SDA) are available national statistics and other secondary data. Primary data was only collected to cross-check important assumptions or fill crucial data gaps.

Table 2: Data sources for supply-demand analysis

Theme	Important data sources	Data quality
Woody biomass resources, forest areas, stocks and yields	WBISPP, 2000/05	Excellent database, but outdated
Public plantations (areas and yields)	Oromia Forest and Wildlife Enterprise and Amhara Forest Enterprise primary data, 2014	Good database but restricted to the regions the enterprises operate
Woodlots (areas and yields)	Bekele, 2011	Data assumed to be accurate
Demographic and macro-economic factors	World Bank Indicators database, 2014	Data assumed to be accurate
Population growth	Central Statistical Agency projections and Census data 1994 and 2007	Discrepancies between World Bank population figures and Ethiopian census 2007
Woodfuel consumption patterns	WBISPP, 2000/05	Excellent database, but outdated
Construction and furniture sector consumption	Ethiopia population and housing census 2007 Hager & Duguma, 2010 Makhado et al., 2009	Data assumed to be accurate No data for public and commercial construction projects available No data for public furniture consumption available
Utility poles consumption	OFWE primary data, 2014	Good database but restricted to the region the enterprise is operating No primary Ethiopian Electric Power Corporation consumption data available
Pulp and paper consumption	FAO Statistics, 2014	Data assumed to be accurate
Wood products trade data	FAO Statistics, 2014 Ethiopia Custom and Revenue Authority, 2013	Data assumed to be accurate. Illegal direct cross-border trade not included
Employment figures	CSA Industry Surveys 2010/2011/2012/2013 OFWE primary data, 2014 Case studies (CIFOR unpublished, IIED, 2009)	CSA data assumed to be accurate; small enterprise data probably incomplete

Table 2: Data sources for supply-demand analysis

Theme	Important data sources	Data quality
GDP contribution	CSA Industry Surveys 2010/2011/2012/2013	Data assumed to be accurate
Ethiopian wood processing industries	Bekele, 2011 CSA Industry Surveys 2010/2011/2012/2013	Datasets require verification and update

Wood balance methodology

A wood resource balance compares the supply of wood raw material with its use in a national economy (e.g. wood, paper products and energy use). In other words, it is a consistency check between all sources of wood materials against the balance sheet total of the consumption side.

In order to compare all different commodities selected for the wood balance analysis, a common unit is needed. Therefore, all figures in the balance are converted into solid m^3 roundwood equivalent (m^3 excluding bark). This is the usual unit employed with regards to forest removal data, meaning that less conversion is needed on the supply side of the balance. With regards to the demand side, however, many wood uses and products are recorded in different units. Therefore, conversion factors are needed to convert from different wood products such as m^3 sawnwood or panel, ton of pulp or energy units into m^3 roundwood. Various parameters influence these conversion factors, including wood properties (specific weight), moisture content of the wood, efficiency of the processing, etc. For example, one m^3 of sawnwood will have one m^3 solid wood equivalent, but it will take more volume of roundwood to produce one m^3 of sawnwood due to the loss of residual products, such as chips and sawdust. Thus, the roundwood input required may be two m^3. For the purpose of this study, the conversion factors shown in Table 3 have been used.

Table 3: Roundwood equivalent conversion factors

Wood product	Conversion to m^3 harvested roundwood	Comment
1 m^3 roundwood (logs, poles)	1.0	Only includes roundwood that leaves the forest, no harvesting losses are considered. This corresponds to the harvesting volumes as indicated in the growing stock and yield calculations for forests and plantations.
1 m^3 fuelwood (round, split)	1.0	
1 ton charcoal	7.6 (a)	This factor refers to low efficiency earth kiln charcoal production.
1 m^3 construction sawnwood	2.0 (b)	Factor refers to dimensioned construction sawnwood produced using available technology, in individual cases the factor may vary between 1.5 and 2.5
1 m^3 plunks (sawnwood by product)	1.6	Plunks are boards and solid wood residues from the sawmilling process, which are not standard dimensioned lumber assortments. In Ethiopia, plunks are used in construction and furniture production.

Table 3: Roundwood equivalent conversion factors

Wood product	Conversion to m³ harvested roundwood	Comment
1 m³ particle board	1.5 m³ (c)	Factors are averages of best industry practice. Primary data from Ethiopian "chipwood" factories indicate a recovery of 2.3 m³ intake for 1 m³ chipwood boards.
1 m³ chipwood (Ethiopian production)	2.3 m³	
1 m³ fiber board	1.8 m³ (c)	
1 m³ plywood	2.0 m³ (c)	
1 ton paper, paperboard, newsprint	3.9 m³ (c)	
1 ton wood pulp	4.5 m³ (c)	Weighted average of wood pulp import mix to Ethiopia, which is dominated by chemical wood pulp.
1 ton furniture	4.0 m³ (d)	This factor assumes intake of processed wood products (i.e. sawnwood, plywood and panels) with the respective conversion factors and further processing losses of 50%.
1 average utility pole	0.6 m³ (e)	There are various dimensions of utility poles. The most common one is 10 m length and 29 cm diameter.
1 average construction small pole	0.06 m³ (e)	There are various dimensions of utility poles. The most common one is 8 m length and 10 cm diameter.

Sources: (a) Factor as applied in WBISPP, 2010 (b) Authors' experience in African sawmilling industries (c) Forest Product Conversion Factors for the UNECE Region, 2010 (d) Authors' experience in African furniture industries (e) Market observation in Ethiopia

Double counting in the wood balance approach

The wood resource balance takes into account the fact that wood is a material that can be used and reused in multiple processes and several times (e.g. for material use and then for energy use). Co-products of the wood-processing industry (chips from sawmill industry) can easily be used directly in on-site integrated processes (e.g. sawmilling residues for energy generation or pellet production in sawmills); or the co-products are sold to consumers that use the fibers for external processing (e.g. chips from sawmill used for pulp production).

There is a risk of double counting wood materials when calculating the wood resource balance, especially given that the balance needs to include net trade, comprising import and export volumes. Unavoidable double counting is balanced out by maintaining consistency on both sides of the SDA equation.

Due to double counting, it is necessary to take into account residue use and recycling, which adds to the total balance on the supply side. The supply side sum of the balance sheet is higher than the actual supply of wood from forest, woodlots and plantations. The difference between the two roughly indicates the amount of recycling and international trade in the sector. Double counting shows the real amount of wood used by the industry and because wood is used multiple times, this is an appropriate way to demonstrate the overall relevance of woody biomass. In the Ethiopian context, the amount of recycled wood waste is low compared to the direct supply sources.

Wood balance calculations

The wood balance calculation uses input data collected from national statistics and/or key forest sector informants. Based on this information, data gaps (or supply sources) can be estimated, i.e. for roundwood sourced from wood extraction in natural forest and woodlands not officially recorded or categorized as informal trade.

Table 4: Important data assumptions in wood balance calculation

Computed data	Formula
Domestic consumption of any wood product	= Domestic production + Imports - Export
Unsustainable woodfuel supply from forest, woodland, shrubland	= Woodfuel consumption - Sustainable supply from forest, woodland, shrubland - Woodfuel from woodlots and plantations - Woodfuel from industry waste
Unspecified industrial wood source (illegal logging, informal trade, plantations without regular management, PFM)	= Total industrial roundwood[1] consumption - Supply from public plantations - Supply from woodlots - Official imports

2.2 Important input assumptions

The following sections explain important overarching input assumptions and proxies used for the SDA for 2013 and the baseline projections for 2033. Assumptions specific to the sub-sector analyses are explained subsequently in the respective chapters.

2.2.1 Demographic and macro-economic assumptions

The national Woody Biomass Inventory Strategic Planning Project (WBISPP) conducted in 2000 offers the most important reference point in this historical analysis. The WBISPP gives a population total of 67 million in 2000, which corresponds to the Work Bank's estimate of 66 million for the same year. However, for 2013 there are diverging figures regarding current population and projected population growth. Most notably, the Ethiopian census from 2007 (CSA, 2010b) gives a total population figure of 74 million, whereas the World Bank/UN record a total population of 80 million.

The analysis carried out for this report applies the CSA population data based on the 1994 and 2007 national census. Population forecasts (2.61% annual growth until 2025) were used according to the CRGE strategy paper (2011). In principle, the calculation is based on conservative assumptions to provide robust inputs for forest sector planning.
The electrification rate is an important input parameter used to estimate consumption of wood products, i.e. woodfuel. According to the IFC Lighting Africa Report (2011) as well as the current GTP, electrification in Ethiopia will proceed rapidly with grid access for 50% of the rural population and 100% of the urban population by 2025. This Review used the following assumptions:

Table 5: Population and access to electricity in 2013

Population	n	ratio	Access to electricity (n)	ratio
Total	85,800,000	100%	22,000,000	25% of total
Rural	69,800,000	81%	9,000,000	13% of rural
Urban	16,000,000	19%	14,000,000	86% of urban

Source: Population data: World Bank indicators (2014); Electrification rate: World Bank indicators (2014) and IFC Lighting Africa (2011) modeled growth until 2025

[1] Industrial roundwood is a term that includes all industrial wood in the rough (sawlogs and veneer logs, pulpwood and other industrial roundwood) and, in the case of trade, chips and particles and wood residues. This includes sawlogs produced by smallholders.

Table 6: Projected population and access to electricity in 2033

Population	n	ratio	Access to electricity (n)	ratio
Total	143,000,000	100%	97,000,000	68% of total
Rural	107,000,000	74%	61,000,000	66% of total
Urban	36,000,000	26%	36,000,000	100% of total

Source: Population data: World Bank indicators (2014) projected with UN World Population Prospects (2012), medium fertility variant; Electrification rate: World Bank indicators (2014) and IFC Lighting Africa (2011) modelled growth until 2025 extrapolated until 2033.

Economic growth is the major driver for certain forest sub-sectors, especially for pulp and paper consumption and industrial wood product consumption (panels, sawnwood) in the construction sector, as commercial construction and infrastructure development increases with growth. Economic growth influences purchasing power, improving the ability to switch fuel sources from wood to electricity or to purchase more and higher value wood furniture. Paper consumption (for commercial and private use) increases with economic growth. Over the last decade, Ethiopia has experienced double digit GDP growth rates. With a view to the future development paths, this growth is expected to continue. However, considering a harmonized approach with national strategy planning (i.e. GTP and CRGE), this Review assumes an average long-term GDP growth of 8% until 2033 (corresponding to the CRGE planning data, which indicates an 8% average GDP growth as the low development scenario).

2.2.2 Wood supply assumptions

Forest and woodland areas

The WBISPP provides a comprehensive analysis of the natural resource base, with estimates for forest area, stock and yield information for the year 1989/90 and projections of the resource base for selected regions until 2014.

The latest official estimates on forest and woodland resources in Ethiopia originate from the 2010 UN Forest and Agriculture Organization (FAO) Forest Resource Assessment (FRA). FRA figures, however, refer to the 2005 WBISPP projections. The figures indicate a loss in forest area, but almost no losses for wood- and shrublands compared to 2000.

Since the available forest (and plantation) resource is the most crucial input factor for the SDA supply side, the WBISPP projections were reviewed and cross-checked with a simplified forest area model that compared agricultural expansion and population growth between 2000 and 2014. Results indicate that the loss in forest area correlates to the increase in agricultural area due to population growth. The increase in cultivated area between 2000 and 2013 was 16.3 M ha (based on WBISPP, 2000 and World Bank for 2013). Loss of forest, woodlands and shrubland in the same period amounted to 14.1 M ha (WBISPP projection) and 16.2 M ha (FSR verification model), respectively. The results of this verification process are shown in Table 7.

For this FSR, the high forest area of 3 million ha was used, while for woodland (21.8 million ha) and shrubland (20.6 million ha) the projected figures of the WBISP were applied. The lower high forest figure was chosen due to the widely held expert opinion that deforestation rates in this forest cover class have been higher than estimated by official sources.

Table 7: Forest and woodland resources in 2013 (million ha)

Resource types	WBISPP 2004 (for 2000)	WBISPP areas as stated in FAO's FRA 2010 report	WBISPP areas as projected for 2013	FSR verification 2013
High forest	4.1	3.3	3.2	3.0
Woodland	29.2	55.9	21.8	20.7
Shrubland	26.4		20.6	19.8
Total	59.7	59.2	45.6	43.5

Table 8: Standing stock, MAI and sustainable woodfuel yields

Resource	Standing stock (m^3/ha)	MAI (m^3/ha/year)	Annual sustainable yield (million m^3)	Branches, twigs and leaves (BTL) in million m^3
High forest	132	5.6	17.1	3.4
Woodland	21	0.8	16.7	3.3
Shrubland	15	0.5	9.9	2.0

Source: WBISPP, 2004; BTL volume is additional 20% of annual yield (WBISPP, 2004)

The standing stocks and mean annual increment (MAI) for the three vegetation types were derived from the WBISPP (Table 8).

Another important source of woodfuel is biomass resulting from the conversion of forest, woodlands and shrubland to other land uses. Expansion of agricultural land correlates to population growth. Time series analysis of World Bank figures reveals an average per capita requirement for agricultural land in Ethiopia of around 0.2 ha. Ethiopia's population in 2013 increased by almost 2.1 million compared to the previous year. Thus, expansion of agricultural area amounted to around 0.5 million ha, which was primarily forest conversion. Based on the expansion of agricultural land, the potential woodfuel produced from land use change in 2013 amounts to 19.5 million m^3.

Area exclosure resources

Area exclosure is one of the most widespread forms of re-greening degraded landscapes in Ethiopia today (Lemenih & Kassa 2014). It involves protecting degraded areas from any form of cultivation, cutting of trees and shrubs, or grazing by livestock, mainly through social fencing. This is meant to allow regeneration and fosters natural ecological succession for the rehabilitation of deforested areas or degraded forests. Two types of area exclosure management are observed. The first one involves no additional management activities other than protecting enclosed areas against livestock and human interference. Ecological succession occurs from buried or dispersed seeds. The second type, which is the most common, involves the planting of seedlings (exotic or indigenous species), aerial seeding and construction of soil and water conservation structures to speed up succession through the modification of microclimatic and soil conditions.

Regional States are rapidly increasing areas put under exclosure and, by the end of 2013, exclosure covered 1.54 million ha in Tigray and 1.55 million ha in Amhara (Lemenih & Kassa, 2014). This results in a total area of more than 3 million ha. Exclosed areas are expected to increase by 2% per year, reaching a total of around 5 million ha in 2033, which could contribute to achieving Ethiopia's New York Summit commitment to rehabilitate 15 million ha of degraded landscapes.

Plantations and woodlots

Data on public plantations and woodlots was directly sourced from OFWE, AFE and Bekele (2011). Compared to recent publications, which

Table 10: Key assumptions regarding plantations and woodlots in Ethiopia

Resource	Area in ha
Public plantations Oromia (a)	57,700 ha
Public plantations Amhara (a)	32,100 ha
Chipwood plantations, i.e. Tigray and SNPP (a)	15,000 ha
Public plantations other regions (b)	Unspecified sources (est. of 52,000 ha, but not verified)
Peri-urban energy plantations (b)	26,700 ha
Private/community small-scale woodlots (c)	778,000 ha
Total	909,500 ha

Sources: (a) Primary data private chipwood companies, OFWE and AFE 2014;
(b) Bekele, 2011; no update available;
(c) Bekele, 2011 (754,900 ha) projected with an annual growth of 1.5% until 2013.

Table 10: Key assumptions regarding plantations and woodlots in Ethiopia

Resource	Species	Rotation	MAI
Public plantations (a)	Eucalyptus	18 years	18 m³/year
Public plantations (a)	Cypress	25 years	13 m³/year
Public plantations (a)	Others	25 years	13 m³/year
Woodlots Oromia (b)	Eucalyptus	5 years	15 m³/ year
Woodlots other regions (b)	Eucalyptus	5 years	15 m³/ year
Peri-urban energy plantations (b)	Eucalyptus	5 years	15 m³/ year

Sources: (a) National average figures based on Moges et al, 2010;
(b) Figures based on expert estimates.

usually cite a total public plantation area of 190,400 ha, the current assessment concludes that plantations cover 105,000 ha (consisting of OFWE and AFE), as a reported plantation area of around 52,000 ha in Tigray and Southern Nations, Nationalities and People (SNNP) could not be verified. Thus, any supply from these sources would fall under unspecified sources in this Review. As shown in the table below, there are at least 15,000 ha of plantations exclusively producing for large chipwood factories located in Tigray and SNPP.

For private/community woodlots and fuelwood plantations (all Eucalyptus) producing mainly small poles and woodfuel, this Review assumes average rotation cycles of five years and MAI of 15 m³. Many of these woodlots also produce utility poles and sawlogs, but production volumes are low compared to short rotation production (according to OFWE, only around 5,000 m³ of utility poles were produced in woodlots in 2013).

Based on the information provided by OFWE and AFE, roughly 80% of the standing stock is aged 15 years or above and 18% of the growing stock is 5 years or younger. The age classes between 5 and 15 years represent only 2% of the total area. State forest enterprises currently pursue a strategy of stretching the available resource base in order to address the replanting gap of the last years.

Species distribution for OFWE and AFE is 54% Eucalyptus, 31% conifers (i.e. Cypress) and 15% other species such as softwoods, e.g. Pines, and hardwoods such as Acacia.

Table 10 summarizes this Review's key assumptions with regards to public plantations and private woodlots in Ethiopia.

The production of plantations and woodlots in 2013 is shown in Table 11. The potential harvesting volumes for plantations can only be roughly estimated due to incomplete information and lacking data for plantations not under OFWE and AFE management. The harvesting stock for these areas was calculated drawing on the standard thinning regimes for Ethiopia: 153 m³/ha for Eucalyptus and 135 m³/ha for Cypress. However, most stands have not been thinned regularly, thus the standing stock might be significantly higher (> 200 m³/ha).
Chipwood plantations produced 270,000 m³, production from public plantations was 271,000 m³, and total wood production (fuelwood and construction poles) from woodlots amounted to 11.7 million m³ in 2013.

Table 11: Plantations and woodlot production in 2013

Resource	Production (m³) 2013
Public plantations (a)	271,000
Chipwood plantations (a)	270,000
Woodlots (b)	11,700,000
Peri-urban energy plantations (b)	80,000
Total	12,250,000

Sources: (a) Calculations based on OFWE and AFE data and on Bekele (2011);
(b) Calculations based on Bekele (2011).

2.3 Unspecified sources

Although industrial roundwood resource data is generally available (taking into account the above-mentioned restrictions on accuracy and the lack of up-to-date primary data), it was not possible to identify all direct industrial roundwood sources for the 1.8 million m³ consumed in 2013 (see Wood Balance in section 2.5). The following table gives an overview of the possible unspecified roundwood sources.

Table 12: Unspecified sources of industrial roundwood

Possible sources	Explanation
Unregistered / informal imports	The CSA collects industry data regarding the sources of raw materials, as industrial wood and furniture companies submit what share of raw material originates from domestic versus imported sources. CSA 2013 statistics suggest that 508,000 m³ roundwood was imported and 257,000 m³ was sourced domestically. The domestic figure roughly matches the official harvesting volumes given by OFWE and AFE. However, imports far exceed official import figures (only 2,100 m³ was officially imported in 2013, according to FAO). This significant deviation applies for all years since 2009 and there is no clear explanation available for this. The FSR assumes that industry intake data is more realistic than official trade data. The most plausible reasons include: (1) official imports of roundwood to Ethiopia are not recorded adequately in the national system and thus are not properly submitted to FAO; (2) informal imports that are not recorded at all (the processing companies are presented with import and tax documents, which have been obtained illegally at the border); or (3) from illegally harvested volumes in Ethiopian natural forests and plantations that are endowed with false import documents. Informal trade is common along Ethiopian borders. However, no trade volume estimates are available. An approximation could be the unrecorded import volumes from CSA industry statistics vs. official import statistics.
Participatory forest management (PFM)	PFM arrangements cover approximately one million ha in Oromia. However, the extent to which this area is under regular management is generally unclear and industrial roundwood extraction volumes from PFM are unknown. The area could produce volumes of around 2 million m³ (sustainable harvesting rate of 2 m³ / ha / year). However, at the time of this Review, the only known PFM Forest Management Unit (FMU) extracting timber is Dodola, with marginal volumes supplied to the market. Over the last 5 years, PFM has been scaled up in Oromia by 1) Farm Africa through the Bale Mountains Eco-Region Sustainable Management Programme (Norway, Irish and Netherlands funded) and the Strengthening Sustainable Livelihoods and Forest Management Programme (EU funded) as well as 2) OFWE through EU funding (Gobeze et al. 2009).
Illegal harvesting	Illegal harvesting of industrial roundwood may take place in natural forests and public plantations. Current natural forest area is estimated to be around 2.9 million ha. It is highly likely that a certain share of the roundwood in the Ethiopian market originates from illegal activities. Expert estimates suggest that between 30% and 50% of Ethiopian construction and furniture timber production is based on illegal harvesting, amounting to 2 - 3 million m³. Further, illegal harvesting may occur in public plantations, most likely in degraded plantation areas, as explained below.

Table 12: Unspecified sources of industrial roundwood

Possible sources	Explanation
Undocumented public plantation management	As stated in the section on plantations and woodlots, the plantation area under regular management is found in Amhara and Oromia and amounts to a total of around 89,800 ha. The existence and condition of the remaining estimated 52,000 ha plantation area (as stated by Bekele, 2011) in other regions could not be verified. These plantations, however, can be a source of roundwood, extracted either legally or illegally. Since it is not a regular management scheme, the potential volumes may vary significantly from one year to the next. Under regular management, these areas could supply around 1 million m³ annually (assuming Eucalyptus with an MAI of 20 m³/ha/a and rotation of 18 years). However, actual production potential (in terms of area and MAI) is certainly far below this.

2.4 Wood balance for Ethiopia in 2013

The wood balance for 2013 reveals a total wood consumption in Ethiopia of 124 million m³, of which 116 million m³ is woodfuel (fuelwood and charcoal) (see Figure 1). The construction sector was the second largest wood consumer in Ethiopia with a total of roughly 6.6 million m³ consumed for new housing construction and replacement. Furniture production accounted for around 0.8 million m³. Additionally, more than 0.5 million m³ roundwood equivalents of paper products were consumed.

The supply side analysis of the balance indicates that most of the woodfuel is provided from natural forests and woodlands (109 million m³). Small-scale woodlots and plantations account for roughly 7 million m³ of the woodfuel demand in 2013. Assuming that natural sustainability (annual increment, or tree growth) constitutes the maximum usable woodfuel volume plus volumes resulting from conversion of forest/woodland to agriculture, there was a woodfuel gap of 37 million m³ in 2013. The 37 million m3 shortfall is provided from unsustainable extraction, i.e. above the annual increment, which results in a reduction of standing stocks.

The construction sector wood demand is mainly supplied from small-scale woodlots and from public plantations (together around 5.2 million m³). Industrial wood products for construction, such as kiln dried sawnwood and wood-based panels are either produced in Ethiopia or imported. However, overall net import volumes (balance of imports minus exports in the same product group) are small (80.000 m³ wood products and 20,000 m³ wood furniture).

Wood demand for industrial furniture production is mainly supplied by public plantations and imported products. In both the construction and the furniture sub-sectors, rural household wood supply is frequently directly sourced from adjacent natural resources.

In total, there was a theoretical industrial roundwood supply gap in 2013 of around 1.8 million m³, mainly for construction and furniture industry wood products. This gap was closed by harvesting roundwood in natural forests and woodlands. This might have happened illegally or through PFM (see section 2.3 “Unspecified sources”). Detailed analyses of the sub-sectors for woodfuel, construction, furniture, pulp and paper and utility poles are presented in the section 2.5.1.

Table 13: Consolidated wood balance for Ethiopia in 2013

Production (supply side)	In million m³ roundwood		Consumption (demand side)
Sustainable woodfuel forest, wood-/ shrubland	70.144	110.644	Woodfuel
Unsustainable woodfuel forest, wood-/ shrubland	37.128	4.871	Charcoal private use
Woodfuel private woodlots	6.639	0.363	Charcoal industry use
Woodfuel from public plantations	0.074	2.754	New housing construction
Peri-urban energy plantations	0.080	3.447	Housing replacement
Woodfuel area exclosure	1.642	0.457	Modern and non-residential construction
Woodfuel from waste	0.171	0.329	Furniture rural households
Unspecified sources	1.827	0.343	Furniture urban households
Roundwood private woodlots	5.030	0.135	Furniture commercial and public consumers
Roundwood public plantations	0.541	0.043	Utility poles
Net furniture imports	0.020	0.521	Paper consumption
Net roundwood imports	0.002		
Net sawnwood imports	0.044		
Net wood-based panels imports	0.044		
Pulp and paper imports	0.521		
Total	**123.907**	**123.907**	**Total**

2.5 Wood balance sub-sector analyses

2.5.1 Woodfuel sub-sector analysis

Woodfuel is the most important forest product consumed in Ethiopia, with a total volume of around 116 million m³ in 2013. The demand and supply patterns for woodfuel were thoroughly analyzed in the WBISPP in 2000. For the purpose of this Review, the WBISPP was used as a starting point to update the current demand and supply situation for the year 2013. Woodfuel is essential for household heating and cooking, including in urban areas. As Ethiopia's economy and population grows, woodfuel demand is expected to grow by roughly 40% by 2033, despite efforts to increase rural electrification and promote alternative sources of energy. This high, unsustainable, and growing level of woodfuel consumption exerts a high and growing pressure on forest resources and contributes to forest and land degradation, soil erosion and loss, water pollution, landslides and flooding. A number of ongoing programs aim to rehabilitate and revive the rural landscape to a more productive condition that contributes to people's livelihoods and to stabilization of the environment.

The main criterion for analyzing the woodfuel sub-sector is the extent of the existing forest resource base in 2013. There are no up-to-date reliable forest area estimates, and recent sources that refer to forest cover and deforestation rates vary significantly. For this Review, the authors have established forest and woodland areas as explained in section 2.2.2. In addition, the role of small-scale woodlots and trees on farms for woodfuel supply has significantly increased. Current areas are detailed in Table 9.

On the demand side, woodfuel consumption is driven by demographic and socio-economic factors. Population growth is the most important driver since fuelwood/charcoal makes up a certain amount of almost every Ethiopian's energy mix. Individual woodfuel consumption patterns are defined by access to woodfuel (e.g. rural vs. urban population), availably of alternative energy sources (other biomass, fossil fuels, and electricity) and the

Table 14: Adjustment parameters for per capita consumption of woodfuel

Parameter	Woodfuel savings
Savings due to electrical lighting per capita (a) Adoption rate: 100% in all electrified households	0.15 m³/a
Savings due to electrical cooking per capita (a) Adoption rate: 10% in electrified rural households; 20% in electrified urban households (b)	0.60 m³/a
Savings due to improved cooking stoves Adoption rate 40% (c)	4.18 m³/a

Source: based on WBISPP and other sources; (a) Calculated based on WBISPP; percentage of woodfuel used for lighting and mitad baking; (b) Gebreegziabher, Z. et al (2009); adoption rate of around 20% of electrical mitad in urban areas; due to less financial capacity, adoption rate was assumed by authors to be only 10% in rural areas; (c) according to CRGE estimates.

economic freedom to choose freely between energy sources. Since WBISPP information on consumption patterns is out-of-date as explained above, the WBISPP data from 2000 was adjusted for 2013 with the following parameters, as listed in Table 14.

For the 2033 projection, the following assumptions were considered:

- Electrification rate as described in section 2.2.1.
- Distribution of improved cooking stoves according to CRGE plans: 34 million between 2005 and 2030.
- Increasing share of urban population according to section 2.2.1.

The resulting average per capita woodfuel consumption in 2013 and 2033 is shown in Table 15 below:

Table 15: Average per capita woodfuel consumption in 2013 and 2033

Year	Consumption
2013	1.35 m³/a
2033	0.99 m³/a

Sources: calculation based on WBISPP regional population and regional woodfuel consumption patterns and adjustment parameters.

As highlighted in the sub-sector balance (Table 16), current woodfuel demand falls above the sustainable woodfuel yield potential. A volume of roughly 37 million m³ is covered by non-sustainable woodfuel extraction from natural forest.

Small-scale woodlots, community woodlots, and trees on farms have increasingly become important sources of fuelwood in rural areas. Based on WBISPP (2000), around 5% of the rural household fuelwood demand was covered from such sources. It is likely that this percentage has increased, especially in areas where supplying fuelwood from forests and woodlands has become increasingly difficult.[2] The total area of these woodlots was estimated to be around 705,000 ha in 2010 (Bekele 2011). These woodlots are managed under multi-purpose working cycles, providing fuelwood, small poles and utility poles. Of the total woodfuel demand, 6.6 million m³ is covered by woodlots (which represents around 57% of their total annual productivity of 11.7 million m³).[3]

According to Bekele (2011), there are 26,700 ha of peri-urban fuelwood plantations, primarily located around Addis. These plantations provided another 80,000 m³ in 2013. Public plantations have the potential to become important sources of woodfuel. In 2013, they officially produced 74,000 m³. If replanting and new plantation establishment increases, significant thinning volumes suitable for woodfuel production can be expected in the coming years.

[2] WBISPP indicated that the number of woredas that are consuming more than the sustainable supply of woody biomass amounts to 307 out of a total of 500 (just over 60 percent). Even within a specific woreda, there are Farmers Associations (the smallest administrative unit) that are in "surplus" while others are in "deficit."

[3] The figure of 6.6 million m³ was derived by subtracting the supply of construction poles (5.1 million m³) from woodlots from total woodlot production. Hence, it was assumed that the remaining 6.6 million m³ were used for woodfuel.

Table 16: Woodfuel sub-sector balance in 2013

Supply	In million m³ roundwood		Demand
Sustainable woodfuel forest, wood-/ shrubland	70.144	110.644	Fuelwood
Unsustainable woodfuel forest, wood-/ shrubland	37.128	4.871	Charcoal private use
Woodfuel private woodlots	6.639	0.363	Charcoal industry use
Woodfuel public plantations	0.074		
Peri-urban energy plantations	0.080		
Woodfuel area exclosure	1.642		
Woodfuel from waste	0.171		
Total	**115.878**	**115.878**	**Total**

Other woodfuel sources play only minor roles for the supply. Wood waste volumes from domestic industries (i.e. sawdust and chips) are not currently re-used for energy production. In some instances, offcuts are used as fuelwood or for charcoal production. Small poles that are dumped after being used for scaffolding and formwork in the construction sector are also recycled as woodfuel. The total waste volume currently used is estimated at about 171,000 m³.

Forest areas regenerated through exclosure are gaining increasing importance as a resource for woodfuel. Due to the severe level of degradation in these areas and their protection status, the baseline assumption is that 50% of the maximum theoretical MAI in woodlands (0.8 m³/ha/year) is extracted for woodfuel purposes. In 2013, total woodfuel extraction amounted to 1.6 million m³.

Figure 3 shows that roughly one third of woodfuel is sourced from unsustainable extraction in forests and woodlands. This indicates that the sustainable harvest needs to grow faster than demand in order to meet growing future needs. In addition to the need to establish more sustainable sources of woodfuel, a strategic option is also to reduce consumption in general through alternative energy sources and lifestyle changes with regards to cooking practices.

The wood flows in the woodfuel sector are characterized by two parallel systems, which interact to a certain extent: (1) natural resources based and (2) woodlot based flows.

Figure 4 below visualizes the volumes of wood flows (in m³ equivalents) in the sub-sector, demonstrating that the woodlots account only for 5.7% of the total volumes consumed. Significant volumes are supplied from natural forests and woodlands. It is important to note that woodfuel demand is growing at 1% per year, amounting to about 40 million m3 over 20 years.

Figure 3: Woodfuel supply and demand patterns

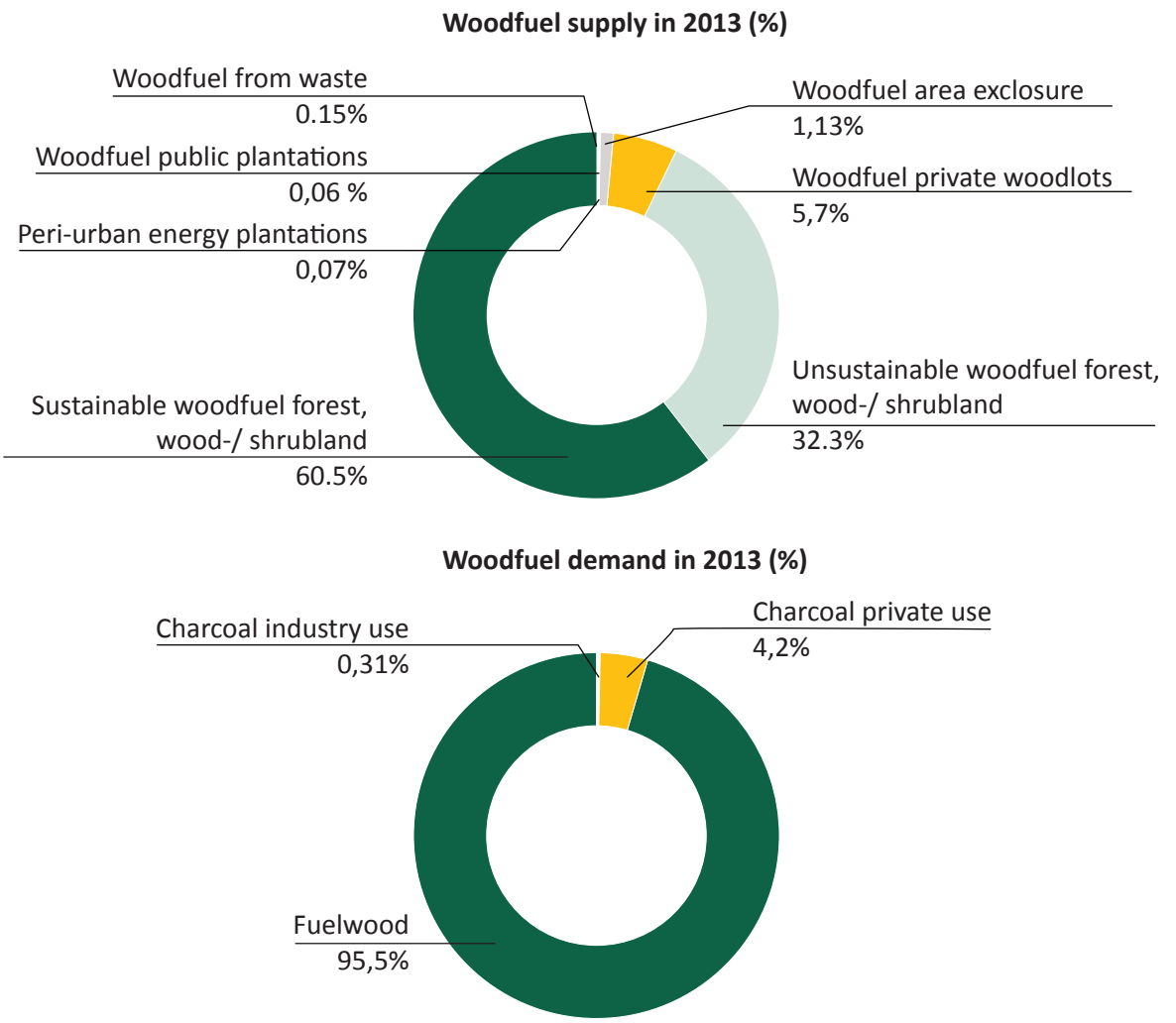
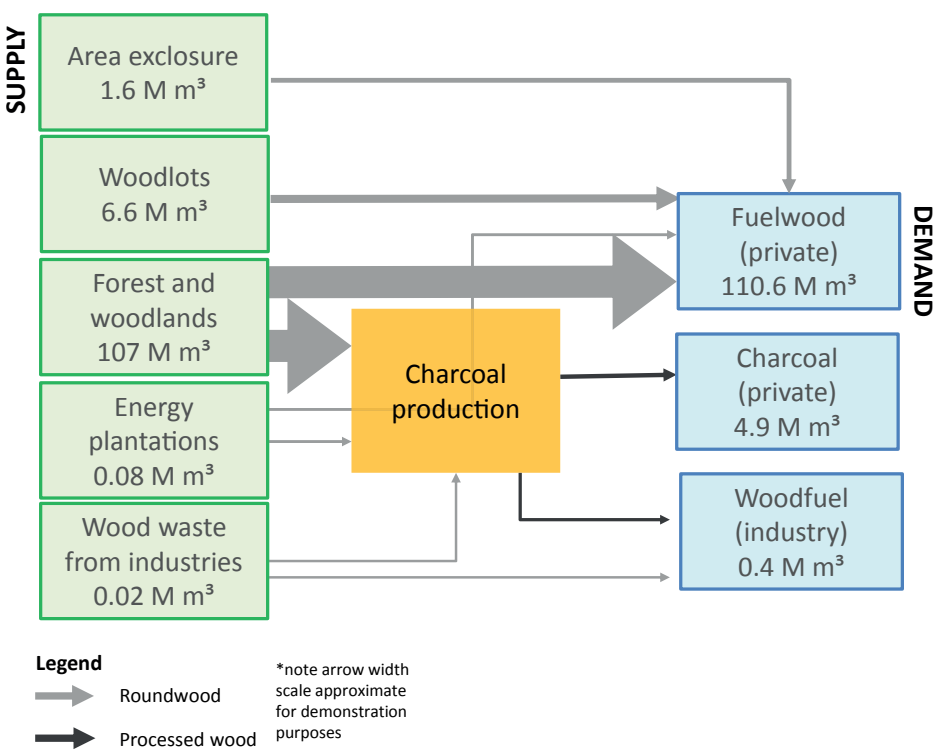


Figure 4:Wood flows in the woodfuel sub-sector



2.5.2 Construction sub-sector analysis

The construction sub-sector consumed around 6.7 million m³ in 2013. There are three main segments in this sub-sector: 1) the construction of new housing units for the growing population, 2) the replacement/modernization of old housing units, and 3) public and private sector infrastructure and commercial constructions for non-residential uses.

The Ethiopian housing sector is currently dominated by traditional construction types. The 2007 census (CSA, 2010b) estimated that 96.5% of the population lives in traditional building types, such as wood and mud constructions. Except in Addis Ababa, Harer, Dire Dawa, and a few other urban centers, most houses are built using traditional methods, with thatched or tin roofs. Only 3.5% live in houses made of hollow blocks or concrete. New housing units are constructed according to the proportions shown in Figure 5 (knowing that especially in Addis, replacement of housing with modern construction has been continuously enhanced).

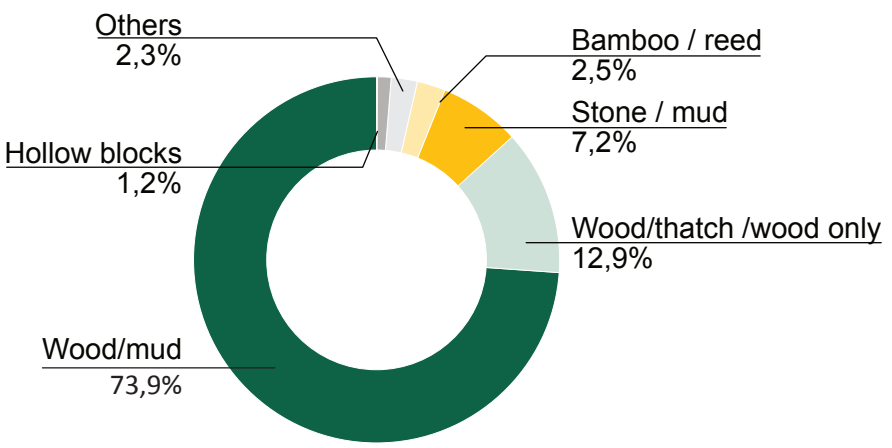
Traditional housing requires replacement after an average of 20 years. Thus, the 2007 housing type distribution was also applied for the population from the years 1973 (houses that were replaced in 1993 in a first cycle and replaced in 2013 in a second cycle) and 1993 (indicating the houses built in 1993 are to be replaced in 2013) (Figure 6), which gives the required total replacement figures for 2013.

In 2013, the population grew by 2.021 million. Assuming an average of five persons per household, there were an estimated 405,000 new housing units, of which 397,000 used structural timber in their designs (as indicated in figure below). Moreover, 490,000 housing units (276,000 housing units from 1993 and 214,000 housing units from 1973) were replaced (of which 442,000 houses included structural timber elements; as shown in Figure 6 below). For the projection of wood demand in the construction sector until 2033, the following assumptions apply:

- From 2013, 25% of new housing units in urban areas will be built using concrete and hollow blocks.
- Planning figures relating to the replacement of old, sub-standard housing units with modern construction designs (condominiums, etc.) were derived from the GTP and CRGE, indicating a replacement rate of 50,000 units annually.

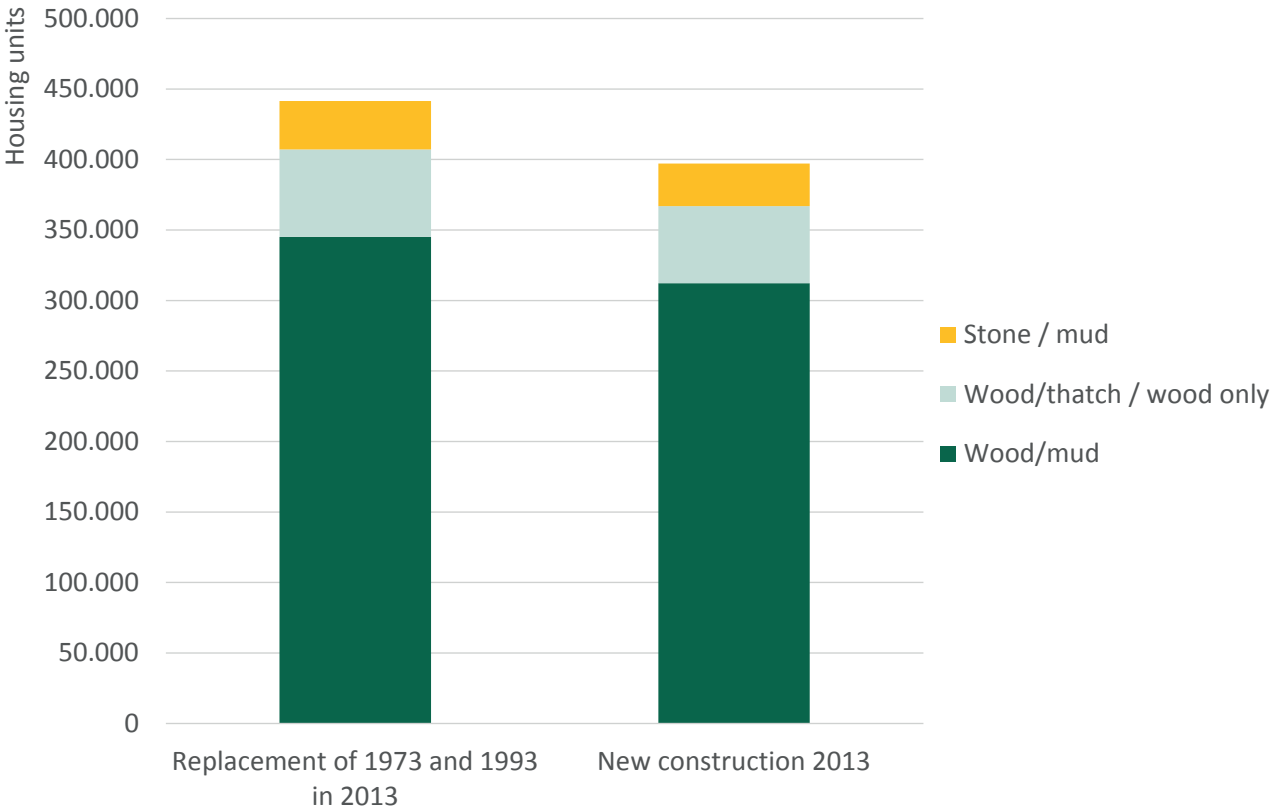
These assumptions suggest that the construction sector is tending toward reduced wood demand moving forward. However, there are tendencies that with increasing purchasing power and GDP, the average size of housing unit increases (resulting in an increase in wood products consumption).

Figure 5: Main housing construction designs in Ethiopia



Source: Census, 2007 (CSA, 2010b)

Figure 6: Houses with structural timber elements built and replaced in 2013



Source: Census 2007 (CSA, 2010b) and population data by CSA; assumption: average of five persons per household

The roundwood volumes consumed in traditional housing construction were estimated based on case studies undertaken by Hager & Duguma (2010) and Makhado et al (2009). These studies analyzed the average wood consumption in rural Ethiopian/ African construction. Table 17 below shows the average volumes derived from these studies and used for this Review.Total wood volume consumed in 2013 for new housing construction was 3.5 M m^3 and 2.8 M m^3 for replacement of old housing units (Figure 7).

Information on infrastructure and commercial construction activities was not available. Thus, national consumption volumes of wood-based panels (i.e. for formwork) and industrial sawnwood were used to estimate the consumption volumes of this segment, since such wood products are not used in traditional housing construction.

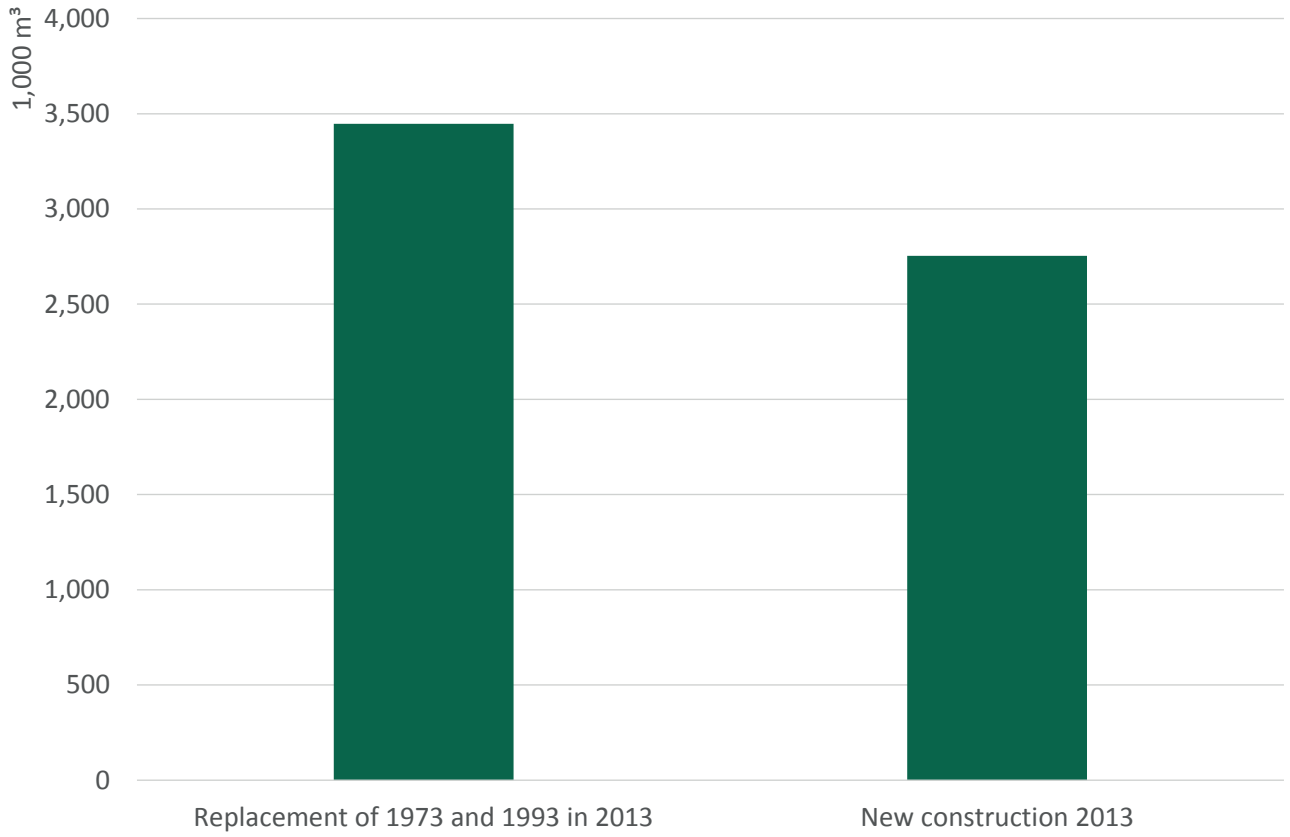
Modern construction requires different types of wood products as compared to those used for traditional construction. Main wood products used in modern construction are wood-based panels for interior work and for concrete formwork, quality lumber and poles for scaffolding and formwork support. Data for modern construction activities in Ethiopia is scarce. Based on the industrial input-output statistics and import data for the wood and furniture sector, it can be assumed that

Table 17: Average wood volume consumption in construction designs

Construction type	Average wood volumes consumed	Comments
Wood/mud	9 m^3	Due to iron roofs, more wood is needed for stabilization in roof and walls
Wood/thatch/wood only	3.5 m^3	Light construction type, less wood required
Stone/mud	1 m^3	Mainly for roof
Hollow blocks and others	3 m^3	For formwork, support poles, scaffolding

Sources: Hager & Duguma (2010) and Makhado et al (2009)

Figure 7: Wood volume consumed in new and replacement constructions in 2013



at least 457,000 m³ of such kinds of wood products are consumed.

The demand for small poles for scaffolding and formwork pins was estimated based on construction permits for multi-storey construction in Addis. Assuming that buildings with more than two storeys and less than ten storeys represent the majority of small pole demand, the total storeys constructed with support of small poles in 2011 (latest year for this statistic) was 2,000.

To obtain a proxy for the total small pole consumption in this segment, the following assumptions were made:

- Average storey height is 2.5 m
- Average construction area is 625 m² per floor (25 m x 25 m)
- Average consumption of scaffolding poles (10 cm diameter) is 25 running meters per 5 m² faced area
- Average number of poles per m² concrete floor is one.

Considering these assumptions, a total of 1.25 million m² floor and 0.5 million m² facade was constructed (buildings between two and ten storeys) in 2011. The total consumption of small poles (8 m length, 10 cm diameter) was around 600,000 with a volume of 37,000 m³.

The calculated wood consumption figures in modern construction are perceived as low, and it is assumed that real demand is significantly higher.

The supply of construction wood originates from four sources: 1) private woodlots, 2) public plantations, 3) imports and 4) natural forests and woodlands, further described below:

1. Private woodlots provide various products, mainly fuelwood and small poles for construction. As stated in section 2.5.1, around 6.6 million m³ of woodlot production is used for fuelwood. Thus, around 5 million m³ are available for use in the construction sector.
2. Plantation harvesting (including chipwood plantations) in 2013 amounted to 541,000 m³. This volume includes utility poles and wood products supplying furniture industries (see section 2.5.4). The construction sector consumed around 166,000 m³ in 2013, which was mainly sawnwood from domestic production.
3. Imports replace domestic production of logs, sawnwood and wood based panels, i.e. formwork

panels are imported. The volumes are comparably low (56,000 m^3).

4. Natural forest/woodlands: The construction sub-sector wood balance (Table 18) reveals a supply gap of around 1.4 million m^3 in volume for which no specific origin could be identified. Since public plantation production figures and import statistics are rather reliable, there are four possibilities for how this gap was closed in 2013: 1) the area of private woodlots and plantations has been underestimated, 2) construction wood is sourced (illegally) from natural forests and woodlands, 3) there are imports that have not been registered, or 4) the wood originates from PFM.[4]

Figure 8 shows that roughly one fifth of the wood products currently consumed in Ethiopia are sourced from unspecified sources, placing the forest resource at risk of irreversible degradation or complete conversion moving forward. Without a sustainable and dedicated source of supply, the construction sector will increasingly make use of less sustainable materials such as bricks or concrete. This represents lost opportunities in terms of green employment generation and domestic wood product value chain development.

Table 18: Construction sub-sector balance in 2013

Supply	In million m^3 roundwood		Demand
Roundwood woodlots (i.e. for traditional construction)	5.030	2.754	New housing construction
Roundwood plantations (for sawnwood and panels)	0.166	3.447	Housing replacement
Imports (panels and sawnwood)	0.056	0.457	Modern and non-residential construction
Unspecified sources of wood	1.405		
Total	**6.658**	**6.658**	**Total**

[4] This calculation is supported by expert estimates that up to 30% of the construction timber market is served with wood from natural forests.

Figure 8: Construction sub-sector supply and demand patterns

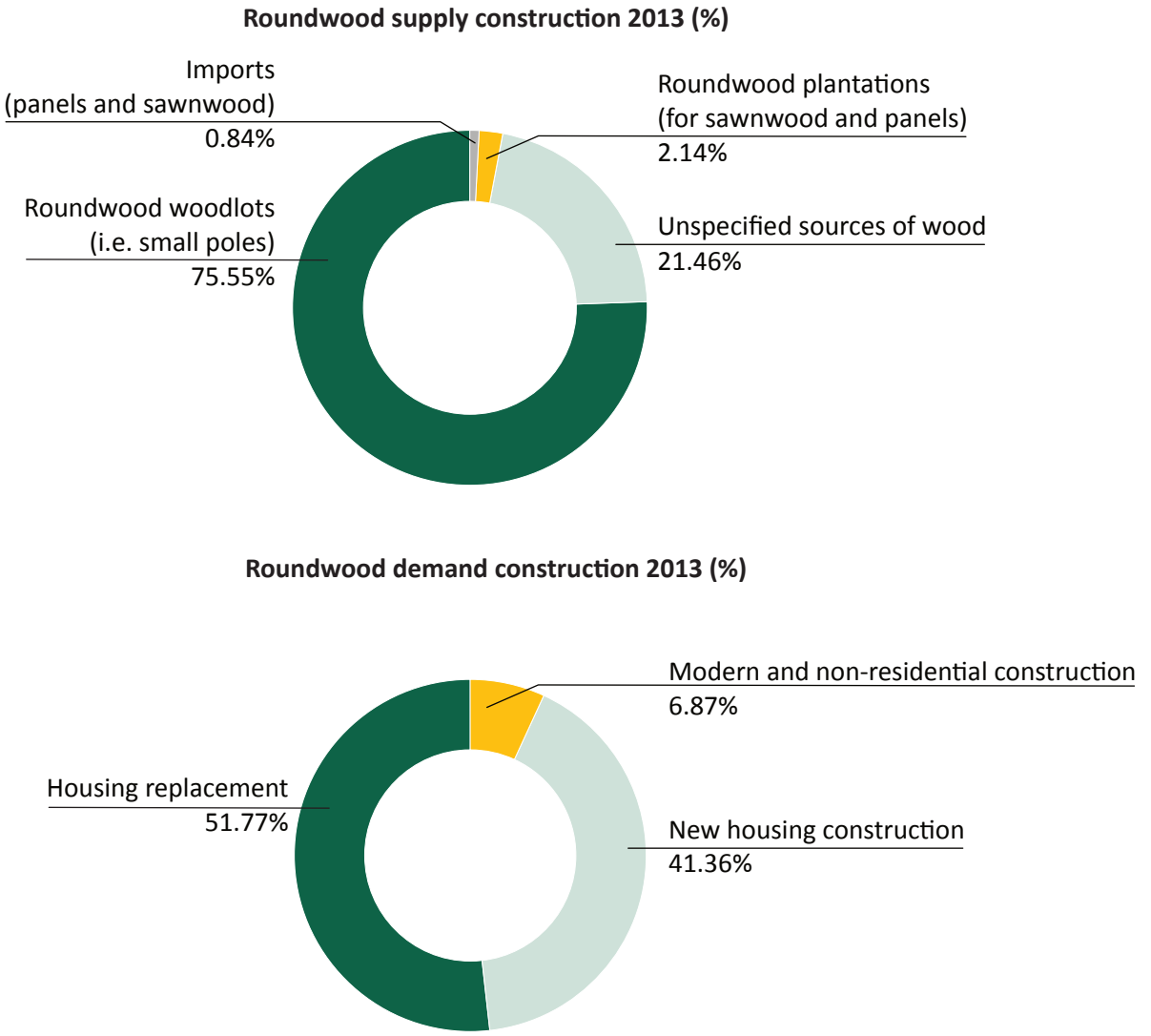


Figure 9:Wood flows in the construction sub-sector

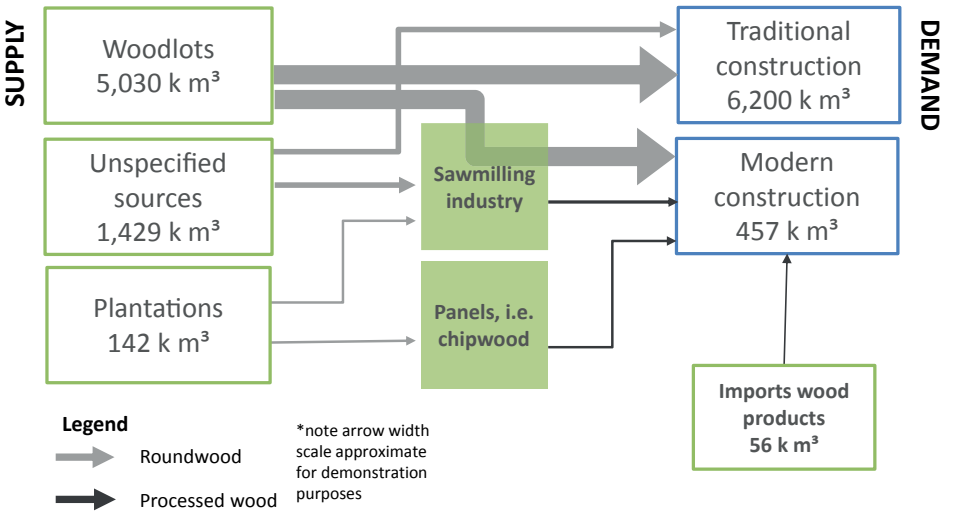


Figure 9:Wood flows in the construction sub-sector

The wood flows in the construction sector can generally be characterized into: (1) formal industrial wood flows and (2) informal small-scale wood flows. These categories interact and are sometimes not entirely distinguishable, as wood waste and raw materials from industrial plantations may enter informal supply chains.

Figure 9 visualizes the volumes of wood flows (in m^3 equivalents) in the sub-sector. The formal industrial flow accounts only for 2% of the total volumes consumed in the construction sub-sector. Significant volumes are supplied from private/community woodlots (i.e. small poles).

2.5.3 Furniture sub-sector analysis

The furniture sub-sector can be divided into three segments:

1. Furniture produced in rural areas by small carpentries or by households themselves.
2. Furniture produced industrially by medium and large companies. This furniture is sold to private consumers/middle class mainly in urban centers.
3. Furniture production for public procurement (schools and offices) and for large commercial buyers (hotels, businesses).

Demand for furniture is driven by population growth and household purchasing power. In 2013, the Ethiopian Industry Statistics registered an intake of 458,000 m^3 roundwood (in the form of panels, plunks and logs) by medium and large furniture producing industries. In addition, the furniture trade balance recorded a net import of 20,000 m^3 roundwood equivalents.

Since no figures are available for public furniture consumption (e.g. schools) or the commercial sector (e.g. for office furniture), it is assumed that 25% of large industry furniture production is for public procurement (equaling 114,500 m^3). The remaining production volume (75% or 343,500 m^3) of the large industry production is sold in urban centers.

Furniture consumption has replacement patterns similar to housing, with a replacement cycle of 20 years. Furniture consumption is also linked to purchasing power increases, reflected in the different consumption patterns of rural and urban households, with urban households using and replacing more furniture than rural households. Given that the urban population is growing faster than the rural population, the trend is towards more furniture consumed per capita.

The estimated average consumption of urban households (230,000 newly established and refur-nished households in 2013) was 1.5 m^3 per new urban household in 2013 (total of 343,000 m^3), and rural furniture demand was estimated at 329,000 m^3 (Table 19). This volume was calculated based on the furniture requirements of new and replaced rural households in 2013 (about 665,000 households) and an assumed demand of 0.5 m^3 new furniture required to equip each household. According to expert opinion, the raw material from this production is mainly sourced from natural forest and woodlands.

Table 19: Furniture sector consumption characteristics

Aspect	Urban structures	Rural structures
Production	Medium and large industries produce and commercialize in urban centers	Small and micro enterprises mainly produce in rural areas and small towns. Rural households partly build their furniture themselves
Consumption	Average furniture volume consumed per urban household is 1.5 m^3 (expert estimation)	Average furniture volume consumed per rural household is 0.5 m^3 (expert estimation)
Sources of supply	Intake of raw material of medium and large furniture producers mainly originates from public plantations and imports	Intake of raw material of small and micro furniture producers mainly originates from local resource forests and private woodlots

Table 20 below summarizes the supply and demand situation in the furniture sub-sector in 2013. An estimated volume of 421,000 m^3 originates from unspecified sources, which is most likely wood extraction from natural forests and woodlands. For the supply of wood for furniture consumption in rural households, woodlots could also be a source of raw material. However, this Review assumes that woodlots provide only woodfuel (see section 2.5.1) and small poles for the traditional and modern construction sector (see section 2.5.2).

Figure 10 indicates that the furniture sector obtains roughly half of its raw materials from unspecified sources. The unknown sources here are mainly illegal wood from forests and woodlands used for furniture in rural areas. The lack of dedicated and sustainable sources of raw materials makes it difficult to invest in wood processing for furniture. Thus, significant investment is needed to establish plantations. Moving forward, priority should be placed on producing affordable furniture for low-income classes and value chain development through small and medium enterprises.

Table 20: Furniture sub-sector balance in 2013

Supply	In thousand m^3 roundwood		Demand
Imports (furniture and pre-products)	54	329	Furniture rural households
Roundwood plantations (direct or as source for pre-products)	332	343	Furniture urban households
Unspecified sources of wood	421	135	Furniture commercial and public consumers
Total	**807**	**807**	**Total**

Figure 10: Furniture supply and demand patterns in 2013

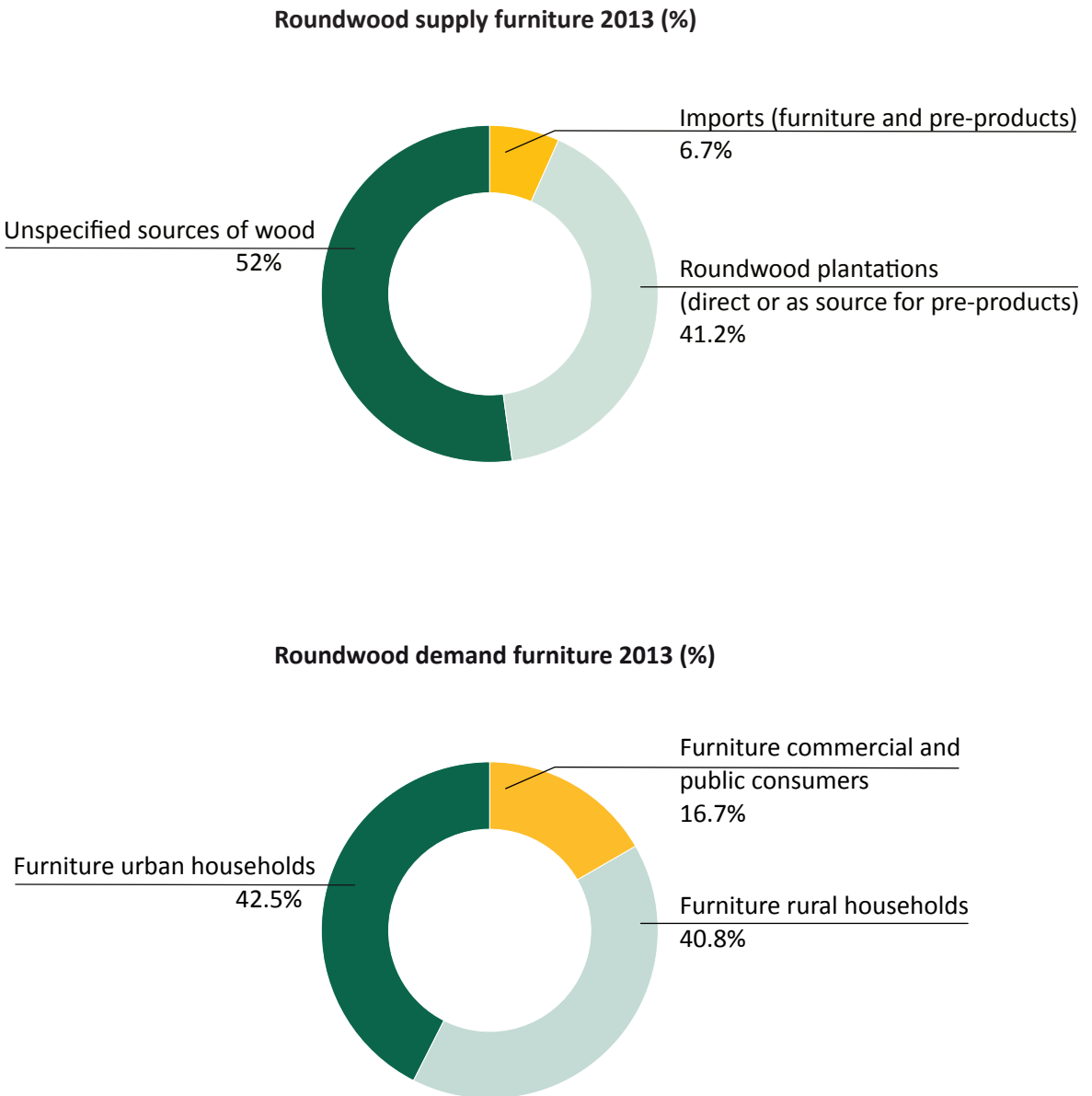
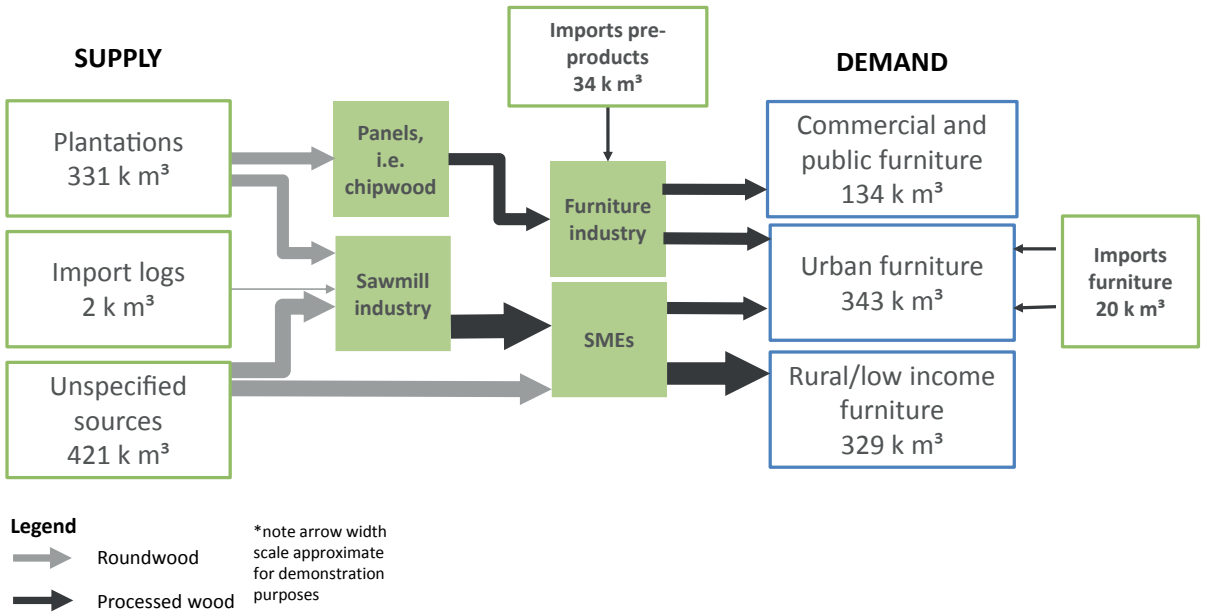


Figure 11: Wood flows in the furniture sub-sector



Note: Large furniture producers have partly integrated sawmilling activities and directly source logs from plantations and imports. For simplicity purposes, this direct log sourcing is not visualized.

The wood flows in the furniture sector are characterized by two parallel systems, which partly interact: (1) formal industrial wood flows and (2) informal small-scale wood flows.

Figure 11 visualizes the volumes of wood flows (in m^3 equivalents) in the sub-sector. The formal-industrial flow (plantations and imports) accounts for 48% of the total volumes consumed. Significant volumes are supplied from private/community woodlots (i.e. small poles).

2.5.4 Utility poles sub-sector analysis

According to official OFWE and Ethiopian Electric Power Corporation (EEPCO) figures, the production of utility poles in 2013 was roughly 65,000 poles, which equals around 43,000 m^3 (average pole volume of 0.66 m^3, corresponding to a pole of 10 m in length with a diameter of 29 cm). No significant pole imports were registered for 2013.

Utility poles are sourced predominately from public plantations. Pole treatment occurs in four pole treatment plants run by EEPCO and some smaller plants. In recent years, private woodlots have emerged as a source for utility poles, but reliable figures are not yet available. One source indicates around 5,000 m^3 stems from private woodlots but this has not been corroborated by other studies. Thus, this Review's SDA did not consider private woodlots as a source of utility poles. In the future, however, woodlots could expand their market share in this sub-sector. The decision of woodlot owners to produce utility poles versus small poles and fuelwood is a trade-off between longer production cycles of 8 to 10 years for utility poles against 4 to 5 year rotation for small poles and fuelwood and higher prices for utility poles (Table 21).

Table 21: Utility pole sub-sector balance in 2013

Supply	In thousand m^3 roundwood		Demand
Roundwood public plantations	43,000	43,000	Utility poles

For 2013, no supply gap could be identified based on the given information. However, as shown in chapter 3 (baseline scenario), due to significant demand increase to meet the planned electrification rate in Ethiopia, the supply gap will increase significantly. If the electrification targets (65% of population in 2033) are met, consumption will increase to 200,000 poles in 2015 and continuously increase to more than 700,000 poles in 2033. On average, this is 400,000 poles or 267,000 m³ per year (Figure 12).

Figure 13 visualizes the volumes of wood flows (in m³ equivalents) in the sub-sector. Moving forward, woodlots have the potential to play an increasingly important role in supplying pole demand.

Figure 12: Utility pole consumption projection in 2033

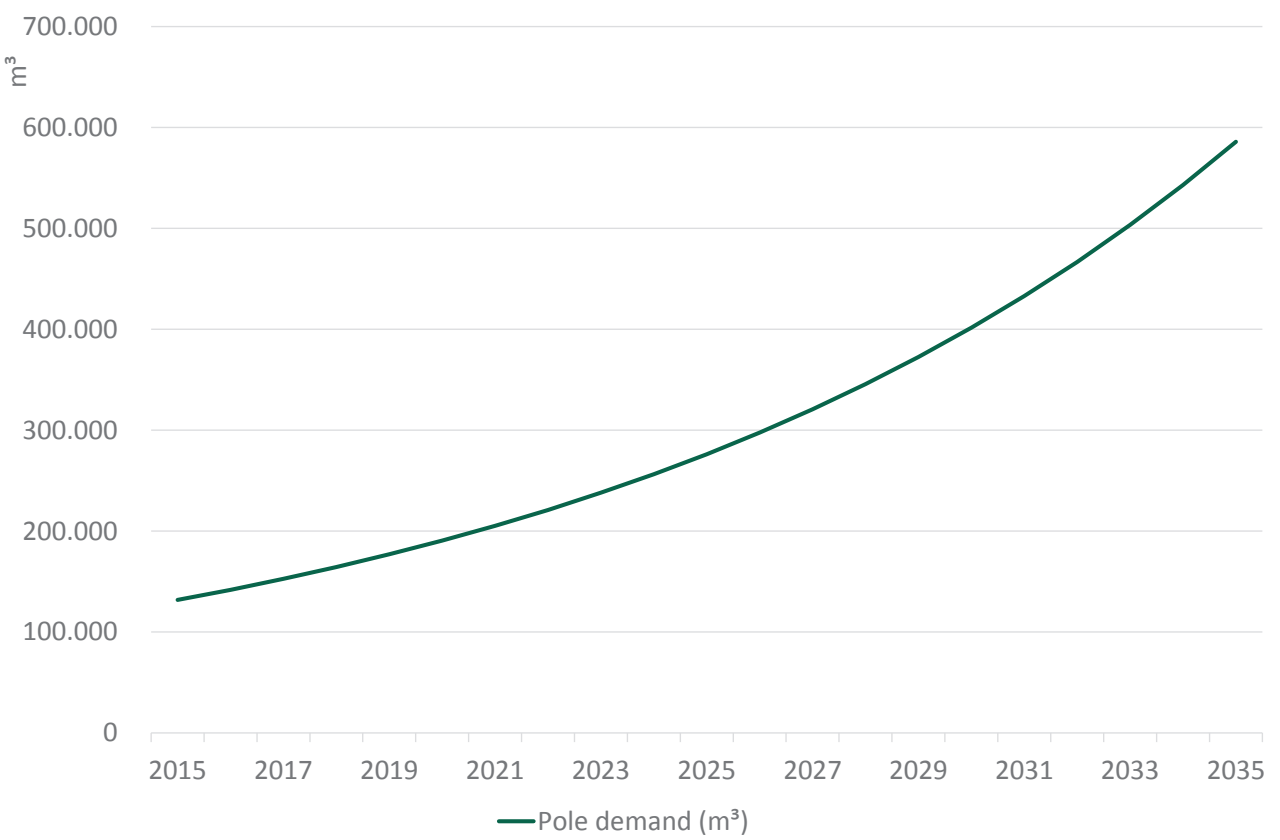
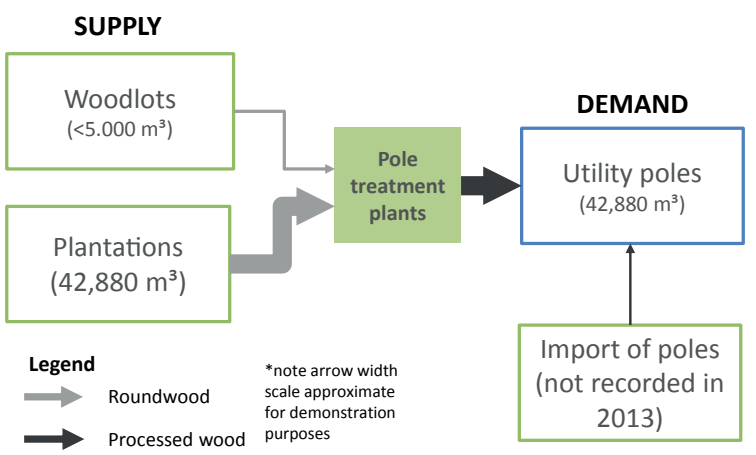


Figure 13: Wood flows in the utility pole sub-sector



2.5.5 Pulp and paper sub-sector analysis

In Ethiopia, more than 0.5 million m³ roundwood equivalents were consumed in the form of paper and newsprint in 2013 (Table 22). Around 0.3 million m³ of this was produced in Ethiopia. However, there is no significant domestic wood pulp production to feed this paper manufacturing. Paper production in Ethiopia is primarily based on recycled fiber. Only non-wood pulp production uses other fiber, producing roughly 29,000 m³ of pulp. Wood pulp for domestic paper and newsprint is imported; with around 40,000 m³ imported in 2013.

Although the pulp and paper sector is important in terms of employment and GDP contribution (see section 2.7), it is not integrated in the Ethiopian forest cluster and its value chains. Considering the projected growth figures in this sub-sector, investment in Ethiopia's forest resource base should be prioritized to supply growing demand from sustainable and domestic production, resulting in significant job creation. However, there is currently no wood pulp and paper industry in Ethiopia to address this growing demand based on domestic forest resources.

2.5.6 Wood products trade

The Ethiopian wood products trade balance has a total volume of 110,000 m³ imports versus 24,000 m³ exports (Figure 14). Main import products were sawnwood and wood-based panels, the major export product (representing almost the total export volume) was sawnwood. Figure 14 shows that imports are roughly six times greater than exports. The wood products currently imported are of relatively high value, and the amount spent on imports could be invested in domestic resources and processing.

In the Ethiopian wood products trade balance, sawnwood has been the only commodity exported in significant volumes over recent years (Figure 15). On the import side, furniture import volumes have increased, peaking at more than 80,000 m³ in 2012. Sawnwood and panel imports have decreased in the same period. Roundwood imports are not significant. The decline of furniture imports in 2013 can possibly be explained by the increase of domestic panel production, which serves as pre-product for the furniture industry.

Table 22: Pulp and paper sub-sector balance in 2013

Supply	in m³ roundwood		Demand
Pulp and paper imports	548,000	548,000	Paper consumption

Figure 14: Ethiopia current wood product trade balance

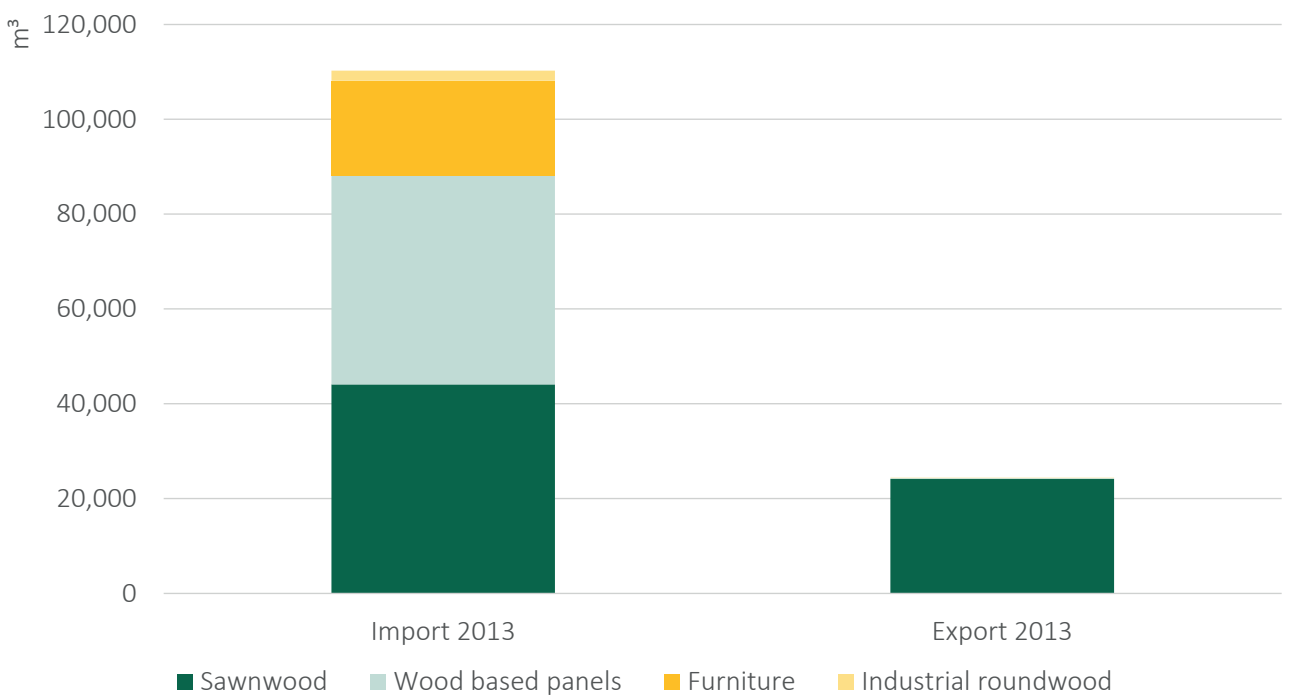
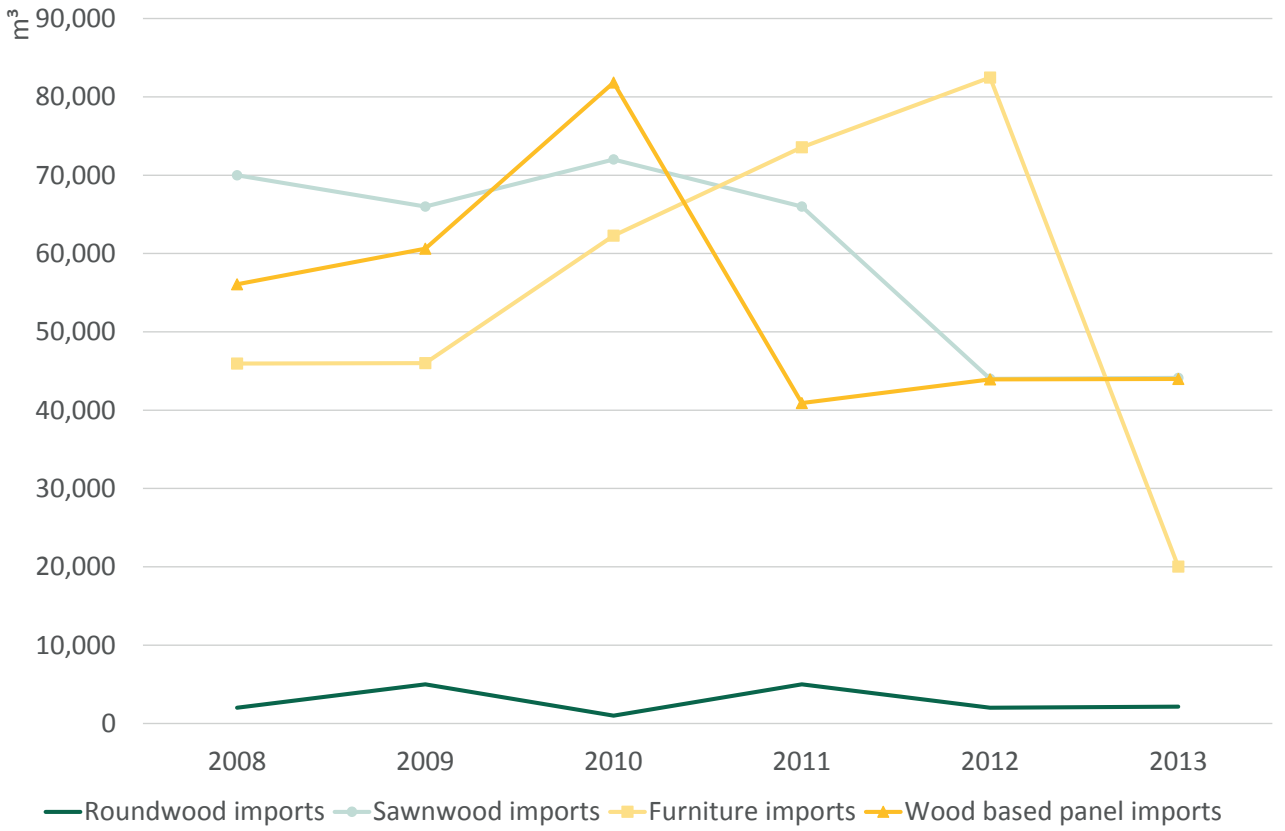


Figure 15: Recent trends in wood products imports



Source: FAO Forestry Stat (for sawnwood, roundwood, wood based panels); CSA for furniture

2.6 Forest industries

The total number of wood processing companies (both formal and informal) in Ethiopia is estimated at 6,200. The CSA industry survey (2012/13) lists 502 companies with more than ten employees (Table 23) in the forestry sector.

A review of wood sector small and medium enterprise (SME) case studies (IIED 2009, and CIFOR unpublished) in Ethiopia indicated that only 30% of the small-scale companies are registered. The Ethiopian Revenues Authority has 1,707 registered small-scale companies, implying that around 4,000 more companies exist. The employment structure for these industries is explained in detail in section 2.8.

Information regarding current intake and production capacity is presented in Table 24. While the intake of sawmills, panel production and furniture is real in terms of wood intake from Ethiopian or imported wood, the pulp and paper intake figure is not currently relevant for the forestry sector. Wood pulp is entirely imported and paper production in Ethiopia is based on non-wood / recycled fibers or direct imports of paper pre-products. Total intake of industries in 2013 was 7.2 million m³.

Table 23: Wood processing companies

Company type	No. in 2012/13
Wood industry (a)	89
Furniture (a)	394
Pulp and paper production (a)	19
Small-scale companies (registered; i.e. furniture) (b)	1,707
Small-scale companies (unregistered) (c)	3,983
Total	**6,192**

Sources: CSA industry survey 2012/13 (companies with more than 10 employees)
(a) Ethiopian Revenue Authority, 2014
(b) Based on IIED (2009) and CIFOR (unpubl.)

Table 24: Intake by wood processing companies

Company type	Intake of wood products in m³ roundwood (2012/13)
Wood industry; i.e. sawmills and particle board (a)	766,000
Furniture (a)	458,000
Small-scale companies (i.e. furniture) (b)	329,000
Pole treatment (b)	43,000
Small-scale companies (unregistered) (c)	3,983
Total	**6,192**

Sources: (a) Intake based on CSA industry survey 2012/13
(b) Intake based on sub-sector analysis section 2.5.1 ff.

Table 25: Sources and intake of wood in forest industries in 2013 (in m³)

Supply	in million m³		Demand
Construction roundwood woodlots	5.030	6.200	Traditional construction
Industrial roundwood plantations	0.541	0.457	Modern construction
Unspecified sources	1.827	0.478	Urban furniture/public/commercial
Imports	0.110	0.329	Rural furniture
		0.044	Utility poles
Total	**7.508**	**7.508**	**Total**

2.7 Forest sector contribution to GDP

In 2013, the forestry sector's total contribution to national GDP was 1% (including the informal sector but not including revenues from NTFPs such as honey, bamboo, gum and resin) and 5% (including woodfuel[5]), respectively. Detailed information on the calculations is presented in the following sections.

Roundwood production

Forest production (excluding woodfuel) contribution to the national economy was calculated for three roundwood sources:

1. **Production from public plantations:** The gross production value was calculated based on average log sale prices as stated by OFWE and AFE for 2013. These prices were applied for the total public plantation production in Ethiopia in 2013.
2. **Production from private woodlots:** Woodlot gross value added used the average market price for an average small pole volume.
3. **Production from unspecified sources:** Natural forest log production used average plantation log prices to calculate the market values.

Table 26 shows the gross production values of the three sources for roundwood in Ethiopia. Total gross production value amounts to USD 370 million. In the case of forestry production, the gross production value equals the gross value added.[6] Hence, the contribution to national GDP was 0.8 %.

Wood processing industry

The total gross production value of the large and medium wood processing sector has increased over the past years, amounting to USD 310 million in 2013 (Figure 16). This increase was mainly driven by the consumption of paper products and steady expansion of the furniture sector. On the other hand, gross value added (GVA) in the sub-sectors shows different patterns. In the wood sector and pulp and paper the GVA is declining, while in the furniture sector the value added is increasing (Fi-

[5] FAO data for 2006 indicates a contribution of 5.2% of the Ethiopian forestry sector to GDP.
[6] The assumption that in forestry, gross production value equals the gross value added is a simplification due to lack of detailed cost structure information of the producing actors. Theoretically, purchased products and materials and service providers should be subtracted from the gross production value to obtain the real gross value added.

Table 26: Gross production values for roundwood production

Plantations	Private woodlots	Unspecified sources (a)
Gross production value, logs: USD 74 /m³	Gross production value, small poles: USD 39 /m³	Gross production value, logs: USD 74 /m³
Gross production value, poles: USD 19 /m³		
Production logs: 473,847 m³	Production small poles: 5,029,998 m³	Production logs: 1,715,387 m³
Production utility poles: 42,880 m³		
Gross production value: USD 36 million	Gross production value: USD 65 million	Gross production value: USD 269 million

Note: Volumes from natural forests are computed as described in section 2.2.2

gure 17). Total sub-sector GVAs amounted to USD 70 million (0.15% of national GDP).

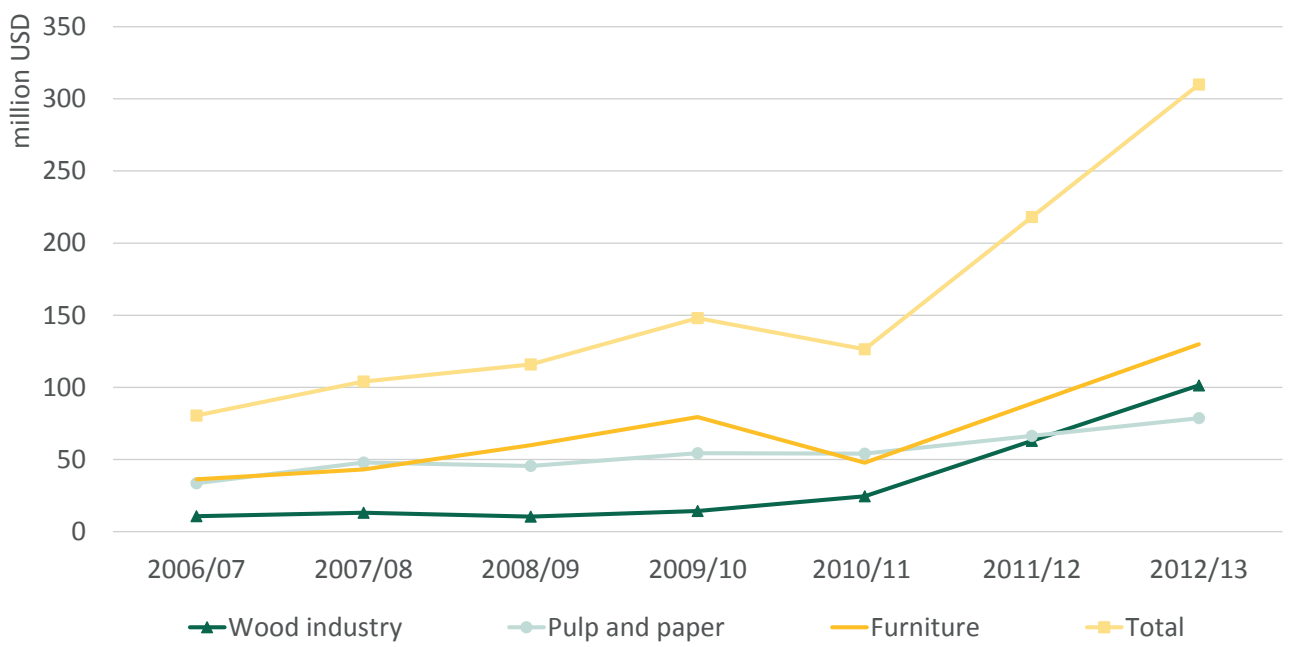
Interpreting these figures is difficult without detailed enterprise information. However, the following assumptions may explain these trends:

- Decreasing GVA is correlated to an increase in cost shares for the purchase of products and materials. In the wood sector, this refers to an increase in roundwood intake costs (logs and transport) and in the paper industry this refers to increasing prices for imported pre-products.
- Decreasing GVA may also be caused by decreasing efficiency in the production process due to old equipment, weak management and poor performance of labor.
- An increase in the furniture sector GVA can be explained by increasing shares of pre-products purchased from domestic sources (i.e. chipwood) instead of expensive import of pre-products. Also, increase in sales prices could be a driving factor.

Especially in the wood sector, the GVA / GVPratio (8% in 2013) reflects performance below good industry practice. In sawmilling and particle board production, the ratio should be between 20% and 30%. The furniture sector's ratio of 33% in 2013 reflects better performance indicators. (Figure 18).

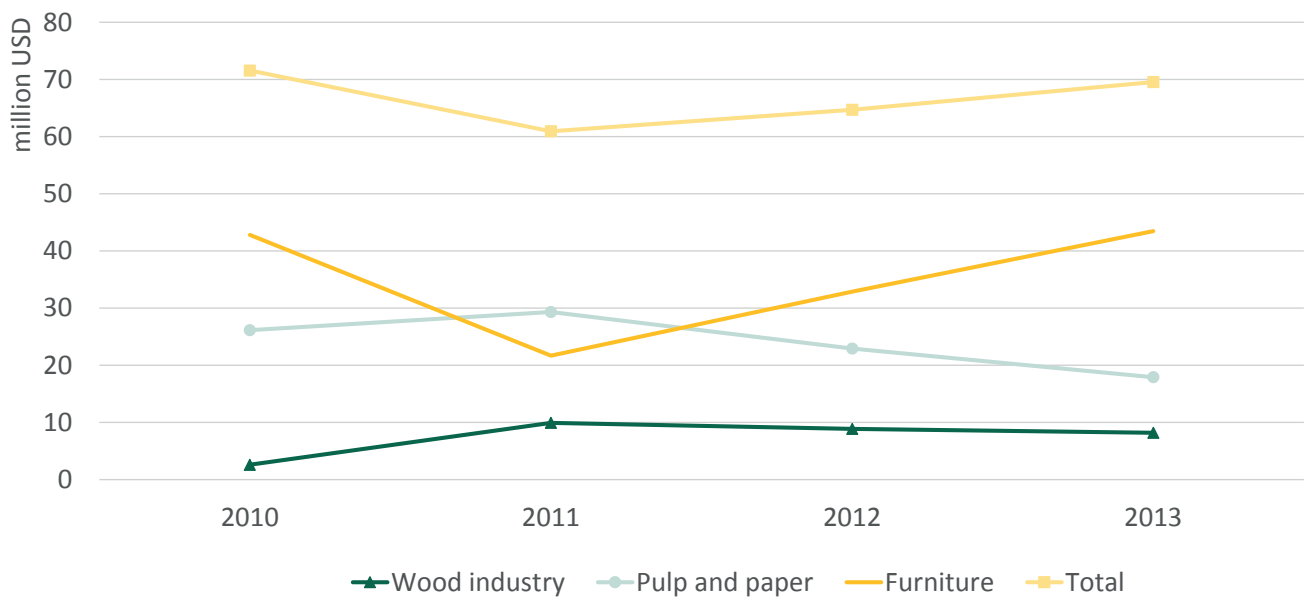
The comparison of the GPV and GVA factor per m³ intake in wood processing industries is shown in Table 27. Large-scale industrial furniture production has the highest GPV per m³ followed

Figure 16: Recent trends in wood processing sector gross production values



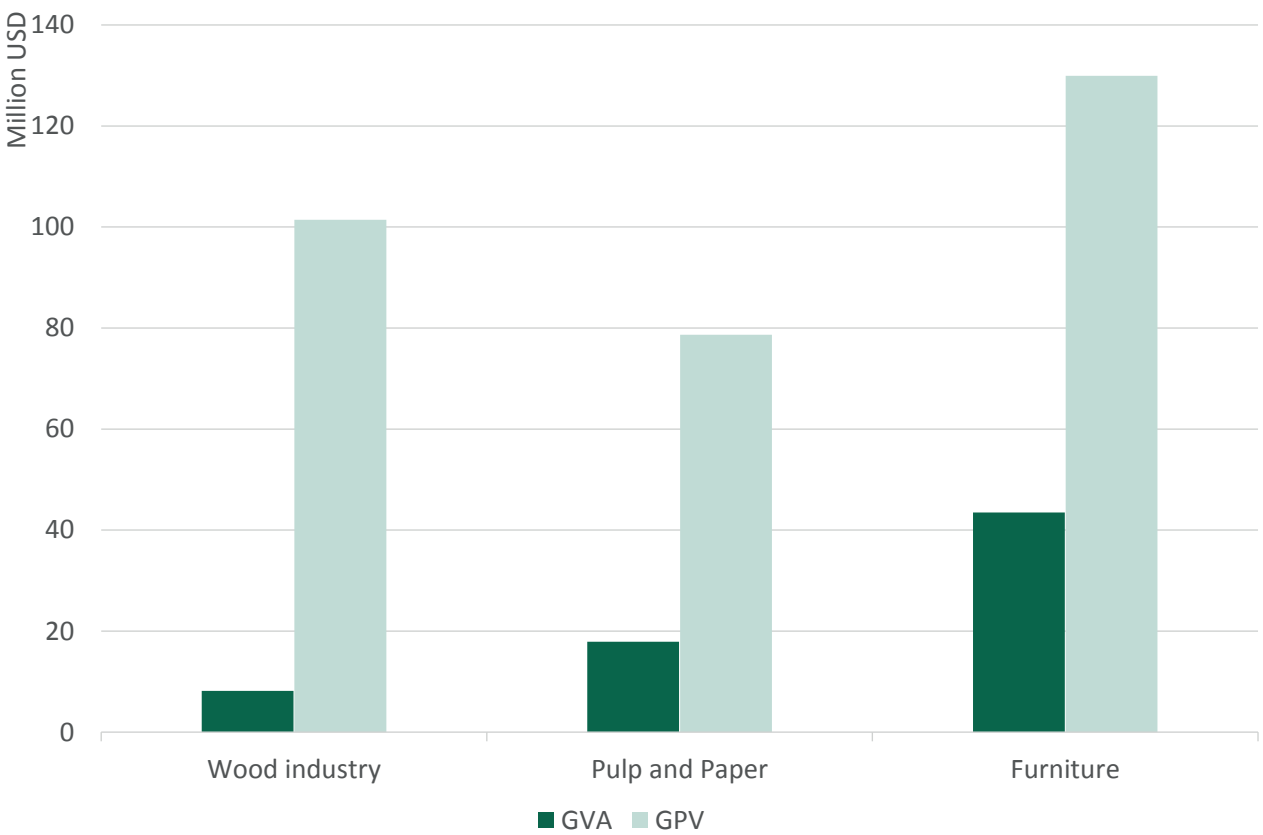
Source: CSA industry surveys; companies with more than 10 employees

Figure 17: Recent trends in wood processing sector gross values added



Source: CSA industry surveys; companies with more than 10 employees

Figure 18: Gross production value vs. Gross value added in 2013



Source: CSA industry survey 2013; companies with more than 10 employees

Table 27: Gross production factor per m³ intake

Company type	Intake 1,000 m³ (equivalents) (a)	Gross production value (million USD) (b)	Gross production value per m³ intake	Gross value added (million USD) (b)	Gross value added per m³ intake
Wood industry (saw-milling and panels)	779	101	130	8	11
Furniture industry	458	130	284	18	33
Pulp and paper	548	79	143	44	95
Registered and unregistered small companies	329	62	187	12	37

Sources: (a) Section 2.6, (b) CSA industry surveys for industry and section 2.6 for SMEs.

Table 28: Economic importance of woodfuel in 2013

Market value approach		Substitute value approach	
Fuelwood price (Birr/m³)	240	EEPCO tariff 2013/14 for households consumption range to 500 kwh (Birr/kwh)	0.55
Charcoal price (Birr/m³)	1,840		
Fuelwood consumed (million m³)	110.6	Energy content (GWh) (1 m³ air dry = 2,200 kwh)	254,133
Charcoal consumed (million m³)	5.2		
		Electricity content (GWh) (25% of energy content)	63,533
Value woodfuel (million Birr)	35,518	Value of woodfuel electricity equivalents (million Birr)	34.943
Total in million USD	**1,869**	**Total in million USD**	**1,839**

Sources: EEPCO (2014) for energy tariff; other data derived from FSR; USD exchange rate 2013 1:19

by pulp and paper. The gross production value of the almost 4,000 small enterprises was calculated based on 66% of the gross production value per m³ for furniture (equivalent to USD 187/m³) due to lower purchasing power in rural areas, where these companies are located. The total contribution of SMEs to GDP was calculated at 0.03%.

Woodfuel

Although the mobilized volumes are significant, no official GDP contribution data for woodfuel is available. To estimate the significance of woodfuel in the Ethiopian economy, two calculation approaches were applied:

1. Calculation of the economic market volume of woodfuel based on market prices for fuelwood and charcoal, combined with estimated volumes harvested.
2. Calculation of the substitution value of woodfuel, using the price of electrical power per kilowatt hour (kWh) of the actual household tariff charged by EEPCO.

Table 28 presents the results of the two calculation approaches, showing that they produce similar figures of around USD 1.8 billion. This corresponds to 4% of the GDP in 2011.

2.8 Forest sector employment

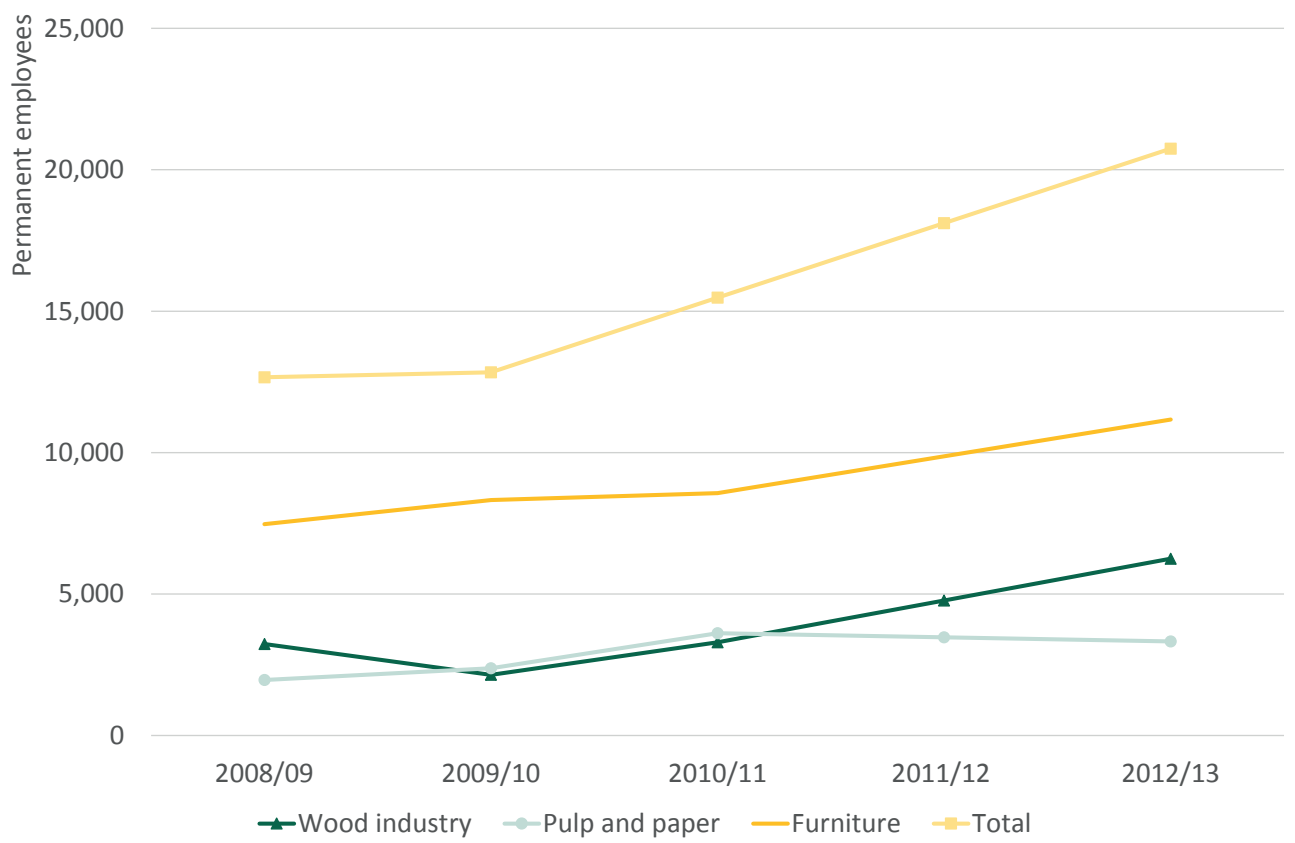
Employment figures for the forestry sector have been obtained from (1) official sources (FAO statistics and CSA industry survey data) and (2) from case studies and literature. The gathered data comprises employment in roundwood production and processing. For small business, only case studies were available. All estimates are converted to full-time equivalents (FTE), meaning that the figures underestimate the full impact as many part-time and seasonal jobs are created. The analysis of employment benefits focuses on formal job creation and does not consider livelihood activities, such as NTFP collection. Figure 19 below shows that employment in medium and large wood industry is steadily growing, creating a significant number of green jobs for Ethiopians, especially in rural areas. The average number of employees in SMEs is five. Thus, an estimated 31,000 persons work in the formal and informal SME furniture sector.

No comprehensive employment data was found for the woodfuel sub-sector. Bekele (2011) reported 276,300 jobs in this sub-sector, but did not distinguish between full-time or part-time employment.

The employment effects of public plantations have been calculated based on primary data from OFWE combined with employment requirement assumptions from similar public plantations. The number of employees in plantations clearly depends on planting and harvesting operations. Since these activities are not currently realized to the full extent, the employment potential is not fully exploited. Table 29 summarizes the results of the data survey, indicating the respective sources and corrections/adjustments.

Based on the roundwood processing figures in section 2.6, an average of 13 FTE employment is created per 1,000 m³ processed in medium and large enterprises (wood industry and furniture), se Table 30.

Figure 19: Medium and large wood industry employment



Sources: EEPCO (2014) for energy tariff; other data derived from FSR; USD exchange rate 2013 1:19

Table 29: Employment in wood production and processing

Industrial sector	No. companies 2013	No. persons employed 2013
Public plantations permanent (a)	-	5,200
Public plantations temporary (a)	-	10,500
Wood industry > 10 employees (b)	89	6,300
Furniture > 10 employees (b)	394	11,200
Pulp and paper > 10 employees (b)	19	3,300
Wood-based SMEs (registered) (c)	1,707	10,200
Wood-based SMEs (unregistered) (d)	3,983	19,900
Private woodlots (e)	-	n.a.
Total	**6,192**	**66,600**

Sources: All figures except for woodfuel are full-time employment equivalents (FTEs)

(a) Primary data from OFWE Arsi branch indicates 0.05 direct full-time employee per ha. This information could be verified with similar data from South African plantations. The OFWE Arsi primary data indicated 0.1 temporary employee per ha/yr. This figure could be verified by OFWE work norm, which indicates of workload of around 500 to 550 man days for establishing, maintaining, pruning and thinning one ha planation. Assuming 250 work days per year and an average rotation of 20 years, this results in 0.1 employee per ha/yr.

Bekele (2011) calculated that around 50 temporary employees are generated for each ha in the year of establishment.

The figures were applied for a total area of 105,000 ha public plantations in Ethiopia (OFWE, AFE and chipwood plantations in Tigray).

(b) CSA industry survey 2006/07 to 2012/13; companies > 10 employees

(c) Ethiopian Revenue Authority; registered small wood processing enterprise (average no. employees: 6)

(d) IIED (2009): Small and medium forest enterprises in Ethiopia: only 30% of companies are registered. Thus, the data for small enterprises (c) was up-scaled. The average number of employees for these enterprises was estimated at 3.

(e) Data based on Bekele (2011) for the year 2009. No update available; unclear if full-time.

Table 30: Industry employment creation factor per 1,000 m^3 intake

Company type	Intake 1,000 m^3	Employees	Employment per 1,000 m^3 intake
Wood industry (sawmilling and panels)	775	6,250	8
Furniture	550	11,950	20
Pulp and paper	550	3,300	6
SMEs	5,690	22,200	55

Note: Pulp and paper is import based. Thus this figure only reflects the potential that a domestic processing industry has to contribute to employment.

2.9 Non-timber forest products

Non-timber forest products (NTFPs) play an important role in the Ethiopian national economy and rural livelihoods. There is growing demand for NTFPs such as forest coffee, honey and gum and resin on national and international markets. Table 31 presents the main NTFPs obtained from Ethiopia's forests and woodlands. The main commercial NTFPs in Ethiopia are forest coffee, honey, bees wax, spices, bamboo, herbal medicines, gums and resins. This section synthesizes data and information available from secondary sources on the main NTFPs and provides an overview of their economic importance in the context of this Forest Sector Review. This complements the wood product analysis above. The gross monitory value is obtained by multiplying the average annual production of each NTFP by their current price per unit on the domestic market.

NTFPs provide important income streams for rural households (Lemenih 2011 and references therein). The annual incomes of farm households that combine NTFPs and farming are higher than those practicing farming only. Table 32 presents a case from southwestern Ethiopia that demonstrates this reality.

2.9.1 Commercial honey production

Ethiopia is the largest African honey-producing country with an estimated production potential of 500,000 tons honey per year. Recent production amounted to 53,675 tons of honey per year, only 10% of the estimated potential. Ethiopia has about 10 million bee colonies and over 800 identified honey-source plants.

In the past, honey production was exclusively traditional. But this trend is now changing with the introduction of modern and transitional hives. This emerging trend has contributed to an increase in honey production. Table 33 below shows the growth rates of beehives and honey production in Ethiopia since 1996.

Table 31: Main NTFPs from Ethiopia's forests and woodlands

Type of NTFP	Remark
Forest coffee	Forest coffee and honey have the highest potential and economic viability;
Honey	
Bees wax	Woodfuel is treated separately in this report because of its national significance.
Spices	
Wild food	
Traditional pharmaceutical products	
Gum and incense	
Bamboo	
Fodder	
Woodfuel (firewood and charcoal)	
Farm implements, climbers	
Spices	

Table 32: Livelihood activities and annual income (ETB/year)

Activities[1]	No. households	Percentage	Mean revenues (ETB2/year)
Farming and forest coffee plus honey production	6	4	3,614
Forest coffee production	32	22	2,700
Farming and forest coffee production	5	4	2,700
Honey production	7	5	2,224
Farming combined with production of forest coffee, honey, spices and bamboo	10	7	1,489
Farming and honey production	15	10	1,444
Farming	70	48	1,317

(1) The categories of activities indicate the respondents' town description of their major occupation. The categorization does not preclude households being engaged in minor additional activities.
(2) ETB = Ethiopian Birr, in the year of research the exchange rate was approximately USD1 = 8.5 ETB.

Source: Chilalo M., Wiersum K. (2011)

Table 33: Number of hives and volume of honey production in Ethiopia

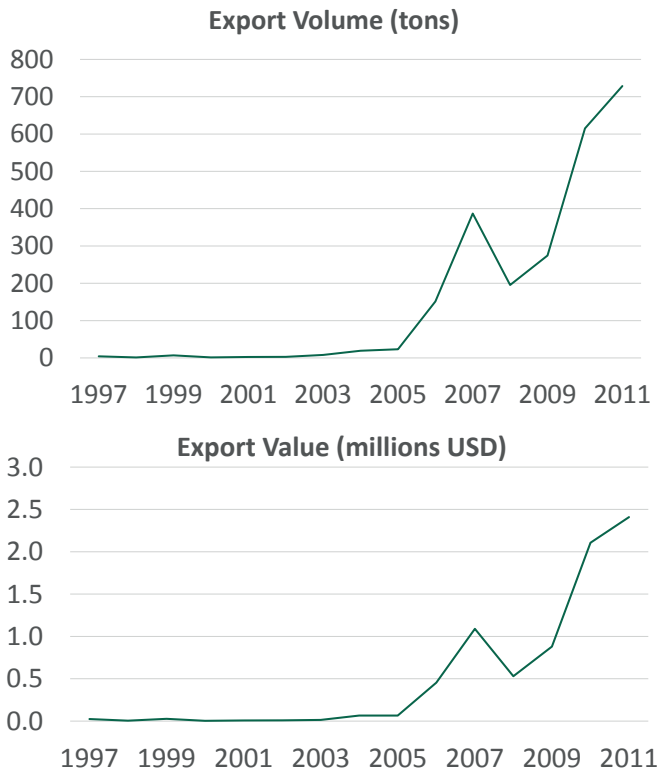
Year	Honey		(Wax tons)
	Beehive ('000)	Honey Production (tons)	Average of 9% of honey yield)
1996/97	3358	13,569	1221
1997/98	3181	12,075	1087
1998/99	3389	13,073	1177
1999/00	3220	11,165	1005
2000/01	3309	11,940	1075
2001/02	4602	17,098	1539
2002/03	4289	18,075	1627
2003/04	4229	25,186	2267
2004/05	4,546	30,382	2734
2005/06	4,013	41,579	3742
2006/07	4,871	51,174	4606
2007/08	4,688	n.a.	n.a.
2008/09	5,146	42,180	3796
2009/10	4,598	41,525	3737
2010/11	5,130	53,675	4831
Average		27,335	2460

Source: CSA (2012a for hives and honey); Wax is calculated based on honey to wax ratio following Legesse (2014).

Figure 20: Ethiopian Honey Export and its value

Year	"Quantity (in tons)"	"Value (in USD)"
1997	4.4	24,731.66
1998	1.3	5,004.24
1999	6.9	27,224.51
2000	1.5	3,417.54
2001	2.7	7,638.24
2002	3.0	9,155.99
2003	8.0	14,268.10
2004	19.2	65,966.26
2005	23.2	66,071.89
2006	151.2	454,515.84
2007	386.9	1,090,496.56
2008	195.6	530,241.79
2009	274.4	880,194.75
2010	615.2	2,106,453.43
2011	728.6	2,409,375.46

Source: Tigray Investment Promotion Office (2013)



The average annual growth rate of the beehives was 3.9% and about 13% for honey production between 1996 and 2011, with a general steady growth over the last 16 years. Honey prices are increasing from roughly ETB 10 to ETB 60 per kg at farm gate. In Addis Ababa, the price of one kg of purified honey is ETB 120. Taking the average price of ETB 80 per kg, and the average annual production indicated in Table 33, the annual monitory value of honey production in Ethiopia amounts to ETB 2.2 Billion. This is without accounting for the increased price from export (Figure 20). Therefore, this figure underestimates the full value of Ethiopian honey production. Export of Ethiopian honey is growing. In the past, honey produced in the country was exclusively used domestically as table honey and for brewing a traditional wine-like beverage called "Tej".

In 2010, China was the world's leading honey producer and Ethiopia was in seventh place. The major export destination of Ethiopian honey is Sudan with a 76% share. The exported volumes had a value of roughly USD 2.5 million in 2011. Mead (Tej) production uses 80% of the total marketable honey at country level; the remainder is consumed as table honey or exported. In fact, the honey price at the domestic market is mostly higher than the international honey price which makes honey export less profitable in Ethiopia (Assefa 2011). Consequently, many companies that attempt to export honey ultimately drop out of the international honey trade and begin targeting the local markets which are still attractive (Legesse 2014).

Another commercial product from bee keeping is bees wax. It was difficult to obtain a complete dataset for beeswax produced in Ethiopia. However, studies show wax yield is always 8-10% of honey yield (Legesse 2014).The bees wax data shown in Table 33 is estimated taking 9% as the average. Several sources also indicate an average annual production of ca. 3,000 tons of wax in the country. Wax has been used domestically for making church candles and has also served as an export commodity. MoANR estimates a volume of around 3,500 tons of beeswax production annually. The market price for wax is slightly lower than that for honey but is more or less comparable. Taking 3,000 tons as the average annual production and ETB 50 as the average price over the years, the economic contribution of bees wax is valued at ETB 15 million annually. Thus, the total annual monetary value of the apiculture industry (honey and wax combined) is estimated at ETB 2.35 billion.

2.9.2 Commercial production of gums and resins

Ethiopia's vast dryland areas are endowed with diverse plant species of high commercial value. Ethiopia dryland biomes are particularly rich in species of the genera Acacia, Boswellia, Commiphora, known for their production of important gums and incense such as gum arabic, frankincense and myrrh. These products are used in various applications from local to multi-billion dollar industries. Ethiopia is among the major producing countries of these products. Gum and resin producing species grow on an area of between 2,855,000 and 4,355,000 hectares. Gums and resins from Ethiopia's drylands are differentiated into aromatic gums/resins and non-aromatic gums/resins as shown in Table 34 below.

Table 35 identifies the estimated annual production potential of three different products. In comparison, the estimated area on which the products grow is provided.

The potential production of three different species of gum and incense trees in Ethiopia is estimated at 70,661 tons. Gum-resins produced in the country are mainly exported. While gum arabic is exported almost exclusively, certain amounts of frankincense are consumed domestically either in religious rituals or for household fumigation. The quantities of gums and resins exported from Ethiopia are summarized in Table 36. The average annual export is about 3,584 tons. There are over forty destinations for Ethiopia's gum-resin products. The most important export destinations are the United Arab Emirates with 18.39 %, Germany with 14.43 %, Tunisia with 13.45 %, China with 9.43 % and Greece with 9.43 %. The bulk (ca. 95%) of the traded gum-resin involves gum olibanum, principally the Tigray type olibanum.

Table 34: Commercial gums and resins

Category	Common name	Botanical source
Aromatic gums/resins	Frankincense/Gum olibanum	*Boswellia papyrifera, B. neglecta, B. rivae, B. microphylla, B. ogadensis*
	True myrrh	*Commiphora myrrha*
	Opoponax	*C. guidotti*
	Hagar	*C. erythraea/C. africana/others*
Non-aromatic gums/resins (gum arabic)	True arabic gum	*Acacia senegal*
		A. seyal

Source: Source: Lemenih and Kassa (2011)

Table 35: Estimated potential and annual production of gum and incense in Ethiopia

Type of product	Estimated area (ha) a)	Estimated annual production (tons) b)
Gum olibanum	2.284,000	*57,100*
Gum arabic	399,700	*4,996*
Gum commiphora	171,300	*8,565*
Total	2.855,000	*70,661*

Source: a) Fitwi 2000; b) Calculated based on 50 trees per ha and yields of 0.5; 0.25 and 1 kg per tree for gum olibanum, gum arabic and gum Commiphora, respectively, as well as the share calculated from 10-year production data for each type in Lemenih and Kassa (2011).

Table 36: Ethiopia's gums and resins exports (2003–2014)

Production year	Quantity (tons)	Value (1,000 USD)
2003	1,544	2,200
2004	3,109	4,369
2005	3,791	4,960
2006	3,529	5,363
2007	3,976	5,650
2008	4,612	6,918
2009	3,563	9,675
2010	4,374	12,686
2011	4,417	12,750
2012	3,504	11,758
2013	3,145	10,825
2014	3,442	12,151
Average	3,584	8,275

Source: Lemenih, M., & Kassa, H. (2014a).

Taking the export value alone, ETB 165,508,000, revenue from gum and resin covers about 0.54 – 0.73% of Ethiopia's export revenues. Ethiopia has 28% of Africa's export trade volume of these products. The estimated potential volume of Ethiopia's natural gums and resins is 70,650 tons. In comparison, the leading exporter of natural gums and resins (except for gum arabic) exported a volume of 21,962 tons in 2005. This demonstrates the huge Ethiopian potential in this sector.

Forest coffee

Ethiopia is recognized as the birthplace of coffee — the world's most traded tropical agricultural commodity. The country is famous for its Arabica coffee beans, a highly regarded and lucrative coffee type. The plant is native to the forests of southeastern and southwestern Ethiopia. The coffee sector contributes significantly to local and national economies and generates considerable employment. Coffee trade contributes 10% to the national GDP and the export of coffee generates a significant volume of foreign trade, accounting in peak years for up to 70% of Ethiopia's foreign exchange earnings (Petty et al. 2004). The coffee sector provides a viable livelihood for roughly 15 million smallholder farmers[7] (ca. 17% of Ethiopian households) who are responsible for growing and picking the coffee beans. In addition, several hundred thousand workers are engaged in harvesting, processing (red cherry or dried pulp coffee in washing stations and hulling mills around the country) and transportation to local markets or for export. Coffee is therefore a vital component of Ethiopia's economy and the source of livelihood for many rural communities.

Approximately 45% of Ethiopia's annual coffee production comes from self-grown wild coffee in the Afromontane rainforests (Workaffess and Kassu, 2000). Local production of forest coffee is considered a valuable natural and organic product. In addition, Ethiopia's stock of forest coffee is a vital pool of biodiversity for the Arabica species (Hein & Gatzweiler 2006). The total yield of coffee attributed to the forestry sector is presented in Table 37 below.

The direct monetary value of forest coffee, taking the average price from the last five years at Addis Ababa based on CSA retail price statistics, is about ETB 75 per kg, with a total value of ETB 11.6 billion. Forest coffee also has indirect value, which is the genetic conservation value. Hein and Gatzweiler (2005) estimated the indirect economic value of wild coffee to amount to between USD 420 and 1,458 million (equivalent to ETB 8.4-29.2 billion).

Traditional health care (traditional medicines)

In Ethiopia, a considerable proportion of the population depends on the traditional health care system. Raw materials for this system are sourced from forests and wildlife, and comprise both herbs/plants and animals. Nearly 85% of the total population is assumed to depend on this form of health care system (WHO, 1998; Zewdu and Demissie, 2001). So far, about 1,000 species of indigenous plants, most of which are wild plants, have been recorded as having herbal medicinal applications. The richness of Ethiopia's various forest types and woodlands with regards to medicinal plants is shown in Table 38.

[7] Source: USAID COMPETE program: Ethiopian coffee industry value chain analysis.

Table 37: Annual coffee and forest coffee production trends in Ethiopia

Year	Total production (metric tons)	45% attributable to coffee from the forest (tons)
2002/03	232,440	104,598
2003/04	274,080	123,336
2004/05	240,180	108,081
2005/06	234,960	105,732
2006/07	343,980	154,791
2007/08	353570	159,107
2008/09	283,000	127,350
2009/10	480,621	216,279
2010/11	449,165	202,124
2011/12	498,765	224,444
2012/13	387,000	174,150
2013/14	380,700	171,315
Average	**343,433**	**154,545**

Source: data compiled from various sources

Table 38: Distribution of medicinal plants in Ethiopia's different ecosystems

Ecosystem	Number of Species	%
Acacia-Commiphora woodland	109	12.0
Montane grassland	93	10.5
Dry evergreen montane forest and evergreen scrubland	83	9.3
Combretum-Terminalia woodland	69	7.8
Moist Montane Forest	48	5.4
Desert and semi-desert scrubland	45	5.1
Afroalpine and sub-afroalpine	44	5.0
Lowland forest	33	3.7
Aquatic	30	3.4
Wetland	23	2.6
Undetermined	300	33.8

Source: NBSAP, 2005

The total value of this product is difficult to obtain by combining the total volume with price per unit because these products are predominantly traded informally and thus unregistered. The estimate provided in this report is based on average values of various studies that attempted to provide monitory estimates of the product. Two important studies in this regard include that of Reichhuber and Requate (2007) in Yayu and Sheko districts of south-west Ethiopia, and that of Mander et al. (2006) for the whole country. The former study provided an estimate of USD 3 and USD 1.80 per hectare for Sheko and Yayu districts, respectively. Based on these estimates, Nune et al. (2010) estimated the total pharmaceutical value of Ethiopian forests to be equal to ETB 569.74 million in 2005. The value of traditional medicine as applied to livestock is rarely studied, although this practice is widespread.

Taking an average of USD 2.2 (ETB 44) per hectare and year as the value applicable to all forest types, the total annual pharmaceutical value of Ethiopia's forests and woodlands can be estimated by multiplying the total forest area in 2013 by USD 2.2, which yields ETB 2.6 billion. This estimate is comparable to the findings of Mander et al. (2006), who calculated the total value added to

Table 39: Examples of medicinal plants used in Ethiopia and their prices (species in the first ten rows were surveyed in practitioners' clinics)

Scientific name	Type of treatment	Part used	Price per treatment (Birr)
Calendula officinalia	Haemorrhoids	Leaf	150
Eucalyptus globulus	Skeletal muscular problems	Leaf oil	250
Matricaria chamomilla	Headache	Leaf	150
Rosmarinus officinalis	Nerve manipulation when partially paralyzed	Whole plant	300
Datura stramonium	Chronic cough, asthma	Seed	150
Lactuca spp., Marrubium vulgare, Cynara scolymus	Hepatitis	Leaf	250
Verbascum	Haemorrhoids, eye diseases	Leaf, flower	250
Coriandrum sativum, Taraxacum officinale	Hepatitis	Fruit, leaf	250
Ricinus communis, Solanum giganteum	Skin diseases	Leaf, seed and fruit	100
Marrubium vulgare	Chronic cough, colds	Leaf, bark	150
Hagenia abyssinica	Intestinal worms, tapeworm	Flower	Na
Eucalyptus spp.	Colds, respiration difficulties	Leaf	Na

Source: Deffar, 1998.

the economy from traditional medicine in the year of 2005 as ETB 2.16 billion. A comparison of the values estimated in this Review and those in Mander et al. (2006) indicates that Nune et al. (2010) significantly underestimated the medicinal value of Ethiopia's forests. Another estimate by Deffar (1998) indicates an even a higher price for traditional herbal treatment (Table 39). For this Review, we adopted the estimate made by Mander et al (2006) according to which about 56,000 tons of medicinal plants are harvested and used annually in Ethiopia.

Bamboo

Recent estimates indicate that the current cover of bamboo forests ranges between 500,000 and 700,000 hectares. This cover is mainly comprised of *Yushania alpina* k. Schum (highland bamboo) and *Oxytenanthera abyssinica* (A. rich) Munro (lowland bamboo), both endemic to Africa (Embaye 2000). Bamboo is a fast-growing plant that can be harvested in 3–5 years to provide biomass required for various applications, including local or high-value modern furniture, as building material, pulp and paper, particleboard and the like. However, until very recently, bamboo use in Ethiopia was restricted to local application and light furniture. Production remains characterized by limited modernization. Yet, the local economic importance is considerable. The annual economic value of bamboo in Ethiopia was estimated by Nune et al (2010). By adapting this estimate based on market assessment and averaging the price of a culm in Asossa (for lowland bamboo) and Goba (for highland bamboo) – average price of 15 Birr per culm – the annual economic contribution of bamboo to the GDP can be estimated at ETB 56,250,000. According to Nune et al. (2010), close to 750,000 people have access to a bamboo resource with each person consuming an average of 5 culms per year.

Spices and Condiments

Ethiopia is one of the largest consumers of spices in Africa and the majority of spices produced in Ethiopia (80%)> are consumed domestically. People use spices to flavor bread, butter, meat, soups, and vegetables, as well as for medicines and perfumes. A significant amount of the spices traded and consumed in the country come from forest

ecosystems. Commercial species such as Aframomum angustifolium (Korerima), Piper capense (Timiz) and ginger are found as indigenous wild species in the moist tropical forests. Harvesting of these wild spice resources is widespread in many areas of southern Ethiopia, namely Sheka, Kaffa, Bench Maji, South Omo and Gamo Gofa. The history of spice use in Ethiopia is ancient and spices have always been and remain basic food items in the diet of the Ethiopian people. However, in recent decades, export of spices has steadily increased. In 2010, spice exports reached 15,000 tons, equaling a value of USD 18.6 million. Export earnings grew from USD 3.7 million in 2004 to USD 18.6 million in 2010, confirming progress and potential. Sudan and some Middle Eastern and North African countries are major destination of spice exports. Up to 1,208 tons of spices are produced from the forests in southwest Ethiopia (Vivero, 2002). At the current price of ETB 20 per kilo this amounts to a total monetary value of ETB 22 million.

Fodder

Ethiopia's rural economy depends on mixed livestock and crop production. The livestock sub-sector plays an important role in ensuring food security, preventing extreme poverty, acting as a natural bank and providing energy and fertility to sustain the crop sub-sector. Livestock supplements the livelihoods of about 75 million people living in rural Ethiopia. In pastoral areas, representing about 20% of the total population, livestock is the main livelihood support system. Ethiopia's livestock production is characterized by open grazing, where animals freely roam and find feed from open grazing lands and woodlands. Forests, woodlands and shrublands are major grazing sites and sources of fodder for Ethiopia's livestock population. According to WBISPP (2005), about 5% of forest, plantation and bamboo, and 24% of woodland, bushland and shrubland are subject to livestock grazing. Forests and woodlands provide 15% and 60% of total feed requirements for livestock during summer and winter, respectively, for the estimated 35 million tropical livestock units (TLU), which is equivalent to close to 70–80 million herds in Ethiopia. Assuming a six-month dry and rainy season and an average of 3 kg of dry matter per TLU per day, the total fodder obtained from forests and woodlands of Ethiopia is equal to 14.2 million tons of dry matter per year. Nune et al (2010) estimated annual fodder production to be 8.08 million tons per year in 2005, with a total value of ETB 1.73 billion. Taking the same price as that cited in Nune et al. (2010) (ETB 215/ton), the estimated annual monetary value of fodder is ETB 3.05 billion per year.

Wild food

More than 450 species of wild trees and shrubs have been recorded as important traditional food sources in Ethiopia, most of which are forest plants (Lemenih 2010). The majority of these species (ca. 72%) contain edible fruits and/or seeds, and the remaining vegetative parts – leaves, stems and tubers/roots – are eaten. *Moringa stenopetala*, for example, provides edible as well as nutrient-rich leaves and shoots, which also have medicinal values. Moringa is a widely consumed household food in the semi-arid regions of southern Ethiopia, particularly in Konso (Menfes, 2010). The fruits of *Cordia africana, Balanites aegyptiaca, Dovyalis abyssinica, Ficus* spp., *Carissa edulis* and *Rosa abyssinica* are commonly consumed in rural Ethiopia. The fruits of *Opuntia ficus-indica* and *B*orassus aethiopum are consumed and traded in the market for cash income generation in Tigray and Afar. Similarly, a large number of species of wild animals, including fish, mammals and birds, are utilized for food or trophies, in many cases providing direct income.

The total annual economic contribution of the NTFPs sub-sector to the GDP is summarized in Table 40 below. The total value added to the GDP from NTFPs equals ETB 20.1 billion, which is considerable (Table 40).

Table 40: Contribution of NTFPs to Ethiopia's national GDP

NTFP type	Total annual Gross value (Billions of ETB)
Honey	2.20
Bees wax	0.15
Forest and semi-forest coffee	11.60
Fodder	3.05
Gum and incense	0.17
Traditional pharmaceutical products	2.66
Bamboo	0.06
Spices	0.02
Total	20.10

2.9.3 Challenges and opportunities for the NTFPs sub-sector

Ethiopia's NTFPs sub-sector has significant potential for development and modernization through value-added processing and quality improvements. Current production is characterized by traditional low technology and capital intensive systems. Most NTFPs are traded raw without value-added processing. Given that there is a high market demand for some NTFPs both domestically and internationally, there is significant opportunity to optimize their economic contribution through value-added processing such as quality improvement, packing, labeling, and certification. The modernization of production systems through appropriate technology can increase the already significant economic contribution of NTFPs to Ethiopia's economy. Moreover, there are significant untapped volumes of NTFPs in the country. For instance, current annual gum and incense production is only a fraction of the 70,000 tons of annual production potential. A high degree of technological innovation, including value-added processing, may be necessary to achieve high quality and quantity production and to meet the quality standards demanded on international markets. For instance, forest coffee produced through project-based support that focusses on quality improvement, certification and export markets manages to fetch at least twice the price of coffee that is traditionally produced. Improvements in quality through use of appropriate technology will help secure better market integration and higher prices.

Strategic investments in adding value to and exporting NTFPs can contribute significantly to export diversification. Ethiopia has not yet established itself as significant supplier of NTFPs such as honey and spices on the world market and there seems to be no understanding of the potential of the sub-sector at policy makers' level. For example, only 1% of the total honey production is currently exported. Another opportunity to optimize Ethiopia's NTFP production is to market the organic nature of many products. Organic certification can increase economic values and returns to producers and traders. Rainforest Alliance certified forest coffee production in Belete-Gera forest of Jimma zone is an exemplary case. Certified producers earn a 15–20% higher price for their coffee at the farm gate, and an additional income equivalent to 40% of the profit from export. In general, the demand for certified products is growing, especially in industrialized consumer countries. Therefore, certification should be taken as an opportunity for increased value and market access. There are also expanding export markets (more destinations) for Ethiopia's NTFPs including regional market integration (e.g. honey export to Sudan).

Participatory Forest Management (PFM) is a means of increasing professionalism and value adding. PFM contributes to the establishment of NTFP cooperatives as means of aggregation and development of the market chain. Cooperative establishment is increasing the integration of producers in domestic and international markets (e.g. for forest coffee). PFM is also contributing to the development of awareness and capacity with respect to quality production and overall value chain development. In combination with PFM, ongoing efforts to reduce deforestation through REDD+ can help to ensure the long-term sustainability of NTFP production and provide incentives for forest protection (see section 2.11). Deforestation and forest degradation results in a declining resource base, placing NTFP production at risk and potentially threatening their availability. The future of some NTFPs such as spices and forest coffee is uncertain if current deforestation is not reversed.

Extension service provision through the recently established MEFCC plays an important role in increasing NTFP productivity. The MEFCC and its subsidiary regional bodies (under establishment) could help in providing the required extension services to assist in the management and production of NTFPs that meet diverse market requirements. The MEFCC could also catalyze public-private partnerships to attract new technology for value addition and facilitate access to niche NTFP markets. Value chains currently involve several intermediaries (or middle men), add little value to the products and result in market inefficiency. Policy adjustments can support reform towards shortened and less fragmented value chains in which smallholders are better integrated. Smallholders lack knowledge of optimum NTFP harvesting techniques, processing, drying, packing and storing in hygienic conditions. This reduces the quality of their harvests and lowers the sale price.

Smallholder NTFP enterprises require business training and capacity building to improve production. NTFP production must be recognized as a local business where local communities and other actors along the NTFP value chain operate as profitable and professional businesses. Training can include how to package/sell/deliver/export NTFPs that meet market quality, certification and branding standards; this will also support aggregation, specialization and professionalization. This will also support aggregation, specialization and professionalization. In parallel, access to the capital required to produce must be facilitated. Access to affordable credit through conventional microfinance institutions in extremely remote areas is limited, creating a barrier to increasing the volume and quality of products. For NTFP marketing, it is unlikely that any single producer could provide enough products to meet the needs of even a small company. This becomes a problem for private sectors attempting to establish NTFP enterprises. Producers should be organized and be able to aggregate their produce to create adequate and steady supplies of NTFPs to major markets.

2.10 Ecosystem services and benefits of forested landscapes

In addition to the diverse wood and non-wood products described above, Ethiopia's forested landscapes provide a wide range of additional ecosystem services benefitting both local forest communities and the global public. These ecosystem services include biodiversity conservation, climate change adaptation and mitigation and livelihoods for local communities (note that section 2.9 on NTFPs covers some of the same information provided here relating to benefits). A recent classification of ecosystem services provided by forests and woodland ecosystems is presented in Table 41. This classification differs slightly from that provided by the Millennium Ecosystem Assessment (MEA, 2005).

Among the many ecosystem services identified in Table 41 and provided by forest ecosystems, three are referred to as the "big three" because they are currently the subject of most interest and have

Table 41: Classification of ecosystem services according to The Economics of Ecosystems and Biodiversity

Ecosystem service category		Ecosystem services provided by forests
PROVISIONING		Water supply
		Timber/fuelwood
		Wild capture and collection Crop production Fodder production
REGULATING		Water quality regulation Stream flow regulation
		Soil maintenance Erosion control
		Moderation of extreme events (flood control)
		Carbon storage
HABITAT		Habitat Maintenance of biodiversity
CULTURAL		Eco-tourism/ recreation Cultural significance

Source: www.TEEB.org

Table 42: Global average estimate of value of selected ecosystem services

Ecosystem service type	Value (USD/ha/yr)
Climate regulation	223
Water quality regulation	6
Water supply	8
Erosion control and sediment retention	245
Soil formation	10
Nutrient recycling	922
Biodiversity conservation (genetic resources conservation)	41
Recreation	112
Cultural	2

Source: Costanza et al., 1997; Krieger 2001.

an established market worldwide. These are: climate change regulation (carbon storage), watershed protection services and biodiversity conservation (FAO 2007). It is difficult to attach financial value to these services since they are not traded directly on the market. Nonetheless, there have been several attempts to quantify their value using various approaches. The first comprehensive attempt to value global ecosystem services was the work of Costanza et al. (1997) that estimated the value of ecosystem services provided by forests to be USD 33 trillion, a figure nearly twice the global gross product at that time. Other estimates also attach similar values to the services provided by forests and other natural ecosystems (Krieger, 2001; Rojahn, 2006). For instance, Rojahn (2006) estimated that the pharmaceutical value of 18 global biodiversity hotspot sites lay between USD 231 and 9000 per ha and year. Table 42 presents the global average value (on a per ha and year basis) of selected ecosystem services.

There have been some attempts to estimate the value of ecosystem services provided by forests and woodlands in Ethiopia. Below is review of these attempts, focusing on the big three services.

Carbon and climate regulation in Ethiopia

The climate regulation services provided by Ethiopia's forests and woodlands can be valued using a number of different approaches, two of which are presented below. The first approach values the potential for REDD+ based carbon payments, and the second valorizes the role the entire forests and woodlands can play in global climate regulation.

Ethiopia holds a large carbon stock in its diverse forest and woodland ecosystems. Based on the 2013 forest area estimate and the projected forest area in 2033, the carbon stocks in Ethiopia's forests, woodlands and trees outside forests are calculated and presented in Tables 43 and 44.

As shown in Table 43, the total carbon stock in Ethiopia's forests and trees outside forests in 2013 was about 6.3 billion tCO2e. Under the baseline scenario projected to 2033, there will be a carbon loss of 410 million tCO2e due to deforestation of natural forests. Establishing the plantations as proposed by this Review (see Chapter 6: Vision 2033 for the Ethiopian forest sector development) will generate carbon enhancements of roughly 89 million tCO2.

The MEFCC is currently preparing a national program for Reducing Emissions from Deforestation and forest Degradation, including the role of conservation, sustainable forest management and forest carbon stock enhancement (REDD+), which includes a landscape-level REDD+ pilot in Oromia, the region holding the majority of Ethiopia's forests. REDD+ has been identified as an opportunity to provide a viable source of sustainable finance for investments in forest management, conservation and restoration to enhance multiple benefits of forests. REDD+ is expected to channel significant international donor funding for net emission reductions achieved. This climate finance could be invested in climate smart agriculture, improved energy use and production and forestry productivity enhancements. These sector interventions will be combined with institutional capacity building to improve government service provision in rural areas.

Table 43: Total carbon stock in Ethiopia's forest and tree resources in 2013 using the FSR area estimate

Forest type	**Cover** (ha) (WBISPP estimate for 2000)	**FSR estimate** (2013)	**Standing stock** (m3/ha; free bole volume)	**MAI** (m3/ha/yr)	**BCEF***	**AGC** (million tons)	**BGC** (million tons; 25% of AGC)	**Total carbon** (million tons C)	**Total** (million tons CO2e)
High forest	4,073,213	2,900,000	132	5.65	1.3	248.8	62	311	1,140
Plantations	501,522	909,500	179	12.5	0.7	56.9	14	71	261
Woodlands	29,549,016	21,500,000	21	0.8	2.8	632	158	790	2,897
Shrublands	26,403,048	20,100,000	15	0.5	2.8	422	105	527	1,934
Cultivated lands (agroforestry)	21,298,529	21,298,529	2.0 (tons/ha)		-	21.2	5.3	26.6	97.6
Total						**1,381**	**345**	**1,726**	**6,330**

Note: BCEF = Biomass conversion and expansion factor. Value taken from IPCC good practice guide; Carbon content = 50% of total biomass; AGC = above-ground carbon; BGC = below-ground carbon.

Table 44: Projected Carbon in 2033

Forest type	**Cover** (ha) (WBISPP estimate for 2000)	**FSR estimate** (2013)	**Historic deforestation rate** (%)**	**Cover projected to 2033**	**Standing stock** (m3/ha; free bole volume)	**MAI** (m3/ha/yr)	**BCEF***	**AGC** (million tons)	**BGC** (million tons; 25% of AGC)	**Total carbon** (million tons C)	**Total** (million tons CO2e)
High forest	4,073,213	2,900,000	2.2	1,854,757	132	5.65	1.3	159.1	39.8	198.9	729.3
Plantations	501,522	909,500	-	1,219,500	179	12.5	0.7	76.4	19.1	95.5	350.2
Woodlands	29,549,016	21,500,000	2.1	13,750,782	21	0.8	2.8	404.3	101.1	505.3	1,852.9
Shrublands	26,403,048	20,100,000	1.8	12,855,382	15	0.5	2.8	294	73 381 252	366 906 259	1 345 322 951
Cultivated lands (agroforestry)	21,298,529	21,298,529	0	30,520,758	2 (tons/ha)			30.5	7.6	38.1	139.9
Total								**964**	**241**	**1,205**	**4,418**

*Note: * biomass expansion and conversion factor; ** calculated from 2000 and 2013 forest area; *** areas deforested are converted into cultivated area (so the area of cultivated land will increase. Considered the area deforested from high forest and woodlands only); **** Including the new 310,000 ha plantation proposed by FSR to close the gap in wood product supply.*

The ultimate aim of REDD+ is to provide rural land users with an incentive to transition to more sustainable land use practices that improve local livelihoods. This could also include incentives for woodlot establishment. In parallel, investment in efficient timber and woodfuel production is a strategic REDD+ option, where commercial forestry will be combined with a smallholder out-grower scheme to reduce pressure on standing forests and thereby generate carbon benefits. Establishment of the 310,000 ha diverse plantations required to fill the roundwood supply gap over the next 20 years would generate roughly 89 million tCO2 through forest carbon stock enhancements. This demonstrates that REDD+ could provide a tangible monetary contribution to achieving sector goals.

In addition to mitigation benefits, forests and trees support Ethiopian farmers to adapt to climate change in increasingly degraded landscapes. In dry seasons and times of drought, forests are often accessed as the last resort for livestock grazing, which is a main livelihood activity for many pastoralists and rural communities (see NTFPs section 2.9).

Watershed protection

Ethiopia's forested landscapes have significant watershed protection value. Being a mountainous country, Ethiopia is considered the water tower of the Horn of Africa. There are 12 major rivers or watersheds that supply water resources to Ethiopians and neighboring countries; water supplies stemming from Ethiopia can reach as far as Egypt. Major rivers include: the Blue Nile, the major contributor to the Nile River; Omo, the major perennial river feeding Lake Turkana; Genalle, Wabi Sebelle and Dawa that flow into Somalia; and the Awash. The forests and woody vegetation covering the hills and mountain tops where these rivers start provide considerable water regulation and watershed protection services. Ethiopia's forests and woodlands provide several functions that ensure regulated flow, including:

- Reducing flooding by storing excess water and slowing water velocity;
- Treating waste water by breaking down and filtering toxins;
- Recharging groundwater;
- Reducing erosion and stabilizing soils;
- Eliminating impurities and maintaining water quality through biological life cycles;
- Maintaining perennial water levels, storing and releasing water continuously; and
- Sustaining farm productivity by stabilizing soil and reducing floods.

In addition, the benefit of Ethiopia's main modern energy sources of hydropower, and the watershed protection services provided by the country's forests and woodlands in ensuring a sustainable supply of energy is huge. Nune et al (2010) estimated the value of the watershed protection benefits provided by Ethiopia's forests and other vegetated areas to be ETB 23.35 per ha and year. This figure is extremely small compared to the global average estimates (see Table 42).

Biodiversity

In terms of biodiversity, Ethiopia's forest ecosystems and natural habitats are rich, including 1,408 known species of fauna and at least 6,603 species of flora that are reported to exist in the country. Of these, 7% of faunal species and 15.1% of floral species are considered endemic, many of which do not occur in other countries. There are several economically important plant species, the most important of which is coffee. The genetic diversity of Ethiopia's wild coffee has a tremendous value in terms of breeding potential for sustaining the world's coffee production. For instance, the economic value of the native gene pool of coffee, with regards to future breeding programs is estimated in the range of USD 420–1458 million (ca. ETB 8,400–29,160 million) (Hein and Gatzweiler 2006). Taking the global value of USD 41 /ha for biodiversity conservation (Costanza et al., 1997; Krieger 2001), the total biodiversity conservation value of Ethiopia's forests, woodlands and shrublands in 2013 could have amounted to USD 980 million (ca. ETB 19.6 billion). Biodiversity also provides economic value through eco-tourism. Existing studies quantifying this value are not available in Ethiopia.

Local benefits of forest ecosystem services such as biodiversity can also be significant. For example, a study of the Ethiopian highland cloud forests in Sheko and Yayu districts found that the net benefits associated with sustainable forest management were higher as compared to alternative land use options due to the high economic value of biodiversity conservation and carbon storage in the forests under study. Although traditional land use systems involving the conversion of forests into agricultural produce are preferred by local farmers,

the sustainable use of the forest through production of semi-forest coffee is in the best interests of the global community, the Ethiopian government and local farmers, when employing a discount rate of 5% and lower (Reichhuber & Requate 2007). This illustrates the economic incentives for local forest communities of this land use system, especially if price premiums for coffee produced using improved management practices are available. In summary, the total ecosystem service value of Ethiopia's forests and woodlands is estimated at ETB 157 billion per year (Table 45). This is significant and should be considered when developing policies and strategies that affect the country's forest sector.

Table 45: Summary: Value of ecosystem services provided by Ethiopia's forest resources

Ecosystem service	Value (ETB, billion)	Remark
Climate regulation	112.9	Global average value per ha/yr
Potential carbon payment in the form of REDD+	23.4	USD 5 price for a tonCO2e. USD 23.4 is for 20 years, which means USD 1.17 per year
Watershed protection	1.06	Nune et al (2010) estimate
Biodiversity conservation	19.6	Estimate global average
Total	**157**	

3 BASELINE SCENARIO 2013 TO 2033

The baseline scenario is based on the following assumptions:

General assumptions:

- Population growth according to CSA population projections.
- 8% annual GDP growth, reflecting the lower estimates of the CRGE.
- 2.4 million ha forest in 2033, 15.1 million ha woodlands, 13.5 million ha shrubland.
- Electrification rate is used as a proxy to project woodfuel consumption and demand for utility poles; Ethiopian rates will increase to almost 60% for rural Ethiopia (Lighting Africa 2011).

Public plantations:

- Increased planting and harvesting until 2016 and from then on, an average area of 5,000 ha is harvested and replanted annually.
- Until 2033, about 90,000 ha will be harvested, corresponding roughly to the current size of OFWE and AFE plantations. The thinning volumes of the replanted areas are considered in this scenario, as well as an additional volume of 25% harvesting and thinning waste used for woodfuel.

Woodlots:

- The area of private woodlots increases annually by 1%, corresponding to mean rural population increase. The area in 2033 is projected to be at 1 million ha.[8]

Woodfuel:

- It is assumed that electrification reduces per capita consumption by 15% for lighting and around 60% for mitad baking; the adoption rate of electrical light is100%; the adoption rate of electrical stoves is 10%.
- Distribution of improved cooking stoves according to CRGE plans: 34 million between 2005 and 2030; improved cooking stoves save 50% woodfuel; adoption rate of improved stoves is 40%.

Utility poles:

- Electrification rates in rural areas (see above), combined with population density. An average of 15 poles per km² was assumed (corresponding to the industry norm of 10 poles per km line). Demand varies between 0.4 and 0.5 million poles per year.[9]

Housing:

- The 2007 distribution of housing types was used; housing replacement is based on 2013 new housing construction figures combined with a 20-year replacement cycle. In 2013, 25% of new housing units in urban areas will be built using non-wood materials (concrete and hollow blocks). Data on replacement of old, sub-standard housing units with modern construction designs (condominiums, etc.) were derived from GTP and CRGE planning figures, indicating a replacement rate of 50,000 units per year.[10] Growth of non-residential construction was correlated with projected GDP growth.

[8] Farmers will have the economic choice between food and wood production within their given financial and physical capacities. Low uptake was assumed for the baseline scenario. However, with increasing productivity of agriculture, more land and resources could be allocated to woodlot management. Another consideration is that fuelwood shortages may increase in certain areas, resulting in higher market prices that encourage farmers to produce woodfuel. However, this potential development was not considered in the FSR baseline.

[9] Kenya has a similar population density per km², and has an annual pole demand of between 0.8 and 1 million poles. Applying alternative calculation models, based on average Kenyan figures, an annual demand of around 1 million poles was calculated for Ethiopia. However, for this Review, conservative estimates were used.

[10] The tendency is that with increasing purchasing power and GDP growth, the average house size increases, resulting in an increase in wood products consumption. However, this has not been factored into the baseline as there is no robust method to quantify this effect.

Pulp and paper:

- Consumption correlates to the mean annual GDP growth of 8%, resulting in 4 kg per capita at a projected GDP of USD 1,300 in 2033 (2013: 1.5 kg) (Hansen, Panwar and Vlosky 2013).
- Projected growth considers the correlation between economic growth and literacy and commercial activities.

3.1 Wood balance in 2033

The baseline scenario and wood balance for 2033 indicates an overall increase in wood demand by 27% of the 2013 figure (total volume 2033: 158 million m^3). The detailed balance for wood supply and demand in the year 2033 is shown in Table 46.

The main driver of demand is woodfuel consumption, which is expected to increase by 22% (Total 2033: 142 million m^3). By 2033, the share of unsustainable woodfuel extracted from natural resources will increase and reach an estimated 56% (80 million m^3) of the demand.

Industrial roundwood consumption will increase by an estimated 76% to 15.7 million m^3 total. The main driver is pulp and paper consumption, with a growth of more than 300%. Significant relative growth is also expected for utility pole

Table 46: Consolidated wood balance for Ethiopia in 2033

Production (supply side)	In million m^3 roundwood		Consumption (demand side)
Sustainable woodfuel forest, wood-/ shrubland	51.383	131.591	Woodfuel
Unsustainable woodfuel forest, wood-/ shrubland	79.505	10.536	Charcoal private use
Woodfuel private woodlots	7.896	0.242	Charcoal industry use
Woodfuel public plantations	0.704		
Woodfuel area exclosure	2.004		
Woodfuel from waste	0.799		
Peri-urban energy plantations	0.080		
Sub-total woodfuel supply	**142.370**	**142.370**	**Sub-total woodfuel demand**
Roundwood private woodlots	6.342	0.503	Utility poles
Roundwood public plantations	2.815	4.605	New housing construction
Unspecified sources	4.393	4.472	Housing replacement
Pulp and paper imports	2.175	2.131	Modern and non-residential construction
		0.627	Furniture urban households
		0.482	Furniture rural households
		0.732	Furniture commercial and public consumers
		2.175	Paper consumption
Sub-total industrial roundwood supply	**15.726**	**15.726**	**Sub-total industrial roundwood demand**
Total	**158.096**	**158.096**	**Total**

consumption and industrial wood products for the construction sector (panels, sawnwood). On the industrial roundwood supply side, a significant increase in sustainable supply is expected to come from private woodlots (14 million m³) and public plantations (2.8 million m³), but due to increasing demand, the estimated industrial roundwood gap remains at 4.4 million m³ in 2033.

If current trends continue, this gap will be closed either by imports or by unspecified sources (illegal and informal activities). The relative shares of both in the 2033 wood balance cannot be projected. However, it is likely that the gap in rural areas will be closed from natural resources and in urban centers through imports. For pulp and paper products, it was assumed that no domestic wood resources based industry will have been established in 2033. Thus, the demand volumes will be fully met by imports unless investments are mobilized.

3.2 Baseline scenario in 2033

The 2033 baseline scenario is sub-divided into a woodfuel scenario and an industrial roundwood scenario. The woodfuel scenario (Figure 21) reveals a continuous decrease in availability of sustainable woodfuel sources. Fifty-six percent of the demand will be covered through unstainable extraction in 2033. The computed gap of woodfuel will amount to 80 M m³.

The industrial roundwood scenario (Figure 22) shows an increase in availability, which is mainly caused by increasing harvesting and replanting volumes in public plantations. The scenario depends heavily on the "even distribution" assumption for the existing plantation area. However, the industrial roundwood supply gap will increase to 4.4 M m³ in 2033.

Figure 21: Woodfuel scenario 2013–2033

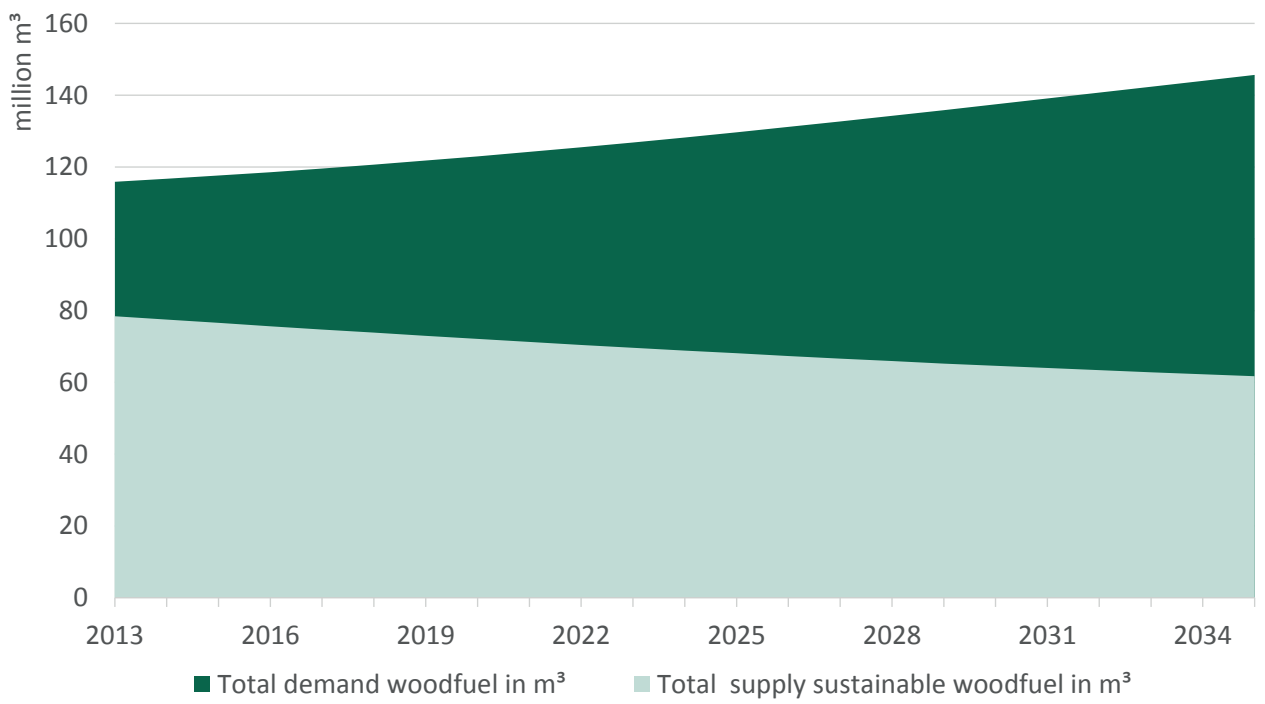
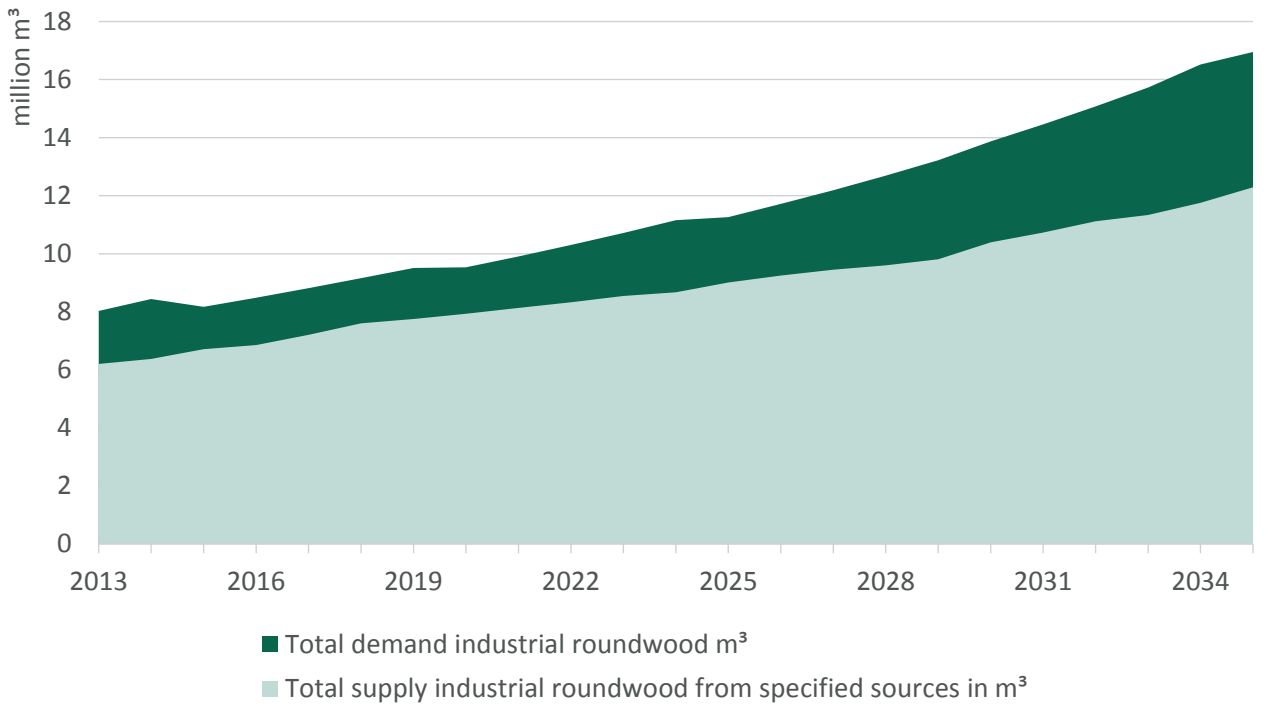


Figure 22: Industrial roundwood scenario 2013–2033



4 INDUSTRIAL ACTORS IN THE ETHIOPIAN FORESTRY SECTOR

To gain a better understanding of potential future developments in the forestry sector, a summary outline of the forestry industry's current situation is provided. This also serves as a background to the investment climate analysis in the next chapter. The information is based on a number of interviews with enterprises representing different sub-sectors. These interviews provide in-depth insights into the private sectors' entrepreneurial activities and their perception of future developments. The main focus of the interviews was the opportunities and constraints facing the development of larger processing industries, since these are considered key potential change agents at industrial scale. Detailed actor analysis for wood processing SMEs is available from IIED (2009). On small-scale private and community woodlots, Kassa and Lemenih (2011) have provided in-depth information. Interviews were not meant to provide comprehensive data, but rather representative insights. Interviews were conducted with the following:

- Ethiopian Chipwood and Furniture (ECAFCO) state company.
- Oromia Forest and Wildlife Enterprise (OFWE), Arsi branch.
- Awasa Chip Wood Factory.
- Pine Wood PLC.
- Maichew Particle Board Company PLC.
- Bamboo sector informant.

4.1 Select actor profiles and business models

All companies interviewed produce primarily for internal consumption, with the construction sector as the leading producer. State-owned forest enterprises, which include OFWE (described in Box 2) and AFE, produce most of the industrially used roundwood in Ethiopia, followed by processors who engage in forest management to secure their resources. Primary processors include saw miller owners, who often form cooperatives of numerous very small saw mills.

Particle board manufacturers

Investments in particle board plants are expanding in Ethiopia. Particle boards are produced by three larger companies, including the state-owned Ethiopian Chipwood and Furniture company (ECAFCO), with an estimated annual production of 8,000 m^3, Maichew Particle Board Company PLC with an annual production reaching 20,000 m^3, and Awassa Chipwood Factory that produces approximately 10,000 m^3 annually. Sources indicate that roughly ten additional small particle board producers exist.

ECAFCO, based in Addis Ababa, is the oldest plant, originally established in 1966 and bought by OFWE in 2007. Maichew Particle Board Company in Tigray, and Awassa Chipwood Factory in Southern Nations and Nationalities' Peoples Regional State started production in 2008 and 2009, respectively. Both have an installed annual capacity of 70,000 m^3 particle boards. However, due to capacity gaps and difficulties in accessing sufficient raw material, actual production is estimated to be only 25–50% of maximum installed capacity. ECAFCO still operates with original equipment, greatly reducing productivity and quality.

Reconstituted wood products are important materials in the construction and furniture industries. Producing these domestically makes the products more accessible while adding value to forests and providing employment. However, the limited raw material supply and technical skills base must be addressed to spark sustainable growth of the industry.

Bamboo products

Ethiopia's large bamboo resources are mainly used by informal, small-scale furniture producers. Similar to particle board production, industrial-scale production of bamboo products is a fairly recent development. The three companies ADAL Industries, Bamboo Star Agroforestry and African Bamboo were established in 2004, 2010 and 2012, respectively. These companies export panels, flooring and furniture. The companies benefit from Ethiopia's large-scale natural bamboo forests in the western and south-central regions. A key product is flooring, produced for internal and export markets. Other products are panels, furniture and smaller items such as curtains and table mats. The Sidama-based African Bamboo plant sources bamboo from cooperatives through an out-grower scheme and is in the process of establishing 1,000 ha of bamboo forests as core plantations to demonstrate best practices and ensure sustainable supply. The two other companies have similar sourcing strategies.

While not directly comparable with industrial timber plantation, successes and lessons learnt from the out-grower scheme and community bamboo forest management can inform the process of establishing similar structures in the timber processing sector.

4.2 Forest management and production

The importance of reliable access to raw material resources is often underestimated at business establishment, later forcing companies to access wood at a high cost from remote areas. This is mainly explained by an overall limited resource base and the absence of enterprises dedicated solely to primary production. Due to unreliable or dwindling raw material flows, unforeseen investments are later required to improve the resource base. The raw material sourcing strategies of larger manufacturers have a strong drive towards vertical integration. Outsourcing even part of the supply logistics is rare. Potential explanations include perceived unreliability and higher cost of outsourcing. As a result, manufacturers become engaged in forest management and lose focus on processing, likely leading to production deficiencies in both forest management and the processing side of the businesses. Companies employ mixed sourcing strategies to either enhance the supply available from their own plantations throughout the year and/or to alleviate constraints caused by restricted accessibility to their own forests during the rainy season. Access to timber from state forests (including those managed by regional forest enterprises) reportedly depends on company size and political influence. Cited stumpage prices vary between USD 15 and 70/m^3. Waste and residues are generally traded, often informally. For example, offcuts and chips are used by smaller producers for value-added products such as charcoal briquettes and particle board.

Out-grower schemes for timber production are limited and seem to be primarily driven by government programs, except for the bamboo model mentioned above. When asked about the reasons for the lack of farmer engagement in forest production, explanations include limited on-farm land availability and mitigated famer interest due to the long-term returns on investment. Thus, significant challenges are associated with smallholder involvement. In addition, food security implications and risk aversion by smallholders need closer analysis. Moreover, a capacity building strategy should be developed for MEFCC extension services targeting woodlot establishment and management.[11]

Sizeable forest plantations have been established through government programs since the 1970s. Species planted include cypress, pine and eucalyptus. Management of these plantations was gradually handed over to regional state forest enterprises such as OFWE and AFE, or manufacturing companies such as Maichew Particle Board Company or Awasa Chip Wood Factory. These companies integrate management of the forest estate and the utilizing industries, i.e. saw milling or production of particle board. All other forest management aspects are also covered by the companies: seedling production, plantation establishment and maintenance, harvesting and transport logistics.

[11] The Royal Norwegian Embassy through their support provided to the CRGE Facility is currently developing a MEFCC capacity building strategy with the objective to support large-scale reforestation linked to REDD+. This will include establishment of regional MEFCC offices

Exploitation of existing plantations is difficult due to rough terrain combined with limited infrastructure and large distances to processing plants. This results in uneven age distribution. Expansion of the plantation estate is limited by sharp boundaries to smallholder farmland, often leading to conflict, encroachment and theft. Regular forest inventories to control and monitor the performance of the forest estate are absent and applied research is limited (e.g. influence of different management techniques, pest and disease control, site-specific species performance). Management regimes lack rigidity and regular interventions such as thinning and harvest. Harvested compartments are immediately replanted with the same species or in the case of eucalyptus, coppiced without a limit on the number of rotations. New species and/or varieties that promise higher yield and better quality are not used. As a result, yields and quality of the crop are lower than in plantations established in similar ecological conditions but where best practice management standards are applied.

Ethiopia's forest plantations offer a good starting point for the development of a vibrant forest-based industry provided that the natural potential is fully exploited through application of best practice forestry standards. Two companies managing forests for industrial wood were visited in the framework of this assessment (Maichew Particle Board Company and the OFWE Arsi Branch). Both have several thousand hectares of planted forests under management. These forests were established decades ago by government initiatives that did not necessarily have industrial production in mind; this is similar to the situation of other forest management and wood processing enterprises in Ethiopia. Once the timber becomes harvestable, the companies struggle with access to the forests. Moreover, site suitability for the chosen species was not a main consideration at the time of planting. As a result, performance in terms of tree growth and quality is limited. Despite the acknowledged importance of these forests for the survival and growth of the companies, and for Ethiopia as a whole, little drive is visible to improve management by applying best practice forest management techniques.

5 INSTITUTIONAL ANALYSIS

This chapter provides an institutional analysis of the forest sector, with a focus on the investment climate to identify barriers to and opportunities for private sector investments in forest establishment and wood processing. The chapter begins with a review of the policies and laws affecting forests, including their effective implementation. Thereafter, the investment climate analysis outlines the main constraints to investment and potential solutions. The analysis is based on a review and consolidation of existing information as well as expert consultations and interviews with governmental and private sector actors. It also takes into account the results of the above supply-demand analysis. The desk-based review was combined with stakeholder consultations and interviews, including government, NGOs, and research institutions, and especially the private sector, including validation workshops with the GTP2 planning committee. In addition, key sector experts were identified early on and invited to a launching workshop where the methodological approach was presented, discussed and validated. Subsequently, a Forest Sector Review expert survey was drafted and circulated amongst the experts. This was combined with fieldwork, where semi-structured interviews were carried out with private sector actors to better understand their priorities and perspectives while obtaining a deeper understanding of their *modus operandi*. The results of this fieldwork include a private sector mapping of the industrial forestry sector, presented in chapter 5. Finally, based on feedback obtained from government stakeholders, a situational analysis of the sector's education and research programs was carried out to provide key recommendations for improvement moving forward.

5.1 National forest management institutions

The Ministry of Environment, Forest and Climate Change (MEFCC) was established in May 2013 with the mandate to develop and implement programs in environmental management and forestry. Prior to this, forestry was addressed under a small section in the Ministry of Agriculture. The creation of the MEFCC demonstrates the growing importance placed on forests and natural resources in Ethiopia's economic development. However, the frequent restructuring of the country's forest institutions has drawbacks, including a lack of government capacity to properly implement utilization and conservation plans for forest resources and a poor forest information management system (MOA 2013). High staff turnover leads to loss of skill and accumulated knowledge resulting in weak institutional memory and information management.

Improved forest information management is required to ensure the sector interventions are achieving the desired impacts. Forest plantation and industry data should be systemically collected and regularly analyzed to identify successes and areas for improvement. The ongoing national forest inventory also provides the opportunity to establish a forest database on the basis of which, information regarding supply and demand can be regularly updated. Interaction between other governmental agencies for data management can also be improved, including through collaboration with the CSA and Ministry of Agriculture and Natural Resources (MoANRs). Ethiopia's REDD+ agenda includes the development of a national forest monitoring system, which aims to streamline forest data collection, including the effects of agriculture and energy sectors on forests.

5.2 Policy and legal frameworks for regulating forests and their application

Land use planning is a pre-requisite for sustainable forest management and forest establishment. To ensure Ethiopia's forest resources are safeguarded, integrated land use planning is required to balance the needs and trade-offs of the rapidly expanding economy. The forest sector is closely linked to other land use sectors, with agriculture, mineral extraction, and infrastructure development (including plans for hydrodam development) affecting forest cover and health. With population pressure and economic growth, many forests and woodlands are experiencing significant degradation and conversion to other land uses – mainly agriculture. The operational plan for implementing the Government's growth objectives are outlined in the current Growth and Transformation Plan (GTP) (2010–2015), which aims to transform the economy to the level of middle income countries by 2025. A main objective of the current GTP (GTP2) is to attract foreign investors interested in producing high-value crops, targeting mainly export markets. Most of the investments in agriculture come at the expense of lowland (humid) forests and dry woodlands (Gambella and Benishangul Gumuz respectively). There is a general misconception that these lands are vacant and unused. However, the SDA above shows that a significant share of the wood products consumed in Ethiopia are sourced from natural forests and woodlands.

Despite ongoing reforms, the policy and legal frameworks regulating forests and land use are considered comprehensive (Climate Focus 2014).[12] The Forest Conservation and Utilization Proclamation (2007) aims to increase the contribution of forest resources to the national economy through sustainable management and utilization. Although all forests in Ethiopia are owned by the state, this Proclamation promotes markets for forest development, including private forest development, allowing forest use rights to be granted to communities, associations or investors. Community consultation is required during demarcation processes and forest management planning. The legal frameworks governing forests are under reform, with a number of amendments required, including: harmonized PFM regulations, clarity regarding REDD+ and carbon benefits, and expansions of small-scale woodlots by farmers. Important for this Review, the need to attract private sector involvement and investment in the sector has been recognized as an issue requiring legal reform.

However, most laws and policies suffer from inadequate implementation and enforcement with full political and administrative support (Bekele 2008). For example, Ethiopia has issued at least six proclamations over the past 40 years in the forestry sector, but few have been implemented with any weight. Effective enforcement requires clear directives and guidelines and a strong organizational structure that is fully staffed and logistically equipped. Regulations/directives and guidelines for proper policy application are absent in Ethiopia, be it at federal or regional levels. A good example in this regard is the use of endangered indigenous tree species. In the 2007 Proclamation, Article 14 (1) states no person may be allowed to cut or use endangered indigenous trees from State forests, and Article 14 (2) states, this list shall be determined by directives issued by the appropriate government organ. Unfortunately, these directives, like many others, have not been issued since the policy was promulgated, and therefore never applied.

Strengthening and clarifying the regulatory authority of non-state actors can also contribute to improved forest law enforcement. In areas where local communities are organized into community-based organizations (CBOs) and have taken on forest management responsibilities (e.g. in PFM), it is critical that these CBOs are supported by the judiciary systems (court) and police forces at local levels to effectively implement their bylaws. Law enforcement agencies (courts and police department) should be sensitized to bylaws and support CBOs to collaboratively implement these. Especially at the local level, investment priorities often override the laws protecting forest resources, with law enforcers, particularly woreda judges, police and administrators' decisions counteracting

[12] See Annex 1 for list of main laws and policies affecting forests.

the forest-protecting bylaws of CBOs. A possible solution to this dilemma is to more fully engage these state administrations in all steps of the PFM process, and organize regular awareness campaigns.

Building capacity to enforce laws should be prioritized for good forest governance. The forest managing organizational structure needs to be reinforced, particularly at the grassroots level. MEFCC structures need to be strengthened at regional and district levels to support the implementation of forest laws. REDD+ may provide the funding to establish decentralized forest management structures. These structures will also play a critical role in providing the extension services required for the promotion of small-scale plantation establishment and proper management.

Forest law enforcement is hampered by the lack of clear boundary demarcation of forests and forest lands. Article 4 (1) of Proclamation No 542/2007 states: "In order to properly conserve, develop and utilize the forest resources of the country, major forestlands shall be designated as state forests, their boundaries shall be demarcated and they shall be registered as protected and productive forests." Enforcement is possible if and only if boundaries are unambiguously defined. Demarcating or re-demarcating forest lands/forest resources, putting clear marks on the ground and producing geo-referenced maps is essential and should be made a priority, as the absence of boundary demarcation is often an excuse for not effectively applying forest laws.

5.3 Investment climate for the private sector

Ethiopia is among the fastest growing economies in the world and the second most populous country in Africa. This offers tremendous investment opportunities. The International Monetary Fund (IMF) recently reported that the Ethiopian Government's investment-led policy had achieved robust growth and progress on the Millennium Development Goals (IMF 2014). In 2013, Agriculture and the service sector still contributed more than 40% of the GDP each. In line with the positive development of this frontier market, Ethiopia also increased its annual foreign direct investment from USD 1.9 billion in 2011 to USD 5.7 billion in 2013. However, according to the World Bank Doing Business Survey, Ethiopia has been slightly losing ground over the last two years (World Bank 2014). In the 2015 survey, **Ethiopia was ranked 132 out of 189 economies** (www.doingbusiness.org/data/exploreeconomies/ethiopia/).

Ethiopia is not yet on the map of the global commercial forest industry. According to a 2012 rating by the International Woodland Company (IWC), which is among the leading institutional forest investors, Ethiopia is currently in the middle of the African league, and there is much room for improvement moving forward. Compared to Tanzania and Mozambique at the top of the list, less land is available in Ethiopia. And compared to South Africa, which has the most advanced commercial forest and forest industry sector in Africa, Ethiopia has less forestry/human capital. A holistic understanding of a successful business climate reveals that socio-economic development is embedded in a productive forest landscape in such a way that environmental services are enhanced (e.g. water-flow, carbon sequestration and biodiversity protected) while any damage is mitigated as far as possible in line with domestic and international safeguards. In this context, forestry as a business requires entrepreneurship including skills and capacity as well as an enforced regulatory framework to attract domestic and international finance. Government policy and action plays an important role in this regard. A public-private dialogue (PPD) where the private sector and Government will interact and agree on agenda items for action will be orchestrated to further elaborate on the current barriers to private sector engagement and the proposed solutions. In an effort to advance towards the PPD, the Review identified the major constraints to private sector investment and community/smallholder involvement[13] as described below.

[13] See Annex 3 for a strength, weaknesses, opportunities and threat (SWOT) analysis of the sector investment climate.

Land availability for reforestation and restoration

The land area currently available for commercial sawlog and woodfuel production is unclear. This includes the land suitable for assisted natural regeneration (ANR) and forest restoration. In parallel to conservation and sustainable management of existing forests, Ethiopia has recognized the need to establish different types of productive forests to reduce pressure on natural forests and woodlands and to ensure that rising demands from internal and regional markets are met with sustainable and domestically produced wood products. At the UN New York declaration on forests in September 2014, Ethiopia committed to reforest 7 million ha of land and restore 15 M ha of degraded lands to meet the goals of the Bonn Challenge. The first step in achieving this goal is identifying and demarcating suitable and conflict-free land to establish plantations and implement ANR. To prevent land use conflicts, participatory land use planning and PFM approaches are required, where communities collectively engage in forest management and rightfully claim land use rights. The reforestation process must follow environmental and social impact assessment standards. State Forest Enterprises, within their mandate and with support from specialized institutions, are best positioned to clarify community claims. The Government responded to the demand for ready-to-invest land by establishing the Ethiopian Agricultural Investment Land Administration Agency. However, available information suggests that this agency has not yet allocated forest land to any investor. An alternative model would be that the State Forest Enterprises provide concessions to private forest investors. However, no such land concession agreement has yet been reported.

OFWE, the largest forest land holder in Ethiopia, reported that it has recently finalized its land demarcation process in the highlands and it estimates that its concession area, including woodlands, covers roughly 2.7 million ha. Most of the area is natural forest, but it also includes a plantation area of 57,000 ha. It can be assumed that a small part of the total concession area is suitable for reforestation or ANR activities. The Amhara Forest Enterprise (AFE) has not yet demarcated its concession area, but started a plantation area of 32,000 ha. In the other regions, plantation areas are even smaller and management and enforcement capacity is expected to be lower. Thus, the largest area for reforestation activities is on private land. As mentioned in the previous chapter, it is estimated that

Box 1: Uganda sawlog production grant scheme

In 2004, Uganda had less than 4,000 ha of forest plantations left, far too little to meet the local demand. Hence the Sawlog Production Grant's Scheme (SPGS) was established to reflect the new forest policy that the private sector will play a major role in commercial forestry. The first phase of SPGS was supported by the European Commission (EC) and Norway later co-financed the second phase. In the upcoming third phase (2015–2020), the EC will invest EUR 16 million. SPGS is providing technical assistance and financial incentives by reimbursing roughly 50% of the plantation establishment and maintenance costs in staggered payments. Conditions for the payment include compliance with quality standards (e.g. only improved seed was used, trees have been properly weeded). By 2012, SPGS had supported more than 300 private forest owners and community associations to establish 47,000 ha of forests. As a result, Uganda today has a visibly vibrant forest industry with a reforested area amounting to around 70,000 to 80,000 ha. These professionally managed forests produce timber more cost competitively compared to the illegal logging operations in the natural forests, thereby reducing forest degradation pressure, in particular along the Albertine Rift Valley – one of Africa's most biodiverse places. The SPGS generated long-lasting benefits for Uganda's economic development. It created private investor confidence in commercial forestry and leveraged substantial private investments, estimated in the range of USD 80 million. Now Uganda benefits from a sustainable resource base, which is starting to attract private investments in modern timber processing plants (e.g. plywood). In addition, the SPGS pioneered the introduction of improved seed, commercialization and the promotion of hybrid clonal planting material, certifying tree nurseries and forest contractors to improve the quality of service delivery and promoting modern silvicultural practices (SPGS, 2014).

nearly 1 million ha of small-scale woodlots exist and that they are growing at a rate of 1.5% per year. **Integrating private small-scale land owners through out-grower schemes offers the most promising approach for commercial reforestation.** Given rising rural population pressures, there are limited possibilities for forest companies (especially international companies) to buy or lease large areas of land for plantation establishment. A promising approach is commercial timber production schemes established as a public-private partnership between OFWE, private investors and small-scale woodlot owners. Core commercial sawlog production areas can be established and managed by OFWE, in a joint venture with a private investor or commercial timber company. This is combined with engagement of surrounding smallholder sawlog producers who receive technical support on growing, managing and marketing sawlogs and quality seedlings to improve production. While not directly comparable with industrial timber plantation, successes and lessons learnt from the out-grower scheme and community bamboo forest management can inform the process. There are also experiences from other countries that could further inform the development of appropriate approaches for the Ethiopian context (see Box 1 for the Ugandan experience).

Access to finance

A significant amount of public and private capital from foreign and domestic investors is needed to meet the sector's productivity goals (USD 356 million by 2033). A series of interviews carried out with the Government and IMF in October 2014 revealed the limited financing available for the industrialization of forestry. The Ethiopian Development Bank for example does not provide specific credit lines for forest investments, only for investments in timber processing industries. Commercial banks, due to lending restrictions, are focusing on short-term credits with high yielding returns. Hence for the forest sector there is no access to domestic credit and State Forest Enterprises are required to invest revenues into GTP priority areas. Governments can play a useful role in triggering initiatives for addressing this issue by organizing sector-specific fora bringing together potential investors and commercial banks.

The state provides few incentives (e.g. tax breaks until start of timber production) for large-scale investments that broaden the resource base. The importance of forestry is not recognized by relevant authorities. This is in contrast to land for agricultural investments, which is clearly indicated in investment authorities' procedures. Direct investment incentives in forest management are not provided. Given the already restricted resource base, further investment in wood processing industries is unlikely. Foreign investors prefer sectors such as agriculture and manufacturing of textiles, plastics and metal. Incentives and insurance are needed to overcome the problem of long gestation periods and relatively low financial returns from some plantation-based investments.

Small and medium forest enterprises in particular face significant difficulties in accessing capital. Interviews carried out with smaller businesses indicate limited knowledge of available financing tools, demonstrating the lack of sector-specific information and the difficult interaction between SMFEs and the formal banking sector. Credits lines adapted to small-scale forestry investments are needed to foster growth and business improvements. Collateral needs to be feasible and adapted to SMFEs and administrative requirements for loans need to be harmonized into accessible and comprehensible packages, made available in rural areas.

Technical efficiency and best management practice

Resource matching, technology and markets are key criteria for success in forestry. Production sites are selected using a site–species–market approach. This means only promising sites will be selected and species will be matched with site conditions and market requirements. Considering that quality seedling production is lacking in Ethiopia, the option to attract a commercial clonal eucalyptus nursery investor e.g. from South Africa should be considered. To ensure the plantation is established using state-of-the-art practice and innovation in species and seed production, international expertise will be sought from business actors. Government investments, joined with private sector investment support, are strongly aligned with the GTP strategy. Foreign direct investment in parti-

cular, can bring technology, sector know-how, and significant additional capital.

Investing in forestry staff provides a promising model for incorporating international best practices incorporated into daily management. Enterprises interviewed for this Review stated very high staff retention, which is considered positive given that in-house capacity remains particularly important for the workforce. However, at managerial level, it can be a sign of stagnation, i.e. staff see little opportunity elsewhere and/or feel overly secure in their positions and as a result have little incentive to improve performance. Moreover, autonomous knowledge transfer based on experience elsewhere does not take place, which is further exacerbated by limited internal capacity building efforts. In the interviewed enterprises, all management positions are filled by Ethiopians with limited experience outside Ethiopia. Further international exchanges, including in the region, should be fostered.

Markets

Enterprises engaged in the forest sector in Ethiopia benefit from the strong internal demand, driven mainly by the construction sector. Much of the development is focused in and around Addis Ababa, making it the biggest market for industrial wood products in the country. Eucalyptus is used primarily for scaffolding and form works, as well as transmission poles bought by the EEPCO. Cypress and pine are used for internal construction purposes such as roofing and to make reconstituted wood products (particle board, plywood) for interior design. Other big but largely informal markets include furniture production and traditional housing construction, which uses mainly smaller eucalyptus poles. Strong domestic demand allows for the sale of many types products of different quality categories.

Formalization of trade can raise government revenues, improve sector efficiency and visibility, and support transformation towards an increasingly export-oriented sector that contributes to foreign currency earnings. Much trade in the sector is currently informal and even large real estate developers like Sunshine Investment Group/ Sunshine construction PLC source materials partly through traders rather than with the original producers. Informal trade is currently resulting in significant losses in government revenue. Although supplying domestic markets with sustainable and high quality timber and wood products is important, strategic investments that increase productivity and overall production can increasingly move the sector towards exports. Exemplified by Ethiopia's growth rates, the country is endowed with favorable conditions for plantations (Bekele 2011).

Green public procurement policies for construction material and furniture can support sector growth. Public markets should be **made transparent and open for the private sector**. Preference should be given to products that are in line with the CRGE strategy supporting green construction and low emission economy. In combination with the Ministry of Finance and based on a detailed fiscal analysis, tax benefits for wood processing machinery and transport vehicle imports should be provided. Public procurement policy should support the use of modern wood products in the construction sector and public housing programs. Utility poles for electrification and raw material production for the domestic pulp and paper industry should be prioritized to avoid future imports.

Business associations

The private forestry sector can be significantly strengthened by establishing business associations, both for growers and wood processors. None of the stakeholders interviewed was affiliated with or knew of private sector organizations, e.g. associations, syndicates or unions of growers, or processors or traders in the sector. Rather, each company works on its own or in some cases has a bilateral relationship with similar enterprises. The absence of such organizations contributes to the low visibility of the sector and means government has to engage with individual firms rather than a broader platform, if at all. Such associations can play an important role in providing room for the private sector to voice their demands, pool resources, and render resource access more organized. Especially for small-scale woodlots owners, such platforms provide a means of communication that encourages knowledge sharing and experience exchanges.

5.4 Regional analysis

The above description of the investment climate takes a national perspective. However, since Ethiopia has a strong federal structure it is also important to review the investment climate from a regional perspective. Oromia has the strongest institutional capacity in the forest sector and therefore has also attracted the first REDD+ pilot project (see section 2.10 on environmental services). Box 2 below describes OFWE, a model used for the establishment of the AFE. Other regions with substantial forest cover such as Benishangul-Gumuz, Southern Nations Nationalities and People Region (SNNPR) and Gambella have no regional forest enterprises and the Bureau of Agriculture is responsible for forestry.

Ethiopia's federal system of administration with nine regional states and two city administration councils devolves significant power, allowing regional states to raise revenues, plan and implement their own development activities – including natural resources management – within the framework of the policies and proclamations issued by the federal government. The Government of Ethiopia has increased its focus on sustainable environment and forest management and development over the past decades, which is reflected by regional priorities and investment plans. Several environmental and development issues have been incorporated in the constitution, and various relevant strategies, policies and proclamations related to sustainable development have been adopted. For example, the Oromia 2003 forest proclamation recognizes community ownership as the third ownership category, additional to state and private ownership and Oromia sees PFM as a promising forest management approach.

5.5 Research and education in the forestry sector

Forestry research began in Ethiopia around the mid-1950s and was consolidated in the 1970s through the establishment of the Forest Research Centre (FRC) and the Wondo Genet College of Forestry and Natural Resources (WGCF-NR), which is now part of Hawassa University. Initially, forestry research and related education was focused on plantation forestry and forest restoration through ANR to support and provide technical assistance for plantation establishment and peri-urban fuelwood development projects. The current forest education and research agenda can be broadly divided into the following seven categories:

1. **Natural forest research:** understanding the nature of Ethiopia's natural forests, such as their species composition, regeneration ecology, carbon stock and growth conditions. More recently, sustainable forest management aspects that focus on sustainable wood extraction have been included in the research agenda.
2. **Plantation and agroforestry:** screening various species (exotic plus indigenous) for energy plantation, industrial plantation, agroforestry pur-

Box 2: Oromia Forest and Wildlife Enterprise (OFWE)

The Oromia Forest and Wildlife Enterprise (OFWE) was established in 2009 to manage forests on behalf of the regional state. In 2008/2009, OFWE had an annual turnover of approximately USD 14 million and more than 2,100 staff. In the original set-up, a Forest Fund administered by OFWE kept the profits and was used for a number of purposes set out in the regulation including: (i) support forest and natural resource development work; (ii) finance studies; and (iii) introduce modern technologies to boost OFWE production and productivity, establish new industries, and participate in investments. OFWE seed financed one of the most successful commercial banks in Ethiopia, the Oromia International Bank, the Oromia insurance company and other investments. Since 2013, OFWE has been managed by the Oromia Government Supervisory Agency administering the profits of OFWE and five other state-owned enterprises. OFWE with permission of the Oromia Supervisory Agency can enter into joint ventures with foreign companies.

Note: Regulation No. 122/2009

poses and for rehabilitation of degraded lands. Stand silviculture management such as spacing, weeding, pruning, thinning and the like are also covered.

3. **Wood utilization research:** characterization of indigenous and exotic tree species for timber and various applications. This category covers for example: characterization of wood properties, studying seasoning behavior and durability, termite resistance, and wood chemical treatment behaviors. Characterization of underutilized indigenous and exotic species is also a research topic aimed at expanding species choices for timber use.
4. **Tree seed research:** biology and physiology of tree seeds from the perspective of storage condition requirements, longevity, germinability and treatment requirements, nursery life span and seed pathology.
5. **Non-timber forest products:** understanding and managing the resources base, improving production and productivity; investigating less known and used NTFPs, their socio-economic importance, trade, and marketing.
6. F**orest protection:** pathological and entomological studies related to Ethiopia's forests, fire control and other related topics are covered.
7. **Socio-economic aspect:** understanding socio-cultural values of forests, their local and national contributions, value chain and market aspects of forest products, imports and exports.

This comprehensive program demonstrates how the research agenda has expanded rapidly over the last five to ten years. However, the quality of education and research is considered to have been declining. Conventional field assessments and experiments dominate the research project portfolio. These are not irrelevant as such, but are often poorly designed and suffer from weak follow-up, leading to a limited number of successfully completed projects as well as unpublished research results. Second, most research personnel lack the required skills and experience to successfully design and implement scientifically rigorous and innovative experiments. Third, most experiments lack proper data collection protocols, documentation, data analysis, and interpretation.

Furthermore, the link between research and sector development is very weak, in part due to the poor forestry extension system. The development impacts from past and current research are generally considered low. The forest research system is poorly equipped and lacks modern facilities, further exacerbating the problem. Existing laboratory facilities are old and most equipment worn out or out of order. However, for state-of-the-art research such as cloning, genetic characterization or wood research, modern laboratory equipment is essential. The research system also suffers from the lack of skilled personnel in some disciplines such as wood technology, forest protection, forest genetics, as well as laboratory technicians for modern and high tech equipment operations. To better allow the forest research system to support and influence forest development in Ethiopia, these constraints need to be addressed and extensive human and institutional capacity building support need to be provided.

The barriers to improving the effectiveness of research include the lack of attractive job opportunities in the forest and wood processing sector, both for researchers and practitioners. This results in less motivated students applying for forest-related courses and less qualified graduates looking for work in the sector. This is despite the highly attractive current career and business opportunities related to payments for environmental services (e.g. related to REDD+ or hydropower payments) and the prospects of attracting forest investments in plantation and timber processing.

Research and education recommendations

In order to improve the forest research and education system in Ethiopia, the following recommendations are provided:

- Improve demand for high quality education and research by developing a forest industry and bio-economy that offer attractive career opportunities, particularly in rural areas;
- Make the education system more career-based, for example by including a six-month compulsory practical course;
- Develop a flexible curriculum allowing for modification based on changing needs, and allowing for guidance to be provided by a forestry education advisory committee consisting of state forest enterprise, private forestry/timber processing entrepreneurs, NGOs, research organizations, etc.;
- Implement at EEFRI and Wondo Genet results-based career systems with performance in-

dicators such as peer-reviewed publications and student scoring for quality teaching. High performing staff need to be rewarded and a career path offered, while those with low performance may need to be transferred to more suitable positions;
- Manage forest research and education institutions well and provide reasonable resources. Encourage quality education at all levels;
- Attract Ethiopians with PhDs and timber engineering degrees who are working abroad to return to Ethiopia by offering preferential loans for returning entrepreneurs, teaching opportunities for late career returning experts or by financing high profile young researchers working on selected key forestry and wood processing technologies (see tentative list below).

Proposed key forest and wood processing technologies for applied research investments

To develop a competitive forest and wood processing industry, substantial investments in quality research and industrial development are required. Technology developed also has to be well-coordinated and managed in partnership between research organizations and the industry. Tentatively, the following technologies have been identified for targeted investments:

1. Clonal nursery technology and high value seed propagation and certification
2. Development of a bio-economy based on modern timber product processing and manufacturing
3. Inclusive business innovations for sustainable forest management and commercial plantation forestry engaging communities and large-scale industries
4. Ecosystem services and sustainable use of biodiversity
5. Environmental and social safeguards for sustainable economic development.

For each key technology, research and development programs should be supported based on competitive tender and implemented together with international partners.

6 VISION 2033 FOR THE ETHIOPIAN FOREST SECTOR DEVELOPMENT

The following indicates the major development potential of main sub-sectors identified as having the most promising potential to contribute to Ethiopia's industrialization goals. The Vision builds on the baseline scenario analysis and identifies promising development pathways and investment requirements for each sub-sector. In addition, the GDP contribution and employment benefits for each development pathway are presented. The investment pathways aim at addressing the estimated roundwood gap for the year 2033 through industrial development. Table 47 below summarizes the key inputs and outputs for the sub-sectors based on a joint effort in investments in industrial plantations and industrial processing facilities, followed by a qualitative description of each sub-sector.

6.1 Construction sector

The construction sector represents the most important source of demand over coming decades, justifying its prioritization for forest sector investments in industrialization. The expected increase in total demand from 6.7 million m^3 to 11.2 million m^3 by 2033 is driven by residential construction – with around 0.8–0.9 million new and replacement housing units built annually – as well as a growing commercial construction sector for non-residential purposes (offices, hotels, shopping malls, administration). Alongside the increase in total demand, the type of wood products required will also change. The small poles and low quality chipwood and lumber currently dominating the sector should gradually shift towards higher quality wood products (kiln dried lumber, MDF/HDF/OSB panels, interiors). This is a tendency based on changing consumer requirements/preferences, including:

- Growing per capita income increases the surface area of middle class private housing units, which are increasingly built using modern, attractive designs with wooden elements serving constructive and decorative functions.
- Large-scale commercial construction requires standardized formwork and scaffolding systems, which can be easily set up and re-used several times (such systems can either be made of steel/aluminum or of quality wood products).

The construction sector could be an important driver of green growth, supporting Ethiopia's transition to a new, sustainable development model in line with the CRGE strategy. The use of wood as a major construction raw material could partly or fully replace high emission construction material, such as aluminum, plastics or cement. The estimated industrial roundwood gap for the construction sector in 2033 of more than 3.4 million m^3 is mainly driven by demand for higher quality industrial wood products (panels and sawnwood) used for modern housing designs and non-residential buildings. Currently, Ethiopia does not have the adequate resource base (industrial plantations) or domestic industry required to meet this demand. Thus, establishment of an industrial plantation base to produce the wood products demanded by the construction sector should be an immediate priority. This dedicated and high quality resource base should attract the investment required for development of a sophisticated wood processing industry.

It is important that Ethiopia capitalizes on opportunities for forest sector industrialization offered by the construction sector. Incorporating these strategic investments in the GTP2 will help ensure that high quality wood products are not substituted with alternative products (i.e. steel) or imports. Ethiopia can harness private sector investment in the 245,000 ha of high quality plantations[14]

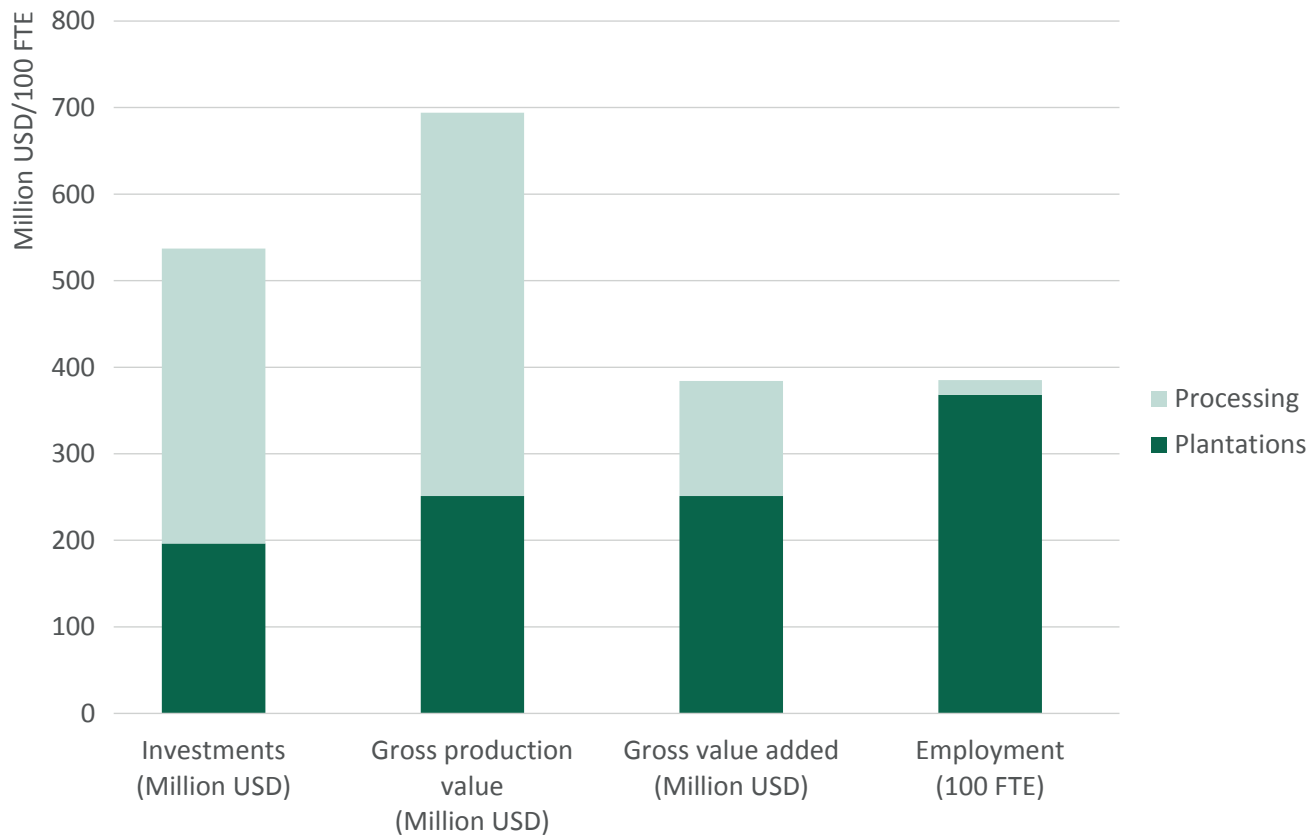
[14] Assuming a harvesting volume of 250 m^3/ha of Eucalyptus after 18 years average rotation.

Table 47: Investment requirements for, and additional economic impact of, plantation establishment in 2033, by sub-sector

	Construction	Furniture	Utility poles	Total
Roundwood Gap				
Gap in 2033 (million m³)	**3.4**	**0.5**	**0.5(d)**	**4.4**
Area required (1,000 ha)	**245**	**35**	**30**	**310**
Plantation investment requirements to fill gap				
Investment requirements (USD/ha)	800	800	800	
Productivity per m³/ha (final harvest)	250	250	200	
Rotation (years)	18	18	12	
Total investment in plantations (million USD)	**196**	**28**	**24**	**248**
Employment benefits				
Employment factor plantations (FTE/m³ production)	0.15	0.15	0.15	
Additional employment plantations	**37,000**	**5,000**	**4,500**	**47,000**
Gross production value/gross value added at current price 2013 (USD/m³ production)	74	74	19	
Additional GVA contribution plantations (million USD)	**251**	**36**	**10**	**297**
Processing industry investment requirements to fill gap				
Investment requirements (USD/m³ intake) (a)	100	50	50	
Total investment requirements (million USD)	**341**	**24**	**25**	**390**
Employment factor (FTE/1,000 m³ intake) (b)	0.5	4	0.4	-
Additional employment	**2,000**	**2,000**	**200**	**4,000**
Gross production value processing at current price 2013 (USD/m³ intake)	130	284	130	544
% of GVA of gross production value according to good industry practice	30%	40%	50%	-
GDP contribution (million USD)	**133**	**55**	**33**	**221**
Total investment (million USD)	**537**	**52**	**49**	**638**
Total additional employment	**39,000**	**7,000**	**5,000**	**51,000**
Annual additional GDP contribution at current price (million USD)	**384**	**90**	**43**	**518**

Notes: (a) Investment requirements have been estimated based on a per m³ intake. However, there is significant room for variance, since technologies and equipment vary, e.g. whether for a few large sawmills or numerous small ones; (b) Employment factors are based on good industry practice based on investments in modern processing lines. Modern industries usually require fewer labor inputs. However, depending on the configuration it might be more cost effective to invest in labor-intensive, low-tech equipment; (c) Woodfuel GDP contribution is a theoretical figure, since this product is unlikely to be offered on the free market in the required amounts and consumers (mainly rural households) will not have the purchasing power to pay for their woodfuel needs; (d) Previous chapters on Utility Poles and Wood Balance, no direct gap has been quantified as it was assumed that available roundwood from plantations will preferentially feed this supply instead of construction timber. However, for the development options this assumption could not be verified.

Figure 23: Construction sector investment requirements and benefits



required by providing clear policy signals accompanied by improvements to the investment climate. Private sector engagement can also help to ensure plantations are managed according to best practice.

Investments in the construction sector will contribute to a dynamic domestic industry with export potential and the ability to supply downstream enterprises. Investments are required in industrial processing (i.e. sawmilling, kiln drying, fiber board production, prefabricated construction elements and secondary processing of quality interiors). As shown in Figure 23, the total investment in the plantations base and industry is estimated at USD 537 million. Total additional employment is estimated to be 39,000 FTEs and an additional GDP contribution of almost USD 400 million (at current price) is expected. To ensure the sector thrives, this Review recommends introducing a modern wood-based housing construction program to ensure Ethiopia's growth is built using sustainable and domestically produced wood products. This should be combined with a training and capacity building program for modern wood processing and wood-based construction.

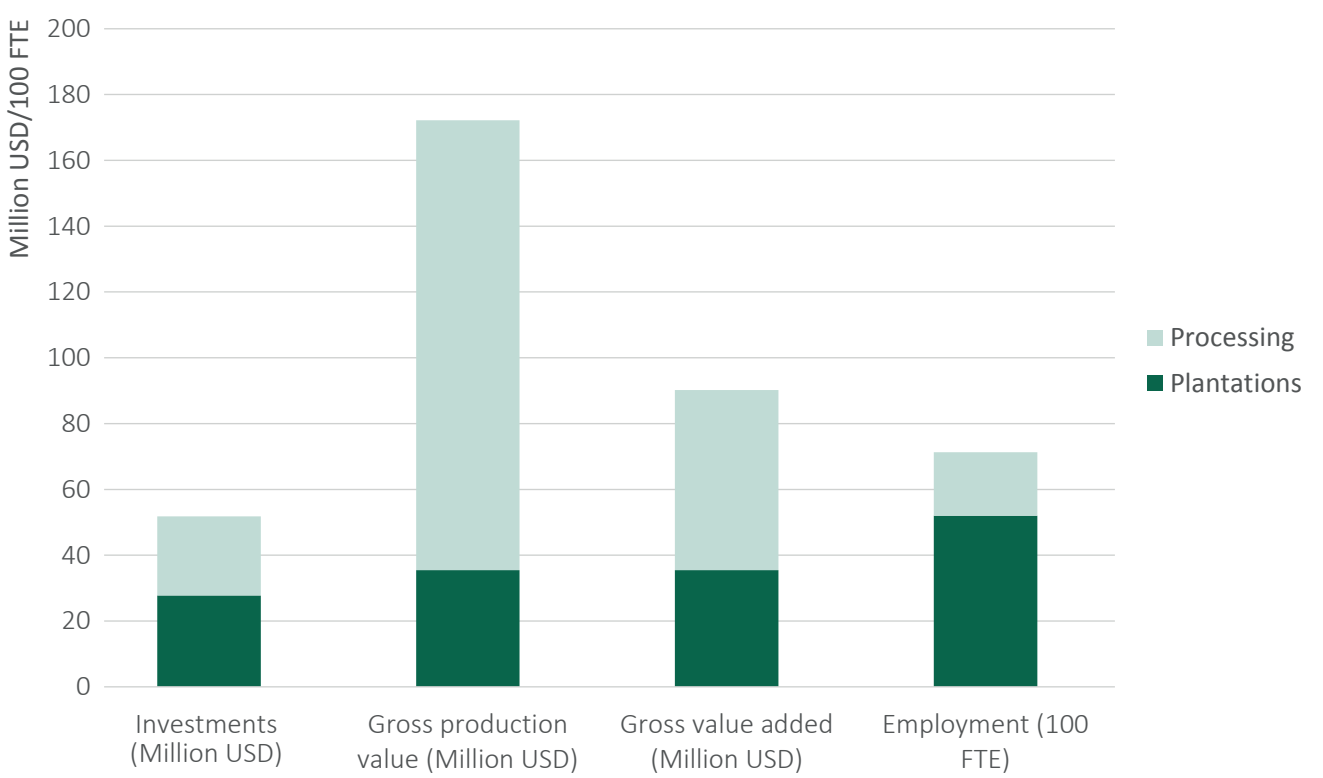
6.2 Furniture sector

Furniture consumption patterns will evolve in line with increasing purchasing power in urban centers and a growing middle class, with demand increasing from 0.8 million m^3 in 2013 to 1.8 million m^3 in 2033. This figure does not include commercial and public sector demand due to a lack of data. Thus, the increment may be significantly higher. Furniture will increasingly become a lifestyle product with frequent changes and shorter replacements cycles. In general, average furniture consumption per household will increase and the quality, functionality and design will increasingly influence the decision parameters of furniture consumers. Commercial demand will increase with ongoing GDP growth and economic activity in urban business centers. New hotel and commercial centers will require standard office furniture and the tourism sector requires modern furniture for rooms and restaurants. In addition, public sector demand for offices and schools ensures steady demand for standard furniture equipment.

Value adding and employment creation per m³ intake in the furniture industry is the highest in all wood processing sub-sectors. Total additional employment is estimated to be more than 8,700 FTEs and an additional GDP contribution of USD 172 million (at current price) is expected. The sector today is dominated by demand for low standard furniture for rural and urban households. Around 40% of Ethiopia's furniture is currently produced by formal and informal SMEs with low quality standards, sourcing raw material mainly from unspecified sources. Efficiency and quality improvements should be fostered through capacity building and training, especially for SMEs. Given the significant employment creation (> 40,000 in 2013), investments to enhance the competitiveness of these companies, i.e. through technical upgrading and financial capacity building are important and currently lacking. For example, the production of quality furniture requires kiln-dried timber as a pre-requisite. To ensure in-country production of such inputs, investment in drying facilities is a crucial step that can result in significant value chain upgrading in this sub-sector.

The public purchase of sustainably produced furniture from domestic sources could contribute to achieving economic and environmental development goals. Ethiopia should consider public procurement policy that aims to source furniture made from domestic sources of sustainably harvested wood. This would have a direct impact on natural resource protection by promoting sustainable forest management and sparking the need for establishment of sustainable plantations. The demand resulting from this policy would foster private sector confidence, attracting investments in the resource base and accompanying industry. The large furniture industry currently uses un-dried lumber and domestic chip-wood complemented by imported high quality products (veneer, plywood, kiln-dried lumber). If domestic industries are not able to provide the required volumes and qualities, the growing future gaps will be closed by imports or substituting other furniture materials. To avoid this situation, Figure 26 below shows the total investment requirements in plantations and industry, estimated at USD 47 million. The estimated roundwood gap in the furniture sector in 2033 is 0.5 million m³, which would require a well-managed plantation area of around 35,000 ha. This plantation area should include higher quality species for upper class furniture.

Figure 24: Furniture investment requirements and benefits

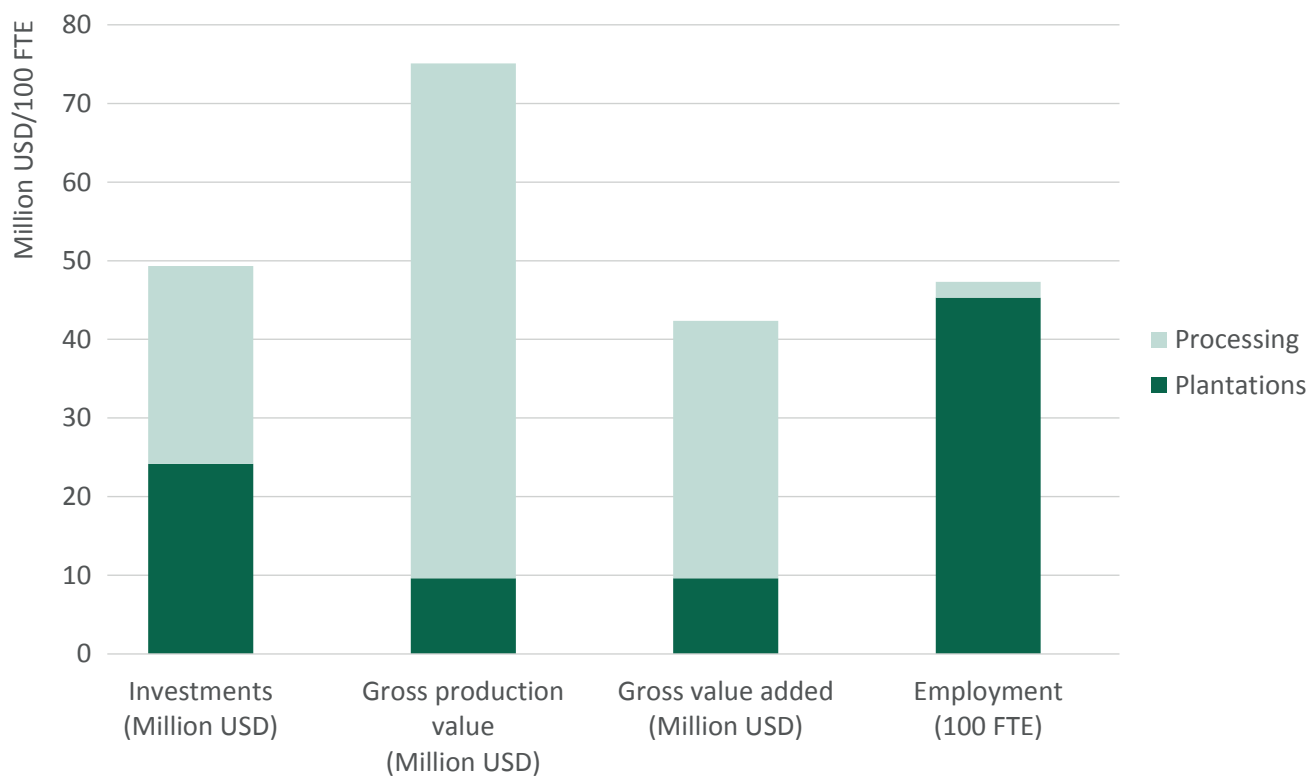


6.3 Utility poles

Driven by national electrification plans, utility pole (transmission pole) demand is projected to increase significantly in the coming years. Baseline scenario calculations suggest that an average of 400,000 m³ poles will be required annually. Ethiopia will likely experience additional demand from neighboring countries such as Kenya, where demand for poles is currently estimated at one million per year and from South Sudan, where no suitable pole plantations and pole treatment facilities exist.

The current plantation base will not support production of the required quantities moving forward, since existing resources are over-mature and unsuitable in terms of dimension and quality. Moreover, pole treatment capacities in Ethiopia are currently composed of four treatment plants (max. capacities unknown) run by the EEPCO, which is at the same time the main consumer of these poles. The establishment of specialized utility pole plantation cycles presents a promising business case due to the comparatively short rotation cycles (maximum 12 years) and the resulting early return on investment. Total plantation requirements in terms of area amount to 30,000 ha. This area could include replanting existing public plantations as appropriate or private plantation establishment. Assuming average annual capacities of 100,000 poles per modern plant, four processing plants would be needed to meet demand. This could be covered by existing plants if capacity was improved. Establishment of new treatment plants may also be necessary, depending on the location of the newly established plantations. As shown in Figure 27, total investment volume in the plantations base and industry is estimated at USD 44 million. Total additional employment is estimated to be more than 5,000 FTEs and an additional GDP contribution of USD 75 million (at current price) is expected.

Figure 25: Utility poles investment requirements and benefits



6.4 Woodfuel

Addressing woodfuel production and consumption requires immediate and comprehensive government action to protect natural forest resources, including woodlands. In contrast to the aforementioned sub-sectors, the aim of woodfuel sector development is to decrease wood consumption. In the long term, it is expected that woodfuel will lose relative importance as an energy source (as indicated in the baseline scenario). However, in the short to medium term, action is needed to reduce the significant pressure currently placed on forests and woodlands. Total woodfuel consumption will significantly increase, from 116 million m^3 in 2013 to 142 million m^3 in 2033. The share of woodfuel sourced unsustainably will increase to 80 million m^3, severely threatening Ethiopia's remaining natural forest resources. On the other hand, per capita woodfuel consumption will decrease by 27%, which is driven by ongoing rural electrification. In addition, it is expected that many woodfuel consumers will switch to other fuels (i.e. in areas where woodfuel is already scarce) and adopt improved cooking stoves to reduce demand.

Private woodlots currently cover 6% of the woodfuel demand, indicating the economic viability of woodfuel plantations for rural landholders. To close the projected woodfuel gap of 80 million m^3 in 2033 with sustainable sources, a plantation estate of almost 4 million ha is required. The investment costs of around USD 2 billion related to such an effort could be reduced if these plantations are established in cooperation with farmers receiving support from government extension services. The main challenges will be: (a) mobilizing the required financial resources, (b) finding enough land to establish the woodfuel plantations (whether commercial or smallholder plantations), and (c) providing farmers with materials and knowledge to implement the activities, and (d) competing with agricultural land. Considering the low value adding factors per m^3 fuelwood (ca. 16 USD/m^3), investments in woodfuel plantations are not considered to be a priority investment that supports transformation to industrial development as laid out in the GTP 2 agenda. Total direct and indirect employment benefits generated through this large-scale activity are difficult to estimate (ca. 200.000). The gross production value in 2033 of these investments in plantation establishment would be more than USD 1 billion at current fuelwood market prices. This production value can only be realized if the rural population is able and willing to pay for fuelwood. As rural households increasingly move towards a cash economy and purchase fuelwood, they could also pay for electricity (note electricity price and fuelwood prices were roughly the same in 2013). Improving rural households' access to affordable electricity may reduce the required plantation area. However, it can be expected that electricity will not fully replace firewood for cooking. The ongoing improved cookstove distribution program is also a considerable factor affecting woodfuel demand moving forward.

7 CONCLUSIONS AND KEY RECOMMENDATIONS FOR GTP2

Ethiopia's forest sector development requires a number of strategic investments and actions to ensure the significant gaps between supply and demand are met with sustainably produced domestic wood products moving forward. Investments in the forest resource base and processing capacity for construction, furniture, and utility pole production can contribute significantly to national CRGE goals of sustainable and climate smart development while generating forest-based jobs and supporting rural development. The future wood product supply gaps present challenges but also significant opportunities for Ethiopia to meet the growing domestic demand for wood products through industrialization, forest establishment, and sustainable forest management. Increasing sector productivity through these investments will contribute to achieving Ethiopia's goals of establishing and sustainably managing 7 million ha of forests before 2030. Moving forward, partnerships between public and private actors and communities are considered a promising model for achieving sector development goals. Taking the findings of this Review into account, the following policy recommendations are proposed.

Invest first in the forest resource base, including through smallholder engagement: As Ethiopia's forest resource is limited and continues declining, the establishment of commercial plantations is a priority and has the potential to address deforestation by reducing pressure on natural forests and woodlands and providing sustainable sources of wood products to reduce the projected future supply gaps and support implementation of the national REDD+ strategy. Given limited land availability, woodlots should play an important role in transforming the sector to one that produces high-quality industrial timber. Experience in other African countries suggests that quality timber production can be achieved through the establishment of a core dedicated commercial plantation combined with out-grower schemes that engage surrounding communities. This approach fosters technology spill-over from commercial plantations to woodlot owners and generates significant local socioeconomic development while meeting the commercial timber production demands of a country increasingly modernizing its construction and housing sectors.

Secondly, invest in forest industry: From the different sub-sectors identified, the construction sector, the furniture sector and utility pole markets are the priority areas which can contribute substantially to increasing the sector's industrialization. In order to achieve this, substantial investments are required in the resource base and industrial capacity for timber transformation. Private sector engagement, including through public-private and community partnerships will play a crucial role in meeting the sector investment requirements.

Reinforce capacity and extension: The establishment of peri-urban plantations and private woodlots, combined with a plantation program to produce industrial roundwood and poles, established through a partnership of private investors, government and communities through an out-growers scheme should be technically supported through a functional forest extension system.

Engage private sector: With limited government financing for the industrialization, the forestry sector would benefit significantly from increased engagement of the private sector to provide additional capital and know-how. Investment-ready land needs to be identified and a tangible incentive system needs to be put in place to encourage investment in the sector taking into account the long-term nature of investments in forests/trees and the need for a relatively large area to make economically viable investments. Continuous efforts should also be put in place to ensure the private

sector is well informed of investment opportunities that exist in the forest sector. Foreign investment can also provide the technology, skills and international best practice required to increase sector productivity, including modern nursery establishment and tree breeding programs for promising species and clones.

Facilitate access to finance: A national or regional Forest Fund, providing concessional loans, loan guarantees or result-based incentives by partly reimbursing plantation establishment and maintenance, should be established to channel and attract investments in forestry and mobilize domestic private capital. This fund should also have a dedicated technical assistance facility that can provide capacity building support.

Establishment of sector business associations: Strengthening existing and establishing new tree growers' and timber manufacturer associations is crucial for strengthening the sector's political visibility and allowing it to speak in a more united voice.

Research and education: A forest information and research action plan should be elaborated to harness the potential of research and improved knowledge management to advance sector development through informed and evidence-based policy making. An applied research agenda needs to be combined with an incentive system to attract and maintain motivated and well-qualified professionals to the sector.

Demand-side policy: A public procurement policy requiring sustainable and quality certification for key wood products should be considered to encourage investments in sustainable forest management, industrialization and professionalization of the sector. This helps to ensure domestic enterprises contribute a significant share of the country's growing demand for wood products. Public policy should also consider introducing a modern wood-based housing construction program to ensure higher quality wood products have a sustainable source of demand. In parallel, unsustainable fuelwood demand needs to be addressed in the short to medium term by providing affordable electricity as an alternative to unsustainable woodfuel extraction, which is an important driver of deforestation and forest degradation in natural forests and woodlands.

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ANNEXES

Annex 1: Main laws and policies affecting forests

Annex 2: Investment climate SWOT analysis

Annex 1: Main laws and policies affecting forests

Policy or law	Main objective	Limitations
Environmental Policy of Ethiopia (1997)	Sustainable development of natural and cultural resources, including agriculture, forest, biodiversity, water	
Highlights importance of community participation and integrated management	Lacks clear implementation timeframe and procedures through legal provisions	
Environmental Impact Assessment Proclamation (299/2002)	Seeks to predict and manage environmental effects of proposed development activities through transparency and accountability	Conflicts with land lease policy for agriculture investment which is generally considered generous
Forest Conservation and Utilization Policy and Strategy (2007)	Support forest sector productivity to meet demands for forest products Increase contribution of forests to national economy through promotion of private forest development	Does not recognize or incorporate participatory forest management
Proclamation to Provide for the Development, Conservation & Utilization of Forests (542/2007)	Legalizes the above forest strategy. This proclamation is currently under revision	The proclamation does not elaborate the incentives provision for private investors as in the forest policy and strategy (2007), focusing more on the duties and obligations of private forest developers than on the incentives to attract them.
Rural Land Administration and Land Use Policy and Strategy (2004)	Ensures state and public ownership of rural land, including participation and rights of land owners in land management; registration and holding certificates	
Federal Rural Land Administration and Land Use Proclamation (456/2005)	Establishes sustainable use and favorable system of rural land administration in Ethiopia through cadastral mapping and land certification	
Investment and agriculture development policy	Agriculture sector is considered highly investment friendly	
Growth and Transformation Plan (GTP) (2010-2015)		
Resettlement and food security policy		Much resettlement results in clearing of forests. Besides the formal government-led resettlement programs, individual farmers descend from highlands and spontaneously settle in forested areas, carving out farm plots with little restrictions.

Policy or law	Main objective	Limitations
National Energy Policy (1994)	Indicates the development and utilization of traditional energy resources to meet national energy security. It recognizes supply of alternative sources to increase the national energy supply mix and ease the pressure on biomass resources. Recognizes the need to increase the biomass energy source through afforestation, re-forestation and agro-forestry schemes, and also develop the bio-fuel program for transport fuel. The policy requires that all energy developments consider environmental protection.	The policy is not clear in its details, or has little plan to show how it intends to increase the biomass energy source through afforestation, reforestation and agroforestry schemes.
Federal Investment Proclamation (2012)	Provides overarching framework for regional investment proclamations on allocation of land for investment Provides private investors the right to use land for "agricultural development activities" in accordance with federal and regional laws.	
Agricultural Development-led Industrialization (ADLI) Strategy (1993)	Aims to strengthen the linkages between agriculture and industry by increasing the productivity of small-scale farmers, expanding large-scale private commercial farms, and reconstructing the manufacturing sector so as to use the national human and natural resources	

Annex 2: SWOT analysis of forest sector investment climate

Strengths	Weaknesses
■ Costs of land are low and provided on a long-term basis to investors by Regional States and the Ethiopian Agricultural Investment Land Administration Agency ■ Moody has increased Ethiopia's credit worthiness to B+ which has opened up Ethiopia's access to commercial foreign loans ■ Ethiopia recently attracted the first private equity funds (Schulze Global Investment, Ascent Rift Valley Fund), which will provide experience with related financing vehicle ■ First class forest growth conditions in the highlands but very high population density and competition with food crops ■ Strong political support from newly created Ministry of Environment and Forest ■ Increasing recognition by development partners to support the development of a commercial forestry sector (e.g. Norway, World Bank, Finland and Germany) ■ Government willingness to highlight forest sector in next GTP	■ Land availability unclear and land tenure situation requires development of partnership models with communities ■ Limited access to affordable long-term finance ■ Foreign private financial institutions cannot operate in Ethiopia ■ Despite offer to provide land at low cost, limited investor interest to invest in forestry ■ Lacking institutional and individual commercial forestry and timber processing expertise ■ Requirement to purchase government bonds equivalent to 27% of each commercial loan and for commercial banks to hold 40% of loans in short-term credits is restricting access to long-term affordable capital ■ Transport logistics is poorly organized and relatively expensive ■ Limited commercial forestry expertise ■ Lack of professional clonal nursery ■ Legal restrictions on charcoal production and timber production from sustainable natural forest management ■ Investment code 1996 restricts foreigners from investing in sawmilling and timber production
Opportunities	**Threats**
■ Road infrastructure investments are expected to reduce production/transport costs and crowd in private sector forest investments ■ Joint ventures between local enterprises and foreign companies can provide access to new technology (e.g. clonal nurseries, timber processing equipment), skills and knowledge ■ FSC certified charcoal and timber production from sustainable natural forest management ■ Potential to meet growing demand for paper, construction wood and furniture ■ Export diversification and import substitution through forestry ■ Pole market for rural electrification will be growing	■ Limited institutional and individual commercial forestry and timber processing expertise ■ Competition from, or market control by, state-owned enterprises ■ Foreign currency shortages or capital transfer restrictions ■ Weak cross-sectoral collaboration, placing forests at risk of conversion to other land use such as agriculture ■ Better investment climate for forestry in other countries in Africa (and elsewhere) ■ Population growth and continued degradation associated with current practices.

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