



Tanzanian Wood Product Market Study

Final report for the Forestry Development Trust

Tanzanian Wood Product Market Study

Client

Forestry Development Trust (FDT)

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CONTENTS

Acknowledgements.....	9
1 Executive summary	10
2 Objective and approach	16
3 Supply analysis	17
3.1 Introduction.....	17
3.2 Commercial tree plantations in Tanzania.....	17
3.2.1 Plantation area and ownership.....	17
3.2.2 Plantation Species	21
3.2.3 Plantation quality and productivity	21
3.3 Timber supply forecast.....	22
3.3.1 UNIQUE supply forecast to 2035	22
3.3.2 Comparison of Indufor and UNIQUE supply forecasts.....	30
3.3.3 Supply from natural forests	32
4 Demand analysis	33
4.1 Historical trends in wood products demand.....	34
4.2 Actual wood product demand.....	35
4.2.1 Domestic consumption	35
4.2.2 International trade.....	37
4.3 Demand forecast 2035	43
5 Supply-Demand Analysis.....	45
5.1 Sawlog SDA.....	46
5.2 Wood fibre SDA	48
5.3 Transmission pole SDA	49
6 Wood products markets in Tanzania	50
6.1 Market environment	50
6.2 Market segments.....	50
6.2.1 Construction.....	51
6.2.2 Carpentry and furniture	56
6.2.3 Packaging and pallets.....	59
6.2.4 Transmission poles.....	61
6.2.5 Paper products.....	62
6.2.6 Biomass	65

6.3	Wood product prices in Tanzanian markets	66
6.4	Export markets	67
6.4.1	African export markets	68
6.4.2	Middle East export markets	76
7	Plantation based value chains in Tanzania	78
7.1	Sawn timber	78
7.1.1	Current state, trends and outlook	78
7.1.2	Value addition & profitability.....	82
7.1.3	Strengths, weaknesses, opportunities and threats	85
7.1.4	Key constraints and potential interventions.....	88
7.2	Transmission poles	90
7.2.1	Current state, trends and outlook	90
7.2.2	Value addition & profitability.....	91
7.2.3	Strengths, weaknesses, opportunities and threats	93
7.2.4	Key constraints and potential interventions.....	94
7.3	Veneer and plywood	96
7.3.1	Current state, trends and outlook	96
7.3.2	Value addition & profitability.....	97
7.3.3	Strengths, weaknesses, opportunities and threats	99
7.3.4	Key constraints and potential interventions.....	101
8	Business models for transition of the sector	103
8.1	Characterization of the four clusters.....	105
8.2	Innovative business models	108
8.2.1	Sawn timber business model	109
8.2.2	Veneer/plywood business models.....	113
8.2.3	EWP business models.....	117
8.2.4	Prioritization of business models per cluster	124
9	Recommendations	126
9.1	Plantation data	126
9.2	Transition of value chains and cluster development	126
9.3	Transition of the market environment.....	127
10	Bibliography	130
11	Annex	132

LIST OF FIGURES

Figure 1: Tanzania's 2016 plantation areas by ownership and species	18
Figure 2: Distribution of pine and eucalyptus plantations and woodlots in the Southern Highlands, 2013	20
Figure 3: Plantation species composition	21
Figure 4: Scenario 1 – total wood supply forecast to 2035 by ownership (including thinnings)	24
Figure 5: Scenario 1 – supply forecast to 2035 by species and product regime.....	25
Figure 6: Scenario 2 - total wood supply for years to 2035 by ownership	26
Figure 7: Scenario 2 - supply forecast to 2035 by species and product regime	27
Figure 8: Sawlog assortments BAU – Scenario 1.....	28
Figure 9: Sawlog assortments - Scenario 2	28
Figure 10: Indufor's supply forecast for Tanzania to 2030 – standing volume (stumpage).....	30
Figure 11: UNIQUE's supply forecast to 2030 - standing volume (stumpage).....	31
Figure 12: Wood consumption by main product in Tanzania in 2013	35
Figure 13: Wood consumption by main market segment in Tanzania in 2013	36
Figure 14: Tanzania trade balance of wood products in 2013.....	37
Figure 15: Wood product imports Tanzania 2011-2015	38
Figure 16: Hardwood sawnwood imports from Malawi 2010-2015 and average import prices	38
Figure 17: Treated poles/post imports from South Africa 2010-15 and average import prices	39
Figure 18: Wood based panel imports from China, Kenya, Malawi and South Africa 2010-2014 and average import prices in 2014.....	40
Figure 19: Wood product exports Tanzania 2011-2015.....	41
Figure 20: Wood furniture exports Tanzania 2011-2015.....	41
Figure 21: Wood furniture imports Tanzania 2011-2015	42
Figure 22: Paper products trade balance and domestic consumption for Tanzania 2011-2015	43
Figure 23: Forecast of wood products consumption in Tanzania 2035	44
Figure 24: Consumption of wood products in Tanzania by market segments 2035.....	44
Figure 25: Summary Supply-Demand Scenario (Business As Usual scenario)	45
Figure 26: Sawlog/plywood SDA 2015-2035 under BAU (scenario 1).....	46
Figure 27: Sawlog/plywood SDA 2015-2035 under extended rotation for STGs (scenario 2)	47
Figure 28: Wood fibre supply demand balance 2015-2035.....	48
Figure 29: Eucalyptus pole supply demand balance 2015-2035.....	49
Figure 30: Floor area annually constructed in Tanzania 2005-2013	52
Figure 31: Wood product demand forecast in Tanzanian construction 2013 to 2035	54
Figure 32: Demand forecast for carpentry and furniture in Tanzania 2013 to 2035.....	58
Figure 33: Wood pallet demand forecast 2035	60
Figure 34: Transmission pole consumption by TANESCO and REA and short-term forecast	62

Figure 35: Paper consumption in Tanzania 2011-2015.....	63
Figure 36: Paper consumption forecast for Tanzania 2013 to 2035.....	64
Figure 37: Wood products imports by Ethiopia, Kenya, Zambia, Rwanda, Uganda and Malawi in 2013	69
Figure 38: Wood products imports by East African countries in 2013	69
Figure 39: Wood products imports Ethiopia 2010-2015.....	70
Figure 40: Wood products imports Kenya 2010 and 2013	71
Figure 41: Wood products imports Zambia 2010-2014	72
Figure 42: Wood products imports Rwanda 2010-2015.....	73
Figure 43: Wood products imports Uganda 2010-2015	74
Figure 44: Wood products imports Malawi 2010-2015	75
Figure 45: Wood products imports by Saudi Arabia 2010-2015.....	76
Figure 46: Wood products imports by United Arab Emirates 2012-2014	77
Figure 47: Wood products imports by Oman 2012-2015	77
Figure 48: Sawn timber value chain	81
Figure 49: Value addition along the sawn timber value chain.....	83
Figure 50: Stumpage price for diameter classes in government plantations (TFS)	84
Figure 51: Cutting schemes using standard dimensions.....	84
Figure 52: SWOT sawn timber value chain	87
Figure 53: Pole value chain	91
Figure 54: Value addition along the transmission pole value chain	92
Figure 55: SWOT pole value chain.....	94
Figure 56: Veneer & plywood value chain	96
Figure 57: SWOT Veneer and plywood value chain	101
Figure 58: Proposed Clusters in the Southern Highlands of Tanzania.	107
Figure 59: Key assumptions feeding into business models.....	108

LIST OF TABLES

Table 1: Plantation areas in Tanzania 2013* and 2016.....	18
Table 2: The large industrial plantation investors in Tanzania	19
Table 3: Management assumptions used for supply modelling – Scenario 1.....	23
Table 4: Scenario 1 – supply forecast to 2035 by species and product regime	25
Table 5: Scenario 2 – supply forecast to 2035 by species and product regime	27
Table 6: Approx. annual average projected stumpage volumes (m ³) 2016 – 2030	32
Table 7: Forecast assumptions on wood products consumption and substitution in the construction sector.....	55
Table 8: Forecast assumptions on carpentry and furniture consumption and substitution	58
Table 9: Wood product prices encountered in regional markets, mill gate prices and average import prices.....	66
Table 10: Sawmill technologies being used in Tanzania	80
Table 11: Prices and profits along the sawn timber value chain	82
Table 12: Constraints and potential interventions in the sawn timber value chain.....	88
Table 13: Revenue from 1 hectare of Eucalyptus versus Pine for one rotation	92
Table 14: Constraints and potential interventions in the transmission poles value chain	95
Table 15: Log classes suitable for veneer and plywood production	97
Table 16: Capital investment for veneer and plywood production	98
Table 17: Constraints and potential interventions in the veneer and plywood value chain	102
Table 18: Investments requirements for sawn timber production.....	110
Table 19: Economics of sawn timber business model	111
Table 20: Further optimization potentials for sawn timber model	112
Table 21: Priority in the different clusters for sawn timber model	113
Table 22: Investments needed for veneer and plywood production	114
Table 23: Economics of plywood business model.....	115
Table 24: Further optimization potentials for plywood model.....	116
Table 25: Priority in the different clusters for plywood model.....	117
Table 26: Investments needed for blockboard production	118
Table 27: Economics of blockboard business model	119
Table 28: Further optimization potentials for blockboard models.....	120
Table 29: Priority in the different clusters for blockboard model	121
Table 30: Investments needed for gluelam production.....	122
Table 31: Priority in the different clusters for Gluelam case	123
Table 32: Priority in the different clusters	125

ACRONYMS

BAU	Business As Usual
CCA	Copper Chrome Arsenate
CIF	Cost, Insurance & Freight
EWP	Engineered Wood Products
FDT	Forestry Development Trust
GDP	Gross Domestic Product
GHG	Green-house gas
GoT	Government of Tanzania
GRAS	Green Resources AS
KVTC	Kilombero Valley Teak Company
LVL	Laminated Veneer Lumber
MAI	Mean Annual Increment
MDF	Medium Density Fibreboard
MNRT	Ministry of Natural Resources and Tourism
MPM	Mufindi Paper Mill
NDCs	Nationally Determined Contributions
NBS	National Bureau of Statistics
NFC	New Forests Company
NHC	National Housing Corporation
NRB	Contractors Registration Board
PFP	Participatory Forest Management Program
R&D	Research and Development
REA	Rural Electrification Agency
rwe	round wood equivalent
SDA	Supply and demand analysis
SHIVIMITA	Tanzania Forest Industries Federation (Shirikisho la Viwanda vya Mimitu Tanzania)
SMEs	Small Medium Enterprises
SPGS	Sawlog Production Grant Scheme
STGs	Small Tree Growers
SUT	Supply Use Table
TAFORI	Tanzania Forest Research Institute
TANESCO	Tanzania Electricity Supply Company
TANWAT	Tanganyika Wattle Company
TBA	Tanzania Building Agency
TBS	Tanzania Bureau of Standards
TFS	Tanzania Forest Service
ToR	Terms of Reference
TRA	Tanzania Revenue Authority
VC	Value chain
VCA	Value Chain Analysis
WP	Work package

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1 EXECUTIVE SUMMARY

Introduction

The Forestry Development Trust (FDT) is working with all segments of tree grower and numerous public and private forestry service providers in Tanzania's Southern Highlands, seeking to transform the commercial forestry sector by facilitating market system changes. A special emphasis is placed on ensuring small to medium scale tree growers enhance their position and contribution within the commercial forestry sector.

UNIQUE completed this wood product market study to help assess the current state of the sector and propose a set of recommendations that FDT and other actors in the sector can pursue to support the transformation. This executive summary first sets out the current conditions in the sector, focusing on the supply base, the processing landscape and demand for wood products. It then highlights the scale of the opportunity in Tanzania, which is significant, before recommending how these opportunities can be realized.

Supply and quality of plantations

Small and medium scale tree growers are a key supply source for the sector

The current forest plantation area in Tanzania (including small scale woodlots) is estimated to be 325,000 hectares, with the key species being pine (65%) and eucalyptus (20%). The balance is largely made up by Teak and Black Wattle.

Previous studies underestimated the contribution of small and medium scale tree growers, but the recent remote sensing study completed by FDT highlighted their growth as a segment and importance as a source of supply in terms of hectares planted. It is estimated that in 2016 circa 174,000¹ hectares were owned by small and medium scale tree growers, 54% of the total, with the balance consisting of 100,000² hectares of TFS plantations (31%) and 51,000 hectares of large private plantations (15%), owned by five major actors. The small-scale grower segment is also the one segment with strong potential to make future gains in both productivity and area.

This shift in the supply base has major implications for the sector, as small and medium scale tree growers typically use local low quality seed, practice poor silviculture and practice short rotations. This results in woodlots that produce poor quality, small diameter trees and are substantially less productive than the large private plantations. In addition, the disaggregated and dispersed nature of small scale tree growers renders it challenging to service them with cost effective processing solutions that maintain quality. There must therefore be a recognition that whilst the supply base is growing, and being driven by small and medium scale growers, this is not a direct substitute for large plantation supply that is higher quality, more cost effective to process (for most value chains) and has a more reliable supply flow.

¹ Calculated through modelling taking into account age structure and assumed rotation lengths as specified in Section 3. Baseline is a reported small and medium scale tree growers' area of 169,000 ha for 2013 (FDT, 2016).

² Calculated through modelling taking into account age structure, assumed rotation lengths and TFS planting activity for 2013 – 2016 (TFS, 2017). Baseline is an area of circa 84,000 ha in 2013 (AFF, 2011; TFS, 2016). See Section 3 for details.

Supply conditions are variable across the Southern Highlands

In addition to the rise of the small and medium scale tree growers, there needs to be recognition of the different supply conditions experienced within the Southern Highlands, that have a direct impact on the viability of investments by private actors, public sector and development initiatives. The viability of any proposed business model in an area will be determined by a set of enabling conditions that include the volume of woodlots, quality of woodlots, dispersal of growers, aggregation of growers, predictability of supply, quality of infrastructure and presence of lead actors demonstrating good practice. Historically this has led to the sector and supply base developing fastest near government plantations, as the infrastructure and security of supply has led to investments that have crowded in other market actors.

Volume is limited due to short rotations and poor silviculture being practiced

Considering the hectares planted in Tanzania and the favorable growing conditions, the overall volume of standing timber is low and of poor quality due to poor silviculture and short rotations employed by the majority of tree growers in the Southern Highlands.

The processing landscape

The current supply base is a key constraint to processing investment

The current supply base remains a key constraint on the processing landscape in Tanzania, with the majority of sawn timber processors remaining small entrepreneurs operating mobile ding dong type sawmills with low recovery rates of 20-35% and producing low quality sawn timber. Where woodlots are dispersed, of poor quality and limited in volume, these highly mobile millers are the only actors able to utilize small log volumes from poorly accessible woodlots profitably, and therefore currently constitute an important outlet for small tree growers (STGs).

This current state, and especially the dispersed nature of supply, emphasizes the requirement to improve the productivity and quality of woodlots to improve grower returns and enable a commercial proposition for processors to invest in better quality processing technology that can increase both the recovery rates and the quality of sawn timber. Without this step change in quality and productivity, it is likely that the business model for better quality processing will remain unattractive in a significant proportion of the Southern Highlands.

Where enabling conditions are sufficient there has been investment in the sector

Despite ding dongs remaining the primary processing technology, especially to service STGs, there are examples of investment in processing from new and existing players, in stationary mills processing higher quality sawn timber and also veneer and plywood facilities. While they are sometimes being hampered by limited access to finance and technology, these cases have demonstrated that where the enabling conditions are right, and the supply of sufficient raw material of acceptable quality can be assured, investment can be attracted to drive value in the sector.

Demand for wood products

The demand for wood products is expected to continue to grow

Wood product demand is driven largely by the construction, furniture and paper sectors. Other sectors using wood are power transmission, using eucalyptus poles (a key market for STGs) and the transport sector consuming wood in the form of pallets and boxes. Wood product demand is expected to grow strongly, more than doubling in round wood equivalent (rwe) between 2013 (national consumption of 2.3 million m³ rwe) and 2035 (5.2 million m³ rwe), driven primarily by the construction sector and paper consumption.

There remains a challenge of poor quality products reaching the market

Despite the strong expected growth in demand, there are challenges related to the quality of current supply not always meeting market expectations, increasing the risk of substitution for alternative materials (e.g. steel, aluminum, concrete) or imports. This has been the case in the transmission pole market with the Tanzania Electricity Supply Company (TANESCO) considering switching to concrete poles and also with the requirement for treated sawn timber for quality roof trusses in construction. In addition, there is currently a lack of compliance with regulation and standards that further impacts the drive towards quality in the sector. For a strong and functioning commercial forestry sector, there is the requirement to ensure that there are clear market signals between the end market and suppliers to ensure demanded products are delivered to the market.

Interconnectedness of supply, processing and demand

Credible sector solutions need to drive greater productivity in small grower woodlots

The supply, processing and demand landscape for commercial forestry in Tanzania are highly interconnected, requiring any credible value-driven solution to ensure sufficient focus on driving better productivity of current STG woodlots. As well as negatively impacting growth and standing volume, poor quality woodlots reduce the financial viability of improved processing technologies, which in turn reduces recovery rates and quality of processed timber. This can then have a knock-on effect of depressing demand for end products as they are not of sufficient quality for the market and substitutes are sought.

With small and medium scale tree growers now accounting for the majority of hectares planted, enabling them to lengthen the rotation of their woodlots and also practice better silviculture to increase productivity and quality, remains the critical constraint that development actors should aim to address to drive transformation of the sector. There are however certain areas in the Southern Highlands where the enabling conditions are sufficient today to drive profitable processing investment. These areas should also be targeted to ensure progression of the sector, as other interventions areas develop the longer-term quality of supply base.

Supply / Demand gap

If current practice continues, the supply deficit will continue to grow

Based on the hectares planted and an estimation for productivity and of rotation age by each supply segment (assuming continuation of current practice), a forecast supply volume was estimated at 3.2 million m³ (rwe) in 2035. When compared to the demand forecast there remains a supply deficit in the market, which increases significantly between 2025 and 2035 to a supply gap of 3 million m³ (rwe). The supply – demand gap is mainly constituted by large diameter sawlogs for sawn timber and veneer production (1.4 million m³) and wood fibre for pulp and particle/fibre board (1 million m³). It is expected that progress in the sector will be able to reduce the deficit, as there are significant gains to be made from: a) increasing productivity; b) lengthening rotation; and c) increasing recovery rates through better processing technology. For example, lengthening STG rotations from currently 12 to standard 18 years for sawn pine timber reduces the sawlog supply gap by 50%.

Scale of the opportunity

The commercial forestry sector in Tanzania has significant potential to increase the incomes of small tree growers as well as drive industrialization and employment in primary and secondary value chains.

STGs will benefit from increasing the value of their standing timber and by being incorporated into more productive value chains

STGs will benefit primarily by increasing the value of their standing timber achieved through better silviculture and lengthening rotation, but they will also benefit if additional markets for their trees can be created, and if they can work together as groups to aggregate supply and create more certainty of supply for processing investments.

The sawn timber value chain will remain the key value chain for STGs in the Southern Highlands and can provide significant gains in efficiency and quality if the enabling conditions for better processing can be met and the switch away from ding dongs to more efficient band saws can be made.

The transmission pole value chain is potentially attractive to STGs due to the relatively quick and high return on investment but the market remains limited by the national market outlook for poles in Tanzania.

The veneer/plywood value chain is relatively new but is potentially attractive to STGs as it offers a new market for short diameter eucalyptus logs and an alternative use for woodlots originally planned for poles. Nonetheless, quality requirements for raw material are key and must be primarily addressed to further develop this market segment.

The production of wood fibre for pulp, particle and fibre board could be a promising market option for STGs if large industrial actors invest in processing industries, organize raw material supply from STGs in out-grower schemes, and substantially support STGs in improving growth performance and product quality.

Industrialization of the sector and in secondary value chains has the potential to drive significant benefits

As well as industrialization within the commercial forestry sector (through processing investments), improving the quality, consistency and the availability of wood used in other value chains, such as construction, furniture and paper production, has the potential to lead to significant growth in these sectors, creating further jobs and also having substantial income and tax revenue benefits for Tanzania. In addition, the comparative advantage provided by the growing conditions in the Southern Highlands means the sector has the potential to be competitive regionally for wood products.

Realizing the opportunities

A cluster approach is a suitable way to consider processing investments

Apart from the continued support to woodlot establishment and management by STGs, there are other potential interventions - crucial to the long-term development of the sector - that can help to support processing investment in areas where it is commercially viable. These include:

- a) Identifying areas of high plantation/woodlot forest cover as a basis for the development of wood processing industries;
- b) Development area forecasts to determine the appropriate type and scale of industries;
- c) Support potential investors during feasibility and business planning, and design of suitable aggregation structures including operationalization of growers' associations and development and implementation of supply-demand information systems;
- d) Vocational training related to technical skills required by processing industries;
- e) Training STGs in log grading according to potential product classes; and
- f) Promotion of more adaptive forest management regimes (in particular for eucalypts) which can – to some extent – address short-term changes in markets while catering to the limited planning horizon of small growers.

The business model and commercial viability are key to delivering sustainable outcomes

When considering potential business models for new investments there are a minimum set of conditions that must be met. There must be a minimum annual wood production of the required dimension and quality, acceptable transport infrastructure and distance to trading points, at least basic organization of STGs in groups which can act together, and other infrastructure suitable for a wood based industry. The criteria will change depending on the type and scale of the investment, but the quality and productivity of woodlots in a dispersed environment will often be the key determinant of commercial viability and remain a localized constraint in much of the Southern Highlands. In addition to commercial viability, the existing entrepreneurial capacities of the area will be important as lead actors can help to catalyze change.

The business models set out in the main report, namely, quality sawn timber, veneer and plywood, blockboard and engineered wood products (EWP) are all valid opportunities if the right conditions are met.

In addition to the specific focus on opportunities for interventions within value chains, there is also an opportunity to look to create the enabling sector conditions that will help support development of the sector. These include:

- Create a shared vision for the evolution of the sector between key public and private sector actors including focus on a positive investment environment;
- Improve communication between raw material producers, wood processors and final consumers of wood products;
- Promote application of and compliance with standards for raw material (log grading) and wood products (technical specifications); and
- Compile relevant information and data on:
 - Plantation based value chains and wood product markets, and their relevance for the environment, national economy and rural development.
 - The positive effects of sustainable biomass for national energy supply and GHG balance and of wood as construction material, and promote the results at policy level.
 - Initiate the dialogue with public sector actors to evaluate possibilities for pro-wood procurement policies.

Conclusion

The commercial forestry sector in Tanzania is in a period of transition as the supply base moves away from the large private and government plantations towards small and medium scale tree growers. This shift in supply has created challenges as the processing landscape is not set up to efficiently serve small growers and the quality and productivity of their woodlots are low, meaning the sector is performing well below its potential. With small and medium tree growers set to remain key players in the sector, there is therefore a vital need to ensure continued focus on driving higher productivity and quality in their woodlots.

From a market perspective, there is the requirement to look to catalyze investment in better processing technology, but only where a minimum set of conditions are met. Over time, as the productivity and quality of small tree grower woodlots increases and they evolve as grower groups, these conditions will start to be met in more areas of the Southern Highlands and stimulate further investment.

From a policy perspective, there is a need to ensure that there is an aligned vision for the evolution of the sector so that market actors can all contribute to the creation of a competitive, inclusive and resilient sector. This should help to demonstrate the potential of plantation based value chains and wood products markets, and their relevance for the environment, national economy and rural development. In addition, better linkages between different actors in the value chain should be sought, standards for raw material and wood products should be promoted and there could be the opportunity to try to drive pro-wood procurement policy from public sector sectors to help drive demand for wood products.

2 OBJECTIVE AND APPROACH

The Forestry Development Trust (FDT) aims to transform the commercial forestry sector in Tanzania by facilitating market system changes. To date, FDT's efforts have largely focused on the supply side – including tree improvement research, seed supply, and the development of tree grower services in support of woodlot establishment and management. However, the success of these investments is dependent upon the strength of wood product markets.

Hence, the objective of the present study was to develop an understanding of the wood product supply-demand situation and future supply-demand scenarios in Tanzania. The study findings are aimed at supporting the design of appropriate FDT strategy and interventions by highlighting opportunities for improving competitiveness and resilience of, and inclusiveness in the sector and formulating corresponding recommendations.

In support of this key objective, the study focused on:

- Understanding the current and future wood product supply-demand situation in Tanzania, considering domestic and international market dynamics.
- In-depth value chain analyses for a number of key products in order to understand the strengths, weaknesses, opportunities and threats for each product group.
- Developing a prioritized set of recommendations for FDT intervention to strengthen wood product markets and enhance the competitiveness, resilience and inclusiveness of the sector.

The study was implemented in three distinctive phases. In phase I, the approach and methodology guiding the data assessment and analysis were elaborated. This resulted in a concrete work plan for the implementation of phase II, the supply and demand analysis (SDA) and value chain analysis (VCA), and an exact definition of the timeline until delivery of the final report (phase III).

The study was conducted between September 1st 2016 and June 21st 2017, and comprised:

1. Thorough review of existing data and literature;
2. Two field missions of the team to the Southern Highlands to undertake the VCAs (October and November 2016; see Annex for list of interviewed actors);
3. Survey of regional wood product prices in Dar es Salaam, Mwanza, Mbeya, Arusha and Dodoma (October 2016);
4. Market survey in Dar es Salaam aiming at final consumers of wood products in various industrial sectors (November 2016; see Annex for list of interviewed actors);
5. Validation workshop in Dar es Salaam with stakeholders from the public and private sector (December 2nd 2016; see Annex for list of participants); and
6. Verification and review of draft report and model assumptions with FDT and PFP (January to June 2017).

3 SUPPLY ANALYSIS

3.1 Introduction

This chapter presents the predicted wood supply situation from forestry plantations in Tanzania. Information has been obtained from the Tanzanian Forest Service (TFS), FDT, interviews with the main private sector players and from published literature. It also includes the latest results from a remote sensing study of the Southern Highlands by FDT in 2016, which for the first time estimates the area planted by small tree growers (Figure 2). Combining this information, the wood supply situation for Tanzania was then predicted, using yield tables developed by Indufor for TFS (Indufor, 2011) and applying contrasting management regimes for the different species and categories of ownership. Various assumptions have had to be made (and these are explained in the text), notably due to the lack of detailed age structures, growth data and quality information for the private sector plantations and uncertainty regarding the degree of compliance with standard management regimes – especially rotation length and thinning interventions.

3.2 Commercial tree plantations in Tanzania

3.2.1 Plantation area and ownership

There are three main categories of plantation ownership in Tanzania – namely, large private investors, state-owned plantations and those planted by small-medium private tree growers. Whilst good information exists on the government plantations and the areas planted by the large, private companies in Tanzania, there has been much speculation in recent years regarding the extent of the plantation areas belonging to small private tree growers (STGs). FDT's 2016 remote sensing study (based on 2013 data) has largely answered this question, though detailed information on the plantations' ages and condition is still lacking. Table 1 summarizes the plantation areas, whilst Figure 1 shows the breakdown by species and ownership category.

State-owned plantations: The Government of Tanzania (GoT) has substantial (*ca.* 100,000 ha) timber plantations, of which over 50,000 ha is in the Southern Highlands. The Sao Hill plantation in particular has been the main supplier to the commercial forestry industry for many years and will continue to do so until the private sector's plantations come on stream.

Private sector: Private investment in tree plantations in Tanzania started around 1949 when the Tanganyika Wattle Company was set up around Njombe. The private sector has increasingly become the main investors in the commercial forest sector in Tanzania, with a plantation area in 2016 of around 51,000 ha.

The main drivers of this private sector investment in the sector have been the availability of large tracts of suitable land for commercial forestry plantations and the forecasts showing a growing demand for many forest products. The Southern Highlands have proven to be well suited to afforestation with pines and eucalypts in particular. Investors have been able to secure rights to large areas of land for tree planting, though this has proved more difficult in recent years and stalled the planned plantation expansion of many of the companies.

Table 1: Plantation areas in Tanzania 2013* and 2016

Plantation ownership	2013	2016	Notes	Source
State (TFS):				
Countrywide Sub Total	83,695	100,368	<i>60% (ca.50,000 ha) being Sao Hill plantation in S. Highlands</i>	AFF, 2011; FDT, 2016; TFS, 2016 & UNIQUE modelling
Large Scale Private (LSP):				
Green Resources Ltd	12,654	17,230	<i>Target 25,000 ha</i>	FDT, 2016 & UNIQUE interviews
TANWAT Ltd	15,000	15,000	<i>Inc. ca.6,000 ha of A. mearnsii</i>	"
Kilombero Valley Teak Co. Ltd.	8,200	8,200	<i>Land constraint to expansion</i>	PFP, 2016
Mufindi Paper Mills Ltd.	5,600	6,009		PFP, 2016
New Forests Co. Ltd	1,600	4,888	<i>Land constraint to expansion</i>	FDT, 2016 & UNIQUE interviews
Sub Total	43,054	51,327		
Small scale Tree Growers (STGs):				
Southern Highlands only	169,165	174,143	<i>Based on 2013 Landsat8 data; Southern Highlands only; avg. size 2,8 ha; ca. 60,000 tree growers</i>	FDT, 2016 & UNIQUE modelling
Sub Total	169,165	174,143		
Grand Total	295,914	325,838		

* 2013 figures are included since they form the base-line for UNIQUE's predictive models discussed later in this chapter. 2013 data sets comprised the most complete information. No more recent data was available, especially for large shares of national wood product demand and small and medium private plantation areas.

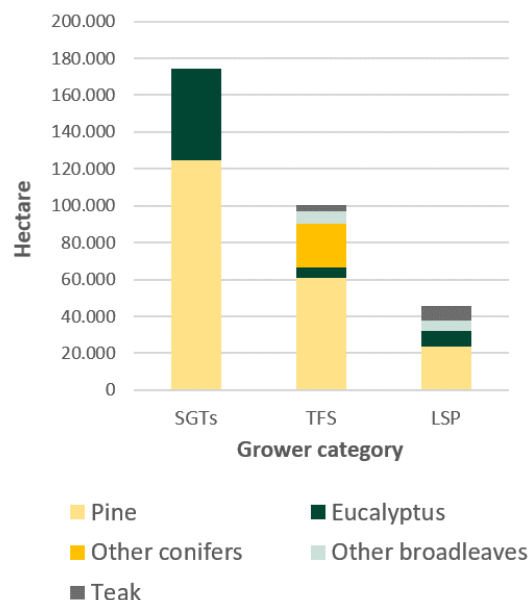


Figure 1: Tanzania's 2016 plantation areas by ownership and species

Source: see Table 1

The private sector can be divided into a small number of large ‘industrial’ investors and many thousands of small-medium scale growers. Table 2 shows the details of the large industrial companies involved in Tanzania’s commercial forest sector.

Table 2: The large industrial plantation investors in Tanzania

Company	Year started	Main spp.	Main products	Notes
Tanwat	1949	<i>Acacia mearnsii</i> ; <i>Pinus</i> spp.; <i>Euc</i> spp.	Tannin; pine sawlogs; eucalyptus poles; power (2.5MW biomass plant)	Established by Commonwealth Develop- ment Corporation - CDC; now Rai Group
Mufindi Paper Mill	1986	<i>P. patula</i>	Virgin natural sack kraft pulp	Rai group bought 2004; supplied from GoT's Sao Hill plantations
Kilombero Valley Teak Co. KVTC	1992	<i>Tectona grandis</i> (Teak)	Sawn timber	Estab. by CDC; since 2011 – Global Environment Fund - GEF (77%) & FinnFund (23%)
Green Resources Ltd.	1997	<i>P. patula</i> ; <i>Euc.</i> spp.	Sawn timber and poles	Planting target is 25,500 ha; new planting on hold since 2015
New Forest Company Ltd.	2006	<i>P. patula</i> ; <i>Euc.</i> spp.	Sawn timber and poles	Expansion plans on hold due to land shortage

Source: UNIQUE 2017

The details of the small-scale investors have only become apparent following FDT’s remote sensing study of the Southern Highlands region carried out in 2016 (Figure 2). Landsat8 images from 2013 were used and the preliminary data was validated on the ground by FDT to refine the estimates. The summary data was made available to UNIQUE in late 2016 and is presented in Table 3.

It is important to note that the remote sensing exercise does not detect trees four years or younger or woodlots of 0.8 ha or less; secondary field data was used by FDT to extrapolate. It is not known with any certainty how much of the planting (particularly of the small-scale growers) could be for fuelwood rather than other timber products.

Of note is the recent (November 2016) initiative by the Government of Tanzania and Government of Finland to make available ca. 80,000 ha of land for private investors in the Ruvuma region (PFP, 2016). Since this initiative is still in the planning phase, however, it has not been factored into the supply forecasts presented later in this section.

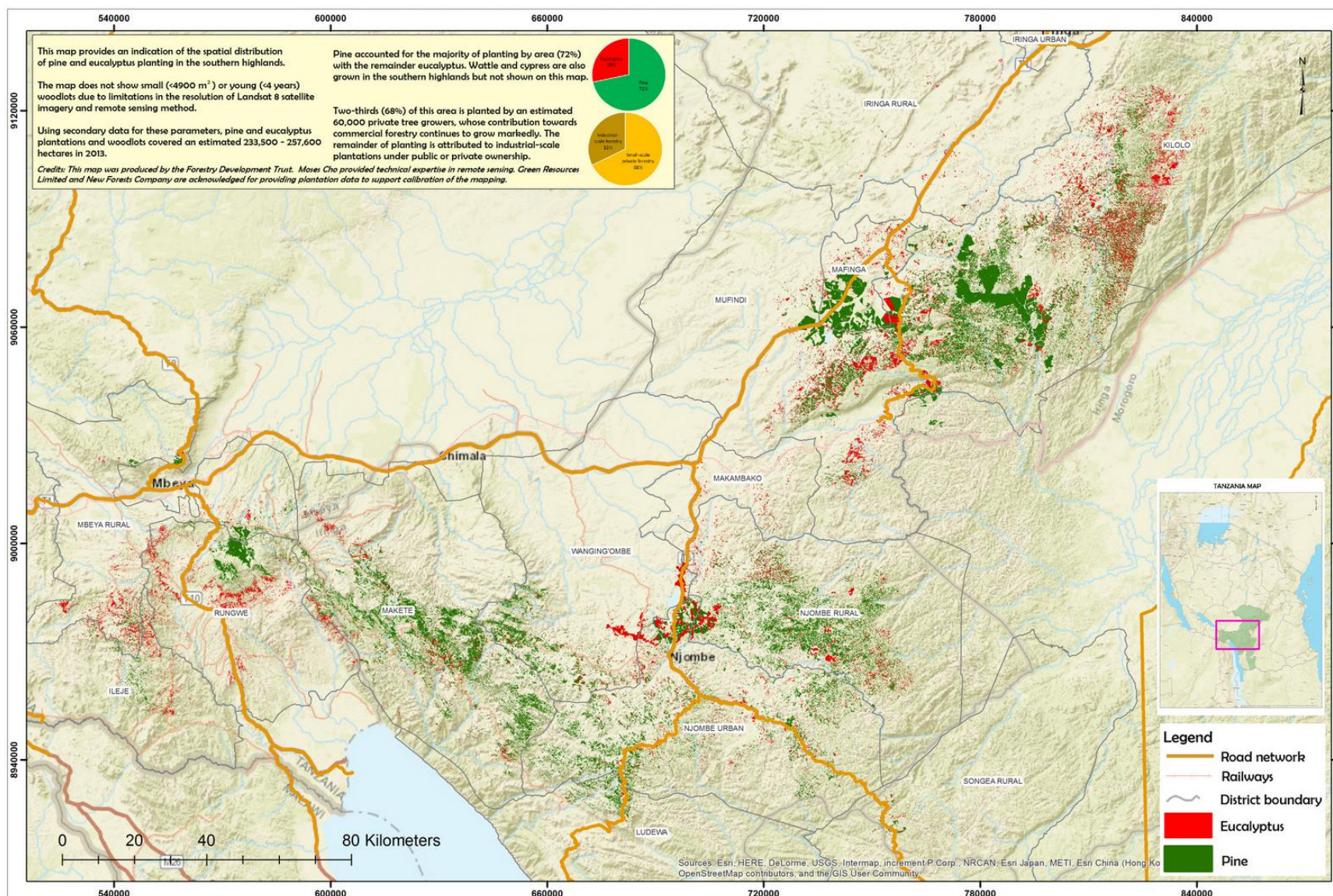


Figure 2: Distribution of pine and eucalyptus plantations and woodlots in the Southern Highlands, 2013

Source: FDT, 2016

3.2.2 Plantation Species

The species composition of the plantations is shown in Figure 3. Pines – and particularly *P. patula* grown for sawlogs – dominates with 65% of the total plantation area. Pines produce a general purpose timber for the construction and furniture industry and although the rotation is long (around 15-20 years to grow to the optimum size for efficient processing, depending on the growth and log size required), the logs are relatively easy to saw. Most small tree growers currently favour pines over other species, with many reported to sell their pines trees much earlier than 15 years in order to raise cash.

Eucalypts comprise 20% of the plantation area. *E. grandis* is the main species and is widely grown for bioenergy, small poles and for larger (transmission) poles. Eucalypts have not generally been grown for sawlogs in the region, although recent shortage of pine in the market place has stimulated a turn to eucalypts as a source of timber. Whether this leads to an increase in eucalypt planting specifically for sawlogs in the future remains to be seen.

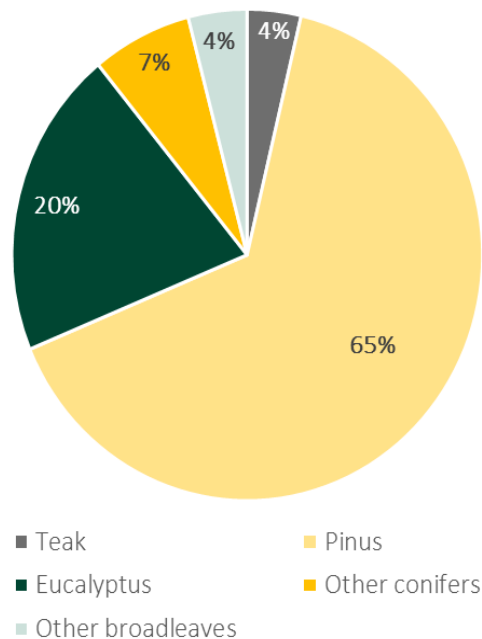


Figure 3: Plantation species composition in Tanzania in 2016 (Source: UNIQUE 2016)

Growers have also experienced difficulties accessing the eucalypt transmission pole market (which is further explained later in this report). Hybrid eucalypt clones – and especially *E. grandis* x *E. urophylla* (GU) – are now increasingly grown by the larger companies due to their resistance to major pests and diseases and their adaptability to specific sites. Small tree growers, however, generally do not have access to these improved, hybrid clones which are being introduced by the larger private companies (including through FDT’s collaborative tree improvement initiative) and are still under test within trials.

The ‘other broadleaves’ are mostly Black Wattle (*Acacia mearnsii*) and small areas of other species such as *Grevillea robusta*, *Milicia excelsa* and *Cedrela odorata*. ‘Other conifers’ comprises mostly *Cupressus lusitanica*, which produces a superior timber to *P. patula* but is significantly slower growing and susceptible to various pests.

3.2.3 Plantation quality and productivity

The key elements that impact positively on plantation productivity and quality are well known from countries where commercial plantation forestry is highly developed – for example, South Africa and Brazil. They include the following:

- Using only improved genetic material that has been tested in the environment being planted;
- Thorough land preparation – especially cultivation and pre-plant weed control;
- Timely planting, early in the rainy season;
- Ensuring high early stocking (survival) by quickly replacing dead trees soon after planting;
- Minimizing competition through intensive weeding until canopy closure; and
- For those plantations being grown for timber and select poles, timely thinning and pruning operations are then important.

Tree plantations in Tanzania show a wide range of quality and growth. TFS's plantations (and especially those in the Southern Highlands) have suffered from a lack of silvicultural treatments post-establishment, with little pruning or thinning undertaken. This has resulted in smaller diameter growth and poor quality, knotty logs. The large private sector companies are generally adopting appropriate silvicultural treatments to maximize sawlog (or pole) yields though there still remains some room for improvement to achieve higher growth rates and better quality logs. In contrast, the vast majority of the smaller growers in the Southern Highland region started with little or no technical advice on cultivating their tree crops. Hence most used unimproved, locally collected seed and many plantations are not weeded sufficiently. As the plantations grow, many of the small growers are not pruning or thinning their trees – at least in the proven way which would improve the quality and growth of larger trees. The consequences of this for the small growers are poor growth rates and low quality trees, resulting in crop yields often well below what the site could support and also lower financial returns than expected for the grower. Although sound advice on best practices of plantation management is provided by government extension, private outgrower schemes and programmes such as FDT and PFP, this information has not reached all tree growers and anyway, will take time to have an impact on the market.

3.3 Timber supply forecast

3.3.1 UNIQUE supply forecast to 2035

With new plantation data available from FDT, TFS and the current study, UNIQUE developed an Excel-based model to produce an updated prediction of the future supply of wood in Tanzania. As noted previously (Section 3.2.1) this model used 2013 data, being the most complete information on plantation areas. UNIQUE's model made certain assumptions in order to predict the growth of the forest resource over the next 20 years. These assumptions can be changed as new information becomes available or to explore various alternative scenarios. The main assumptions used are described below.

Areas and age classes were derived from various sources, namely:

- TFS plantations were based on AFF's 2011 report for age classes >3 years; and on data provided by TFS for age class <3 years;
- Large private sector data were obtained from interviews and published reports; total areas only were generally available;
- Small-scale grower data originated from FDT's 2016 remote sensing data and FDT's household survey in 2015. The latter study provided a good indication of average woodlot size for the small tree growers in the Southern Highlands and also estimated that 43% of the area was under 5 years old (data from FDT, 2016).

The **growth model** employed was based on yield tables developed by INDUFOR in their 2011 study. These were based on actual measurements made in Tanzania for the main commercial tree species. For each silvicultural regime (e.g. *P. patula* grown for sawlogs), there are nine site indices/yield tables, showing expected growth over the rotation on nine different site types. For UNIQUE's model, the lower and middle band of yield tables were used (each being an average of three of INDUFOR's yield tables), to cover low and medium growth expectations. The lower band of site class yield tables were used to predict growth of the STGs' plantations. This reflects a sub-optimal silvicultural regime, which is currently the case for the majority of STGs. For TFS's and the large private companies' plantations, the mid-range site class model was used, reflecting average growth expectations, based on publicly available growth data and observations.

In terms of the **silvicultural regimes**, the range of plantation rotations are summarized in Table 4. Whilst we would not recommend harvesting sawlogs at the lowest age limit (unless they come from thinning operations), in reality this is happening and especially with the STGs. With regard to STGs, it would appear that applied rotation lengths are highly variable. The model takes this into account by splitting STG plantation areas in two groups, STG1 and SGT2, the former applying short rotations, the latter longer rotations (Table 4). The long rotation age assumes harvesting the plantations at an age that generally optimizes the return to the grower – namely, when the trees reach the optimum sizes for the specific market. STG1 make up about 60% of the total STGs' plantation area, STG2 about 40%. The mean annual increment (MAI) has been computed from the rotation age corresponding to the appropriate growth model.

The models used 2013 as the baseline. This was to tie in with the national demand figures, for which 2013 was the latest available dataset. Projections were then made up to 2035. Two contrasting but realistic scenarios were modelled, to see the impact of one of the main variables – the rotation age for pine sawlogs – on the future wood supply: these two scenarios are described in the following sections.

Scenario 1: Business as Usual

This scenario assumes STGs harvesting their pine sawlog crops at 10 (STG1) and 15 years (STG2) respectively, with TFS harvesting at 18 years and the large private companies at 16 years. 10 years is considered the minimum harvest age to obtain sawlogs with reasonable wood quality and dimensions. Whilst some STGs are cashing in their investment even younger than 10 years, it is assumed that the majority will wait until their trees reach a more profitable size and quality, especially as they are made aware of the opportunity costs of cutting immature trees.

Table 3: Management assumptions used for supply modelling – Scenario 1

MARKET	SGT1	STG2	TFS	LSP
	Rotation length (yrs.) / MAI (m3/ha/yr)			
<i>P. patula</i> fibre	12 / 12.6	12 / 12.6	12 / 20.8	12 / 20.8
<i>P. patula</i> sawlogs	10 / 8.9	15 / 11.1	18 / 18.4	16 / 18.4
Teak sawlogs	20 / 9.4	20 / 9.4	20 / 21.2	20 / 21.2
Other conifers sawlogs	15 / 8.9	15 / 8.9	15 / 8.9	15 / 8.9
Other broadleaves sawlogs	25 / 11.1	25 / 11.1	25 / 11.1	25 / 11.1
Eucalyptus poles	8 / 5.1	15 / 6.8	16 / 11.6	12 / 11.1

Figure 4, Figure 5 and Table 5 show the predicted total wood supply in Tanzania to 2035, by ownership and main product respectively, for scenario 1. NB. The production figures in all the graphs and tables are roadside roundwood volumes and assume an average of 30% harvesting losses.

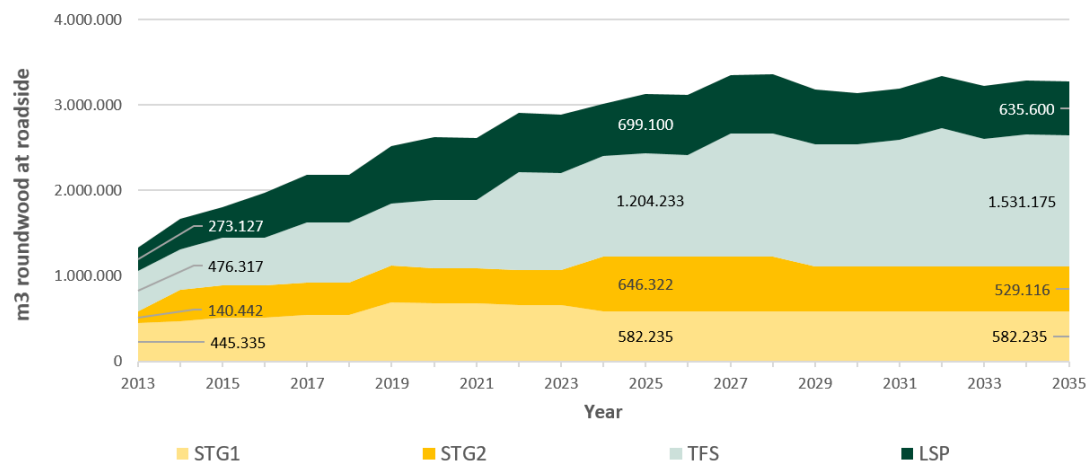


Figure 4: Scenario 1 – total wood supply forecast to 2035 by ownership (including thinnings)

Source: UNIQUE 2017

STGs are clearly already major actors in Tanzania's forest sector, supplying an estimated 43% (0.59 M m³) of total supply volume of 1.4 M m³ in 2013. By 2025 the STGs are projected to supply 1.2 M m³ (38% of 3.2 M m³ total); and 1.1 M m³ (33% of 3.2 M m³ total) by 2035.

TFS's plantations increasingly come into play in future years as the large areas planted over the past 10 years reach maturity. By 2025, TFS are predicted to supply 37% of the total 3.2 M m³, with this rising to 46% of the total wood produced by 2035 (3.3 M m³).

The large scale, private producers (LSPs) show a similar trend to TFS, as their plantations reach maturity. By 2025, LSPs are predicted to produce 22% of total wood supply, but dropping to 19% of the total by 2035. This scenario assumes that the LSPs are not able to significantly increase their area of plantations beyond their current (2016) levels.

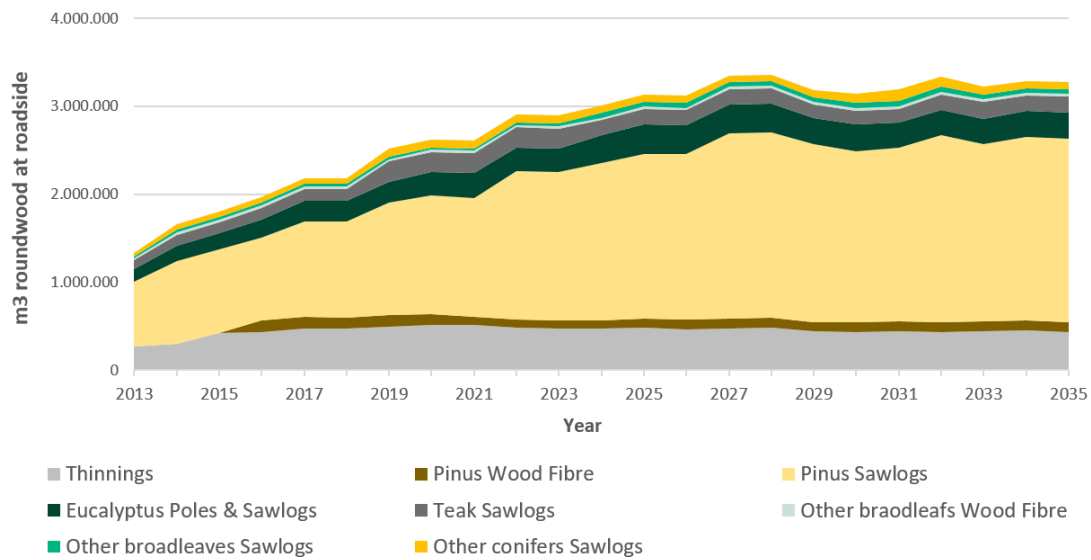


Figure 5: Scenario 1 – supply forecast to 2035 by species and product regime

Source: UNIQUE 2016

Table 4: Scenario 1 – supply forecast to 2035 by species and product regime

	2013 (m³)	2025 (m³)	2035 (m³)
Total	1,348,570	3,208,703	3,339,908
Pinus fibre	0	92,503	111,642
Pinus sawlogs	749,566	1,957,504	2,147,659
Teak sawlogs	102,278	170,468	187,360
Eucalyptus poles & sawlogs	135,172	333,681	290,542
Other broadleaves fibre	28,679	28,679	28,679
Other broadleaves sawlogs	17,973	53,610	52,379
Other conifers sawlogs	42,479	84,077	85,234
Thinnings	272,421	488,181	436,413

Scenario 2: Improved STG management

This scenario assumes an increase of STGs rotation lengths by 3 years - i.e. STG1 harvest after 13 and STG2 after 18 years. This is closer to the optimum rotation for producing quality sawlogs and particularly if thinnings have been carried out. At 18 years the sawlogs have a bigger diameter, enabling more efficient conversion (assuming that appropriate processing technology is used – as discussed in chapters 7 and 8). In theory at least, this should enable the growers to obtain a better price for their trees. Thus Table 4's assumptions apply for Scenario 2 with the exception of the STGs, with *P. patula* sawlogs being harvested at 13 years for STG1 and 18 years for STG2.

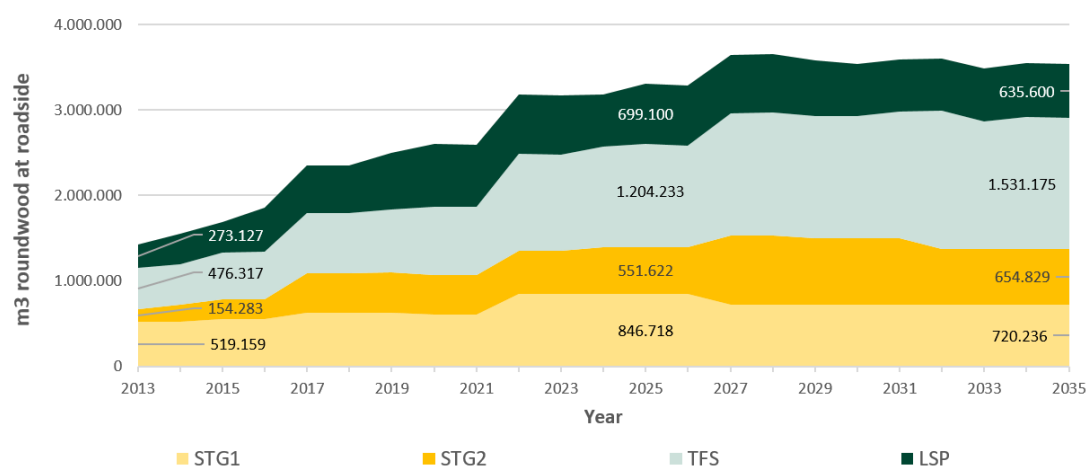


Figure 6: Scenario 2 - total wood supply for years to 2035 by ownership

Source: UNIQUE 2016

Scenario 2 predicts a 6% overall increase in wood supply to 3.54 M m³ by 2035, compared with 3.34 M m³ under Scenario 1. The supply from STGs increases by 2025 to 1.4 M m³ (42% of total) and by 2035 to 1.4 M m³ (39% of total).

This illustrates the importance of encouraging STGs not to harvest their trees too young, although it is assumed that many will continue to liquidate their investments whenever cash is needed, rather than waiting until their trees are larger and of higher value.

Under Scenario 2, TFS and LSP supply remains the same as under Scenario 1.

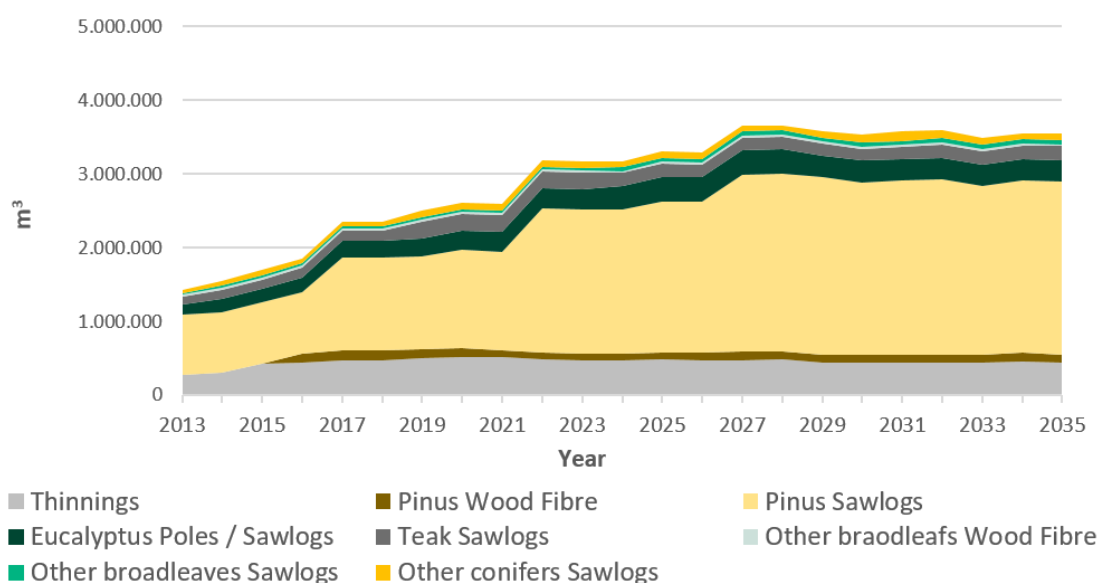


Figure 7: Scenario 2 - supply forecast to 2035 by species and product regime

Source: UNIQUE 2016

Table 5: Scenario 2 – supply forecast to 2035 by species and product regime

	2013 (m³)	2025 (m³)	2035 (m³)
Total	1,422,885	3,301,674	3,541,840
Pinus fibre	0	92,503	111,642
Pinus sawlogs	823,883	2,050,475	2,349,591
Teak sawlogs	102,278	170,468	187,360
Eucalyptus poles	135,172	333,681	290,542
Other broadleaves fibre	28,679	28,679	28,679
Other broadleaves sawlogs	17,973	53,610	52,379
Other conifers sawlogs	42,479	84,077	85,234
Thinnings	272,421	488,181	436,413

The BAU (Scenario 1) predicts a total volume of roundwood logs available of 3.21 M m³ and 3.34 M m³ in 2025 and 2035 respectively, compared to 3.30 M m³ and 3.54 M m³ for the longer rotation under Scenario 2.

As noted previously, the importance of STGs is clear, with them having a major impact on Tanzania's current and future wood supply. The challenges with STGs should not be underestimated, however. STGs are a huge number of small and often scattered growers and many have not embraced the best operating practices as noted in section 3.2.3. The business-orientated approach of clustering the STGs is strongly recommended and this is explained later in this report.

In terms of pine sawlogs alone, the BAU predicts 2.15 M m³ of pine sawlogs at 2035, compared with 2.35 M m³ from Scenario 2. What this comparison doesn't reflect is the big difference in **log sizes (assortment)** between the two scenarios. To investigate the impact of this, the UNIQUE model was further developed to predict expected log assortments.

Whilst there was insufficient data to be able to develop detailed diameter distributions, average stem diameters and heights³ and a taper function (1cm diameter reduction per metre height) were applied to predict the log assortment for the two scenarios (Figure 8 and 9).

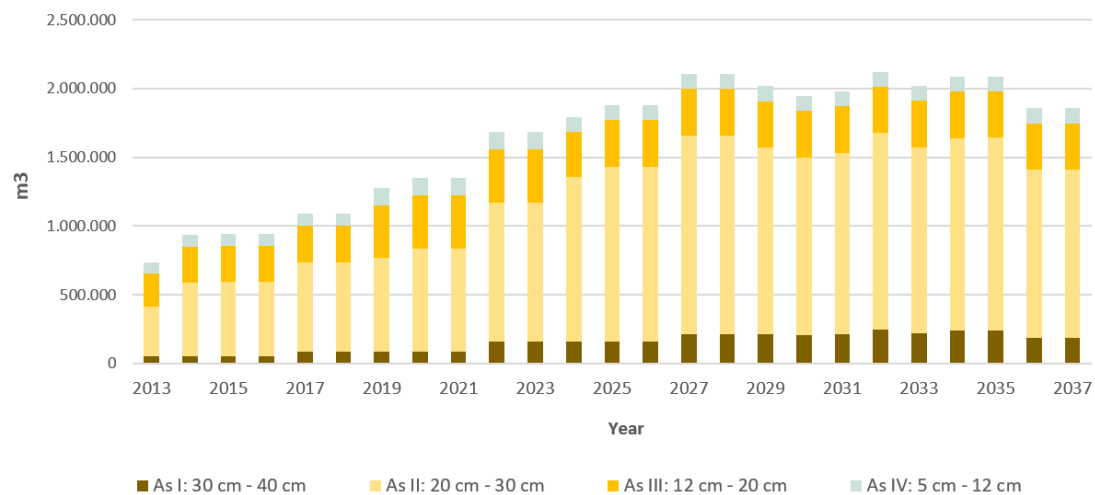


Figure 8: Sawlog assortments BAU – Scenario 1

Source: UNIQUE 2017

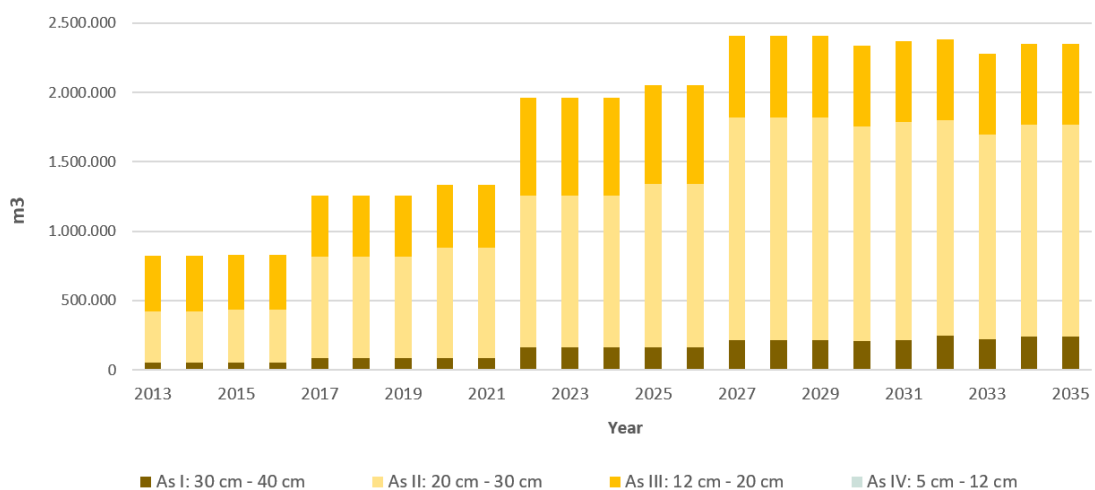


Figure 9: Sawlog assortments - Scenario 2

Source: UNIQUE 2017

³ Derived from the INDUFOR yield tables

The longer rotation (Scenario 2) ultimately produces a higher volume of the larger diameter sawlogs. Only increasing STGs' *Pinus patula* rotations by 3 years leads to a 10% increase in total national pine roundwood production by 2025 and 13% by 2035, respectively. The share of the smallest roundwood assortment projected in Scenario 1 has all been replaced by larger assortments in Scenario 2. As noted previously, larger diameter sawlogs enable more efficient processing and in theory at least, gives the grower a higher value product to sell.

Limitations of the model

Any predictive model is only as good as the data it uses and the assumptions it makes. UNIQUE's model has used the best available data for plantation areas in Tanzania and used the most recent growth models available for the country. It should be stressed, however, that there are still significant gaps in the data, especially with regard to our knowledge of plantation ages and their growth rates. This is especially true for STGs whose plantations are already supplying the major share of the logs in the market place. These limitations are further explained in the following sections.

Plantation age structure: There are significant gaps in our knowledge of the age structure of the plantations and this holds true for all categories of growers. For the STGs, FDT provided estimates based on extrapolation from their surveys – namely, < 5yrs – 43%; 6-10 yrs - 25%; 11-15 yrs - 22%; 16-20 yrs - 5%, 21-25 yrs – 4% and >25 yrs - 1%. For TFS's plantations, the model uses the age structure of the plantations largely from 2011 and doesn't factor in actual harvesting plans that might (and indeed do) fluctuate according to policy decisions. More accurate information on plantation ages should be gathered, which in the case of STGs will require substantial further field survey work.

Plantation growth: In addition to the above, little is known about the site indices (i.e. the current and expected growth rates) - particularly of the STG's plantations. The site visits undertaken by the UNIQUE team combined with the information already known from the region, lead us to conclude that the vast majority of these small plantations are under performing in terms of their growth potential and maximizing their value for the grower – hence the use of low site indices to forecast future yield in the model. This can change but will take a major effort from those involved in the commercial forest sector in the country – notably FDT, PFP and TFS. The practices that will make a difference are well documented and include the use of improved planting material (matched to particular sites), intensive weeding up to canopy closure and adopting timely thinning regimes.

Silvicultural regimes: The regimes described and used in the model are clearly not being universally applied in the country. However, the regimes indicate the recommended best practice, even if they are not widely adopted as yet by all tree growers. It has been noted earlier that small-scale growers (who will soon become a major supplier of timber in the country) are widely reported to be cutting their trees at a young age. This is a direct consequence of high demand – especially for pine – and also to realise cash. Many also are not thinning their plantations, which reduces the size (diameter) of the final crop trees and consequently reduces their value. This also reduces the timber recovery when sawing the logs. It is expected that growers will increasingly understand the financial consequences of harvesting immature and smaller trees (largely through the ongoing interventions of FDT and PFP) and will increasingly adopt the recommended practices.

Log quality: Mention is made throughout this report on the poor quality of many of the plantations in the country. This is related to a number of factors but especially the seed origin and silvicultural practices such as weeding, thinning and pruning not being widely applied. These best practices not only determine the final log quality but many of them also influence the trees' growth rates as well. UNIQUE's supply model does not factor in this quality issue, though it will have a significant impact on the added value chain – as discussed later in the report.

Sensitivity analysis: The supply forecast presented in this Chapter has only looked at two possible scenarios, based around a short and longer rotation for the STG's pine sawlog production. UNIQUE's model can, however, be used to test the impact of many key variables on future production. The model should also be updated as more accurate information is obtained on the country's plantations and especially when there is a better understanding of the ages and growth rates of the STG's plantations.

3.3.2 Comparison of Indufor and UNIQUE supply forecasts

An Indufor study conducted for PFP in 2017 estimated the wood supply from both government and private plantations (excluding natural forests) to be 1.4 Million m³ stumpage volume in 2016, rising to 5 M m³ by 2030 (Nb. these figures are standing volumes, known as stumpage). By 2030, an estimated 50% of this volume was expected to come from STGs (labelled as woodlots in Figure 10). A sharp drop in government (TFS) supply around 2016/17 was due largely to the age structure and also over-harvesting (particularly in Sao Hill plantation). Thereafter, the supply from private companies and non-industrial (i.e. small growers) was predicted to steadily increase (Figure 10).

By 2025, the total supply was forecast to reach 2.9 M m³ with only 20% coming from government plantations.

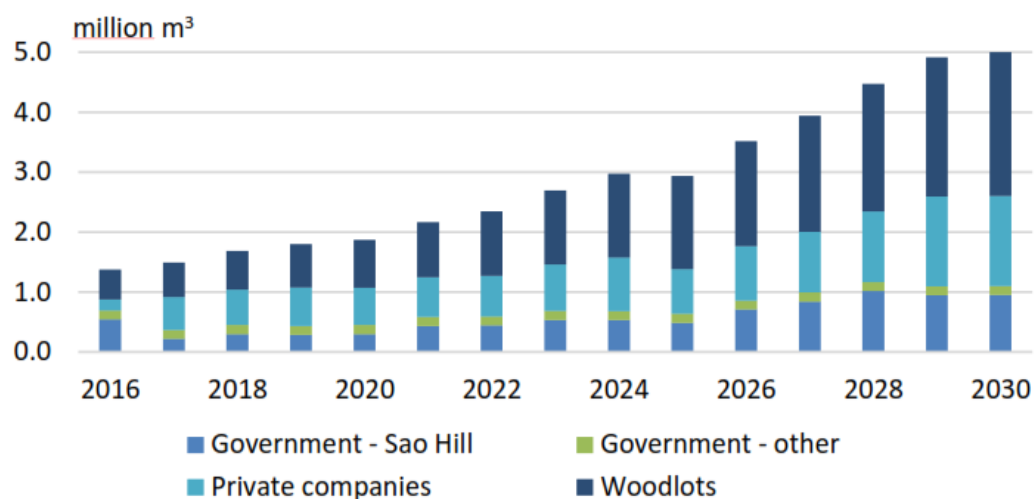


Figure 10: Indufor's supply forecast for Tanzania to 2030 – standing volume (stumpage)

Source: PFP, 2017

In comparison, Figure 11 shows UNIQUE’s standing volume prediction from Scenario 1 for the same timescale as Indufor’s graph (Figure 10). UNIQUE’s wood supply forecasts predict a peak being reached earlier. By 2025, the total supply was forecast to reach a higher value of 3.2 M m³ with a higher proportion, 37%, coming from government plantations.

The modelling Indufor carried out as part of Private Forestry Programme (PFP) was intended to support the analysis on possible investment opportunities in Ruvuma region. It was done at a highly aggregated level taking into consideration the simultaneous, more detailed modelling efforts of UNIQUE. The basic assumptions related to plantation areas, ownership shares and respective productivity levels are largely the same or very similar. The main difference leading to the very obvious differences in the supply projections are the assumed rotation lengths: the Indufor model applies a 25-year rotation for all TFS plantations and a 15-year rotation length for STGs in general.

The UNIQUE model in turn assumes only 18 years for TFS pine plantations and 10 to 15-year rotations for STGs. The largest single share of the latter group being pine in short rotation⁴ applying a 10-year rotation length. This leads to a culmination of wood supply after 2030 in case of the Indufor model, while UNIQUE’s wood flow increases much earlier and reaches its peak in the years 2027 and 2028.

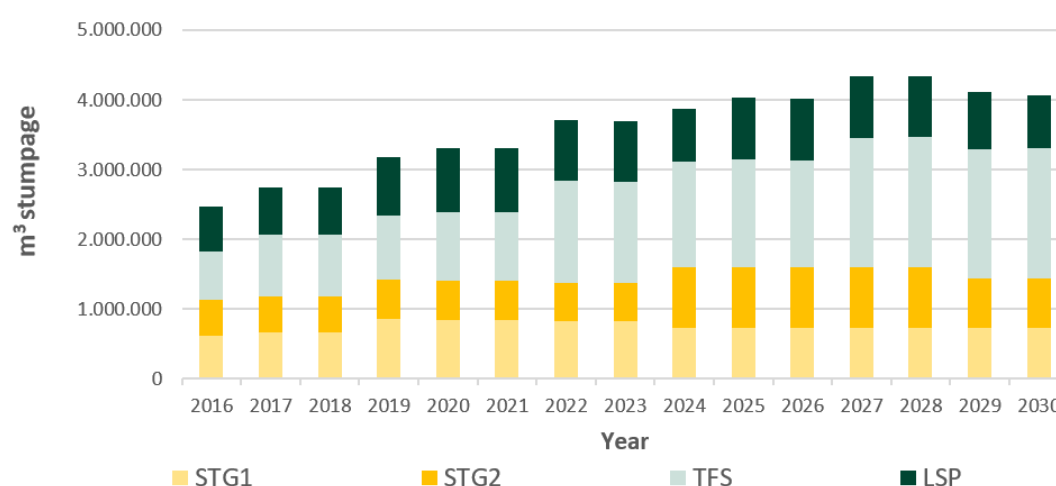


Figure 11: UNIQUE’s supply forecast to 2030 - standing volume (stumpage)

In order to compare the projections despite the differences in applied rotations lengths, it is useful to calculate average annual wood supplies per owner group. This way different years of supply culmination are balanced. The average annual wood supply (as stumpage volume) per user group between 2013 and 2030 are very similar for both projections (see Table 6); they only differ significantly for TFS plantations. This can be explained by Indufor applying a very

⁴ The UNIQUE model assumes two groups of STGs. One applying a shorter, the other applying a longer rotations (see Section 3.3.1 for more details).

conservative MAI of 4 m³/ha/yr for about one third of TFS' plantations⁵. UNIQUE applies, for approximately the same area, MAIs averaging about 9 m³/ha/yr.

Another difference is that the structure of the Indufor model is static in terms of total plantation area. The UNIQUE model on the other hand assumes an increase in TFS net plantation area due to the very intense planting activity in the past five years compared to a relatively small harvested area.

Table 6: Approx. annual average projected stumpage volumes (m³) 2016 – 2030

	Indufor (m ³)	UNIQUE (m ³)
Woodlots	1,200,000	1,350,000
Private industrial	700,000	750,000
TFS	750,000	1,250,000
Total	2,650,000	3,350,000

3.3.3 Supply from natural forests

Supply of industrial roundwood from natural forest is hard to estimate since the officially licenced volumes are arguably too low compared to the real volumes traded in the market. Studies cited by INDUFOR (2011) and Ngaga (2011) come up with estimates of up to 500,000 m³ industrial roundwood being harvested annually from natural forests.

The demand analysis in this study (chapter 4) establishes a volume of more than 400,000 m³ (rwe) that was consumed by Tanzanian industries in 2013. Hence, being in the range of the estimates of authors like Milledge and Elibariki (2005). This volume seems reasonable, considering the registered hardwood sawmilling capacity of some 473,000 m³ (FBD, 2005).

Supply of wood from natural forests was not included in UNIQUE's models due to the uncertainty of the information.

⁵ Comprised of all non-pine plantations

4 DEMAND ANALYSIS

To establish the link between demand and supply for plantation round wood, the subsequent analysis is applying round wood equivalents (referred to as m³ (rwe)) as a measure of the volume of logs (round wood) used in the manufacturing of wood-based products (including sawn timber, wood pulp, paper, wooden furniture, joinery and wood based panels). The calculation of round wood equivalents for processed wood products is based on technology conversion rates, which are typical for Tanzanian industries (PFP, 2016 and confirmed during the field work for this study). For imported products, internationally recognized conversion rates were applied as established by UNECE (2010).

In the following sections, the main wood products' consumption patterns are described for the most important wood consuming industries in Tanzania.

Logs of wood are predominantly consumed in **primary processing of wood products and in the construction sector** (i.e. as poles and posts for scaffolding and shuttering). Logs for primary processing originate both from natural forests or plantations.

The construction sector is the major consumer of **eucalyptus posts, sawn wood and wood based panels** (particle board, fibre board and plywood), which is **either applied for temporary uses on the construction site**, e.g. to support shuttering, **or form permanent constructive elements** in walls and roofs. The quality requirements for temporary and permanent uses in construction differ substantially and would enable more detailed differentiation (e.g. wood in permanent uses should be dry and treated) by suppliers. Major raw material source for this type of wood products are plantations, given a significantly limited availability of natural forest timber for uses in urban areas.

The **furniture sector** is also consuming a notable volume of **sawn timber, wood based panels and a modest volume of logs**. Further the sector consumes significant volumes of **secondary processed wood products**, such as carpentry works, moulded MDF or sawn wood etc. The sector is either using plantation based sawn timber for the production of frames of upholstered furniture and beds or consumes natural forest species for the production of solid wood furniture. Large scale production of e.g. school furniture is increasingly drawing on softwoods from plantations. The exact share of each source is not clear, but it is assumed that a significant share of natural forest timber is still included in the sector's consumption. Other wood based panels, such as fibre/particle board and gluelam boards/blockboards are increasingly used in furniture production.

Secondary processed wood products include a wide range of products, e.g. carpentry, doors and door frames, window frames, pallets, boxes. Again, the **construction sector is the most important consumer** of carpentry, flooring, windows and doors. The furniture sector mainly consumes pieces of carpentry, furniture parts and gluelam products.

Amongst the other sectors, only **the transport sector** is of relevance with modest consumption volumes of **pallets and boxes**. In this product group both natural forest and plantation species are used; exact shares are unknown.

The electricity sector consumes wooden **poles for electricity transmission**. Most transmission poles are consumed by TANESCO and are usually CCA treated eucalyptus logs. TANESCO tenders in three-year cycles.

There is only one **paper** producing company in Tanzania, namely Mufindi Paper Mills (MPM). MPM consumes **pine** logs for pulp production and eucalyptus and wattle for energy.

4.1 Historical trends in wood products demand

Information about Tanzanian wood product markets are scarce and scattered and the quality and reliability of information varies between market segments. This study's analysis focussed on key market segments with the presumably highest demand of industrial round wood.

The starting point for the analysis of historical demand was the national Supply-Use-Table (SUT)⁶ for the year 2007, which provides detailed consumption values for wood products by Tanzanian industries and households. Thus, it provides entry points for the estimation of wood product volumes currently consumed in Tanzania. However, knowing that this information is based on official statistics, which are frequently subject to systematic errors and do not consider many informal wood material flows, the results must be interpreted carefully.

According to the SUT, the total value of wood products consumed in 2007 was 1.9 billion TSh, of which 56% were consumed by industries (incl. processing to finished products), 31% by private households (mainly wood fuel and furniture), and 13% were bought by enterprises as fixed assets (secondary processed wood products and furniture). The detailed break-down of intermediate consumption by SUT and typical demand patterns as described in studies by other authors and as encountered during the market survey undertaken in Tanzania in 2016 shows that the construction sector was the major wood (round wood and processed wood products) consuming industry in Tanzania, followed by the wood processing sector itself (consuming mainly logs). The furniture sector ranked as the third largest wood products consumer, using processed wood products. The overall volumes consumed by other industries are marginal. However, wood fuel is commonly used across many industrial sectors.

The reconstruction of wood products consumed in 2007 is difficult. However, based on the methodological approaches explained in chapter 6.2, a rough estimate of the wood volumes is possible. The wood volumes consumed in 2007 were estimated at a total of 1.9 million m³ (rwe).

The most recent comprehensive figures on market volumes in Tanzania were presented by INDUFOR (2011), indicating a consumption volume of 1.5 million m³ (rwe) of industrial roundwood for the year 2010, of which 62% was consumed by the construction sector, 17% by the pulp and paper sector, 10% by furniture and carpentry businesses and 11% for utility poles. However, the study underestimated the consumption of natural forest hardwoods, only taking into account the volumes officially licenced for harvesting (around 50,000 m³). Taking into account an estimate of around 400,000 m³ (rwe) of natural hardwoods (see chapter 3.3.3), the total volume consumed in 2010 was likely around 1.9 million m³ (rwe). Hence, the demand for plantation roundwood established by INDUFOR for 2010 and demand established in the present study for the years 2007 and 2013 (almost 2 million m³ (rwe), see chapter 4.2 for details) are complementary and match in terms of overall volume and relative shares of market segments.

⁶ Source: TBS website 2016; no more recent version available.

4.2 Actual wood product demand

4.2.1 Domestic consumption

The actual wood product consumption volumes were estimated by crossing and triangulating various sources of information:

- Supply-Use-Table of 2007;
- Census of Industrial Production of 2013;
- Housing and Population Census of 2012;
- Most recent national accounts data of 2014; and
- Numerous publications and studies on wood consumption patterns for construction, furniture, electrification, energy and packaging in Tanzania (see bibliography).

The results of the analysis for the year 2013⁷ are presented in Figure 12, showing wood consumption by product type, and Figure 8, showing consumption by sector.

The total volume of wood products consumed in 2013 was 2.3 million m³ (rwe). Plantation sawnwood was by far the most important wood product (1 million m³ (rwe)), representing 44% of total consumption. Hardwood sawn wood constituted the second largest volume (20%), followed by pulp and paper products (19%) (Figure 12).



Figure 12: Wood consumption by main product in Tanzania in 2013

Source: UNIQUE; excluding wood fuel consumption

The most important consumer was the construction sector with around 1.6 million m³ (rwe). The furniture sector consumed 0.2 million m³ (rwe). Pulp and paper products totalled almost 0.4 million m³ (rwe). (Figure 13)

⁷ 2013 was chosen as reference year for this study, since for that year the most complete data set of national economic and international trade data was available.

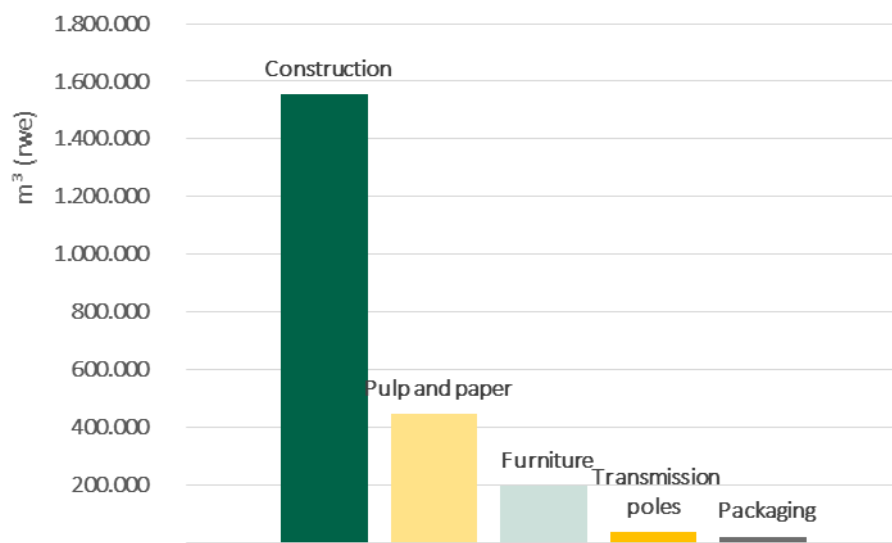


Figure 13: Wood consumption by main market segment in Tanzania in 2013

Source: UNIQUE; excluding wood fuel consumption

For each of the key market segments (construction, furniture, pulp and paper, packaging, and electrification), a detailed description of market dynamics and trends with regard to wood product consumption, product specifications and growth potential is presented in section 6.2 of this report.

4.2.2 International trade

Wood products trade balance 2013

The trade balance for wood products in 2013 shows a deficit of 370,000 m³ (rwe), which is mainly caused by imports of paper products and wood furniture (Figure 14). On the other hand, Tanzania is a net exporter of sawnwood (i.e. hardwood sawnwood, namely Teak) and exports decent volumes of paper products (i.e. uncoated Kraft paper from MPM production). The share of imported wood products in domestic consumption in 2013 (compare chapter 4.2.1) was considerable:

- 40% for transmission poles;
- 46% for plywood and veneer;
- 55% for paper products (100% if excluding MPM production of uncoated Kraft paper); and
- 98% for fibre and particle board.

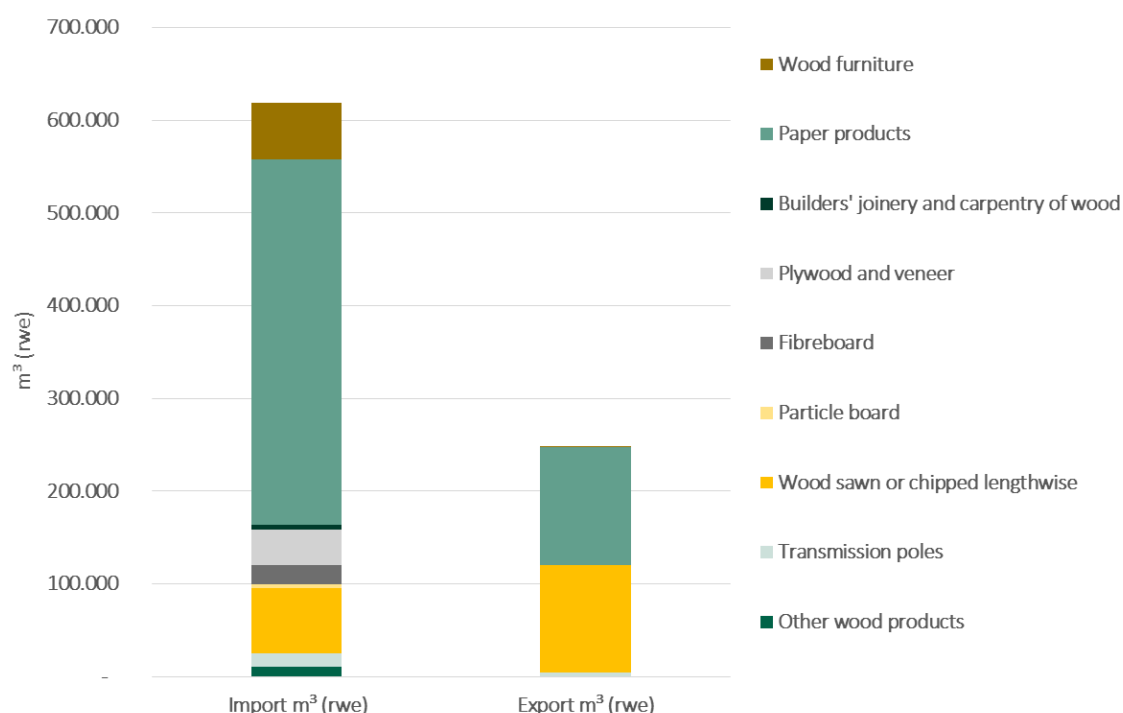


Figure 14: Tanzania trade balance of wood products in 2013

Source: UNIQUE based on UN Comtrade database 2016; excluding pulp, paper and furniture

Wood products imports

Tanzanian wood product imports have shown volatility since 2011 (Figure 15). A significant increase in imports occurred in the years 2014 and 2015, which was mainly caused by substantial imports of transmission poles from South Africa (in Figure: “wood in the rough” and “hoopwood”). Other imports comprise mainly sawnwood (i.e. sawnwood from Malawi) and wood based panels (plywood, particle and fibre board from China and Kenya). The total import

volumes in 2015 converted to almost 200,000 m³ (rwe). However, if excluding transmission pole imports, the overall import trend shows stable, but slow growth.

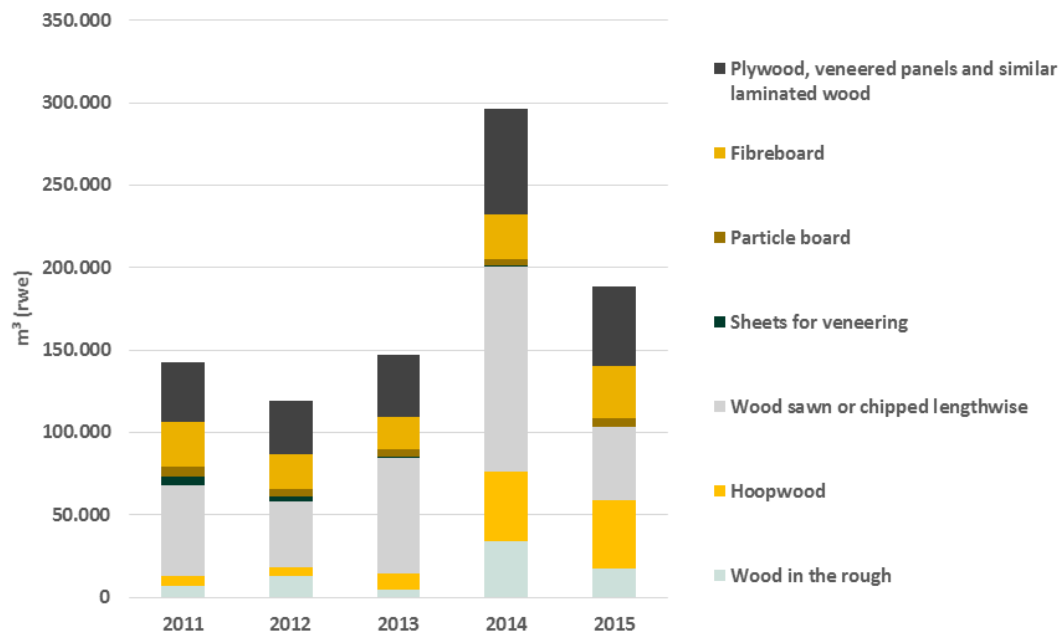


Figure 15: Wood product imports Tanzania 2011-2015

Source: UNIQUE based on UN Comtrade database 2016; excluding pulp, paper and furniture

Malawi has been the main country of origin for sawnwood (i.e. hardwood) in recent years. The following figure illustrates development of import volumes and average import prices. It shows import price levels between 140 USD/ton and 160 USD/ton (around 250 USD/m³). Prices significantly dropped in 2013/14, while import volumes increased substantially.



Figure 16: Hardwood sawnwood imports from Malawi 2010-2015 and average import prices

Source: UNIQUE based on UN Comtrade database 2016

Treated poles and posts are another important import product to Tanzania, mainly originating from South Africa (Figure 17). Volumes increased in the years 2014 and 2015 due to large scale tenders by TANESCO, which could not be supplied by domestic producers. Import price trends show a decrease. The average price in 2015 was 600 USD/ton (or around 300 USD/pole) in 2015.

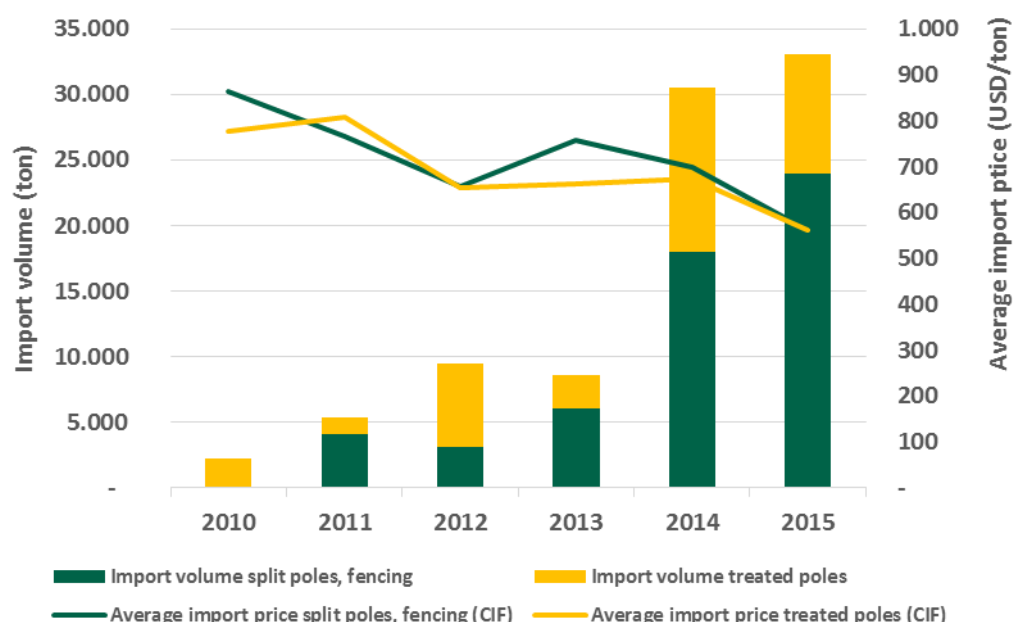


Figure 17: Treated poles/post imports from South Africa 2010-15 and average import prices

Source: UNIQUE based on UN Comtrade database 2016

Wood based panels are mainly imported from China and Kenya. The following figure shows the total import volume for the five-year period 2010 to 2014 and average import price per product by country of origin (for 2014). China and Kenya are the biggest exporters of wood based panels to Tanzania, setting price benchmarks for Tanzanian producers, i.e. the plywood import prices of 800 to 940 USD/ton. Imports from Malawi are the cheapest, however, volumes imported are small. South African products are comparatively expensive, but likewise account only for small import volumes.

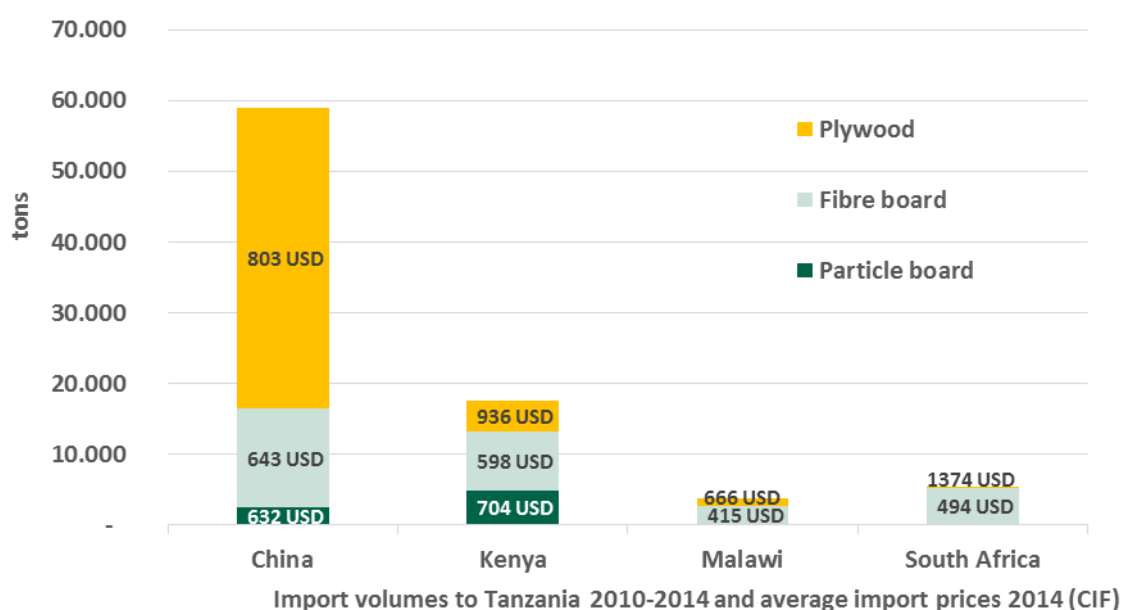


Figure 18: Wood based panel imports from China, Kenya, Malawi and South Africa 2010-2014 and average import prices in 2014

Source: UNIQUE based on UN Comtrade database 2016

Wood product exports

Tanzanian exports of wood products play only a minor role in trade. The volume of all exported wood products during 2011-2015 oscillated around 150,000 m³ (rwe), with a significant peak in 2014. In general, Tanzania shows slightly increasing export figures since 2011. Hardwood sawnwood is the most important export product followed by treated poles and posts (included in figure in “Hoopwood”). In 2015, veneer sheets appeared on the list of export products. However, the volume of around 3,000 m³ (rwe) is still comparatively low. (Figure 19)

Main export destinations in recent years were Kenya for poles, India and China for hardwood sawnwood, and China for veneer sheets.

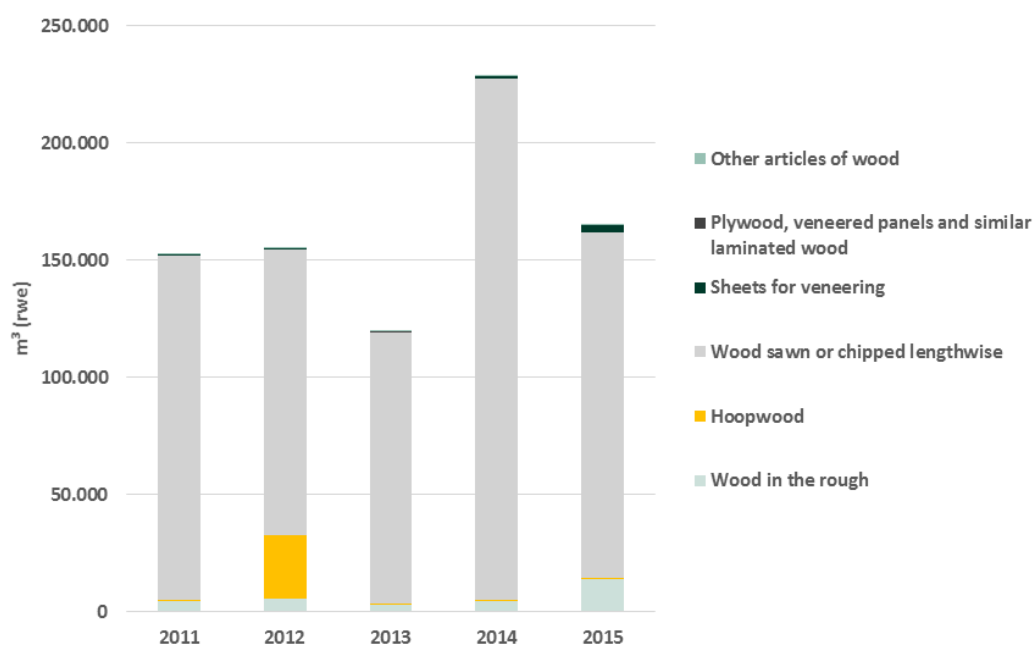


Figure 19: Wood product exports Tanzania 2011-2015

Source: UNIQUE based on UN Comtrade database 2016; excluding pulp, paper and furniture

Wood furniture trade

Tanzanian exports of wood furniture are marginal with 280 tons in 2015, coming down from 700 tons in 2011 (Figure 20). Wood furniture imports are in comparison high and oscillate around 20,000 tons annually (Figure 21).

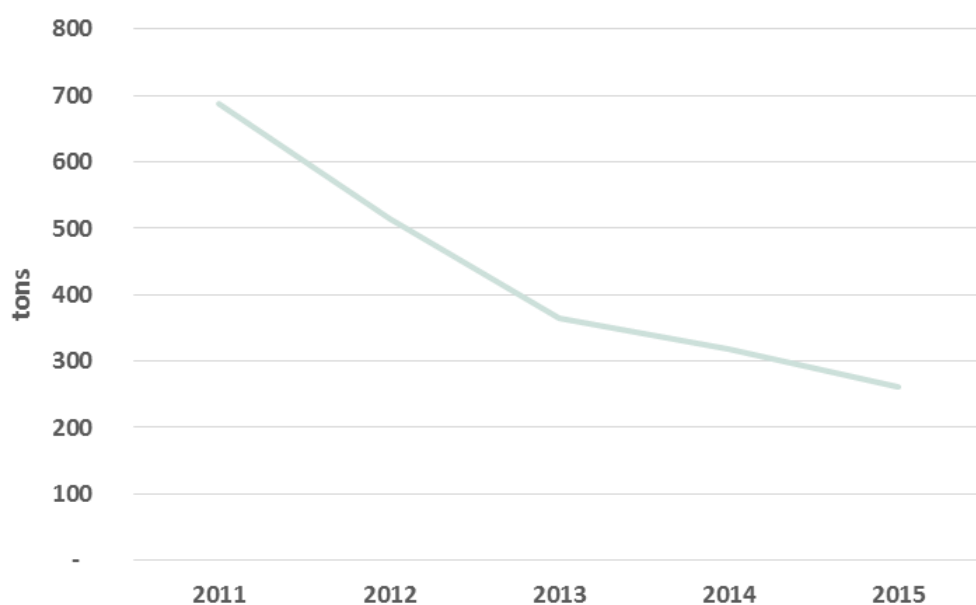


Figure 20: Wood furniture exports Tanzania 2011-2015

Source: UNIQUE based on UN Comtrade database 2016

Tanzania is importing all types of wood furniture. Out of 52,000 tons total furniture imports in 2015, around 37% was made of wood. The ratio has come down from 47% out of 47,000 tons in 2011, indicating an increasing share of non-wood furniture in imports.

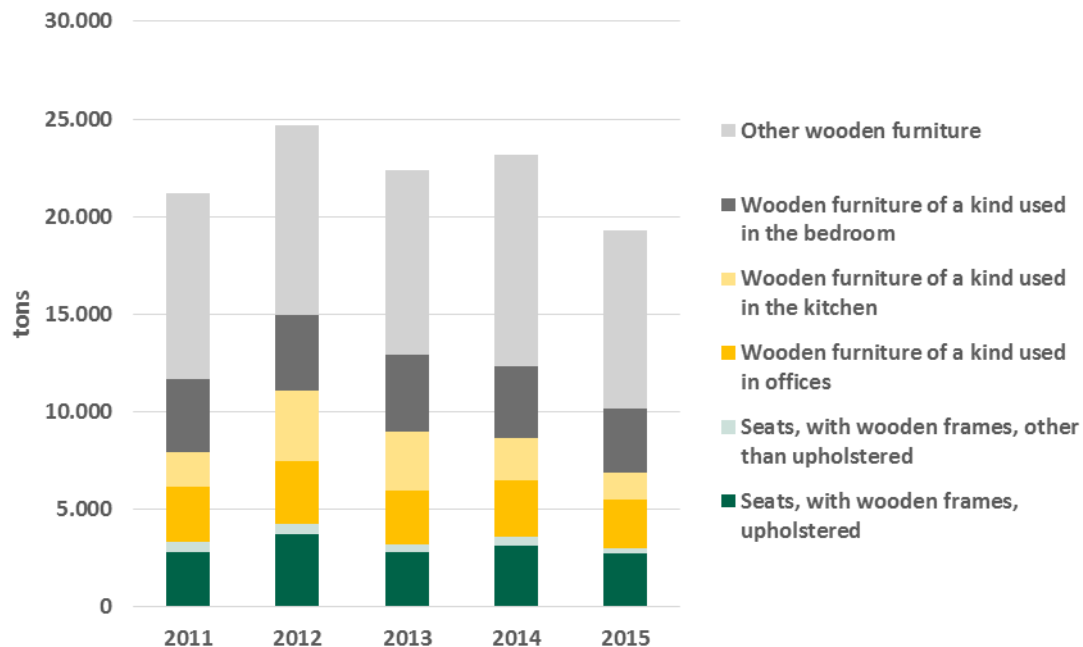


Figure 21: Wood furniture imports Tanzania 2011-2015

Source: UNIQUE based on UN Comtrade database 2016

Trade in paper products

Tanzania depends on imports of almost all paper products, except for Kraft paper (commonly used for packaging and wrapping), which is produced by MPM. Domestic consumption volumes have increased from 115,000 tons in 2011 to 136,000 tons in 2015. Products originate from a variety of countries, with the main suppliers being China, South Africa, Kenya, India and Turkey. The Tanzanian exports are constituted of Kraft paper produced by MPM (mainly exported to Kenya), the export volumes represent roughly 50% of MPM's actual production capacity.

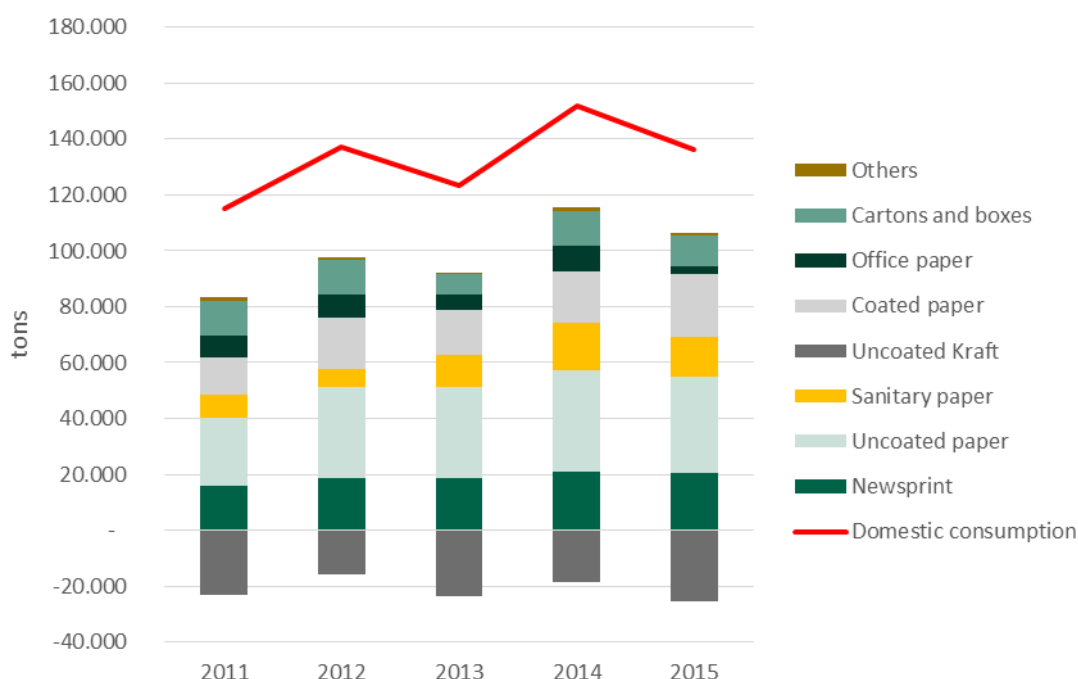


Figure 22: Paper products trade balance and domestic consumption for Tanzania 2011-2015

Source: UNIQUE based on UN Comtrade database 2016; negative values show net export, positive values show net imports

4.3 Demand forecast 2035

The demand forecast indicates the volumes of wood products demanded by the Tanzanian market in the future. However, the forecast does not ‘predict’ from where these products will be sourced (either domestically or imported). This depends on the future investment activities in Tanzanian wood processing industries (from small to large scale) and their ability to meet domestic demand patterns (quality, price, standards).

Further, the demand forecast does not consider any major ‘game changers’ such as investments in large scale wood processing industries, or a policy-driven promotion of wood consumption, e.g. in public procurement or energy sector policies.

The forecasted demand (excluding potential exports and wood fuel) of wood products in 2035 shows an increase of 2.9 million m³ (rwe) compared to the base year 2013 (Figure 23).

Total volume of wood products` demand in 2035 is estimated to be around 5.2 million m³ (rwe).⁸

All groups of wood products will experience significant growth with plantation sawnwood being the most important wood product in demand growing by more than 1 million m³ (rwe).

⁸ The PFP study “Financial and Economic Analysis of Private Forestry Investment Opportunities in Ruvuma Region (2016) predicts a consumption volume for the year 2030 of around 2.8 million m³ (rwe) in a conservative scenario and a volume of round 4.5 million m³ (rwe) in a realistic scenario. The present study predicts a total of 4.2 million m³ (rwe) roundwood consumption in 2030 (excluding woodfuel) Hence, the demand forecasts of the present study and the PFP study are in similar ranges.

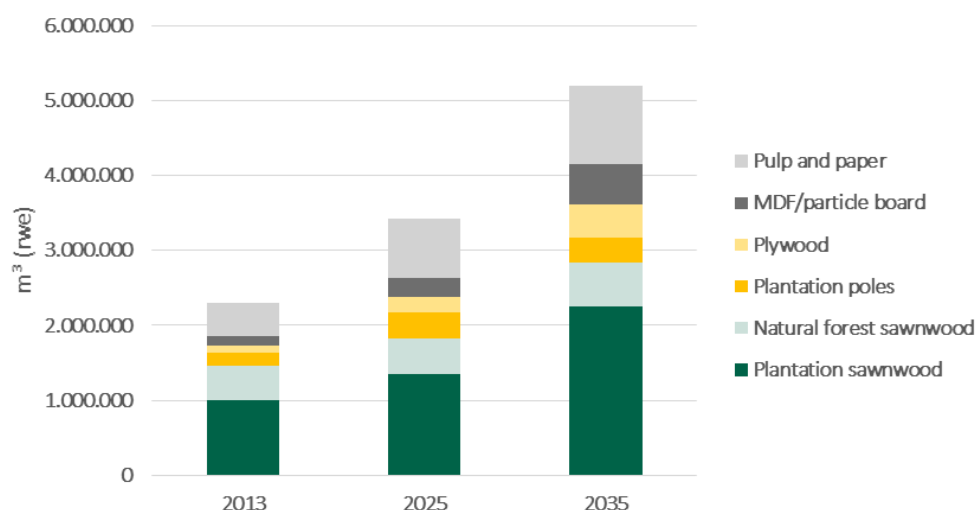


Figure 23: Forecast of wood products consumption in Tanzania 2035

Source: UNIQUE

The breakdown of demand by wood product market segment shows that the construction sector will be the main driver of wood consumption in Tanzania (Figure 24). Paper consumption is expected to grow as a function of population growth and increasing purchasing power. Generally, furniture is predicted to experience strong growth due to growing population and increasing purchasing power. The packaging sector is also expected to become an important consumer of wood products with improving infrastructure coupled with population growth and increasing purchasing power, resulting in an increasing demand for fast moving consumer goods. The key assumptions supporting the forecasted demand are explained in the respective chapters on markets for construction, furniture, paper, packaging and transmission poles (chapter 6.2).



Figure 24: Consumption of wood products in Tanzania by market segments 2035

Source: UNIQUE

5 SUPPLY-DEMAND ANALYSIS

In the following, the results of the supply and demand analysis are merged into the supply-demand analysis (SDA). Given the restricted knowledge on the supply side about age class structure and management practices, in particular for smallholder plantations, the SDA is reflecting the 'Business as Usual' supply forecast (described in chapter 3.3.1). Supply from natural forest is not considered. The demand predictions are based on the assumptions explained in section 6.2 for the main wood products' consuming sectors in Tanzania.

The overall SDA predicts a plantation roundwood supply gap (Figure 25), which will be met by imports and roundwood from natural forests. The roundwood gap seems to become substantial from the years 2025 onwards.

However, if paper products and wood based panels continue to be imported in the absence of investments into industrial pulp and paper processing and wood based panel production, the real gap will be significantly smaller. Thus, the challenge will be to identify market options for the roundwood volumes predicted to enter the market in the future and match these volumes with the specifications required by the local industries.

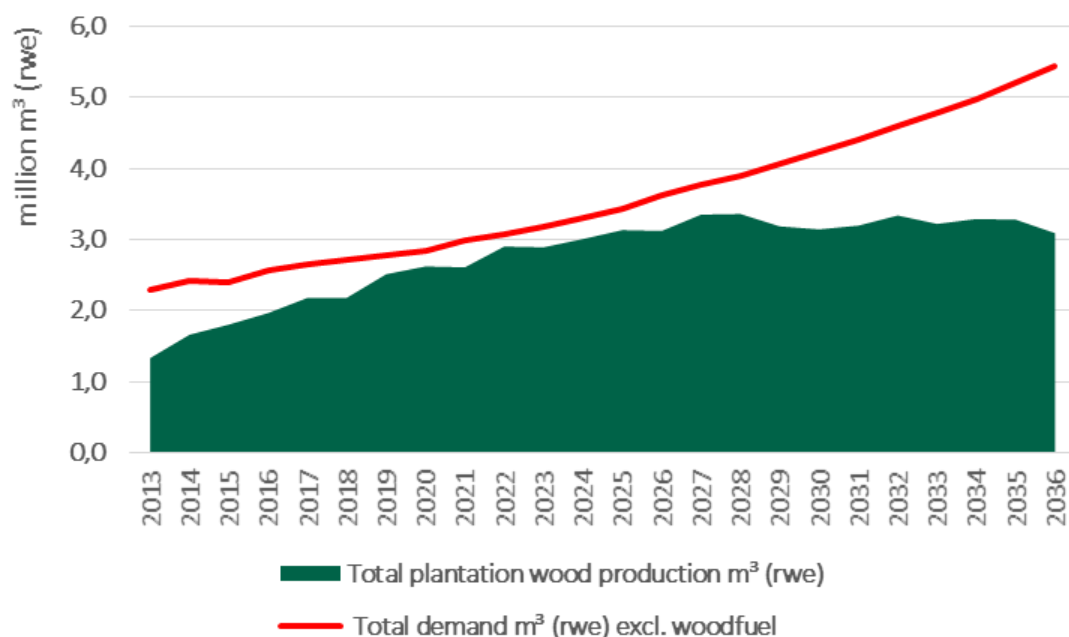


Figure 25: Summary Supply-Demand Scenario (Business As Usual scenario)

Source: UNIQUE

In subsequent chapters, an attempt is made to better differentiate the SDA according to future roundwood volumes and predicted demand of market segments.

Breaking down the supply-demand scenario according to raw material characteristics required by the different market segments reveals a different picture of the future supply situation. The subsequent analyses compares the following:

- Demand of sawlogs/plywood with sawlog production forecast;
- Demand for paper products, fibre and particle board with forecasted pulpwood and thinning volumes; and
- Demand for transmission poles with forecasted eucalyptus pole production.

5.1 Sawlog SDA

The SDA for sawlogs and plywood shows an increasing supply of raw material in the coming years (Figure 26). Even taking into account that Teak will be mainly exported, there is still a slight surplus of sawlogs to be expected in the years 2022 to 2028. However, in the long run the demand will surpass domestic availability of sawlogs, requiring investments in support of productivity increases and plantation area.

Further, it can be assumed that a substantial share of the forecasted sawlog volumes will not have sawlog quality and thus will be consumed in processing for other products, e.g. low quality plywood/plywood middle layers or in pulp and fibre board production (see Wood fibre SDA section 5.2).

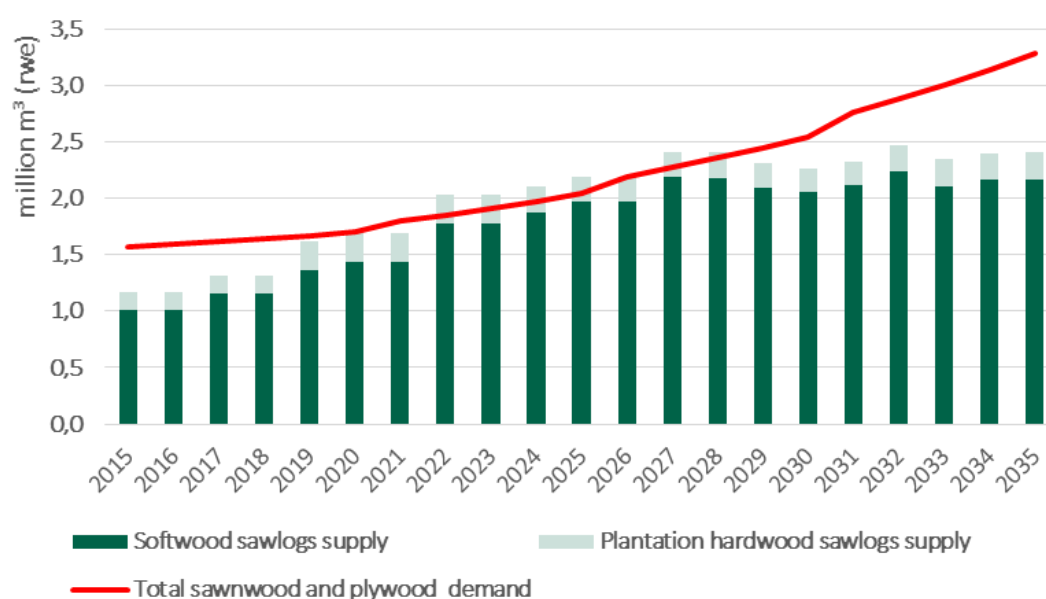


Figure 26: Sawlog/plywood SDA 2015-2035 under BAU (scenario 1)

Source: UNIQUE

The predicted supply gap is a result of the common smallholder practice to harvest before rotation end (around year 12 instead of year 18). The following analysis illustrates that compliance with a good practice sawlog regime could significantly reduce future supply shortage (Figure 27). From 2022 until 2030 the sawlog volume would be sufficient to meet domestic market demand; the supply gap after 2030 would be less severe.

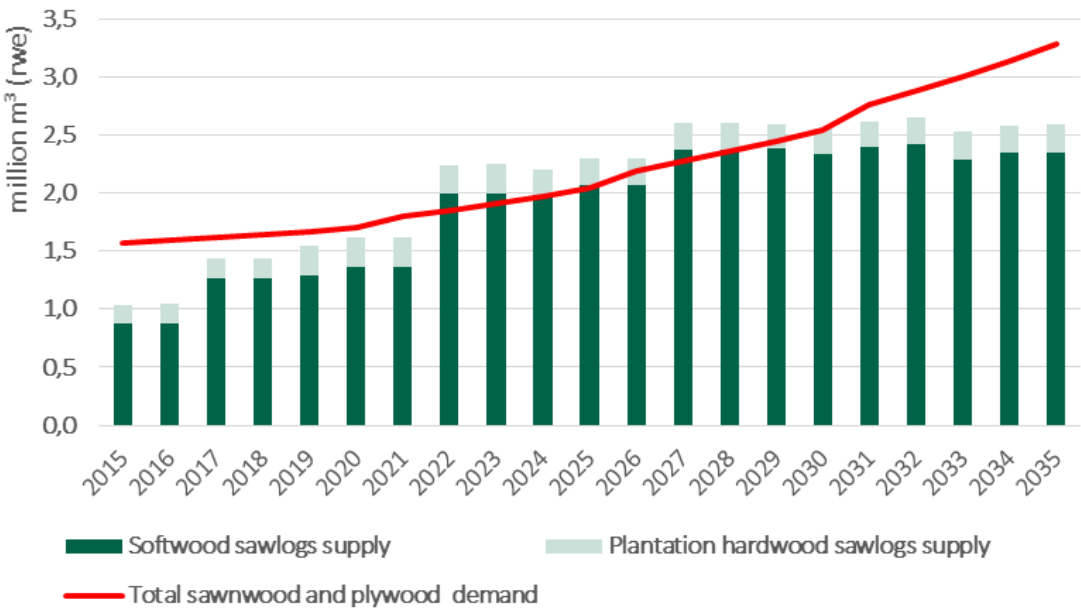


Figure 27: Sawlog/plywood SDA 2015-2035 under extended rotation for STGs (scenario 2)

Source: UNIQUE

5.2 Wood fibre SDA

The balance for wood fibre products shows a supply deficit, which reaches more than 1 million m³ (rwe) in 2035, when compared with the pulpwood volumes coming online and thinning volumes expected from other management regimes (Figure 28).

The predicted volumes of wood fibre will be provided from plantations established by MPM to sustain their own demand and become independent from Sao Hill supply. Thus, these volumes will not become freely available to the market.

The forecasted thinning volumes are based on the assumption that thinnings are realized and management regimes are complied with as outlined in chapter 3. Up to date, no significant wood panel industries are located in Tanzania. Thus, there is an interesting volume of around 500,000 m³ freely available for potential producers of particle or fibre boards. However, there is a number of open questions related to this potential, such as:

- Quality and type of thinnings, since first thinnings are usually not suitable for panel production;
- Spatial distribution and accessibility of these volumes;
- Mill gate cost of the raw material; and
- Organization of STGs to ensure regular supply for large scale investment in wood based panel production.

Other raw material suitable for wood based panel production could be derived from low quality outputs of sawlog and transmission pole regimes.

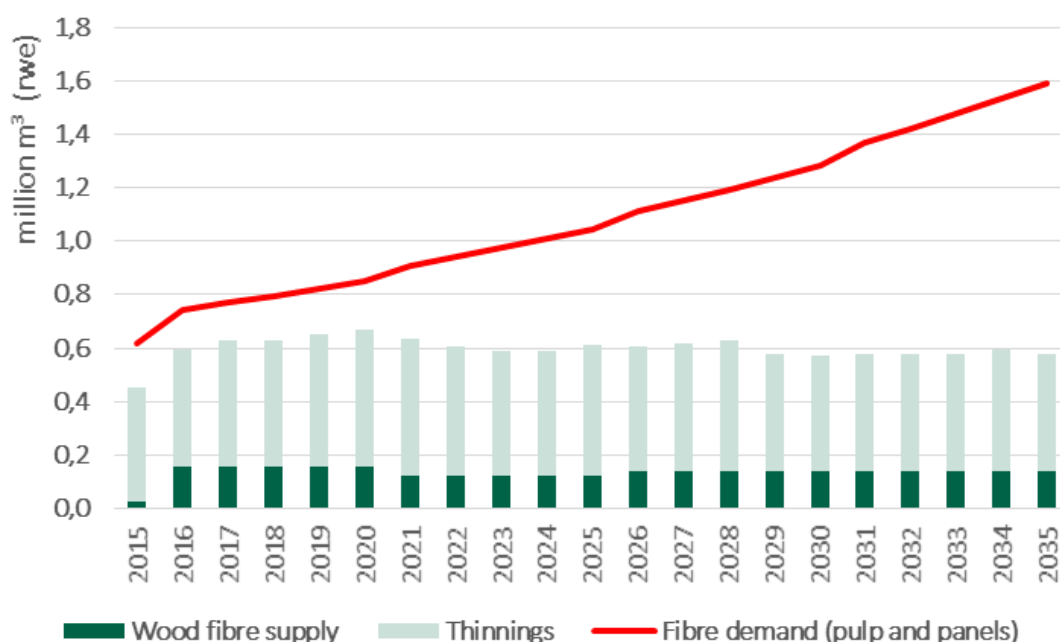


Figure 28: Wood fibre supply demand balance 2015-2035

Source: UNIQUE

5.3 Transmission pole SDA

The balance of eucalyptus pole supply and transmission pole demand shows an increasing surplus of production (Figure 29). However, it should be noted that this does not indicate a surplus of transmission pole production. A large percentage of poles do not qualify as transmission poles (between 30-40%, or even lower at 15-25% for STGs). While building poles are not a high value product, this market does at least provide an outlet for poles that do not qualify as transmission poles. However, the challenge will be to find attractive markets for large eucalyptus poles, e.g. in veneer/plywood production. The predicted increase in domestic plywood demand offers positive market signals for further investigating options of Eucalyptus veneer and plywood production (compare Sawlog/plywood SDA, section 5.1). However, raw material requirements for plywood requires regular pruning, which is currently not common in transmission pole regimes and thus, the poles produced in existing stands may not deliver the required raw material.

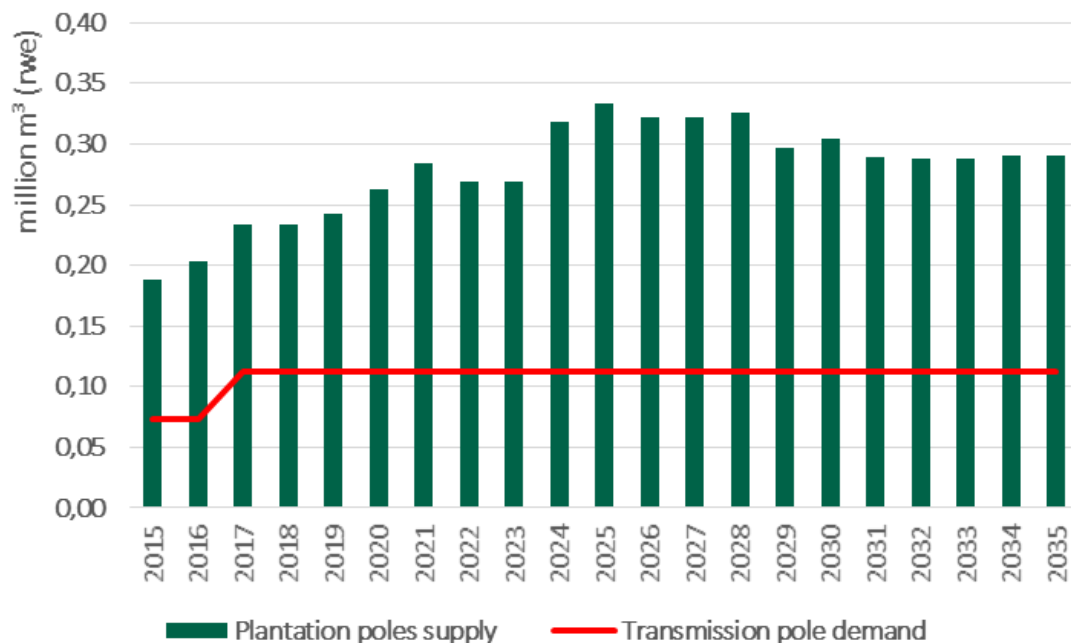


Figure 29: Eucalyptus pole supply demand balance 2015-2035

Source: UNIQUE

6 WOOD PRODUCTS MARKETS IN TANZANIA

6.1 Market environment

Wood products consumption is not only a function of supply and demand, but is also subject to dynamics and trends of the market environment, which may speed up, slow down or even stop specific consumption trends.

This study has identified a set of major discrepancies of relevance for the Tanzanian wood products markets between the national policies and their implementation.

- An international megatrend positively influencing wood consumption is the development of green growth strategies which incorporate the use of renewable and sustainably produced materials and energy sources into development targets. Tanzania's Vision 2025 and the Big Result Now (BRN) initiative are geared towards inclusive growth and economic transformation. Furthermore, Tanzania's NDCs commits the country to a climate friendly economic growth path (GoT, 2015).
- Although the importance of the wood sector is recognized at policy level, there is no coherent policy in place to actively promote wood product value chains. The link between rural development and sustainable urbanization is not well established.
- Wood biomass is not perceived as a sustainable source of energy and its use by industries not promoted although sustainable biomass could contribute significantly to Tanzania's green growth goals. In contrary, the use of natural gas by national industries is actively stimulated by government

6.2 Market segments

In the course of the demand analysis (chapter 4), five major market segments for wood products consumption were identified:

1. Construction sector
2. Carpentry and furniture
3. Wood packaging
4. Transmission poles
5. Paper

In the following sections of this chapter, each of these market segments is described according to main actors, market governing factors and currently prevailing key market trends. It further details the volume of wood products currently consumed and describes the assumptions for the forecast of future consumption volumes (analysis presented in chapter 4.3 'Demand forecast').

6.2.1 Construction

Actors and sector governance

Construction activities in Tanzania are driven by private and public investments. Public sector activities are largely undertaken through the National Housing Corporation (NHC), Watumishi Housing Company (WHC) and the Tanzania Building Agency (TBA). They develop housing for civil servants and realize large scale public building projects (e.g. schools, universities, ministry buildings), contracting services of private construction companies.

The private property developer market caters to building housing for middle-upper income classes, and development of commercial projects (offices, shopping malls, etc.). However, these structures are changing, with NHC and WHC also targeting individual private consumers and TBA insourcing the realization of construction projects instead of contracting them.

At the time of this study, several large-scale housing projects were underway by parastatal/private developers in the urban centres. The projects have volumes of several dozen to several hundred housing units aiming at middle to upper income classes. Mortgage programs have been put in place to enable citizens to acquire property. However, about 80% of the population in Tanzania cannot afford a decent house because of *“economic hardships due to high cost of materials, labour and technical know-how”* (Kwamana, 2015).

Tanzania's housing deficit is about 3 million units, with the annual demand growing between 200,000 and 300,000 units (Kwamana, 2015). In the face of the ongoing urbanization trends the situation is likely to worsen especially in urban centres. To date, there is no large scale national social housing program in place to address this challenge.

In rural areas houses are built by individuals ('own-account'). They either build the houses on their own or contract the services of SMEs, e.g. for erection of walls or roofing. These rural homes constitute the vast majority of buildings constructed in Tanzania.

In any case (public or private), buildings higher than two storeys must be realized by contractors listed with the Contractors Registration Board (NRB). The contractors are classified according to company size, and the set of services and equipment they offer. Class I contractors are the largest and class VII the smallest. The latter are not allowed to build multi-storey buildings. Large contractors generally run their own carpentry workshops. The NRB monitors the contractors' capacities, offers capacity building and other support with the aim to ensure quality in the construction sector and compliance with Tanzanian construction guidelines. The listed contractors should adhere to an ethical code of conduct, which also foresees the use of qualitatively appropriate construction materials.

The Tanzania Bureau of Standards (TBS) publishes standards of direct relevance to the construction industry. However, for many years formulation of standards has been slow mainly due to lack of sufficient human and financial resources on the part of TBS and lack of direct commitment by the industry in standardization of works. Building regulations currently in use are frequently outdated and their enforcement is weak. While the formulation of building regulations is done at ministry level, their enforcement is the responsibility of the local government authorities. Lack of appropriate building regulations and standards, and enforcement thereof, contributes to poor quality of buildings and weak demand for high quality construction materials.

Any building activity should be licenced by the respective construction department in each district. However, estimates of interviewed actors indicate that more than 50% of buildings in rural areas and informal urban settlements might not be licensed⁹. Since construction activities are licensed locally, hardly any consolidated physical information of construction activities in Tanzania is available. However, the national accounts statistics collect information on value adding and gross production in industrial sectors, e.g. in construction of buildings.

The most recent comprehensive national accounts dataset is available until the year 2013. Based on this information an approximation of constructed floor area in Tanzania was possible, which is a crucial input factor for estimating wood product consumption volumes in construction (see section on market volumes below).

Figure 30 presents the development of construction sector activities from 2005 to 2013 for the three building types 'urban residential', 'non-residential', and 'rural own-account' buildings. The annually constructed floor area increased from 6.5 million m² in 2005 to 8.2 million m² in 2013. It shows that residential buildings in urban areas and non-residential buildings (also mainly in urban areas) are increasing, whilst the annual construction of rural houses has not been growing. Hence, the development is reflecting (1) the urbanization trend, (2) increase in commercial investments, and (3) the increasing housing deficit in Tanzania for basic housing.

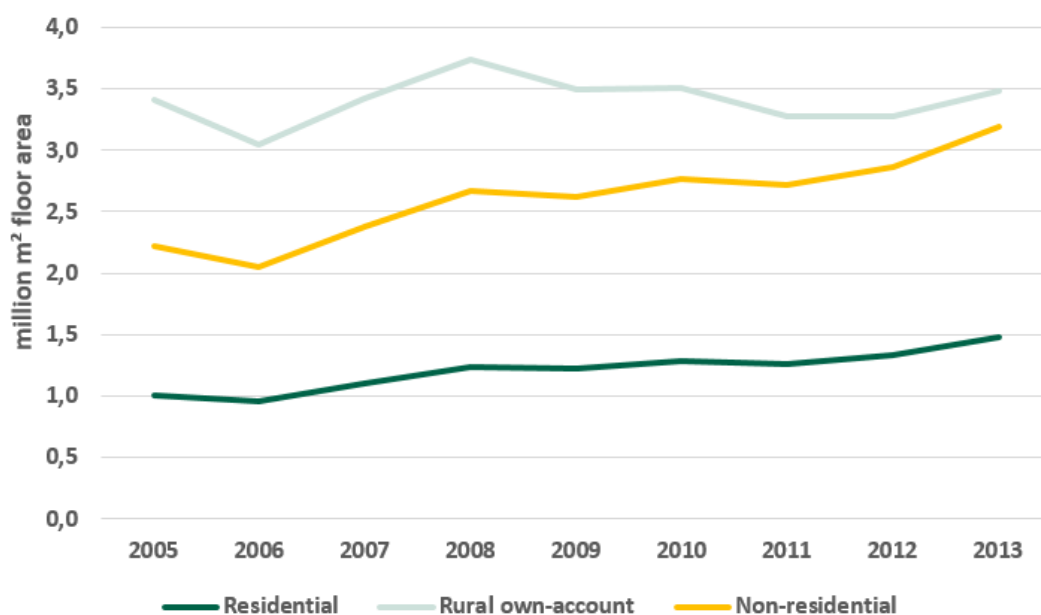


Figure 30: Floor area annually constructed in Tanzania 2005-2013

Source: UNIQUE based on NBS, 2014 (National Accounts of Tanzania Mainland 2001 – 2013); KPMG, 2014; CAHF, 2016

⁹ Some actors even name figures as high as 70% of all buildings being not licensed.

Market trends

The following socio-economic trends are driving growth in the construction sector and impact wood products consumption patterns:

- Population growth and urbanization is defining overall housing construction volumes and regional distribution of construction activities. The annual demand for housing will continue to increase in line with the forecasted population growth of around 3% p.a.
- Economic growth and private investments influences construction activities related to non-residential buildings (offices, hotels, shopping malls, etc.). GDP growth in recent years has been on average 7% p.a. (at constant market prices 2001; NBS, 2014) and is expected to continue at this level. Thus, non-residential construction activities will likely continue growing. Furthermore, overall economic growth has an impact on purchasing power of individuals, which effects the design of private housing units, in particular in urban areas (e.g. huger floor area per unit, high quality building materials, etc.).
- Public investment in government buildings, schools, hospitals, social housing etc. is subject to budget plans, which define investment volumes and regional focus of the activities. The construction volumes to be realized by the government in the coming years could not be identified during this study. However, public construction projects depend directly on tax revenues, and by extension on the country's economic performance. Further, bilateral cooperation is frequently co-financing the construction of public sector buildings.

The following trends were identified during interviews with contractors and real estate companies with regard to wood products consumed in the construction sector:

- Urbanization is a key issue. Most large-scale housing projects and commercial buildings are realized in urban areas. Thus, building types will increasingly be multi-storey buildings, which usually do not have timber supported roof constructions, but are rather concrete works requiring poles and plywood for scaffolding and shuttering. When it comes to large scale projects, contractors are increasingly turning to non-wood scaffolding and shuttering since quality plywood shuttering systems are not available in Tanzania.
- Large scale housing projects involve the construction of several dozens to hundreds of similarly designed houses, requiring standardized products, e.g. roof trusses. Currently these are made on-site. The contractors have difficulties purchasing the volumes and qualities they require, thus, articulating preferences for non-wood trusses or pre-fabricated wood trusses (which do not exist in Tanzania). This development must be seen in relation to the bottleneck in treated structural timber supply (next bullet point).
- Treated timber is commonly accepted as the only way to construct quality roof trusses. However, its availability is limited and the market is "flooded" with improperly treated products (not pressure treated). Reliable suppliers for larger volumes of treated timber are limited to the large players Sao Hill Industries, NFC and TANWAT.
- Increasing purchasing power is resulting in larger floor areas for housing units. While roof trusses for the current standard housing size of around 60 m² per unit can be built from commonly available planks and boards, larger roof trusses require longer and stronger timber, which is scarce due to lack of large dimension sawlogs and their processing. A possible solution would be to use small dimension timber (e.g. from STGs) producing gluelam timber and similar structural engineered wood products (EWP). However, these products are hardly known by contractors and architects in Tanzania. Nonetheless, interviewed actors would be willing to "try" using them at a small scale.

- Modernization (repair and replacement of defect structures) of existing housing units will increase with increasing purchasing power. There are currently around 6 million housing units with iron sheet roofs, almost all of them using wooden roof trusses (approx. 1.8 million m³ timber). Modernization of these roofs and trusses will become more common.
- There is a general lack of knowledge in modern wood construction and the application of modern wood products (EWPs) in the construction sector. In combination with lack of compliance with construction standard, there is almost no potential for wood products to conquer significant market shares from concrete and bricks in the housing markets.

Market volumes and demand forecast

The volume of wood products consumed in the year 2013 in the Tanzanian construction sector (excluding carpentry works) was estimated at more than 0.8 million m³ (rwe), comprising 1,000,000 m³ (rwe) softwood sawnwood (mainly pine) mainly in roof trusses (new and modern), 135,000 m³ building poles (mainly eucalyptus) and 33,000 m³ plywood/panels (see Figure 31Error! Reference source not found.).

For the forecast of wood consumption in construction in the year 2035, it is assumed that the historical trend of the period 2007 to 2013 will continue for the three building types: non-residential (5% p.a.), urban residential (5% p.a.) and rural housing (0.5% p.a.). The modernization rate of housing and roof trusses was predicted to grow from 2.5% in 2013 to 5% in the year 2035.

The wood consumption patterns for each building type were established based on interviews and on a review of construction sector studies in Tanzania. Key features of these patterns are presented in Table 7. The same table describes the estimated substitution rates of wood products by non-wood products, based on expert interviews and literature review.

The demand forecast indicates an increase in wood products consumption from 1.2 million m³ (rwe) in 2013 to 2.6 million m³ (rwe) in 2035 (Figure 31Error! Reference source not found.). This forecast does not consider any major game changers, such as large scale social housing programs being implemented or the active promotion of wood products in the construction sector. Neither the successful introduction of EWPs nor a significant increase in wood processing efficiency was considered.

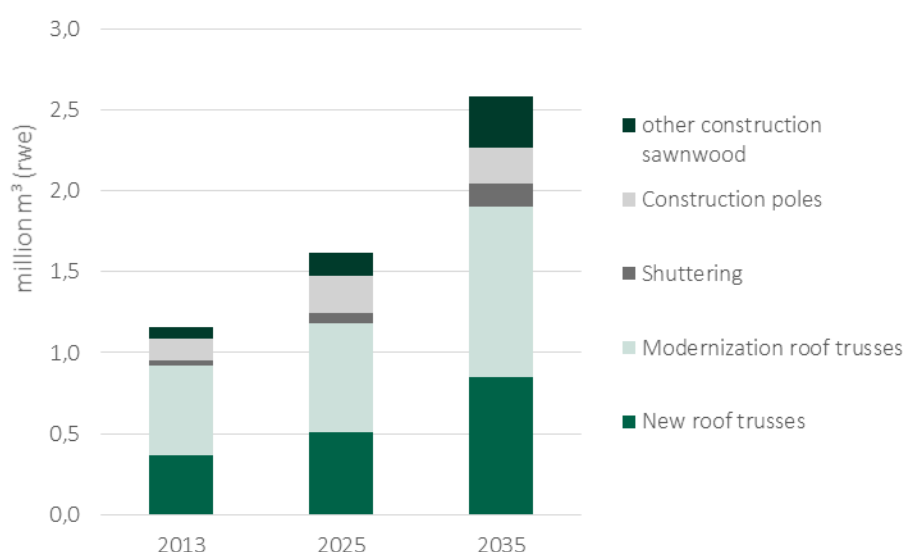


Figure 31: Wood product demand forecast in Tanzanian construction 2013 to 2035

Source: UNIQUE

Table 7: Forecast assumptions on wood products consumption and substitution in the construction sector

Building type	Assumptions for wood products consumption patterns*	Main sources of information
Rural housing	- Rural houses are pre-dominantly single-storey buildings. - Sawnwood (mainly pine) is used in roof trusses. Sawnwood should be treated, but in the majority of cases it is not. - Around 2.1 m³ sawnwood is consumed per roof truss of a 60 m² house. - Five million houses with wooden roof trusses exist, with 2.5% being renovated annually¹⁰. The rate of modernization will increase with growing GDP and purchasing power capacity to 5% until 2035. - Substitution of wooden roof trusses with iron will reach 20% in 2035.	Primary data from contractors, real estate companies and construction departments at district level. 2012 population and housing census.
Urban residential	5% of this building type is higher than two storeys; wooden roof trusses are not used. 95% of buildings have roof trusses. Average floor area is 90 m². - Made from bricks/concrete, requiring building poles and shuttering (see factors for non-residential building). - Substitution of wooden roof trusses with iron will reach 20% in 2035.	Primary data from contractors, real estate companies and construction departments at district level.
Non-residential building	- All buildings are concrete buildings requiring building poles and shuttering. - On average of 2.5 eucalyptus poles are used per m² floor area. By 2035 75% of poles will be substituted by metal pipes. - Shuttering is done with plywood. 0.018 m³ plywood is required per m² floor area; plywood is re-used four times. By 2035 20% of shuttering will be made of aluminum and other substitutes. - Battens and planks (rough sawn timber) for scaffolding and holding shuttering panels are consumed at 0.02 m³ per m² floor area. They are re-used only once. By 2035 it will be substituted at 20%.	Primary data from contractors, real estate companies and construction departments at district level. Nyamoga et al (2016) Mufuruki et al (2008)

Source: UNIQUE; *Other wood products are used in doors, windows, fittings, etc. (see chapter 6.2.2 on furniture and joinery).

¹⁰ Considering experiences from other countries and expert opinions, the modernization rate could be as high as 5% (or 20 years modernization cycle). However, knowing that the majority of the house owners in this segment are in lower income classes and maintenance is not a top priority compared to other daily needs and requirements, the rate was set at 1%.

6.2.2 Carpentry and furniture

Actors and governance

The carpentry and furniture sector is dominated by a huge number of micro, small and medium enterprises. They either offer their services directly to the consumers or work as sub-contractors for construction companies.

The activities of these actors are closely related to the construction sector and its market dynamics. Another important market is public procurement of furniture. Many small and medium size enterprises in the wood sector are represented by the Tanzania Forest Industries Federation (Shirikisho la Viwanda vya Misitani Tanzania, SHIVIMITA).

Large construction contractors frequently run their own furniture and carpentry workshops, sourcing raw material from intermediary traders or (i.e. when treated timber is required) directly from the producers.

The products produced are as numerous as the raw materials (plywood, sawnwood, MDF board, blockboard, etc.) and species (natural forest and plantation) used. The carpentry and furniture sector in Tanzania still consumes significant volumes of natural forest timber. As described in the supply-demand analysis, the sourcing of this timber is frequently “informal”. Prices for natural forest timber have significantly increased in recent years and availability is declining.

This sector is strongly affected by frequently changing consumer preferences regarding styles and designs. Competition by imported furniture is of huge relevance. The average import price of wood furniture in 2015 was USD 1.2/kg (CIF), which indicates low quality furniture. If considering the local market prices for sawn hardwood timber of around USD 0.9/kg to USD 1.3/kg, local producers are likely finding it difficult to be competitive. There is also an increasing trend in importing pre-fabricated carpentry and fittings for construction works, e.g. CNC worked MDF mouldings. There are few Tanzania companies engaged in the production of such products, e.g. TANWAT has established processing lines for mouldings and wood panel doors, and some other larger companies are engaging in carpentry as part of their value adding strategy.

Plantation timber (softwoods) and wood based panels of any type are increasingly used and are increasingly used for frames and doors, and in local furniture manufacturing.

SMEs hardly participate in public tenders due to the complex procedures. There is no established communication channel to articulate SMEs interests to policy actors and large-scale consumers. Frequently public tenders for furniture (schools, office) require native hardwoods in their specifications losing out on the potential cost reduction from using low cost plantation species (i.e. pine).

Compliance with standards and quality requirements is rare in the sector, caused by lack of training and advanced processing technologies, but also difficult access to standard specifications (only available as hardcopies and in English).

Market trends

Overall market size is increasing alongside the growing construction sector (see construction sector trends in chapter 6.2.1). Other important changes are taking place in this market segment, offering possibilities, but also posing threats to Tanzanian producers and products:

1. Plantation timber is increasingly accepted by the market. However, a real substitute for natural hardwoods has not been identified so far. Eucalyptus and Teak are frequently discussed as options, but due to lack of quality sawn wood in the domestic market, the use and demand has not taken off yet. Eucalyptus products in particular would require additional treatment to influence wood characteristics (e.g. darker colours are preferred by the market).
2. There are signs of increased substitution of solid wood products with wood based panels of any kind (i.e. plywood, MDF and blockboard; imports have increased by 20% since 2011; see chapter 4.2.2) in various applications (i.e. doors, fittings and furniture).
3. Wooden window frames are increasingly replaced by aluminium, which is readily available and cheaper than timber (compare study by Nyamoga et al, 2016). Further the aluminium frames show better work-match characteristics than wood frames. In the long run, wooden window frames will likely lose importance.
4. Other wood and non-wood substitutes have also become increasingly important (WPC¹¹, MDF mouldings, etc.). Import trends in the furniture sector show decreasing shares of wood furniture and an increase in plastic and metal furniture (import share of wood furniture in total furniture imports has decreased from 47% in 2011 to 37% in 2015; see chapter 4.2.2).

Market volumes and forecast

The market volume of furniture and joinery was 590,000 m³ (rwe) in 2013, of which 12% were imported wooden furniture. Although plantation timber has entered the market (e.g. frames for upholstered furniture, beds or for doors), the majority of wood consumed were natural hardwoods. The exact shares of plantation versus natural forest timber could not be established in the course of this study.

The demand forecast for carpentry and furniture predicts a volume increase by 250% between 2013 and 2035. The forecast for the years 2025 and 2035 (Figure 32) shows a decreasing share of sawn wood and an increase in wood based panels. The indirect effect of this substitution process can be a higher efficiency rate in terms of round wood use, provided that these wood based panels are produced in the country.

¹¹ WPC = Wood Plastic Composite

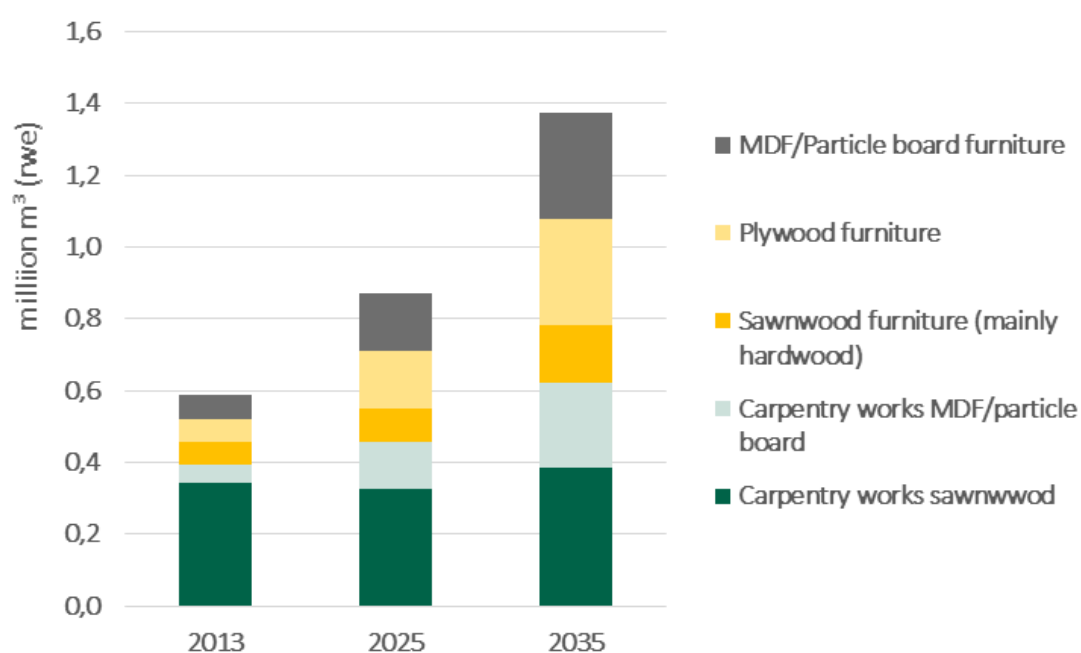


Figure 32: Demand forecast for carpentry and furniture in Tanzania 2013 to 2035

Source: UNIQUE

The wood consumption patterns in furniture production and carpentry were established based on interviews, and on construction and furniture sector studies. Key features of these patterns are presented in Table 8. The same table describes the substitution rates of wood products by non-wood products. The substitution rates are estimates of the authors derived from expert interviews and literature review.

Table 8: Forecast assumptions on carpentry and furniture consumption and substitution

Segment	Assumptions for wood products consumption patterns*	Main sources of information
Joinery in construction	- Consumption will grow with growth in the construction sector (see forecast chapter 4.3). - Average consumption of sawnwood in construction for doors, windows, fittings etc. is 0.009 m³ (rwe)/m² for modern (i.e. high rise buildings) and 0.045 m³ (rwe)/m² in traditional housing. - These volumes will be substituted by wood based panels at 35% until 2035. - Wood based panels materials will substitute sawnwood at 25% in 2035.	Primary data from contractors and real estate companies. Nyamoga et al (2016) Mgana, (2013)
Furniture	- Demand will grow with newly established households. - Each household demands a volume of 150 kg of wood in furniture.*	Population forecast by NBS

Segment	Assumptions for wood products consumption patterns*	Main sources of information
	50% of the wood furniture volumes in 2035 will be made up of plywood and MDF. - Public procurement and commercial furniture consumption were considered as a share of GDP (0.3%). - Replacement of old furniture has not been factored in.	Average weight of household furniture (UK statistics) CSIL (2016) National accounts 2007

Source: UNIQUE; * Average weight of wood furniture per household is estimated to be three beds, upholstered furniture, table and four chairs, two wardrobes.

6.2.3 Packaging and pallets

Actors and governance

Wood packaging materials and wood pallets are becoming an increasingly interesting market in Tanzania (KPMG, 2013). This market segment is not easy to assess, since packaging materials are frequently produced by the main consumers themselves on the basis of sawn wood and wood based panels. However, consumption patterns of wood pallets, being the most prominent product in this segment, can serve as indicator for the dynamics in this market and future potentials.

There are several producers of wood pallets in Tanzania, amongst them are Sao Hill Industries (SHI) and New Forests Company (NFC), both producing softwood pallets. Coca Cola has installed their own pallet production line. Furthermore, there are smaller producers around Mbeya, producing pallets of natural hardwoods and eucalyptus. Most pallets are used for the distribution of fast-moving consumer goods, such as beverages and food products.

During the market survey, consumers of softwood pallets articulated problems with quality and durability. Softwood pallets in the distribution of beverages only have a 4 to 5-time re-use cycle. Since they are frequently stored outside, they are exposed to rain and extreme temperature changes, on top of their heavy duty tasks. One of the largest consumers (Tanzanian Breweries Ltd.) is exclusively using natural hardwood pallets, which apparently endure up to three years. However, availability is increasingly becoming a problem, generating interest in alternatives, e.g. in eucalyptus pallets.

Pallets and wood packaging are frequently perceived as being a product in which low quality raw materials can be used. This is true to some extent as long as products comply with product specifications according to end-use. With increasing demand for softwood sawnwood, pallet production will compete with economically more attractive market segments in construction and furniture. Thus, availability of softwood sawnwood for packaging may become limited. Alternative materials could be introduced (e.g. pressed wood from sawmilling residues), but require investments in research and development.

Although large producers and distributors consider standardized packaging and transport as the most effective way for product distribution, prevalent conditions still favour manual loading and loose packaging due to weak infrastructure and lack of modular transport in rural areas, and the availability of “cheap” labour.

Market trends

Two major trends were identified for the consumption of wood pallets in Tanzania:

1. Fast moving consumer goods (food and beverages) will be increasingly distributed all over Tanzania. With improving infrastructure, wood a packaging will increase market share. The trend is further enhanced by increasing integration of Tanzania into global trade.
2. Pallets and plywood are the most common wood packaging materials. However, there are specific quality requirements to be considered. Standards are available, but just like in other market segments, standard compliance and control is weakly developed in Tanzania.

Market volume and forecast

Based on expert interviews and expert estimates, an actual consumption volume of 20,000 m³ (rwe) of pallets was established for 2013. As a main indicator for future growth, transport sector statistics were analysed.¹²

The forecast of future demand (Figure 33) draws on an average annual growth rate of 7%¹³, resulting in a consumption volume of 38,000 m³ (rwe) in 2025 and 75,000 m³ (rwe) in 2035. The species consumed for pallet production may vary, depending on the end-use of the pallets. A mix of softwood and hardwood sawnwood is assumed.

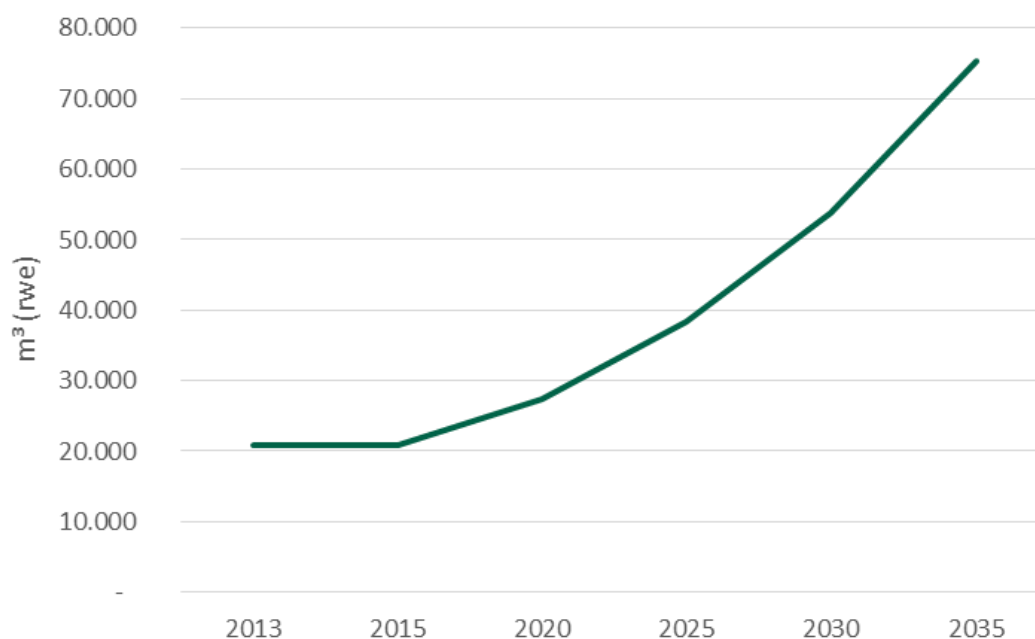


Figure 33: Wood pallet demand forecast 2035

Source: UNIQUE

¹² Growth rates of transport sector GDP (including transport of persons and goods) was 6.6% p.a. between 2007 and 2013 (NBS, at constant prices 2001). Furthermore, the registration of transport vehicles (for goods) in Tanzania has grown with 15% p.a. between 2005 and 2010 (ADB, 2013).

¹³ Other studies (e.g. IT, 2012) forecast an increase between 7% and 8% of road transport of goods in Tanzania until 2030.

6.2.4 Transmission poles

Actors and governance

The domestic market for transmission poles is clearly defined by the volumes required by TANESCO and the Rural Electrification Agency (REA). Hence, it is a transparent market in terms of volumes and final consumers. Purchase of poles follows a tri-annual tender process. However, the volumes may vary significantly from one tender period to the other, depending on available financial resources of TANESCO and REA.

Suppliers of transmission poles are the large plantation companies owning treatment plants and a number of other treatment plants buying green poles from other growers and TFS (see chapter 7 on transmission poles value chains). Tenders are open for international bidders; enabling South African suppliers to regularly sell poles to Tanzania (see chapter 4.2.2 on imports).

Some of the national pole suppliers perceive the tender process as not transparent or feel bypassed especially when very large volumes are tendered (the ability to provide large volumes is one of the competitive advantages of South African suppliers). However, TANESCO is following tender procedures according to the public procurement regulations, which foresee that at least 10% of the tendered volumes/values must be allocated to Tanzanian suppliers. On the other hand, TANESCO claims that the quality of CCA treated poles from Tanzanian suppliers has worsened in recent years, leading to TANESCO considering switching to Creosote treated poles and a range of other measures to address quality.

Substitution of concrete poles for wood poles is not common and is unlikely to become an important issue, at least until transport infrastructure in rural areas improves¹⁴.

Since the national market is limited, many actors are targeting the export market, i.e. East African neighbours, with Kenya being the main target country.

Market trends

The main trends in the national transmission pole markets are:

1. Domestic market volumes for transmission poles are limited and will likely decline after 2035 (foreseen year for completion of the rural electrification process). Then, replacements will become the main demand driver.
2. Installed capacities in Tanzania are approx. 500,000 poles per year (mainly CCA treated). Thus, theoretically the capacity surpasses the forecasted national demand by around 100,000 poles (see section on market volume and forecast). Any changes in TANESCO procurement policies (for example the requirement for Creosote treated poles) would require technical changes in installed treatment capacities. Nonetheless, excess capacity of CCA treated poles is expected to increase.
3. Export markets (i.e. in Eastern Africa) are perceived as being an attractive option and alternative market for Tanzanian pole producers. However, these countries pursue their own rural electrification and procurement policies and are subject to macro-political

¹⁴ In the mid-term, concrete poles will not surpass more than 40,000 poles p.a. (personal communication TANESCO).

influences, which are hard to predict. Kenya, for example, is regularly announcing a massive change to concrete poles. South Sudan, which is frequently mentioned becoming a major consumer of poles is still in political turmoil, and the same applies to eastern DRC.

4. Many countries have established huge pole treatment capacities (i.e. Kenya: 1 million poles and 350,000 in Uganda; Source: Cheboiwo (2014)), with producers targeting domestic and export markets. South Africa hosts a competitive and large pole treatment sector. Competition in general will increase in domestic and export markets. The competitive edge is sustainable access to large volumes of quality raw material.
5. There are other (growing) market segments related to treated wood products (e.g. construction timber and panels). Treatment plants should be encouraged to strategically review their options in these markets.

Market volume and forecast

TANESCO has announced an annual demand of around 350,000 poles for the next three years (Figure 34). The same annual demand can be assumed until 2035 (chapter 4.3), probably going up to 400,000 poles. Actual volumes may vary from year to year. The majority of the poles will be 10-metre poles. Exports are not considered in the forecast. Volumes between 50,000 and 100,000 poles for export seem reasonable, but cannot be substantiated.

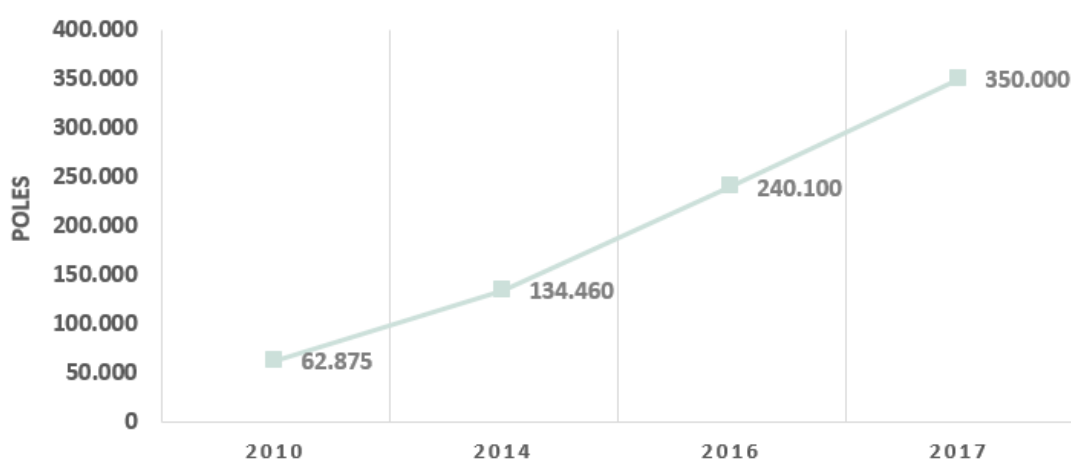


Figure 34: Transmission pole consumption by TANESCO and REA and short-term forecast

Source: UNIQUE based on TANESCO

6.2.5 Paper products

Actors and governance

The two main actors in Tanzania's wood based paper production are MPM and TFS. TFS has long term contracts with MPM, supplying roundwood from the Sao Hill plantations. MPM consumes around 200,000 m³ annually, although maximum production capacity is double that size. In order to become more independent from government supply, MPM has started to establish its own pulpwood plantations. Approximately 50% of MPM production of Kraft paper is exported.

Market trends

The consumption of paper products comprises four major product groups:

1. Coated/uncoated paper for news print, books, commercials: Consumption is stagnating in Tanzania. As a function of population growth, literacy rate and purchasing power, there should be significant growth. However, with new media and internet having become more important in recent years, demand will not follow the traditional growth path.
2. Sanitary papers: The consumption of these products will increase with growing population and purchasing power.
3. Office paper and coated papers: These paper products are mainly used in private enterprises and public administration. Their consumption depends on economic growth and public investments.
4. Packaging paper (cartons and uncoated papers): This product will become increasingly important with growing national and international trade. Consumption and growth is influenced by the country's economic performance and its involvement in global trade.

Market volume and demand forecast

Tanzania is a net importer of almost all relevant paper products (except for Kraft paper, which is usually used for packing and wrapping). The consumption of all paper products has increased from 414,000 m³ (rwe) in 2011 to 490,000 m³ (rwe) in 2015.

Newsprint has been growing stable and slowly. All other paper products show stronger, although volatile growth throughout the analysed period (Figure 35). Starting from low volumes, sanitary paper consumption is increasing rapidly.

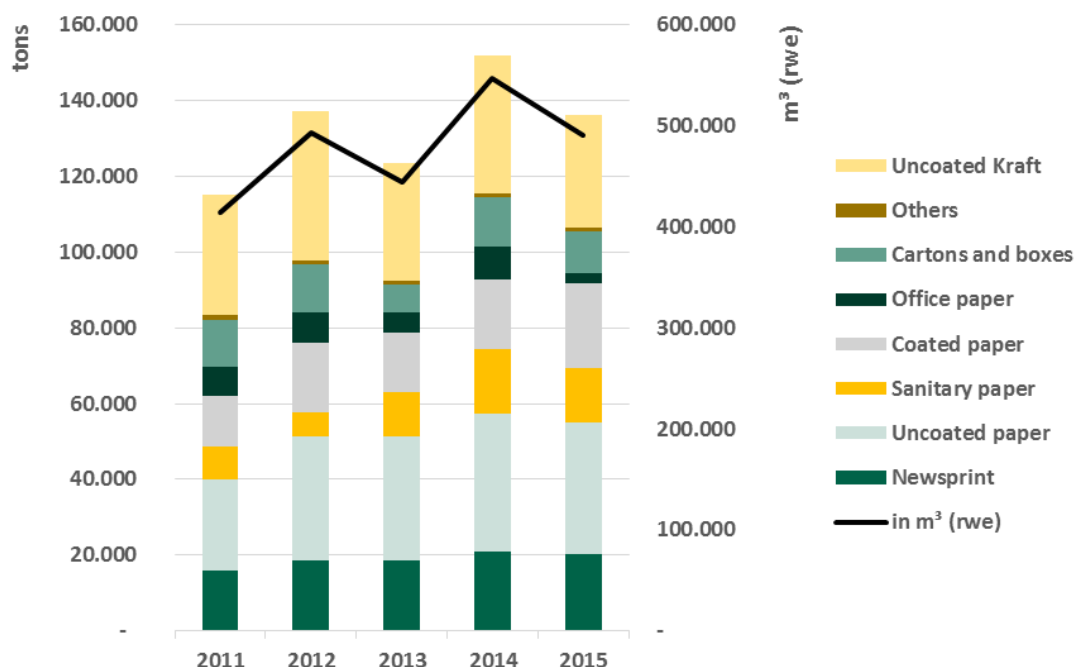


Figure 35: Paper consumption in Tanzania 2011-2015

Source: UNIQUE based on UN Comtrade 2016 and MPM production data

Paper production worldwide increasingly relies on recycled raw materials and alternative fibre sources (e.g. agricultural residues). Thus, the conversion of paper demand into roundwood equivalents must be interpreted carefully. Given the fact that most of the paper consumed in Tanzania comes from countries such as China, India or South Africa, it is reasonable to assume that up to 50% the raw material used for producing this paper is made up of recycled materials. Thus, the demand for fresh fibre is likely much lower (circa 50%) than the volumes shown in the time series analysis (Figure 35).

Future demand for paper products in Tanzania was calculated based on population projections from NBS and applying the historic 5-year-average (2011-2015) per capita paper consumption inflated by 7% p.a. to reflect increasing purchasing power. The resulting forecast for paper demand is 0.8 million m³ (rwe) in 2025 and 1.1 million m³ (rwe) in 2035 (Figure 36).

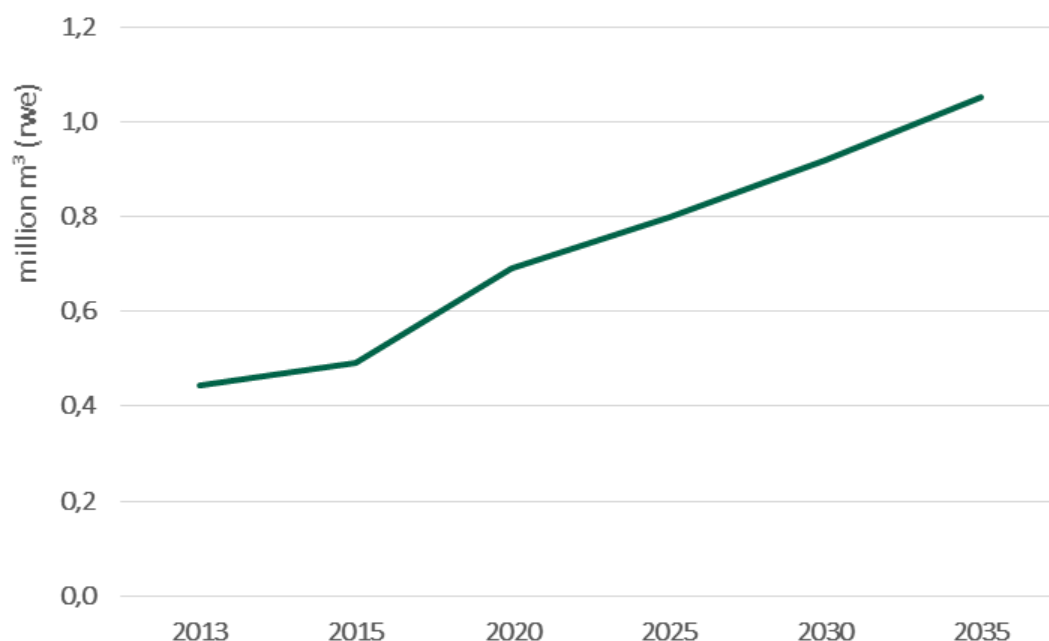


Figure 36: Paper consumption forecast for Tanzania 2013 to 2035

Source: UNIQUE

Whether this demand will be met by domestic production or imports depends on industry investments, which have been stagnating in the pulp and paper sector in recent years. Worldwide pulp production capacity has stabilized since several years, with the increasing demand being met by increased recycling. The pulp and paper sector is a globalized sector, which is highly competitive and price sensitive. Investments in the pulp and paper sector are depending on the secure availability of low cost raw materials, infrastructure/market access and economies of scale; globally even small pulp and paper mills have an annual intake of around 1 million m³ (rwe). Thus, it is likely very likely that future demand will be met by imports not effecting the national round wood supply-demand.

6.2.6 Biomass

The use of wood biomass for energy production in agricultural and industrial processes is very common in Tanzania. The Annual Survey of Industrial Production and Performance for the year 2008 identified an industrial consumption value of TSh 22 billion. The most recent Census of Industrial Production of 2013 shows a consumption equivalent to TSh 37 billion of wood fuel (fuelwood and charcoal) by Tanzanian industries.

A rough estimate of the related volumes can be made by assuming a price of average wood fuel. Knowing that the prices vary significantly depending on availability, source and distance from producer to consumer, the following numbers should be interpreted carefully. Furthermore, statistics do not differentiate between charcoal and fuelwood.

Interviewed biomass traders stated fuelwood prices at around 100,000 TSh/ton in Dar es Salaam and 25,000 to 50,000 TSh/ton at plant gate in Southern highlands. Many large consumers of fuelwood have special agreements with suppliers and plantation owners, and prices are frequently lower than common market prices (sometimes as low as 10,000 TSh/ton). If assuming an average price of 50,000 TSh/ton¹⁵ in 2013 the consumption volume is 730,000 m³ woodfuel.

However, overall there seems to be a decreasing trend in wood fuel consumption for industrial purposes, which was confirmed by actors interviewed in the course of the present study. This trend is driven by two factors: 1) the easy availability of low-cost agricultural residues; and 2) the shift from biomass to natural gas in industries. An important exception from this trend are large players that have installed large-scale biomass power plants to produce energy for industrial processes and feed excess electricity into the national grid (e.g. TANWAT, UNILEVER). These actors usually rely on own wood fuel plantations, estimated at around 10,000 ha in 2015. Biomass is sourced from various areas and suppliers. Thus, the share of plantation based biomass in the overall consumption could not be established during this study. However, interviews with traders and consumers of wood biomass indicate that plantations present a significant contributor of overall demand. Accordingly, the sources of raw material include:

- Woodfuel plantations that have been established to serve this market segment;
- Thinnings and waste from plantation forestry and wood processing industries (using plantation timber); or
- Woodfuel made of trees that are not suitable for other market segments (e.g. large dimension trees that cannot be processed by mobile sawmills).

The total market volume for industrial woodfuel indicates a rather stable outlet for low quality wood from plantations and specialised woodfuel plantations. However, in the face of the predicted increase of thinning volumes and low quality logs coming online in the future (see chapter 3), the question will be how to maintain and increase these market volumes.

¹⁵ This is a mix price calculation, assuming that around 70% of the industrial woody biomass for wood fuel is consumed as charcoal and around 30% as fuel wood.

6.3 Wood product prices in Tanzanian markets

The prices for wood products in Tanzania vary according to region and supplier. Thus, there is no national commodity price, e.g. for rough sawnwood. The following table presents the results of price survey undertaken amongst wood product dealers in Dar es Salaam, Mbeya, Mwanza, Arusha and Dodoma. The table also includes mill gate prices of large domestic producers of wood products and import prices for wood based panels and sawnwood¹⁶. The overview indicates regional differences, with very high prices in Arusha and Dar es Salaam and low prices in Mbeya (note: the low sawnwood prices in Mbeya may be a function of high local availability and import pressure by Malawi imports). However, Tanzania is not import dependent on sawnwood and import prices are not a threat to domestic production competitiveness.

Table 9: Wood product prices encountered in regional markets, mill gate prices and average import prices

Product specification as encountered in market		Market price in TSh/m ³					List price in TSh/m ³	
Sawnwood		Dar	Mwanza	Arusha	Dodoma	Mbeya	Mill gate price South. Highlands	Import price 2015 (CIF)
Sawn wood pine	2x4x12, untreated	431,000	377,000	700,000	323,000	215,000	-	500,000
Sawn wood pine	1x8x12, untreated	861,000	700,000	807,000	646,000	323,000	-	
Sawnwood pine	2x4x12, kiln dried	-	-	-	-	-	450,000	
Sawnwood pine	2x4x12, treated	-	-	-	-	-	550,000	
Sawn wood (hardwood)	from Malawi, dimensions and quality unknown	-	-	-	-	-	-	
Natural forest sawnwood	2x6x8	-	1.507.000	-	-	-	-	-
Wood based panels		Dar	Mwanza	Arusha	Dodoma	Mbeya	Mill gate price South. Highlands	Import price 2015 (CIF)
Plywood low quality	9mmx4x8	-	-	-	578.000	-	950,000	1,500,000
Plywood	Marine board, 12mmx4x8	2.170.000	2.025.000	1.181,000	1,881,000	2,025,000	1,100,000 (most likely no Marine board)	
Blockboard	18mmx4x8	-	-	4,500,000	-	-	1,200,000	
MDF board	18mmx4x8	1,447,000	1,157,000	1,254,000	1,543,000	1,543,000	-	1,000,000

¹⁶ NOTE: Import prices are taken from UN Comtrade database, which provides price data per ton. The conversion of prices into m³ inheres numerous conversion steps, which may cause inaccurate results of the price per m³ stated in this table. The conversion factors used were taken from UNECE 2010.

Product specification as encountered in market		Market price in TSh/m ³					List price in TSh/m ³	
Poles		Dar	Mwanza	Arusha	Dodoma	Mbeya	Mill gate price South, Highlands	Import price 2015 (CIF)
Building pole Euc,	7-10 cm; 6 m	352,000	118,000	176,000	88,000	88,000	-	-
Transmission pole	Import South Africa (average)/ 9 m stout local production	-	-	-	-	-	650,000	600,000

Source: UNIQUE based on interviews and UN-Comtrade

It is important to note, that the price survey is based on a small number of one to two wood product dealers per region and is not representative. Thus, the prices presented in this chapter may include significant deviations from common average prices.

A direct comparison of import prices with locally produced products prices is not possible, since statistical records of product specifications of imported products are not accurate enough (e.g. poles are not specified according to size classes and for sawn timber it is not stated whether it is planed or dried).

During the market survey, no domestically produced wood based panels were detected in the regional stores. Prices of imported wood based panel prices in the Tanzanian markets tended to be much higher than the prices realized by local producers, i.e. for high quality plywood (at mill gate). On the other hand, imported Kenyan plywood was sold at much lower price (not knowing if this was just singularity in that specific case). Prices for plywood are highly sensitive to quality grading. Thus, the detected price differences do not necessarily indicate higher competitiveness of domestic production versus imports and vice versa).

6.4 Export markets

Tanzania is not an important exporter of primary and secondary wood products. The only exception is hardwood sawnwood (namely Teak and some indigenous hardwoods), which is mainly exported to South and East Asia (see chapter 4.2.2). It will take between five to ten years until (1) the currently still immature plantations supply sufficient raw material to cater for domestic and for export markets, and (2) Tanzanian industries have achieved a higher level of competitiveness in terms of efficiency and quality. Nonetheless, it is important to note that export markets are an attractive option for companies already having reliable access to wood resources and willing to invest in modern processing facilities. For these “early movers” the subsequent analysis provides useful information on selected export markets. However, each export-based business plan requires an in-depth analysis of the targeted country, its market segmentation, accessibility and potential competitors.

International market dynamics are subject to a variety of factors, such as economic performance of targeted countries, development patterns of domestic wood industries in these countries, and the strategies of international competitors. Hence, this analysis can only provide an actual image of the status quo for selected countries, knowing that the situation may change rapidly.

The export market analysis was undertaken for a group of East African countries and a group of countries in the Middle East.

6.4.1 African export markets

In summary, African countries show similar wood product import patterns. Import demand of African countries would match pretty well the short and medium term raw material availability forecasted in the supply analysis (chapter 3). However, with their actual set-up, Tanzanian wood processing industries and value chains are not yet prepared to supply large quantities of export products. Furthermore, the domestic market promises offtake of substantial volumes of wood products of any type (see demand analysis (chapter 4) and market survey (chapter 6)). The proposed business models in chapter 8 explain in detail the requirements for small growers and processors to achieve a higher level of competitiveness, which may lead to better participation in international markets. Nonetheless, global experience shows that major drivers of export activities are usually large-scale wood processing industries, which source from integrated plantations and out-growers. Such investment and business models are pursued in Tanzania by actors like Green Resources, KVTs and NFC. A game change in this regard may become the envisaged plantation investments in the Ruvuma Region, where around 80,000 ha are planned to be reforested in the coming years by large investors.

Trade with treated poles shows an interesting triangular pattern across East Africa: Tanzania exports to Kenya, Kenya exports to Uganda, Uganda exports to Tanzania, and South Africa is exporting to all of them. Another important source of treated poles is Zimbabwe.

Sawnwood is the most common product imported by African countries. However, softwood sawnwood is imported in significant volumes only by Ethiopia and Zambia. Natural forest hardwood sawnwood is traded more frequently in East Africa.

Plywood is a very popular import product due to its multiple uses in all sectors. Currently the main supplier to East Africa is China (and partly South Africa).

Fibre and particle board are the most important import products in all African countries. However, Tanzanian industries do not account for significant production capacities (in fact no production in 2016). Particle and fibre board production could absorb huge quantities of small diameter logs from thinning and final harvest, and residues from sawmilling industries. However, investment requirements are comparatively high and international competition is tough¹⁷. Large scale investments are unlikely to be realized in Tanzania in the short term. On the other hand, there is an increasing number of small and medium size technologies for the production of particle and fibre board operating in Asian countries (e.g. India, Viet Nam). Whether or not these technologies are a feasible option for the Southern Highlands requires in-depth analysis of their underlying business models and economics.

Figure 37 shows the total volumes of imported wood products by the six analysed countries in the year 2013 (most recent year of complete datasets for all countries).

¹⁷ The worldwide production of wood based panels is dominated by South American and Asian producers, who produce in large scale plants (intake from 100,000 m³ to 1 million m³), making use of economies of scale. They frequently produce the raw material in own plantations (vertical integration) with raw material costs below 10 USD/m³.

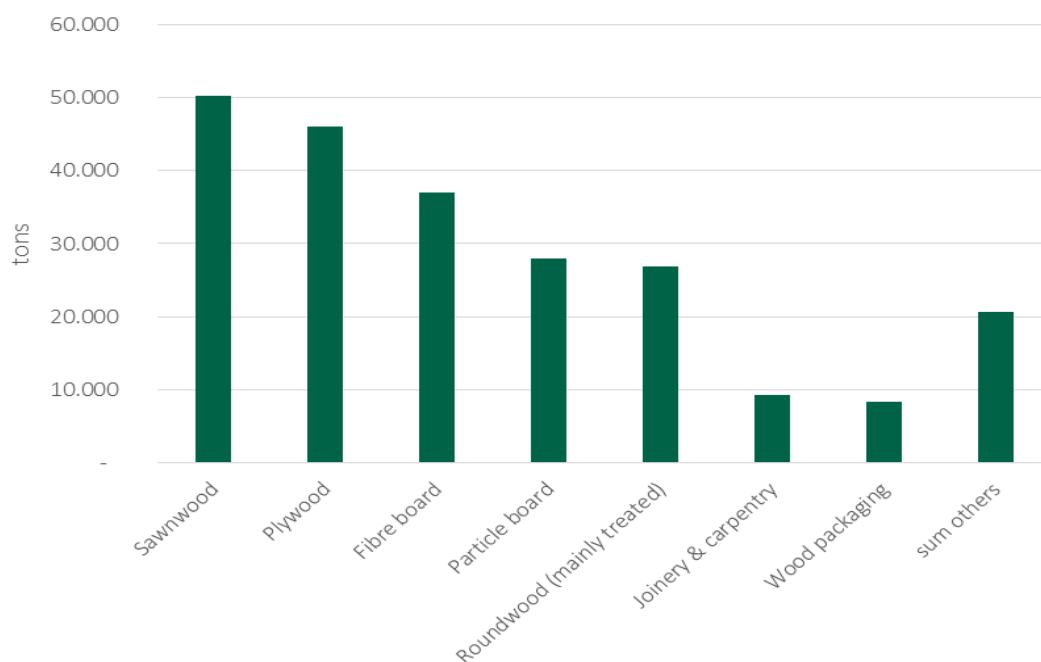


Figure 37: Wood products imports by Ethiopia, Kenya, Zambia, Rwanda, Uganda and Malawi in 2013

Source: UNIQUE based on UN Comtrade, 2016

The following figure summarizes the import market volumes for the six analysed countries in 2013. Amongst the group of analysed countries, Ethiopia is the most important importer in terms of overall volumes (approx. 100,000 tons), followed by Kenya (approx. 50,000 tons) and Zambia (approx. 40,000 tons).

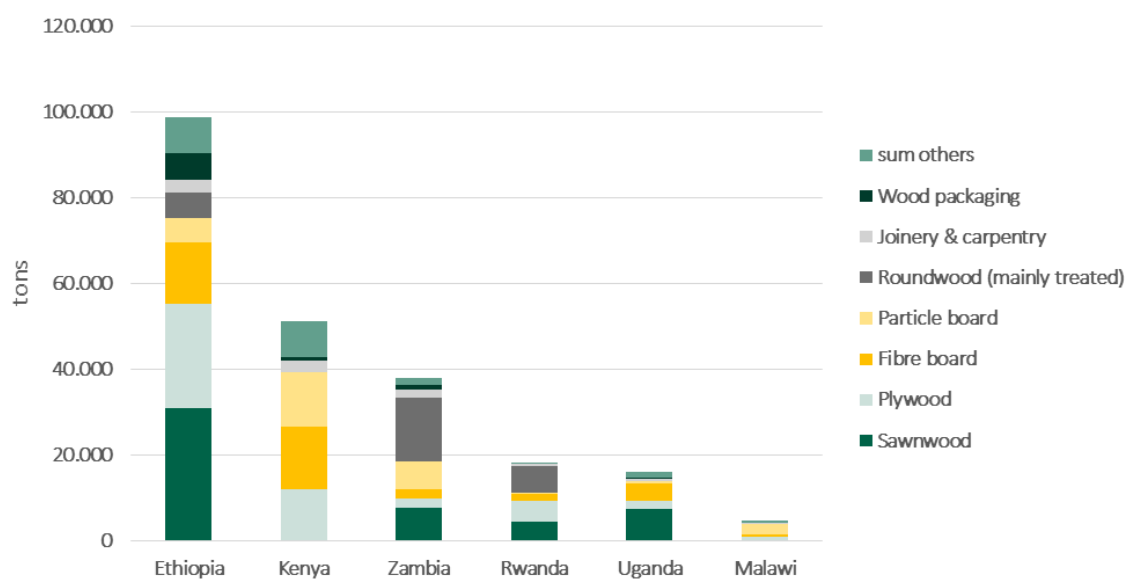


Figure 38: Wood products imports by East African countries in 2013

Source: UNIQUE based on UN Comtrade, 2016

In the following sections, the developments of wood products imports for selected East African countries are illustrated. For better visualization only 'important' import volumes are presented. The order of countries presented is prioritized according to total import volume.

Ethiopia

Ethiopia is the largest east African importer of wood products. Imports have increased substantially since 2012, driven by the booming economy and the country wide supply deficit of wood products. Key import products are softwood sawnwood from Austria and wood based panels and joinery from China.

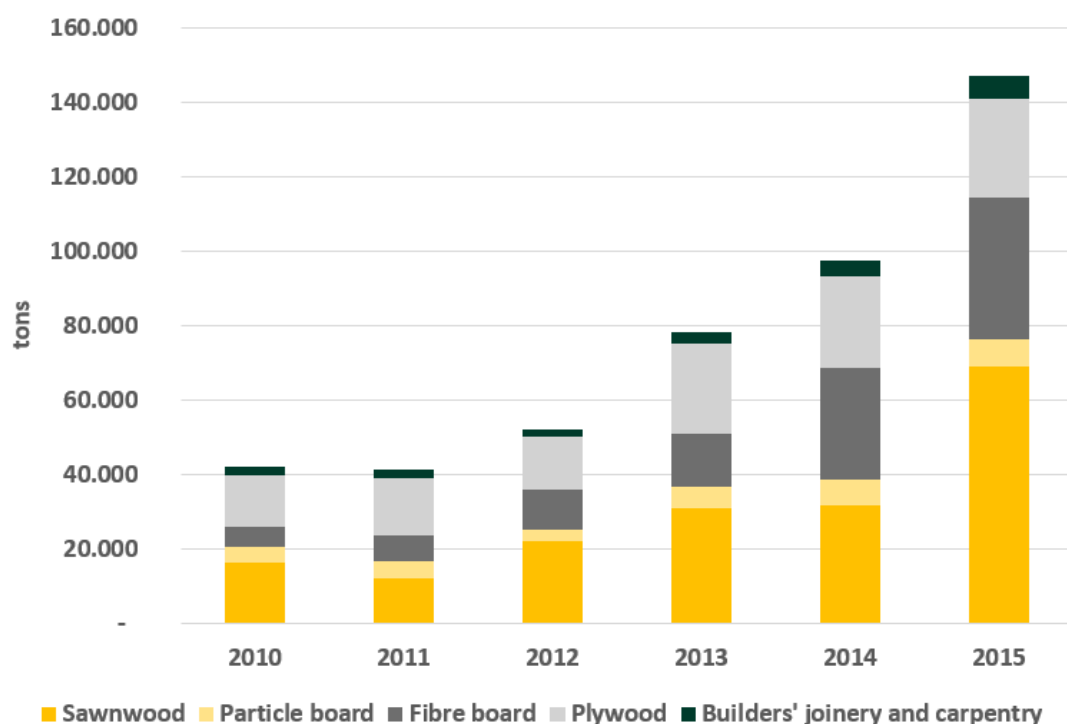


Figure 39: Wood products imports Ethiopia 2010-2015

Source: UNIQUE based on UN Comtrade, 2016

Kenya

Trade data for Kenya was only available for the years 2010 and 2013, showing an increasing import trend for treated poles (e.g. from Tanzania) and wood based panels (mainly from China).

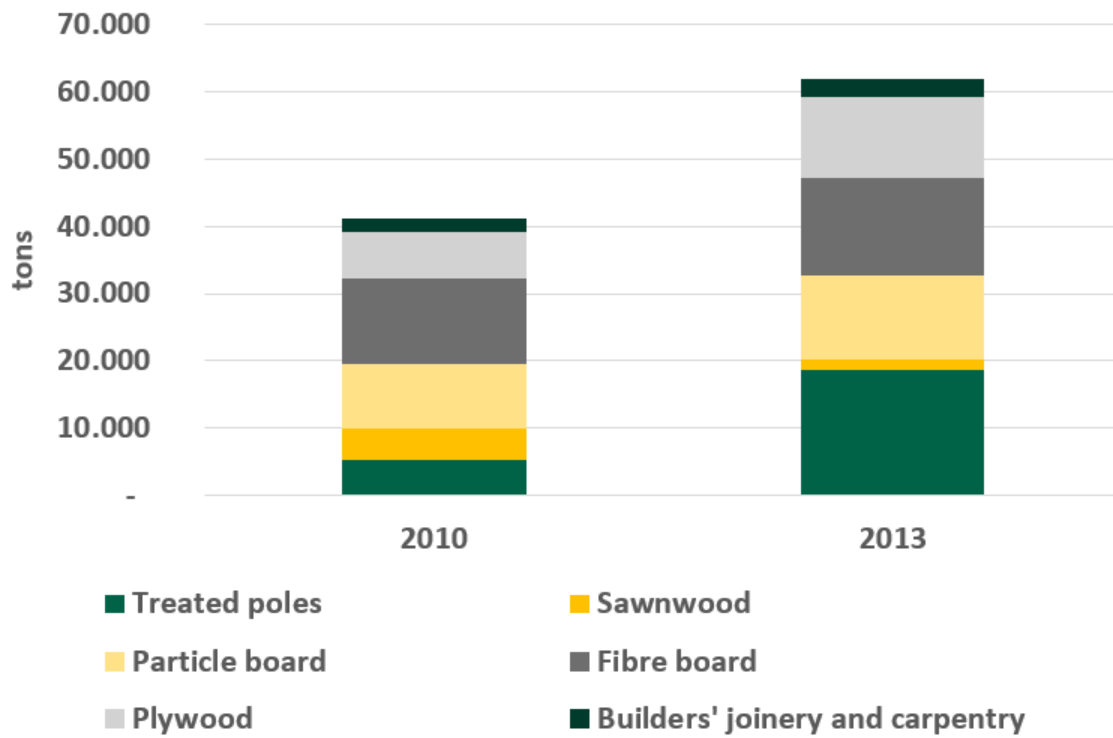


Figure 40: Wood products imports Kenya 2010 and 2013

Source: UNIQUE based on UN Comtrade, 2016

Zambia

Zambia is the third largest importer of wood products amongst the analysed African countries. The country's imports increased rapidly from 2011 to 2012, more than doubling the import volume. Import growth was driven by treated pole imports from Zimbabwe and South Africa and sawnwood imports from South Africa, Malawi and Zimbabwe. Zambia imports both softwood and hardwood sawnwood.

Plywood comes mainly from China and Malawi, while particle and fibre board is being imported mostly from South Africa, Zimbabwe and China.

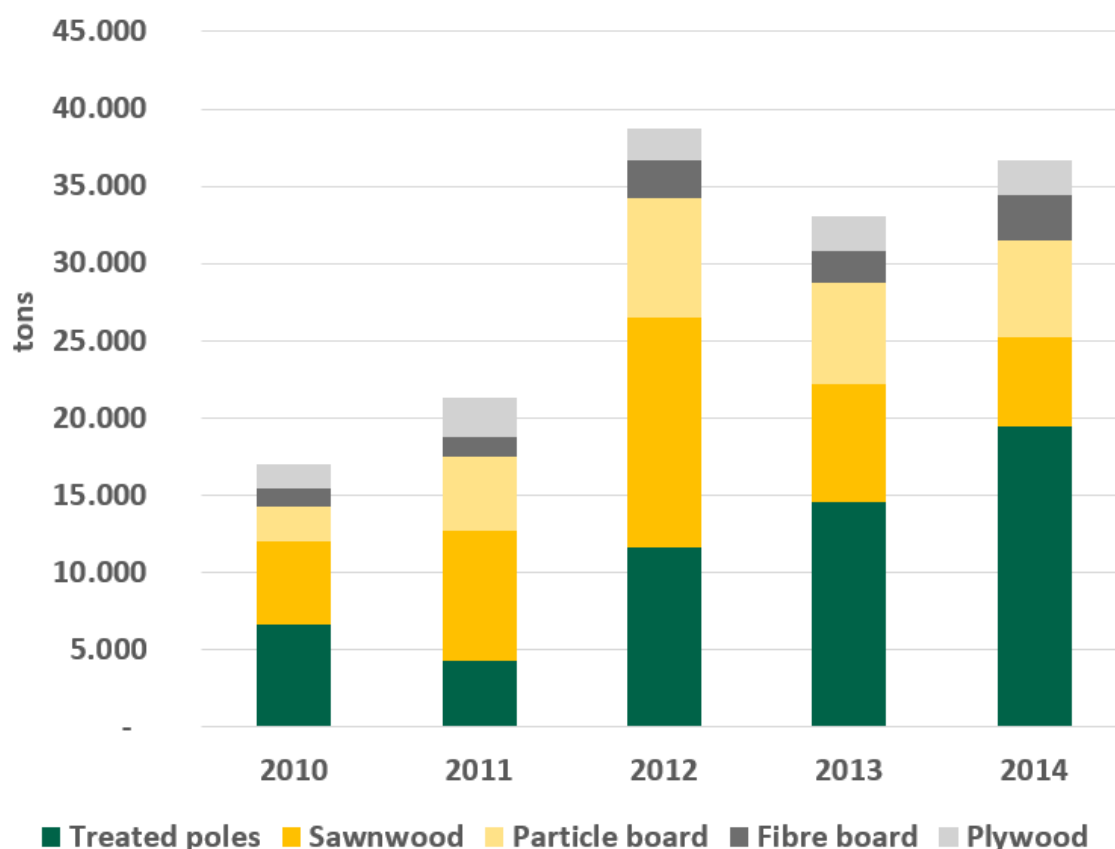


Figure 41: Wood products imports Zambia 2010-2014

Source: UNIQUE based on UN Comtrade, 2016

Rwanda

Rwanda's wood product imports have grown steeply from 2010 to 2014 driven by roundwood and joinery. The decline in 2015 is linked to overall economic slowdown, but appears rather drastic and is not fully explicable (Figure 42).

Treated poles were mainly imported from South Africa and Uganda, sawnwood (i.e. tropical hardwood) from China and wood based panels from China and the Emirates. The joinery and carpentry products are also mainly coming from China and the Emirates.

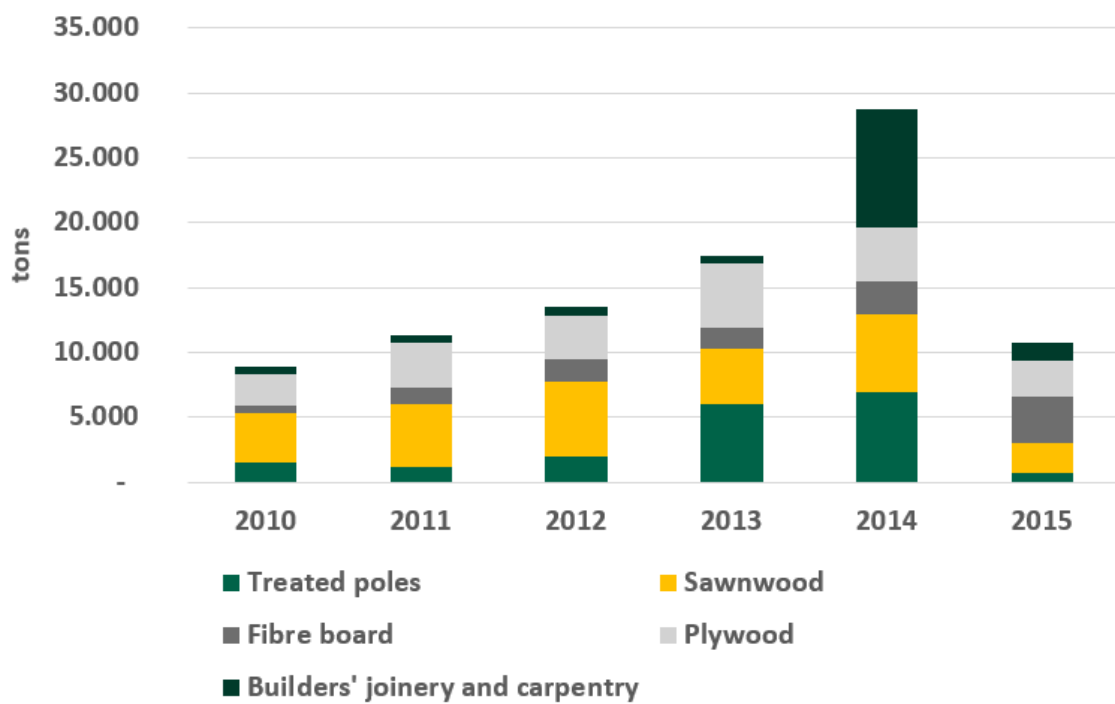


Figure 42: Wood products imports Rwanda 2010-2015

Source: UNIQUE based on UN Comtrade, 2016

Uganda

Uganda's imports do not show significant growth dynamics (Figure 43). Stable volumes of sawnwood (i.e. tropical hardwood) are imported from DRC. Wood based panel imports originate from a broad variety of countries with China, Kenya and South Africa being the most important suppliers. When treated poles were imported they came from Kenya or South Africa.

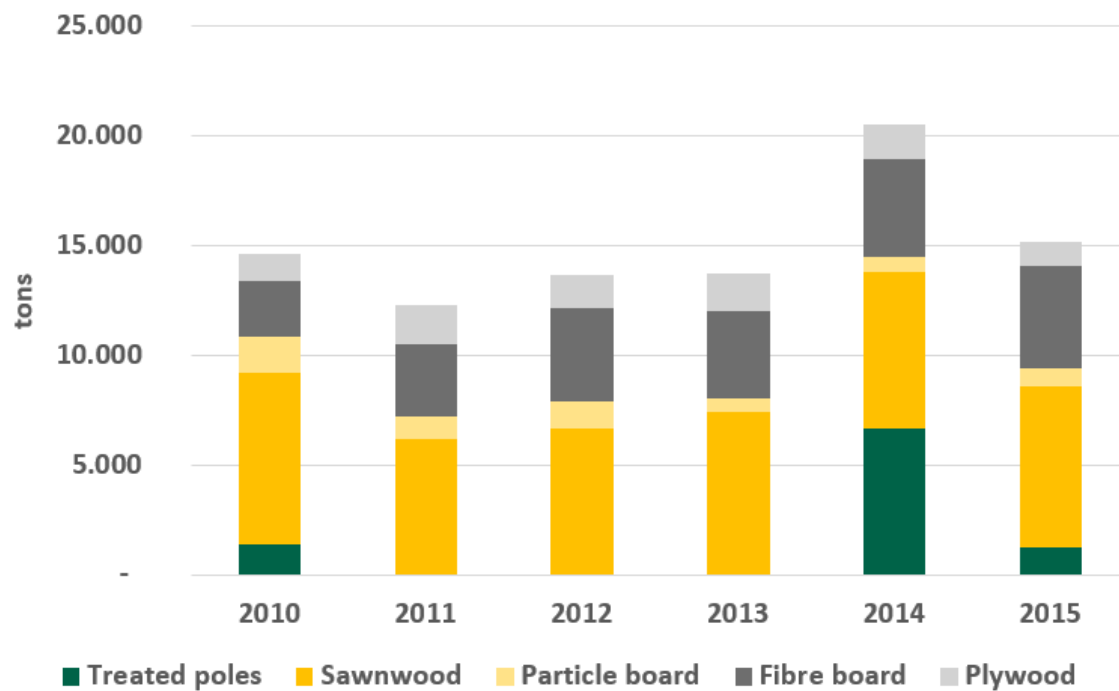


Figure 43: Wood products imports Uganda 2010-2015

Source: UNIQUE based on UN Comtrade, 2016

Malawi

Malawi's overall import volume of wood products is marginal compared to the neighbouring countries (Figure 44). Wood based panels, mostly particle board, are the main products imported.

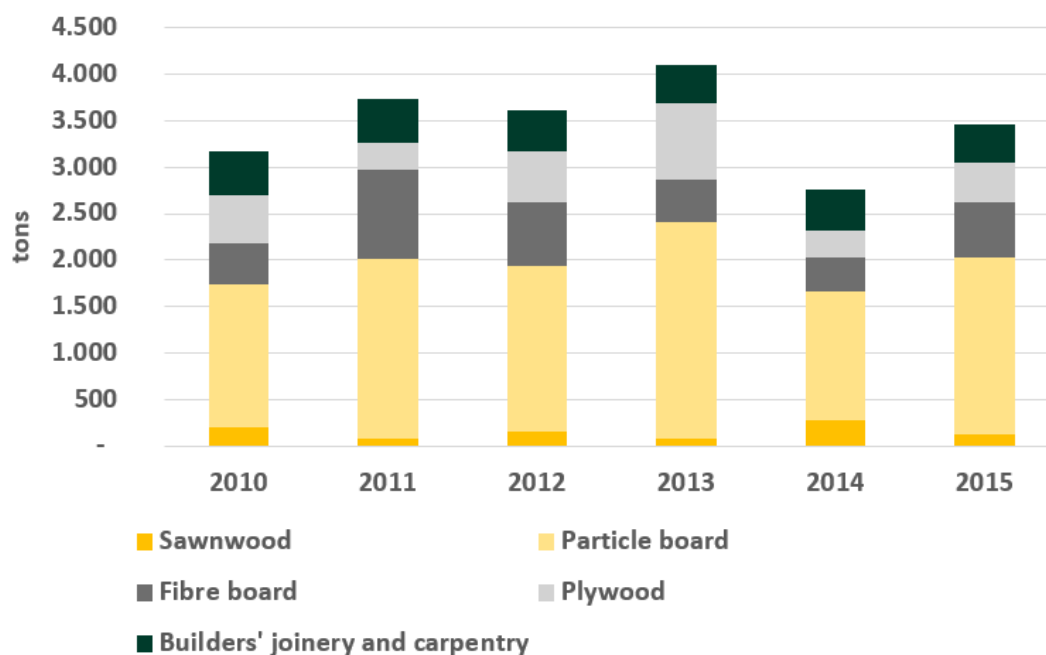


Figure 44: Wood products imports Malawi 2010-2015

Source: UNIQUE based on UN Comtrade, 2016

6.4.2 Middle East export markets

Middle East markets show commonly huge import volumes (due to absence of own forest resources) and stable growth figures (Figure 45, Figure 46, Figure 47). In the following sections, the import data for these markets is presented briefly since Tanzanian competitiveness in these markets is actually limited and accessibility is difficult. Middle East markets are supplied with quality sawnwood from Chile, New Zealand and Europe and wood based panels from Asia. Nonetheless, these countries will remain import markets in the long term. Thus, regular monitoring of their import requirements and product specifications is recommendable.

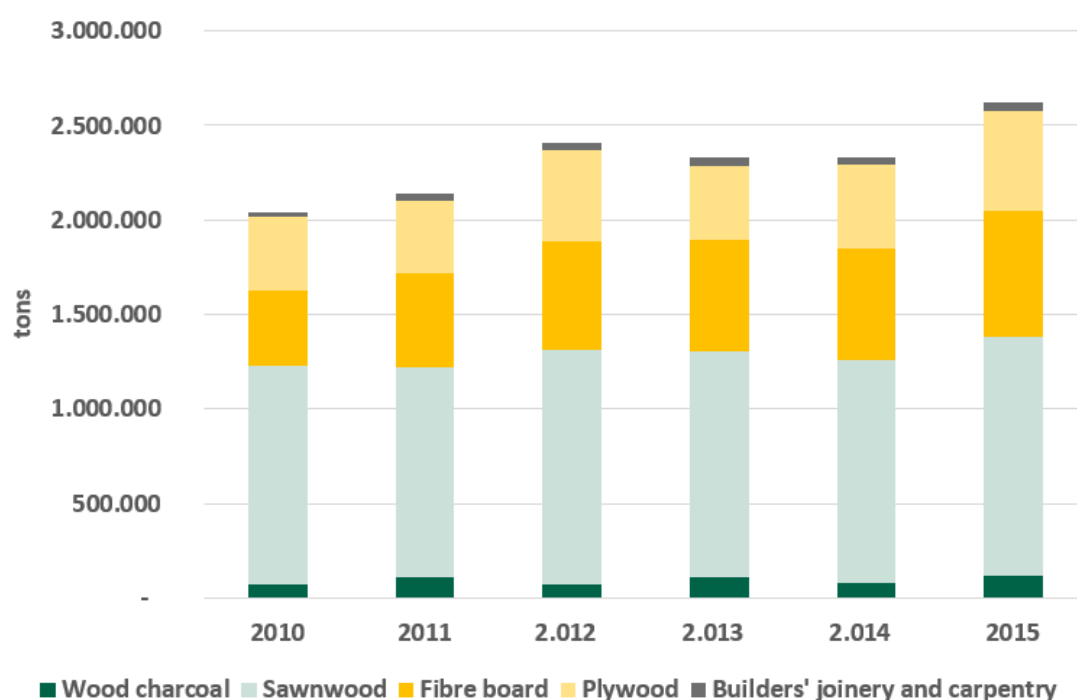


Figure 45: Wood products imports by Saudi Arabia 2010-2015

Source: UNIQUE based on UN Comtrade, 2016

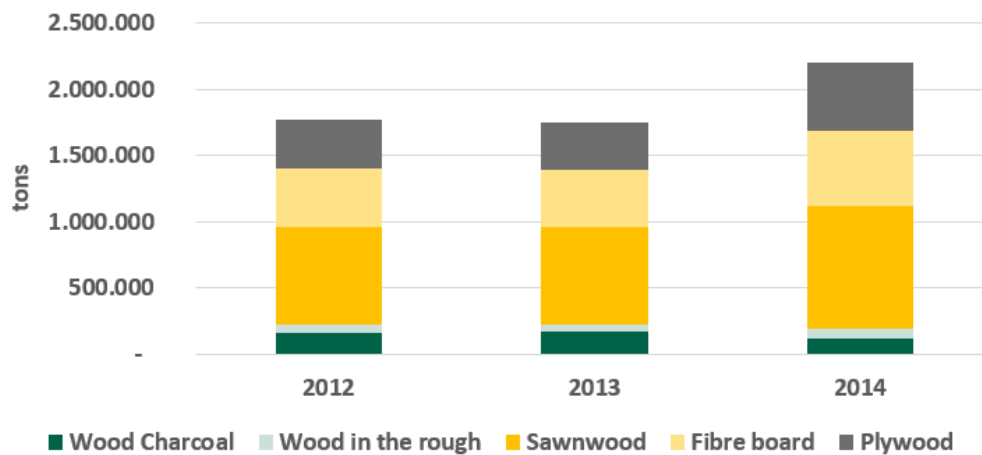


Figure 46: Wood products imports by United Arab Emirates 2012-2014

Source: UNIQUE based on UN Comtrade, 2016

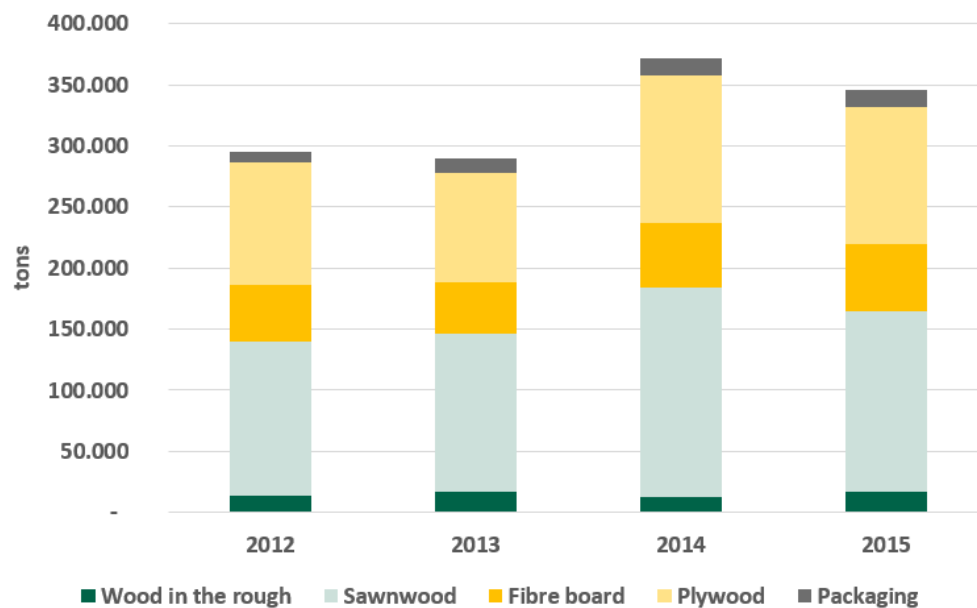


Figure 47: Wood products imports by Oman 2012-2015

Source: UNIQUE based on UN Comtrade, 2016

7 PLANTATION BASED VALUE CHAINS IN TANZANIA

In this chapter, each value chain is described as follows:

- Current state, trends and outlook;
- Estimated value addition and profitability;
- Analysis of the strengths, weaknesses, opportunities and threats (SWOT), related to aspects of competitiveness, resilience and inclusivity; and
- Constraints specific to the value chain and propose potential interventions.

7.1 Sawn timber

7.1.1 Current state, trends and outlook

The Southern Highlands supply most of the sawn timber consumed in the country (INDUFOR, 2011). Although no quantitative estimates exist, a large part of the sawn timber from the Southern Highlands is estimated to go to larger markets such as Dar es Salaam and Arusha, and a much smaller share to export markets in neighbouring countries. Exports to Kenya, formerly a major export destination, have drastically reduced following the lifting of a timber harvesting ban in that country in 2012. Sawn timber comes mostly from pines, which make up an estimated 72% of forest plantations and woodlots in the Southern Highlands¹⁸, and to a smaller extent from eucalyptus and a range of native species. The market share of eucalyptus is increasing (although at low rates) due to declining supply of pine of suitable age and size against an increasing demand. Supply of eucalyptus timber is influenced by what could be termed as ‘unplanned’ supply – namely, old/mature eucalyptus trees left behind after buyers have selected trees suitable for utility poles are commonly processed into sawn timber. Besides ‘unplanned’ supply, eucalyptus is being perceived a potential substitute for hardwood sawn timber from native species, presenting an opportunity for promoting eucalyptus. However, processing eucalyptus timber requires specific knowledge and technology, which are presently lacking in Tanzania. Thus, intervention in eucalyptus processing is key to unlocking this potential.

Sawmillers source logs from government plantations and STGs. Some large companies, e.g. Sao Hill Industries (GRAS), NFC, KVTC and TANWAT, are pursuing a vertically integrated business model. However, due to immaturity of their own plantations, these actors currently also source from third parties.

According to interviews, the price of round wood from STGs is generally lower than from government plantations by up to 40%. The downside of sourcing from STGs is that tree quality tends to be poorer and access more difficult than in government and large private forest plantations. However, field observations revealed a lack of quality management in some government plantations as well (also verified by the INDUFOR market study of 2011).

Sawn timber processing is dominated by ding dong type of sawmills. This type of sawmill is used both at small and medium scales of operations, with its use estimated at 78% of all sawmill

¹⁸ This estimate is based on preliminary results of remote sensing work that FDT is presently undertaking. A review by Ngaga (2011), reports that Pines make up 78% all plantations and woodlots in Tanzania (Ngaga, 2011. Forest plantations and woodlots in Tanzania). PFP (2016) estimates that 89% of all species sold by private tree growers are pines.

technology used across the Southern Highlands (PFP, 2016). These small-scale sawmillers source their materials mostly from STGs, having limited access to government plantations.¹⁹ The ding-dong sawmills include imported (mainly AMEC from China) and locally-fabricated machines, which are predominantly used by small sawmillers (500-1,000 m³ annual intake) as they are readily available and cheap. Some mobile sawmillers also use chainsaws to produce planks from trees in hard-to-reach locations. In very remote places, e.g., in parts of Kilolo district, pit sawing has also been reported. Many medium (3,000-5,000 m³ annual intake) and large sawmillers (>5,000 m³ annual intake), however, are using improved sawmill technologies, and in a few cases include kiln-drying of timber. These technologies range from Kara type, circular sawmills to different types of vertical, horizontal and mobile band saws. The transition to improved sawmill technologies is, however, slow and hampered by many constraints such as difficulty in accessing modern technology and the required capital. An overview over the different saw types, their importance and main characteristics is presented in Table 10.

In the last few years a considerable number of entrepreneurs, acting along the whole supply and value chain have emerged. The links in the value chain vary from:

- Fully integrated businesses, growing, harvesting and processing their own and third party timber;
- Mobile operators harvesting and milling on-site in third party plantations and woodlots, selling planks in retail or to wholesalers;
- Traders buying standing stocks to harvest and trade logs to stationary mills and
- Traders buying and aggregating already sawn timber for onward sale.

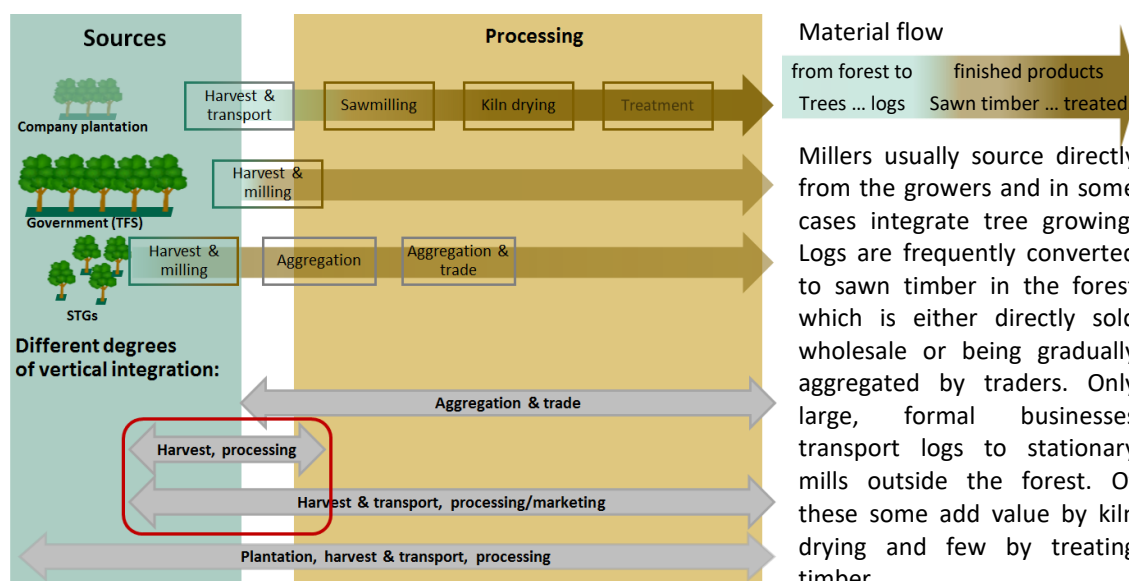
For smaller quantities in particular, trade via intermediate timber traders is typical. These intermediate traders buy sawn timber from tree growers and sawmillers for onward sale to next level traders, who then bulk and sell to retailers/wholesalers (Figure 48). Retailers or wholesalers usually present the final contact to the end-user/final consumers. Small and medium sized entrepreneurs (who are often tree growers too) frequently provide other services as well such as nurseries, planting and thinning. These SMEs combining a variety of service including harvest and trade are an important entry point for the development of the wood based value chains sourcing from small and medium growers. Detailed descriptions of these actors can be found in previous studies such as INDUFOR (2011) and PFP (2016).

¹⁹ Harvesting licenses for government plantations are issued based on the processing technology and capacity. In particular small entrepreneurs using ding dong mills claim to be bypassed when licenses are issued in favour of bigger companies and entrepreneurs who had licenses in the past.

Table 10: Sawmill technologies being used in Tanzania

Sawmill technology types		Approximate extent of use	Characteristics
Mobile	Pit and chain saw	< 3% of the milling operations in private plantation forests	Low recovery and productivity Poor product quality Suitable for individual trees with difficult access
	Ding dong saw	~ 50% of sawmill operations in government forests > 90% of sawmill operations in private forests	Low recovery of 20-35% Poor product quality Suitable for diameters of up to 35cm Suitable for scattered plots and low harvesting volumes per site
	Kara type, circular sawmill	~ 20% of sawmills operating in government forests 1 sawmill in private forests	Recovery ca. 35-40% Product quality depends on operator Suitable for sawlogs of up to 35cm
	Band saw (Chinese and American models)	~ 1% of sawmills	Recovery ca. > 40% for logs > 30 cm diameter Product quality depends on operator
Stationary	Vertical band saw (Chinese model)	~ 5% of the sawmills using wood from government forest	Recovery > 40% Suitable logs size from 30 cm
	Horizontal band saw (Chinese and Indian models)	~ 5% of the sawmills using wood from government forest	Recovery > 40% Suitable for logs from 40 cm diameter Product quality depends on operator

Source: PFP, 2016; UNIQUE, 2016



Third party providers buying standing stock, harvesting and converting logs to planks in the forest or at the forest edge provide an important service in particular for STGs.

Figure 48: Sawn timber value chain

Source: UNIQUE

With support from PFP and NGOs, growers have formed Timber Grower Associations (TGAs). Estimates put the number of TGAs at over 100. The management and support of associations to their members tends to be very weak, and is largely restricted to mobilisation for training, i.e. an entry point for the NGOs working with STGs. UWAMIMA in Njombe district is a positive exception, getting involved in marketing of timber products of their members.²⁰

There is evidence of an emerging trend in substitution of timber in the construction sector. The factors driving this trend include low quality of timber, rising price of timber against a decline in prices of some alternatives, and the potential of re-using other materials numerous times in case of temporary applications such as shuttering and scaffolding.

The construction sector also consumes timber treated with preservative chemicals. Key consumers include large construction projects as well as individual housing property owners. However, availability of properly treated timber currently remains low. Traders in Mafinga estimated the share of treated timber to be about 10% of their total timber sales. Treated timber faces two major challenges in the market: 1) significantly higher market price of around 25% mark-up per m³ (compared to “cheap” rough sawn timber) making it unaffordable to many buyers; and 2) presence of “fake” treated timber²¹ compromising customer confidence.

²⁰ UWAMIMA, which is considered the most advanced TGA in the region, has been getting substantial support from an NGO. Without this support, perhaps it would be in a similar state to other associations.

²¹ Timber must be pressure treated with CCA (or similar chemicals) to enhance durability. Timber merely soaked in CCA, or with other chemicals with similar colour, cannot easily be distinguished but will decay as fast as untreated timber.

7.1.2 Value addition & profitability

The value addition by milling is substantial, i.e. the price of sawn timber is around twice as high at the point of sale than the roundwood timber value (Table 11 and Figure 49). If using band saws rather than ding dong or similar saws the added benefit can be twofold: (i) reduced losses during conversion; and (ii) better sawn timber quality which can result in higher prices depending on the point of sale. The prices given by the Mufindi Sawmillers Association indicate that timber produced with ding dong mills is sold at approximately 20% lower prices regardless of species. Price difference for pine in Dar es Salaam is in a similar range.

Table 11: Prices and profits along the sawn timber value chain

Location/technology		Unit	Pine	Eucalyptus
Stumpage price private growers		TZS/m ³ standing	80,000-120,000	45,000
Sawn timber price point of production				
At forest road	Ding Dong ¹	TZS/m ³ sawn timber	359,000	300,000
At mill gate	Stationary band saw ²	TZS/m ³ sawn timber	358,000	N/A
Profit sawn timber producer				
At forest road	Ding Dong ¹	TZS/m ³ sawn timber	45,000	20,000
At mill gate	Stationary band saw ²	TZS/m ³ sawn timber	150,000	N/A
Sawn timber price in retail				
In Mafinga	Ding Dong ¹	TZS/m ³ sawn timber	535,000	360,000
In Dar Es Salam	Ding Dong ¹	TZS/m ³ sawn timber	542,000	432,000
	Stationary band saw ²	TZS/m ³ sawn timber	670,000	N/A
Profit sawn timber				
In Mafinga	Ding Dong ¹	TZS/m ³ sawn timber	148,000	32,000
In Dar Es Salam	Ding Dong ¹	TZS/m ³ sawn timber	120,000	24,000
	Stationary band saw ²	TZS/m ³ sawn timber	120,000	N/A
¹ Milling in the forest, assumed recovery rate 37%				
² Advanced milling technologies in Mafinga, assumed recovery rate 47%				

Source: PFP (2016) values presented are rounded

Figure 49 provides an example for two different value chains, producing sawn timber from pine with ding dong type saw mills versus production with band saws in Mafinga. While the stumpage price is similar, value addition and profits of processors and traders are significantly higher in scenario 2. Recovery rate log to sawn timber is assumed to be 37% for ding dong saws and 47% for stationary band saws. Higher recovery rate translates into a relatively lower stumpage cost if expressed as sawn timber equivalent. The relative share of stumpage cost in the overall value addition and profits are additionally influenced by higher revenue at the final point of sale in Dar es Salaam.

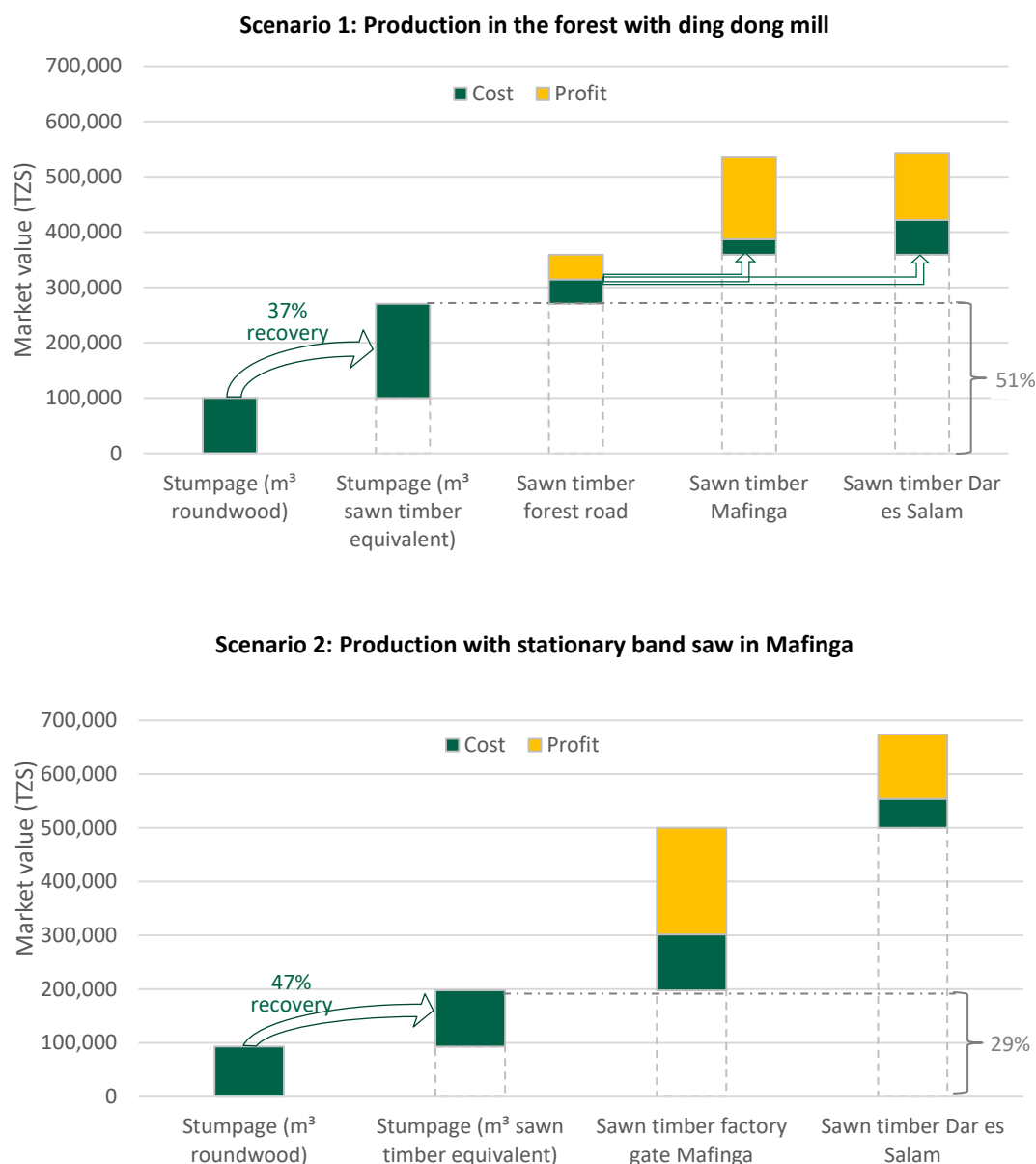


Figure 49: Value addition along the sawn timber value chain

Source: based on PFP (2016)

The profit of timber growers was not assessed, however growing trees is considered a profitable form of land use in the Southern Highlands. It is likely that by acting as a group rather than individuals, farmers could improve their profits to some extent (related to e.g. bargaining power, linking buyers to groups of growers thereby reducing transaction cost of the buyer, engaging in some form of value addition themselves). A business model is provided in section 8.2.1.

While better quality of sawn timber is reflected in higher prices and ease of sale, this is not the case for trees/logs. Stumpage prices from government plantations increase exponentially with diameter but only up to a diameter of 35cm (Figure 50). Given that prices of private growers are oriented on government prices, a similar pricing pattern seems likely. As a result, there is little

incentive to invest in large dimension timber by (i) increasing rotation length and (ii) investing into activities such as thinning. Pruning, if done at the right time, correctly and in conjunction with producing larger diameter trees, can substantially increase the value of sawn timber by allowing production of knot free timber (see Figure 51). However, at the moment price incentives are not passed on to the grower.

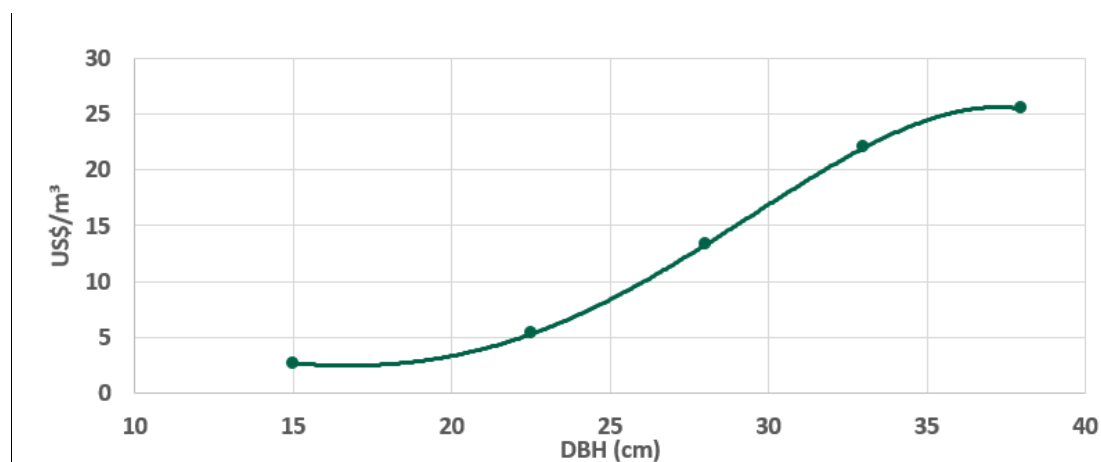


Figure 50: Stumpage price for diameter classes in government plantations (TFS)

Source: GoT Forest Amendment Regulations (2015)

The impact of knots in sawlogs on timber is illustrated in Figure 51 below: The output on knot-free sawn timber with a 20 cm log is zero, in logs of 40 cm, at least some planks show at least one clear face. The interactions between poor pruning and knot defects, such as rotten or loose knots, seemed to be not yet well understood/appreciated by tree growers and many sawmill operators.

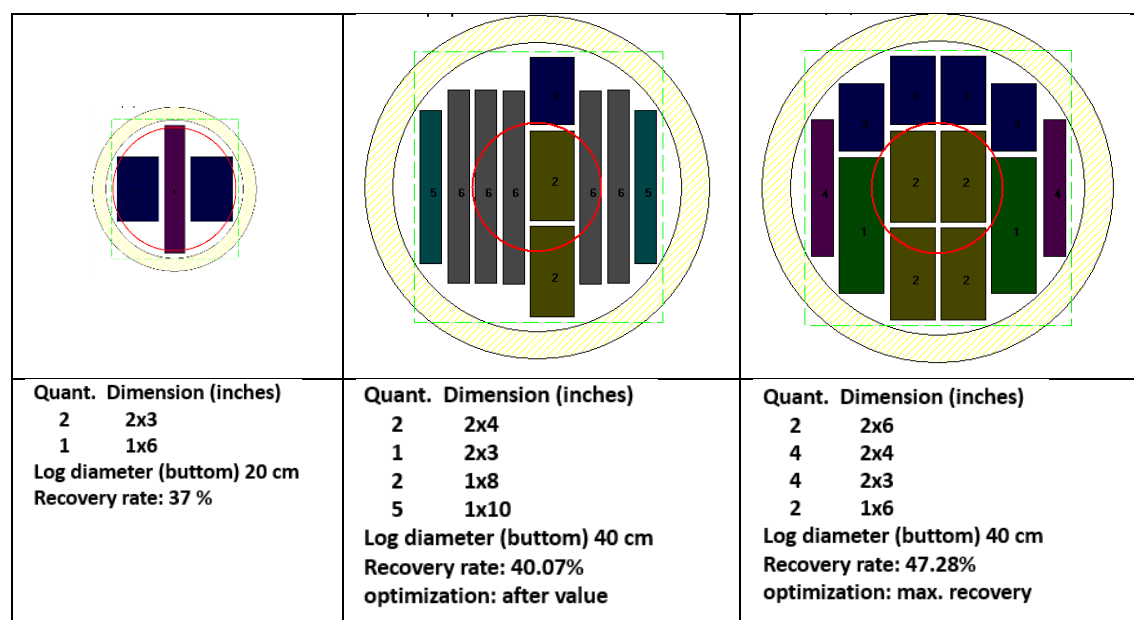


Figure 51: Cutting schemes using standard dimensions

Source: UNIQUE 2016, using simulator Optimber; outer circle is big end diameter with bark, inner yellow circle is small end diameter under bark, red circle is a knotty core of 18 cm as it is obtained with current pruning method.

Markets within the Southern Highlands only provide limited incentive for processors to improve technologies as price differentiation between high and average quality is variable. Buyers of timber are often more concerned about price than about quality, especially when the timber is used for construction. In the regional market, prices for high quality and poor quality timber differ by ca. 20% between ding dong sawn timber and timber processed with a band saw. Timber traders reported that high quality timber sell faster than poor quality. In Dar es Salaam, there are reports of significant price differentiation, with high quality timber fetching about 20%-27% higher price (PFP, 2016 and INDUFOR, 2011). The lack of grading sawn timber and logs according to a clear set of quality standards hinders the implementation of improved processing and forest management standards geared to produce better quality timbers by growers and processors.

7.1.3 Strengths, weaknesses, opportunities and threats

Strengths

Entrepreneurship: A wide variety and growing number of entrepreneurs are engaged in the sawn timber value chain, spanning from the above mentioned fully integrated forestry and processing companies to highly mobile, smaller players catering only to a section of the value chain. This diversity of harvesters/processors and traders contributes to the inclusion of small tree growers and their scattered and often poorly accessible woodlots into the value chain. Furthermore, potential shortfalls in timber supply from government forest may be compensated by timber volumes coming online increasingly from small and medium growers.

Strong and growing markets: Sawn timber from the Southern Highlands is traded throughout Tanzania. Sawn timber is, and will likely remain, a key material for the construction sector despite substitution with other timber products and materials.

Weaknesses

Low product quality: Poor quality is a problem associated with both saw logs and sawn timber. Poor quality saw logs include bent logs and logs with many dead knots. Such logs are the result of using poor quality seeds, lack of proper silviculture and short rotation length. Poor quality sawn timber, i.e., uneven dimensions, blue stains, bending and cracking is a result of poor sawmilling and drying technologies, and negatively affects the competitiveness of sawn timber in increasingly selective markets against other materials.

Dispersed and unpredictable supply: Woodlots and medium sized plantations outside government forests are scattered across the Southern Highlands and are often not easily accessible, resulting in higher transaction and aggregation costs. Small tree growers often base their decision to harvest on an immediate cash need rather than a set production target, making forecasting of product groups coming online within a given period difficult. As a result, processors prefer sourcing from government plantations despite the higher prices.

Losses through inefficient saw milling technology: Smaller entrepreneurs usually use very basic technologies with low recovery rate and quality of sawn timber. A situation that is unlikely to change unless key constraints, i.e. limited access to better technology (knowhow and finance) and guaranteed minimum log supply needed to recover the investment in better technology in due time can be overcome.

Undifferentiated log sales and absence of suitable log grading: At the moment plantations/woodlots ready for harvest are mostly sold as standing trees. The price of the trees is usually set according to diameter classes but does not take into account log quality. It is usually left to the buyer of standing stock to find markets for trees or sections which are not suitable for the intended purpose, and/or high quality logs may be used for a low end/value product. As a result (i) the grower does not maximise his return (rather profit from onward sales of 'other' categories goes to the buyer of standing stock), and (ii) value addition potential may be lost as logs are not allocated to the best/most suitable product.

Infrastructure: Access to plantations, and in particular woodlots, is often difficult with poorly developed road systems in rural areas. Mobile milling plays an important role in bringing these trees to markets nonetheless, as sawn timber can usually be extracted manually where logs cannot.

Opportunities

Efficiency and quality gains through improved processing: By applying better – but not necessarily high-tech – sawmilling technologies and improving operators' skills, recovery rates and product quality could be improved substantially. Furthermore, by increasing the proportion of timber sawn with stationary mills, wood residues otherwise wasted can be converted to other marketable products.

Entrepreneurs are interested in wood processing as a long-term business venture: Almost all the interviewed saw millers indicated interest to continue investing into their businesses in order to expand and upgrade.

Development potential of existing tree growers associations: The many existing TGAs were established with the support of projects such as PFP. While their managerial and technical capacities are still very low, members recognized the need of coming together in order to be more powerful market actors. Associations have the potential to provide their members with technical knowhow and market information, improve market access by linking them to buyers; helping to aggregate woodlots ready for harvest into economically more viable batches; and, in the long term, add value to their members' forests by engaging in primary processing. Such associations could also form integral parts of tree growers and processing clusters (see chapter 8).

Increased demand for quality sawn timber products: The steadily increasing demand for high quality timber products, i.e. planks with precise dimensions, smooth surfaces, kiln dried and treated with preservatives, will help to push the shift to better processing technology as well as better forest management (in particular if higher log quality results in higher stumpage prices).

Threats

Substitution with other materials: Globally, the trend is a shift away from sawn timber and towards Engineered Wood Products (EWP) such as plywood, fibre board and particle board. Additionally, non-wood based materials are competitive too and available for substitution of sawn timber in construction, interior fittings and furniture. While the demand trend for sawn

timber in Tanzania is still positive, investors should consider diversifying production towards EWP to increase their resilience to market changes.²²

Increasing competition amongst processors may lead to the gradual exclusion of local SMEs:

Processing companies need secure access to logs to be economically viable and access to finance to grow, improve and diversify their production. Small entrepreneurs such as the majority of mobile saw millers have neither. Instead, they often rely entirely on wood from STGs – an unpredictable supply source – and do not have access to finance given their small and usually informal businesses. On the contrary, well established processors and traders have access to government forest resources, can finance business expansions internally and/or have enough assets and turnover to get credits or co-investors. Competition between these very different actor groups is likely to lead to a consolidation of the wood processing sector, which may however come at a cost to STGs who currently rely on small mobile millers for market access.

Strengths	Weaknesses
▪ Wide variety of entrepreneurs engaged in the value chain allows mobilization of wood supply from very different sources and different scales. ▪ The sawn timber market is expected to remain strong, with sawn timber remaining a key material for the construction sector regardless of the many materials available for substitutions.	▪ Large quantities of low quality sawn timber available in the market are likely to accelerate substitution of timber with other materials. ▪ Dispersed and unpredictable supply from woodlots and small plantations results in high transaction costs and difficult business planning for processors. ▪ Inefficient milling technology and associated low recovery rate and product quality are unlikely to change without better access to knowhow and finance for entrepreneurs. ▪ Undifferentiated log sales and absence of log grading are likely to cause economic losses for the grower and reduces value addition potential.
Opportunities	Threats
▪ Efficiency and quality gains in the existing processing plants as well as mobile mills can be realised with basic technology upgrades. ▪ Entrepreneurs see their investment in the wood processing value chain as a long term business venture. ▪ The existing tree growers associations provide an entry point for cluster development. ▪ Increasing demand for high quality sawn timber products provides the foundation for investments in better saw technology.	▪ The global trend shows a shift away from sawn timber and towards panels and EWP. Processors must upgrade their technology to stay competitive in the sawn timber market and where possible diversify. ▪ The increasing competition between processors for raw material supply is likely to lead to a consolidation in the sector. Small mobile saw millers are likely to be the losers. With them, the market link of small tree growers may be threatened.

Figure 52: SWOT sawn timber value chain

²² EWP also include products based on sawn timber such as bare core, and finished products such as Gluelam and block board.

7.1.4 Key constraints and potential interventions

Key constraints for the sector as a whole are the limited access to information, finance, technology and knowhow, and the absence of log grading and, related to it, the wholesale of stands regardless of product categories. Specific to the sawn timber value chain is the mismatch between the key products – standard size boards requiring long logs with diameters above 35 cm – and tree size (small) and quality (often low) actually available from small tree growers.

Many of the potential interventions would benefit from a supply based cluster approach, i.e. combining growers with similar characteristics, constraints and opportunities, and matching them with industries of appropriate type and scale to be established within a (or across several) cluster(s) with the aim to improve markets for small tree growers in particular and increase efficiency and competitiveness within the value chains. Potential interventions within clusters include mapping of supply, design of aggregation structures including operationalization of TGAs and development and implementation of supply-demand information systems.²³ This application could include the provision of price information, e.g. quarterly updates of prices for key log and product categories.²⁴ Additional interventions, related to specific constraints are listed in Table 12.

Table 12: Constraints and potential interventions in the sawn timber value chain

Constraints	Potential interventions
Limited access to information, finance, technology and knowhow: ▪ Market demand and raw-material supply information is hard to access/not available ▪ The knowhow on product options and technologies is limited ▪ Suppliers for milling technology and after-sales support are not available in the country. ▪ Commercial banks are unlikely to give loans to new entrants/small businesses ▪ Skilled operators for saw mills are not available/must be trained by the investors	▪ Embedded into the proposed cluster approach (see chapter 8.2) collect and provide basic information and estimates regarding forest area, species composition and age, and current wood product users ▪ Support potential investors during scoping and business planning ▪ Vocational training
Milling technology/target products and log supply do not match.¹ ▪ Logs supply of suitable quality and dimensions for standard sized sawn timber is limited. Shorter than standard logs are usually left behind in the forest/are used for low value products such as fuel wood.	▪ Work with growers to switch to better seedling material and improve management standards: – Building know how and capacity for appropriate forest management – Changing decision making processes by e.g. providing access to finance² and establishing the framework for transparent forward contracts

²³ PFP is in the process of developing a corresponding application.

²⁴ Such market information systems will not replace the negotiation of prices between supplier and buyer, but merely serve as a guidance for either party.

Constraints	Potential interventions
▪ The market for small diameter logs from thinning is very limited.	▪ Research and provide information on other products and technologies more suitable to the available raw material supply such as producing bare core and block board.
Short and small diameter logs are frequently not used (mobile milling) because: ▪ Transport fees are based on timber piece, rather than total volume transported. As a result utilisation of shorter or small diameters logs producing short and narrow boards is often not done. ▪ Local carpenters prefer standard length and width boards.	▪ Work with government to adjust the regulations to a volume based system. ▪ Vocational training of carpentry businesses.
Absence of log grading leads to: ▪ Economic losses for growers who sell logs without differentiating by quality (target product) ▪ Higher quality/large dimension logs do not get a price premium (Figure 50) i.e. growers have little incentive to increase rotation length/invest into additional forest management activities such as pruning and thinning ▪ Full value addition potential is not realised as logs are not allocated to the most suitable product.	▪ Design a suitable log grading system together with relevant stakeholders from the industry and government. ▪ Strengthen the ability of small tree growers to grade their forest according to product classes and sell trees rather than entire woodlots.

¹ Production of standard size planks requires long straight logs with large diameter. However, the majority of the small tree growers prefer to harvest early (small diameter) and tree form is frequently not suited to production of long planks.

²Access to finance can also be related to solving short-term financial constraints (e.g. for school fees or during unforeseen events such as illness often driving the decision to harvest) through informal approaches such as village loan and saving schemes.

7.2 Transmission poles

7.2.1 Current state, trends and outlook

Transmission poles include large-sized poles used to support electricity lines (transmission poles), and smaller poles used for telecommunication lines. Poles for fencing are a related, minor segment of the pole market. Transmission poles in Tanzania come from eucalyptus only. However, according to Tanzania Electric Supply Company (TANESCO) product specification all tree species with a wood density of more than 400kg/m³ qualify. The main consumers of transmission poles in the country are TANESCO and the Rural Energy Agency (REA). Quality standards are set by TANESCO in collaboration with Tanzania Bureau of Standards (TBS). The quality specifications for transmission poles are detailed in TANESCO's wood poles & blocks specifications (S-11). The specifications include:

- Specific requirements for minimum top and butt diameters, for different pole lengths (9 to 14 m);
- Taper – from top to butt of the pole length – should not exceed 10 mm per m;
- Length variations – should not be more than 75 mm shorter or 150 mm longer than the nominal lengths;
- Bark – removal of barks and absence of inner bark in dressing/treatment; and
- Appropriate moisture content at which to treat the poles (25%).

Green poles are sourced from both government plantations and private tree growers. A key issue with sourcing from government is that the buyer has to purchase the entire forest compartment and clear-fell it, yet only about 30-40% of the trees meet the quality for transmission poles; hence, the rest end up in sawlogs and firewood (PFP, 2016). According to interviews, on STGs' woodlots the proportion of transmission pole quality trees is even lower – estimated at about 15-25% of standing trees.

The green poles are treated using chemicals – both creosote and chromated copper arsenate (CCA). The trend has been to move away from creosote due to its well-known long-term harmful impacts. CCA has become more prominent, as it is safer. However, in the future TANESCO will tender for both CCA and creosote-treated poles. The main problem, irrespective of treatment chemical, is the poor method of pole treatment that does not ensure adequate impregnation of the wood. Another challenge is the quality of the green poles: due to sourcing from various tree growers, it is not possible to ascertain whether all green poles come from mature trees²⁵ – as it is difficult to verify age of all trees cut.

Both large and small pole growers operate in the Southern Highlands. Large companies, e.g., TANWAT, NFC, and Sao Hill Industries (GRAS), with vertically integrated treatment plants dominate the market. In Mafinga town several small treatment plants exist. As shown in Figure 53, the value chain is fairly simple. The actors along the transmission pole value chain include tree growers, green pole suppliers/traders/agents who harvest and transport poles, and treatment plants marketing treated poles. According to treatment plant managers, demand for green poles exceeds supply even though there are numerous Eucalyptus woodlots in the

²⁵ Tree age influences wood density.

Southern Highlands (see chapter 3). Owners of treatment plants bind significant capital in poles during drying while facing uncertain cashflow as, according to interviews, the tendering processes is not always transparent and payments by TANESCO are often delayed. Conversely, traders of green poles carry no such financial burden, rather their activities are geared towards a fast turnover of capital, buying from farmers and selling to treatment plants. These actors have been described in detail in previous studies, see, e.g., PFP (2016) and INDUFOR (2011).

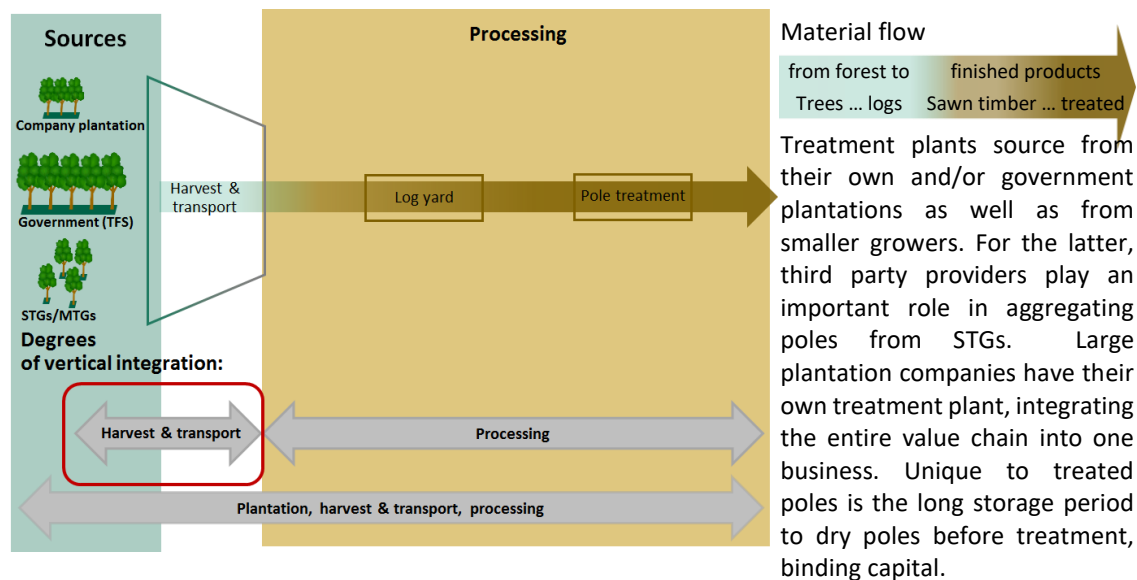


Figure 53: Pole value chain

Source: UNIQUE

The national demand for transmission poles is large and considered to remain steady at 350,000 poles/year, plus variable volumes of exports to neighbouring countries (see chapter 6.4). However, TANESCO is estimated to import about 30-50% of its transmission poles from other countries, i.e. South Africa, Uganda and Zimbabwe (see chapter 4.2.2 on historical imports of poles).

7.2.2 Value addition & profitability

Transmission poles are a key and highly profitable product from eucalyptus woodlots/plantations. Table 13 shows a simple calculation of the revenues from eucalyptus transmission poles, versus pine sawlogs over 20 years. Even with few eucalyptus trees suitable for transmission poles revenues will be much higher than for pine owing to the shorter rotation length and substantially higher revenue per tree.

Table 13: Revenue from 1 hectare of Eucalyptus versus Pine for one rotation

Item	Unit	Eucalyptus Transmission poles	Pine Sawlogs
Initial stocking	trees/ha	1,111	1,111
Survival ¹	%	70	70
	trees/ha	778	778
Stems of suitable quality ¹	%	20	50
	trees/ha	156	389
No. of harvests in 20 yrs	-	2	1
Revenue^{2,3}	TZS/tree	20,000	6,000
	TZS/ha	6,221,600	2,333,100

¹ Well managed woodlot using conventional (vs. improved) seed, but without thinning or pruning.

² Revenue/tree is a conservative assumption based on prices recorded in interviews. Prices can be substantially higher, depending on the location/accessibility of the woodlot, number of suitable trees and negotiation skills of the grower.

³ The cost of establishment and management are assumed to be equal for eucalyptus and pine and hence, are not reflected here

Nonetheless, the main value addition and highest profit is made at the treatment plant, which is also where the single largest cost is incurred and a lot of capital is bound in the log yard (see Figure 54). Similar as in the sawn timber value chain, the tree grower selling standing trees for poles has the lowest gain, having low bargaining power selling individually, and with prices influenced by government rates.



Figure 54: Value addition along the transmission pole value chain

Source: based on PFP (2016); for 9m poles from small growers delivered to TANESCO.

7.2.3 Strengths, weaknesses, opportunities and threats

Strengths

Quick return on investment for tree growers: Transmission poles offer tree growers a relatively quick return on investment with trees ready for harvest after 8-10 years. After harvesting the first crop, the trees can be coppiced for two more rotations, keeping costs low. In comparison, the rotation age for quality saw logs from eucalyptus is 10 years and above, for pine even longer. By improving silviculture (as already promoted by FDT, PFP and others) returns per unit area of woodlot/plantation can be further increased.

Weaknesses

Low product quality: Poor quality of woodlots and trees used for poles, as well as shortcuts allegedly taken by processors (e.g. not drying logs properly thus reducing the absorption of CCA) negatively impacts the return of growers, availability of large poles, and last but not least durability and therefore customer confidence in wooden poles. Quality management is clearly an issue along the entire value chain, i.e. from the grower, via the processor and the final customer – responsible for quality control and if necessary rejection of sub-standard poles.

Dispersed and unpredictable supply, insufficient infrastructure: Similar to the sawn timber value chain, the dispersed nature of supply from STGs raises transaction and aggregation cost. In contrary to the sawn timber value chain, poor infrastructure cannot be overcome by processing on-site.

Insecure market: While the national demand for wooden transmission poles is deemed to be steady for the foreseeable future, the domination of the market by two players which (i) face frequent cash constraints (making annual tender volume unpredictable), (ii) seem to give preference to imported poles over those produced in the country, and (iii) have shown indications of introduced a new standard treatment requiring substantial investments to upgrade the existing treatment plants, all reduce confidence in the viability of the sub-sector. Exports to neighbouring countries are unlikely to buffer any significant reduction of domestic market demand.

Opportunities

Switch to other high value products: Growers of eucalyptus – at the moment focussing on the pole market – are likely to profit from the increasing acceptance of eucalyptus sawn timber and investments into new technologies such as spindle-less veneer peelers (see section 7.3). To realise these opportunities adaptations to the current single focus management (to the extent that it is actually practised) towards management systems leaving more options may be needed.

Threats

Substitution with other materials: In Tanzania, similar to neighbouring countries, a potential substitution of wooden poles with concrete poles surfaces intermittently. However, concrete poles are more expensive in acquisition (but not over their lifetime)²⁶ and are harder to transport

²⁶ In Kenya concrete poles cost ca. twice as much as wood poles but also have a much longer predicted lifetime of 25 years.

than wooden poles, especially on poor quality, rural roads. In Kenya – likewise promoting a switch to concrete poles – the share of these has remained very small with an estimated 20,000 concrete poles annually against total annual consumption of nearly 400,000 poles. If quality issues can be overcome, wooden poles stand a good chance to keep their market segment.

Change of treatment standard: In 2017, TANESCO moved to change its pole standard, requiring treatment with creosote, although this was subsequently modified to allow both creosote and CCA following discussions with market players. Given that TANESCO is the biggest buyer in the country, abrupt changes in treatment standards can cause uncertainty in the marketplace, affecting treatment plants (who may have to either retrofit their installations, switch to other products (e.g. treated sawn timber, currently at low volume) or cease operations), tree growers (speculating on high revenues from transmission poles) and saw millers and veneer/ply producers (who would benefit from additional high quality logs being available more readily).

A summary of the pole value chain SWOT analysis is presented in Figure 55.

Strengths	Weaknesses
Growing eucalyptus for poles offers relatively high returns in short time. The ability of eucalyptus to coppice keeps management cost low in subsequent rotations.	- Low quality of woodlots, with few trees suitable for poles prevents growers from reaping the maximum benefit on their investment. - Sub-standard treatment by processors and insufficient quality control/enforcement by clients negatively affects durability and by extension confidence in the product. - Dispersed and unpredictable supply in combination with weak infrastructure raises transaction and aggregation cost.
Opportunities	Threats
High quality trees suitable for poles can also be used for other, high value target products such as veneer/ply and sawn timber (requiring an adjustment in management (longer rotation and thinning))	- Substitution with concrete poles in response to the limited durability of wooden poles has been discussed occasionally, but is unlikely to be implemented in the near future. - Competing use of standing trees means ease of diverting would-be green poles to production of other wood products - Future uncertainty in wooden pole treatment required by TANESCO, in light of 2017 move to change the current treatment from CCA to creosote (subsequently modified to allow both treatments).

Figure 55: SWOT pole value chain

7.2.4 Key constraints and potential interventions

Key constraints in the pole value chain are the high transaction and aggregation cost when sourcing from STGs, limited confidence in wood poles as part of long-term power infrastructure related to sub-standard product quality, and the insecure outlook of the sub-sector despite forecasted steady demand for wood poles. Similar to the sawn timber value chain, potential

interventions can be linked to the proposed cluster approach (chapter 8). The promotion of more adaptive forest management regimes can to some extent address short-term changes in markets while catering to the limited planning horizon of small growers. Quality issues of the final product must be primarily addressed by the key buyers, i.e. TANESCO and REA. Further details are provided in Table 14.

Table 14: Constraints and potential interventions in the transmission poles value chain

Constraints	Potential interventions
Limited information on future supply of green poles from STGs may pose a constraint in decision making for investments into new plants or upgrade of existing ones, especially for processors relying to a larger extent on poles from STGs vs from government or own plantations.	▪ Embedded into the proposed cluster approach (see chapter 8.2) collect and provide basic information and estimates regarding forest area, species composition and age, and current wood product users. ▪ Work with tree growers associations enabling them to become the point of contact for buyers and, mid-term aggregators of raw material.
Use of poor quality poles and sub-standard processing of poles by some processors leading to reduced durability. Related factors are: ▪ Need to store poles for several months prior to treatment for drying vs. the difficulty to predict short term demand of poles by TANESCO ▪ Substantial delays in payments by TANESCO and connected cash flow constraints of suppliers to buy green poles in a timely manner.	Delivery of quality poles has to be enabled and enforced by the final clients, i.e. TANESCO, REA and other buyers. Involvement by FDT will be limited to enable growers to grow high quality trees suitable for transmission poles.
Insecure outlook for the sub-sector against the background of changing to creosote treatment and substantial share of imported poles.	Encourage farmers to grow trees suitable for products other than transmission poles: ▪ Continue to promote the use of high quality seed material and sound basic management standards to grow trees suitable as saw and veneer logs. ▪ Design more flexible management regimes allowing growers to either target different products from the same woodlot or adjust to a different target product as needed.* ▪ Support the sector to lobby against the proposed change to creosote.

* There are limitations to adaptive management regimes, in particular in regard to thinning which has to be done early enough to have the desired effect on diameter growth. However, a more flexible management will not just cater to market changes but can also take into account the often limited ability of STGs to plan long-term (i.e. decision making often being based on short-term cash needs rather than long-term targets). An example could be to recommend at least one early thinning operation and a number of pruning lifts, which would stimulate diameter growth and higher quality logs for a range of end markets.

7.3 Veneer and plywood

7.3.1 Current state, trends and outlook

National and Chinese investors have recently set up small to medium sized factories in the highlands producing veneer for export and plywood products catering to the national market. By far the biggest veneer and plywood factory with an intake capacity of 15,000m³/yr is TANWAT in Njombe. In early 2017, four smaller producers are established in and around Mafinga, with at least two of them producing plywood, with intake capacities in the range of 5,000m³/yr. Recent investments are spurred by the availability of spindle-less peelers which allow the use of short logs (1.3m) with a diameter as small as 10cm while achieving recovery rates of 40-80% depending on diameter. The smaller factories near Mafinga use the new technology while TANWAT uses a spindle peeler. With both technologies hard and soft wood can be processed, although currently the industry focusses on eucalyptus.

Veneer production catering to overseas markets requires high quality logs, i.e. logs free of dead knots, and a production technology that will minimise splitting of veneer sheets (e.g. soaking of logs and kiln drying of veneer sheets). On the other hand, plywood manufactured in vertical integration with veneer can use lower quality veneer, and – by extension – lower quality logs. The standard of the produced plywood (marine board²⁷) is able to compete with similar products imported from Asian countries used in construction.

According to PFP (2016), producers source logs from government plantations as well as private growers, usually from distances under 200km. In some cases the veneer/plywood production is only part of a larger business, i.e. horizontally integrated with utility pole production and sawmilling allowing the use of logs (or parts) unsuitable for poles or milling to be used for veneer production. The material flows and different levels of integration are illustrated in Figure 56.

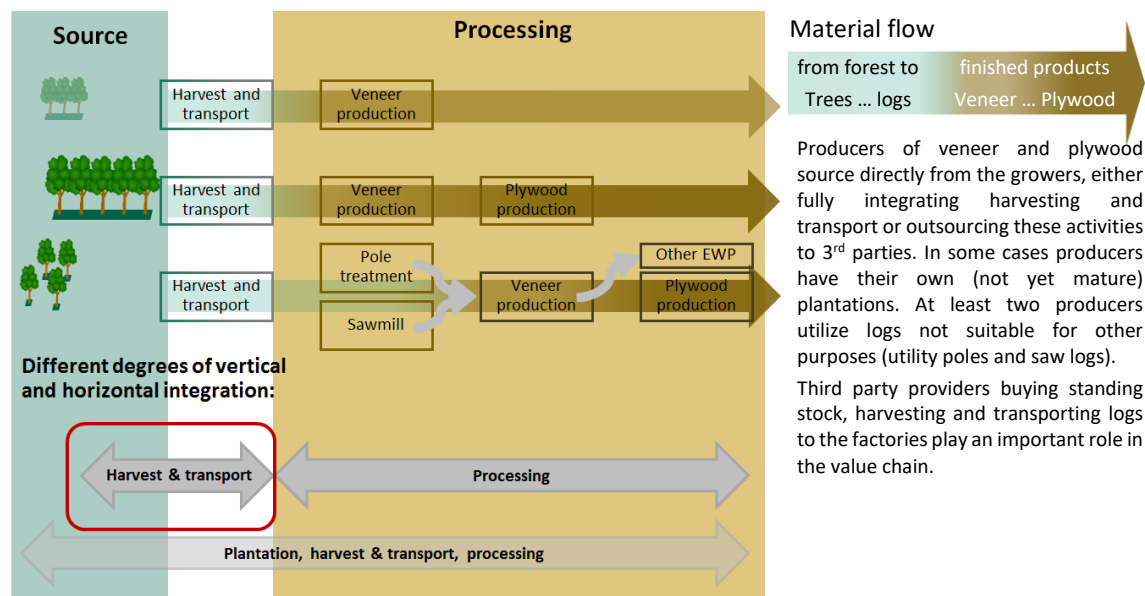


Figure 56: Veneer & plywood value chain

²⁷ Marine board is used primarily for concrete form work but also for other purposes in construction.

Softwood logs (pine) used in veneer production must be processed while green, i.e. ideally within 24 hours after harvesting. For full length logs, the interval between harvest and processing can be slightly longer. This requires just-in-time logistics - i.e. constant harvesting operations and a catchment area with suitable infrastructure. Processing of eucalyptus or older softwood logs without prior treatment such as soaking or steaming, will result in damage to the peelers and lower quality veneer. However, none of the producers visited had invested in soaking pits or kiln dryers.

The existing investments into veneer and plywood production indicate a positive trend towards better utilization of different log dimensions and qualities, and shows confidence of the already established/experienced actors into this value chain. The trend to use and produce more plywood in the country indicates interest in Engineered Wood Products (EWP); however, EWP are highly diverse and require clear standards (e.g. strength, moisture absorption) to be introduced and up-scaled with success.

7.3.2 Value addition & profitability

The PFP study (2016) analysed the profitability of veneer production for the Indian market, stating that with a profit margin of 18%, it offers slimmer margins than in other value chains. According to the interviewees, further value addition by producing plywood is profitable. One businessman stated that his breakeven point is at 50% of the maximum capacity.²⁸ Businesses producing plywood benefit from the comparatively low quality requirements for logs, making resource access easier and potentially cheaper (Table 15).

Table 15: Log classes suitable for veneer and plywood production

Log classification	Key quality requirements	Stumpage cost (TZS/m ³)	Suitable for	
			Veneer	Plywood
Utility poles	▪ Taper < 1cm/m ▪ Top diameter > 14cm	≥ 25,000 depending on dimensions	Yes	Yes
Saw logs	▪ Diameter preferably > 40cm ▪ Low taper ▪ Few cracks	45,000	▪ Without cracks ▪ Free of dead knots	▪ With minor cracks
Fuel wood	▪ Any dimension and quality	10,000	Not suitable	▪ Logs ≥ 10cm diameter and 1.3m length

Source: stumpage cost: PFP (2016), interviews

²⁸ Average capacity assumes 200 working days of 8 hours.

The ex-factory price for plywood produced in Mafinga (Marine board)²⁹, ranging between TZS 50,000-55,000, compares well with similar products and quality imported from China. In combination with low transport prices to Dar es Salaam (using empty backload) boards can be sold at competitive prices. The capital expenditure (CAPEX) required for the small-scale production units currently favoured by investors is low, even if including the soaking/steaming pit and kiln dryer (Table 16). See chapter 8.2.2 for model calculation on improved veneer business models.

Table 16: Capital investment for veneer and plywood production

Unit	Estimated cost/unit (USD)	Comments
Spindle peeler (2.5m)	120,000	▪ Log diameter > 30cm, but larger diameters preferred to operate economically
Spindle-less peeler (1.3m, Chinese make)	20,000	▪ Log diameter > 10cm
Plywood press	30,000	
Soaking pit	500	▪ Reducing wear and tear machinery and downtime ▪ Improvement of product quality (smooth surface, colour) ▪ Reducing splitting of sheets (in particular important if trading veneer) ▪ Improving efficiency in-line plywood production
Steaming pit*	10,000	
Veneer dryer	20,000	

**usually used for sliced veneer*

²⁹ NOTE: Marine board is a term widely used in Tanzania for any plywood. However, Marine board is a clearly defined international product specification. The currently produced plywood in Tanzania does usually not qualify as Marine Board.

7.3.3 Strengths, weaknesses, opportunities and threats

Strengths

Suitable and affordable peeler and plywood technology: The spindle-less peelers already used by the majority of the veneer producers, allow utilization of small dimension logs and logs not straight enough for utility poles or saw logs. Furthermore, the technology is relatively simple and does not require specifically trained engineers for production. The available peeler and plywood press technology allows gradual upscaling of operations according to the investors financial abilities, raw material availability and market demand.

High and growing demand for plywood: Trade statistics indicate increasing demand for plywood. Provided that quality and pricing continue to compare well with imported products, further upscaling of existing businesses is likely and the potential of installing factories in areas currently without wood processing industries should be explored. For the type of plywood produced currently, logs with minor defects such as small knots can be used, thus allowing the use of logs or pieces not suitable for poles or milling. Also, wastage of veneer is reduced as plywood production can utilize split veneer not suitable for export.

Weaknesses

High quality veneer logs are hard to access: Production of veneer requires high quality logs, i.e. without knots. Such logs are currently not readily available as forest owners do not prune trees, and because veneer production competes with other high value products – in particular utility poles.

Reliance on imported technology and inputs: The machines for both veneer and plywood production are imported directly by investors, i.e. technical know-how (for market entrants) and spare parts have to be procured from overseas. The additional cost for experts and spares has to be reflected in the investment plan. Likewise, inputs, in particular glue, are sourced from Asia and require sound planning to avoid down-time due to long delivery time.

Difficult supply logistics: Processing of (soft wood) logs to veneer within 24 hours reduces the need to pre-treat logs but requires secure and fast supply chains. If sourcing from small tree growers, supply logistics are more challenging due to the scattered small volumes, unpredictable time of sale (tendency to sell logs based on household needs rather than rotation period or set target diameter), and lacking infrastructure. By stock-piling logs and investing in soaking pits likely interruptions in supply can be buffered.

Opportunities

Installation of processing plants in areas currently without forest based industries: The relatively low investment cost and option to gradually upscale production facilitates investments in locations with substantial wood resources but without forest based industry. Investors would benefit from shorter transport distances helping with just-in-time supply logistics (as opposed to increasing capacity in e.g. Mafinga and source logs from farther away) and potentially (likely only initially) lower log cost offsetting the disadvantage of not being horizontally integrated in the new place of production. Such investments should ideally follow the proposed cluster approach (section 8.2).

Small investments can increase processing efficiency and product quality: Production efficiency and product quality can be improved and losses reduced by investing into basic pre-processing (soaking) and kilns for drying of veneer sheets.

Plywood as entry point for other engineered wood products: The good economic performance of plywood production and growing demand of plywood can be used to promote the production and uptake of other engineered wood products (EWP) such as veneer lumber, particle board, fibre board and chip board.

Threats

Changes in parameters outside the influence of the processors: Such parameters include:

- Changes in cost of raw material because of adjustments in royalties and/or increased competition for logs from private growers;
- Changes in competitiveness against imported products influenced by e.g. exchange rates, increased efficiency of overseas producers and shipping cost; and
- Changes in overland transport cost related to e.g. fuel prices.

According to PFP (2016) producers of veneer have a relatively low ability to buffer disadvantageous changes. Plywood producers currently have a higher profit margin. Producers can reduce the threat to their business by striving to improve overall efficiency, e.g. using economies of scale and horizontal integration, and a higher degree of value addition.

Supply security: With more entrants and/or upscaling of wood based enterprises competition for logs will increase, potentially leading to disruptions in supply. The threat could be lessened by horizontal integration (using parts of logs dedicated primarily to other purposes) and building up supply buffers (which will however, bind capital). Outgrowers schemes, i.e. long-term supply agreements between growers and processors, do not exist but may become an option as growers organise themselves into associations or similar entities, providing an entry point for legal agreements.

Information as basis for investment decisions: Potential investors require reliable information on raw material supply, its quality and accessibility, and aggregation structures required. Such information is currently not available for forest resources outside government plantations.

Low degree of standardization: EWPs, including different plywood products, should comply with international performance standards including bonding quality, durability and strength, allowing correct product selection and comparison of products from different producers by the end user. Such standards are not yet implemented in Tanzania.

An overview of the strengths, weaknesses, opportunities and threats of the veneer and plywood value chain is provided in Figure 57.

Strengths	Weaknesses
▪ Peeler and plywood technology is suitable for the available raw material and affordable ▪ Demand for plywood is growing ▪ Higher profit margins of plywood vs veneer reduces susceptibility to threats	▪ Limited availability of high quality logs for veneer production (as final product) ▪ Reliance on imported technology and inputs exposes processors to the risk of downtime ▪ Difficult supply logistics potentially causing downtime and / or higher costs
Opportunities	Threats
▪ Scale and type of technology is suitable for the establishment of wood-based processing industry in areas currently without such industrial plants ▪ Efficiency and quality gains in the existing processing plants can be realised with basic technology upgrades ▪ Plywood can serve as an entry point for other Engineered Wood Products (raise consumer awareness for the potential of EWPs)	▪ The competitiveness of the veneer and plywood industry is influenced by parameters largely outside of their control: cost of raw material, efficiency gains Asian producers and import conditions, fluctuations in shipping cost ▪ Supply security: competition with other high value wood products (utility poles) ▪ Limited information required for investment decisions may lead to no/failure of investments ▪ Absence of standardization and product quality control may compromise confidence of customers in domestically produced EWPs

Figure 57: SWOT Veneer and plywood value chain

7.3.4 Key constraints and potential interventions

The constraints in the veneer and plywood value chain are similar to the ones in the sawn timber and pole value chains, i.e. are related to technical knowhow and information, lack of standards and quality control, and reliable access to suitable raw material qualities and quantities. The constraints specific to the veneer and plywood value chain and potential interventions are listed in Table 17.

Table 17: Constraints and potential interventions in the veneer and plywood value chain

Constraints	Potential interventions
Limited access to information, finance, technology and knowhow: ▪ Market demand and raw-material supply information is hard to access/not available ▪ Technology must be imported resulting in high transaction costs ▪ Commercial banks are unlikely to give loans to new entrants/small businesses ▪ Skilled operators for processing plants are not available/must be trained by the investors	Support the installation of veneer/plywood plants in areas without wood based industries: ▪ Collect and provide basic information and estimates regarding forest area, species composition and age, and current wood product users ▪ Support potential investors during scoping and business planning ▪ Vocational training
Absence of standards for and limited awareness of EWP may damage the outlook for the sub-sector: ▪ Customers may be disappointed if national products do not correspond with their expectations causing substitution with imported products or different materials ▪ Comparability of EWP with other wood products or other materials is often pre-requisite for decision making	Develop basic product standards for common EWP building on globally used industry standards² working with authorities and industries (processing and e.g. construction) Standards are an important factor for increased market uptake and can be the basis for promoting EWPs.
Limited access to high quality logs & insecure supply: ▪ Management practises are not suited for production of knot free timber required for high quality veneer ▪ Decision to harvest is driven by cash-need rather than set management targets ▪ Higher quality logs do not get a price premium¹, i.e. growers have little incentive to invest into additional forest management activities such as pruning	Improve forest management standards by continuing to work with growers: ▪ Building know how and capacity for appropriate forest management ▪ Changing decision making processes by e.g. providing access to finance and establishing the framework for transparent forward contracts Develop and implement concepts for reliable supply logistics working with formal businesses and organisations³: ▪ Processors ▪ Traders supplying processing plants ▪ Grower groups

¹ The ability of processors to pay higher prices should be explored in detail before encouraging growers to cater to higher quality log production. According to PFP (2016) veneer producers are unlikely to be able to increase their log purchase cost substantially.

² E.g. TBS norms and international standards (EU Norms (EN) or American Society for Testing and Materials (ASTM)).

³ Giving preference to already established businesses and organisations is likely to lead to a consolidation of the most professional actors in the wood value chain while ensuring that industrial development takes place in currently under-developed areas which may seem unattractive to established businesses as they cannot rely on existing sourcing structures and horizontal integration.

8 BUSINESS MODELS FOR TRANSITION OF THE SECTOR

The proposed business models aim at improving value chains actors' ability to react to future market requirements. The aim is to make better use of the available resources by the existing actors, thereby enabling them to advance gradually along a transition path towards more competitiveness and resilience.

The four outlined business models in this chapter are examples of promising options in the identified regional contexts of this study. However, they require further refining and fine-tuning as more details about the raw material supply, specific cost factors and investment requirements become available.

Challenges specific to small tree growers

Independent small tree growers (STGs) face several problems concerning their optimal participation in timber value chains. Beside the poor quality of the wood (a result of poor genetic material and sub-optimal management), STG woodlots are scattered, provide small volumes and are often far away from good roads. As a result, raw material is difficult and expensive to feed into advanced value chains which would maximize value addition. The scattered nature and low volumes of woodlots deters investment into better processing technologies, often requiring centralised processing in factory settings, with higher recovery rates and better product quality. Therefore, the economically feasible options for value chains including STGs are reduced to a few options.

The market opportunities of STGs are closely linked to their market power. As long as they act as individuals, traders and vertically structured entrepreneurs will be able to reap disproportionate profits. Considering the currently available low qualities and small volumes from individual woodlots, many STGs will likely only have access to the lower quality product market segments.

Developing pro-smallholder business models

Developing business models for smallholders requires consideration of the weaknesses of the smallholder wood production as well as the restrictions of the available conversion technologies and demand in local and regional markets. New business models have to include substantial changes in management and organization of the smallholders.

A substantial change to be addressed is **silviculture and management**. Seed improvement is being addressed by FDT's Tree Improvement Programme, however, smallholders show a clear trend to buy the cheapest seeds available at the market rather than investing in improved material. Secondly, where thinning and pruning operations are carried out, they are carried out poorly. Operations are performed without a production goal, pruning techniques applied are very poor actually leading to lower rather than better quality logs, and thinning focusses on small and suppressed trees which will have minimal influence on diameter growth of the remaining trees. In short, the additional effort will not result in any pay back to the grower. In the future the focus of post-establishment management must be clearly on promoting diameter growth to shorten rotation cycles and/or to grow bigger trees in the same rotation cycle.

Remote areas with only few woodlots are unlikely to provide the necessary basic conditions for pro-smallholder business models. Hence, for interventions to have impact these should **focus**

on areas that meet a minimum set of conditions: namely, minimum annual wood production, acceptable transport conditions and distance to trading centres, at least basic organization of STGs in associations, cooperatives or acting as a community. By identifying and working in clusters of STGs which meet these conditions business models can be piloted with acceptable levels of effort.

Individual STGs, or even small groups of STGs are not able to provide a critical mass of wood for the different primary conversion industries. By **organizing STGs into groups** like cooperatives or associations, which act together as “entrepreneurs” the small growers can produce enough wood to feed a saw mill or other small business, gather market information, organize common trading and get access to potential investment capital. The development of private sector ‘market intermediaries’ that provide multiple services to growers while aggregating raw material supply to different processors, is another means to address grower organisations’ problems in accessing markets. Processing of the wood close to the plantation areas and transporting the semi-finished products to the markets would enable STG groups to generate additional value. There is also the (limited) possibility to make use of the production residues, mainly in form of energy generation. This could be heat for kiln-drying or electric power for further conversion or manufacturing processes.

Cluster focus

The proposed **business clusters** should be understood as a geographic concentration of interconnected businesses, suppliers, and associated institutions in the forest and wood sector in the Southern Highlands of Tanzania (Figure 58). In order to increase the productivity and quality with which companies can compete on a local, regional, national or global level, important pre-conditions have to be fulfilled: namely a) acceptable transport costs of round wood and wood products to the markets (depends on distance; available transport means and their quality); b) a minimum critical volume of wood in a certain quality delivered continuously to the markets; c) available human resources (including evaluation of their skills); d) infrastructure for a wood based industry; and e) capital available (private or loans).

The cluster approach will enable sector development initiatives to focus on promising regions where targeted activities lead to a sustainable development of the participation of smallholders in the value chain. According to the areas pre-selected for stakeholder interviews and information gathering for this study, four clusters are proposed: Njombe, Mafinga/Sao Hill, Iringa/Kilolo and the surroundings of the Kilombero Teak Company. In these clusters, support activities should focus on independent smallholders (ca. 1-20 ha) and medium sized tree growers (ca. 20 – 500 ha).

Outgrowers linked to companies or other programs, in general are guided by big players and already get technical assistance, plant material and management advice in accordance to the business plan. Also marketing of the produced wood is mainly solved in such contractual situations.

The approach of identifying and promoting inclusive cluster-based business models can be replicated across the Southern Highlands and beyond, e.g. in Makete, where infrastructure development is currently offering new market possibilities.

A cluster is usually working most efficiently and successfully if it can draw on the capacities of experienced entrepreneurs, who are willing to take the role of a **lead actor** in a proposed

business model. Usually such lead actors are large companies (e.g. in an outgrower based business model) or specialised wood processing companies with good market access (e.g. export markets). These actors need to be mobilized and integrated into an inclusive business model approach that simultaneously increases the competitiveness and entrepreneurial success of the lead actor, and supports development of the other cluster actors.

Cluster development, needs to take into account the **timeline for feasible implementation**. In certain cases, a promising business model may be implemented immediately, if supply is readily available and entrepreneurial capacity is in place. On the other hand, implementation of a business model may require setting up pre-conditions, such as capacity building or capital access, or it just requires time until raw material will be available in sufficient quality and quantities.

8.1 Characterization of the four clusters

Cluster 1: Iringa / Kilolo Cluster

The Iringa / Kilolo Cluster is an area where the conditions for value aggregation are less favourable. Smallholders are relatively far from industrial processing units and the road infrastructure leads to long travel times even for shorter distances (Figure 58). Roundwood transport therefore is not economically feasible. The conditions require processing close to or at the plantations and the only technology available at the moment are ding dong sawmills. The poor recovery rate and quality of wood from these saws does not allow generation of higher profit margins which could be (partly) transferred to smallholders. The visionary approaches recommended for this cluster are based on organizing the tree growers: a) to provide a critical mass of wood of good quality to feed a determined processing unit; b) to promote the establishment of processing units at a place central to the woodlots of the small tree growers; c) to build up a trading and marketing structure for the organization; and d) to provide further training in silviculture, forest management and wood processing. The only big player in the cluster is New Forests Company (NFC). NFC runs a kind of outgrower assistance program, but according to the interviews they want to become independent from these growers and produce wood in their own plantations.

Cluster 2: Njombe cluster

The Njombe cluster is characterized by a strong trading culture of sawn timber (Figure 58). Well working tree grower associations exist, that might already be classified as medium sized tree growers (20 to 500 ha). They are frequently involved in several steps of the value chain, running nurseries, providing services like harvesting and wood processing or buying standing forests as traders. According to these growers, their activities directly motivate neighboring farmers to grow trees, asking the more experienced growers for advice and help. Despite this, Njombe does not have an advanced processing industry, rather, most of the sawn timber traded is produced by ding dong sawmillers. Small tree growers outside currently not participating in associations could be encouraged to join the entrepreneur structure of Njombe. The focus for this cluster should be to promote the use of better processing technology to improve value generation in the region. Viable options are seen in stationary sawmills (especially band saws), small spindle-less veneer peelers and better use of processing wood residues. A big player in this cluster is

TANWAT, who has a good relationship to surrounding communities for tree growing. They provide seed and technical advice, but have their own plantations which largely supply the wood required for their own consumption. An interesting aspect is the planning for an MDF-mill installation, which may open a window for the use of thinning materials and harvesting slash, as well as for residues of the processing units. However, providing wood for a MDF plant will depend on a) distance (low value of wood residues) and b) quality requirements (species, wood density, bark content, diameter) of the future MDF mill.

Cluster 3: Mafinga cluster

The Mafinga cluster is dominated by three big players: Sao Hill Industries (Green Resources), Sao Hill government plantations and the Mufundi Paper Mill (Figure 58). As noted in the supply section of this report, poor planning and management of the government plantations will lead to a gap in wood supply in the near future. While the big players have guaranteed their wood supply from their own plantations or through long term contracts with the government, the small and middle sized sawmillers are likely to suffer from the wood shortage. Nearly every interviewed wood processor therefore plants trees (between 20 and 60 ha) and also tries to motivate smallholders to do so. According to the interviews, an increase in planted area in the cluster of Mafinga was perceived, which was confirmed by the preliminary data of the FDT remote sensing survey. However, the areas are still too young to cover the expected wood shortage from public plantations: the gap will not be filled for several years. Several processes can be expected from this scenario: a) the processing industry will shrink with some factories ceasing business; b) mitigation options are evaluated, e.g. matching log size and quality to the right use³⁰; and c) use the raw material available more efficiently.³¹ Many technical options are available to make profitable use of smaller wood pieces, chips or sawdust as engineered wood products (Gluelam, blockboards, particle or fibre boards, etc.). While board mills require higher investments to be competitive, blockboards or Gluelam could be an option to develop value chains integrating small tree growers. The value chains presented for this cluster will focus on such innovative products.

Cluster 4: Kilombero Teak cluster

In the Kilombero cluster the focus is set by the hardwood supply situation (Figure 58). Teak is the main species grown but also some eucalypts. The main end products for hardwoods are sawn timber or veneer. In Tanzania, hardwoods from native forests are becoming less and less available, but hardwoods are necessary for applications requiring higher strength or durability. Teak or eucalypts could play an important role in substituting native hardwood species in the market-place. One of the opportunities for small dimension saw logs from hardwoods is the production of blockboards or Gluelam, producing bigger dimensioned products with high dimensional stability. Teak wood already has a good market reputation and is easy for marketing at national and world markets, offering high value addition potential.

³⁰ Currently trees from Sao Hill are sold on stumpage to MPM, leading to many bigger trees suitable for sawmilling going to the paper industry, while tree tops and smaller logs remain as slash in the forest.

³¹ Recovery rates for the main products (planks in sawmills) are only 50%. Smaller dimension sawn timber and residues are treated as waste and burned.

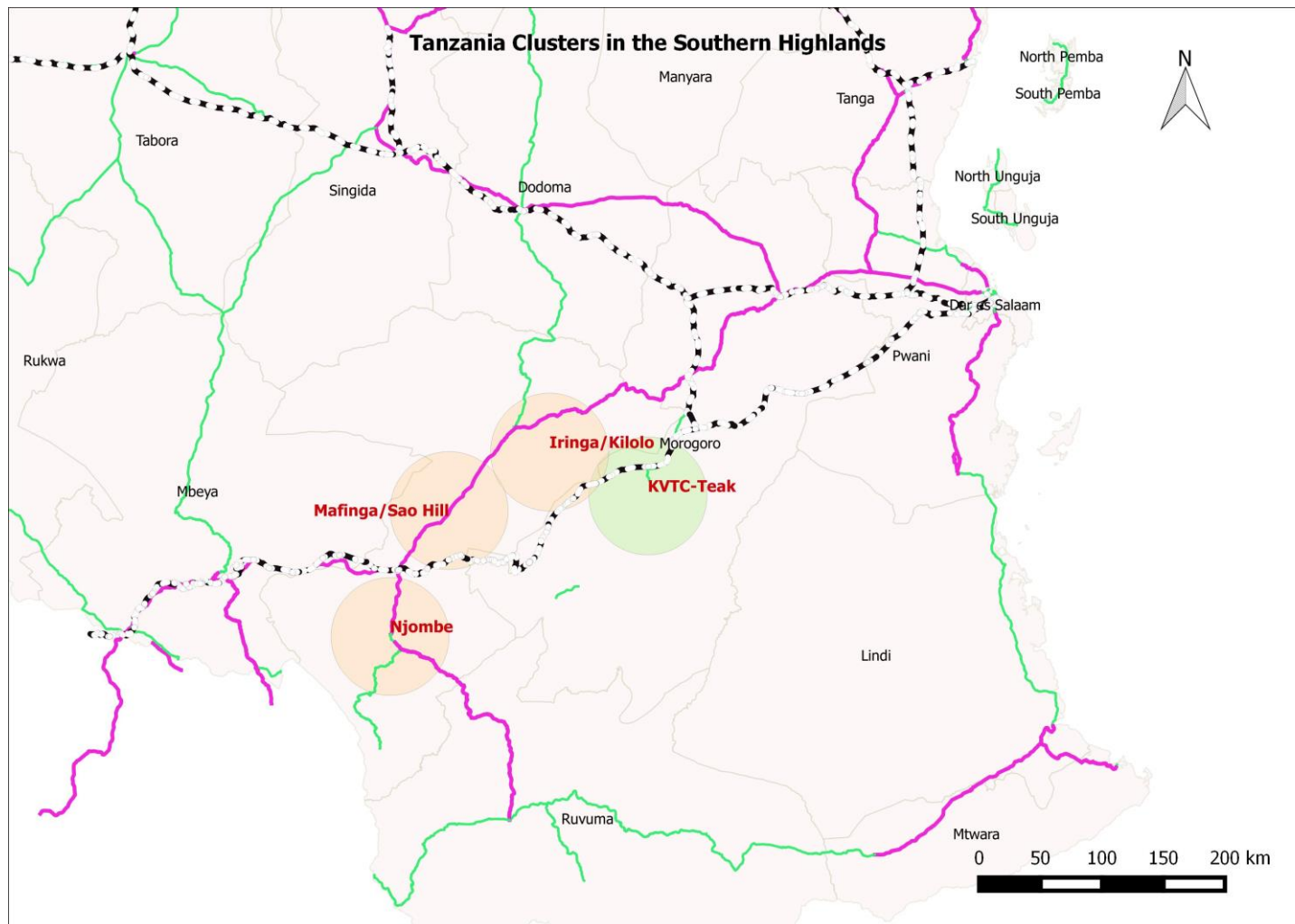


Figure 58: Proposed Clusters in the Southern Highlands of Tanzania.

Source: UNIQU; Each cluster has a diameter of 100 km.

8.2 Innovative business models

The presentation of the innovative business models is structured as follows:

- Short description of the basic conditions found in the area. A certain business model might be applicable in all four clusters, but with changing priority depending on the situation of the STGs;
- Description of the conditions that have to change to make the business model technically and economically feasible in the area (STGs, wood processors, logistics in the broader sense, market conditions); and
- Description of possible profit margins, including the underlying assumptions (Figure 59).

An overview, showing the ranking of the importance of the business model in the respective clusters is provided in section 8.2.4.

There are a number of key assumptions that feed into each business model and these can impact various stages of the value chain – from the trees growing in the plantation to market access (Figure 59).

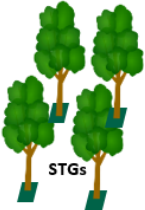
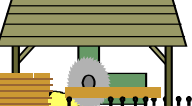
	Tree growing: ▪ Area and volumes provided, considering spatial aspects ▪ Quality resulting from improved seed, silviculture and management practiced by the STGs
	Harvesting and hauling ▪ What techniques are applied in the region ▪ How and in what quality and dimensions the wood is provided to the market participants
	Processing ▪ What are the processing technologies applied? ▪ Efficiency and quality of the production process and the resulting quality
	Transport and Infrastructure ▪ Transport distance and related costs for marketing ▪ Infrastructural conditions
	Markets and Communication ▪ Access to information (prices, demand, quality aspects, volumes) ▪ Access to markets and product marketing

Figure 59: Key assumptions feeding into business models

In the subsequent sections of this chapter, we present the business models that we found might fit into the different conditions prevailing in the various clusters as described earlier. The overall economic analysis and potential of a cluster cannot be calculated with any certainty due to the lack of data with regard to plantation age distribution, productivity, quality and access (infrastructure). FDT's remote sensing and ground truth data are not specific enough to allow more detailed analysis. The clusters themselves are also not yet clearly defined on the ground. However, in the underlying Excel sheets where the single business cases are calculated, assumptions have been presented about the possible profitability of each case.

The baselines for calculating the business models are coming from INDUFOR and FDT data and estimates. Only in the case of the peeled veneer case was UNIQUE experience taken from other projects, in addition to publications and interview data. For a detailed industrial planning of each business case another study would have to be conducted, focusing on interviews about technologies available in Tanzania and what the related costs are.

Validation for the business model figures is difficult, as all available data and sources were used to make a good estimation of the financial outcomes. Benchmarking with other countries is very time and cost intensive, since it requires a lot of data collection, adaption to Tanzanian conditions and additional assumptions which were out of the scope of this study.

8.2.1 Sawn timber business model

The sawn timber business model encompasses a shift to improved sawing technology, especially moving from the ding dongs to more efficient band saws – either mobile or stationary. Investment in new technology will be required, which could be an entrepreneur or through a local TGA. The STGs will also need organizing better to ensure a supply of logs to justify such investment. In the long-term, log quality will have to improve in order to produce a higher value product.

For feeding a small mobile or stationary sawmill a yearly log input of about 7,000 m³ is necessary, corresponding to 25 m³ of round wood processed per day. Assuming that the increment over a rotation length of 20 years is 20 m³/ha/yr, a harvesting volume of 400 m³/ha can be expected. If 50% of this volume has the minimum diameter required for sawmilling an average of 35 ha has to be harvested every year to provide enough input for a mill, translating into 700 ha under permanent forest management for sawlog production. Higher processing capacity of the sawmill or deviating site productivity of the woodlots, will result in an adjustment to the minimum area dedicated to sawlog production.

Table 18: Investments requirements for sawn timber production

Situation	Solution	Support	Investments needed
Small scattered plots Age and species distribution are not planned for a specific target	Organize STGs to provide a critical mass on raw material at a given quality on an annual basis	- Form associations to get a minimum area for feeding a roundwood transformation technology - Train STGs on target oriented silviculture and management	- Technical, social and legal advisor organizing STGs: 2 per cluster (5,000 US\$/month) - Technical instructor organizing and conducting training: 2 per cluster (5,000 US\$ per month)
Poor quality sawlogs do not allow optimal value aggregation	Change management standard	(see training on silviculture and management above)	
Use of ding dong sawmill with low recovery rates and producing poor quality timber Limited know-how for sawmilling high tensioned hardwoods;	Change to mobile / stationary band saws	- Provide investment advice - Provide training to association members	- Sawmills from 30,000 to 100,000 US\$, including spare parts for 1st year - Technical instructor: 1 per cluster (2,500 US\$ per month)
Poor infrastructure does not allow transport of round wood to industrial centres / results in very high transport cost	Processing within the cluster	Facilitate access to capital for buying adequate technology	- Investments in above mentioned mobile or stationary sawmills - Provide access to capital
Poor market information and trading opportunities	Collection and dissemination of market information at cluster level	- Build up a trading system with access to market information and data - Capacity building to association and their administration	- Building up a market information system (smartphone app-existing) - Technical instructor (already included in line 1) and investment in technology (1,500 US\$ per cluster)

Table 19: Economics of sawn timber business model

			enter data	calculated					
cost centre	activity	cost centre	costs	unit	comment	productivity parameters	value	Unit	%
Tree growers	tree growing by STG	plant material	54.00	US/ha	1100 trees/ha * 5 Cent/plant	rotation length	20	years	
		labour costs	150.00	US/ha	interviews entrepreneurs, to be confirmed	Mean anual increment	20	m³/ha/yr	
		weeding		US/ha	not done or no costs	total volume produced	400	m³/ha	
		fertilizing		US/ha	not done or no costs	sawlog	200	m³/ha	50%
		pruning	140.00	US/ha	2 prunings, interviews entrepreneurs	veneelog	0	m³/ha	0%
		thinning	160.00	US/ha	2 thinnings, interviews entrepreneurs	harvesting residues	200	m³/ha	50%
		overhead calculation		US/ha	(please specify)	other prodcuts	0	m³/ha	0%
		subtotal:	504.00	US/ha		control sum:			100%
STEP 1		costs/m³ of produced roundwood	2.52	US/m³					
Harvesting operator	harvesting operations by association	felling			n.a.				
		delimbing			n.a.				
		sectioning/bucking			n.a.				
		hauling			n.a.				
		loading			n.a.				
		overhead calculation	4.00		interviews and expert guess				
		subtotal:	4.00	US/m³					
STEP 2		costs/m³ of loaded roundwood	6.52	US/m³					
Transport roundwood	transport organized by association		4.00		calculated for average transport distance of 10 km, 0.4 US\$/km/m³ (small truck)				
STEP 3		costs/m³ round wood at millgate	10.52	US/m³					
Processing	sawmilling costs with band saw	millgate costs logs	10.52	US/m³	log price own calculation	productivity parameters	value	Unit	
		material costs 1 m³ sawn timber	23.38	US/m³	log price vs. recovery rate	recovery rate	45	%	
	processing costs	capital costs (30,000 US)	1.10	US/m³	INDUFOR report	mill capacity	10000	m³/round wood/yr	
		direct production costs	12.50	US/m³	INDUFOR report	yearly harvesting area	50	ha/yr harvested	
		overheads	12.30	US/m³	INDUFOR report	total area necessary	1000	ha	
STEP 4		total costs 1 m³ of sawn timber at mill	49.28	US/m³					
Communication and Trading	trading by association	estimated administration costs:	2.00	US/m³	expert guess				
STEP 5		total costs:	51.28	US/m³			US/km/m³	distance (km)	
Transport	Transport to market by association	transport costs	36.00	US/m³	Interviews: transport costs of 0.04 - 0.06 cent /m³/km	transport costs	0.06	600	
STEP 6		total costs 1 m³ of sawn timber at market (Dar Es Salam)	87.28	US/m³	(estimated 600 km)				
Economic balance									
Selling point	costs	price	profit margin	unit	comment				
standing forest	2.52	30.00	27.48	US/m³	INDUFOR data (adapted)				
after sawmilling product 2x4/2x6/2x3	49.28	115.98	66.70	US/m³	costs independent from product)				
after sawmilling prodcut 1x6	49.28	99.41	50.13	US/m³	costs independent from product)				
after sawmilling product 1x8	49.28	173.97	124.69	US/m³	example 1: Mafindi (milling costs independent from product)				
after sawmilling product 1x10	49.28	218.71	169.43	US/m³	example 1: Mafindi (milling costs independent from				
market product 2x4/2x6/2x3	87.28	228.00	140.72	US/m³	Market Dar (interview data)				
market product 1x6	87.28	180.00	92.72	US/m³	Market Dar (interview data)				
market product 1x8	87.28	320.00	232.72	US/m³	Market Dar (interview data)				
market product 1x10	87.28	404.00	316.72	US/m³	Market Dar (interview data)				

Table 20: Further optimization potentials for sawn timber model

Step in the chain	Improving potential	Expected results
STEP 1: silviculture /management	Seeds	Faster growth and higher quality saw logs
	Pruning	Production of higher proportion of clear wood
	Thinning	Shift towards bigger diameter trees
	Commercialization of thinnings (at the moment weak markets)	Make better use of produced raw material
STEP 2: harvesting	Commercialization or technologies that enable the use of crown slash and smaller diameter logs	Make better use of produced raw material
STEP 3: transport	Better access/roads to the woodlots	Reduce transport costs significantly
STEP 4: processing	Better sawmilling technology	Higher recovery rate and quality of sawn timber
	Kiln drying and treatment	Use residues for energy/heat generation; higher prices for dry or treated sawn timber
	Training in maintenance and availability of spare parts / technical support	Maintain high quality processing Less standing time and higher productivity
	Secondary transformation	Make use of smaller sized sawn timber, reduce waste and higher value generation
	Make use of sawmilling residues	Less waste of raw material, higher value generation
STEP 5: Trading / Marketing	Direct commercialization of products	React to market requirements (dimensions, demand, oversupply, etc...) Profit margin remains in association
STEP 6: Transport	Organizing own transport	Profit margin remains in association More flexibility in the production / storage Just in time delivery

Table 21: Priority in the different clusters for sawn timber model

Cluster	Relevance	Observation
Kilolo / Iringa	++	- many very small STGs with scattered plots - poorest infrastructure (roads) - lowest planning level, unplanned mix of species and age structure
Njombe	+	- more Medium Sized Tree Growers (MTGs) - well organized with better access to capital - higher level of value aggregation possible - model in remote areas with higher aggregation of STGs still interesting
Mafinga	+	- technically most developed wood processing cluster with installed entrepreneurship - due to differences in the supply chain (government plantations) differences in the industrial development over the last years- better developed industrial processes - model in remote areas with higher aggregation of STGs still interesting
Kilombero	+	- more hardwood based region, more difficulties in sawmilling can be expected - other value chains are feasible and may generate higher value aggregation - model in remote areas with higher aggregation of STGs based on conifer timber still interesting

legend: - = not applicable, 0 = low, + = medium, ++ = high

8.2.2 Veneer/plywood business models

Peeled veneer and plywood production is another interesting business case for STGs, especially with the recent introduction of spindle-less lathes into the region. The requirements for wood production are basically the same as for sawmilling, but peeling requires less knowledge for processing and is suitable for processing of high-tension hardwoods such as eucalypts. Spindle-less lathe peelers are also able to peel logs of smaller diameters providing an outlet for thinnings and small dimension logs from final harvest. Due to the shorter log length of 4 feet (optionally 8 feet) cracking and splitting is less severe as of 12 feet logs used for saw milling. The recovery rate in the peeling process is much higher than in sawn timber, since there are no big off-cuts or losses by saw kerfs. Soaking logs of Acacia or Eucalyptus will further reduce processing losses and increase production efficiency. Furthermore, the processing procedure allows to benefit from even small proportions of clear wood (peeled veneer layers generally have a thickness between 1.5 and 3 mm).

The highest losses at the existing veneer production facilities observed during the field visits are generated in the poor production process itself: logs are too dry for peeling, the clipper is directly attached to the peeling machines (results in warping and splitting), and veneer sheets are dried in the sun (also results in warping and splitting). The best veneer sheets may be exported to Asian markets, while the rest can be used for local plywood production. The plywood produced for the local markets do not meet with any internationally accepted standards.

To improve returns in the veneer value chain, logs should be pre-treated (at least soaking), rotary peelers well maintained (to produce veneer layers of constant thickness and quality), and veneer sheets oven-dried and integrated with plywood production.

For feeding a small rotary peeler a minimum of a yearly log input of about 7,000 m³ is a reasonable target. Assuming that the increment over a rotation length of 20 years³² is 20 m³/ha/yr, a harvesting volume of 400 m³/ha can be expected. If 70% of this volume has the minimum diameter required for sawmilling an average of 25 ha has to be harvested every year to provide enough input for the plymill, translating into 500 ha under permanent forest management for veneer log production. Higher processing capacity of the plymill or deviating site productivity of the woodlots will result in an adjustment to the minimum area dedicated to veneer log production. The round wood demand for higher processing capacities of the plymill or deviating site productivities of the woodlots can be calculated respectively.

This business model offers considerable potential for STGs who could grow Eucalyptus for larger sawlogs or poles and also have an outlet for the smaller logs. The main constraint at present is that processors currently are not adding value by manufacturing plywood in country. In addition, the recovery is low with poor log handling and drying practices. This results in a lower price offered to growers. This could change with investment by the processors.

Table 22: Investments needed for veneer and plywood production

Situation	Solution	Support	Investments needed
Large quantity of small diameter hardwood logs of poor quality	Rotary peeling of 4 feet (1,20m), water soaked hardwood logs with a spindleless lathe production of plywood	- Know how transfer (training) - Maintenance and repair of machines (training local service providers)	- Simple plywood lines from 80,000 to 150,000 US\$, including spare parts for 1st year - Technical instructor: 1 per cluster (2,500 US\$ per month)
Poor infrastructure resulting in high log transport costs to processing units	Primary (and higher) wood conversion with clusters; or Adding value resulting in higher profit margins, allowing transport over longer distances	- Support small processing units at rural regions (association approach like sawmilling value chain); or - Support building up of processing centers at bigger towns	- Investments in above mentioned plywood line; - Investments in building up associations (see sawmilling value chain) - Professional fund raising / provided access to capital (1 employee for all clusters = 2,500 US\$ per month)
Poor electric power network in rural areas (plywood more)	Generate electric power and heat at	Integrate combined heat and power (CHP) plant utilising	Investment volume: 100,000 to 150,000 US\$; Investment only feasible for a small

³² While rotary spindle-less lathe veneer peelers with allow to process hardwood and softwood logs of smaller dimension and poorer quality higher value can be generated (high quality veneer) if logs of bigger dimension and high proportions of clear wood are used.

power intense than sawmilling)	processing factory	harvesting and processing residues	industrial unit (sawmill, kiln drying, plywood, treatment)
Poor market information and trading opportunities	Collection and dissemination of market information at cluster level	- Build up a trading system with access to market information and data - Technical support in quality production of higher graded plywood.	- Building up a market information system (smartphone app-existing) - Technical instructor (already included in line 1) and investment in technology (1,500 US\$ per association)

Table 23: Economics of plywood business model

		enter data		calculated						
cost centre	activity	cost centre	costs	unit	comment	productivity parameters	value	Unit	%	
Tree growers	tree growing by STG	plant material	54.00	US/ha	1100 trees/ha * 5 Cent/plant interviews entrepreneurs, to be confirmed	rotation length	20	years		
		labour costs	150.00	US/ha		Mean annual increment	20	m³/ha/yr		
		weeding		US/ha	not done or no costs	total volume produced	400	m³/ha		used m³
		fertilizing		US/ha	not done or no costs	sawlog	0	m³/ha	0%	0
		pruning	140.00	US/ha	2 prunings, interviews entrepreneurs	veneerlog	280	m³/ha	70%	280
		thinning	160.00	US/ha	2 thinnings, interviews entrepreneurs	harvesting residues	120	m³/ha	30%	0.00
		overhead calculation		US/ha	(please specify)	other products	0	m³/ha	0%	0
		subtotal:	504.00	US/ha			control sum:		100%	280
		costs/m³ of produced roundwood	1.80	US/m³						
STEP 1										
Harvesting operator	harvesting operations by association	felling			n.a.					
		delimbing			n.a.					
		sectioning/bucking			n.a.					
		hauling			n.a.					
		loading			n.a.					
		overhead calculation	4.00		interviews and expert guess					
		subtotal:	4.00	US/m³						
		costs/m³ of loaded roundwood	5.8	US/m³						
STEP 2										
Transport roundwood	transport organized by association		12.00		calculated for average transport distance of 30 km, 0.4 US\$/km/m³ (small truck)	-> no mobile version as compared to sawmill				
STEP 3		costs/m³ round wood at millgate	17.8	US/m³						
Processing	peeling and plywood production	millgate costs logs	17.8	US/m³	log price own calculation	productivity parameters	value	Unit		
		material costs 1 m³ sawn timber	25.43	US/m³	log price vs. recovery rate	recovery rate	70	%		
	processing costs	capital costs (100,000 US)	3.90	US/m³	complete line: peeler, clipper, dryer, press, sawing, sanding	mill capacity	7000	m³/roundwood/yr		
		direct production costs	90.00	US/m³	(expert guess, literature)	yearly harvesting area	25	ha/yr harvested		
		overheads	30.00	US/m³	(expert guess, literature)	total area necessary	500	ha		
STEP 4		total costs 1 m³ of plywood at mill	149.33	US/m³						
Communication and Trading	trading by association	estimated administration costs:	2.00	US/m³	expert guess					
STEP 5		total costs:	151.33	US/m³				US/km /m³	distance (km)	
Transport	Transport to market by association	transport costs	36.00	US/m³	Interviews: transport costs of 0.04 - 0.06 cent /m³/km	transport costs	0.06	600		
STEP 6		total costs 1 m³ of plywood at market (Dar)	187.33	US/m³	(estimated 600 km)					
Economic balance										
Selling point	costs	price	profit margin	unit	comment					
standing forest	1.8	30.00	28.20	US/m³	INDUFOR data (adapted)					
medium quality plywood	187.33	720.00	532.67	US/m³	interviews in Dar ES Salam					

Table 24: Further optimization potentials for plywood model

Step in the chain	Improving potential	Expected results
STEP 1: silviculture /management	Seeds	Faster growth and higher quality saw logs
	Pruning	Production of higher proportion of clear wood for more face veneer
	Thinning	Shift towards bigger diameter trees allows higher productivity in peeling process;
	Commercialization of thinnings (at the moment weak markets)	Make better use of produced raw material
STEP 2: harvesting	Commercialization or technologies that enable the use of crown slash;	Make better use of produced raw material
STEP 3: transport	Better access/roads to the woodlots; <u>But</u> : with higher profit margins also longer round wood transport possible	Reduce transport costs significantly
STEP 4: processing	More sophisticated plywood processing line	Good recovery rate, reaching international quality standards with potential for export
	Treatment of veneer sheets for outdoor utilizations or durability	Higher prices, access to new markets (utilizations of plywood)
	Training in maintenance and availability of spare parts / technical support	Maintain high quality processing Less standing time and higher productivity
	Other plywood products for the construction sector (joinery products)	New market sectors, prevent from substituting wood with other materials
	Coating with sliced veneer from native species	Reach high quality market segments
STEP 5: Trading / Marketing	Direct commercialization of products by association	React to market requirements (quality, durability, innovative products,...) Profit margin remains in association
STEP 6: Transport	Organizing own transport (association)	Profit margin remains in association More flexibility in the production / storage Just in time delivery

Table 25: Priority in the different clusters for plywood model

Cluster	Relevance	Observation
Kilolo / Iringa	0	- Poorest infrastructure (roads, electric power) - Probably difficulties in know-how transfer and technical support and planning level, unplanned mix of species and age structure - Low investment power
Njombe	++	- Well organized MTGs with better access to capital, experience in entrepreneurship - More likely to get technical support for machinery - Good potential of raw material available
Mafinga	++	- Technically most developed wood processing cluster with installed entrepreneurship, - Interesting option, better use of raw material (less residues) may be able to compensate higher log prices in the future - Higher profit margins than with sawn timber possible
Kilombero	++	- More hardwood based region, more difficulties in sawmilling can be expected, veneer peeling good alternative; - Good potential of raw material available (teak, eucalypts, which are difficult for sawmilling)

legend: - = not applicable, 0 = low, + = medium, ++ = high

8.2.3 EWP business models

Some engineered wood products (EWP) can be produced at relatively small scale, while others require very large-scale investments. In the following section, two business cases are described in detail: for a) blockboard; and b) Gluelam. The framework for large industrial investments (MDF; pulp and paper) is described briefly at the end of this chapter.

Blockboard

In Tanzania, a considerable volume of smaller dimension logs of poor quality originate from hardwoods and softwoods and will continue to be available in the near future. Hardwoods like teak and eucalypts will have an important share in the future, since they also show good growth potential in very dry regions. Whereas the availability of large logs suitable to produce solid wood products of big dimensions is expected to decrease, engineered products like blockboards (made from small blocks and planks glued together) might overcome some of the shortage. The simplest business model only requires a sawmill and workshop for manual gluing of the short planks. Higher productivity and quality can be achieved if using finger-jointing technology and a press. A product already established in Tanzania is coated blockboard, where peeled or sliced veneer is glued onto the surface.

Given the minimalistic raw material requirements and simple processing technology, production of blockboards seems to be an interesting option for Tanzania. A production line can include a veneer peeler unit, using the outer, knot-free part of the log for veneer and the inner, knotty core for boards. Production of uncoated blockboards would be suitable for teak and coated ones for eucalyptus and pine.

Table 26: Investments needed for blockboard production

Situation	Solution	Support	Investments needed
For STGs use the association approach to guarantee supply of wood for the processing units; blockboards would be a secondary transformation process, mainly from sawmilling residues			
Large quantity of small diameter hardwood logs and smaller sized sawn timber (by-products)	Production of blockboards	- Know how transfer (training) in processing technology - Maintenance and repair of machines (training local service providers)	- Technical instructor: 1 per cluster (2,500 US\$ per month) - Vocational training for service providers (mechanics)
Use of ding dong saw with low recovery and producing poor quality sawn timber	Change to band saw for main product, use small diameter logs and off-cuts to produce pieces for blockboards	- Provide investment advice - Provide training to association members	- Mobile band saw: 40,000 US\$ - Re-saw or small band saw, planer, finger jointer, presses: 20,000 US\$ - Simple kiln dryer: 100,000 US\$ - For coated boards - veneer peeler: 60,000 US\$ - Providing access to capital
Poor infrastructure does not allow transport of round wood to industrial centres / results in very high transport cost	Processing within the cluster	Support small processing units at rural regions (in this case association approach like sawmilling VC)	- Investments in above mentioned machinery; (Investments in building up associations, see sawmilling VC)
Poor market information and trading opportunities	Collection and dissemination of market information at cluster level	Build up a trading system with access to market information	- Building up a market information system (smartphone app-existing) - Technical instructor (already included in line 1) and investment in technology -1,500 US\$/assn.

Table 27: Economics of blockboard business model

			enter data	calculated					
cost centre	activity	cost centre	costs	unit	comment	productivity parameters	value	Unit	%
Tree growers	tree growing by STG	plant material	54.00	US/ha	1100 trees/ha * 5 Cent/plant	rotation length	20	years	
		labour costs	150.00	US/ha	interviews entrepreneurs, to be confirmed	Mean anual increment	20	m³/ha/yr	
		weeding		US/ha	not done or no costs	total volume produced	400	m³/ha	
		fertilizing		US/ha	not done or no costs	sawlog	200	m³/ha	50%
		pruning	140.00	US/ha	2 prunings, interviews entrepreneurs	veneerlog	80	m³/ha	20%
		thinning	160.00	US/ha	2 thinnings, interviews entrepreneurs	harvesting residues	120	m³/ha	30%
		overhead calculation		US/ha	(please specify)	other prodcuts	0	m³/ha	0%
		subtotal:	504.00	US/ha		control sum:			100%
costs/m³ of produced roundwood	1.80	US/m³							
STEP 1									
Harvesting operator	harvesting operations by association	felling			n.a.				
		delimbing			n.a.				
		sectioning/bucking			n.a.				
		hauling			n.a.				
		loading			n.a.				
		overhead calculation	4.00		interviews and expert guess				
subtotal:	4.00	US/m³							
costs/m³ of loaded roundwood	5.8	US/m³							
STEP 2									
Transport roundwood	transport organized by association		8.00		calculated for average transport distance of 20 km, 0.4 US\$/km/m³ (small truck)				
		costs/m³ round wood at millgate	13.8	US/m³					
STEP 3									
Processing	sawlogs	millgate costs logs	13.8	US/m³	log price own calculation	productivity parameters	value	Unit	
		material costs 1 m³ sawn timber	19.71	US/m³	log price vs. recovery rate	recovery rate	70	%	
	processing costs	capital costs (100,000 US)	3.90	US/m³	complete line: band saw, re-saw, planer, finger joint, press	mill capacity	7000	m³/round-wood/yr	
		direct production costs	60.00	US/m³	(expert guess, literature)	yearly harvesting area	25	ha/yr	
		overheads	14.00	US/m³	(expert guess, literature)	total area necessary	500	ha	
	total costs 1 m³ of sawn timber at mill	97.61	US/m³						
Communication and Trading	trading by association	estimated administration costs:	2.00	US/m³	expert guess				
STEP 5		total costs:	99.61	US/m³				distance (km)	
Transport	Transport to market by association	transport costs	36.00	US/m³	Interviews: transport costs of 0.04 - 0.06 cent /m³/km	transport costs	0.06		
		total costs at market (Dar)	135.61	US/m³	(estimated 600 km)				
STEP 6									
Economic balance									
Selling point	costs	price	profit margin	unit	comment				
standing forest	1.8	30.00	28.20	US/m³	INDUFOR data (adapted)				
market product 2x4/2x6/2x3	50.00	228.00	178.00	US/m³	Market Dar (interview data), 71% of product				
blockboard	97.61	650.00	552.39	US/m³	29% of product *estimated price, no market yet				
mixed calculation	63.81	350.38	286.57	US/m³	(mix sawntimber 71% and blockboard 29%)				

Table 28: Further optimization potentials for blockboard models

Step in the chain	Improving potential	Expected results
STEP 1: silviculture /management	Potential for improving see plywood VC	The better the raw material the higher is the value generation potential
STEP 2: harvesting	Commercialization or technologies that enable the use of crown slash;	Make better use of produced raw material
STEP 3: transport	Better access/roads to the woodlots; <u>But</u> : with higher profit margins also longer round wood transport possible;	Reduce transport costs significantly
STEP 4: processing	See the sawmilling VC for main products	
	Use of residues and smaller dimensioned stripes and battens	Much higher recovery rate from sawmilling process (20 to 30 %more)
	kiln-drying	improves dimensional stability
	Treatment for higher water resistance	Outdoor utilizations
	Treatment for durability (preservation with CCA)	Use for construction purpose (protection against termites)
	Blockboards with coating of a) peeled veneer and b) or sliced veneer from native species or teak	New market sectors, prevent from substituting wood with other materials
	Tertiary transformation made out of blockboards (furniture, doors, etc...)	New market sectors, increase market potential
STEP 5: Trading / Marketing	See other VC models: profit margin remains in association	
STEP 6: Transport	Organizing own transport (association), profit margin remains in association More flexibility in the production / storage, just in time delivery	

Table 29: Priority in the different clusters for blockboard model

Cluster	Relevance	Observation
Kilolo / Iringa	0	▪ Poorest infrastructure (roads, electric power) ▪ Probably difficulties in know-how transfer and technical support and planning level, unplanned mix of species and age structure ▪ Low investment power
Njombe	+	▪ well organized MTGs with better access to capital, experience in entrepreneurship ▪ better situation for technical support for machinery/maintenance ▪ higher pine proportion
Mafinga	+	▪ technically most developed wood processing cluster with installed entrepreneurship, ▪ interesting option, better use of raw material (less residues) may be able to compensate higher log prices in the future ▪ higher pine proportion – a few pine blockboards already produced (2 workshops and Green Resources – workshop level)
Kilombero	++	▪ Hardwood based region with high teak proportion; ▪ good potential of raw material available (teak, eucalypts, which are difficult for sawmilling but can be used for blockboards)

legend: - = not applicable, 0 = low, + = medium, ++ = high

Gluelam

Gluelam production is a possibility to overcome several problems associated to poor quality and small dimension logs. Gluelam has been one of the main products preventing substitution of wood with other materials in the construction sector in the last decades. Due to its outstanding physical properties, it is highly suitable for construction.

The production process includes finger-jointing sawn timber planks, connecting them lengthwise. This is followed by gluing the planks on their faces to produce beams of variable size. Gluelam beams can be produced at variable dimensions and have higher strength and dimensional stability (nearly no swelling / shrinking process) than the original solid wood. To ensure compliance with security standards in the construction sector, the boards have to be graded with a testing machine (dynamic Modulus of Elasticity - MOE) before gluing them together. Overall, the production process is quite sophisticated and requires large processing facilities, high kiln-drying capacities and hot presses with high energy consumption. A production line cannot be assembled in a low cost and low-tech way like for plywood and blockboard production, making the investment more suitable for bigger market players. It is unlikely that STGs participate in this value chain apart from providing the timber. However, the ability to use short logs and high-tension hardwood, and the possibility to remove defects in the production process, make this value chain a suitable outlet for STG timber.

Table 30: Investments needed for gluelam production

Situation	Solution	Support	Investments needed
Small scattered plots where age and species distribution are not planned for a specific target	Organize STGs to be able to provide a critical mass on raw material at a given quality on an annual basis	- Form associations to get a minimum area for feeding a roundwood transformation technology - Train STGs on target oriented silviculture and management	- Technical, social and legal advisor organizing STGs: 2 per cluster (5000 US\$/month) - Technical instructor organizing and conducting training: 2 per cluster (5000 US\$ per month;
Poor quality sawlogs do not allow optimal value aggregation	Produce higher quality sawlogs	(see training on silviculture and management above)	(covered above)
Processing of the wood at forest site with ding dong sawmills with poor sawn timber quality and low recovery rates	Improve recovery rate (reduce waste of raw material) and quality of sawn timber (higher price)	- Use mobile / stationary band saws - Adequate training to association members	- Sawmills from 30,000 to 100,000 US\$, including spare parts for 1st year - Technical instructor: 1 per cluster (2500 US\$ per month)
Big quantity of small diameter hardwood logs of poor quality	Provide it to a GLUELAM industry	Technology has to be introduced by a big player	Provided by big players
Poor infrastructure increase log transport costs to processing units	Higher profit margins may allow a wider transport radius around the processing unit, but it too long distances will reduce the profit share	Support installation of better infrastructure to remoter rural areas	Provided by government / big players

The economics of the Gluelam business model are expected to be similar to that of blockboard (Table 27).

Table 31: Priority in the different clusters for Gluelam case

Cluster	Relevance	Observation
Kilolo / Iringa	0	▪ Poorest infrastructure (roads, electric power) ▪ Unlikely that a Gluelam investor chose the region, therefore longer transport distances;
Njombe	+	▪ Good infrastructure, technical know-how, more human resources; ▪ More likely to get technical support for machinery
Mafinga	++	▪ Technically most developed wood processing cluster with installed entrepreneurship, most interesting region for Gluelam producer, ▪ Technical know-how, workers with specific skills available;
Kilombero	+	▪ Hardwood based region, alternative Gluelam with high strength properties ▪ Good potential of raw material available (teak, eucalypts);

legend: - = not applicable, 0 = low, + = medium, ++ = high

Other EWPs

Reconstituted wooden materials have boomed in developing countries during recent decades. Fibre and particle boards - and also the pulp and paper sector - are highly dependent on the raw material wood. There are excellent market expectations and also good profit margins in the sector, but often high investments are required and good infrastructure to transport raw materials to mills and products to the markets is a basic requirement. Such mills, especially for pulp and paper, depend on a continuous and reliable raw material supply, 24 hours and 7 days a week. In addition, board mills need to run at full capacity to amortise the high investments in an acceptable time frame. Such investments generally are only made if a good proportion of the supply chain is in the hand of the mill, to assure continuous supply. The raw material requirements itself are not that high, allowing the use of smaller dimension wood from thinnings or of poorer quality. Nonetheless, basic raw material requirements still apply according to the target product (e.g. fibre length and strength).

TANWAT reported about their plan to open a fibreboard mill (MDF) at their facilities in Njombe. Another player in the sector is Mufundi Paper Mill, already consuming considerable wood volumes from government plantations. Both companies place increasingly focus on raw material supply from their own forest plantations. Some outgrower relations exist, but are not (yet) well-organized nor constitute a very strong relationship. Individual STGs are unlikely to participate in the value chains of these big players. However, if organized in associations with considerable areas and volumes of wood their negotiating power would increase. STGs as an association or other form of organization would be more interesting market partners than if acting individually.

8.2.4 Prioritization of business models per cluster

Of the four clusters identified, Kilolo/Iringa is the least developed, justifying a simple business model such as sawn timber production the most suitable. Mafinga, at the other end of the spectrum, benefits from the mix of large scale plantations and small and medium growers. It also has several well-established processing factories and relevant human resource capital which provide an important basis for upscaling to/installation of more ambitious industrial developments such as plywood mills and gluelam production. In Njombe, bigger private growers exist and are organised, providing entry points for medium-sized investments such as veneer/plywood and blockboard production. Kilombero cluster has a special status due to its focus on hardwoods, in particular teak and the presence of Kilombero Teak Valley Company already working with the surrounding communities. Here, options that replace sawmilling into the standard long planks (more difficult for hardwoods) should be developed.

Table 32: Priority in the different clusters

Cluster	Key characteristics	Relevance of business cases			
		Sawn timber	Veneer / plywood	Block-board	Gluelam
Kilolo / Iringa	▪ Very many small STGs, woodlots scattered widely, mix of species and age structure very heterogenous ▪ Poor infrastructure (roads, power) ▪ No/very limited entry points (growers' organisations) for transfer of know-how, technical support and planning ▪ Larger growers, STG groups or established processors who could access/directly finance processing facilities do not exist ▪ Large distance to existing processing hubs	++	0	0	0
Njombe	▪ Good raw material supply with high proportion of pine ▪ Good infrastructure ▪ More medium sized and organised growers: better technical know-how and human resources, entrepreneurship, access to finance/capital, technical, ▪ Medium growers and growers organisations provide good entry points for technical support and investments into higher level value addition	+	++	+	+
Mafinga	▪ Mix of government plantations and small/medium growers: good raw material supply with high proportion of pine ▪ Most developed wood processing cluster with established entrepreneurs, good human resource: technical know-how, workers with specific skills ▪ Veneer / plywood and blockboard already produced at varying scale ▪ Most interesting region for larger investments such as Gluelam	+	++	+	++
Kilombero	▪ Good raw material supply of hard woods (teak, eucalypts) ▪ Hardwoods more difficult for sawmilling; alternatives e.g. production of veneer /plywood and blockboard offer good alternatives; production of Gluelam possible	+	++	++	+
Legend: = not applicable, 0 = low, + = medium, ++ = high					

9 RECOMMENDATIONS

9.1 Plantation data

For more accurate planning in the sector, more detailed information on the plantation resource in Tanzania is required and especially from the STGs. It is recommended to undertake further work on the following areas:

- Average size and distribution of plantations;
- Species;
- Quality (related to history of management);
- Actual growth rates, site quality and age classes; and
- Access/infrastructure.

As this new information is gathered, the UNIQUE model should be revised accordingly.

9.2 Transition of value chains and cluster development

The recommendations addressing challenges and opportunities to improve the analysed value chains' competitiveness and resilience are described in detail in the respective chapters of this study (chapter 7 addresses value chains and chapter 8 proposes business models). Each of the analysed value chains account for distinct sets of challenges and potentials, and differ significantly in terms of raw material requirements and processing technologies.

In summary, the recommendations addressing the value chains focus on:

- Improving quality of the raw material (round wood) available for further processing along the value chains;
- Reducing cost of raw material production and trade by increasing productivity of smallholder systems and optimizing supply logistics;
- Increasing efficiency of wood processing and improving the quality of processed wood products;
- Promoting application of and compliance with standards for raw material (log grading) and wood products (technical specifications) in the production process;
- Improving the communication between raw material producers, wood processors and final consumers of wood products; and
- Promoting entrepreneurship and identifying lead actors to build promising business models.

Although each of the proposed activities can be implemented as a stand-alone activity, the best effects and most positive impacts are anticipated when a set of specifically designed activities will be realized in a comprehensive cluster-based approach. To that end, the business models described in chapter 8 frame and describe activity bundles that should be implemented within a specific regional supply-demand context. The proposed business models aim at improving value chains actors' ability to react to future market requirements as described in chapter 6. Thereby making use of the available resources and actors and enabling them to advance gradually along a transition path towards more competitiveness and resilience.

The proposed business models are:

- Aggregating huge numbers of dispersed smallholders currently acting individually;
- Establishing a medium sized high efficiency and high quality sawn timber processing facility in Kilolo;
- Addressing growing market demand for plywood by making use of available low quality roundwood in Njombe;
- Introducing innovative products to the Tanzanian market by promoting Gluelam production in Mafinga, making use of the advanced entrepreneurs in this cluster; and
- Increasing value addition opportunities for hardwood species by establishing blockboard processing capacities in Kilombero.

The outlined business models are examples of promising options in the identified regional contexts of this study. However, they require further refining due to limited knowledge on raw material supply, factor specific costs and investment costs (which require a more thorough analysis of the specific business cases).

Nonetheless, the approach of identifying and promoting inclusive cluster-based business models can be replicated across the Southern Highlands and beyond.

9.3 Transition of the market environment

The promotion of value chains should be accompanied by activities addressing several issues at overarching level, requiring a coherent and coordinated approach of forestry stakeholders:

1. Clarifying the potentials of plantations and wood products in national policies

Tanzania has embarked on a long-term development strategy which aims at achieving sustainable human development with all pre-requisites for a middle-income country by the year 2025. This envisages creation of a strong, diversified, resilient and competitive economy that can effectively cope with the challenges of development, and that can easily adapt to the changing market and technological conditions in the regional and global economy. However, the role of the wood products value chains in this development and the link between rural development and industrial growth is not well established.

Planning departments and private sector associations may compile relevant information and data, supporting positive impacts of plantation-based value chains and wood product markets for environment, national economy and rural development.

2. Facilitate public-private dialogue on cluster development and industry development

The development of smallholder based business models is most promising when clusters specific interventions and incentives are tailor-made. This requires a thorough needs assessment of the actors in the identified clusters and the joint effort of public (i.e. TFS) and private sector (i.e. large commercial companies and early movers) actors contributing to achieve a common aim.

Private sector associations, MNRT/TFS and other actors may initiate cluster specific dialogue platforms to assess the possibilities of targeted interventions and incentives and define the roles of the key actors.

3. Promoting the application and compliance with wood product standards and markets

Application of and compliance with standards is a crucial pre-condition to sustainably develop markets for quality wood products and establish markets for innovative wood products. Standardization processes can only succeed if the full value chain is considered (from raw material to final consumption). There is need to assess priorities for wood products standard setting, initiate processes how to set these standards, and ensure quality management along the value chain.

TBS, NRB, private sector associations and other market actors may develop a road map to accelerate standardization process in the value chains.

4. Promoting a pro-wood public procurement policy

A public procurement policy requiring sustainable and quality certification for key wood products should be considered. 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. This approach must be seen in the context of national green growth policies.

Private sector associations may initiate the dialogue with public sector actors to evaluate possibilities for a pro-wood procurement policy.

5. Initiate R&D agenda on engineered wood products and adapted smallholder plantation management

The wood products markets are rapidly evolving and with them the wood products that are required. The trend of the past decades has shown a shift away from sawnwood towards engineered wood products. The possibilities of EWPs in final uses are numerous, but especially in growing economies the knowledge on these products and their potentials is very limited. Furthermore, there are country and market specific patterns (construction designs, building regulations, etc.) that require EWPs development in regard to these patterns. This includes material testing, standard setting, product durability and preservation options, etc. On the supply side, conventional plantation management regimes are aiming at producing sawlogs, poles or fibre. However, there is room to modify and optimize these systems in order to provide adequate raw material for EWP production.

TBS, TAFORI and private sector associations may initiate a research and development agenda that covers EWP development and adapted smallholder plantation management systems.

6. Facilitating access to market information and communication between producers and final consumers of wood products

The communication between the wood processing sector and final consumers of their products is not well established. Only large producers are in regular contact with their main clients. Thus, market trends and market requirements only trickle down slowly to wood processing SMEs and they are not able to react timely to recent development. Furthermore, global trade enables consumers to access almost any wood product in required quantities and qualities from external sources. Domestic SMEs are in threat of being by-passed and losing market shares.

Private sector associations and market intermediaries may initiate communication and dialogue channels that informs wood processing SMEs about actual market trends and client requirements.

7. Developing curricula on wood products in construction sector relevant professional education

The knowledge amongst designers, architects and engineers on the use of wood products (sawnwood and even more EWPs) for structural applications is not widely spread in Tanzania. Curricula at universities and colleges focus on conventional building systems and building materials. However, designers and architects are crucial to increase market shares of structural wood products.

Universities, training institutes and private sector associations may develop curricula on wood applications in the construction sector.

8. Clarifying the potentials and limitations of the sustainable use of biomass in energy production

Sustainably produced biomass can contribute to: 1) ensuring energy supply for off-grid energy consumers; 2) providing heat for industrial processes (e.g. in agriculture or cement production); and 3) reducing Tanzania's greenhouse gas (GHG) emissions. On the other hand, the biomass market offers decent outlets for forest waste, thinnings and industrial waste wood, thereby improving economic viability of plantations and wood processing industries. However, the use of sustainably produced biomass is not actively promoted in Tanzania; rather, the use of natural gas is receiving public support in current policies. The use of forest biomass as feedstock for industrial and agriculture has reduced and there is the threat that this market will be lost for plantation based value chains.

MNRT, TAFORI and private sector associations may compile information and data that supports the positive effects of sustainable biomass for national energy supply and GHG balance and promote the results at policy level.

9. Promoting awareness on wood as sustainable construction material

The importance of the construction industry in Tanzanian economy is generally acknowledged, but at the same time it can be a major source of environmental damage caused by the production of conventional construction materials (steel, aluminium, plastic, concrete, bricks). A number of the industry's activities are environmentally not sustainable partly due to lack of awareness of environmentally sound practices and technologies. Thus, the application of sustainable construction practices and materials that are environmentally friendly on the one hand and contribute to socio-economic development on the other, is key to achieve increasing market demand for (preferably domestic) wood products.

Ministry of Works, NRB, TBS and private sector associations may compile information and data that supports the positive effects of wood as construction material and promote the results at policy level.

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11 ANNEX

List of interviewed actors

		Grower	Trader	Sawmiller	Contractor	Nursery	Pole treater	Plywood	Tannin	Energy plant	Workshop	Euc	Pine	Wa tile	Cypress	Euc poles	Euc timber	Euc veneer	Pine saw log	Chainsaw	Ding-Dong	Other	Sells standing	To process
Name	Region																							
Mponji Kimilavatali	Njombe	✓										✓	✓						✓				✓	
Jonas	Njombe	✓			✓	✓						✓	✓		✓									
Shedrack Mbiga	Njombe	✓	✓	✓								✓	✓			✓			✓					
Shaibu Masasi	Njombe												✓						✓				✓	
Lazarus Mbilinyi	Njombe	✓										✓	✓		✓		✓		✓					
Japhet Essau																								
Mkakata	Iringa	✓		✓									✓			✓			✓	✓	✓			✓
Agrey Kivamba	Iringa	✓										✓	✓						✓					✓
Anton Msuva	Iringa	✓											✓	✓	✓				✓				✓	✓
Acklen Msola	Iringa	✓																	✓				✓	
Galos Nyamwoga	Iringa	✓											✓						✓				✓	
Ignas Kikove	Iringa	✓																	✓				✓	
Fred	Iringa			✓																	✓			
Sadoki Kianza	Iringa			✓																		✓		
Samaria Wikedzi	Iringa	✓				✓						✓	✓			✓								✓
Amran Mkakanzi	Iringa	✓				✓						✓	✓	✓	✓	✓		✓	✓		✓			
Gao Jian Jiang	Iringa		✓					✓										✓						
Awadhi Said Shedaffe	Iringa						✓																	
Boniface P Chumo	Iringa		✓																					
Zedeck Ng'elenge	Iringa	✓				✓						✓	✓			✓			✓				✓	
Richard Ndeke	Njombe	✓	✓	✓								✓	✓						✓		✓			✓
Saimon Mtweve	Njombe	✓											✓										✓	
Menard Mwigune	Njombe	✓											✓						✓		✓		✓	
Laurent M Mfugale	Njombe	✓											✓						✓		✓		✓	
Isaya Yotamu	Mbeya		✓	✓									✓						✓		✓		✓	
Amanisye Mwachang	Mbeya	✓											✓						✓				✓	
Sikujua Kibona	Songwe	✓	✓	✓									✓						✓		✓			
Ntuta Jumapili	Songwe	✓											✓						✓				✓	
Pasaka Mwasenga	Songwe	✓											✓						✓				✓	
Adam Mwakang'ata	Mbeya		✓																					
Lazaro Mwampamba	Mbeya		✓																					
Josiah Satiel M	Mbeya										✓													
TANWAT: Prashant																								
Palo, Edmund																								
Munubi	Njombe	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓		✓			✓			✓		
NEW FORESTS: Justin																								
Venter, Henk																								
Zonnestein, Agrippa																								
Mandiwona	Iringa	✓	✓	✓		✓	✓					✓	✓			✓			✓			✓		
Association of																								
Sawmillers Mafinga:																								
Henry Leukambinga																								
(chairman) y Willian																								
Mgowale (secretary)	Mafinga	✓	✓	✓	✓						✓		✓						✓			✓		
Daniel Msigwa	Mafinga	✓	✓	✓									✓						✓			✓		
Halidi Imam Shekedo	Mafinga	✓	✓	✓									✓						✓			✓		
Amar Shangvy																								
(Tanganyika																								
Plywood)	Sao Hill							✓										✓						
GREEN RESOURCES:																								
John Sondi, Svein																								
Mathiesen	Sao Hill	✓	✓	✓		✓	✓				✓	✓	✓			✓			✓			✓		
8 traders in timber cit	Njombe																							
Keepson Nyondo																								
Ngimba Emmanuel	Iringa		✓																					
Qwihaya Enetrprise	Iringa			✓			✓	✓																
Steven Nsenge	Iringa		✓																					
Mufindi Tea Mill	Iringa											✓												
NN	Iringa		✓																					
George Kitomari	Iringa			x																				
Kitabu tea factory										✓		✓												
Lesheya Enterprise	Iringa					✓																		
Lafarge-Holcim	Mbeya									✓														
Wakulima Tea Compa	Mbeya									✓		✓												
Mufindi Paper Mill	Iringa									✓		✓	✓											
Tanzania breweries	Mbeya and Dar																							
SBC (Pepsi)	Mbeya and Dar									✓														

Market actor interviews

Name	Organization
Bhavik	SBC Dar es Salaam
Paskali Massawe	Watumishi Housing Company
Eng. Simon Kihyo	TANESCO
Ben Sulus	SHIVIMITA
Sheikh M. Bawazir	Dezo Civil Contractors Co.Ltd
Kahana Lukumbuza	Private consultant
Jayanti R. Pindori	Dezo Civil Contractors Co.Ltd
Fabian Mwakatuma	TBL
Arch. Edwin J. Mnunduma	TBA
Eng. Salvatory Rusimbi	TBS
Clifford F. Hungu	NHC
David Jere	CRB
Arch.Elius Mwakalinga	TBA
Paras Sha	BIDCO
Kassim Mtisi	Woodfuel trader

List of validation workshop participants, 2nd December 2016, New Africa Hotel, Dar es Salaam

Name	Organization
Eng. Kakuru Mkama	TBS
Ludovick Uronu	FBD
Eng. Sana Idindili	TANESCO
Ben Sulus	SHIVIMITA
Edgar Masunga	TTSA
Kahana Lukumbuzya	Private consultant
Laurent Mfugale	TGAs Apex
Dr. Samora Macrice	SUA
Dr. Lawrence Mbwambo	TAFORI
Leonard Mahenda	Quihaya
Fabian Mahenda	Quihaya
Lazarus Mbilinyi	Tree grower
Ngibuini Mwaniki	Private consultant
Thomas Hilton	FDT
Yuda Mkollo	FDT
Michael Hawke	PFP
Nicholas Moore	PFP
Simon Milledge	FDT
Kastory Timbula	FDT
Christian Held	UNIQUE
Paul Jacovelli	UNIQUE