



KCFP value chain assessment

Sawn Timber

June 2019

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Supply constraints have led to high prices of sawn timber; underutilized capacity presents opp. to increase prod., lowering prices & meeting demand

Value chain structure and volumes: Sawn timber, historically sourced predominately from KFS, goes through limited processing at one of the hundreds of licensed mills before going to the market

Demand: Construction, specifically trusses, & furniture will continue to drive demand as Kenya urbanizes

Supply: Sawn timber value chain will remain dependent on KFS supply base but if barriers to using eucalyptus and grevillea can be overcome, these alt. species can contribute to filling supply gap

Processors: Large amount of underutilized capacity in part due to a recent proliferation of smaller, licensed mills

Imports: Import volumes have historically been low, playing a small role in meeting supply deficit

Substitutes: Price sensitivities & supply gap have led to market starting to opt for substitutes such as steel in construction and EWPs for furniture

Prices: Prices are sensitive to government policy & supply constraints, prices currently very high, low product differentiation has led to one dominate market price for softwood sawn timber, at which imports are also sold

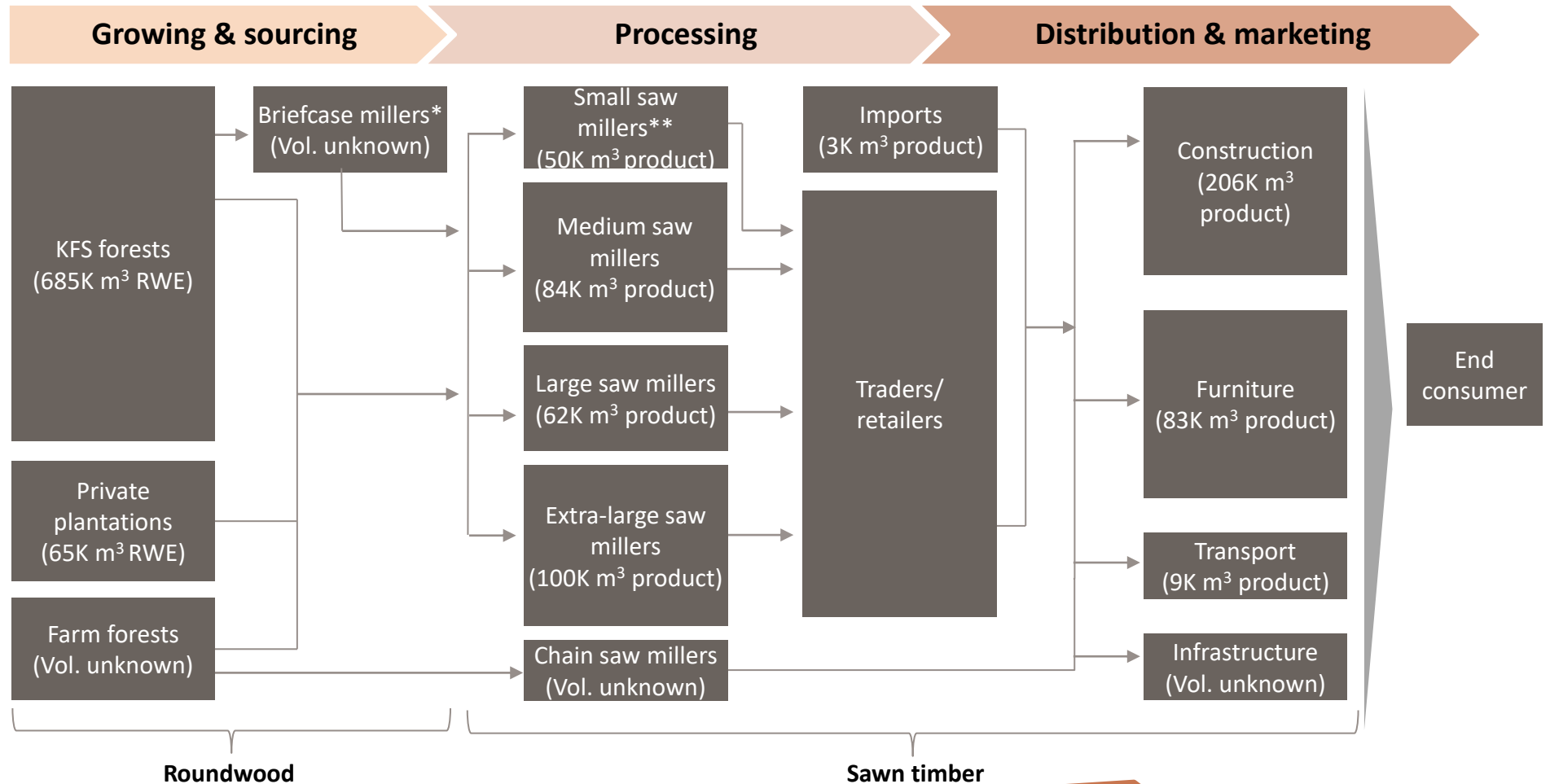
Margin analysis: Recovery rates (RR) greatly affect roundwood input costs; inefficiencies in RR combined with high prices of roundwood make milling difficult to do profitably esp. for large mills with high overhead costs

Outlook: In the long term, if KFS plantations continue to be logged at an unsustainable rate, there will be extremely low production utilization and the KFS supply base will be depleted; properly managed KFS plantations & farm forest supply could enable local production to sustainably meet 99% of demand by 2050

Competitiveness: Without intervention in major supply base investments, prices of sawn timber likely to continue increasing as demand grows, forcing the market to switch to substitutes

Areas for future research: Answering key outstanding questions around demand, market preferences, processing inefficiencies & costs, & viability of farm forest aggregation to support design of effective interventions

Sawn timber, historically sourced predominately from KFS, goes through limited processing at mills before going to the market



As a result of the recent KFS logging ban, sawn timber production has decreased an estimated 78% to just 66K m³ of product, driving up the price

Notes: *Briefcase millers refers to licensed millers with access to KFS trees who sell the felling area license or roundwood instead of milling it themselves **Consumption distribution between construction & furniture based on demand estimates

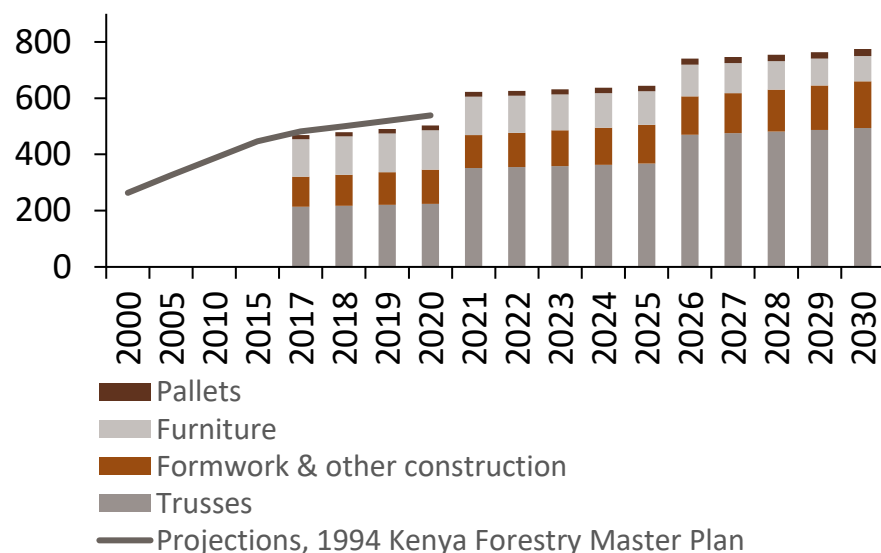
Source: OCA consultations and analysis



Demand is estimated to be >490K m³ sawn timber, largely driven by roofing trusses and is expected to grow due to urbanization

Estimated sawn timber demand (2000-2030)¹

m³ product, thousands



69% of the national demand for sawn timber is estimated to come from the construction industry

- Furniture is estimated to drive 28% of the total national demand; preference for pine and imported hardwoods

Demand for sawn timber estimated to grow at CAGR of 4.2%, driven primarily by construction sector

- Pop. growth & urbanization increasing housing needs; construction to grow at 6.2% p.a.²
- Big Four agenda unlikely to drive demand as consultations indicated gov't will use alternatives

Most of this demand is expected to be in urban centers & their surrounding counties



Official demand figures last updated in 1994

Additional research needed to get accurate data on key parameters for bottom-up calculation; highly dependent on timber used per m² of construction

- Model also sensitive to furniture parameters and assumptions; furniture demand is particularly challenging to calculate as there seems to be significant latent demand from high prices

County construction economic activity as percentage of total KE construction, 2017³

1	Nairobi	38.91%	6	Kisumu	2.68%
2	Kiambu	12.23%	7	Isiolo	2.12%
3	Mombasa	8.24%	8	Muranga	1.77%
4	Machakos	3.81%	9	Elgeyo-Marakwet	1.77%
5	Nakuru	3.69%	10	Marsabit	1.62%

Historical: Production levels sensitive to gov't policy as vast majority of sawn timber production is from KFS-grown cypress

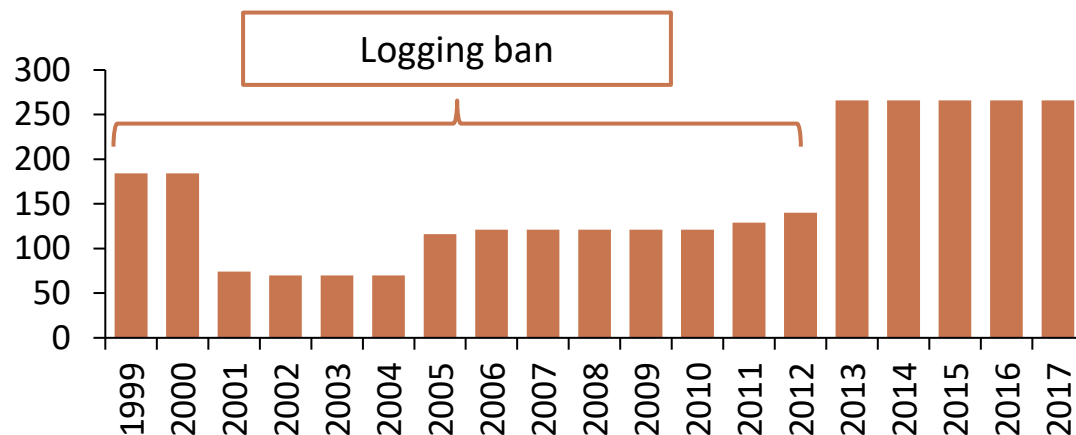
Millers have strong preference for softwoods, sourced almost exclusively (>91%) from KFS, yet indicate challenges as quality & size of KFS trees has been declining

>91%
wood supply
from KFS*

- While there is a preference for pine & cypress, cypress dominates species used given larger stock & use of pine for veneer production
- Some use of alt. woods (e.g. grevillea & eucalyptus) from private sources but not common
- ~96% of the cypress and pine stock in Kenya is on KFS plantations;¹ licensed millers pre-qualified & then apply for annual licenses for a felling area for which they are responsible for harvest & haulage
- Indications from consultations that areas with better trees were given to larger mills; size & quality of trees felled has been decreasing in past years

Historical sawn timber production (1999-2017)²

m³ product, thousands



As a result of reliance on KFS, production is sensitive to government regulation

- First logging ban decreased production by ~60%
- Limited access to KFS supply by 3 of the big 5 companies helped ensure base levels of production remained
- Chainsaw milling & imports increased during this period to help meet demand

Notes: *Estimated for 2017

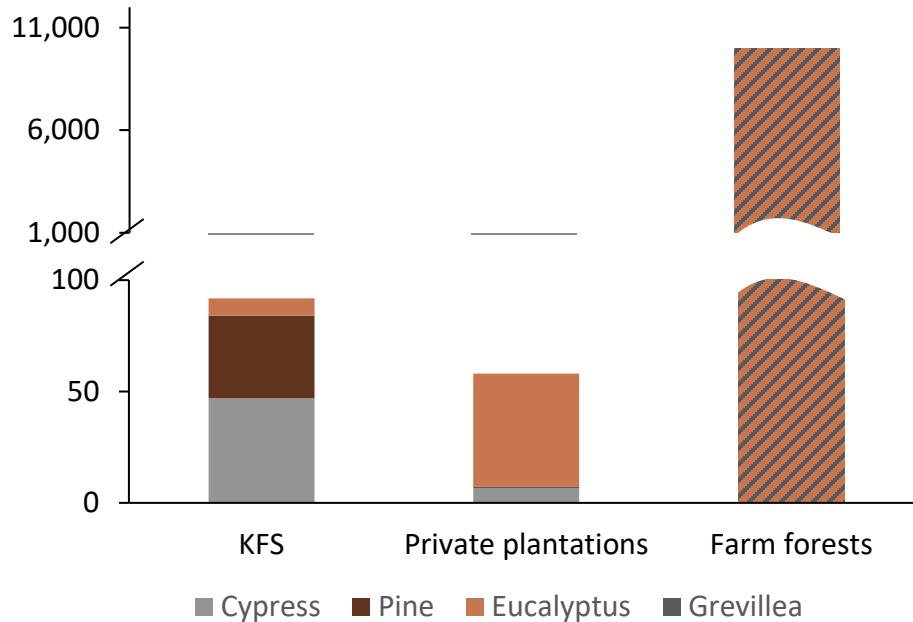
Source: OCA consultations and analysis; ; 1) WANLEYS Consultancy Services, *Analysis of demand and supply of wood products in Kenya*, (Kenya: Ministry of Environment, Water and Natural Resources (MEWNR), 2013) 2) Food and Agriculture Organization of the United Nations (FAO), *Forestry Production and Trade*, Rome: FAO, 2018),

<http://www.fao.org/faostat/en/#data/FO>.

Forecast: KFS to remain main supply base for softwood sawn timber; unexplored opportunity to utilize large eucalyptus and grevillea base

Distribution of species by supply base

Ha., thousands



Farmers unlikely to be incentivized to grow softwoods due to long rotation lengths & high opp. costs

- Returns from cypress for timber lower than euc. for poles (11.97% IRR poles vs. 7.59% for sawn timber)
- Challenges with land availability and secure land titling; including land costs, the net present value of the investment is negative

Forestry economics, 1 ha. cypress, Inc. land costs	Internal Rate of Return (IRR)	Net Present Value (KES)	Net Profit in Yr. 22 (KES)
Status quo growing	6.41%	-280,085	1,479,884
Best practice growing	7.49%	-212,599	1,929,351

Minimal KFS replanting & poor silviculture regimes foreshadow a declining, insufficient supply base

- KFS currently has over 40K ha. unplanted land,¹ this is ~30% of their total land
- Extraction from KFS likely over the rate of sustainable supply

Despite large available supply, millers are hesitant to process eucalyptus & grevillea

- Reasons cited inc.: lower efficiency (installed tech. not well suited for hardwoods), higher maint. costs, fragmented location, mixed market demand
- ! Additional researched needed to know if these barriers be overcome to better leverage eucalyptus & grevillea base for sawn timber



Increase in number of mills has resulted in excess capacity; minimal value addition and product differentiation in the market

In the last decade there has been a proliferation of mills

- >160% increase in number of registered mills since 2008; many mills bought Wood-Mizer one-banded saws
- Minimal overhead costs allow small mills to make a profit despite low recovery rate (RR)
- Many small mills are not operational and consultations indicate up to 20% may be “briefcase millers” with no intention of sawing

	Mill size			
	Small	Medium	Large	XL
Number registered, est.	480	240	80	5
Saw type	Circular	Band	Band	Industrial
Est. recovery rate (RR)	20%	46%	46%	55%
Average production capacity (m ³ product/day)	5	8	12	83
Total installed capacity, est. (m ³ product/yr.)*	564,000	479,400	235,000	100,000
2017 total production, est. (m ³ product)**	50,000	84,000	62,000	100,000

Total 2017 production was a small fraction of installed capacity (<45%), utilization constrained by supply base

- Current saws inefficient for eucalyptus sawing; double-banded saws would improve ability to use euc. supply
- Given high underutilization and supply constraints, unlikely that the number of mills will increase in the short- to medium-term and without intervention, one-banded & circular saws will remain dominant technology

! Minimal value addition done by processors despite indications that consumers are willing to pay a premium for properly seasoned & treated timber; more information needed to understand potential market failure

- Kiln usage very uncommon; air drying sometimes done by yard owners
- Most of the wood in Kenya is not treated following a warning from gov’t on carcinogenic nature of chemicals

Notes: *Assumes all registered mills have capacity (i.e. no “briefcase millers”) **Production by miller is calculated by assuming extra-large are operating at full capacity & the remaining amount of 2017 national production (as reported by FAO) is distributed by the percentage contribution by miller size of estimated total 2017 production calculated from consultation data

Source: OCA consultations and analysis; 1) FAO statistics, [2018], <http://www.fao.org/faostat/en/#data/FO>,

Imports have played a small role in filling the supply deficit, representing only 5% of consumption in the last 10 years

Actual imports likely higher than reported figures due to illegal importation & poor data quality

- Est. that 20% of hardwood & 5% of softwood timber imported is done so illegally¹
- Therefore, total imports between 2008 & 2017 were likely ~132K m³ product, ~6% of consumption

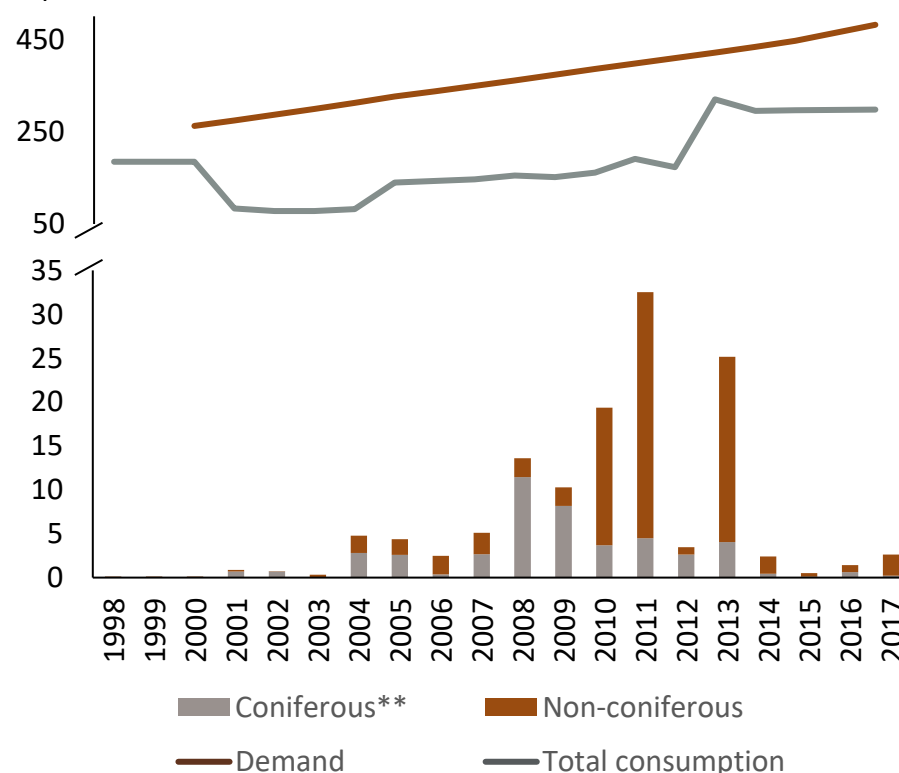
Traders indicate barriers that restrict ability to use imports to fill demand gap

- Large volumes needed to make imports viable; high associated costs requires a lot of capital, often unattainable by traders
- Informal costs such as bribes, political risks, & excessive bureaucracy also mentioned as reasons traders are hesitant to import more
- Shifting policy such as frequent changes to import duties creating instability in business environment

Gov't has used policy tools in the past to help facilitate additional imports; in 2003, gov't issued zero rate import duty & increased speed of customs clearance process²

Reported imports, consumption, & est. demand (1998-2017)^{3*}

m³ product, thousands



Given large unmet demand, it's still unclear why imports haven't increased to fill gap

Note: *Fluctuations are likely due to partially to poor data quality; in 2011 KFS began system of data collection at borders³; ** FAO Stat data broken down by coniferous and non-coniferous species which maps onto our usage of softwoods and hardwoods (respectively)

Source: OCA consultations and analysis; 1) WWF, *Overview of the timber trade in East and Southern Africa*, (2017) 2) United Republic of Tanzania, Ministry of Natural Resources and Tourism, *Market Study on Timber Market Dynamics in Kenya* (2011) 3) The Food and Agriculture Organization of the United Nations (FAO), *Forestry Production and Trade*, (Rome: FAO, 2019)

<http://www.fao.org/faostat/en/#data/FO>.

Despite preference for wood, demand for sawn timber switching to alternatives given high relative cost, particularly true for furniture

	Trusses		Formwork			Furniture		
Material	Sawn timber	Steel	Sawn timber	Laminated lumber	Aluminum	Sawn timber	EWP	Plastic
Durability	15-20 years ¹	Up to 50 years ¹	Use 6 times	Use >100 times	Use >300 times ²	Not typically key factor in demand		
Price (KES)	57 per m ² /yr.	17 per m ² /yr.*	29K per m ³ product	300K per m ³ product	n.d.	1.80 per cm ² **	0.31 per cm ²	0.26 per cm ²
Market preference & trends	<ul style="list-style-type: none"> Steel is becoming more common in the market although preference still for timber Trend of switching to alternatives highlighted by gov't use of steel in the Big Four agenda 		<ul style="list-style-type: none"> Sawn timber still preferred due to lower upfront prices & ability cut into needed lengths Aluminum was not mentioned in consultations, unknown how commonly it is used Government's planned use of expanded polystyrene, which doesn't need formwork, in the Big Four agenda highlights substitution trend 			<ul style="list-style-type: none"> Wood preferred but switching given prices; price sensitivity varies by customer segment Large Kenyan wood furniture mfr. plans to stop local mfr. soon given high costs & cheap imports Imports 40%-50% cheaper than locally mfr. furniture, even inc. import duties and taxes; imports grew at CAGR of 24%, compared to 10% for furniture production³ 		

Notes: *Assumes 0.035 m³ of wood trusses needed per m² of floor space, 70% of the volume of timber is needed for steel, and density for a steel used as beams (78.5 kg/m³); ** Price calculated from prices of coffee tables as per cm² of surface area to allow for comparable prices

Source: OCA consultations and analysis; 1) Sheraz Romie, *Advantages and disadvantages of steel as a structural design material* (2015), <https://www.slideshare.net/sheerazgulabro/aquib-steelysconcrete>; 2) Kumkang Kind, *Total Formwork Solutions Provider*, [page 13,] <http://www.kpda.or.ke/documents/Kumkang/Kumkang%20Kind%20aluminum%20formwork%20catalog.pdf>; 3) Ahveninen Harri, Irura Stephen, Odera Meshack, Paulina Maria, Dowdall Georgia, Manji Farah, *Furniture industry in Kenya - Situational Analysis and Strategy*, (Kenya: Ministry of Industrialization and Enterprise Development (MOIED), 2015)

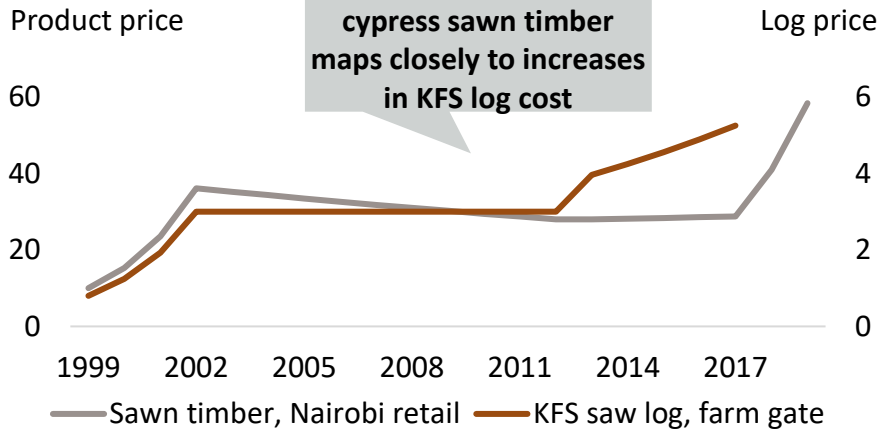


Sawn timber prices dependent on government regulation due to reliance on KFS, with imported sawn timber sold for a similar price as domestic product

Cypress prices^{1,2}

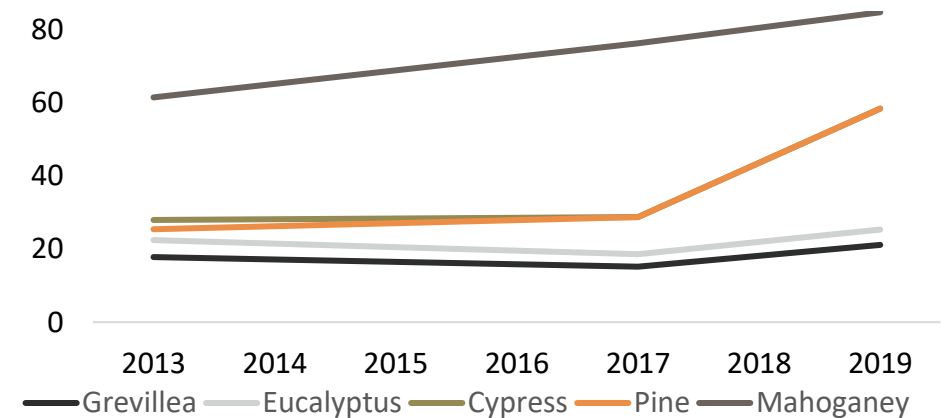
m³, KES thousands
Product price

Changes in retail price of cypress sawn timber maps closely to increases in KFS log cost



Sawn timber Nairobi retail prices^{1,2}

m³ product, KES thousands



Prices of sawn timber have been increasing but stable partially due to relatively consistent KFS prices

- Given low product differentiation, typically one dominate market price for all wood of a specific species
- Imports are typically sold at the same price as local production

Variation in prices by locations and species reflect large contribution of transport and roundwood costs to overall cost of production and distribution

- Market prices in Mombasa ~15% higher than in Nairobi due to longer distances between mill and market
- Market prices of euc. & grevillea are 18% lower, on average, than cypress & pine, likely due to farmgate prices being 33% less; may also reflect lower willingness to pay as typically used in lower-end markets

Future price trends highly dependent on gov't policy and other supply base trends; prices likely to stay constant around 2017 prices in short-term but could decrease if supply constraints are eased

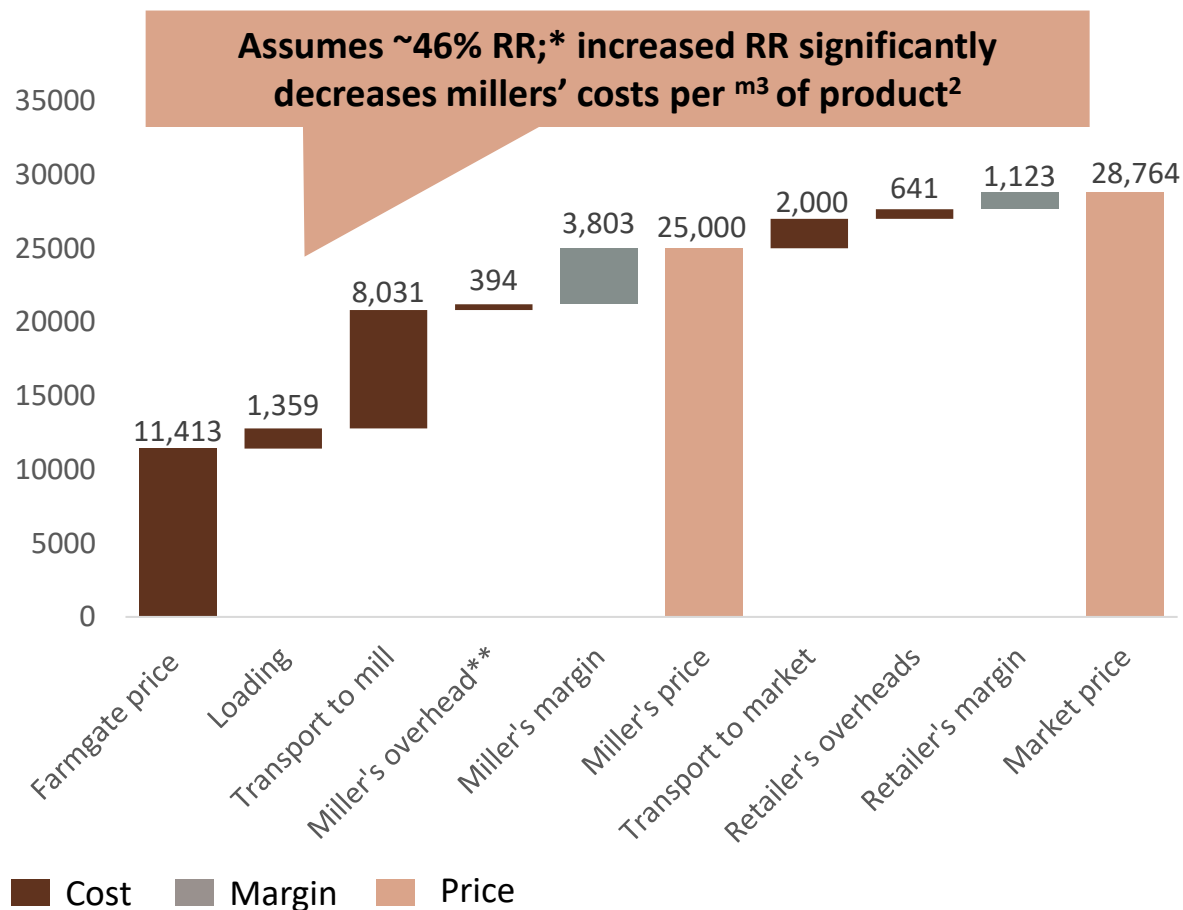
Source: OCA consultations and analysis, 1) Techel Grit and Wathum Gilbert, *Kenya Commercial Forestry Sector Programme Development Markets, value chains & timber trade options*, (2014); 2) United Republic of Tanzania, Ministry of Natural Resources and Tourism, *Market Study on Timber Market Dynamics in Kenya* (2011) 3) Arch. Francis Gichuhi Kamau, "Construction Materials cost. 2016. Nairobi, Kenya", [2016], <https://www.a4architect.com/2016/03/construction-materials-cost-2016-nairobi-kenya/>



Roundwood largest cost for sawn timber; transport to mill also major cost

2017 cost distribution, medium mill

KES per m³ product, cypress¹



Reliance on KFS helped keep costs lower & milling profitable

- KFS prices for wood stable and lower than market rates
- Millers can sell offcuts; receiving additional revenue

Larger mills have more overhead costs, making it harder to mill profitably without steady supply

- For example, they maintain full time workforce
- Estimated that overhead is ~10% higher for larger mills
- Means consistent supply of logs necessary to remain profitable



Additional data needed to better understand costs by size of mill

RR unlikely to change in short-term given new investments in tech. unlikely, changes in margins remain dependent mainly on log input costs

Note: *i.e. ~2 m³ of roundwood for 1 m³ of final product; **Miller's overheads include electricity & blades; retailer's overheads includes all costs incurred from mill to market

Source: OCA consultations and analysis; 1) Techel Grit and Wathum Gilbert, *Kenya Commercial Forestry Sector Programme Development Markets value chains & timber trade options*, (2014); 2) Cheboiwo Joseph, *Commercial Forecast of timber industry in Kenya*, (2016), [page 4]

With proper KFS management and use of farm forest resource base, 99% of demand can be met sustainably by 2050

	Growing & sourcing	Processing & manufacturing	Distribution & marketing
Current	<p>.11M <i>m³ RWE sourced</i></p> <p>Wood sourced only from private plantations as KFS supply base will have been depleted</p>	<p>7% <i>Utilization rate of millers*</i></p> <p>Larger mills will have to close with smaller mills only intermediately milling</p>	<p>6% <i>Demand met with local production</i></p> <p>Minimal demand will be met, driving up prices and increasing illegal logging & imports</p>
Moderate	<p>1.4M <i>m³ RWE sourced</i></p> <p>Enhanced planting and sustainable extraction; 91% of supply from KFS</p>	<p>81% <i>Utilization rate of millers</i></p> <p>Mills will be able to increase their production, sustain operations of larger mills</p>	<p>69% <i>Demand met with local production</i></p> <p>Significant portion of demand would be met sustainably, stabilizing prices</p>
Optimistic	<p>1.9M <i>m³ RWE sourced</i></p> <p>Enhanced planting, sustainable extraction, & use of farm forests; 64% of supply from KFS</p>	<p>117% <i>Utilization rate of millers</i></p> <p>Mills that had previously been non-operational could re-open</p>	<p>99% <i>Demand met with local production</i></p> <p>Demand would be met, likely driving prices down</p>

Note: *Utilization rate of millers considered "operational" (e.g. could resume milling with no start-up costs needed)

Source: OCA consultations and analysis



Sawn timber will remain an important product in Kenya, but without intervention, the supply base won't sustain the value chain

Necessary conditions to realize optimistic scenario

KFS land is used optimally & planting well managed

Aggregation of farm forest supply is financially viable

Millers will invest in double banded saws to mill eucalyptus

Demand will continue to grow

Minimal switching to substitutes or imports

Likelihood



- Given entrenched interests of extra-large players & shifts needed in KFS mgmt., significant change unlikely, esp. in short- to medium-term



- Increases in efficiency or decreases in transport costs likely needed to make farm forests financially viable, no change on the horizon



- Many millers recently invested in Wood-Mizers, showing willingness & ability to invest in tech., but given underutilization, unlikely to upgrade soon



- Demand, particularly for construction applications, is not likely to reduce given national economic & urbanization projections



- Wood coming online in Uganda in the next 10 years could compete; given likely supply constraints leading to higher prices, substitution will increase

Given major barriers to changes to the supply base status quo, without intervention, sawn timber production will be unable to meet demand and increasing prices will drive the market to switch to substitutes



Additional research is necessary to fill key data limitations & outstanding questions to refine intervention targeting and prioritization

Validating demand figures

- Refine demand projections, particularly latent demand in the furniture industry
- Could use additional interviews with formal & jua kali (informal) manufacturers to gather this data
- Can use bills of quantity and consultations with NCA* to validate construction figures
- Based on size of latent demand, may influence Gatsby interventions as furniture has specific market preferences (e.g. pine, kiln-dried)

Viability of using farm forest supply base

- Model financial viability of aggregating farm forest supply using existing data (e.g. One Acre Fund partnership & Chris' model) as assumptions
- Market-test euc. & grevillea with formal industry consumers to test willingness to use & pay
- Important to understand if Gatsby investments in farm forests programs will be effective for easing sawn timber supply constraints

Opportunity for value addition

- Better understand willingness to pay for high quality sawn timber & the size of the market
- Can be done in tandem with the validation of demand figures with NCA & furniture mfr. consultations
- Model the financial returns for millers or yard owners to invest in kilns and possibly other value addition opportunities (e.g. grading)
- May be opp. for Gatsby to create market-linkage interventions around value addition

Understanding variance in margins

- Use additional research on the costs and margins of different size mills to better understand variance in margins
- Can continue building relationships with the extra-large mills and do a broad-based survey with smaller actors, maybe through TMA
- Will help identify returns on different interventions to improve processing efficiency

