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Wood Supply Chain in Rwanda

A Market Analysis

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A Market Analysis

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Registered offices:
Bonn and Eschborn, Germany

Promotion of Economy and Employment (Eco-Emploi) Programme
P.O.Box 59, Kigali, Rwanda
T: +250 788 187 800
F: +250 252 572 439
E: giz-ruanda@giz.de
www.ecoemploi.org
www.giz.de/rwanda

Authors:
Raphael Tsanga
Quentin Ducenne
Claudien Habimana
Robert Brasseur
Paolo Omar Cerutti

Photos:
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Design:
Jannu Chudal/Asha Ltd.

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Abbreviations

ATF Corp.	African Timber and Furniture Corp. (Fictitious name)	NFMP	National Forest Management Plan
BAU	Business As Usual Scenario	NPV	Net Present Value
CAI	Current Annual Increment	NWP Llc	National Wooden Products Llc (Fictitious name)
CBA	Cost-Benefit Analysis	PMH	Productive Machine Hour
CIFOR	Center for International Forestry Research	PPP	Purchasing Power Parity (current USD)
CO ₂	Carbon Dioxide	Pte	Private
Corp.	Corporation	R&SD	Resources and Synergies Development
DBH	Diameter Breast Height	REMA	Rwanda Environment Management Authority
DFMP	District Forest Management Plan	RNRA	Rwanda Natural Resources Authority
DFO	District Forest Officer	RoE	Return on Equity
DFS	Deutsche Forstservice GmbH	RoI	Return on Investment
DR	Discount Rate	RWF	Rwandese Franc
EDPRS	Economic Development and Poverty Reduction Strategy	RWFA	Rwanda Water and Forest Authority
EUR	Euro	SFM	Sustainable Forest Management
FMU	Forest Management Unit	SME	Small and/or Medium Scale Enterprise
G/ha	Basal area per hectare	SMH	Scheduled Machine Hour
GIZ	Gesellschaft für Internationale Zusammenarbeit	STP Llc	Smart Timber Processing Llc (Fictitious name)
GNI	Gross National Income	TIF	Trees Inside Forests
TOR	Terms of Reference	TMIS	Timber Marketing Infrastructure & System
GoR	Government of Rwanda	TOF	Trees Outside Forests
ha	hectare (10,000 sqm or m ²)	TOFo	Trees Outside Forests (other land cover classes; agroforestry)
HH	Household	TOFs	Trees Outside Forests (shrubland and savannah)
IRR	Internal Rate of Return	USD	United States Dollar
Llc	Limited Liability Company	Ve/ha	Volume of energy wood per hectare
Ltd	Limited	Vs/ha	Volume of service wood per hectare
m ³	cubic meter	Vt/ha	Total volume per hectare
MAI	Mean Annual Increment	Vti/ha	Volume of timber wood per hectare
MINAGRI	Ministry of Agriculture and Animal Resources	WACC	Weighted Average Cost of Capital
MINERENA	Ministère des Ressources Naturelles	WIP	Work in Progress
MININFRA	Ministry of Infrastructure	WTB	Willingness to Buy
N/ha	Number of trees per hectare	WTS	Willingness to Sell
NFI	National Forest Inventory	WVC	Wood Value Chain
		y.	year or financial year

Executive Summary



The wood industry is a relatively large pool of jobs. Overall, more than 75,000 people, mostly in rural areas, derive their income from timber business.

Since 2001, the government of Rwanda has started several reforms to improve the forestry sector in the country, as the importance of the timber business and its contribution to national economy were neglected. This report, supported by the Promotion of Economy and Employment Programme (Eco-Emploi), a Rwandan-German Development Cooperation Programme with Technical Assistance by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), presents a qualitative and quantitative analysis of timber value chain in the country and provides some financial and economic modelling as to the future choices available to policy and decision makers, as well as technical partners such as GIZ.

The national production of sawnwood – with all the caveats and hypotheses presented in the methodology – is estimated to be about 275-300,000m³/yr. Not all this timber is produced in Rwanda, as results indicate that timber is also imported from both Uganda (9%) and DRC (13%). About 95% of the supply of sawnwood consists of four species, namely Eucalyptus, Pinus, Grevillea and Cypress. Imports from neighboring countries are more concerned with hardwood such as Libuyu and Muvula. The majority of sawnwood is produced by pit-sawyers. Yields are generally low and the quality of products available downstream is bad.

The wood industry is a relatively large pool of jobs. Upstream of the sector, the estimated number of producers is about 1,100 individuals and traders 1,000 people. In total, the production segment includes around 6,600 permanent jobs and 10,000 temporary jobs. Downstream, sawnwood business generates 1,700 direct jobs and 2,700 temporary jobs. Overall, more than 75,000 people, mostly in rural areas, derive their income from timber business.

Given average cost in USD/m³ for timber (most traded species, planks and beams) both originating in Rwanda (USD128/m³) and DRC/Uganda (USD791/m³), the total value of traded timber could be around USD76 million/yr. Profit margins for Eucalyptus are around 20%, while they are generally higher for other species.

The wood Value Chain in Rwanda is but a part of a whole forestry sub-sector. However, it is a key facet of the rural economy since circa 10% of the land (255,672 ha is covered by (un)productive forests, 66 % of them being privately owned and, alas, in poor condition (standing stock = 50 m³/ha). Only 44% of this resource is suitable to timber processing. However, the majority of the growing population of Rwanda live in rural areas where fuel-wood and charcoal are - and will remain for long - the major source of renewable energy. The gap between woody biomass supply and demand is huge (Figure 1) and it is widening as time goes by.

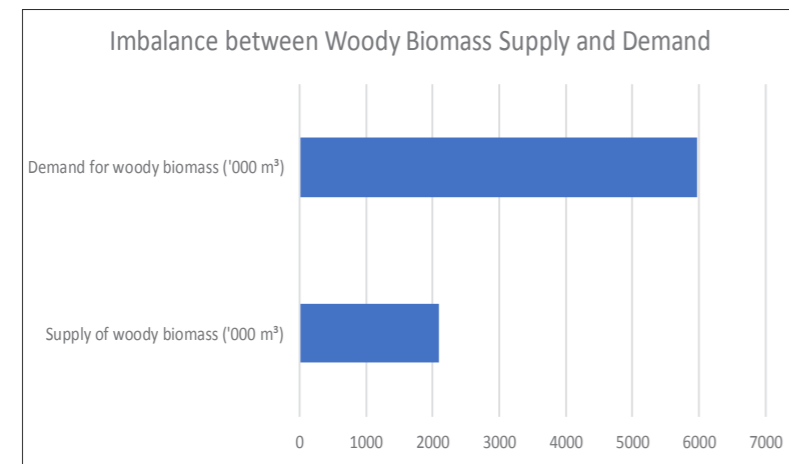
Land is a scarce resource in Rwanda, with a human population of circa. 500 inhabitants / km². At present, value added by the timber industry accounts for 0,02% of the economy, i.e. there is room for further improvement.

Restoring the forest productivity could take between ten and twenty years if dedicated efforts are made and substantial financing is available. Three broad and not mutually exclusive scenarios are developed and contrasted to the Business as Usual Scenario.

1. Scenario-1 represents the development of the timber industry through minimal investment, focusing on SMEs¹ requiring each less than USD one million investment. The average firm is represented by Smart Timber Processing (STP Llc.). It relies on domestic timber only, and has a national

1. Small and Medium Scale Enterprises

Figure 1. Woody biomass supply and demand



- scope with a very narrow wooden product offering: kiln dried planks and beams.
- Scenario 2 represents the development of the timber industry through medium investment (circa. USD 6 million per company). The average firm is represented by National Wooden Products (NWP Llc.). Like STP Llc. It relies on domestic timber only.
 - Scenario 3 represents the development of the timber industry through large investment (circa. USD 20 million per corporation). The average firm is represented by African Timber & Furniture Corp. (AT&F Corp.). Unlike STP Llc. And NWP Llc, it pursues international development in

the region and relies on red wood import from DRC.

Under our assumptions all companies are financially profitable (Table 1). From the economic standpoint, only the small business model, i.e. STP Llc is not profitable with a benefit-to-cost ratio equal to one (Table 2).

Assuming Rwanda maintains and even improve its good business climate; promote foreign investment; and continue to improve access to capital with borrowing rate under 10%, investing in the timber industry will be fairly attractive.

Table 1. Financial indicators

	STP Llc	NWP Llc	AT&F Corp.
Description (figures in '000 USD unless*)			
Total number of employees	27	175	524
Number of employees in Rwanda	27	175	365
Initial investment required	813	6,152	20,333
Target annual turnover	855	5,850	56,722
Loans from outside suppliers	500	2,000	10,000
Annual vol. of eq. domestic round wood	7,054	32,747	13,425
Annual import of wood (m³ sawn wood)	n.a.	n.a.	46,025
Average cost of timber	USD 10	USD 10	USD 600
Financial performance			
Net Present Value (DR = 11%) in '000 USD)	42	2,222	15,094
Internal Rate of Return	14%	25%	31%
Payback period (in year, rounded up)	6 years	5 years	5 years
RoE (Return on Equity) if leverage 0,66; WACC : 9,2 %	-	-	11,9 %

Table 2. Economic indicators of business models

	STP Llc	NWP Llc	AT&F Corp.
NPV in '000 USD	52	3,005	21,598
IRR	12%	22%	29%
Pay-back period (in year, rounded up)	6 years	6 years	5 years
Benefit to cost ratio	1	1,1	1,1

From our financial and economic analyses, it makes sense to invest in the development of the timber industry in Rwanda. Capacity building, massive investment in adequate infrastructures, tools and machinery, capacity building in both technical and managerial disciplines, including timber marketing, all of them are necessary and attractive to seasoned investors.

However, the supply of quality domestic timber is not secured yet. Therefore, the development of the timber industry should include international scope, i.e. importing rough timber from DRC and exporting finished products in neighbouring countries such as Burundi, Uganda, Tanzania, Kenya.

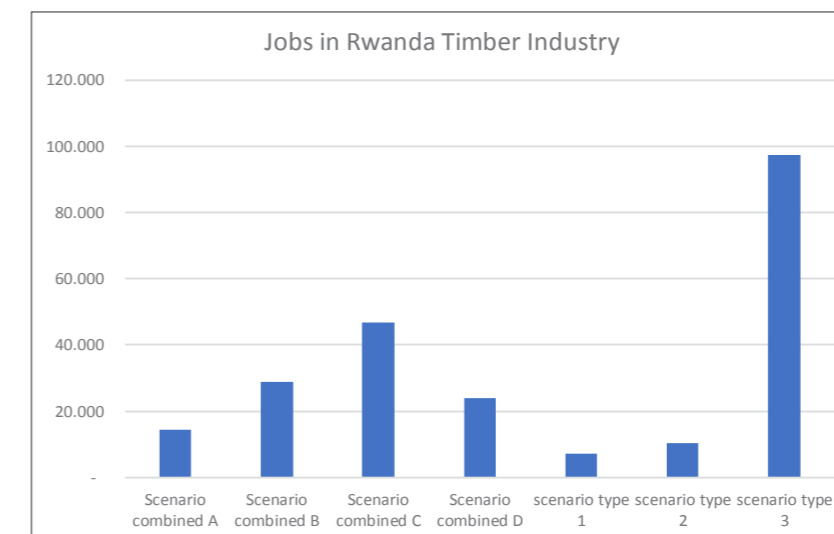
A timber industry driven by a capital-intensive strategy can create jobs as well (Figure 2). The corner stone lies in the value added in timber processing and subsequent marketing effectiveness. Should decision-makers and policy makers join force to develop this industry in Rwanda,

they should make sure investments amount to a critical mass, and businesses achieve adequate scale. Put simply, investing in kiln driers exclusively would be a waste of money. Likewise, investing in modern saws and further timber processing without securing the supply of quality timber – domestic and from DRC – would be a failure too. Prioritization is of course needed and investments in those segments of the value chain are indeed necessary, but the value chain should be seen as a continuum, whereby investments can be targeted but they must be part of a whole.

Over the next ten to fifteen years, the timber industry could double or triple direct and indirect jobs in Rwanda, and exceed USD 200 millions in worth.

Engaging with top decision-makers and their advisers, with real buyers, real donors and real investors, will tell if Rwanda is going to give birth to the “African Ikea”.

Figure 2. Jobs resulting from non-mutually exclusive scenarios



Introduction



There is high economic potential as well as a good potential for generating employment in production, processing and marketing of timber-derived products.

The work leading to this report has been financially supported by GIZ/Eco-Emploi Programme and conducted over 6 months between 2018 and 2019. It details the timber value chain in Rwanda. The value chain has been assessed through a methodology (described in the details in the next section) which has focused on getting a general picture of the people involved and the dynamics occurring along the value chain, from upstream operations in the forests of Rwanda to downstream activities occurring in the main cities of the country. After a description of the methods used, results will be discussed. A first series of results will detail some fundamental values (e.g. species and product traded, their costs, profit margins, and estimate of the national trade plus imports). A second part of the results will use those findings in addition to various secondary data (mainly taken from the national inventory (DFS et al., 2016), and present some financial and economic analyses performed with the aim to provide GIZ and policy makers with potential avenues for intervention in the forest sector in Rwanda. Next, conclusions and recommendations are presented. Despite the limited sample used and timespan covered in our investigations, we believe our conclusions and recommendations are solid enough to strengthen the decision-making process into which the Government of Rwanda and their partners have engaged. Indeed, the value of this economic and financial exercise lies in addressing the right issues and exploring broad trends and major scenarios.

The Rwandan economy has developed rapidly in recent years as a result of reforms that encourage investors to settle in the country. This influx of foreign investment is also expected to occur in the forestry sector, with increasing demand of timber and processed products notably for construction and carpentry. There is thus high economic potential as well as a good potential for generating employment in production, processing and marketing of timber-derived products.

Many efforts to improve the functioning of the forestry sector have been undertaken for almost two decades. These include revision of the Forest Code of 1988, and especially the adoption of new forest policies that emphasize sustainable management, encourage the private sector to invest in timber production while ensuring the sustainability of the forest and improvement of the living conditions of local populations.

Over the years, however, various reforms have not yet realized their potential and they have not yet resulted in the development of a performing, sustainable, and well-organized wood industry in the country. Wood-based resources play an important role for the population and they remain the main source of energy and timber across the entire nation. Yet timber and woodfuel are today mixed value chains, they often compete for the same resources, and overall both value chains are still embryonic.

Since 2000, a ban on the exploitation of public forests has increased the pressure on private woodlots, which in recent years have become the main supplier of timber for the local market. The vast majority of current demand is supplied by pit-sawyers and chainsaw millers whose current operating mode does not make possible the emergence of a competitive timber market in terms of quality and volume of sawnwood produced.

One of the priorities of the 2018 forestry policy was to increase the contribution of the forestry sector to the national economy by increasing the added value from production to manufacture of high-quality finished products. In general, national production and therefore the overall contribution of the forestry sector to the national economy is poorly known. The development of a sustainable and high value-added sector therefore requires the identification of the actors and the constraints they face in their activity. This will enable policy makers to put in place supportive policies that unlock the potential of the timber value chain in terms of job creation and contribution to the national economy.

Methodology



Overall, 414 operators along the value chain have been interviewed in 30 Districts. The upstream value chain was analyzed through meetings with operators and members of local communities.



Figure 3. Sampled Sectors

Production, processing and sale of sawnwood (i.e. trees that have been cut into logs and then processed – generally on-site – to produce sawn products such as planks) are the different aspects of the value chain that have been studied in both urban and rural areas. The approaches used for data collection are described below. Overall, 414 operators along the value chain have been interviewed in 30 Districts.

A note of caution is worth mentioning before describing the methods and the results. Given time and budget constraints, a choice was made to obtain a deeper knowledge of the dynamics of the value chain, more than the quantities produced and traded. In practice, this means that instead of sampling timber markets or main operations in the forests or trade routes for a given period (e.g. 12 months to account for seasonality of operations), respondents were asked to recall their past operations. Results will nonetheless present estimates for production and trade, but it must be made clear that estimates have been extrapolated from recall data, which present their own set of limitations.

Production and sales

The upstream value chain was analyzed through meetings with operators and members of local communities. The identification of the main sites where timber is produced or traded was done in two stages. The first step consisted of meetings with the District Forest Officers (DFO) in each of the 30 Districts of Rwanda. DFOs were asked to identify the Sectors in their District where forest-related operations were common. Out of a total number of 416 Sectors across Rwanda, DFOs identified about 155 Sectors where forestry operations

are common (either production or trade). The word ‘common’ in this case means that operations are sustained and regular during the production season (about 3-4 months per year, see results) but also maintained at a lower level during the rest of the year, with possible halted operations in the worst months of the rainy season.

Among the 155 Sectors identified, 96 were selected for field visits to operators and the local population (Figure 3).

It is important to note that the remaining 261 Sectors (416-155) may still provide forest resources and host both production and trade of timber, but they were not deemed by DFOs to be among those with a regular and sustained production. This is relevant because, as explained above and reiterated again below, in order to extrapolate to the national level, one needs to make hypotheses about non-visited Sectors. As a general rule, in order to avoid over-estimating national production and consumption, for this assessment production in the remaining sectors has been estimated using the District’s lowest production of the lowest month.

Focus group discussions (FGD) then took place with the three groups of actors within the communities: elders, women and young people. Group discussions focused on the benefits that community members derive from logging and the use of these benefits.

After interviewing the DFOs, the team reached the selected Sectors, located operators through snow-balling interviews, asked their willingness to participate in the interview, and eventually interviewed them. Interviews were done through a semi-structured questionnaire (Annex I). Questions asked touched upon the demographics of the respondent; the reasons for their involvement in the sector; the details of the way they conduct their operations (e.g. funding sources, investment of profits, assets owned, etc.); the number of people involved in the activity in the area, or competitors; and specific questions about the volumes, products, and prices in four different periods. The four different periods were: First and second, the two months before the interview took place (e.g. if the interview took place in December, they reported on October and November); Third, the best month of the year in terms of number of operations and volumes traded; Fourth, the worse month of the year.

Data analysis

Data were coded, translated from Kinyarwanda to English, notably in the case of FGDs, and entered into MS Excel© for treatment. Extrapolation of figures to national level requires hypotheses to be made about several variables. The hypotheses explained here have been proposed and discussed with several members of the GIZ and RWFA teams in Kigali, and later adjusted to better fit conditions on the ground.

Given that four points (in time) were collected (i.e. operations and data for four months across the year), hypotheses are mostly needed to extrapolate those four months to the annual production and trade over twelve months. The key parameters supporting this extrapolation are the seasonality of production and trade, for which a specific question was asked to respondents (see results), and the number of people engaged in the timber business.

Production and trade in Rwanda seem largely concentrated during three/four months. Conversely, during about three months production seems at its lowest. In the remaining six months of the year, production is reported to be 'average', depending on several conditions

(largely climatic conditions such as rain which slows down operations in the forest). Information gathered in FGDs suggest that hypotheses could be slightly different for trade, because once timber products have been brought out of the forest, the most active trading period could extend a bit longer than the most active production months. Given the nature of these extrapolations, we decided to maintain the same hypotheses for both production and trade.

As to the number of people engaged, a question was asked to DFOs and also the all respondents about the number of 'competitors' or people conducting their same job in the area of interest, generally intended as the same Sector. A corollary question to allow extrapolations to be more precise was asked about the origin and the destination of the traded products, i.e. within Sector, District or across the entire country. In each sampled Sector, the average number of operators reported by all respondents in the that Sector was used. For non-sampled Sectors, the minimum number of operators found in any of the sampled Sectors was used.

The practical implications of this series of hypothesis will be discussed further, when results will be presented.

Business strategy

Engaging into business strategy often starts from market opportunities. There are several ways for businesses to compete against each other. Some businesses choose to compete through prices, i.e. the lower the price the more customers they – hope to – get. Some compete through quality, i.e. provide some above average products which sell at premium prices, some attempt to differentiate and conquer niche markets, some enjoy a strong brand or try to develop one, etc.

The five forces model developed by Porter (1979) simplifies and clarifies how competition and market forces work inside a given industry², in our case the timber industry, and its context.

Business options in the timber industry will be assessed from two different angles. They will be assessed from a broad and collective

angle, mainly useful to policy-planners and decision-makers, i.e. economic analysis. Three broad scenarios will be considered.

Business options will be assessed from an individual investor's angle, i.e. financial analysis. Three cases will be addressed, i.e. a small-scale business such as a SME fitting the scenario 1 context and two large-scale operations fitting scenarios 2 and 3 respectively. The fictional business models we will develop can be regarded as the average representative operations for each scenario envisaged.

The business as usual (BAU) scenario is explored and described using the findings from the surveys and secondary data available to our teams. We refer to it as BAU scenario hereafter. In addition, three broad scenarios are envisaged as follows:

1. Timber industry resulting from moderate investment and capacity building in current operations nationwide. The industry would mainly rely on domestic source of timber, i.e. TIF. We refer to it as scenario 1 hereafter. This scenario is not capital intensive.
2. Timber industry resulting from substantial investment and capacity building in current operations nationwide. The industry would mainly rely on domestic source of timber, i.e. TIF. This scenario does not pursue any strong timber product export policy. We refer to it as scenario 2 hereafter.

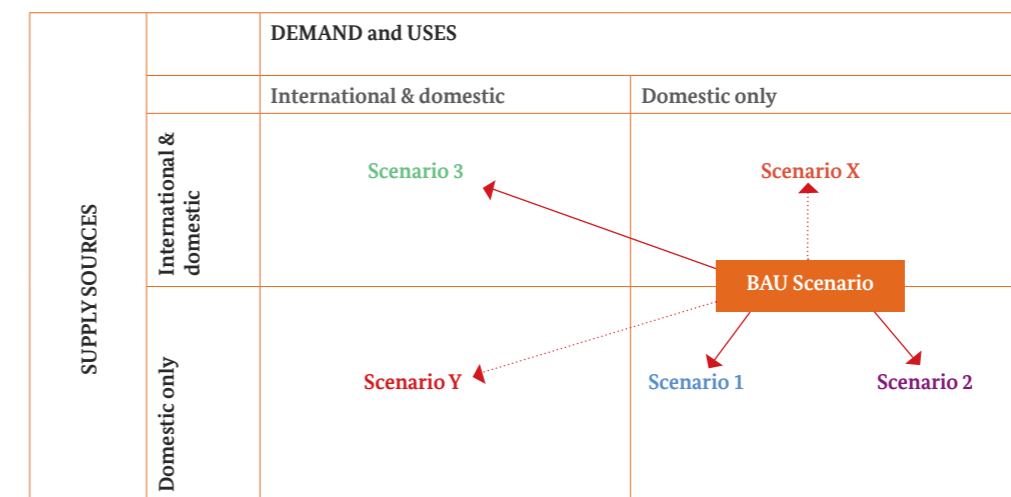
3. Timber industry resulting from substantial investment and capacity building in current operations nationwide. The industry would rely on domestic source of timber, i.e. TIF and imports from DRC, the latter being more important. This scenario pursues an obvious timber product export policy. We refer to it as scenario 3 hereafter.

These scenarios are not mutually exclusive, i.e. they can coexist in Rwanda. The BAU scenario is actually a combination of scenarios 1 and 2 and to a certain extent scenario 3 since circa 50,000 m³ of red wood is imported from DRC annually. This scenario calls for further improvement. Forests covers over 20% of the national territory, i.e. that a large portion of the scarcest resource of Rwanda, i.e. land, should contribute more to the whole economy.

Scenarios 1, 2 and 3 can be further explored. Scenarios X and Y cannot be developed further for the following reasons.

Scenario X translates into a timber industry aiming at meeting the domestic demand while relying on both domestic and DRC timber resources. This is a challenging scenario because the domestic purchasing power is not high enough to enable DRC natural forest timber to enter a mass market in Rwanda³. Products built with timber from DRC are traded in niche markets. It is unlikely that Rwanda will import

Figure 4. Pathways of the Timber Industry in Rwanda



2. The definition of the border of an industry is not as obvious as it may seem.

3. Une grande partie de la population est incapable d'acheter des menuiseries en Libuyu et doivent accepter des qualités médiocres (Brasseur, 2019).

large quantities of eucalyptus trees from DRC. Due to transport cost and perhaps levies, eucalyptus from DRC would not be competitive as compared to Eucalyptus in Rwanda. Both North and South Kivu provinces are densely populated too, i.e. the demand for farm land and energy wood are very high and growing. Scenario Y translates into a timber industry aiming at meeting both the domestic and international demand while solely relying on domestic timber resources. This scenario is unrealistic since BAU scenario suggests that the Rwanda timber industry has to rely on overseas resources to meet the domestic demand alone. The gap between sustainable supply of woody biomass and demand for woody biomass is simply too big, even if forest productivity is significantly increased over the next ten or twenty year. It is very unlikely that Rwanda becomes a net woody biomass exporter.

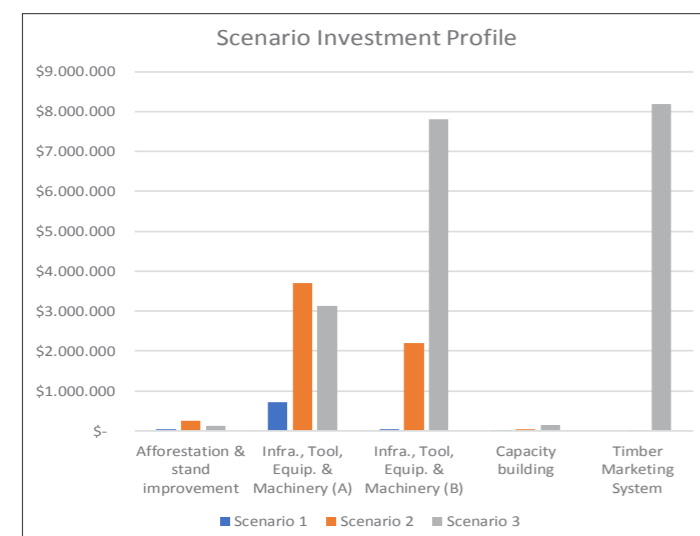
Scenarios 1 and 2 can be both envisaged. They both rely on secured domestic supply of timber. Two avenues may be considered. Scenario 1 will require some substantial investment in developing the domestic supply, i.e. large-scale tree planting. On the one hand, the gap between demand and supply has to be reduced. On the other hand, the competition between energy wood and timber is so high, it has to be alleviated. Scenario 1 will not incur substantial investment in the industry modernization. In this respect, only some incremental change is expected through limited capacity building and enhanced tools.

Conversely, scenario 2 aims not only to significantly increase the supply of woody biomass but also to enter into radical change in terms of downstream processing. The level of investment in the supply of timber would be of the same magnitude in both scenarios 1 and 2. However, much larger investment is needed in terms of new technology and modern tools.

Scenario 3 follows a different path. It does not focus so much on increasing the supply. Indeed, domestic production of timber has to be raised, but not to that level has commanded by scenarios 1 and 2. Conversely, it will strongly rely on hard wood imports from DRC. Developing the Rwandese timber industry on imported hard wood from DRC may be seen as a risky business. International trade is not always as smooth as it should and forest governance in DRC has still a long way to go. Risky businesses require higher ROI. If such a scenario is envisaged, then it has to supply the regional market, i.e. Burundi, Tanzania, Uganda, Kenya, etc. because the industry cannot survive on the domestic market alone. The combination of domestic and overseas niche markets for products made from imported hard wood and sold at premium prices is the foundation for sustainable international ventures.

Each scenario has a specific investment profile as illustrated in Figure 5. Each scenario requires adequate investment of different magnitude (Figure 6).

Figure 5. Scenario Investment Profile



Note: the magnitude of investment is in USD million. However, the scale given in the graph above is for illustrative purpose only.

The BAU scenario requires no new investment. In this scenario, it is assumed that operators use fully amortized and depreciated assets, facing maintenance and replacement costs only. No investment is made neither in afforestation nor in capacity building.

Conversely, scenarios 1, 2 and 3 require investment as follows:

- Afforestation & stand improvement. Needless to develop the case here since findings from the NFI can be referred to. There is a big gap between woody biomass demand and supply, including timber. Any timber industry development policy will have to look at the issue of sustainable supply. Developing sustainable supply involves afforestation and rejuvenation of unproductive forest stands. Scenarios 1 and 2 put a strong emphasis on the improvement of domestic supply.
- Infrastructures⁴, Tools⁵, Equipment⁶ and Machinery⁷ (A) abbreviated ITEM (A). It may include all tangible fixed and other operating assets needed in operations such as managing, tree felling, pruning, debarking, pit sawing, skidding, cabling, transporting, storing, sawing, drying, etc. ITEM (A) are those assets used along the value chain from logging to the first stage of downstream processing, i.e. timber and lumber, e.g. planks and beams.
- Infrastructures⁸, Tools⁹, Equipment¹⁰ and Machinery¹¹ (B) abbreviated ITEM (B). It may include all tangible fixed and other operating assets needed in operations such as managing, storing, sawing, dressing, mouldering, gluing, polishing, carving, painting, assembling, etc. ITEM (B) are those assets used along the value chain from the first stage of downstream processing to selling finished goods such as

furniture, doors, window frames to businesses, retailers or the end-users.

- Capacity building. Brasseur (2019) acknowledges the local know-how in Rwanda timber industry. Brave workers manage to transform trees into rough timber with virtually no technology. In the BAU scenario, this is referred to as a “no tech-low cost” strategy. However, the expert also points out the blatant lack of technical knowledge and skills resulting in low quality products. There is some room for further improvement in terms of technical knowledge and skills. Scenarios requiring some substantial investment in new tools, machinery and equipment also require substantial investment in capacity building. There is room for improvement in labour force productivity too.
- Timber Marketing Infrastructure and System, abbreviated TMIS. There are virtually no marketing efforts in the BAU scenario¹². On the one hand, there are very standard products and virtually no new products. On the other hand, customers have a good idea about eucalyptus products while information asymmetry occurs in pine and other species products. Scenario 1 involves no marketing system¹³ since the investment effort is spread on the first segment of the value chain, i.e. B2B markets where operators know each other and where a very narrow offer prevails. Scenario 2 would need some marketing efforts because there will be some improvement in the quality of wooden products. Interestingly enough, in the case of scenario 3, the investment in setting up and operating a TMIS is as high as the investment in afforestation in Rwanda. This is obviously related to the strong international trading dimension of scenario 3.

4. Offices, other administrative buildings, dryer foundations and buildings, shelters, warehouses, etc.

5. Saws, files, chainsaws, axes, pick-axes, shovels, bush-knives, etc.

6. Safety gear, blade sharpener, ribbon tensioning, automation units, etc.

7. Drying units, debarker, and fans, rig saw (main saw), circular saw, bandsaws, grinding machines, etc.

8. Workshops, shops, showrooms, etc.

9. Chisels, hammers, electric tools such drilling machines, chippers, etc.

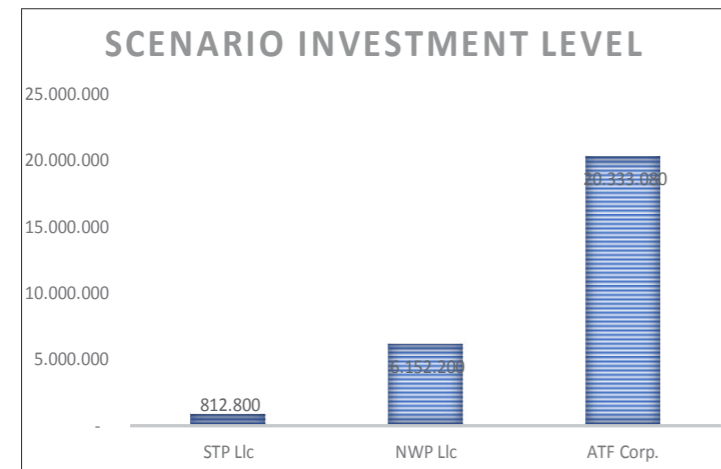
10. Safety gear, grinder, elect

11. Moulders, polishers, etc.

12. Cost structure of both producers and traders reveals that marketing cost is < 1% of the total cost.

13. A timber marketing information system includes market intelligence, markets surveys, value proposition, branding, sale strategies, customer relationship management system, etc.

Figure 6. Scenario Investment Level (STP Llc, NWP Llc and ATF Corp. are fictitious names, see below)



Note: the magnitude of investment across scenarios differs significantly as illustrated above.

Developing the timber industry in Rwanda from a regional perspective involving formal imports and exports would need circa. half a billion USD over the next ten years. Improving the BAU scenario nationwide with a strong focus on securing domestic timber supply would need circa. one hundred million USD. Scenario 2 stands on the middle ground. The relative investment effort is more important than the estimates at this stage.

Most figures about technical data, sale prices and costs are derived from our own investigations. In this respect they can be seen as up-to-date and realistic figures. However, they cannot be taken as the most accurate figures. Firstly, they come from sampling units, i.e. a sampling error occurs. Secondly, technical data may vary with technology and financial figures which may vary over time. Reliable information is what we need. Accurate data is a rather elusive objective which can mislead decision-makers. The validity of assumptions is much more important than the accuracy of data.

So, the focus should be put on assumptions and line of reasoning, not accuracy. It means readers must exert judgement when comparing, for instance, financial indicators such as an internal rate of return (IRR). In the scope of this assessment, an IRR of 7.6 % and an IRR

of 7.9% cannot be seen as significantly different. Conversely, a relative difference of 20-30% between indicators suggests room for some strong preference. In the example given above, 7.6 % versus 9 % suggests a real difference.

We perform economic analyses pertaining to scenarios. We perform financial analyses pertaining to business cases (or business options) as described in unit 3.2 hereafter.

Business analysis

We need to suggest business role-models, that is, business cases before performing financial analyses (see unit 3.3 below). Fictional commercial names are used here¹⁴.

1. Smart Timber Processing Llc, abbreviated STP Llc. This new venture, an SME, falls into scenario 1. It aims at conducting operations such as afforestation, logging, and downstream processing stage (A). They sell dried timber to other businesses (B2B markets). Their size is modest, i.e. annual turnover < USD 300,000.
2. National Wooden Products Llc, abbreviated NWP Llc. This new corporate company falls into scenario 2. It aims at conducting operations such as afforestation, logging, and downstream processing stages (A) and

(B). They sell dry and dressed timber to other businesses (B2B markets) as well as finished products to customers in Rwanda (B2C markets). They rely on domestic timber supply only. They do not export. NWP Llc is medium-size company, i.e. annual turnover < USD 3 million.

African Timber and Furniture Corp., abbreviated AT&F Corp.. This new corporate falls into scenario 3. It aims at conducting operations such as logging, and downstream processing, from dressed and dried lumber to flooring, window frames, doors, coffins, up to the premium wooden furniture, doors and stairs. They sell dried timber to other businesses (B2B markets) as well as finished products to customers in Rwanda (B2C). They rely on both domestic and DRC timber sources. They export finished goods to Burundi, Tanzania, Uganda, DRC and Kenya. AT&F Corp is a large company, i.e. annual turnover > USD 20 million with a strong focus on international trade¹⁵.

Financial analysis

From a financial angle, our analysis provides useful initial guidance to private investors. What is the most profitable option? Is the return worth given the risk? How many years before it starts generating profits? Chainsaws versus handsaws? Oven drying versus air dry-

ing or no drying? etc.

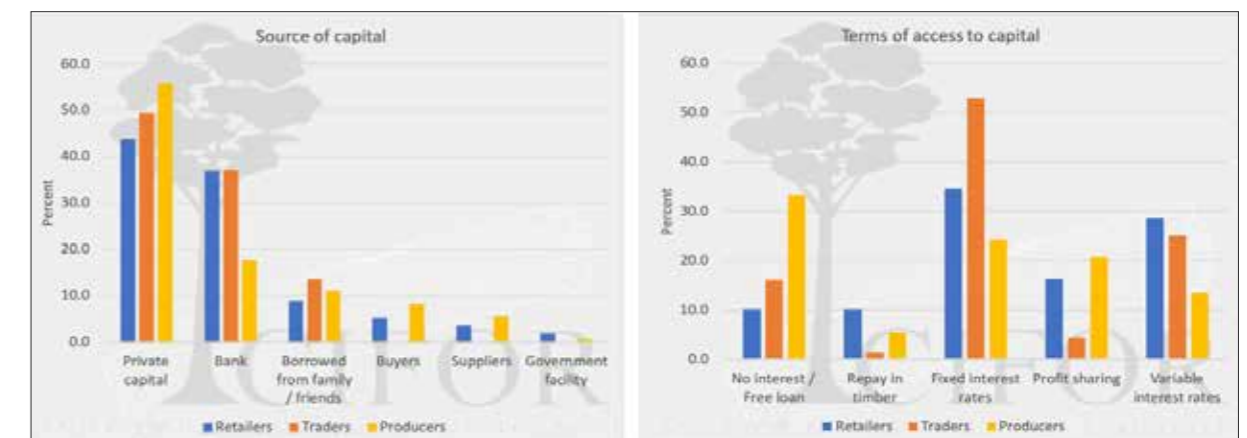
Our financial analysis includes:

- Presenting three illustrative business cases using realistic figures.
- Computing indicators such as net present value (NPV), internal rate of return (IRR) and payback period of role-model businesses matching scenario investment profiles (see unit 3.4 below).
- Break-even analysis, in terms of business size, cost of woody biomass and selling price.
- Sensitivity analysis, in terms of discount rate, interest rate, main business strategy.

From a purely financial angle, investment decisions do not take job creation into account. Since financial analysis is meant to help profit-driven decision-makers, the bottom line is – almost – fully encapsulated into the ROI. Put simply, it means an investor is likely to pursue a business opportunity returning an ROI of 18% through heavy mechanization and very few new jobs over a business opportunity returning an ROI of 15 % through minimum mechanization and many new jobs. In the scope of our analyses, investors are ethical people but they are neither social entrepreneurs nor altruists¹⁶.

From a mathematical angle, *time value for money*¹⁷ is translated into a *discount rate*. Choosing a value for the discount rate can result in never-ending argument since it deals

Figure 7. Source of, and terms of access to capital



15. According to the World Bank Group (2019) : « Trading across Borders: Rwanda made trading across borders easier by expediting the acceptance of customs declarations and liberalizing the warehouse services market ».
 16. Policy-makers may use various incentives to promote jobs, but financial decision-making remain about making money and mitigating risks.
 17. Value for money refers to quality. Time value for money is an economic concept involving inflation and risk. See the concept introduced in Annex III.

14. Should such fictional names exist in the real world, it would be pure coincidence.

with uncertainties and future events. Therefore, we choose a value inside the commonly agreed range of values in emerging markets, i.e. between 8% and 15% (Gittinger, 1972). Our calculations will use a 11% discount rate.

We assume inflation will impact salaries, other costs and revenue evenly. Loans from commercial banks and formal credit institutions are available at 12% in Rwanda while loans from private lenders such as family and friends are available at 15%. Loans from overseas banks and other capital providers are available at 8%.

In the case of large business opportunities, i.e. ventures pertaining to scenarios 2 and 3 and requiring substantial investment, the weighted average cost of capital (WACC) will be computed using an expected return on equity (RoE) of 10 %. The maximum leverage or gearing is set to 0,5¹⁸.

Compound interest applies on loans, where applicable grace period granted by lenders cannot exceed two years. However, lenders and borrowers agreed interest can be repaid on an annual basis and principal at the end of the lending period of time, i.e. interests will not accrue¹⁹. From the preliminary findings from CIFOR (2019), producers and traders/retailers mainly access capital to purchase more timber and / or increase business. Behind this explanation, it is worth to remind that forest owners wish to be paid quickly and by no means – except for some exceptions – can they wait for the producers to be paid before cashing their due. The producers and traders/retailers need substantial cash reserve unless they operate at a small-scale level, and that is happening in Rwanda.

Indeed, there are 2.284 enterprises of which 21 account for 51% of the total capital invested in the wood sector (ICON, 2017) (see figure 13 above). These 21 enterprises surely achieve some economy of scale, i.e. they process more than 51% of the total volume of timber, perhaps 70 % or 80 % of circa. 250,000 m³ of do-

mestic sawn timber. The estimated 40% processing yield²⁰ given the techniques and tools currently used in Rwanda, the volume of round wood and logs to be purchased could amount to 625,000 m³. If the stumpage fee is 10 USD / m³; the standing stock is valued at USD 6,250,000. The smaller players, i.e. 2.263 SME buy circa. 156,250 m³, a global expenditure of USD 1,560,500, or an individual average expenditure of circa. USD 690. This expenditure related to the standing stock in the forest. The forest owner may organize the felling and bucking operations himself / herself and sell sawn timber, adding value in the process.

All in all, at an average price of RWF 115,000 / m³ of domestic timber, assuming the average SME purchase circa. 69 m³ per annum, it needs circa. RWF 8.000.000 or USD 8,800²¹. It may seem a rather modest cash reserve, but in relative terms, it is a lot²². Hence, small-scale stakeholders rank access to capital as the number two problem, just behind the poor forest standing stock (CIFOR, 2019).

Regarding depreciation and amortization, the following rules will apply. Land is not depreciated. We choose linear depreciation schemes over accelerated depreciation schemes. While depreciation and amortization values are embedded in analyses, they do not show. Linear depreciation explains why, all in all, we choose an average salvage value of 15% after ten years of operations.

Regarding taxes, the major tax is corporate income tax, circa 30%; social security is added to it although social security payment per se is not a tax by a deferred labour payment instead. VAT is not considered since it is not an income more an outcome for the company. It is a cost to the end-user and a revenue to the Government.

Economic analysis

In terms of the timber industry as a whole, given the socio-economic context of the country, and taking the national policies into account, what does make sense? There is no obvious and easy answer to this policy question. Economic analysis may provide a solid line of reasoning to policy-planners and policy-makers, hence improve the decision-making process. However, it does not substitute for judgment. Decision-makers such as investors can refer to section 3.3 above for initial guidance. However, in-depth feasibility studies including due diligence are necessary when investments exceed USD 5 or 10 million. Not to mention an in-depth economic analysis of the timber industry in Rwanda would easily require substantial investigations. We can only introduce the main issues at stake here.

Our economic analysis includes:

- A description of three scenarios against the BAU scenarios.
- An assessment of value creation and capture along the value chains.
- Computing benefit to cost ratios in every scenario²³.

With- and without-project analyses as often performed to gauge the economic benefits of change, here the modernization of the timber industry in Rwanda.

18. It means that debt cannot be higher than equity.

19. Accrual compounded interests are financially devastating above 5% per annum and for long term borrowing, i.e. > 5 years. For example, RWF 1.000.000 borrowed at 12% over 8 years carries cumulative interests as high as circa. RWF 1.476.000, i.e. 1,5 times the principal borrowed. Unless the business is extremely profitable, this kind of financing option is simply a venture killer.

20. This has not been assessed accurately. It could be slightly higher (Up to 50%) when modern techniques and technologies are used, and it could be considerably lower (as low as 15-20%) when inadequate techniques / technology is used.

21. It means 8,7 times the income per capita, GNI PPP / pop. 2018.

22. In Germany, 8,7 times the the income per capita 2017, amounts to circa. USD 389,000.

23. One often refers to cost-benefit analysis (CBA).

Findings



The recorded sales show that 95% of the supply of sawnwood consists of four species, namely Eucalyptus, Pinus, Grevillea and Cypress.

Operators along the timber value chain

The timber supply chain refers to a set of activities including production and processing of sawn wood at the local level, transport and sales in urban areas. Different professional figures play different roles along the value chain, with specific roles depending on the products traded and activities carried out. In Rwanda, timber supply chain actors can be grouped into several categories (Figure 8).

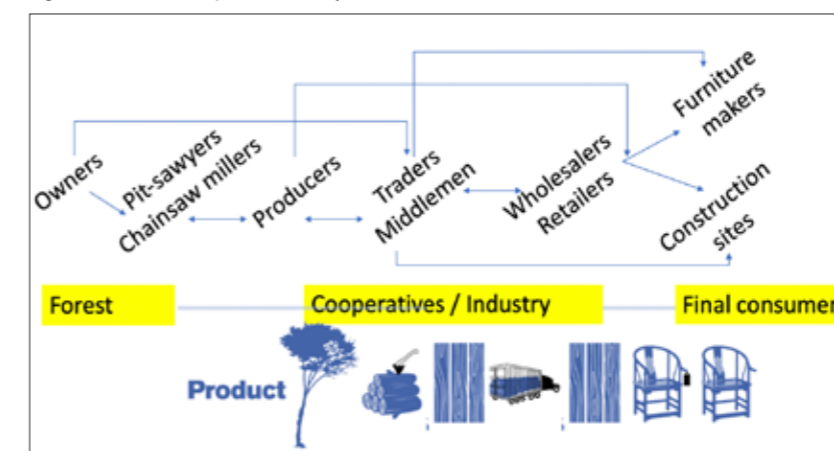
Although a schematic representation may make things look simple and directly connected, in reality there are a lot of informal relations occurring all along the value chain – or grey areas, as they will be described later in the economic and financial assessment. It is those grey areas which determine the real functioning and dynamics of the value chain.

It is worth noting here that the term ‘producers’ is used in Figure 8 may be misleading, as this category of people do not really ‘produce’ tim-

ber. It is maintained for want of a better term, but it must be clear that producers are people who have a very close link to forest owners and generally manage teams of pit-sawyers and chainsaw millers who cut the trees and process them into planks and beams, before they sell the products further down the value chain, either to traders or middlemen, or on some occasions even to final consumers. Producers play a pivotal role in timber production as sponsors of timber harvesting and also as job providers for pit-sawyers. Pit-sawyers are recruited after having agreed on the work to be conducted and paid on the basis of the pieces produced.

Woodlot owners include individuals or legal entities who have decided to dedicate their forest land to timber production. Owners also include the central Government, Districts, and private institutions (such as Churches and tea growers’ associations) and families. The Government is involved in timber production through (i) the system of timber concession that allows logging companies to harvest

Figure 8. Schematic representation of timber value chain in Rwanda



timber on behalf of the Government and (ii) through co-management contracts with tea growers. In some cases, the Government may sell standing trees to the private sector through public procurement procedures. Private institutions and families produce timber from their own woodlots.

Traders and middlemen build and maintain commercial relationship between timber producers and potential buyers, either wholesalers/retailers or even final consumers. Geography sometimes plays a role in defining 'local' vs 'global' traders, as some of them specialize in their own Sectors/Districts while some others have a national coverage, making deals across the national territory and re-investing profits to that purpose, increasing their networks of contacts.

It is important to emphasize there is a high level of mixed roles between producers, traders and wholesalers/retailers. Generally, producers are closer to the forest and direct production, while traders are closer to the final consumers. Yet, it is often possible to find traders who source directly from the forest, and producers who sell directly to the final consumers. It is probably better to look at the value chain in Rwanda in terms of business models. On one side, a tendency to vertical integration, i.e. businesspeople trying to cover the entire chain, from production to sales to final consumer. On the other side, a tendency to specialization, i.e. some producers have strong networks and connections to forest resources and forest owners, so they specialize in sourcing timber

and only sell to traders. These concepts and ideas will take a more concrete form in the economic and financial analysis presented below, where fictional companies will be used to model the possible future development of the timber sector in Rwanda.

The age class suggests that the vast majority of producers (64%) and traders (57%) is ranging from 20 to 40 years old. The profile of operators is relatively different when comes to the level of education. Overall, the majority of operators attended primary school, but more recent entrants tend to have higher degrees than older entrants. Also, producers and chainsaw millers/pit-sawyers have lower level education than other groups (Figure 9).

The timber production and sales are not new activities in Rwanda, but they have attracted large numbers of people recently. The oldest producers and wholesalers/retailers entered the activity in 1970s. In the recent years, the business of sawn wood has become very attractive for people living in rural and urban area and a large majority has established business in the last 5 years (Figure 10). According to operators, the main motivations of new entrants are related to the profitability of the business and the need to increase revenues, followed by lack of alternative job opportunity.

In addition to the motivations evoked by the operators, several other reasons can explain the development of the wood industry in its current form. The first reason of the development of this sector in particular for upstream

Figure 9. Age classes (percent of respondents)

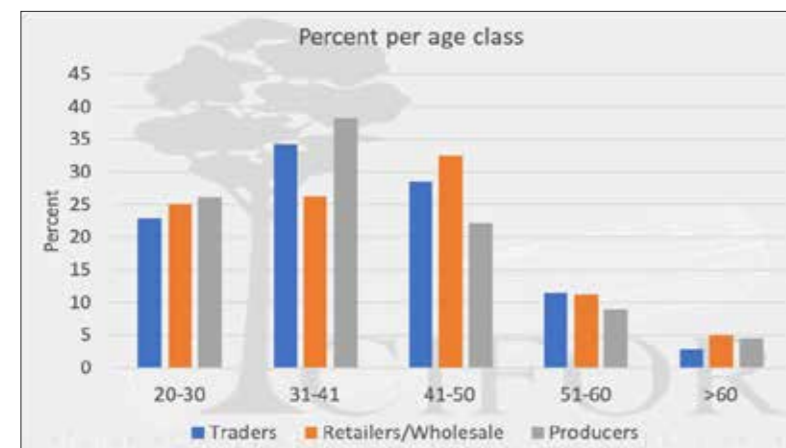


Figure 10. Years since business was established



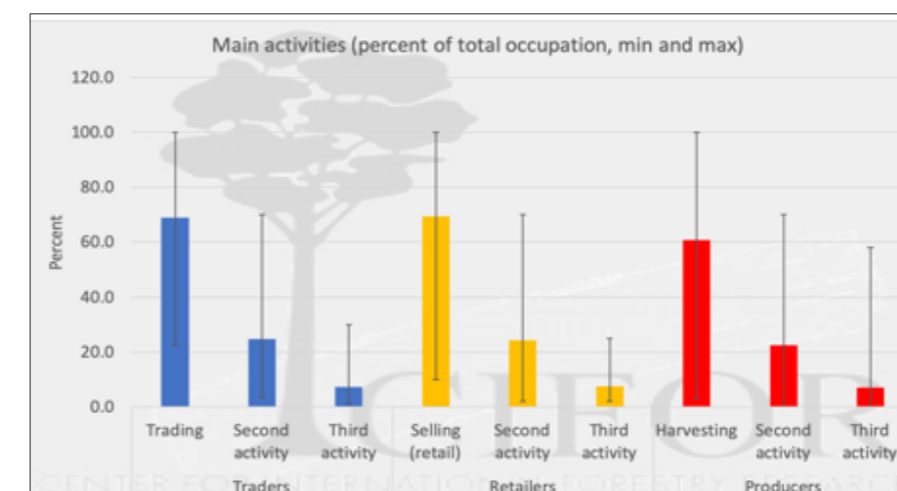
operations is the easy access to the sector. Producers buy trees at relatively low prices from woodlot owners who are often farmers. In a context of resource scarcity, there is thus an asymmetry in information sharing between low sales prices of trees and profit margins for producers. Taxation is also an incentive, since producers pay a relatively low price of about 1,500 Rwandan francs to harvest trees on an area equivalent to 1 hectare. For producers, access is easy since the initial investment of acquiring a saw is 25,000 Rwandan francs. Despite the arrival of the chainsaw as a working tool, the hand saw remains the most used instrument by operators because of its low price and low maintenance costs.

Importance of sawnwood business

Timber business does not look to be a transient activity for many operators (Figure 11). Most of the respondent's time is dedicated to their activity. Traders spend on average 69% of their busy time in trading timber, 25% in a secondary activity, and 7% in a third activity; producers spend around 60% of their active time on the timber business. Secondary activity is for the vast majority (90%) agriculture, and third activity is vast majority dealing in livestock (89%).

In addition to these income generating activities, operators mentioned small business, carpentry and construction as additional sources

Figure 11. Main activities of timber operators along the value chain



es of income. With an annual growth rate of around 6%, combined with population growth and the boom in the real estate sector, the timber business is an opportunity to make money with interesting profit margins.

Two variables illustrate the importance of the sawnwood business for value chain actors. These include the use of credit and the use of borrowed funds. Firstly, operators do not hesitate to use credit to conduct their operations. In the last 5 years, 52% of retailers report having access to formal credit (i.e. banks, SACCO, micro-credit) and 34% have access to informal credit (i.e. moneylenders, other sawnwood specialists etc.). Traders access both formal (39%) and informal credit (49%). Access to formal and informal credit is more balanced among producers reporting that 44% had access to formal credit and 45% to informal credit. The preference for informal credit is largely due to difficulties in accessing bank credit. About 37% for traders and retailers claim to have access to bank credit. This percentage drops to 18% for producers.

The majority of operators reinvest the capital in their activity. For traders and retailers, capital is used in 61% of cases to increase the business, i.e. to conduct more operations, buy equipment (Figure 12), and to reach out to more customers and suppliers. In 32% of cases, capital is directly used to buy timber needed to keep business going. Producers have an opposite trend, with 55% of them using capital to buy access to the resource, generally trees and timber which they then sell on to traders/retailers.

There exists many individual pitsawyers who only use handsaw and they also produce and

sell timber. These may be more localized and surely more sporadic operations than our sample, but they still contribute volumes to supply the national demand. Chainsaw acquisition is a recent trend in terms of investment. This trend is expected to progress rapidly to replace hand saws in the medium term, as is the case in other countries across Sub-Saharan Africa.

Seasonality

The period in which the demand for sawnwood is the most important is between the months of June and August. Conversely, demand is lowest during the months of December, January and April. In-between months have a relative 'average' production, depending on localized situations (rains, road condition, etc.).

Result show a strong connection between timber production and seasonal variation. The period between May and September corresponds to the long dry season and is the most suited period for timber production activities. This is the period during which operators are the most active, also because the construction business' demand for timber is higher.

When asked about seasonality of business, producers and traders tend to have very similar answers, though traders have somewhat longer 'high' seasons. This similarity indicates, among other things, that no group in particular constitutes large stocks of timber, because demand is too high and supply cannot follow. This result can also be interpreted as a lack of enough financial resources that could enable traders to build up stocks, apart from

those few who can put timber aside for 2-3 years for drying (a tiny minority as of yet). In fact, stock-building for a long period requires significant financial resources, but as the difficulties reported by the operators show, one of the main difficulties encountered by the actors is the lack of capital.

Timber production (sites and sales)

When asked about the sources of supply, 57% of traders and 61% of producers say they buy products or trees as appropriate across the country. The similarity of responses between producers and traders indicates that traders' activity is very much tied to that of producers, as already mentioned in the case of seasonality above. The geographical spread of the supply source to the whole country is also an indica-

tion of the high mobility of the actors according to the availability (or better, lack thereof) of the resource.

If the forces behind sourcing timber are similar between producers and traders, differences in behaviour occur when selling products. Producers will look for trees and woodlot across the country, but once they find the raw material and they have sawnwood ready to sell, they tend to sell within the District of production, generally to traders who then move planks and beams across the country (with support from transporters or by hiring/using their own transport means, e.g. truck), generally towards large towns (Figure 13).

With this highly dynamic context in mind, one can check in which Districts the largest businesses were met (Figure 14).

Figure 13. Sourcing and selling of timber (various categories)



Figure 14. Districts with producers with largest businesses (top 10)

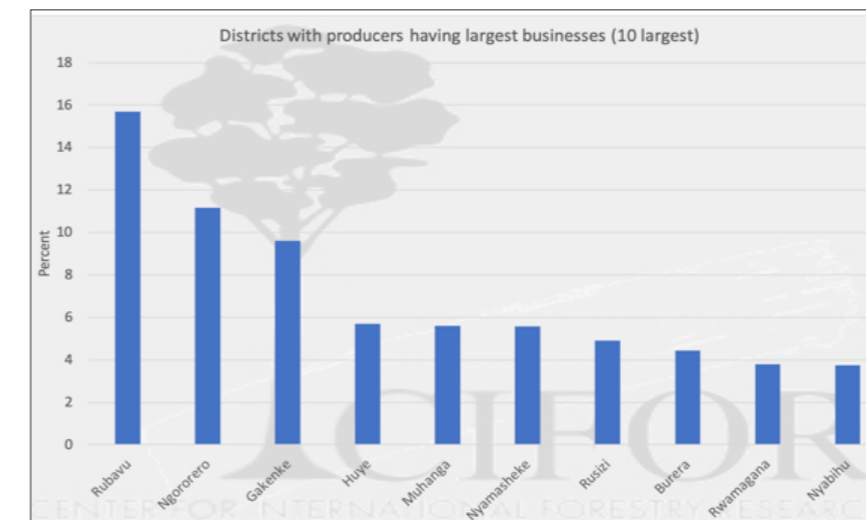
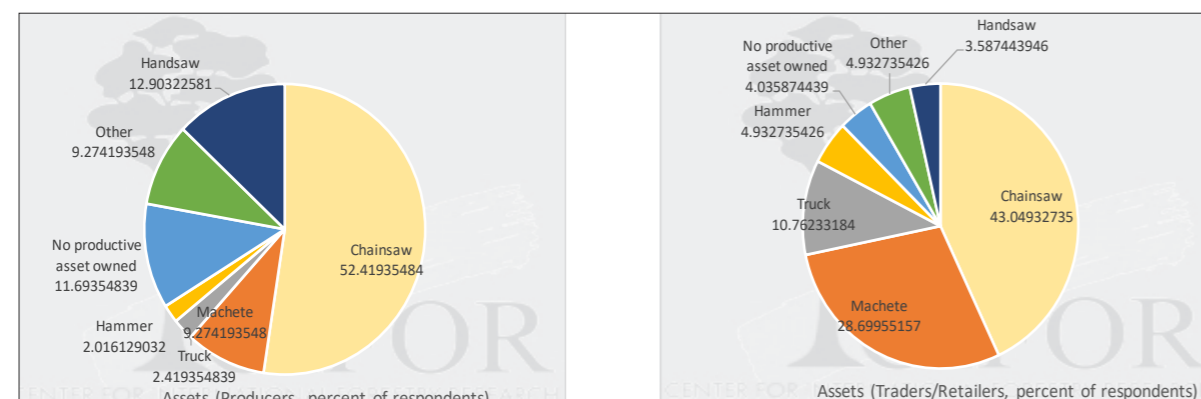


Figure 12. Ownership of productive assets



It is important to keep in mind (as explained in the methodology) that ‘producers’ were met and asked to provide the volumes and prices for 4 points in time (best, worse, and two previous months). This means that the place where those business were made is not necessarily the Cell, Sector or District where the interview was conducted. Hence Figure 14 is just a relatively correct indication about those Districts where more businesses are being conducted, on average across the year. A different methodology would be needed if one wants to know exactly which Districts produce most timber and which less.

Products, species and prices

The recorded sales show that 95% of the supply of sawnwood consists of four species, namely Eucalyptus, Pinus, Grevillea and Cypress. Species imported from neighboring countries (DRC, Uganda) consist of Libuyu and Muvura (Figure 15).

Before continuing, one result deserves to be mentioned here. Interviews indicate that species such as Afromosia (*Pericopsis elata*) are available on the market on demand. Afrormosia is a CITES species (Convention on International Trade in Endangered Species), and it is sourced from the DRC. Authorities on both sides of the border have difficulty in effectively controlling the trade in this type of wood which can easily be mixed with other species and can only be detected by the specialist’s

eye. Yet a special CITES permit is needed for this commerce. A specific recommendation deserves to be made here, for authorities to be alerted that the trade can occur and it deserves to be monitored better than the current level.

The four species mentioned above are used mainly for the production of planks (about 75-80% of sales), and beams (or madrier, in French, about 20-25%). The vast majority of beams and planks are produced by pit-sawyers and chain-saw millers with important implications for quality. Production techniques result in poor quality products with very variable dimensions. Unlike other countries in the sub-region where sawnwood sold has several quality options, here only rarely grading is done, and the beams and planks that results from operations are often unsuitable for joinery and used for most cases in the construction sector. Of course, this could also be a case where, because the construction sector is currently driving demand, there is not much request for better grading of products. Also, exceptions exist. For example, part of the pine planks is produced by one of the few processing industries in the country. These industrial planks are of very good quality, dried and sale in markets throughout the country.

Among the most traded species, Pinus fetch the highest prices, also because part of it is produced from industrial sawmills with much better standards of quality, and Eucalyptus the lowest (Figure 16).

Figure 15. Traded species (percent of total recorded)

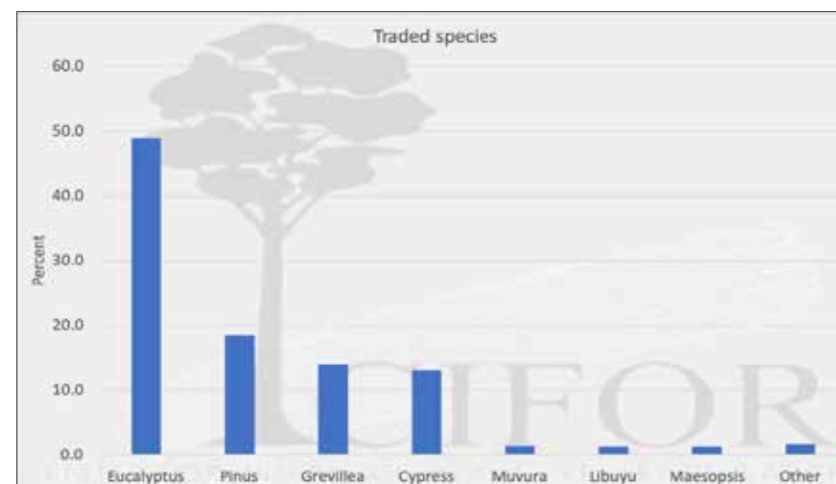
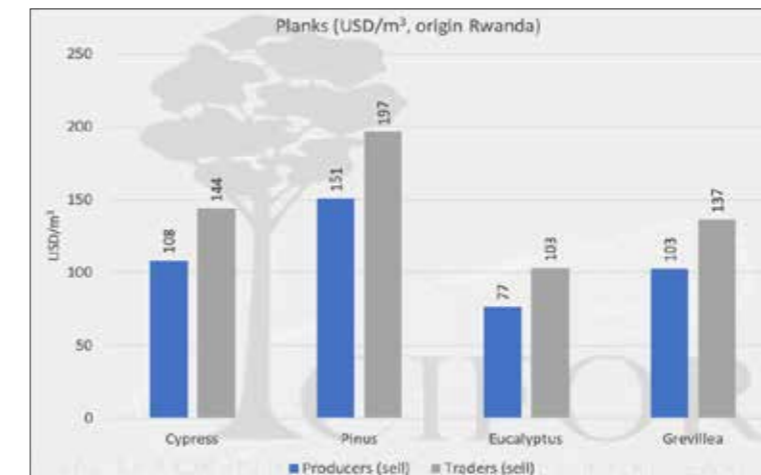


Figure 16. Selling prices for planks (Four most traded species, USD per cubic meter)



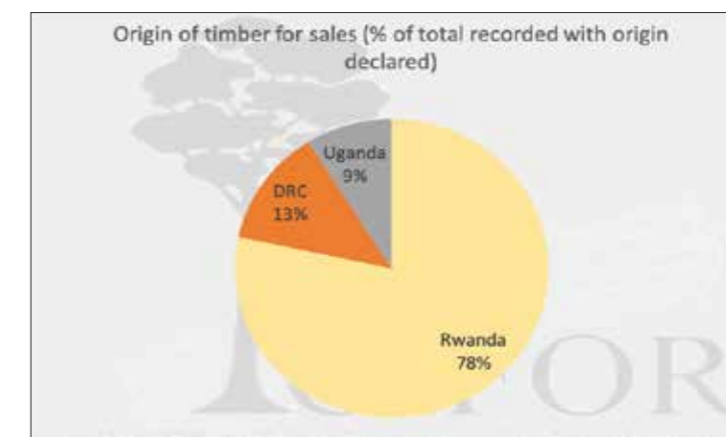
Products imported from the DRC fetch much higher prices, with Libuyu going as high as about USD775/m³ (generally imported as beams) and Muvura at about USD691/m³ (also generally imported as beams). They are largely used for carpentry and furniture making, and their price is also dependent on the route through which they reach Rwanda. Products that pass through the Rubavu-Gisenyi border post are more expensive reportedly because of higher customs duties. To reduce costs, some importers of Congolese timber pass through Uganda. According to the importers, tariffs on entry into Uganda are significantly lower and as this country is a member of the East African Community, products can go directly to Rwanda free of customs duties because of the free movement of goods in the EAC common space. (Annex II lists prices per product, species at the District level. As noted above, prices per District are only indicative as respondents gen-

erally reports prices for their business, which can take place also in other Districts).

Volume and profits sharing

With all the caveats and hypotheses presented in the methodology in mind, total national trade of sawnwood is estimated to be about 275-300,000m³/yr. Not all this timber is produced in Rwanda, as results indicate that timber is also imported from both Uganda (9%) and DRC (13%) (Figure 17). We could not determine how much timber declared as originating from Uganda is actually of DRC origin passing through Uganda, but because most of the species are those produced largely in DRC (especially Libuyu), it is fair to assume that a large part of the timber declared of Ugandan origin is in fact originating in DRC.

Figure 17. Declared country of origin for sold products (percent) bic meter)



This means that traded timber originating from Rwandan forests is about 215-235,000m³/yr. This estimate is higher than the projections of LTS which placed the national demand at 162,000 cubic meters by 2020 (LTS, 2010). This can be explained by the increase of the population and especially an average annual growth estimated at 7.15% during the last eight years. The strong growth has driven a boom in the construction sector and consequently a faster progression of the sawn timber market.

Given average cost in USD/m³ for timber (most traded species, planks and beams) both originating in Rwanda (USD128/m³) and DRC/Uganda (USD791/m³), the total value of traded timber could be around USD76 million/yr.

Profit margins vary between producers and traders, and species and products. For example, eucalyptus, which accounts for about 50% of traded volumes (Figure 15), generates about 21% profits for producers, 16% for traders and 14% for retailers. Profits are higher for traders and retailers when they sell Pinus, Cypress or Grevillea (Figure 18). It is difficult to estimate profits for producers, notably for pinus, because the market is also sourced by industrial sawmills which has a completely different structure of costs, which were not assessed by our survey but which will be considered in the financial and economic estimates below.

In closing this part of the findings, and before moving to the financial and economic analyses, it is worth reminding, as also indicated in most of the interviews and discussions with DFOs

and operators, that the timber value chain in Rwanda has to face two imbalances which are of paramount importance, as also indicated in the NFI (DFS et al., 2016), especially when one focuses on trees inside forests (or TFI in the NFI). Firstly, the forest stands show a low standing stock and the statistical distribution curve of stem diameters revealed an abnormal shape (see tables in Annex III). Secondly, the gap between the sustainable supply, circa. two million oven dry tons per annum and the demand, circa. six million oven dry tons per annum, is huge. This gap in demand is obviously – at least partly – filled in through both formal and informal timber imports from DRC.

Policy-planners face two more issues when dealing with supply of timber. Firstly, the demand for fuelwood is growing and trees that could be standing as future timber source are felled down prematurely. This is a mere consequence of need satisfaction priority, i.e. fuelwood – related to cooking – over timber. The growing demand for fuelwood is impacting the supply of timber. Secondly, as interviews conducted for this assessment indicate, the lack of proper silviculture results in many cases in poor bole shape, hence timber low in quality.

The timber industry in Rwanda can create and consolidate a position either on domestic market or on both domestic and international market.

We could not elaborate a growth model to predict how long it will take to rehabilitate forests in Rwanda, i.e. to bring their productivity back

to acceptable level (8 m³/ha/yr) but this could take between 10 and 20 years if all endeavours are made in due course with proper funding.

Environmental impact

Logging takes place mainly in private forests (66%) and to some extent in public forests (34%). According to forest regulations, harvesting of forest resources must be done in accordance with a forest management plan including private woodlots with an area greater than two hectares. The law does not set clear rules for industrial logging, nor provides clear guidance for chainsaw operation. Pitsawyers have no obligation regarding the minimum operating diameters nor for cutting non-mature trees.

The outdated tools used by pitsawyers has negative impacts on forest stands. The use of hand saws favours clearcuts. Selective cutting would force the sawyers to move the logs too far apart or install many structures for sawing too many logs. While research shows that in other Central African countries, small-scale sawyers opt for big trees, stands with large trees are penalizing. Trees with large diameters should be an asset in terms of wood yield and quality but they become a constraint in this type of operation. The immediate consequence is a very low recovery rate and a large waste of the raw material.

Discussions with local communities, corroborated by producers show that poor management of logging operations has significant effects on forest cover. Species preferred by artisanal loggers such as markhamia and cypress tend to become rare. At the same time, the area of forest plantations is considerably reduced. Tables 3 and 4 present community perceptions of forest cover change over time and impacts.

The operators of the sector seem quite aware of the environmental impacts of deforestation on their activity. Among the causes of deforestation, logging and illegal logging are among the top three drivers of observed changes in forest cover (Figure 19 in the next page). Paradoxically, the recommended solutions to reduce the loss of the most used species mention primarily the reduction of trees used as fuelwood. This means that for the operators the reduction of the environmental impacts depends a lot of effective regulations of the production of wood energy, that is the real competitor of the wood industry.

Timber Industry competitiveness

Competition factors are the same for SEAL, NFC, and all players in the Rwanda timber industry. However, these firms do not have the same capacity to adapt to competition and

Figure 18. Examples of profit margins.

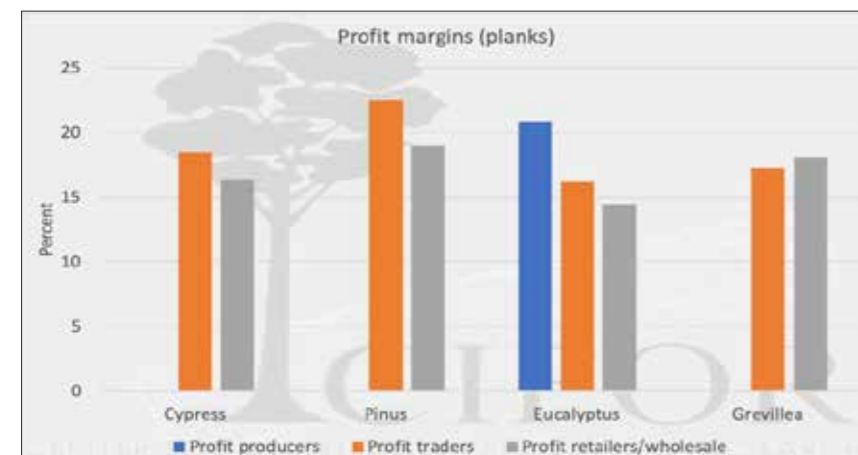


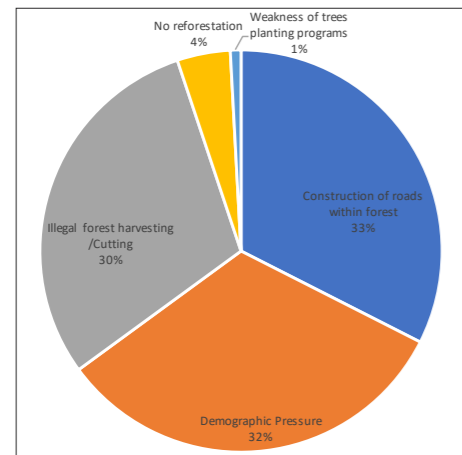
Table 3. Change in forest cover

Change in forests/trees cover/abundance of important tree species changed over time	%
Disappearing of some tree species	32
Reduction of woodlots	31
Climate change	31
Reduction of timber for construction	5

Table 4. Impacts of tree cover in the community

Impact of changes of trees cover in the community	%
Reduction of sawn wood and fire wood	42
Higher soil and wind erosion	21
Reduction of rainfall	21
Increasing of desertification area	9
Reduction of timber plantation	3

Figure 19. Cause of tree cover change

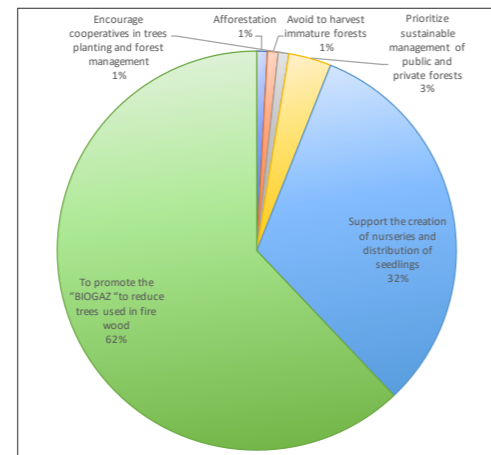


external forces. For example, all firms do not have the same liquidity reserve or the same amount of cash on their bank account. Some informal businesses, e.g. self-employed tree fellers might not have a bank account at all. Some timber businesses are administered, managed and run by true professionals while other are run in a very informal way and most likely on season basis.

In short, the timber industry in Rwanda is above all constrained by supplier, i.e. the shortage of quality raw material, the relatively low purchasing power of its domestic market base, and the strong presence of affordable substitutes. The threat of new entrants is not that high because timber processing is capital intensive, which create a barrier to entry for medium to large-scale operations. Afterwards, it creates a barrier to exit. The internal rivalry is fierce because logging and to a certain extent processing take place in poor socio-economic conditions where workers do not make a decent living, i.e. value added is very limited.

From both social and economy angles, informal businesses are sub-optimal. Obviously, people involved in informal timber operations earn a living but there are at least two downsides. Firstly, the tax basis is reduced. Secondly, workers doing a dangerous job have no social security when severe injuries occur. Informal businesses distort competition.

Figure 20. Solution to avoid forest loss



Profitability and investment opportunities

These findings are mainly derived from analyses described in section 3 above.

We assume AT&F Corp shareholders will provide some private equity as high as 66%, allowing them to enjoy debt at 8% interest rate. For all projects, we have taken a salvage value of Back office & admin. Investment, Infra., Tool, Equip. & Machinery (A), Infra., Tool, Equip. & Machinery (B), Capacity building and Timber Marketing Infrastructure & System equal to 15% of initial investment. Figures used in our financial analyses are provided in Annex V.

Findings are summarized through key financial indicators as follows (Table 5).

Actually, three very different businesses cannot be compared using absolute financial figures. If all assumptions translated into data used in financial computation hold, these three businesses are financially profitable, i.e. all of them return a positive NPV and an IRR > DR (11%). The Return on Equity (RoE) seems even attractive – at first glance – with a leverage of 0,66 (60% of initial capital comes from shareholders and 40 % of the initial capital is provided by external lenders at an 8% interest rate; the WAAC²⁴ is computed using 8% debt rate and an expected 10 % return on private equity). However, a RoE of circa 12% given i) the risk implied

Figure 21. Competition and market forces in the timber industry



Table 5. Financial indicators

	STP Llc	NWP Llc	AT&F Corp.
Description (figures in '000 USD unless*)			
Total number of employees	27	175	524
Number of employees in Rwanda	27	175	365
Initial investment required	813	6,152	20,333
Target annual turnover	855	5,850	56,722
Loans from outside suppliers	500	2,000	10,000
Annual vol. of eq. domestic round wood	7,054	32,747	13,425
Annual import of wood (m ³ sawn wood)	n.a.	n.a.	46,025
Average cost of timber*	USD 10	USD 10	USD 600
Financial performance			
Net Present Value (DR = 11%) in '000 USD)	42	2,222	15,094
Internal Rate of Return	14 %	25 %	31 %
Payback period (in year, rounded up)	6 years	5 years	5 years
RoE (Return on Equity) if leverage 0,66; WACC : 9,2 %	-	-	11,9 %

24. $((2*8\%) + (3*10\%)) / 5 = 9,2\%$. The WACC is seen as the true cost of capital when capital comes from investors having different profiles and appetites.

by the business, ii) the capital-intensive nature of it and iii) the long pay-back period (5 years) is not impressive.

Financial modelling obviously incurs some simplification. There are thousands of variables in the plant of our fictional NWP Llc or AT&F Corp²⁵. Cost of goods sold in itself is another source of paramount variation, because there are not only seasonal timber prices variation but also substantial and often unpredictable quality variation in raw material.

One may argue about the price of wood imported from DRC. One may argue about the sale price of stairs on regional premium markets. Actually, one may question all and every single figure used in our analysis. Arguing about figures used in computation – unless totally unrealistic – is pointless. It is a fact of life: most figures are variables.

All businesses are profitable, but the smallest business could easily become unprofitable, for example a slight increase in stumpage value (10%) would drive the business to bankruptcy²⁶. Sensitivity analysis and break-even analy-

sis will shed light on the relative robustness of each business models.

In the continuum from BAU model (with an annual turnover of USD 8,800) to AT&F Corp. with an annual turnover of USD 60 million, three main factors explain the financial performance:

1. Scale, and economy of scale. Ratios such as volume of timber processed / employee, dollar sale / volume of raw material; dollar sale / employee are given in *table 6* below.
2. Scope, offering, and vertical integration (*see table 6*). The first two businesses have a national scope only while AT&F Corp pursues both national and international operations. There is very limited vertical integration in the case of STP Llc, fair vertical integration in the case of NWP Llc and strong vertical integration in the case of AT&F Corp.
3. Access to capital. The smallest business has to face the highest cost of capital. It is unfair but, alas, it is a fact of life (Piketty, 2013). This cost of capital has a major impact on profitability (*see sensitivity analysis below*).

Table 6. Scale, Scope, Offering and Access to Capital

	STP Llc	NWP Llc	AT&F Corp.
Scale			
Timber processed / employee (m ³)	261	187	26
Dollar sale / volume of raw material (\$/m ³)	121	179	4,225
Dollar sale / employee (\$)	31,667	33,429	108,248
Scope	National	National	International
Offering	Specialized	Diversification	Diversification
Number of different products	4	13	28
(If versioning in dimensions factor 5)	-20	-65	-140
Average price per product*	9.5	18.69	94.33
Type of markets	Mass	Mixed	Premium
Access to capital			
Initial capital required (\$)	500,000	2,000,000	10,000,000
Interest rate on debt	15%	12%	8%
(WACC)			9,2%

25. For further understanding of the theory of constraints, see Goldratt and Cox (1986). Operating machine alone generate thousands of variables related to capacity, machine availability, down-time, idle time, schedule operating time (set up ; Schedule machine hour ; SMH), productive machine hour (PMH.) is subject to statistical variation etc.

26. Buying domestic wood at USD 11/m³ results in a negative NPV in the case of STP Llc.

Table 7. Sensitivity Analysis

Sensitivity analysis variable	STP Llc	NWP Llc	AT&F Corp.
Reference values NPV '000 USD	42	2,222	15,094
DR			
NPV using DR = 13 %	15	1,748	12,487
Interest rate (r)			
NPV using r 10 %	150	2,395	14,050
NPV using r 15 %	No change	1,963	10,886
Sales volume			
NPV if 90% sales volume ½ finished products	-197	1,474	17,331
NPV if 90% sales volume finished products	No change	1,126	4,532
Cost of woody biomass			
NPV if stumpage domestic wood 9 USD	74	2,352	15,142
NPV if stumpage domestic wood 12 USD	-22	1,964	14,999
NPV if cost of imported timber + 10 %	No change	No change	5,290
NPV if cost of imported timber + 20 %	No change	No change	-4,513
Pricing policies			
NPV if prices discount by 10%	-332	-206	-5,081

Since STP Llc makes simple products of fair quality, using two timber species only - pine and eucalyptus – their trained workforce can achieve some high yields. Sensitivity analysis is summarized in *Table 7*. We use the NPV as the financial indicator to gauge business profitability since it is easy to interpret²⁷. A negative NPV means unprofitable business, i.e. financially not sustainable business.

Sensitivity analysis is performed while the value of a single variable is altered *mutatis mutandis*. Albeit figures about the financial performance are self-explanatory, it is worth mentioning the following:

1. Access to capital at rate < 15% is a must for companies like NWP Llc. Such SMEs cannot meet high financial obligations.
2. A decrease in sales of semi-finished products such as plain wood planks and beams is actually profitable for AT&F Corp., which means this large company should not manufacture low added value products. Expensive machinery represents a major fixed cost and AT&F Corp. must focus on premium high margin products.

3. Obviously, change in stumpage value (domestic woody biomass) negatively impact the financial performance of NWP Llc. And even more so STP Llc, causing bankruptcy of the company in the latter case.
4. Prices of imported timber has some major impact on AF&T Corp., causing bankruptcy as soon as price increase reaches circa. 16%.
5. A 10% decrease in activity (sales down by 10%) and a 10% discount on prices are both detrimental to business performance, but the latter is much more severe since assets have been used to produce goods while slowing down business (less production) save on variable costs, e.g. purchase less raw material.
6. Variation of 10-20% in these factors cause major changes in financial performance because gross margins range from 8% to 18%. Timber and furniture businesses do not deliver high margins. Raw material and CAPEX are high, i.e. increases in the price of raw material combined with a slowdown of activity cause devastating damages.

27. NPV and IRR are two faces of the same coin. When IRR = DR, then NPV equals to zero.

Table 8. Economic Indicators of Business Models

	STP Llc	NWP Llc	AT&F Corp.
NPV in '000 USD	52	3,005	21,598
IRR	12 %	22 %	29 %
Pay-back period (in year, rounded up)	6 years	6 years	5 years
Benefit to cost ratio	1	1,1	1,1

The break-even analysis was not carried out but the models suggested that any production decrease over 20% and any price discount greater than 20% will make business on the verge of bankruptcy.

It is important to note that the three businesses described here are not mutually exclusive, at least to a certain extent, i.e. as long as there is enough raw material in the forest.

Scenario analyses

This unit presents the findings from our economic analysis (summarized in Table 8). It is worth to keep in mind that market prices have been used in this analysis. In the following cases, we could or we should use shadow prices instead but it was too complicated to be worth the effort. Shadow costs could be used in the following cases:

- The cost of unskilled labour or unemployed people. The number of unskilled people involved in all three scenarios is small as compared to the BAU scenario. Hence, we have chosen to use an FMV price. If the project (one of our fictional companies) hire unemployed people, i.e. people doing nothing, with zero productivity, we should zero the cost of their labour in our economic analysis. Indeed, the whole economy loses nothing in transferring someone unemployed to a productive business.
- Training of staff; in financial analysis, training cost is assessed by using the cost of consultant trainers; in economic analysis, we could use the education cost incurred by improving skills of staff.

Intangible benefits are not converted into monetary terms because such conversion arise a lot of controversy, i.e. some distraction in the

decision-making process. However, analysts usually agree to acknowledge them. In the timber industry in Rwanda, such intangible benefits include:

- Better and prettier furniture. An ugly piece of furniture, e.g. a chair provides the same service to its user as does a well designed and well built one. The same applies to door, eco windows, etc. It is an intangible benefit.
- People working in safe environment, e.g. using personal safety gear will be better-off; its is an intangible benefit.
- Forest stands improved as a result of the projects will likely play a positive role in the entire landscape, providing scenic spots, decreasing and erosion, etc. Those intangible benefits are acknowledged.
- Etc.

Taxes have been treated as transfer cost. We have assumed there was no subsidies involved, although this could be different in reality. All three businesses are profitable. However, the benefit to cost ratio is only 1.1 in the case of NWP Llc and AT&F Corp., suggesting there is little room for manoeuvre when more conservative figures are used. In the case of STP Llc, the ratio is equal to one (actually just above one but the second-place decimal is meaningless given the accuracy of underlying data). From an economic standpoint, and solely based on the economic analysis, this scenario should not be implemented.

It is worth to look at the value added by these three scenarios, and their impact on direct and indirect jobs created. Here, we will take into account the direct jobs necessary for implementing the scenarios, as well as the indirect jobs resulting from the multiplier effect of the scenarios. Scenarios are not mutually exclusive. In

reality, it is very likely a combination of scenarios will happen, i.e. X ventures similar to STP Llc, Y SMEs such as NWP Llc and Z large firms such as AT&F Corp. Very often – and the case currently prevails in Rwanda – we find $X > Y > Z$, i.e. many small players, very few big players. It is another illustration of the Pareto law here.

Policy makers and decision makers could wish to know what scenario has to be promoted should employment be on the top of the agenda. Here comes a somewhat counter-intuitive finding. One could expect that systematic modernization and mechanization will inevitably result in some huge increase in labour productivity, hence, less labour needed. This is true when the final output, i.e. the product, remains unchanged. However, mechanization and modernization may achieve more productive labour and more labour needed if value is added in the process.

In plain terms, if we choose a capital-intensive over a labour-intensive scenario while aiming at the same output, it will increase unemployment. Conversely, if we choose a capital-intensive over a labour-intensive scenario while aiming at more valuable output, it may decrease unemployment and will likely create new jobs.

Unskilled jobs resulting in low value added usually result in fewer indirect jobs as compared to qualified labour. Consequently, investing in ITEM (A) create less jobs than investing in ITEM (B), even if ITEM (B) is more

capital intensive than is ITEM (A). However, if a – rather extreme – scenario require only robots and very few people to operate the plant, this assumption no longer holds obviously²⁸.

Let's define four combinations of scenarios, and let's add three basic scenarios (see Table 9). Scenarios are implemented through companies such as STP Llc, NWP Llc and AT&F Corp. Combining scenarios result in a mix of company types. Conversely, implementing scenario 1 require only companies similar to STP Llc. A very large number of combinations is possible. Let's bear in mind a major constraint in Rwanda: the availability of woody biomass. Not the total woody biomass but the woody biomass available from TIF and suitable for timber production purpose.

At present, the domestic woody biomass processed into timber is roughly 250,000 m³. If the supply of this raw material is constant in the next ten years, for example we can run 35 companies such as STP Llc or 7 companies such as NWP Llc and that is all. From the NFI findings (DFS et al., 2016) we understand that forest productivity could be increased, albeit not overnight. We will envisage combined scenarios where woody biomass availability is doubled and even quadrupled²⁹, the latter for illustrative purpose only.

Scenarios C and 3 are unrealistic, at least under the current circumstances. Rwanda forest stands, i.e. TIF cannot produce as much timber

Table 9. Timber processing scenario implementation and woody biomass requirement

Scenario	Woody biomass available for timber processing (m ³)	Number of companies type STP Llc	Number of companies type NWP Llc	Number of companies type AT&F Corp.
Scenario A	250,221	15	4	1
Scenario B	500,443	30	8	2
Scenario C	974,035	60	16	2
Scenario D	251,378	16	3	3
Scenario 1	246,881	35	0	
Scenario 2	229,232	0	16	
Scenario 3	241,654	0	0	18

28. Although designing, operating, maintaining robots still need human labour. In our case, machinery is not built in Rwanda, and some maintenance and spare parts cannot be provided in Rwanda. In such case, jobs created are outside Rwanda. Whatever the technology is, some local labour force will be needed.

29. This increase in production is not realistic over a period of ten years. However, it could happen over a period of 20 or 30 years.

as required by scenario C, and importing over 800,000 m³ of red wood from DRC won't be easy³⁰. Nevertheless, these scenarios could become realist someday. In our analysis, their usefulness is to help decision-making on strategy. =Direct jobs are derived from the description of operations pertaining to each type of company. Indirect jobs are derived from a multiplier effect, not easy to assess with accuracy. However, if there is some bias in the computation, it equally affects all scenarios, hence it does not alter the line of reasoning.

Jobs created in the timber industry resulted from two opposite drivers, i.e. mechanization and value added. However, mechanization, i.e. capital, creates wealth. Without mechanization and modern operations, it is not easy to create value (Figure 22).

The promising combinations of scenarios under the current circumstances are Scenario combined B and Scenario combined D but the former requires some substantial effort in the supply of domestic woody biomass while the latter must rely on adequate import of red wood from DRC.

Promoting improvement of SMEs such as STP Llc will not help creating jobs. Interestingly, promoting medium size only, targeting the domestic market only does not do much better. At present, the domestic market is not ready for premium wooden products delivered at such a magnitude. Premium products must be sold overseas, i.e. in the region, hence the scope of AT&F Corp. and its capacity to create value, and many jobs (Figure23).

Figure22. Value addition explained

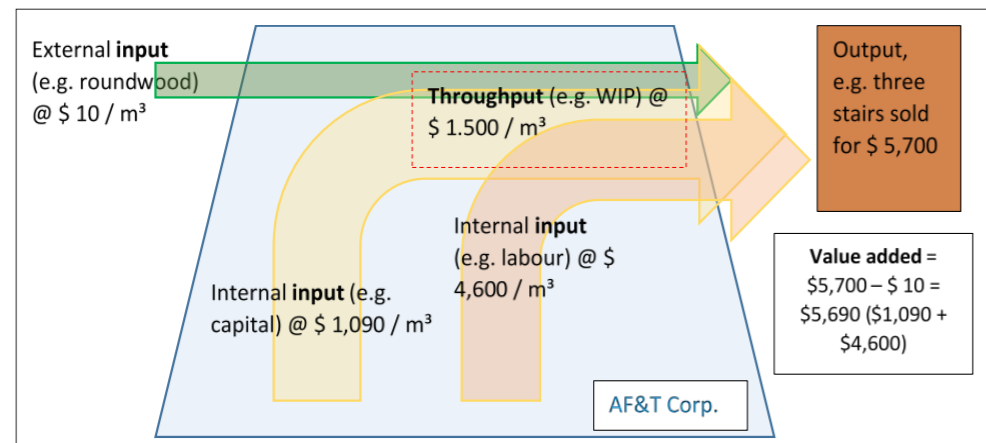
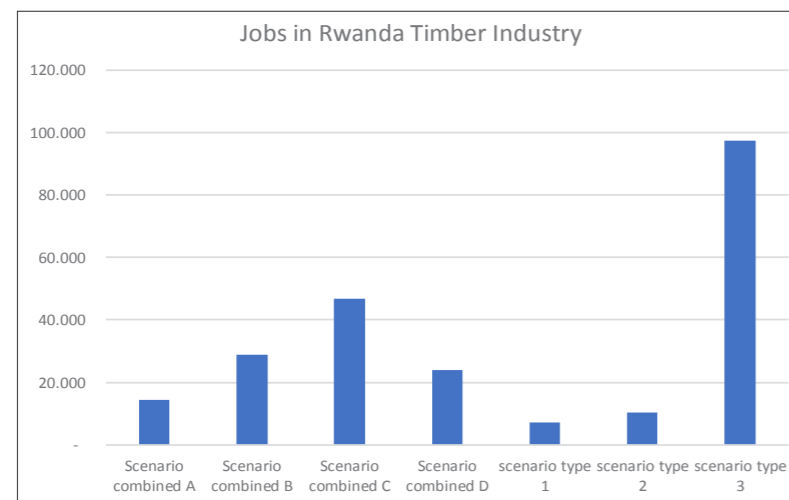


Figure23. Jobs resulting from not mutually exclusive Scenarios



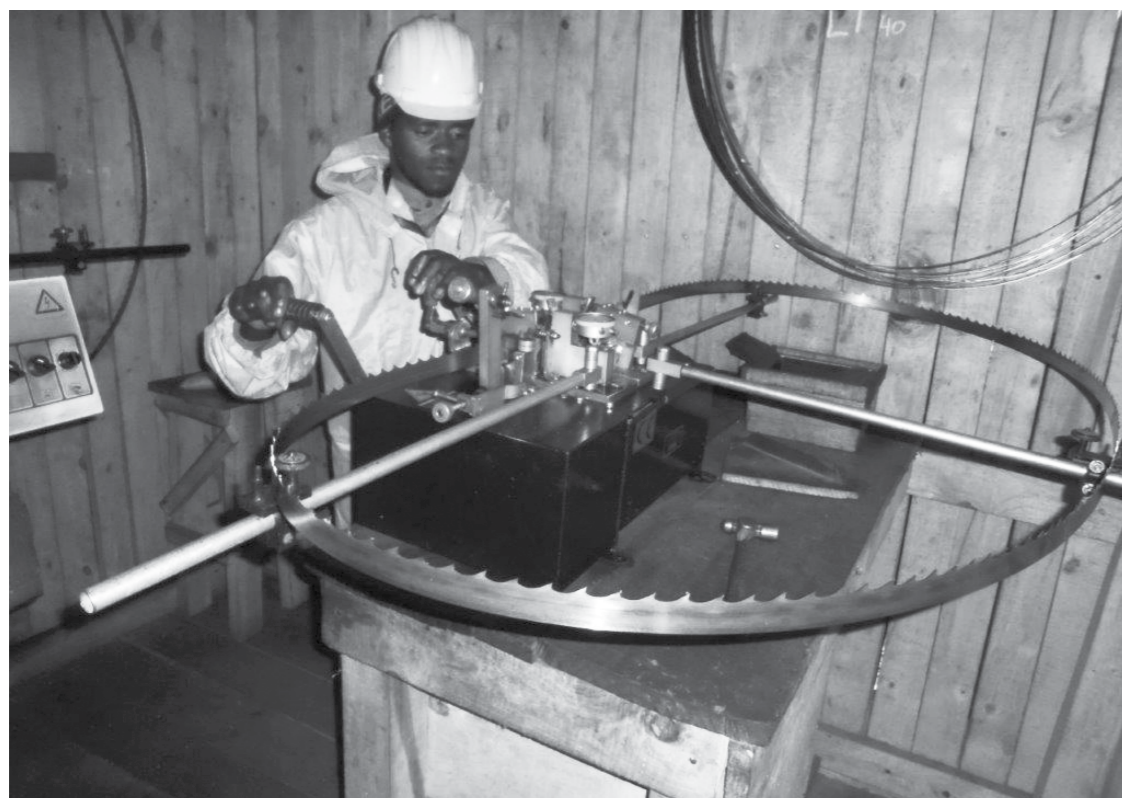
30. It is an illustration of the theory of constraints. First, the domestic woody biomass supply was the bottleneck. Then, the supply of red wood from DRC becomes the new bottleneck. Whatever scenario chosen, there will be a bottleneck, in the forest, in the market or in the process, etc.



The timber supply chain refers to a set of activities including production and processing of sawnwood at the local level, transport and sales in urban areas.



Discussion



Overall, more than 75,000 people, mostly in rural areas, could derive their income from timber production and trade.

Economic Benefits, Profitability and Jobs

The wood industry is a relatively large pool of jobs. Upstream of the sector, the estimated number of producers is about 1,100, with about 1,000 traders. In total, the production segment includes around 6,600 permanent jobs and 10,000 temporary jobs. Downstream, saw-wood business generates 1,700 direct jobs and 2,700 temporary jobs.

Overall, more than 75,000 people, mostly in rural areas, could derive their income from timber production and trade. As everywhere in Central Africa, local communities are the main beneficiaries of chainsaw milling. Much of the value added is redistributed at the local level to customary owners who sell trees, local wages, and transportation from production sites to evacuation points.

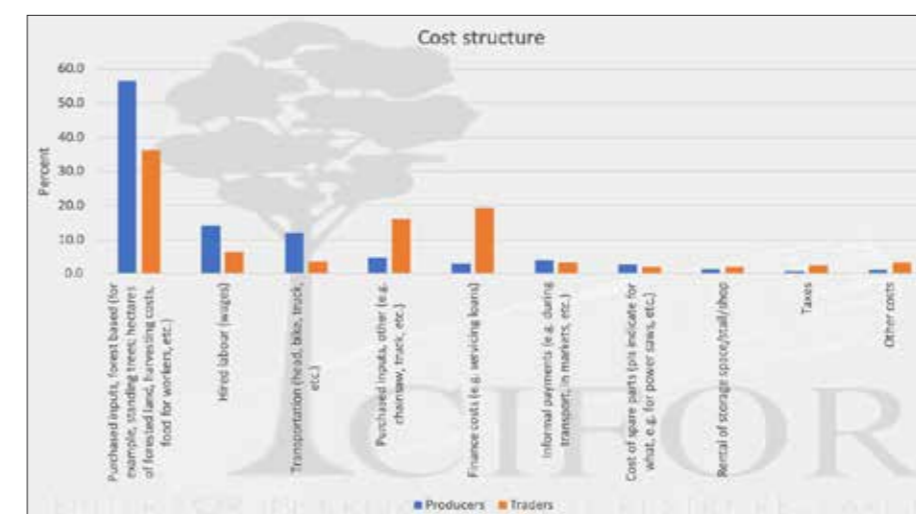
Unlike traders and retailers who pay few taxes or renting warehouses in markets, producers

and woodlots owners are net beneficiaries of logging because they bear very little cost for the first and no costs for the second. Sometimes, traders directly finance upstream operations, which can increase their expenses (Figure 24).

The state benefits formally and informally from this activity. At the level of local communities, logging revenues are mostly used to meet basic family needs (tuition fees, buying the land and livestock). Part of this income is reinvested in the timber business or to repay loans made for this purpose.

As explained in the findings and depending on which model the value chain will adopt in the future – in case of external interventions and/or policies promoting one model more than another – the number of jobs provided by the improved value chain could greatly expand (e.g. see Figure23).

Figure 24. Cost structure for producers and traders (percent of cost/m3 of timber traded)



Barriers to the development and implementation of sustainable timber value chains

The development of a sustainable value chain in Rwanda goes through several stages, from planting and monitoring of forest plantation to marketing, wood production and processing. All these options will be assessed in more detail in the next sections. Suffice here to say that operators are well aware of the existence of many weaknesses and obstacles which – if left unresolved – may hamper the development of the value chain in the future. The interviews with the producers show that the first difficulty that is mentioned is the rapid reduc-

tion of forest resources, immediately followed by several problems related to lack of capital for investment and assets' financing (more below) (Figure 25).

When asked, operators are ready to offer solutions (Figure 26). Yet, as it is often the case, it is difficult for operators to identify who should be responsible to adopt and implement those solutions, as they require decisions and follow-up action in order to improve the value chain.

Although time and resources for this assessment did not allow a thorough analysis of all these problems and proposed solutions, some of them are presented and discussed in more detail in the following sections.

Figure 25. Main problems

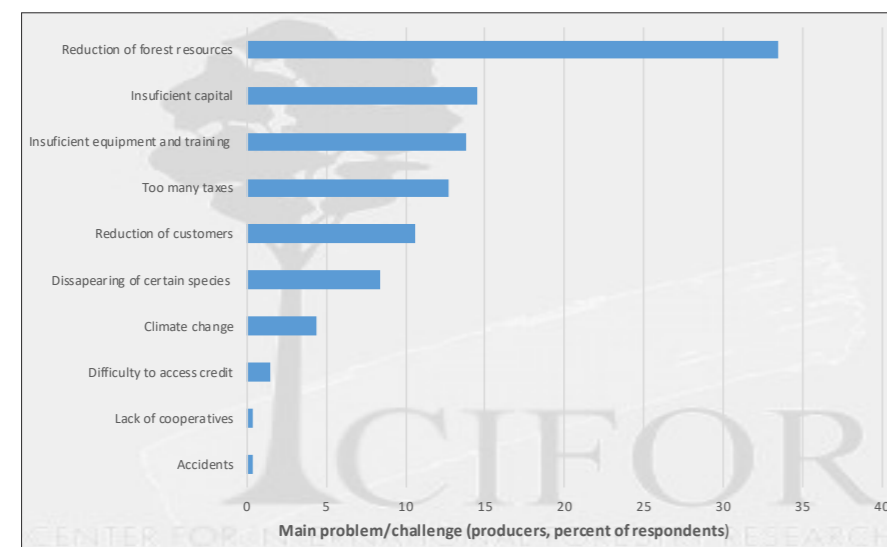
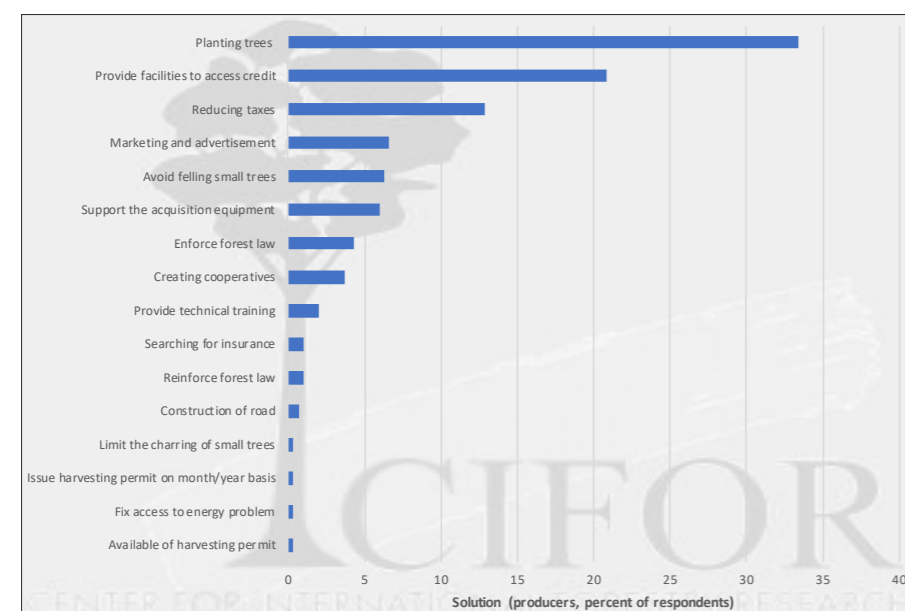


Figure 26. Proposed solutions



Insufficient capital and difficulty to access formal credit

As discussed above in the economic and financial analyses, the lack of capital and access to sources of capital are among the main constraints to a better development of the value chain. Producers and traders / retailers use both formal and informal means to finance their business with a slight preference for informal mechanisms. For traders and retailers, capital is used in 61% of cases to increase the business, i.e. to conduct more operations, buy equipment (see below), and to reach out to more customers and suppliers. In 32% of cases, capital is directly used to buy timber needed to keep business going. Producers have an opposite trend, with 55% of them using capital to buy access to the resource, generally trees and timber which they then sell on to traders/retailers.

The funds invested in the timber business have different origins according to the actors. Producers, for example, prefer to use their own funds to finance their activities, notably to buy more trees and increase their activity. Only 28% of producers report having used a bank loan in the last 5 years. Traders and retailers rely more on bank loans than producers.

The lack of capital also explains at least partly the low use of eucalyptus in carpentry. The relatively long drying time (more than a year) demand significant capital to build stocks without compromising one's activity. Most operators do not have such capital and they thus follow the demand (i.e. sell low-quality products) with poor-quality timber instead of investing time and money in producing better quality one.

Low quality of sawn wood and outdated technology

Chainsaw milling and hand sawing operations pose many problems. This is not, of course, a critique of the current loggers and chainsaw millers, who conduct their operations most of the time in very harsh conditions with a display of great capacity for adaptation and professionalism. Yet, the methods used are not conducive to a good quality of finished products.

Trees are sometimes cut very high (up to 1-1.5m) with the ax, for better comfort of cut and to avoid a long and more difficult cutting operation at the ground level or 20-30cm height. The work is long and painful for each operation. A team of two workers saws an average of 10 planks per day, and the time for a complete clear-cut is very long. Conversely however, the current cutting method is only suitable for clear-cutting, because selective logging (which could improve the quality of the best trees) would force the loggers to move logs around the stand for long distances or install many structures for sawing for a small volume each. A direct consequence of this problem is that, ironically, stands with big trees are penalized: instead of being nurtured for providing a great asset in terms of wood yield and quality, they become a constraint to this type of operations (too big, too heavy, difficult to move around, etc.). Hence, recovery rates are very low.

Also, the thicknesses and widths of the products vary very much. No or only rudimentary grading is done, and the resulting planks and beams are often unsuitable for carpentry, hence they go to the construction sector. It is thus the method of sawing that determines the entire value chain afterwards. In other words, the subsequent professions and steps in the value chain are forced to adapt to the low quality of raw material, limited supply of dimensions, very heterogeneous quality of which generally only small percentages can be used for good carpentry and furniture making.

Conversely, as discussed above, the methods used provide jobs for many workers and relatively good levels of remuneration for the most specialized among cutters (RFW 500/plank on average). Hand-saws are also less dangerous than chainsaws in some cases. Also, the hand-saw does not represent a huge investment beforehand, and it is often shared between two or three members of the cutting team. In addition, maintenance is limited to regular sharpening. This is changing, of course, and it will be changing even faster as time goes by: Chainsaws will replace hand-saws and will one day dominate the logging and initial processing. Work is much faster and less restrictive than with axes and hand-saws. Cutting can be done in one single operation and the log can be pro-

cessed, in most cases, on the spot, with planks and beams being then transported to the nearest road.

Of course, initial investment is bigger and the skills needed are larger: Chain, guide, filter, carburettor adjustment, string replacement for starting, etc. Additional costs for chains, oil, fuel also are bigger, but once these tasks are mastered, the speed of work will make this cutting method the replace hand-saws in most cases. Yet, unless operators become very skilled, precision and quality of initial products will not improve much, with heterogeneous thickness and widths. In fact, in some countries, we have found that initial recovery rates can even be lower than those obtained with hand-saws.

Poor Timber drying

This is arguably the biggest constraint faced today by the timber sector in Rwanda. As discussed in the financial and economic analyses, one action in only one activity will certainly not solve the general under-performance of the sector, but if one had to priorities intervention, timber drying would be a good candidate.

During fieldwork, three methods of drying have been identified, called here 'ancestral', traditional and modern. The ancestral method is the dominant method. Freshly sawn wood is purchased by the carpenter who stores it near the workplace, often directly under the effects of the sun's rays. Depending on the type of wood and their needs or orders they receive, they use this stock on a need basis, without being able to check the moisture content of the material or even that all the material used in the production of one piece (e.g. a door or a bed) comes from the same stock. The moisture content can thus vary from one plank to another and even inside the same plank since the part in contact with the ground will always contain more moisture. Under these conditions, pines and cypresses dry quicker than eucalyptus, which is much more difficult to handle. This is one of the reasons why eucalyptus is not a favoured species for carpentry, especially since (with the problems highlighted above) the stocks received often come from younger and smaller trees which are almost systematically more difficult to handle than planks coming from older and bigger trees.

The traditional method can be described as a good method of pre-drying only if the wood remains under shelter for a long time. It consists in superimposing planks on each other under a (possibly) ventilated shelter, thus favouring a progressive drying. However, the ideal moisture content of 15% is also difficult to be reached with this method. In some cases, as for example on the timber market in Kigali, a company proposes an improved version of the method, by drying the wood in a cell fed with heat by means of a firewood. Unfortunately, only 'noble' sawnwood from the DRC enter this drying process because of the high cost (RWF15,000 per plank), and also because eventually the market is not ready to understand and appreciate the difference between well-dried wood and standard quality.

Even in the case of improved methods, only rarely the progression of drying seems to be respected: The normal process should heat moderately at the beginning, then rising the temperature towards the end of the drying cycle. Instead, with this method, heat managed is very random, leading to various types of follow-up problems, such as collapse (of the cells of wood due to temperatures too high), or 'cementation' (hardening of the periphery of the wood which prevents moisture from getting out). In any case, the finished products (generally of Libuyu) are better than standard ones.

In the case of the modern method (artificial drying), the woods are selected and stored on laths in the dryer. Probes driven into several pieces of wood and at different places in the dryer, provide the average moisture content of the wood via a computer program that will drive the drying process according to the initial moisture content, the thickness of the wood, the type of wood and the final moisture content to be achieved. Sprinkling takes place before starting a new drying cycle to avoid carbonization. The heat source delivered to the furnace is produced by burning wood waste. There is only one drying cell of this type throughout the country (NFC company).



The development of a sustainable value chain in Rwanda goes through several stages, from planting and monitoring of forest plantation to marketing, wood production and processing.



Conclusions and Recommendations



Despite the many challenges, Rwanda enjoys two competitive advantages. Firstly, the good business climate prevailing in Rwanda can attract investors. Secondly, Rwanda sits between DRC – a potentially giant timber provider – and countries such as Burundi, Uganda, Tanzania, Kenya, and even Eastern DRC where the demand for premium timber products is not met yet.

A densely populated country with a growing population and agricultural areas of decreasing fertility faces many challenges. Human encroachment on forest areas is under control but forest stands are not productive enough, i.e. the unbalance between the need for woody biomass and the sustainable supply reaches 4 million m³ per annum, an alarming situation (DFS et al., 2016).

As of today, the timber sector is indeed a source of income for thousands of people living in urban and rural areas. The results of this study show that about 25-30,000 direct (permanent and temporary) jobs are created, with about 75,000 people dependent on this activity, with an estimated turnover of 76 million US dollars. Despite these contributions to the national economy, numbers can and should be increased and improved, as shown by the financial and economic analyses presented in this document.

Developing the timber industry in Rwanda is necessary. This is unlikely the number one priority of the country, but it should be among the top priorities because food security, farm land productivity and woody biomass are interlinked issues. Despite the many challenges, Rwanda enjoys two competitive advantages. Firstly, the good business climate prevailing in Rwanda can attract investors. Secondly, Rwanda sits between DRC – a potentially giant timber provider – and countries such as Burundi, Uganda, Tanzania, Kenya, and even Eastern DRC where the demand for premium timber products is not met yet.

The methodology used for financial and economic modelling in this document has several areas requiring cautious interpretation. We

(as well as policy makers and technical and financial partners such as GIZ) deal with future events and no model is good enough to predict business development in the next ten years. The complexity of the value chain should not be underestimated. The opportunities derived from investing in the timber industry in Rwanda are real too. In the best-case scenario, one hundred thousand jobs, most of them qualified jobs, could be created over ten years, perhaps even earlier, should an international scope be instilled in the timber industry. Will Rwanda timber industry nurture the right business culture and will the “African IKEA” be running by 2023? It is possible. Above all, it will take leadership and some dedicated business focus.

The strategy will have to deal with uncertainty outside the timber industry. The first and by large most important use of woody biomass is firewood and to a lesser extent charcoal. Therefore, it is pointless to address timber supply without addressing firewood supply since it is virtually impossible to produce timber without producing woody by-products³¹ suitable to energy consumption. Besides, the need for firewood and charcoal comes first because it relates to primary needs such as cooking and heating. The country is densely populated, and the first and most important land use is agriculture. In Rwanda, many productive forests are degraded or very degraded with low standing stocks and low annual increments.

There will be no convincing timber industry without some major improvement on the domestic supply of timber, i.e. an industry relying mainly on import from DRC would be seen – and rightly so – as very risky. However, trees out of forest such as those grown in various agroforestry schemes may provide a significant share

31. Sawdust, off-cuts, other residues on the show such as branches, stumps, tree tops, etc.

of woody biomass needed for firewood, leaving more timber available from trees inside forests. In short, the development of the timber industry cannot be explored outside the entire rural development context, hence its complexity.

Capital intensive scenarios are compatible with labour intensive options as long as downstream processing aims at a large offering. Logging is not where the money should go. The vast majority of terrains in Rwanda is characterized by hills and steep slopes prone to erosion. The Eastern Province where gentler slopes are found also includes the Akagera National Park where timber and firewood harvesting are not allowed. Such a topography hampers systematic mechanization, i.e. labour force and unmechanized works are still very relevant.

All scenarios envisaged in this document through – fictional but realistic – business models, i.e. STP Llc, NWP Llc. and AT&F Corp. are financially profitable. This is, of course, in theory. The first scenario, i.e. the development of SMEs such as STP Llc is not economically convincing, with a benefit-to-cost ration equal to one. The lesson to learn from it is not about the size of the business per se but about the value added: in the case of STP Llc, timber is not processed further enough to create adequate value. Vertical integration must deserve some special attention in further analysis.

Despite having achieved impressive results, socio-economic patterns remain labour-intensive in rural areas. The BAU scenario reportedly employs circa 28,000 people and sustains a USD 71 million market. The mixed scenario combining 16 STP Llc., 3 NWP Llc. and 3 AF&T Corp. would employ - directly and indirectly - circa. 24,000 people and could sustain a USD 200+ million market.

Given the short time and resources allocated to conduct this assessment, conclusions can only go as far as this. More in-depth assessments are needed though: Investors and decision-makers may need to get additional information and use business models under different assumptions, i.e. simulation is needed. On the other hand, engaging into heavy computation is premature at this stage. We believe our analyses provide policy and decision makers with sufficient information for them to decide whether

or not they wish to pursue the development of the timber industry in Rwanda. The next step is upon them; hence a few recommendations are useful on the way forward.

Improve forest management and silvicultural practices

Here are some important points that forest managers must keep in mind: trees will have to provide the maximum amount of timber that is supposed to replace timber from the DRC. It is therefore necessary to adapt silviculture with more selective cuts and to lengthen the rotation. Secondly, trees must be disease and insect resistant: the selection of seed suppliers is very important, but also the choice of species.

If species diversification is interesting in terms of disease resistance, it is less the case for timber production: investments often require specializations and a great diversity of woods can penalize. For example, producing large series of butted wood panels of a single species is feasible. On the other hand, doing it with ten wood species would be difficult for production (tools may be different, type of glue, drying time, etc.), storage and sale. The silviculturalists must therefore find a compromise and concentrate on a few species only (this is the case for the moment). When a forest area is granted to a concessionaire, they will manage the forest in relation to their needs. Forest officers are required to regularly monitor whether the contract is well respected from a silvicultural point of view.

If a concession is allocated to a timber processor, the goal will be to produce and harvest as many good trees as possible with large diameters. A good silvicultural solution would be to practice selective cutting before clear cutting. The owners of other concessions (tea producers for example), must also be informed about the interest in practicing selective silviculture. They will then be able to sell the best trees to the industrial processor and make the forests more profitable. The same should be done with smaller private owners, which is obviously difficult because they think more about the short-term gain.

Modernize logging practices and build the capacity of operators

If the country wishes to make better use of its natural resources from planted forests, it will be necessary to modernize the still largely artisanal sector, which will not disappear in the short-term. In many countries around the world, this evolution has been gradual and adapted to the needs. In the case of Rwanda, the evolution cannot be done very quickly: moving from axes or hand-saws to a chainsaw or move from manual transport to that operated by large skidding equipment is revolutionary for the people concerned. This is necessary because the volume of processed wood depends on the type of company that can be set up (see proposed models). It is an economic law: no investor would set up a working tool such as a modern sawmill, a panel manufacturing plant, peeling, etc. if they have no guarantee of volume of raw materials and the possibility of selling all the stock produced.

Training must be undertaken, whether managed by the private sector or the public authorities. Training can be centralized in a training centre that is unique in the country or can be combined with companies.

What has been observed in a company such as SEAL is that the managers have to do everything at the same time: set up the production site, regulate all administrative procedures, meet the expectations of everyone, etc. Managers cannot themselves properly train dozens of young people without any experience. In addition, logging takes place outside the processing site, so monitoring is less efficient.

Workers should be able to distinguish the quality of a tree, to ensure more care for the tree with the potential for more and better logs. They must also know the concepts of environment and understand the important issue of deforestation if the environment is not rebuilt later.

Governments should have access to regular data on logging in their country: cutting locations, area, volume, category of diameters, uses, etc. By collecting this data, they will be able to compare the reality with the overall strategy and the needs of the companies. Well-targeted information brings efficiency to decision-making.

Improve working methods and quality of sawnwood

Sawing is a critical step because it impacts on the work downstream. A poorly sawn timber produces a poor yield. As for logging, training can be made on the processing site: they include the use of sawing machines, the qualitative classification of sawn products, the driving of motorized machines, the safety at work, the maintenance and the repair of the blades, etc.

An administrative task such as an inventory of logs and products sawn or left in the form of poles would allow the manager to better manage the activity and respond quickly to customers. These statistics can be transmitted to the public authorities for inclusion in summarizing tables of all forestry sector activities.

Improve the competitiveness of products on the market

Grading of sawnwood according to the presence of certain defects should be created and applied in Rwanda, as is done for many species around the world. For eucalyptus, three possible choices could be agreed: the first choice would be free of defects, the second from minor defects and the third from all defects that are acceptable for carpentry. The sales prices of the flows will vary according to the quality.

Promote drying

Wood drying should be better controlled to produce better products: the threshold to reach is 15% moisture content (20% in some cases could also do). This is especially relevant to interior carpentry (doors, stairs, panelling, etc.) and furniture making. Coffins are less concerned unless they are stored for some time inside a building. Construction products do not require extensive drying.

Natural drying is a well-established practice among the operators of the value chain. But this technique needs to be improved. Obtaining better results requires a few precautions. The wood should be sheltered from the weather, in a well ventilated shed and avoid the contact of the wood with the soil that absorb moisture by

capillarity. The pre-drying process should not go too fast at the risk of deformations, which is often the case. Stacking wood on solid ground could reduce these deformations.

The multiplication of artificial drying possibilities across the country should also be encouraged. As it stands, there is only one artificial drying cell across the country set up by a forestry company. The setting up of these drying units is an important condition of the quality of the products required for carpentry.

Economic and financial scenarios

We cannot recommend a scenario in particular. We can draw attention on particular facets of the challenges ahead in order to improve pathways to a modern timber industry in Rwanda. We have clarified the rationale behind decision-making processes, at least as far as quantitative analysis is concerned.

Analyses are as robust as assumptions lying beneath them. Therefore, we recommend to cross-check assumptions and prices. The point is not to get average prices in Rwanda for each and every input and output variables. The point is to look for mistakes. Financial data about equipment is very hard to obtain. Suppliers are reluctant to disclose their prices because they see no direct benefit for them in sharing data. They can disclose prices and other technical specifications to potential buyers, not to researchers and consultants. There is a way around it. It is suggested to approach reliable business managers, through personal acquaintance and get information from them.

The next suggestion is to stay as close as possible to the true / existing business. We used fictional companies in this document, but they were developed using some experience and data from real companies, some of them still in operation at the time of writing. Should further analysis be required by the decision makers in Rwanda, this approach should be followed.

Let us bear in mind that developing a business plan and carrying out due diligence for a company aiming at a USD 60 million turnover would usually require investigations and analyses over a period of 5 to 9 months and will involve a multi-disciplinary team: foresters,

downstream processing technicians, financial analysts, managers, lawyers, marketing experts, statisticians, etc. Such feasibility studies are costly, a few hundred thousand USD dollars at least. It may sound expensive but no serious investor would – in his right mind – invest USD 20 million without a proper due diligence.

Last but not least, crunching numbers, interpreting financial and economic ratios and elaborating models and scenarios are no substitute for judgement. The ultimate test is meeting with top decision-makers and their advisers, with real buyers, real donors and real investors, and engaging into serious discussions as if Rwanda wanted to give birth to the “African Ikea”.

Annexes

Annex 1: Questionnaire

These questionnaires have to be discussed with GIZ-Rwanda and the Ministry of Land and Forestry and adapted to local conditions and final objectives before fieldwork commences. Also, all local names (e.g. tree species) have been translated in Kinyarwanda.

Value chain questionnaire (one-to-one with operators)

Applies to:

1. Producers: Pit-sawyers, tree growers, forest owners, people who produce sawnwood from standing trees; [Note. These are the labourers who do the physical work of pit or chain sawing. If the business is owned by someone else, that person is the trader, see below];
2. Timber Intermediaries / Agents / Brokers / Middlemen [These people search out and/or organize sawnwood supply for other people in the sawnwood value chain (i.e. do not buy and sell, but work on commission or contract for a trader or other actor in the marketing chain, or help producers secure access rights in production areas)];
3. Transporters: People who transport sawnwood from one location to another (may not necessarily be the final market. These people may be owners of the timber as well as owners of the means of conveyance, or even simply the drivers. It’s an important node and we need to understand the costs/benefits of these people)
4. Traders: People who both buy and sell sawnwood, but don’t sell directly to consumers [Note. These can be the owners of the sawn business, but do not conduct the operations in the forest themselves];
5. Wholesalers/Retailers: People who sell sawnwood directly to consumers.

A. General Information

1. How do you describe your involvement in the sawnwood business?*

Actor Categories	0=No; 1=Yes	Year established/started	Rank in order of importance to income
1. Producer: Do you produce sawnwood?			
2. Agent/Broker/Middleman: Do you search out and/or organize sawnwood supply for other people in the sawnwood value chain? (i.e. does not buy and sell, but works on commission or contract for a trader or other actor in the marketing chain)			
3. Transporter: Do you transport sawnwood?			
4. Trader: Do you both buy and sell sawnwood, but don't sell directly to consumers?			
5. Wholesaler/Retailer: Do you sell sawnwood directly to consumers?			
6. Other, specify			

*Indicate all that are applicable; actors may fall in more than one category.

2. Estimate the number of individuals operating within your area of operation and how and why the number has changed over the past 5 years* [Note. This is specific to each category, depending on answer to question #1 above, but if the interviewee has suggestions on other categories, please record the number as well]

0. Name of area of operations (sub-county, district, multiple districts...)			Why change occurred?
	Current number	5 years ago	
1. Licensed sawnwood producers			
2. Un-licensed sawnwood producers			
3. Sawnwood agents/brokers/middlemen			
4 Sawnwood transporters			
5. Sawnwood traders			
6. Sawnwood wholesalers/retailers			

*Avoid double counting. For those who are involved in multiple levels of the marketing chain count them under the category they get the most income from.

3. Demographic information

1. What year were you born?	
2. What is the gender of the respondent? (0=Male; 1=Female)	
3. Civil status (1=married (or equivalent relationship); 2=unmarried; 3=widowed)	
4. What is the highest level of education you attained? (PhD, MSc, BSc, High School, Technical college...)	
5. Rwandan or non-Rwandan?	
6. Sawnwood wholesalers/retailers	

B. General Information about Sawnwood Business

1. Basic information about business

1. Are other members of your household currently engaged in sawnwood business? (0=no, 1=yes)	
1a. If yes, who are engaged and what are their roles? (across various related activities, e.g. husband working as harvester, wife managing shop...)	
1b. Are other members of your household indirectly engaged in sawnwood business, e.g. through selling food to harvesters/marketers, taking care of children while parents are at work? Who are engaged, and what are their roles?	
2. During the past 6 months, how many people outside of your own household have you employed on a full time basis? (i.e. only those engaged in sawnwood business)	

3. During the past 6 months, how many people outside of your own household have you employed on a part-time, seasonal or contract basis? (i.e. only those engaged in sawnwood business; consider formal employment rather than casual day labor)	
4. Do you belong to a cooperative group or association that is focused on the sawnwood production or trade? (0=No; 1=Yes)	
4a. If yes, what is the name of the group or association?	
4b. If no, why don't you belong to any cooperative/association?	
5. What proportion of your total income comes from sawnwood business?	
6. What other sources of income do you have? Name two and indicate proportion income: 6a)..... 6b).....	a) % income:..... b) % income:.....
7. Has your business accessed formal cash credit at any time during the past 5 years? (i.e. banks, ROSCAS, microcredit etc.) (0=No; 1=Yes)	
8. Has your business accessed informal cash credit at any time during the past 5 years (i.e. moneylenders, other sawnwood specialists etc.) (0=No; 1=Yes)	
9. In your estimation, what percentage of the sawnwood that passes through your business is produced legally?	
10. Do your customers demand *legal* products?	
	Rank 1 Rank 2 Rank 3
11. During which months is the demand for sawnwood highest?	
12. During which months is the demand for sawnwood lowest?	
13. Which districts do the majority of sawnwood that passes through your business come from?	

2. Where does the money/capital (for setting up your activities?) come from?

Tick source	Terms of access (Code A)	Purpose (For what did you use the money?)
<input type="checkbox"/> Private capital	#NA	
<input type="checkbox"/> Borrowed from family / friends		
<input type="checkbox"/> Bank		
<input type="checkbox"/> Government facility		
<input type="checkbox"/> Suppliers		
<input type="checkbox"/> Buyers		
<input type="checkbox"/> Informal local moneylenders		
<input type="checkbox"/> Other.....		

Code A

1. Fixed interest rates
2. Variable interest rates
3. Repay in timber
4. Profit sharing
5. No interest / Free loan
6. Other (specify).....

11. Market dues		
12. Payment to middlemen/brokers		
13. Food for workers		
14. Cost of spare parts (pls indicate for what, e.g. for power saws, etc.)		
15. Finance costs (e.g. servicing loans)		
16. Other costs, specify.....		
17. Total Costs		
18. Value of capital stock (i.e. trucks, bicycles, saws etc; include any stored sawnwood that was carried over from previous month)		

3. What are the costs associated with your sawnwood business?

	Amount paid per year
1. Harvesting license	
2. Transport license	
3. Trading license	
4. Income tax	
5. VAT	
6. Other, specify	

*Note: the above table should only include costs that were not captured above in 3.

D. Interactions with Forest Sector Officials and other Government Officials and Community Leaders

1. During the past 6 months approximately how many times have you or a representative of your business interacted (i.e. in person) with representatives of the following organizations regarding your business?

Organization	Number of interactions
1. District Forest Officer or Forest Inspection Division	
2. Rwanda Wildlife Authority representative	
3. National Forest Authority representative	
4. Other government officials	
5. Community leaders	

E. Enumerator Comments on Irregularities or Interesting Issues of Note with Interview (Continue on back page if necessary)

Focus group discussion questionnaire Instructions

Categories (6-12 people per group):

- One group with local leadership (both those with knowledge of the trade (including harvesting and/or selling trees) and those without)
- One group with women (both those with knowledge of the trade (including harvesting and/or selling trees) and those without)

- One group with resident youth (mixed in gender; resident; both those with knowledge of the trade (including harvesting and/or selling trees) and those without)

Selection methodology of the groups: ask the headsman for the three categories

Overview

1. What are the main sources of timber in your area? (Probe for forest regime type: natural forests on public land, natural forest reserves, government forest reserves, plantations and then scattered trees on private land including on-farm trees)	
Which timber species do people generally harvest in this community?	
Have there been changes in these preferred species over time?	
In what ways are members of this community involved in timber trade	
How does timber trade benefit the community in your area?	
How does timber trade benefit individuals in your area	
Who benefits and how? • (probe for and distinguish between selling trees (income from sales; incentives for conserving forests etc.) and harvesting (remittances, positive externalities (e.g. cooking for harvesters) etc.)	
For those receiving direct and indirect income from timber trade, what are your major uses of that money?	
How does timber trade affect the community in your area? (probe for any costs or losses associated with timber trade from the different timber sources, who is affected and how are they affected?) • (probe for and distinguish between selling trees (restrictions on forest use, tenure conflicts, elite capture, environmental impacts etc.) and harvesting (environmental impacts incl. stealing trees, increased labor burden for women when husbands go on harvesting operations etc.)	

Rules of access

1. If someone from the village wants to sell trees for timber, what are the rules? Probe for how and by whom ownership of/the right to sell tree resources is decided in different tenure regimes, any environmental assessments, prices and income distribution (incl. commissions) etc.)	
2. Can women, youth, or non-Rwandans own/sell/benefit from selling trees? If yes, How?	
3. If someone from the village wants to harvest trees for timber, what procedures do they follow? (Probe for access to harvest area; access to the tree in the different tenure regimes; payments, etc.)	
4. If someone from outside wants to harvest trees for timber, what are the procedures?	
5. Is this the same for all species? Is this same for all forest types?	
6. What is the role of community members/village headmen/chiefs/DFOs in managing the forest resources? (Probe specifically for their role in regulating timber harvesting and trade; how their involvement is perceived (what do they get out of the trade?); do they have the authority to regulate harvesting and trade? Do they have a role in coordinating harvesting/trade?)	
7. If you were to give suggestions on changing/improving these rules of access, ownership and benefits at the community level, what recommendations would you make and why?	

Environmental impacts/conservation

How have forests/trees cover/abundance of important tree species changed over time in your area. (probe for change in forest cover and changes in availability/abundance of important tree species)	
What caused these changes? If cutting for timber is not mentioned, then probe on how timber trade affects forests in the area	
What has been the impact of changes in tree cover in the community? (Probe on issues of water availability and quality, firewood availability, pasture availability, forest foods and medicinal plants availability, crafts materials, etc.)	
What have been done and by whom to address the effects of timber trade on forests and trees? How effective/ineffective have those measures been?	
What do you recommend to ensure that timber trade does not result in forest loss and loss of important timber species?	

Major trends/changes in sawn wood business since 2012

Since 2012, how have the following changed:	General Trend 1=Decreased; 2=No change; 3=Increased	Reason for Change If applicable
1. The price of a standard sized (8x2) board of low value sawnwood such as kirundu/antiarus/mukede/false mvule		
2. The price of a standard sized (8x2) board of medium value sawnwood such as musizi/mwatai-bale/albizia		
5b. The price of a standard sized board of plantation species such as pinus/cypress		
6 The general availability of sawnwood		
7 The distance that sawnwood is transported from forest gate to the end market (i.e. where consumer buys)		
8 The demand for sawnwood by consumers		
9. Number of rules and regulations regarding harvesting		
10. Number of rules and regulations regarding transporting		
11. Number of rules and regulations regarding selling		
12. The cost of obtaining permission to legally harvest sawnwood		
13. The cost of obtaining permission to legally transport sawnwood		
14. The cost of obtaining permission to legally sell sawnwood		
15. The enforcement of rules and regulations regarding sawnwood harvesting		
16. The enforcement of rules and regulations regarding transporting sawnwood		
17. The enforcement of rules and regulations regarding selling sawnwood		

How have the following policies or events affected your sawn wood business over the past five years?

1. Introduction of environmental police	
2. Ban on confiscation of illegal timber from within timber yards	
3. Forest produce check points on roads by various local governments etc.	
4. Others (specify)	

Annex II: Indicative prices per products, species and districts

Table 1. Bugesera: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Eucalyptus	86088
	Grevillea	205833
	Pinus	137580
Planche	Cedrela	84167
	Cypress	97500
	Eucalyptus	81569
	Grevillea	88817

Table 2. Burera: Products, species and prices

Products	Species	Price sold (RWF/m3)
Planche	Eucalyptus	51455
	Grevillea	72315

Table 3. Gakenke: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	71429
Planche	Eucalyptus	101086
	Grevillea	150226
	Pinus	222222

Table 5. Gicumbi: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Eucalyptus	67403
Planche	Cypress	111458
	Eucalyptus	65000
	Grevillea	72756
	Markhamia	122222

Table 6. Gisagara: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	83333
	Eucalyptus	62500
	Grevillea	59524
Planche	Cedrela	46667
	Cypress	82783
	Eucalyptus	74955
	Grevillea	101865
	Spathodea	88889

Table 7. Huye: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	48148
	Pinus	34271
Planche	Cedrela	160000
	Cypress	167767
	Eucalyptus	88143
	Grevillea	123779
	Markhamia	193333
	Pinus	122383
Spathodea	231250	

Table 8. Kamonyi: Products, species and prices

Products	Species	Price sold (RWF/m3)
Planche	Cypress	166667
	Eucalyptus	60000
	Grevillea	100000

Table 9. Karongi: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Eucalyptus	68182
Planche	Cypress	108210
	Eucalyptus	79783
	Grevillea	92820
	Pinus	128580

Table 10. Kayanza: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	58889
	Eucalyptus	86111
	Grevillea	63492
	Pinus	187994
Planche	Cypress	106173
	Eucalyptus	84167
	Grevillea	112032
	Pinus	979630

Table 11. Kirehe: Products, species and prices

Products	Species	Price sold (RWF/m3)
Planche	Eucalyptus	80990
	Grevillea	109109
	Markhamia	208333
	Pinus	222222

Table 12. Muhanga: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	101429
	Eucalyptus	75833
	Grevillea	69444
	Pinus	78819
Planche	Cedrela	83333
	Cypress	117003
	Eucalyptus	65385
	Grevillea	92448
	Markhamia	100000
	Pinus	117361

Table 13. Musanze: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	42284
	Eucalyptus	63542
Planche	Alnus	74074
	Cypress	74560
	Eucalyptus	60869
	Grevillea	67064
	Markhamia	80295
	Pinus	50223

Table 14. Ngoma: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Eucalyptus	40441
	Grevillea	26042
	Markhamia	58824
Planche	Avocatier	124868
	Cedrela	85037
	Cypress	108105
	Eucalyptus	69124
	Filao	55556
	Grevillea	85586
	Markhamia	110240
	Pinus	111111
Spathodea	105653	

Table 15. Ngororero: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	46148
	Eucalyptus	32680
	Pinus	40948
Planche	Cypress	76724
	Eucalyptus	61840
	Grevillea	90229
	Pinus	86812

Table 16. Nyabihu: Products, species and prices

Products	Species	Price sold (RWF/m3)
Planche	Alnus	41667
	Eucalyptus	54683
	Grevillea	67708

Table 17. Nyagatare: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Eucalyptus	66690
	Pinus	138889
Planche	Eucalyptus	94470
	Grevillea	126101
	Pinus	227865

Table 18. Nyamagabe: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	83333
	Eucalyptus	71905
Planche	Cypress	74571
	Eucalyptus	67429
	Grevillea	91376
	Pinus	107203

Table 19. Nyamasheke: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Eucalyptus	17949
	Pinus	16667
Planche	Cedrela	117647
	Cypress	83529
	Eucalyptus	56352
	Grevillea	75618
	Markhamia	100000
	Pinus	117040
	Spathodea	93750

Table 20. Nyanza: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cedrela	83333
	Cypress	34722
	Pinus	176711
Planche	Cedrela	111111
	Cypress	110957
	Eucalyptus	79236
	Grevillea	88393
	Pinus	129630

Table 21. Nyarugenge: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	56944
	Pinus	35769
Planche	Eucalyptus	69853
	Grevillea	37531
	Pinus	166667

Table 22. Nyaruguru: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Pinus	63321
Planche	Cypress	83500
	Eucalyptus	60988
	Grevillea	65174
	Pinus	74823

Table 23. Rubavu: Products, species and prices

Products	Species	Price sold (RWF/m3)
Planche	Grevillea	65189
	Eucalyptus	55188

Table 24. Ruhango: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	69444
	Eucalyptus	51190
Planche	Cypress	84744
	Eucalyptus	69869
	Grevillea	84251
	Markhamia	152941
	Pinus	80000

Table 25. Rulindo: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	43403
Planche	Cedrela	62500
	Cypress	235294
	Eucalyptus	56760
	Grevillea	53156

Table 26. Rusizi: Products, species and prices

Products	Species	Price sold (RWF/m3)
Planche	Cedrela	87294
	Eucalyptus	66011
	Grevillea	76910
	Markhamia	109958
	Pinus	84510
	Podocarpus	61728

Table 27. Rutsiro: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cypress	83333
Planche	Cypress	96752
	Eucalyptus	57111
	Grevillea	85795
	Pinus	120000
	Spathodea	78000

Table 28. Rwamagana: Products, species and prices

Products	Species	Price sold (RWF/m3)
Madrier	Cedrela	72222
	Eucalyptus	64286
	Grevillea	46324
	Markhamia	70370
	Pinus	27778
Planche	Cedrela	98897
	Cypress	277778
	Eucalyptus	76297
	Grevillea	101909
	Markhamia	98316
	Spathodea	101852

Table 29. Purchase prices, sales and profit (all species) per district – Traders/Wholesalers/Retailers

Districts	Products	Average price purchase (RWF/m3)	Average price sold (RWF/m3)	Profit (RWF)
Bugesera	Madrier	70537	81503	10966
	Planche	91209	107096	15888
Burera	Planche	65034	75221	10186
Gakenke	Planche	83793	97574	13782
Gasabo	Madrier	290863	357196	66333
	Planche	119183	146388	27205
Gatsibo	Madrier	81212	95758	14545
	Planche	131271	167271	36000
Gicumbi	Madrier	46608	151442	104834
	Planche	100179	118675	18496
Gisagara	Madrier	36765	40441	3676
	Planche	75833	90481	14648
Huye	Madrier	65372	79465	14093
	Planche	97452	117685	20232
Kamonyi	Madrier	70437	78373	7937
	Planche	86900	105036	18136
Karongi	Madrier	355994	399342	43347
	Planche	126763	161110	34347
Kayonza	Madrier	87235	98156	10920
	Planche	95009	108122	13113
Kicukiro	Madrier	87540	105476	17937
	Planche	97905	111472	13567
Kirehe	Planche	108336	133053	24717
Muhanga	Madrier	40179	48231	8052
	Planche	77302	88178	10876
Musanze	Madrier	103086	114205	11118
	Planche	43141	51323	8182
Ngororero	Madrier	132370	150057	17687
	Planche	118545	138495	19949
Nyabihu	Planche	73064	89206	16141
Nyagatare	Madrier	73529	82721	9191
	Planche	112572	134615	22043
Nyamagabe	Madrier	78391	90292	11902
	Planche	83389	105734	22344
Nyamasheke	Planche	67614	78812	11198
Nyanza	Madrier	20833	26042	5208
	Planche	98084	121791	23707
Nyarugenge	Madrier	316690	400010	83320
	Planche	260536	355594	95058

Nyaruguru	Madrier	49541	63649	14108
	Planche	72401	87232	14831
Rubavu	Madrier	313690	419643	105952
	Planche	81282	95513	14231
Ruhango	Planche	171409	200969	29560
Rulindo	Madrier	34583	39328	4745
	Planche	127739	145249	17511
Rusizi	Madrier	392791	436078	43287
	Planche	112400	135939	23539
Rutsiro	Planche	71759	82130	10370
Rwamagana	Madrier	110489	126303	15815
	Planche	183115	217239	34123

Annex III: Excerpts from National Forest Inventory Report (2016)

7.1 General Inventory Results

7.1.1 Forest Plantations (TIF)

The productive forest plantations (TIF) inventory for all Districts / Rwanda gives following summarized results:

	N/ha	G/ha	Vti/ha	Vs/ha	Ve/ha	Vt/ha	Vt
Mean [-]	144.64	5.28	21.77	15.32	12.94	50.03	12,791,777
Standard Deviation (SD)	194.78	9.47	72.98	27.48	32.34	105.06	26,860,354
Coefficient of Variation (CV) [%]	134.67	179.40	335.20	179.34	250.03	209.98	209.98
Level of Confidence [%]	95.00	95.00	95.00	95.00	95.00	95.00	95.00
Standard error of the mean	6.67	0.32	2.50	0.94	1.11	3.60	920,221
Standard error of the mean (e) [%]	4.61	6.15	11.48	6.14	8.57	7.19	7.19
Margin of Error (E) [%]	9.07	12.08	22.57	12.07	16.83	14.14	14.14

7.1.2 Shrubland and Savannah (TOFs)

The assessment of shrubland and savannah (TOFs) for Rwanda gives following summarized results:

	N/ha	G/ha	Vti/ha	Vs/ha	Ve/ha	Vt/ha	Vt
Mean [-]	57.69	1.81	1.77	2.41	5.68	9.86	1,406,351
Standard Deviation (SD)	97.11	3.42	7.75	4.99	16.04	25.85	3,687,013
Coefficient of Variation (CV) [%]	168.34	189.47	438.02	206.90	282.56	262.17	262.17
Level of Confidence [%]	90.00	90.00	90.00	90.00	90.00	90.00	90.00
Standard error of the mean	3.46	0.12	0.28	0.18	0.57	0.92	131,428
Standard error of the mean (e) [%]	6.00	6.75	15.61	7.38	10.07	9.35	9.35
Margin of Error (E) [%]	9.89	11.13	25.73	12.15	16.60	15.40	15.40

The overall number of trees per ha averages at 57.7 trees/ha, the basal area per ha (G/ha) is 1.81 m²/ha, while the total volume per ha (Vt/ha) reaches 9.86 m³/ha, being one fifth of the volume in forest plantations. Timber volume (Vti) comprises with 1.77 m³/ha less than 10 % of the timber volume in forest plantations, service wood volume (Vs) comprises with 2.41 m³/ha approximately a sixth of the service wood volume of forest plantations, and energy wood volume (Ve) comprises with 5.68 m³/ha approximately half of the energy wood volume per ha of forest plantations. While the overall basal area and volume values per ha can be considered low, the

Rwandan shrubland and savannahs still have considerable volume reserves that can be given with 1,406,351 m³ as approximately 11 % of the national forest plantation stock.

Considering the Rwandan population of 10,515,973 people²⁵, a – theoretical stock, since concentrated in the East, of shrublands and savannah of 0.13 m³/capita is available (regarding supply / demand estimations please refer to Chapter 0, page 126 ff.).

7.1.3 Agroforestry and Trees on Other Land Cover Classes (TOFo)

The assessment of agroforestry and trees on other land cover classes (TOFo) in Rwanda gives the following summarized results:

	N/ha	G/ha	Vti/ha	Vs/ha	Ve/ha	Vt/ha	Vt
Mean [-]	25.14	0.90	1.30	1.66	4.08	7.05	10,272,751
Standard Deviation (SD)	36.44	1.37	3.61	2.92	7.85	12.86	18,732,186
Coefficient of Variation (CV) [%]	144.93	152.79	276.64	175.34	192.05	182.35	182.35
Level of Confidence [%]	90.00	90.00	90.00	90.00	90.00	90.00	90.00
Standard error of the mean	1.21	0.05	0.12	0.10	0.26	0.43	620,285
Standard error of the mean (e) [%]	4.80	5.06	9.16	5.81	6.36	6.04	6.04
Margin of Error (E) [%]	7.91	8.34	15.10	9.57	10.48	9.95	9.95

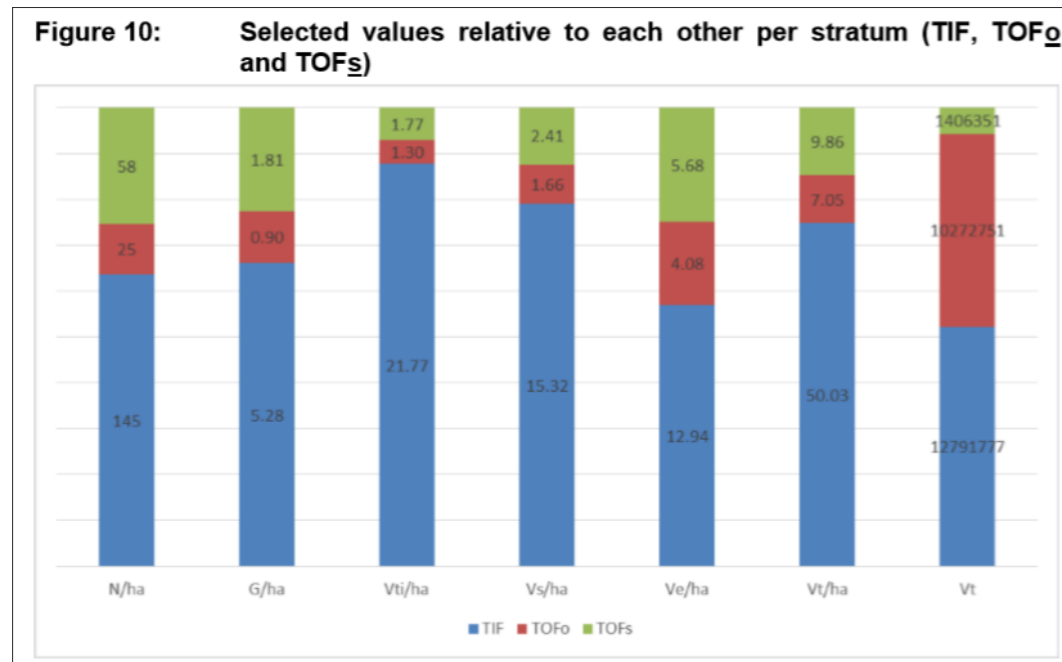
The average number of trees per ha is with 25.14 trees/ha expectedly low due to the multi-use system in agro-forestry or other land cover classes²⁶. The overall basal area per ha (G/ha) is 0.90 m²/ha, while the total volume per ha (Vt/ha) reaches 7.05 m³/ha, being approximately 70 % of the volume in shrubland / savannah. Timber volume (Vti) comprises with 1.30 m³/ha less than 10 % the timber volume in forest plantations on the same area and is even lower than in shrubland / savannah. Service wood volume (Vs) comprises with 1.66 m³/ha approximately 66 % of the service wood volume of shrubland / savannah, and energy wood volume (Ve) comprises with 4.08 m³/ha approximately 73 % of the energy wood volume per ha of shrubland and savannah. It has to be considered that the quality of timber wood and service wood can be expected to be lower than that in forest plantations or even shrubland and savannah, since trees in agroforestry areas are rather large-crowned single trees, naturally producing a rather short but big-diameter, tapered stem that is more often bent or has other issues such as damages lowering the quality for timber and service wood.

Considering the TOFo stratum area in Rwanda of 1,456,629.98 ha, a total volume of 10,272,751 m³ results, which is approximately 80 % the total volume provided by forest plantations and approximately 7 times the total volume provided by shrubland and savannahs in Rwanda. Considering in addition a total population of 10,515,973 people²⁸, a stock of agroforestry and trees on other land cover classes of 0.98 m³/capita is available in Rwanda.

7.1.4 Comparison of Assorted Values – TIF, TOFs and TOFo

7.1.4.1 National level (Rwanda)

The following Figure depicts selected values of the three assessed strata throughout the country.

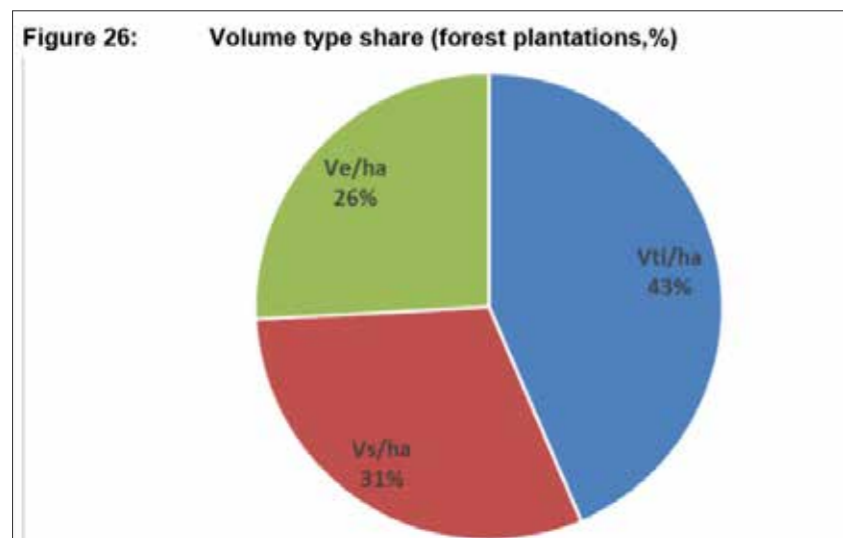


7.2.1.4 Ratio of volume types

Regarding the share of the different volume types for timber, service wood and energy wood on the whole country (50.3 m³/ha, or 12,797,777 m³), overall 21.6 m³/ha fall under timber wood, while the remaining shares fall under service wood (15.6 m³/ha) and energy wood (13.1 m³/ha).

It will be seen further in the report, that the Western Province is highly responsible for this high timber wood proportion in plantation forest, being the major plantation wood stock of the country and presenting a high rate of timber wood (53 %).

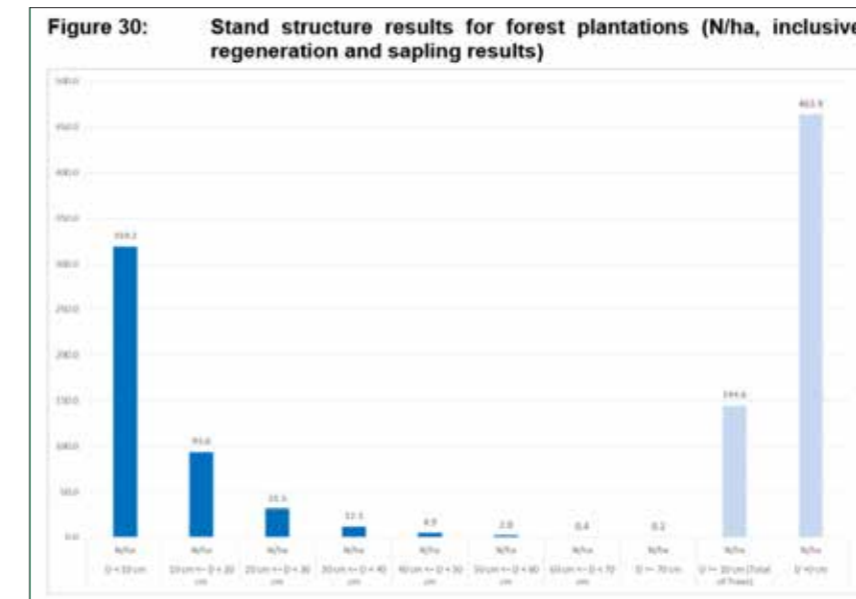
As seen above, this high timber wood proportion is mainly composed by large diameter trees in the stands of *Pinus patula*. Indeed the Dref of the tree of medium basal area is 31.0 cm for this species. *Pinus patula* timber wood stock is almost 3.7 Mill. m³ (66 % of timber wood), followed by *Eucalyptus* spp. (1.3 Mill. m³, 24% of timber wood).



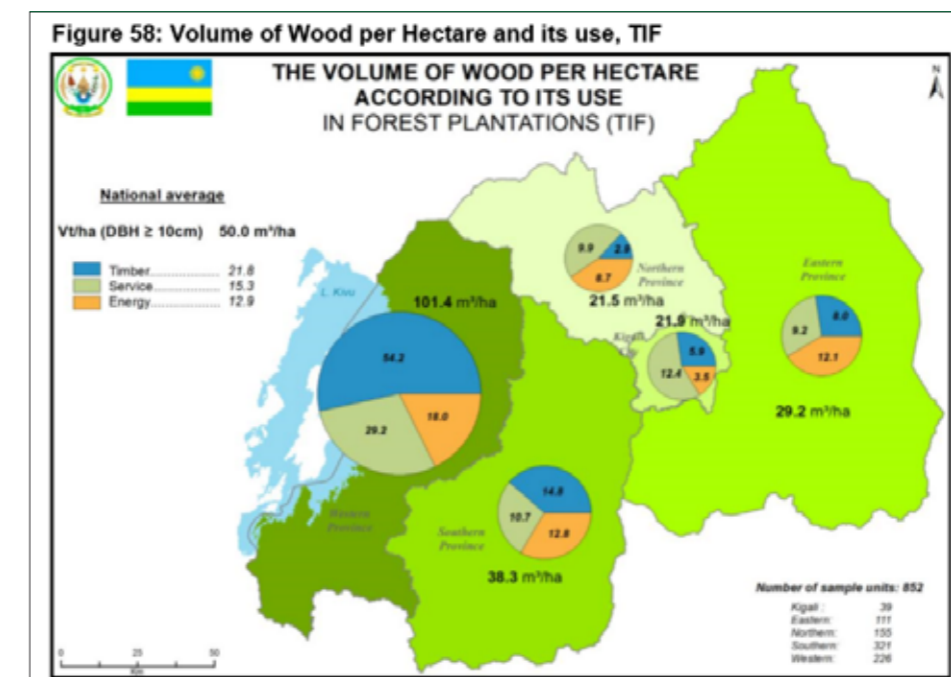
7.2.1.8 Stand structure results (N/ha)

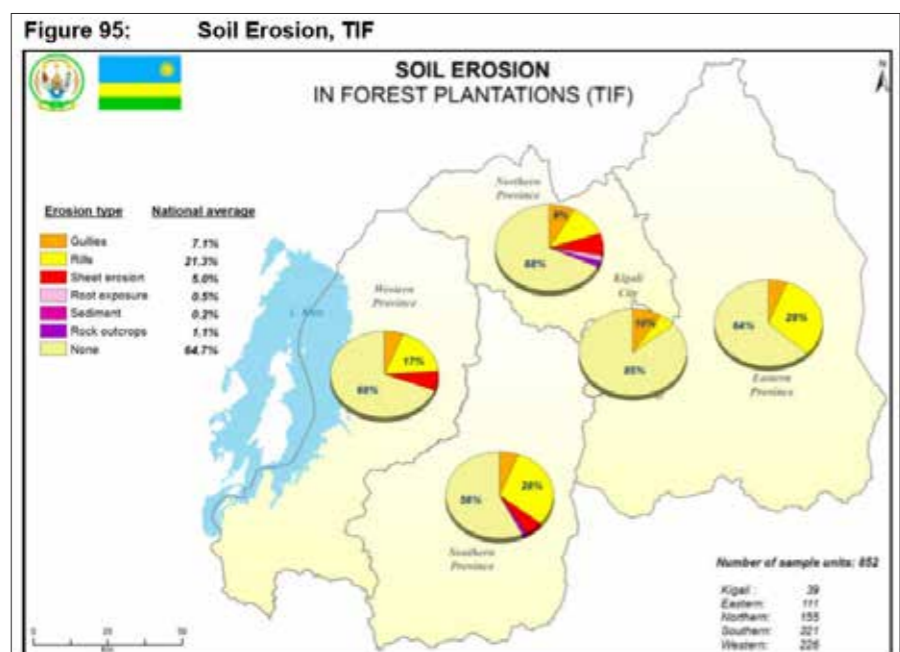
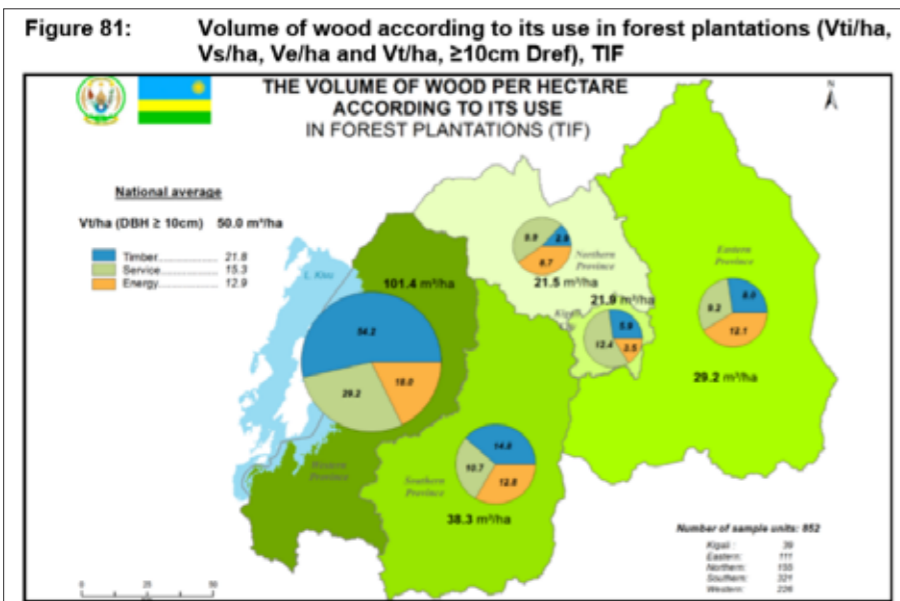
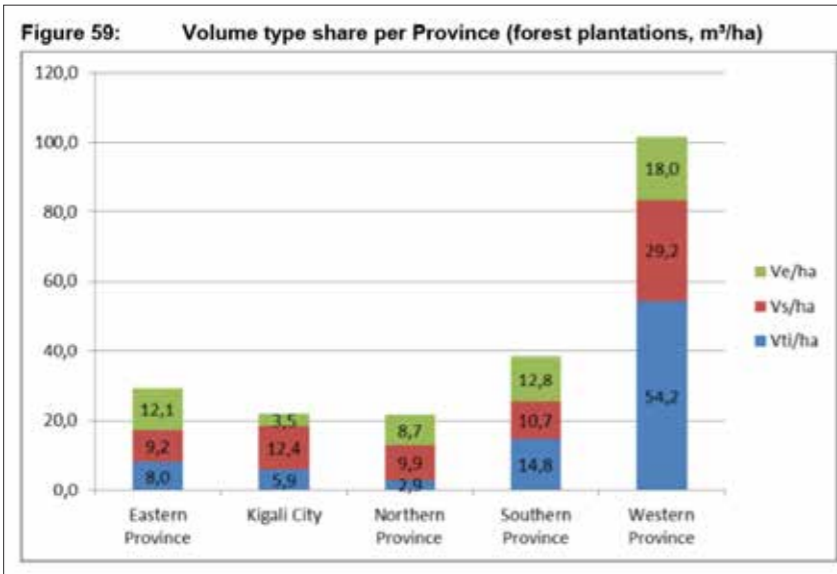
a. Stand structure results (N/ha) -all- species

Figure 30 shows the distribution of (i) tree number per ha and (ii) regeneration / sapling number per ha within Dref classes for forest plantations (N/ha, inclusive regeneration and sapling results), all species gathered.



A prevalence of trees within the smaller Dref classes is obvious with about two thirds (65.0 %) of all trees (Dref ≥ 10 cm) are within the smallest Dref class of 10 - 20 cm (of which 57.52 % are *Eucalyptus* spp). This corresponds to a negative exponential curve, which is typical of well-balanced stands. In this case however, one can observe very low stocking levels in higher Dref classes, most likely due to overutilization of sub mature trees in the coppice with standard stands and in high forest treatment regime.



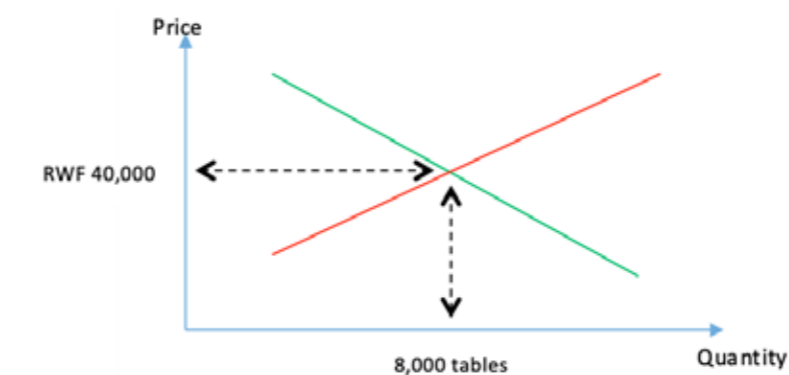


Annex IV: Useful theories and business facts about Rwanda

Useful Theories

The following basic clarifications are relevant to readers with no economic background. Those interested in using more accurate information could read books listed under references here above. The following principles and theories are not presented in any particular order. They are very relevant to this study because costs, prices, consumer's behaviour are central to business strategies and investment decisions.

The supply-demand model and companion principles



The product, e.g. a wooden table sells for RWF 40,000 in Kigali. Urban retailers sell 8,000 units per annum at RWF 40,000 apiece. Urban retailers or sellers are behind the supply curve (red line). Similarly, householders and enterprises, i.e. end-users are happy to purchase one or several wooden tables at his unit price; altogether 8,000 tables were purchased. They are behind the demand curve (green line).

The supply (or offer) – demand model can be as useful as it can be misleading. Like any model, it suggests a simplified explanation of economic behaviour. This model works best in efficient markets, where prices and quantity, i.e. offer/ supply and demand / consumption are elastic.

Efficient markets are characterized by transparency, i.e. virtually no information asymmetry. However, research conducted in the last six months suggested otherwise: market for eucalyptus timber is quite efficient, mostly because it is dominant and many transactions occur while market for pine timber is rather inefficient and information asymmetry prevails.

Elasticity is useful for explaining the behaviour of sellers and buyers in the market. We will come back to elasticity a bit later. A new assumption is introduced here: we deal with rationale operators, i.e. each and everyone want to maximize his or her profit. A trivial illustration is given hereafter.

Rationale sellers will try to sell as many tables at the highest possible price. They do not want to make a loss, so there is a threshold below they do not want to sell. This is the willingness to sell (WTS). It may vary from seller to seller. Let's keep it simple: they do not want to sell under the cost, that is, the minimum price is equal to the cost.

Buyers, conversely, will try to buy all the table they need at the lowest possible price. They want to get value for money, i.e. pay the right price for the quality meeting their expectations. There is a ceiling to that, i.e. the highest price they may pay. This willingness to buy (WTB) varies from buyer to buyer. How the WTS and the WTB elate to the supply-demand model? Very few end-users could afford

buying tables at RWF 65,000. And very few sellers would accept to sell tables below RWF 20,000. This model WTS – WTB encapsulates the individual transaction, i.e. negotiation power of suppliers versus customers, and a tricky notion: value versus price.



The bluish double-head arrow represents the room for negotiation. At both extremes, unfair deals take place, i.e. a win-lose situation where either the buyer or the seller gets the lion's share. In the middle, fair deals are struck, a win-win situation. This simple model helps explaining the value versus price. Price is what you pay. Value is what you get. Quality is the subjective assessment of value. So quality is about perception. It is assumed that quality products are more expensive, so high prices convey high quality. In the real world, it is not that simple.

Price-elasticity play an important role. The demand for a given product is price-elastic when it is easily impacted by the price of this product. The supply of a given product is price-elastic when it is easily impacted by the price of this product.

In Rwanda timber industry, the following may constraint price-elasticity:

1. Purchasing power of end-users;
2. Natural supply of domestic source of timber;
3. Limited imports;
4. Lack of downstream-processing capacity delivering high quality products.
5. Etc.

Demand and consumption are often different. In short, consumption relates to the share of demand that the market can satisfy. For instance, there is a demand for wooden chairs, but the industry cannot supply that many chairs because there is inadequate supply of quality logs and inadequate drying capacity and inadequate downstream processing know-how and machinery. This illustrative case could explain why, for example 68% of chairs used in the country are imported plastic, metal and wooden chairs.

Substitution and usefulness are the last two basic principles we wish to introduce. A wooden chair is not like a plastic chair but both items can be used as a seat. Plastic chair is thus a substitute for wooden chair. The principle applies to virtually all wooden products: their substitutes in plastic or metal they can fulfil similar functions.

Business strategy, risk, interest rate, competition and comparative advantage

Business strategy forms a nexus of disciplines, principles, theories and tools. We do not provide here some support for a crash course on those topics. Instead, we wish to emphasize the key elements business strategists usually need before engaging into new venture or up-scaling existing operations. A few pre-conceived ideas need to be addressed here.

“Businessmen do not invest in risky ventures”

It is wrong. Smart investors assess risks and risk mitigation capacity. Usually, where there is zero risk, there is no profit. It translates into interest rates. High risks command high returns, i.e. any profit-driven investors will seek high return on investment (ROI) whenever risks are high. For some reasons, government bonds in many wealthy countries are reportedly risk-free and command the lowest return in the economy. In short, no risk, no market reward. However, investors come in all shapes of risk-profile. It is a kind of continuum. At one extreme, risk-averse investors will purchase swiss bonds only. At the other end of the continuum, we find business angels investing in ten highly risky start-ups where, hopefully, one is very highly profitable while nine go bankrupt within three years.

“Vertical integration allows higher profits through economy of scale”

It depends but most often, it is untrue. Smart outsourcing usually provides the best trade-off. Let's imagine that all operators involved in timber industry in Rwanda would work for, say, ten corporations. Firstly, we are not far from an oligopoly often resulting in distorted prices. Except for a few industries³² with very solid barriers to entry, such businesses are short-lived. Intuitively, integration can only be achieved by company with a certain size. A business aiming at vertical integration have to buy its own saws or chainsaws, own skidders and trucks, own sawmills, own carpentry workshops, own retail outlets, etc. Even wealthy companies could be reluctant to do so. It is about the size of investment on the one hand and the perception of risks of the other hand.

Let's consider an investor considering purchasing her own trucks. The company may buy three new trucks, for a total amount of USD 300,000 or outsource transport. The company will need to pay for drivers and other fixed costs even when business is low. In case of accident, the loss can be severe and there is some risks about being compensated by insurance companies. On the other hand, the transport industry in Rwanda is reasonably well developed, so the smart investor will shop around and try to get the best deal while transferring risks to someone else.

“Relying on domestic source of timber only is the ideal long-term strategy”

This assumption is likely flawed. Here comes Ricardo's law. Rwanda is a small and densely populated country. Land is primarily needed for agriculture. Securing domestic supply of timber is one thing. Developing the timber industry is entirely different. Rwanda is not good at producing timber: limited forest areas, huge woody biomass demand-supply unbalance, few tree species convenient for downstream processing, slow growth, etc. Successful businesses engage in what their doing best, i.e. where they do have some competitive advantage. Nevertheless, Rwanda landowners and Rwanda state do own forest areas where timber can be produced. Rwanda possess a very good business climate, and is located at a cross-road between DRC – a potentially huge producer – and other countries where demand for timber is difficult to meet: Burundi, Tanzania, Uganda, and other countries in the region. If policy-makers have to guide investment strategies in the timber industry, they should consider Ricardo's law. Downstream-processing require substantial investments and so does tree planting and timber production. The first one is to favour over the second one, given the advantage of Rwanda is business management and business climate as compared to its capacity to produce land-consuming raw material.

³². Airbus, Boeing, and a few other businesses build long haul airplanes. A few enterprises are able to build and launch satellites. A few enterprises can build military jets or military submarine or nuclear reactors.

“The more timber we may produce in Rwanda the better”

While it makes sense to produce some timber in Rwanda, it is unwise – and probably impossible - to maximise the production. The demand for energy wood is growing and it is very high. Pareto’s law, or the 80-20 law, can be useful too. We should not be surprised if 80% of the value in the timber industry come from 20% of the volume of timber processed in the country.

The time value for money is a principle worth to mention. It underlays the discounted cash-flow valuation techniques we find in both financial and economic analyses. As the saying goes “a bird in hand worth two in the bush”. This is especially relevant to the forestry sector because trees take time to mature. While we talk in monthly- or a few year-horizons in agriculture, we often talk in decades in forestry. Timber is a wooden product that often requires the largest stems as compared to fuel-wood and service wood.

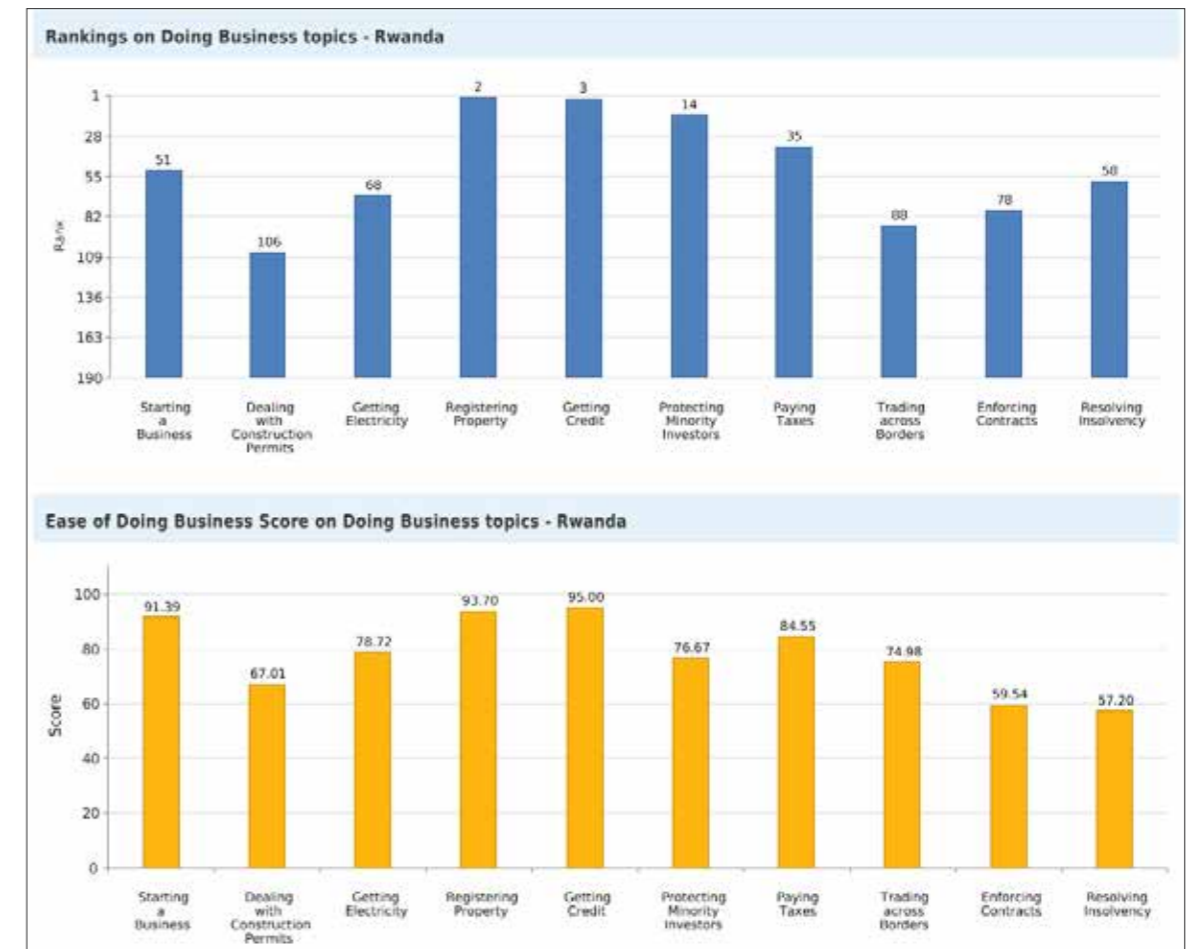
The Theory of Change

Policy-planners and policy-makers in Rwanda are making every endeavour towards economic development, including creation of jobs and alleviating poverty. The forestry sector surely can contribute to this national objective. Substantial investment is needed in operating assets – adequate mechanization – and capacity building, i.e. a broad base of competent technicians. Developing a theory of change would be useful here. It will show the pathways from business as usual to modern timber industry in Rwanda more clearly.

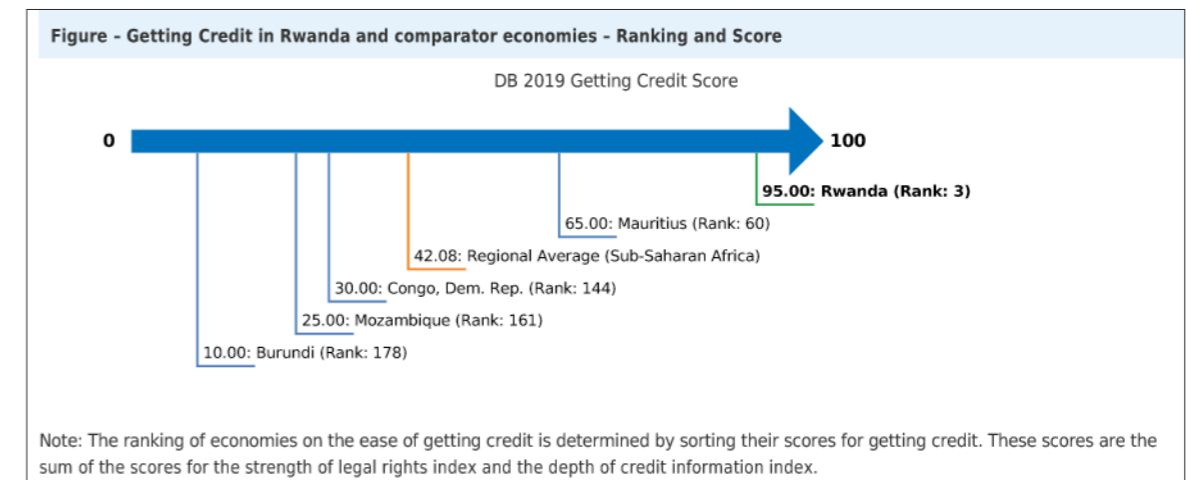
The Theory of Constraints

This theory is central to managing processes, such as downstream processing. Research and books from Goldratt and Cox (1986) are good references in this respect. Notions like bottleneck, throughput, unbalanced system, excess capacity and statistical fluctuations are very relevant to further assess the current technical and economic performance of the timber industry in Rwanda.

Business Facts about Rwanda



Source : World Bank Group (2019)



Note: The ranking of economies on the ease of getting credit is determined by sorting their scores for getting credit. These scores are the sum of the scores for the strength of legal rights index and the depth of credit information index.

Source : World Bank Group (2019)

Doing Business 2019 Rwanda	
Details - Paying Taxes in Rwanda - Tax by Type	
Taxes by type	Answer
Profit tax (% of profit)	25.7
Labor tax and contributions (% of profit)	6
Other taxes (% of profit)	1.5

Source : World Bank Group (2019)



Source : World Bank Group (2019)

Labor Market Regulation - Rwanda	
Details - Labor Market Regulation in Rwanda	
	Answer
Hiring	
Fixed-term contracts prohibited for permanent tasks?	No
Maximum length of a single fixed-term contract (months)	No limit
Maximum length of fixed-term contracts, including renewals (months)	No limit
Minimum wage applicable to the worker assumed in the case study (US\$/month)	0.0
Ratio of minimum wage to value added per worker	0.0
Maximum length of probationary period (months)	6.0

Source : World Bank Group (2019)

Working hours	
Standard workday	8.5
Maximum number of working days per week	6.0
Premium for night work (% of hourly pay)	0.0
Premium for work on weekly rest day (% of hourly pay)	0.0
Premium for overtime work (% of hourly pay)	0.0
Restrictions on night work?	No
Whether nonpregnant and nonnursing women can work the same night hours as men	Yes
Restrictions on weekly holiday?	No
Restrictions on overtime work?	No
Paid annual leave for a worker with 1 year of tenure (working days)	18.0
Paid annual leave for a worker with 5 years of tenure (working days)	19.0
Paid annual leave for a worker with 10 years of tenure (working days)	21.0
Paid annual leave (average for workers with 1, 5 and 10 years of tenure, in working days)	19.3

Source : World Bank Group (2019)

Redundancy rules	
Dismissal due to redundancy allowed by law?	Yes
Third-party notification if one worker is dismissed?	Yes
Third-party approval if one worker is dismissed?	No
Third-party notification if nine workers are dismissed?	Yes
Third-party approval if nine workers are dismissed?	No
Retraining or reassignment obligation before redundancy?	No
Priority rules for redundancies?	Yes
Priority rules for reemployment?	No

Source : World Bank Group (2019)

Redundancy cost	
Notice period for redundancy dismissal for a worker with 1 year of tenure	4.3
Notice period for redundancy dismissal for a worker with 5 years of tenure	4.3
Notice period for redundancy dismissal for a worker with 10 years of tenure	4.3
Notice period for redundancy dismissal (average for workers with 1, 5 and 10 years of tenure)	4.3
Severance pay for redundancy dismissal for a worker with 1 year of tenure	4.3
Doing Business 2019	Rwanda
Severance pay for redundancy dismissal for a worker with 5 years of tenure	8.7
Severance pay for redundancy dismissal for a worker with 10 years of tenure	13.0
Severance pay for redundancy dismissal (average for workers with 1, 5 and 10 years of tenure)	8.7

Source : World Bank Group (2019)

Job quality	
Equal remuneration for work of equal value?	No
Gender nondiscrimination in hiring?	No
Paid or unpaid maternity leave mandated by law?	Yes
Minimum length of maternity leave (calendar days)?	84.0
Receive 100% of wages on maternity leave?	Yes
Five fully paid days of sick leave a year?	Yes
Unemployment protection after one year of employment?	No
Minimum contribution period for unemployment protection (months)?	n.a.

Source : World Bank Group (2019)

Business Reforms in Rwanda
In the past year, <i>Doing Business</i> observed a peaking of reform activity worldwide. From June 2, 2017, to May 1, 2018, 128 economies implemented a record 314 regulatory reforms improving the business climate. Reforms inspired by <i>Doing Business</i> have been implemented by economies in all regions. The following are reforms implemented since <i>Doing Business</i> 2008.
✓ = <i>Doing Business</i> reform making it easier to do business. ✗ = Change making it more difficult to do business.
DB2019
✓ Starting a Business: Rwanda made starting a business less costly by replacing electronic billing machines with free software for value added tax invoices.
✓ Getting Electricity: Rwanda improved the monitoring and regulation of power outages by beginning to record data for the annual system average interruption duration index (SAIDI) and system average interruption frequency index (SAIFI). Rwanda also made getting electricity more time and cost efficient by having the utility supply all connection material.
✓ Registering Property: Rwanda made registering property easier by improving the land dispute resolution mechanisms of the land administration system.
✓ Getting Credit: Rwanda strengthened access to credit by enacting a new insolvency law. An automatic stay is now imposed on secured creditors for a period of 6 months and the law provides for reliefs from such stay when the assets are perishable or are not needed for the reorganization of the company.
✓ Trading across Borders: Rwanda reduced the time required to export and import by implementing the Single Customs Territory, risk-based inspections and online certificates.
✓ Enforcing Contracts: Rwanda made enforcing contracts easier by issuing new rules of civil procedure which limit adjournments to unforeseen and exceptional circumstances.
✓ Resolving Insolvency: Rwanda made resolving insolvency easier by making insolvency proceedings more accessible for creditors and granting them greater participation in the proceedings. Rwanda also made resolving insolvency more difficult by hindering the continuation of the debtor's business during insolvency proceedings.

Source : World Bank Group (2019)

DB2018
✓ Dealing with Construction Permits: Rwanda increased quality control during construction by introducing risk-based inspections.
✓ Registering Property: Rwanda made registering property easier by implementing online services to facilitate the registration of property transfers.
✓ Protecting Minority Investors: Rwanda strengthened minority investor protections by making it easier to sue directors, clarifying ownership and control structures and requiring greater corporate transparency.
✓ Paying Taxes: Rwanda made paying taxes easier by establishing an online system for filing and paying taxes.
✓ Enforcing Contracts: Rwanda made enforcing contracts easier by making judgements rendered at all levels in commercial cases available to the general public through publication on the judiciary's website.
DB2017
✓ Starting a Business: Rwanda made starting a business easier by improving the online registration one-stop shop and streamlining post-registration procedures.
✗ Dealing with Construction Permits: Rwanda made dealing with construction permits more cumbersome and expensive by introducing new requirements to obtain a building permit. It also strengthen the quality control index by implementing the qualifications required for architects and engineers.
✓ Registering Property: Rwanda made it easier to register property by introducing effective time limits and increasing the transparency of the land administration system.
✗ Paying Taxes: Rwanda made paying taxes more complicated by introducing a requirement that companies file and pay social security contributions monthly instead of quarterly.
✓ Trading across Borders: Rwanda made trading across borders easier by removing the mandatory pre-shipment inspection for imported products.
✓ Enforcing Contracts: Rwanda made enforcing contracts easier by introducing an electronic case management system for judges and lawyers.

Source : World Bank Group (2019)

<p>DB2016</p> <ul style="list-style-type: none"> ✓ Starting a Business: Rwanda made starting a business easier by eliminating the need for new companies to open a bank account in order to register for VAT. ✓ Dealing with Construction Permits: Rwanda made dealing with construction permits easier by adopting a new building code and new urban planning regulations. ✓ Getting Credit: In Rwanda the credit bureau started to provide credit scores to banks and other financial institutions while the credit registry expanded borrower coverage, strengthening the credit reporting system. ✓ Protecting Minority Investors: Rwanda strengthened minority investor protections by introducing provisions allowing holders of 10% of a company's shares to call for an extraordinary meeting of shareholders, requiring holders of special classes of shares to vote on decisions affecting their shares, requiring board members to disclose information about their directorships and primary employment and requiring that audit reports for listed companies be published in a newspaper. ✓ Paying Taxes: Rwanda made paying taxes easier for companies by introducing electronic filing and making its use compulsory. ✗ Trading across Borders: Rwanda increased the time and cost for documentary and border compliance for importing by making preshipment inspection mandatory for all imported products. ✓ Resolving Insolvency: Rwanda improved its insolvency system by introducing provisions on voidable transactions and the approval of reorganization plans and by establishing additional safeguards for creditors in reorganization proceedings.
<p>DB2015</p> <ul style="list-style-type: none"> ✗ Starting a Business: Rwanda made starting a business more difficult by requiring companies to buy an electronic billing machine from a certified supplier. ✓ Dealing with Construction Permits: Rwanda made dealing with construction permits easier by eliminating the fee for obtaining a freehold title and by streamlining the process for obtaining an occupancy permit. ✓ Getting Electricity: In Rwanda the electricity company made getting electricity less costly by eliminating several fees. ✓ Getting Credit: Rwanda improved access to credit by establishing clear priority rules outside bankruptcy for secured creditors and establishing clear grounds for relief from a stay of enforcement actions by secured creditors during reorganization procedures.

Source : World Bank Group (2019)

<p>DB2014</p> <ul style="list-style-type: none"> ✓ Starting a Business: Rwanda made starting a business easier by reducing the time required to obtain a registration certificate. ✓ Dealing with Construction Permits: Rwanda made dealing with construction permits easier and less costly by reducing the building permit fees, implementing an electronic platform for building permit applications and streamlining procedures. ✓ Registering Property: Rwanda made transferring property easier by eliminating the requirement to obtain a tax clearance certificate and by implementing the web-based Land Administration Information System for processing land transactions. ✓ Getting Credit: Rwanda strengthened its secured transactions system by providing more flexibility on the types of debts and obligations that can be secured through a collateral agreement. ✓ Protecting Minority Investors: Rwanda strengthened investor protections through a new law allowing plaintiffs to cross-examine defendants and witnesses with prior approval of the questions by the court. ✓ Paying Taxes: Rwanda made paying taxes easier and less costly for companies by rolling out its electronic filing system to the majority of businesses and by reducing the property tax rate and business trading license fee. ✓ Trading across Borders: Rwanda made trading across borders easier by introducing an electronic single-window system at the border. ✓ Resolving Insolvency: Rwanda made resolving insolvency easier through a new law clarifying the standards for beginning insolvency proceedings; preventing the separation of the debtor's assets during reorganization proceedings; setting clear time limits for the submission of a reorganization plan; and implementing an automatic stay of creditors' enforcement actions.
<p>DB2013</p> <ul style="list-style-type: none"> ✓ Getting Electricity: Rwanda made getting electricity easier by reducing the cost of obtaining a new connection. ✓ Enforcing Contracts: Rwanda made enforcing contracts easier by implementing an electronic filing system for initial complaints.

Source : World Bank Group (2019)

<p>DB2012</p> <ul style="list-style-type: none"> ✓ Starting a Business: Rwanda made starting a business easier by reducing the business registration fees. ✗ Registering Property: Rwanda made transferring property more expensive by enforcing the checking of the capital gains tax. ✓ Getting Credit: In Rwanda the private credit bureau started to collect and distribute information from utility companies and also started to distribute more than 2 years of historical information, improving the credit information system. ✓ Paying Taxes: Rwanda reduced the frequency of value added tax filings by companies from monthly to quarterly.
<p>DB2011</p> <ul style="list-style-type: none"> ✓ Dealing with Construction Permits: Rwanda made dealing with construction permits easier by passing new building regulations at the end of April 2010 and implementing new time limits for the issuance of various permits. ✓ Getting Credit: Rwanda enhanced access to credit by allowing borrowers the right to inspect their own credit report and mandating that loans of all sizes be reported to the central bank's public credit registry. ✓ Trading across Borders: Rwanda reduced the number of trade documents required and enhanced its joint border management procedures with Uganda and other neighbors, leading to an improvement in the trade logistics environment.
<p>DB2010</p> <ul style="list-style-type: none"> ✓ Starting a Business: Rwanda made starting a business easier by eliminating the notarization requirement; introducing standardized memoranda of association; putting publication online; consolidating name-checking, registration fee payment, tax registration and company registration procedures; and reducing the time required to process completed applications. ✓ Registering Property: Rwanda reduced the time required to transfer property through ongoing improvements in the property registration process. ✓ Getting Credit: Rwanda strengthened its secured transactions system by allowing a wider range of assets to be used as collateral, permitting a general description of debts and obligations in the security agreement, allowing out-of-court enforcement of collateral, granting secured creditors absolute priority within bankruptcy and creating a new collateral registry. ✓ Protecting Minority Investors: Rwanda strengthened investor protections through a new company law requiring greater corporate disclosure, increasing director liability and improving shareholders' access to information. ✓ Trading across Borders: Rwanda reduced the time required for trading across borders by introducing administrative changes such as expanded operating hours and enhanced border cooperation and by eliminating some documentation requirements. ✓ Resolving Insolvency: Rwanda improved its insolvency process through a new law aimed at streamlining reorganization procedures. <p>Labor Market Regulation: Rwanda increased the maximum duration of fixed-term contracts and eliminated the obligation to notify and seek the approval of a third party in cases of redundancy dismissals.</p>

Source : World Bank Group (2019)

<p>DB2009</p> <ul style="list-style-type: none"> ✓ Dealing with Construction Permits: Rwanda made dealing with construction permits easier by streamlining project clearances for the second year in a row—combining the procedures for obtaining a location clearance and a building permit in a single application form—and by introducing a single application form for water, sewerage and electricity connections. ✓ Registering Property: Rwanda reduced the cost and time to register property by replacing the 6% registration fee with a flat rate, regardless of the property value, and by creating a centralized service in the tax authority to speed up the issuance of the certificate of good standing. ✓ Trading across Borders: Rwanda reduced the time for exporting and importing by extending the opening hours of customs points, implementing or improving electronic data interchange and risk-based inspection systems and making improvements in the transport sector. ✓ Enforcing Contracts: Rwanda made enforcing contracts easier by launching 3 commercial courts—in Kigali, in Northern Province and in Southern Province.
<p>DB2008</p> <ul style="list-style-type: none"> ✓ Dealing with Construction Permits: Rwanda made dealing with construction permits easier by decentralizing the permit system—which reduced the time for getting a building permit and an occupancy permit—and by reducing the time for obtaining an electricity connection. ✓ Trading across Borders: Rwanda made trading across borders easier by expediting the acceptance of customs declarations and liberalizing the warehouse services market.

Source : World Bank Group (2019)

Item	Tree species	Production targets			Pricing policies (USD)			Revenue target			Wood consumption target		
		STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.
1 Table	Average quality		8.000	2.000		56		448.000		112.000		0	0
	High quality											0	717
	Average quality		6.000	2.000		60		360.000		120.000		0	0
	High quality			20.000		220				4.400.000		0	1.792
	Unit Vol. m³												
2 Chair	Average quality												
	High quality		32.000	10.000		10		320.000		100.000		0	497
	Average quality		24.000			8		192.000				0	0
	High quality			60.000		35			2.100.000		0	0	932
	Unit Vol. m³												
3 Sofa frame	Average quality												
	High quality		7.500			40		300.000				0	566
	Average quality		2.500			40		100.000				0	0
	High quality			10.000		140			1.400.000		0	0	754
	Unit Vol. m³												
4 Bed frame	Average quality												
	High quality												
	Average quality		15.000	2.000		55		825.000		110.000		0	2.047
	High quality			35.000		120			4.200.000		0	0	4.775
	Unit Vol. m³												
5 Door & door frame	Average quality												
	High quality		9.000	15.000		50		450.000		750.000		0	872
	Average quality		9.000			55		495.000				0	0
	High quality			45.000		125			5.625.000		0	0	4.359
	Unit Vol. m³												
6 Stairs 280 cm	High quality												
	High quality			200		1.500			300.000		0	0	38
	High quality			600		1.900			1.140.000		0	0	113
	High quality			3.000		2.100			6.300.000		0	0	565
	Unit Vol. m³												

Item	Tree species	Production targets			Pricing policies (USD)			Revenue target			Wood consumption target		
		STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.
7 Planches	Average quality		15.000			4		60.000				257	0
	High quality											0	513
	Average quality		30.000	10.000		6		180.000		60.000		0	171
	High quality			10.000		6				60.000		0	0
	Unit Vol. m³												
8 Beam plain wood	Average quality												
	High quality		30.000	5.000		11		165.000				684	0
	Average quality		30.000			15		450.000		50.000		1.368	228
	High quality			10.000		18			120.000		0	0	456
	Unit Vol. m³												
9 Beam assembled	High quality												
	High quality												
	High quality												
	High quality												
	Unit Vol. m³												
10 Board assembled	High quality												
	High quality												
	High quality												
	High quality												
	Unit Vol. m³												
11 Window frame	High quality												
	High quality												
	High quality												
	High quality												
	Unit Vol. m³												
12 Flooring	High quality												
	High quality												
	High quality												
	High quality												
	Unit Vol. m³ / m²												

Data on products and pricing policies

	Scenario 1	Scenario 2	Scenario 3			
Afforestation & stand improvement	100	150	50			
Infra., Tool, Equip. & Machinery (B)	20	100	150			
Infra., Tool, Equip. & Machinery (A)	10	50	250			
Capacity building	3	15	40			
Timber Marketing System		10	50			
	STP Lic	NWP Lic	ATF Corp.	Unit price (USD)	Lifespan (Y.)	Investment (USD)
Back office & admin. investment						
Fleet of cars	1	3	18	35,000	5	STP Lic 35,000 NWP Lic 105,000 ATF Corp. 630,000
Computer & IT set	1	19	75	1,000	3	1,000 19,000 75,000
Other office equipment & furniture	1	12	75	5,000	10	5,000 60,000 375,000 41,000 184,000 1,080,000
	STP Lic	NWP Lic	ATF Corp.	Unit price (USD)	Lifespan (Y.)	Investment (USD)
Afforestation & stand improvement						
Tractor & trailer		2	1	42,000	5	STP Lic - NWP Lic 84,000 ATF Corp. 42,000
Set of hand tools	5	22	8	340	10	1,700 7,480 2,720
Seedlings (annual) - 10000 m³ logs/40ha	344.816	1,600.828	656.280	0,1		34,482 160,083 65,628 36,182 251,563 110,348
	STP Lic	NWP Lic	ATF Corp.	Unit price (USD)	Lifespan (Y.)	Investment (USD)
Infra., Tool, Equip. & Machinery (A)						
Plant (A), incl. Warehouse		1	2	600,000	20	STP Lic 600,000 NWP Lic 1,200,000 ATF Corp. 432,000
Driers		4	6	72,000	15	288,000 432,000
Workshop + Yard	1			100,000	20	100,000
Felling and bucking handtools	8	40	20	480	5	3,840 19,200 9,600
Chainsaw, chains & sharpening set	4	20	12	890	3	3,560 17,800 10,680
Tractor and trailer		8	6	42,000	5	0 336,000 252,000
Cable yarding & accessories & fittings		2	1	22,000	5	0 44,000 22,000
Other tools, Equip. and machinery	1	4	2	600,000	15	600,000 2,400,000 1,200,000 707,400 3,705,000 3,126,280

Data on investment related costs

	STP Lic	NWP Lic	ATF Corp.	Unit price (USD)	Lifespan (Y.)	Investment (USD)
Infra., Tool, Equip. & Machinery (B)						
Plant (B)		1	2	600,000	20	STP Lic 600,000 NWP Lic 1,200,000 ATF Corp. 480,000
Tools, equipment, machinery		1	6	800,000	10	800,000 4,800,000
Forklift	1	12	20	50,000	5	50,000 600,000 1,000,000
Other tools, Equip. and machinery		1	4	200,000	15	0 200,000 800,000 50,000 2,200,000 7,800,000
	STP Lic	NWP Lic	ATF Corp.	Unit price (USD)	Lifespan (Y.)	Investment (USD)
Capacity building						
Felling and skidding	1	2	3	7,200	8	STP Lic 7,200 NWP Lic 14,400 ATF Corp. 21,600
First processing	1	2	3	48,000	8	7,200 14,400 21,600
Second processing		2	3	80,000	8	- 14,400 21,600
Second processing advanced			4	80,000	8	- - 28,800
Marketing and sale			3	34,000	8	- - 21,600
Contract management & PR			3	24,000	8	- - 21,600
						14,400 43,200 136,800
						50,000 2,200,000 7,800,000
						7,200 14,400 21,600
						7,200 14,400 21,600
						- - 28,800
						- - 21,600
						14,400 43,200 136,800
						50,000 2,200,000 7,800,000
						7,200 14,400 21,600
						7,200 14,400 21,600
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						50,000 2,200,000 7,800,000
						7,200 14,400 21,600
						7,200 14,400 21,600
						- - 28,800

	STP Lic	NWP Lic	ATF Corp.	Unit cost
HR (labor costs)	\$ 228.000	\$ 1.736.000	\$ 10.310.000	
Operating costs (except HR)	\$ 121.920	\$ 738.264	\$ 2.033.308	
Afforestation & stand improvement	\$ 36.182	\$ 251.563	\$ 110.348	
Operating costs (outsourced drying)	\$ 108.519			
Outsourced transport raw wood	\$ 70.538	\$ 523.960	\$ 1.783.510	
Outsourced transport products	\$ 28.215	\$ 129.385	\$ 2.897.773	

Labor and other operating costs

	STP Lic	NWP Lic	ATF Corp.	STP Lic	NWP Lic	ATF Corp.
Timber Consumption Target	2.822	12.938	4.779			
From Rwanda			24.199			
From DRC						
Round wood requirement				STP Lic	NWP Lic	ATF Corp.
Downstream processing (A)	7.054	12.540	2.052	\$ 10,00	\$ 125,400	\$ 20,520
Downstream processing (B)		20.207	11.373	\$ 10,00	\$ 202,075	\$ 113,732
Rough red timber requirement						
Downstream processing (A) / DRC			7.838			\$ 4,702,500
Downstream processing (B) / DRC			38.188			\$ 22,912,558
				\$ 70,538	\$ 327,475	\$ 27,749,311
Woody biomass purchased	7.054	32.747	59.450			
Woody biomass in goods sold	2.822	12.938	28.978			
Woody biomass residue volume wet	4.232	19.809	30.473			
Woody biomass residue (dry 15% ton)	2.793	13.074	20.112			
Dry woody biomass as plant energy		11.767	18.101			

Timber needs and stumpage value (sawn timber for red wood / DRC)

Economic analysis

AT&F Corp.												
Operation factor	0	0,3	0,8	1	1	1	1	1	1	1	1	1
	FY1	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10		
Gross revenue in '000 USD	\$ -	\$ 17.017	\$ 45.378	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 59.772	\$ 59.772
Revenue (cash inflows) in '000 USD	\$ -	\$ 17.017	\$ 45.378	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722	\$ 56.722
Salvage value												\$ 3.050
Expenditure (cash outflows) in '000 USD	\$ 15.307	\$ 27.127	\$ 39.471	\$ 47.041	\$ 44.884	\$ 45.424	\$ 44.884	\$ 46.904	\$ 44.884	\$ 44.884	\$ 44.884	\$ 44.884
Investment costs	0,5	0,5	0,1	0,1	0,5	0,1						
Back office & admin. investment	\$ 540	\$ 540	\$ -	\$ 108	\$ -	\$ 540	\$ -	\$ 108	\$ -	\$ -	\$ -	\$ -
ITEM (A)	\$ 1.563	\$ 1.563	\$ -	\$ 313	\$ -	\$ -	\$ -	\$ 313	\$ -	\$ -	\$ -	\$ -
ITEM (B)	\$ 3.900	\$ 3.900	\$ -	\$ 780	\$ -	\$ -	\$ -	\$ 780	\$ -	\$ -	\$ -	\$ -
Capacity building	\$ 68	\$ 137	\$ 137	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
TMIS	\$ 4.095	\$ 4.095	\$ -	\$ 819	\$ -	\$ -	\$ -	\$ 819	\$ -	\$ -	\$ -	\$ -
Operating costs	0,3	0,5	1	1	1	1	1	1	1	1	1	1
HR	\$ 3.093	\$ 5.155	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310	\$ 10.310
Operating costs (except HR)	\$ 610	\$ 1.017	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033	\$ 2.033
Afforestation & stand improvement	\$ 33	\$ 55	\$ 110	\$ 110	\$ 110	\$ 110	\$ 110	\$ 110	\$ 110	\$ 110	\$ 110	\$ 110
Cost of timber in '000 USD	\$ -	\$ 8.325	\$ 22.199	\$ 27.749	\$ 27.749	\$ 27.749	\$ 27.749	\$ 27.749	\$ 27.749	\$ 27.749	\$ 27.749	\$ 27.749
Operating costs (outsourced drying)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Outsourced transport raw wood	\$ 535	\$ 892	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784	\$ 1.784
Outsourced transport products	\$ 869	\$ 1.449	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898	\$ 2.898
Financial costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Not applicable												
Gross Profit / Loss	\$ -15.307	\$ -10.111	\$ 5.906	\$ 9.681	\$ 11.838	\$ 11.298	\$ 11.838	\$ 9.818	\$ 11.838	\$ 11.838	\$ 14.888	\$ 14.888
Taxes												
Profit / loss (net cash flows) in '000 USD	\$ -15.307	\$ -10.111	\$ 5.906	\$ 9.681	\$ 11.838	\$ 11.298	\$ 11.838	\$ 9.818	\$ 11.838	\$ 11.838	\$ 14.888	\$ 14.888
NPV	21.598	€										
IRR	29%											
Payback period	5 years											
DR	0,11											
Benefit to cost ratio	1,10											

NWP LIC

Operation factor	0,1	0,5	1	1	1	1	1	1	1	1	1	1	1
FY1	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10				
Gross revenue in '000 USD	585	2.925	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	6.773
Revenue (cash inflows) in '000 USD	585	2.925	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850	5.850
Salvage value													923
Capital principal borrowed													
Expenditure (cash outflows) in '000 USD	4.296	5.624	3.707	4.322	3.707	3.830	4.322	3.707	4.322	3.707	3.707	3.707	3.707
Investment costs	0,5	0,5	0,1	0,1	0,5	0,1	0,1						
Back office & admin. investment	92	92	-	18	-	92	-	-	18	-	-	-	-
ITEM (A)	1.853	1.853	-	371	-	-	-	-	371	-	-	-	-
ITEM (B)	1.100	1.100	-	220	-	-	-	-	220	-	-	-	-
Capacity building	22	22	-	4	-	22	-	-	4	-	-	-	-
TMS	10	10	-	2	-	10	-	-	2	-	-	-	-
Operating costs	0,4	0,9	1	1	1	1	1	1	1	1	1	1	1
HR	694	1.562	1.736	1.736	1.736	1.736	1.736	1.736	1.736	1.736	1.736	1.736	1.736
Operating costs (except HR)	221	369	738	738	738	738	738	738	738	738	738	738	738
Afforestation & stand improvement	75	126	252	252	252	252	252	252	252	252	252	252	252
Cost of timber in '000 USD	33	164	327	327	327	327	327	327	327	327	327	327	327
Operating costs (outsourced drying)	-	-	-	-	-	-	-	-	-	-	-	-	-
Outsourced transport raw wood	157	262	524	524	524	524	524	524	524	524	524	524	524
Outsourced transport products	39	65	129	129	129	129	129	129	129	129	129	129	129
Financial costs	-	-	-	-	-	-	-	-	-	-	-	-	-
Not applicable													
Gross Profit / Loss	-3.711	-2.699	2.143	1.528	2.143	2.020	2.143	1.528	2.143	1.528	2.143	1.528	3.066
Taxes													

Profit / loss (net cash flows) in '000 USD

NPV

IRR

Payback period 6 years

22%

DR

0,11

1,12

Benefit to cost ratio

STP LIC

Operation factor	0,3	1	1	1	1	1	1	1	1	1	1	1	1
FY1	FY2	FY3	FY4	FY5	FY6	FY7	FY8	FY9	FY10				
Gross revenue in '000 USD	257	855	855	855	855	855	855	855	855	855	855	855	855
Revenue (cash inflows) in '000 USD	257	855	855	855	855	855	855	855	855	855	855	855	855
Salvage value													122
Capital principal borrowed													
Expenditure (cash outflows) in '000 USD	1.190	664	664	745	664	692	664	745	664	664	664	664	664
Investment costs	1	0,1	0,1	0,1	0,5	0,1	0,1	0,1					
Back office & admin. investment	41	-	-	4	-	21	-	-	4	-	-	-	-
ITEM (A)	707	-	-	71	-	-	-	-	71	-	-	-	-
ITEM (B)	50	-	-	5	-	-	-	-	5	-	-	-	-
Capacity building	14	-	-	1	-	7	-	-	1	-	-	-	-
TMS	-	-	-	-	-	-	-	-	-	-	-	-	-
Operating costs	0,6	1	1	1	1	1	1	1	1	1	1	1	1
HR	137	228	228	228	228	228	228	228	228	228	228	228	228
Operating costs (except HR)	73	122	122	122	122	122	122	122	122	122	122	122	122
Afforestation & stand improvement	22	36	36	36	36	36	36	36	36	36	36	36	36
Cost of timber in '000 USD	21	71	71	71	71	71	71	71	71	71	71	71	71
Operating costs (outsourced drying)	65	109	109	109	109	109	109	109	109	109	109	109	109
Outsourced transport raw wood	42	71	71	71	71	71	71	71	71	71	71	71	71
Outsourced transport products	17	28	28	28	28	28	28	28	28	28	28	28	28
Financial costs	-	-	-	-	-	-	-	-	-	-	-	-	-
Not applicable													
Gross Profit / Loss	-933	191	191	110	191	163	191	110	191	110	191	110	313
Taxes													
Profit / loss (net cash flows) in '000 USD	-933	191	191	110	191	163	191	110	191	110	191	110	313
NPV	52	€											
IRR	12%												
Payback period 6 years													
DR	0,11												
Benefit to cost ratio	1,01												

National income per capita ('000 \$)		1,01				
	Labour	Value added Labour (in '000 \$)	Value added outsourced services (in '000 \$)	Capital (in '000 \$)	Round wood (m³)	Imported timber (m³)
STP Lic	27	228	207	813	7.054	
NWP Lic	175	1.736	653	6.152	32.747	
AT&F Corp.	336	6.708	4.681	20.333	13.425	46.025
* woody biomass suitable for timber						
		Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Employment
						Direct jobs
						Indirect jobs
15 STP Lic	27	150	9	18	105.806	405
4 NWP Lic	175	1.146	29	135	130.990	700
1 AT&F Corp.	336	4.428	206	447	13.425	336
					250.221	14.425
* woody biomass suitable for timber						
		Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Employment
						Direct jobs
						Indirect jobs
30 STP Lic	27	150	9	18	211.613	810
8 NWP Lic	175	1.146	29	135	261.980	1400
2 AT&F Corp.	336	4.428	206	447	26.850	672
					500.443	28.849
* woody biomass suitable for timber						
		Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Employment
						Direct jobs
						Indirect jobs
60 STP Lic	27	150	9	18	423.225	1620
16 NWP Lic	175	1.146	29	135	523.960	2800
2 AT&F Corp.	336	4.428	206	447	26.850	672
					974.035	46.864

Job creation in relation to woody biomass available for timber production

* woody biomass suitable for timber	Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Direct jobs	Indirect jobs
16 STP Lic	27	150	9	112.860	432	2.840
3 NWP Lic	175	1.146	29	98.242	525	3.930
3 AT&F Corp.	336	4.428	206	40.276	1008	15.243
				251.378		23.978

Job creation in relation to woody biomass available for timber production

* woody biomass suitable for timber	Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Direct jobs	Indirect jobs
35 STP Lic	27	150	9	246.881	945	6.212
0 NWP Lic	175	1.146	29	-	0	0
0 AT&F Corp.	336	4.428	206	-	0	0
				246.881		7.157
* woody biomass suitable for timber						
		Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Employment
						Direct jobs
						Indirect jobs
0 STP Lic	27	150	9	-	0	0
7 NWP Lic	175	1.146	29	229.232	1225	9.170
0 AT&F Corp.	336	4.428	206	-	0	0
				229.232		10.395
* woody biomass suitable for timber						
		Indirect jobs	Indirects jobs	Indirect jobs	Available Biomass* (m³)	Employment
						Direct jobs
						Indirect jobs
0 STP Lic	27	150	9	-	0	0
0 NWP Lic	175	1.146	29	-	0	0
18 AT&F Corp.	336	4.428	206	241.654	6048	91.460
				241.654		97.508

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Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Promotion of Economy and Employment (Eco-Emploi) Programme

P.O.Box 59, Kigali, Rwanda

T: +250 788 187 800

F: +250 252 572 439

E: giz-ruanda@giz.de

www.ecoemploi.org

www.giz.de/rwanda