PRODUCTION AND MARKET DYNAMICS OF SAWN TIMBER AND UTILITY POLES IN TANZANIA

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ABSTRACT

Sawn timber and utility poles are the main forest products which are largely traded in international and domestic markets. However, it is unclear to what extent the recent changes in the allocation and availability of wood raw materials; price and other factors have influenced production and marketing of these products. This study analyzes the production and market dynamics of sawn timber and utility poles in Tanzania. Specifically, the study focused on examining production of sawn timber and utility poles, assessing domestic and export market of sawn timber and utility poles, compare prices of selected sizes of sawn timber in Tanzania markets and identifying main factors affecting the production and marketing of sawn timber and utility poles. Primary data were collected through questionnaires and direct observation. The quantitative data were analysed by using Statistical Package for Social Sciences (SPSS) by computing descriptive statistics to obtain mean and percentage distribution of the responses. The study revealed that the production of soft wood sawn timber exhibited a gradual decreasing trend from 837 926.79 m^3 in 2009/2010 to 552 011.44 m^3 in 2018/2019; while the production of utility poles rose from 313 612 poles in 2015 to 461 449 in 2019. Both export of sawn timber and utility poles exhibited an increasing trend between 2005 and 2009, a sharp drop between 2010 and 2012, and maintained a stable trend between 2012 and 2019. The imports of sawn timber and utility poles exhibited a sharp increasing trend between 2012 and 2014 while steadily decreased for sawn timber and sharply for utility poles from 2012 to 2019. There was a significant difference in prices of nine categories of sawn timber size in major markets in Tanzania ($\chi^2_{(2)} = 46.8813$ $p < 0.0001$). Production of sawn timber is gradually decreasing while that of utility poles is gradually increasing. Production and marketing of sawn timber and utility poles is largely affected by inadequacy of infrastructure and raw materials. The study recommends that,

the government should establish standards that would guide the production and marketing of sawn timber and utility poles in Tanzania.

DECLARATION

I, **Said Habibu**, do declare to the Senate of Sokoine University of Agriculture that, this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

Said Habibu Date

(MSc. Candidate)

The above declaration is confirmed by:

_____ _____

Professor Yonika M. Ngaga Date

(Supervisor)

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DEDICATION

This work is dedicated to my father Habibu Ahmad Kika and my mother Mwanaulu Ally Otto who laid the foundation of my education, to my sisters Asha, Halima, Mwanaid, and Aziza who during my secondary education remained at home. They worked hand in hand with our mother in the village for me to get school fees and other basic needs, to my wife Arafa and sons Khalifa, Habibu and Haruna who all gives me the status of a father.

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LIST OF ACRONYMS AND SYMBOLS

AAC	Annual Allowable Cut
DRC	Democratic Republic of Congo
ECA	United Nations Economic Commission for Africa
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FDT	Forest Development Trust
GDP	Gross Domestic Product
ha	Hectare
HQ	Headquarters
ITTO	International Tropical Timber Organization
LMDA	Logging Miscellaneous Deposit Account
MNRT	Ministry of Natural Resource and Tourism
m^3	Cubic metres
NBS	National Bureau of Statistics
NFC	New Forest Company
NOFIA	Northern Forestry Industries Association
PFP	Private Forestry Programme
PWBIs	Primary Wood Based Industries
REA	Rural Electrification Agency
SHFP	Sao Hill Forest Plantation
SPSS	Statistical Package for Social Science
STGs	Small Tree Growers
TANESCO	Tanzania Electric Supply Company
TANWAT	Tanganyika Wattle Company
TFS	Tanzania Forest Service Agency

TMA	Tanzania Meteorological Agency
TRA	Tanzania Revenue Authority
TTPs	Tropical Timber Products
TZS	Tanzania Shillings
UAE	United Arabs Emirates
USD	United State Dollars
URT	United Republic of Tanzania
VAT	Value Added Tax

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

Plantation forests have been increasing worldwide since 1990 (FAO, 2016). The crucial functions of the forest rest on the conservation functions (protection of soil, water, and combating desertification) and the production functions mainly for commercial purpose. It is estimated that about 76% of the world plantation forests are for commercial production of wood, fiber, and non- wood forest products (FAO, 2016).

Tanzania is blessed with vast forest resources amounting to 48.1 million hectares of forest and woodlands covering 55 % of the total land area of the mainland (MNRT, 2015). The total planted forest plantation area is estimated to be 582 729 ha whereas the largest area (210 000-250 000 ha) being in the southern highlands (Asiad, 2016; Mankinen *et al.*, 2016). Out of this, the government plantations cover 105 625 ha, large private plantation companies own about 54 708 ha while individual woodlots occupy about 422 396 ha. The most important plantation species are pines, cypress, eucalyptus, and teak (Asiad, 2016; UNIQUE, 2017).

In Tanzania, tree planting is rapidly increasing due to an increase in the demand for both sawn timber and utility poles (Ngaga, 2011). According to the market analysis in 2010, it was estimated that, timber export varied from 20 000 to 40 000 m^3 of sawn timber annually; and the four major destinations of timber products included EU, Japan, China, and Kenya, the latter being the key trade partner by absorbing about 67 % of all timber exports from Tanzania (Indufor, 2011). Likewise, the imports of forest products to Tanzania are rising. For instance, between 2007 to February 2018 the value of imported

forest products was TZS 586.3 billion as opposed to TZS 503 billion in the previous years (Abdallah and Masaka, 2018).

It is obvious that, the market is not static; it is changing over time due to changes in the demand and supply. According to Mattson (2003), market dynamics is a change in the stability of exchange relationships and in the interdependence between exchange relationships. Market dynamics show how consumers react to price increase, or how suppliers react to changes in the demand and how changes in one supply-and–demand relationship affects other products or consumer groups.

The Tanzania timber market is influenced by among other things the growth in the construction industry, economy and the population (Indufor, 2011; Chenga and Mgaza, 2016). The improvement of living standards of people stimulates the need for better housing and higher value timber products, resulting to more timber demand for building, furnishing materials, and associated infrastructure (Chenga and Mgaza, 2016). According to the National Bureau of Statistics (2013), the population of Tanzania increased by 30.3 % between 2002 and 2012. According to the 2012 Census, Tanzania had a population of 44.9 million people. In 2019, the population was projected to be 58.01 million people. Population projections showed further that, Dar es Salaam which is one of the main markets for timber would see its population increasing by 26.3 % between 2012 and 2025 (NBS, 2013). This suggests further that, the growth in timber trade triggers engagement of more people in the harvest of forest products to sustain the market (Chenga and Mgaza 2016; Bamwesigye *et al.,* 2018). In line with the improvement of standard of living, the National Electrification Programme triggers high demand for utility poles, which are needed to support electrification in urban and rural communities. However, estimates

show that TANESCO's demand for poles exceed 350 000 due to an increase in customer's connection targets and hence about 30 to 50 % of the poles is sourced from abroad (PFP, 2016). The growth in the construction industry as a result of population increase caused inadequate supply of quality local timber products, as the sawmilling has not kept pace with technological development. This, to some extent, has influenced the construction industry to opt for sawn timber substitutes (Indufor, 2011).

1.2 Problem statement and Justification of the study

Sawn timber and utility poles are the main forest products that are largely traded in the domestic and international markets for earning foreign exchange through export. However, their movement in the entire value chain is not well documented (Bamwesigye, 2019), making it difficult and challenging to establish some marketing strategies. Many studies done so far focused on some aspects/areas in the timber and utility poles marketing chain. For instance, Indufor (2011) studied timber and utility poles market dynamics in Tanzania and in key export markets. Kapinga (2010) conducted a study on the marketing chain for sawn timber, and PFP (2016) conducted a study on sawn timber and utility poles. Lusasi *et al.* (2019) studied the typology of domestic investors involved in tree planting activities in southern highlands, while Milledge *et al.* (2018) focused on the analysis of the commercial forestry development in Tanzania. Other studies include Arvola *et al.* (2019) who focused on the future market potential of timber from small-scale tree farmers. Cheboiwo *et al.* (2018) concentrated on the potential roles of the private sector in development of primary and secondary forest production in eastern Africa. Furthermore, Kilongo (2018) conducted a study on the availability of forest products to support industries in Tanzania, Mgana (2013) did a study focusing on forecasting consumption and substitution of sawn timber products in the building

industry, and Singunda (2010) assessed the economic contribution of private woodlots to the economy of Mufindi District in Tanzania. Another study by Mgaya (2014) analyzed the profitability of growing trees by individual tree growers in Njombe District, Tanzania.

From the aforementioned studies, it was difficult to get a clear picture because the studies provide some spots or scattered information on sawn timber and utility poles making it difficult to draw a conclusive national picture on the current state of production and marketing of sawn timber and utility poles. Given the recent changes in the allocation and availability of wood raw materials, changes in royalty rates, prices, demands, and other factors, it is not clear to what extent these have influenced the production and marketing of sawn wood. Therefore, this study aimed at filling this knowledge gap particularly understanding the trend in the production and export of sawn timber and utility poles. The study also looked at the status of domestic and export markets for sawn timber and utility poles, compared the price of selected size of sawn timber, and identified the major factors affecting production and marketing of sawn timber and utility poles in Tanzania. The findings from this study would help the government and all stakeholders involved in the forest sector to understand the current situation regarding production and marketing of sawn timber and utility poles, and therefore assist them in planning and making informed decisions for sustainability of forests in Tanzania.

1.3 Objectives

1.3.1 General objective

The main objective of this study was to assess the production and market dynamics of sawn timber and utility poles in Tanzania and provide information and statistics to the relevant stakeholders including the government officials.

1.3.2 Specific objectives

The specific objectives of this study were to:

i. Assess the production of sawn timber and utility poles from 2009 to 2019
ii. Assess the domestic and export markets of sawn timber and utility poles
iii. Compare prices of selected sizes of sawn timber in three major markets of sawn timber in Tanzania
iv. Identify the major factors affecting production and marketing of sawn timber and utility poles

1.4 Research questions

This study strove to answer the following questions

i. What is the trend in the production of sawn timber and utility poles from 2009 to 2019?
ii. What is the market situation (traded volumes, demand, specie etc) of sawn timber and utility poles?
iii. Is there any significant difference in prices of sawn timber sizes in three major market centres?
iv. What are the factors affecting production and marketing of sawn timber and utility poles?

1.5 Conceptual framework of the study

The conceptual framework for this study (Figure 1) was built basing on the fact that sawn timber and utility poles are sourced from producers (small, medium, and large producers). Sawn timber reaches the end use market either directly (producer to consumers) or indirectly (producer to intermediates then to consumers). Similarly, the utility poles

follow the same route. However, there are few intermediates for utility poles as opposed to sawn timber because the market for utility poles is limited to Tanzania Electric Supply Company (TANESCO) and Rural Electrification Agency (REA) who usually buy the timber directly from producers.

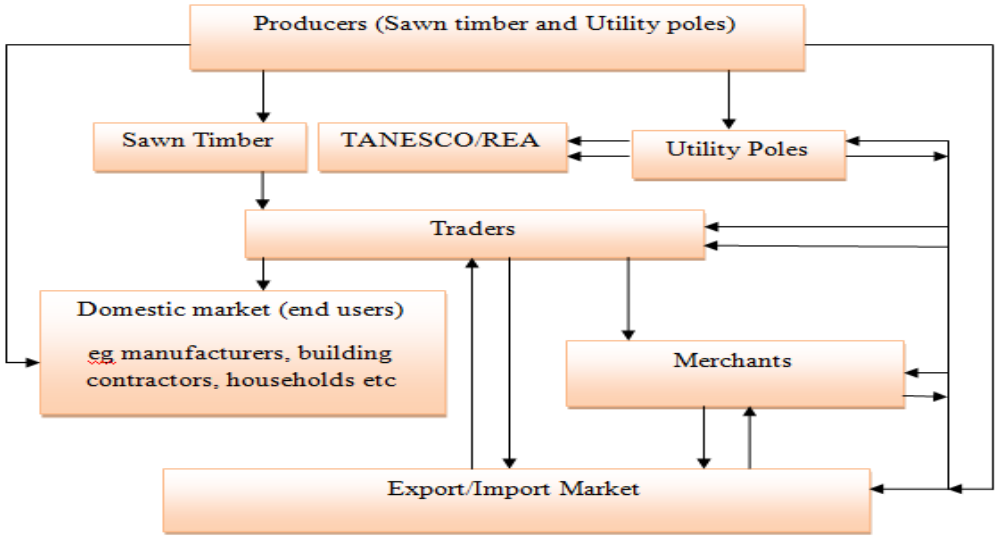

Figure 1: Conceptual framework for the study on production and marketing of sawn timber and utility poles in Tanzania

1.6 Limitations of the study

(i) Lack of cooperation by some small and medium scale producers for fear that information provided would be leaked to Tanzania Revenue Authority (TRA) and be used for taxation purposes. To overcome this situation, the information provided was compared with the production data from Tanzania Forest Service Agency (TFS) headquarters and Sao Hill Forest Plantation (SHFP). In addition, literature search enabled the researcher to obtain contribution of small tree growers in annual sawn timber supply.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 The concept of marketing, market dynamics and marketing chain

Marketing refers to the coordination of economic activities through voluntary exchange between economic actors (Mattson, 2003). Marketing strategies suggests to a producer what to produce and directs the development efforts of processing industry to inform the customers about the availability, quantity, quality, price, and distribution of a product. On the other hand, market dynamics refers to forces, which will influence prices and behaviours of producers and consumers. In a market, these forces create pricing signals, which result from the fluctuation of supply and demand for a given product or service (Mattson, 2003).

Marketing chain refers to a full range of activities which are required to bring a product or service from conception, through different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky and Morris 2001). PFP (2016) showed that, timber trade (including utility poles) can follow four main marketing chains (distribution channels) as indicated in Figure 2.

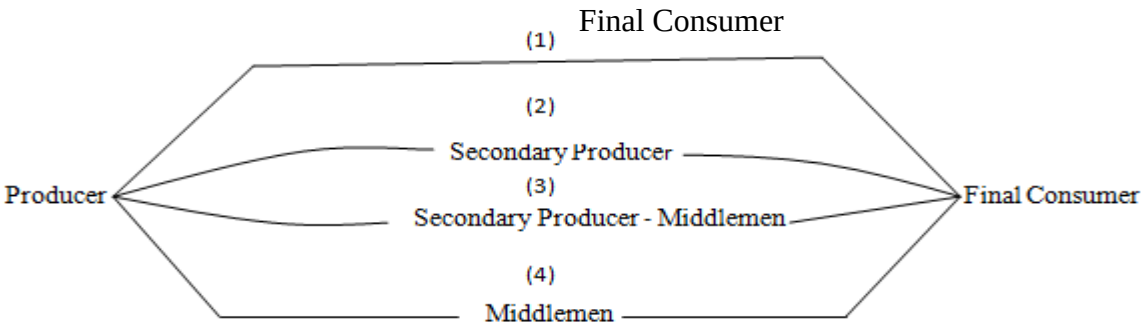

Figure 2: **Distribution channels for timber and utility poles in Tanzania**

Source: PFP (2016)

2.2 Valuation and pricing in marketing

Pricing is one of the most flexible elements of marketing mix that interlink directly and in short term with profitability and cost effectiveness of a company (De Toni, 2017). Typically, in marketing, the main focus is on the development of new products, distribution channels, and communication strategies, which in turn lead to precipitating pricing decisions without properly evaluating market and cost factors (Lancioni, 2005). In this respect therefore, pricing is treated as the simplest strategy within marketing, perhaps because many companies determine their prices based on intuition and the managers' market experience (Simon, 1992). In order to enhance companies' economic and financial performance, the pricing policies should be defined by their internal capacities and on the basic systematic understanding of needs and wishes of their customers as well as market conditions including economic conditions and the degree of competition (De Toni, 2017). The price has great influence on decisions to buy a particular product. Therefore, each price that the seller might charge will lead to a different level of demand and thus different impact on the product marketing (Kotler, 1985). Regardless of the pricing method used, it is critical to know all the costs involved in the delivery of the product or service to avoid possible under pricing and operating costs.

2.2.1 Customer value-based pricing strategy

The perceived value-based pricing is a pricing practice in which the managers take decisions based on the perception of benefits from the items being offered to the customer and how these benefits are perceived and weighed by the customer in relation to the price they pay (Ingenbleek *et al.*, 2010). Therefore, as a cultural orientation of businesses, value-based pricing is derived from a set of routine philosophies and organizational strategies that a specific company could use in order to focus on customer satisfaction and in turn increase their profitability (Cressman, 2012). Therefore, the perceived value-based pricing along with the pricing practices that refer to the use of information about costs and competitors' prices, are intimately related to the product's performance, service and the business as a whole (Ingenbleek *et al.*, 2003).

2.2.2 Competition-based pricing strategy

Competition-based pricing uses as key information the competitors' price levels and behaviour expectations, observed in real competitors and or potential primary sources to determine adequate pricing levels to be practiced by the company (Liozu and Hinterhuber, 2012). The main advantage of this approach is that it considers the actual pricing situation of the competitors, and its main disadvantage is that the demand-related aspects are not considered. Furthermore, a strong competitive focus among the competitors can increase the risk of starting a price war among the competitors in the market (Heil and Helsen, 2001).

2.2.3 Cost-based pricing strategy

Cost-based pricing is the most simple and popular method for setting prices. Historically, it is the most common pricing strategy because it carries a sense of financial prudence.

This involves adding a profit margin on costs, such as adding a standard %age contribution margin on the products and services. First, the sales level (revenues) is determined, and then the unit and total costs are calculated, followed by checking the company's profit objectives and finally establishing the prices. Thus, for the professionals involved in this process, it is necessary to show to customers enough value on products and commercialized services in order to justify the prices charged by the company (De Toni, 2017).

2.3 Overview of sawn timber production, consumption and trade at regional and global level

Globally, planted forests amounted to about 291 million hectares, which is an increase by 105 million hectares since 1990 as results of increased conversion of natural forests for various reasons including the establishment of planted forests (FAO, 2016). About 60 % of the world's forests approximately 2.4 billion hectares are used primarily or partially for the production of wood and non-wood forest products (Brack, 2018).

In 2016, global sawn timber production was about 467 million m^3 (Table 1), which was 3.2 % higher than in 2015 (FAO, 2016). Sawn timber production trend grew consistently over the 2012 to 2016 period (Table 2). This trend was largely due to increasing production in Asia, the Pacific, Europe, and Northern America. In contrast, the production in Africa, Latin America, and the Caribbean remained modest over the same period (FAO, 2016).

Table 1: Regional production of sawn timber in 2016

Region	Volume (million m^3)	Percent
Europe	156	34
Asia and the Pacific	139	30

Northern America	128	27
Latin America and the Caribbean	34	7
Africa	10	2
Total	**467**	**100**

Source: FAO (2016)

The global production and consumption of sawn timber is forecasted to increase to about 520 million m^3 by the year 2020 and 603 million m^3 by the year 2030 (FAO, 2009).

Global trade in sawn timber amounted to 144 million m^3 (31% of production) in 2016. Most of this growth in trade occurred in Northern America, Asia, the Pacific, and Europe. The two main importing regions for sawn timber are Africa and Asia-Pacific region, with net imports of 7 million m^3 and 46 million m^3 in 2016 (FAO, 2016). Europe and Northern America are the main exporting regions, with net exports of 46 million m^3 and 9 million m^3 respectively. Latin America and the Caribbean is a minor net exporter, totalling 4 million m^3 in 2016. Timber and wood products, including paper form an important component of international trade, reaching a value of USD 227 billion in 2016 (Brack, 2018).

Table 2: Regional production trend of sawn timber from 2012 to 2016

	Production volume (Million m^3)				
Region	2012	2013	2014	2015	2016
Africa	10	10	10	10	10
Asia and the Pacific	115	120	125	130	139
Europe	130	140	150	156	156
Latin America and the Caribbean	34	34	34	34	34
Northern America	100	110	120	128	128
Total	**389**	**414**	**439**	**458**	**467**

Source: FAO (2016)

According to Brack (2018), the global trade in logs and sawn timber accounts for about two-thirds of the volume of trade in the timber sector. A significant proportion of the growth in the world trade was found to have been caused by the expansion of the demand

in China. China country has experienced rapid and sustained growth in industries transforming raw material into finished and semi-finished wood products for export to Japan, the Middle East, EU, and the US and for her growing domestic consumption (Brack, 2018).

Forest products statistics show that globally the production of all major products (industrial round wood, sawn timber, wood-based panels, pulp, and paper) has recorded a gradual recovery from 2012. The production in 2016 was higher than in 2015 (and the pre-crisis 2007 level) for all of the product groups including sawn timber (FAO, 2016). The fastest growth was in Asia-Pacific, Northern America, and Europe, likely due to positive economic growth in these regions.

China has grown in importance as both a producer and consumer of forest products, and has recently overtaken a number of other big players in different product groups such as Canada for sawn timber production and the United States of America for sawn timber consumption (FAO, 2016). China is also highly significant in international trade of forest products, being the world's largest importer of industrial round wood, sawn timber, and fiber furnish, and the largest exporter of wood-based panels. In 2016, China's imports of industrial round wood increased by 9 % while sawn timber, panel, and paper production and consumption continued to grow faster than the rest of the world. Most of the international trade in forest products takes place between developed countries and rapidly emerging markets such as China and India. Hence in many developing countries, domestic forest products trade is important for economic development and the livelihoods of communities, even if it may appear to contribute relatively little to the gross national product (Ohwo and Ogaha, 2017; Aiyeloja *et al.*, 2013).

According to ITTO (2016), the net trade in Tropical Timber Products in Africa has been persistently negative. In 2013, the region's imports were USD 1.9 billion higher than its exports. The negative trade balance has widened by almost USD 100 million a year in spite of the fact that the region could become a net exporter (ITTO, 2016).

2.4 Forest product export performance in tropical Africa

The African forestry sector is fundamental in the dynamics of trade and development for the region (Bayol *et al*., 2012; Lukumbuzya and Sianga, 2017). It is understood that African countries have a continual ongoing history of forest management, with a multiplicity of countries recording their fair share of successes and failures (Bamwesigye, 2019). Additionally, Africa is home to vast forest systems including the Congo Basin, which represents the second-largest tropical rainforest in the world (Bayol *et al.*, 2012). Trade in forestry products is critical to African trade routine, with a number of wood and non-wood forestry products featuring in both intra- and extra-continental trade (Bamwesigye, 2019).

According to FAO (2009), the annual primary and secondary wood product exports resulting from tropical forests has exceeded USD 20 billion. In fact, the main export destinations of Africa's forestry sector products are mainly China, the European Union, and Asia (Bayol *et al*., 2012). Africa therefore represents one of the leading forestry sector performers in the world, continuously providing many products to the global market. According to Bahanak and Yves (2014), the central African forestry sectors in 2007 produced nearly ten million m^3 of logs for export only. For example, Gabon is the largest log producer in the Congo basin, with an annual production of three million m^3

(Bayol *et al.,* 2012). The regional trade in natural forest timber from East and Southern Africa is also increasing (Lukumbuzya and Sianga, 2017).

In fact, the income estimates from this trade represent hundreds of millions of dollars over the past ten years (Lukumbuzya and Sianga, 2017). Similarly, a report by the Ministry of Industry and Trade in 2014 noted that forestry made up over 3.3 % of Tanzanian GDP per annum, with forest goods accounting for USD 2.2 billion per year. Similarly, the Tanzanian Ministry of Industry and Trade in 2014 noted an increase of forest product trade, essentially for wood-based products (URT, 2014). Furthermore, the estimated total timber exports were over 250 000 m^3 annually. This was attributed to the effective increment in sawn timber exportation, thus envisaging the projected continuous prosperity of trade in forest products for Tanzania. The primary export destinations for Tanzania's sawn timber include the European Union, Japan, and China. According to Indufor (2011), Kenya represented the largest domestic importer of Tanzania's timber exports with 67 % importation rate, specifically for sawn timber. Similarly, India was the leading export destination on the international scene. Furthermore, the exportation of utility poles was observed to have increased from 905 poles in 2004 to 31 200 poles in 2008 (URT, 2014). The final products are exported to the international markets, with many nations having a high level of market interest in these products. In due course, on the domestic scene, Kenya, Uganda, Malawi, and Zambia are likely to take a centre stage as the penultimate export destination of Tanzania's products of the paper sector (URT, 2014).

International exportation is dominated by markets such as India, SriLanka, Bangladesh, Malaysia, Vietnam, Iran, Egypt, and Saudi Arabia. As Domson (2007) observed, the Ghanaian forestry sector had undergone major expansion concerning the exportation of

wood products. Wood trade is a booming financial activity for the country, accounting for about 60 % of the nation's total export earnings. Uganda is a good example, and whose 24 % of the total land is covered by forests, presented interesting figures on the export performance of the overall forestry sector in the country (Bamwesigye, 2019). The forestry sector is definitely a critical component of the Ugandan economy, generating a substantial amount of the country's total GDP. The total annual production of round wood timber was projected at 34.4 million tons by 2007, a substantial increase of 29.2 million tons recorded in 2003. Actually, of this aggregation, sawn timber production for export also grew from 791 000 tons to 1 million tons between 2003 and 2007. Finally, an empirical analysis by Lukumbuzya and Sianga (2017) of the main features of the export performance of forest products of six sub-Saharan Africa nations provides interesting results. The Democratic Republic of Congo is the leading exporter of forest products in the region, with Kenya being of little significance in terms of the export trade dynamic of the region. In addition, Tanzania is an active exporter of natural forest hardwood timber in East Africa, with solid sawn timber being the most exported product as of 2013. Similarly, Kenya lacks a resounding presence as far as the export of forest products is concerned. However, it is the largest importer of forest products in East Africa, particularly hardwood.

2.5 Overview of the forest sector in Tanzania

2.5.1 Forest resources

In Tanzania main land the area covered by forest and woodland is estimated to be 48.1 million ha comprising 3.3 billion m^3 of trees whereby 97 % of the total volume comes from trees of natural origin and only 3 % comprises the planted trees (MNRT, 2015). As per land-use types, forests in the production, protection and wildlife reserves accounts for

70 % of all trees in Tanzania mainland (Figure 3). The average volume of wood per hectare is estimated at 37.9 m^3 across all land cover types as shown in Table 3.

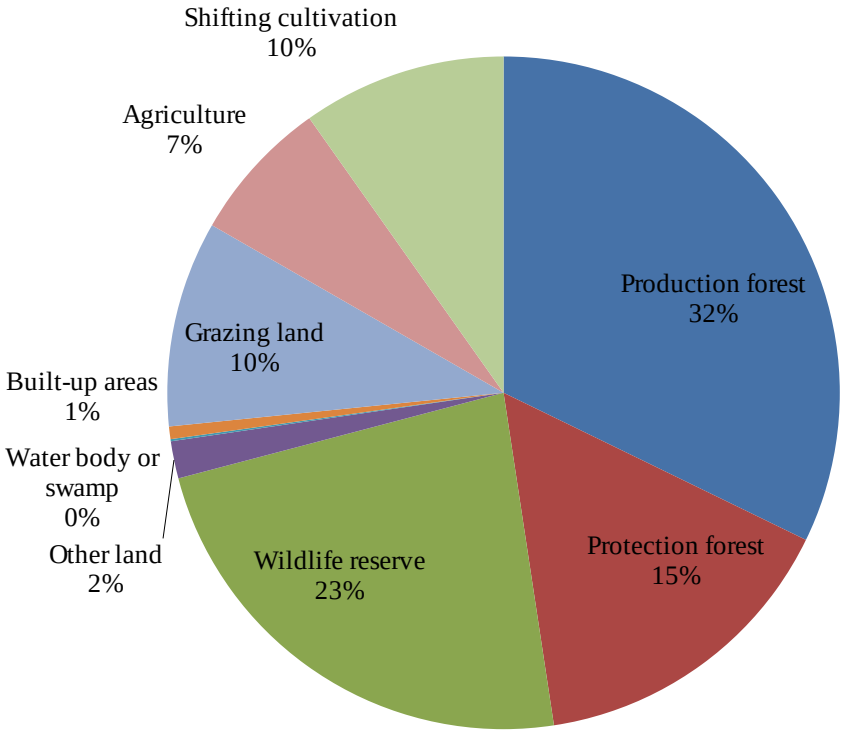

Figure 3: Distribution of all trees in Tanzania mainland by land-use

Source: MNRT (2015)

Table 3: Distribution of forest and woody vegetation by regions

S/N	Region	Total area ha	Mean volume m^3/ha	Total volume Million m^3	Number of trees/ha	Forest + wood-land, % of land area	Forest + wood-land, m^3/ha
1	Dar es Salaam	150 809	24.9	3.7	704	32.5	53.4
2	Morogoro	6 886 883	54.8	376.2	1268	63.6	76.7
3	Pwani	3 196 403	37.4	119.9	1508	58.7	54.5
4	Lindi	6 785 532	55.2	372.8	1622	77.2	64.1
5	Mtwara	1 794 853	43.4	77.5	1685	41.4	81.1
6	Ruvuma	6 338 030	52.6	332	968	74.6	64.9
7	Rukwa	2 167 494	29.7	64.1	454	41.2	57.0
8	Njombe	2 194 407	26.5	58.0	641	37.0	52.2
9	Iringa	3 453 694	37.2	127.8	762	52.1	57.3
10	Mbeya	6 106 391	52.3	318.2	786	70.6	69.7
11	Manyara	4 469 962	19.9	88.4	588	45.5	32.8
12	Dodoma	4 183 192	28.3	117.8	685	32.8	45.3
13	Singida	4 856 938	25.8	124.7	930	45.7	40.1
14	Mara	2 189 924	9.4	20.4	289	15.7	34.5
15	Simiyu	2 345 074	8.5	19.9	186	18.0	30.8
16	Mwanza	1 092 257	13.3	14.5	284	14.3	61.3
17	Kagera	2 527 312	25.1	63.3	763	54.3	39.1
18	Geita	2 098 555	34.5	72.1	674	48.1	60.8
19	Tabora	7 595 994	39.8	301.3	689	61.2	58.9
20	Shinyanga	1 853 931	11.5	21.3	425	17.1	48.2
21	Kigoma	3 819 825	42.4	161.4	534	60.4	61.0
22	Katavi	4 342 814	59.4	256.9	730	82.7	69.2
23	Kilimanjaro	1 250 496	38.5	47.9	579	48.6	66.2
24	Arusha	3 822 918	15.3	58.3	693	43.5	28.9
25	Tanga	2 810 612	41.1	115.2	1576	47.9	67.6
	Total/ Average	**88 334 300**	**37.9**	**3 332.7**	**876**	**54.6**	**59.4**

Source: MNRT (2015)

The total annual supply of wood at national level is currently estimated at 83.7 million m^3 (Table 4). However, only half of this approximately 42.8 million m^3 (Table 4) is available for harvesting at a sustainable level (MNRT, 2015). Since the annual consumption of wood is estimated at 62.3 million m^3, this means that the consumption exceeds the sustainable supply, causing an annual wood deficit of 19.5 million m^3 (MNRT, 2015).

Table 4: Total annual wood supply and annual allowable cut

Vegetation types	Volume m^3/ha	Estimated increment per year m^3/ha	Total annual wood supply m^3	Annual Allowable Cut m^3
Forest	376.3	33.5	29 821 691	12 640 064
Wood land	126.3	2.58	38 200 576	15 696 461
Bush land	114.4	1.39	1 418 165	1 134 532
Grass land	15.8	0.2	565 903	452 723
Cultivated land	146.3	8.45	12 300 819	12 300 819
Open land	16	0.39	35 964	35 964
water	38.4	1.35	1 386 196	586 268
	37.6		**83 729 315**	**42 846 832**

Source: MNRT (2015)

2.5.2 Contribution of forest sector to the National Economy

Forest sector contributes to the national economy through not just employment creation but also revenue generation through collection of various taxes and fees from various stakeholders (PFP, 2016). The average contribution of forest sector to the gross domestic product (GDP) is estimated at 2.5 % (FAO, 2014). However, this figure is believed to be an underestimation because the contribution of forests through catchment and environmental values are not included in the calculation (PFP, 2016). Tanzania's trade in forest products (which include timber, charcoal, wood fuel, and processed wood products

such as panelling and veneer) has been increasing from USD 40 million in 2007 to USD 162 million in 2014 (Lukumbuzya and Sianga, 2017).

2.5.3 Wood-based industries in Tanzania

2.5.3.1 Types and operating status

Primary wood-based industries (PWBIs) in Tanzania plays a major role in the conversion of forest products into various end uses such as timber, plywood, and poles. In Tanzania, majority of wood-based industries accounting for about 97 % are sawmills (MNRT, 2017). However, majority of these wood-based industries are small (75.39%) indicating that the major production of forest products including sawn timber in Tanzania is vested with small producers (saw millers). In addition, it was estimated that about 44.44% of these industries are active, while 45.08 % are sleeping and 10.48 % are dormant (MNRT, 2017). Table 5 shows the type and distribution of wood-based industries in Tanzania.

Table 5: **Type of primary wood-based industries in Tanzania**

Industry type	Total	Percent (%)	Distribution in TFS Zone					
			NZ	SHZ	WZ	EZ	LZ	SZ
Sawmills	609	96.67	269	143	74	26	83	14
Wood based panels	9	1.43	3	5	0	1	0	0
Pole treatment	9	1.43	2	7	0	0	0	0
Wattle extracts	2	0.31	1	1	0	0	0	0
Sandalwood oil & spent dust	1	0.16	1	0	0	0	0	0
Total	630	100	276	156	74	27	83	14

NB: NZ = Northern Zone, SHZ = Southern Highland Zone, WZ = Western Zone, EZ = Eastern Zone, LZ = Lake Zone and SZ = Southern Zone

Source: URT (2017)

2.5.3.2 Installed and utilized capacities of primary wood-based industries and its actual annual wood demand

The total annual wood demands of industries (actual and utilized) are 2 542 614 m^3 (59%) and 703 495 m^3 (16%) respectively (Table 6**).** However, based on the active primary wood-based industries (PWBIs), the actual annual wood demand and utilized capacity is about 1 559 332 m^3 (61%) and 544 752 m^3 (34%) respectively (MNRT, 2017). This implies that there is large number of PWBIs, which are not working. According to MNRT (2017), most of the sleeping and dormant PWBIs had secured harvesting allocations but later they were sold to active millers and or were registered in order to be considered for raw materials allocations from the government productive forest reserves.

The annual wood demand for active PWBIs indicates further the actual wood required in making the industries continue working. However, 1 351 914.68 m^3/year is available for harvesting at a sustainable level based on the available allowable cut from the central government forest reserves (MNRT, 2017). In this regard, the actual annual hardwood and softwood demand by active PWBIs is 487 722 m^3 and 1 072 610 m^3 respectively (MNRT, 2017). Within the actual annual hardwood demand by active PWBIs, 57 % is from forest plantations mainly *Tectona grandis* and *Eucalyptus spp* (MNRT, 2017).

Table 6: **Installed and utilized capacities of the primary wood-based industries and their actual annual wood demand in Tanzania**

Industry type	Capacities (m^3/Year)		
	Installed	Actual	Utilized
Sawmills	3 675 770	2 180 179 (59.31)	542 355 (14.75)
Wood based panels	219 300	134 700 (61.42)	78 467 (35.78)
Pole treatment	414 823	216 235 (52.13)	77 245 (18.62)
Wattle extracts	11 640	11 140 (95.70)	5 380 (46.21)
Sandalwood oil & spent dust	360	360 (100)	48 (13.33)
Total	4 321 893	2 542 614	703 495

Source: MNRT (2017)

2.5.3.3 Technology and efficiency in wood-based industries in Tanzania

The present technology of primary wood-based industries varies from manual (33%) to full mechanized (3%) as shown in Table 7. Currently, the sector is highly dominated by semi-mechanized technology (64%) where most operations are done by both human being and machine (MNRT, 2017). Circular saws were mostly used than other saw types and, industry-operating technology saw type, log form, and the quality of the operator have significant influence on firm productivity. This means that, old obsolete machines, inadequate skilled operator and the use of circular saws yield low productivity (25 - 35 % recovery rate) as opposed to advanced technology, the use of trained personnel, good quality log form and band saws (PFP, 2016; MNRT, 2017; UNIQUE, 2017).

Table 7: **Number of wood-based industries as per technology**

Industry type	Number of industries as per technology		
	Manual	Semi mechanized	Full mechanized
Sawmills	209 (34.32)	392 (64.37)	8 (1.31)
Wood based panels	0	6 (66.6)	3 (33.3)
Pole treatment	0	3 (33.3)	6 (66.6)
Wattle extracts	0	2 (100)	0
Sandalwood oil & spent dust	0	1(100)	0
Total	209 (33.11)	404 (64.20)	17 (2.69)

2.6 Overview of sawn timber and utility poles production, consumption and trade in Tanzania

The major sawn timber trade began in 1990s when it showed a supply shift of wood originating from natural forest to plantation grown soft woods when natural hard wood prices were rising resulting from diminishing sources (Wells and Wall, 2005). Currently,

government plantations are still the major source of industrial round wood in the country. However, according to Ngaga (2011) Sao Hill, which is the largest government plantation, is declining sharply while private industrial plantations are increasingly being established to compensate for the wood industries supply shortages and meet their demand following the declining government supply.

The contribution of small tree growers (STGs) to the total annual wood supply is currently estimated at 43 % supplying 559 000 m^3 of the total supply volume of 1.4 million m^3 in 2013 (UNIQUE, 2017). By 2025, the STGs are projected to supply 1.2 million m^3 which is equivalent to 38 % of the total 3.2 million m^3 and 1.1 million m^3 equivalent to 33% of 3.2 million m^3 of the total wood supply by 2035 (UNIQUE, 2017). In addition, government plantations will increasingly be coming into play in future years as the large areas planted with forests over the past 10 years reach maturity. By 2025, government plantations are predicted to supply 37 % of the total 3.2 million m^3, increasing to 46 % of the total wood produced (3.3 million m^3) by 2035 (UNIQUE, 2017).

Smallholder tree growers are gradually given more attention in contributing to the sawn timber business (Meijer *et al.,* 2015). According to Wells and Walls (2005), smaller plantations are very important as each serves a significant local market in decentralizing production, reducing transport costs and at the same time creating local employment.

Currently, about 422 396 ha of the plantations in Tanzania are occupied by smallholder tree growers (Asiad, 2016), but who are facing many constraints that limit their success. According to Byron’s global analysis (2001), secure property rights to land and trees,

viable production technology, capacity for crop protection and adequate markets are potential factors for large-scale success of smallholder tree growers.

The current demand of sawn timber is attributed to four major subsectors in round wood industry namely, construction, pulp and paper, furniture and joinery, and utility poles (Indufor, 2011: PFP, 2016). Indufor (2011) analyzed the consumption of forest products by forestry sector in Tanzania and revealed that construction consumes the bulk of forest products (62% of the total), followed by pulp and paper (17%), furniture and joinery (10%), and utility poles (11%).

According to Private Forestry Programme (2016), despite the rapid growth of the construction and furniture sectors in Tanzania, there are limited studies estimating the volume of round wood consumed by these sectors. The annual domestic market for poles is estimated to exceed 350 000 in 2016 and is projected to grow up to 400 000 poles by 2020 (PFP, 2016). Although the demand of forest products in Tanzania domestic market is still high, studies show that, the country is still exporting her forest products including sawn timber to over 50 different destinations (Lukumbuzya and Sianga, 2017; Abdallah and Masaka, 2018).

According to Abdallah and Masaka (2018), wood products, which were imported to Tanzania between 2007 and 2018, exhibited a volatile trend, accounting for Tanzania shillings 586.3 billion compared to 503 billion of exported products in the same period. Other studies show that, Kenya, India and China are the Tanzania's most important export destinations for timber accounting for more than 70 % of the value of Tanzania's exports

where Kenya is the single largest destination (Indufor, 2011; Lukumbuzya and Sianga, 2017).

2.7 Drivers of Tanzania timber trade

According to Chenga and Mgaza (2016), there are three main drivers of Tanzania timber trade namely, economic growth, the growth of the construction industry, and population growth.

2.7.1 Economic growth

According to the World Bank (2019), Tanzania is ranked as among the fastest growing economies with economic growth of about 7.0 % per annum. The economy continues to be strongly influenced by the performance of the agricultural sector. Although it only contributes 23 % of the gross value added, the sector employs the bulk of the labour force estimated at 62 % (ECA, 2016). The construction and wholesale and retail trades are the largest subsectors in terms of gross value addition accounting for about 26 % of the gross value added. Both subsectors are growing rapidly. Construction industry in the mainland grew by 16 % in 2014 and by 13.2 % in the second quarter of 2015 (ECA, 2016). Construction activities would likely continue to grow with the continuing urbanization and the growing middle class likely to invest in improved housing. The manufacturing subsector has been growing steadily. On the mainland, the annual growth of manufacturing averaged at 6.6 % between 2010 and 2014 (ECA, 2016). However, its contribution to the gross value added remains small estimated at 6.9 %. Furthermore, the growth rate of the subsector is lower than the rate required in meeting the Government's goal of 23 % contribution to the GDP by 2025 (ECA, 2016). The growth of middle-class income through small and medium enterprises has promoted and improved living

standards. Logically, the improvement of living standards would be accompanied by the need for better housing and higher value timber products, resulting in more demand for timber for building, furnishing materials, and associated infrastructure (Chenga and Mganza, 2016).

2.7.2 Growth of the construction industry

Forest provides over 75% of all construction materials in the country (Ngaga, 2011). The sector has witnessed a rapid growth of buildings thereby demanding many wood materials. However, the industry is increasingly dissatisfied with the quality of local timber products as the sawmilling industry has not kept pace with technological developments or maintained sufficient professionalism (Indufor, 2011). As a result, the construction industry has been driven to opt for sawn timber substitutes including plywood (Indufor, 2011). Tanzania's cities are experiencing high migration rates from rural areas triggering the need for adequate housing (Indufor, 2011). In 2010, the National Housing Corporation (NHC) estimated the deficit of housing nationwide to be 3 000 000 units, with an annual growth in the demand of 200 000 units per annum. In Tanzania, the construction, pulp and paper, furniture and joinery, and utility pole industries consume most supplies of the round-wood, with the construction and pulp and paper sectors consuming about 79 % of supplies from government plantations (Indufor, 2011).

2.7.3 Population growth

The population of Tanzania based on the last census of 2012 has almost tripled in size increasing from 12.3 million in 1967 to 44.9 million people in 2012. Currently, the population is growing at a rate of 2.7 % per annum, which is ranked one of the fastest in the world translating to a net about 1.2 million people being added to the population

annually (NBS, 2013). Growing at this rate, the population of Tanzania is projected to reach 70.1 million people in 2025 (Agwanda and Amani, 2014). The structure and dynamics of the population in Tanzania have several implications not only to the forest sector but also on development in general. As the population grows, so does the demand for resources and an increase in social expenditures (Agwenda and Amani, 2014). When the economy improves, it also affects positively other sectors such as the construction and building leading to an increase in the consumption of sawn timber and wood-based panel products (Ngaga, 1991).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the study area

3.1.1 Location of study area and selection of study sites

The United Republic of Tanzania is located in East Africa between longitude 29^0 and 41^0 East and latitude 1^0 and 12^0 South (NBS, 2018). The Tanzania mainland covers 945 100 km^2 while the islands of Zanzibar account for about 2500 km^2. Tanzania borders Kenya and Uganda on the north, Rwanda, Burundi, and the Democratic Republic of Congo on the west and Zambia, Malawi and Mozambique on the south. Administratively, Tanzania mainland consists of 26 regions while the islands of Zanzibar consist of five regions.

This study focused on the Tanzania mainland particularly in four sites (regions) namely Iringa (Mufindi District), Arusha (Arusha municipality), Dodoma (Dodoma municipality), and Dar es Salaam. In this study, Mufindi District in Iringa region was chosen as the production site because majority (over 80%) of sawn timber production takes place in Mufindi District (Iringa) particularly in Sao Hills Forest Plantation and in various private farms (Ngaga, 2011). On the other hand, Arusha Municipality, Dar es Salaam, and Dodoma are urban areas with major consumption of sawn timber in Tanzania occurs (Ngaga, 1991; Kapinga, 2010). Figure 4 is the map of Tanzania showing location of the study sites.

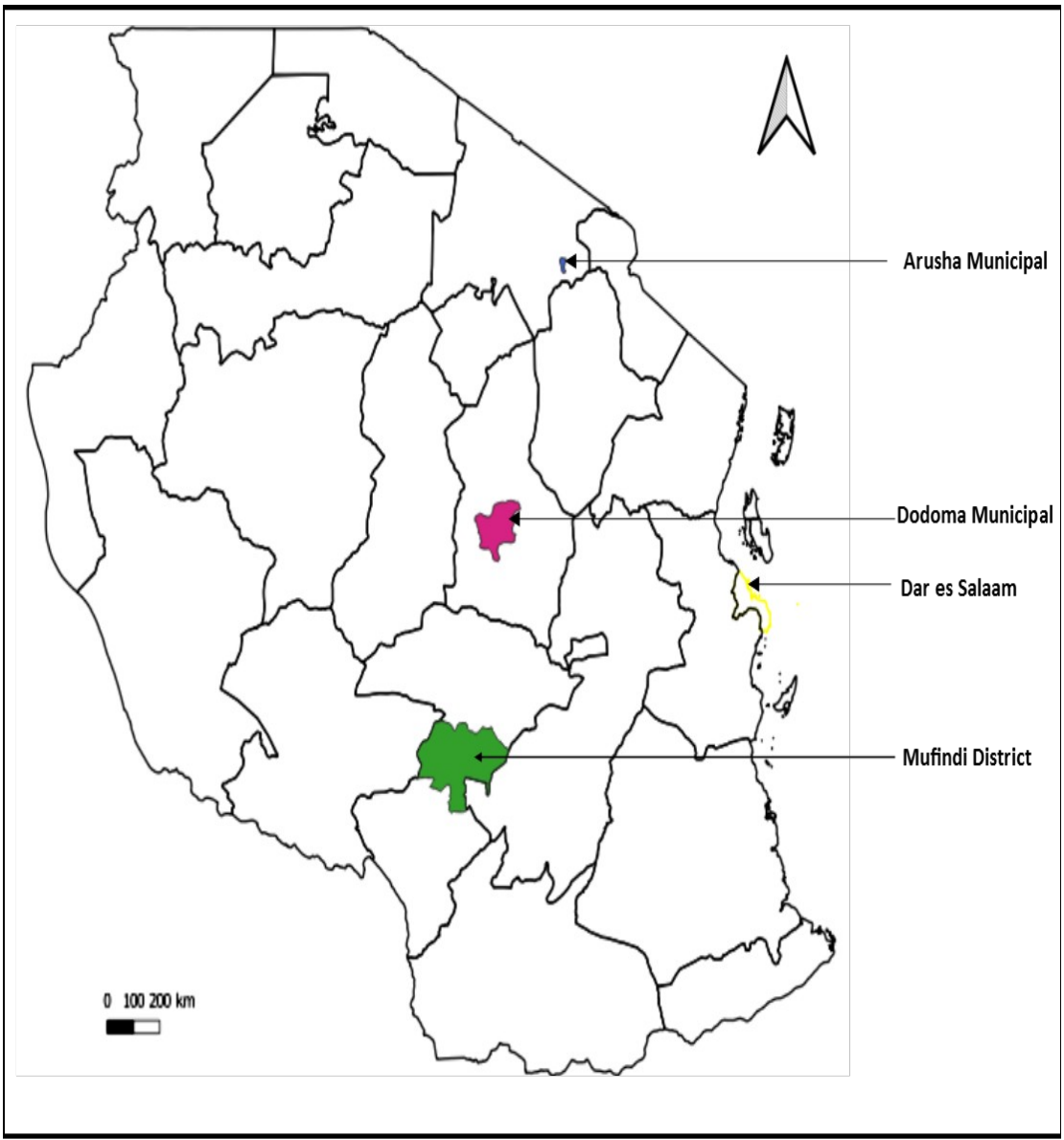

Figure 4: Map of Tanzania showing location of study sites

3.1.2 Climatic condition

The country is believed to have diverse climate, depending on altitude and latitude. The central plateau is relatively dry while the north-western highlands are cool (MNRT, 2015). The rainfall for large part of the country is bimodal with short rains from October to December and long rains from March to May. The mean annual rainfall varies from bellow 500 mm to over 1000 mm per annum (TMA, 2016).

3.1.3 Socio-economic activities

The major economic activity in Tanzania is agriculture, which engages about 66 % of the country's labour force (ECA, 2016). The agricultural sector is the leading contributor to the gross domestic product (GDP) whose share accounts for about 23 % (ECA, 2016). Other activities include manufacturing, construction, tourism, and transport which contribute significantly to the national economy. The agriculture sector, which includes forestry and fishing, has not been growing as rapidly as other sectors. This to some extent has caused the mismatch between economic growth and success in social development (ECA, 2016).

3.2 Research design, sampling procedure and sample size determination

3.2.1 Research design

This study used cross sectional research design since the required data were collected at one point in time without repetition for cross sectional data as recommended by Kothari (2008). For this study, a survey was employed to estimate production and consumption (marketing) of sawn timber and utility poles from producers and traders of sawn timber

and utility poles in Tanzania. The rationale for this approach is based on the fact that, by conducting a survey the assessment is done on spot (Ngaga, 1991).

3.2.2 Sampling procedure and sample size determination

The data required for this study included those on production of sawn timber and utility poles, trade (market) and import/export statistics. The sample sizes were determined differently depending on the population of the target groups in the study sites and the easy of accessibility. A list of registered traders of sawn timber was requested in the respective municipality namely Ilala, Temeke and Kinondoni (Dar es Salaam), Arusha and Dodoma municipalities as a sampling frame. For the large population comprising of traders of sawn timber products, a sample size of not less than 30 % was selected as recommended by Openshaw (1971). On the other hand, a list of saw mills and poles utility plants was requested from Sao Hill Forest Plantation office in Iringa. The saw mills were categorised as small, medium and large based on the annual wood allocations. Small producers were those with less than 5000 m^3 wood allocation per annum, medium producers were those with wood allocation ranging between 5000 m^3 and 10 000 m^3 per annum while large producers comprised those with wood allocations of above 10 000 m^3 per annum. For population comprising of large and medium producers of sawn timber, sample size of 100 % was considered so as to increase precision. For the population comprising of small producers, a sample of not less than 30% was selected as recommended by Openshaw (1971). In the case of utility poles plants, four plants which is equivalent to 57 % were sampled.

However, during data collection, some of the producers in the category of small and medium size were hesitant to provide correct data for fear of taxation by the government.

To overcome this situation, the researcher compared their data with saw log data from government plantations allocated to the saw millers. A list of 457 sawmills (small, medium and large) was made available from Sao Hills Forest Plantation Manager, including the volume of saw logs allocated to them by SHFP annually. On the other hand, the production data from other government plantations were requested from TFS Headquarters. Therefore, this approach enabled the researcher to get production data for sawn timber and utility poles from all the producers. This, in turn, facilitated the estimation of sawn timber production trend from 2009/2010 to 2018/2019 basing on the following assumptions:

(i) The recovery rate for the ding dong saw mills was estimated at 37 %

(ii) The recovery rate for the advanced technology saw mills was estimated at 47 %

(iii) About 51 % of the sawn wood production in the government plantations is done by ding dong saw mills

(iv) About 49 % of the sawn wood production in the government plantation is done by advanced technology saw mills

(v) About 100 % of the sawn wood production in small tree growers is done by ding dong saw mills

In the case of small tree growers in Tanzania, their contribution to the annual sawn timber supply was captured in the literature. On the other hand, the trade data of sawn timber marketing were obtained from the registered sawn timber traders using a sample of 30 % of all traders in the site. A list of traders and end use manufactures (Carpenters) was made available from the office of the District Forest Managers in Kinondoni, Ilala, and Temeke for Dar es Salaam region, Arusha, and Dodoma Municipals for Arusha and Dodoma regions. Traders were categorized into small, medium, and large size categories based on

the information provided from traders about their capital. Small traders were those with capital of less than 5 million while medium sized trader were those with capital ranging from 5 to 10 million, and larger traders comprised those whose capital exceed 10 million Tanzania shillings. However, the provided list of registered end use manufacturers (carpenters) seemed to be insufficient to provide meaningful statistical analysis and hence this group was dropped in the assessment of domestic market (trade) for sawn timber.

The export and import statistics (2005 to 2018) in terms of volume of sawn timber and utility poles, country of origin, and destination were obtained from the Tanzania Revenue Authority (TRA). The data were used in the assessment of import and export market of sawn timber and utility poles. The Tanzania Electric Supply Company Limited (TANESCO) was visited to obtain statistics concerning the demand, supply, forecasted demand, and other types of information regarding utility poles.

3.3 Data collection methods

In this study, both primary and secondary data sources were visited. Primary data were collected using questionnaires answered by saw millers (producers of sawn timber), timber traders and utility poles producers. The questionnaires were designed to capture both quantitative and qualitative data from the interviewee. The quantitative data collected from saw millers included the volume of sawn timber produced per annum while the qualitative data included factors affecting production of sawn timber and utility poles. On the other hand, timber traders were visited to obtain data including the volume of sawn timber traded per annum, price and factor affecting marketing of sawn timber. The questionnaires (Appendix 1 and 2) also considered both structured and semi-structured questions. For the first two days before the actual survey, a pilot study (10

respondents) was carried out in Dar es Salaam and Iringa to check the suitability of the questionnaires for timber traders and producers (saw millers) respectively. The results showed that most of the respondents understood the questions and were capable of providing data from each question particularly for timber traders. In the case of producers, question no 6 and 7 (Appendix 1) which required the producers to provide data on production trend of sawn timber and utility poles from year 2000 to 2018, seemed to be difficult since majority of the producers did not have good records on production and some were not ready to disclose their production data for fear of taxation by the government. To overcome this situation the researcher thought to compare their data with the wood allocated to them by Sao Hills Forest Plantation in the respective years so that estimation can be done.

Other data collection methods used in this study were Focus group discussion (FGD) especially for sawn timber traders, key informant interviews (with District Forest Managers in the study sites, Sao Hills Forest Plantation officials and officials from the Tanzania Forest Research Institute) and direct observation by making field observation and recording of events necessary for obtaining additional information for the study (Appendix 4). These methods were used in order to triangulate or validate the results obtained through questionnaires survey. Secondary data were collected through various sources such as published and unpublished scientific papers, reports and other documents relevant to this study. Government institutions namely TRA, TFS, and TANESCO were visited. The secondary data on import and export of sawn timber were obtained from TRA. The Tanzania Forest Service (TFS) Agency was visited to obtain data on production on saw logs in government plantations while the quantity demanded and supplied for utility poles was obtained from

TANESCO. Since small tree growers were many and sampling of them could be difficult and robust, their contribution in sawn timber production was captured in the literature.

3.4 Data analysis

The data collected were analysed using quantitative and qualitative techniques. The quantitative data were analysed by using Statistical Package for Social Sciences (SPSS) by computing descriptive statistics to obtain mean and percentage distribution of the responses. Content analysis was used to analyse qualitative data by summarising field data based on the objectives of the study. To determine the normality of data on prices of sawn timber in three major markets of sawn timber in Tanzania, the Sharpiro-Wilk test was used and showed a significant ($P < 0.05$) difference between the normal curve and the curve of the prices of sawn timber. This implies that the population from which the data were collected was not normally distributed. Therefore, the Kruskal-Wallis test was used to test whether there is a significant difference between the prices of nine categories of sawn timber size in three major markets of Tanzania namely Dar es Salaam, Arusha and Dodoma.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Production of sawn timber and utility poles in Tanzania

4.1.1 Surveyed producers of sawn timber and utility poles

The study revealed that majority of producers of sawn timber are small sized saw millers (Table 8). This implies that production of sawn timber is skewed to small producers who in turn produce small quantities of sawn timber as compared to large and medium sized producers. In addition, four producers of utility poles which is equivalent to 57% were surveyed. This implies that, production of utility poles is mainly done by large producers which are few in the study site.

Table 8: Surveyed number of producers of sawn timber

Saw Mills	No. of respondents	Percent
Large	3	100
Medium	7	100
Small	126	30
Total	**136**	

4.1.2 Production of sawn timber

The production of Tanzania's soft wood sawn timber is mainly carried out relying on the government and privately owned plantations (small tree growers). The results (Figure 5) for the past 10 years (2009 to 2019) revealed that, annual production trend of sawn timber was decreasing gradually from 837 926.79 m^3 in 2009/2010 to 552 011.44 m^3 in 2018/2019. The detailed calculation of the estimates of sawn timber production is shown in Appendix 5.

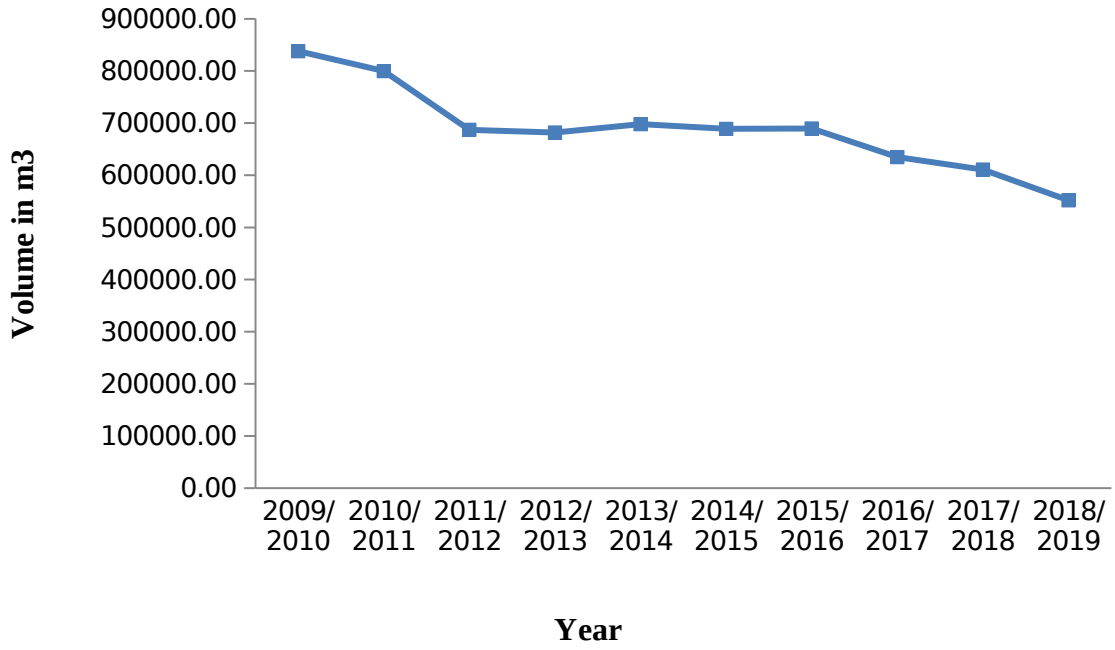

Figure 5: Production of sawn timber in Tanzania from 2009 to 2019

Source: Author (2019)

This decrease in production of sawn timber is attributed to the reason that, government plantations were characterized by over harvest and slow replanting in the past (Ngaga, 2011; Chenga and Mganza 2016; UNIQUE, 2017). This has therefore led to the current low wood allocations in order to normalize forest due to presence of many young stands. In addition, the contribution of privately owned plantations (small tree growers) to sawn timber supply is still low because about 43 % of the woodlots were under the age of 5 years old (UNIQUE, 2017). Furthermore, the contribution of some government plantations (Table 10) was characterized by inconsistence production including no production in some years. For instance, Ukaguru had no production for 8 years consecutively from 2010/2011 to 2017/2018; Matogoro had no production for 7 years in 2009/2010 and from 2013/2014 to 2018/2019. Rubare had no production for 6 years consecutively from 2012/2013 to 2017/2018 and Rondo for 4 years in 2011/2012 and from 2016/2017 to 2018/2019 (Table 9).

This situation may also have contributed significantly to a decrease in sawn timber production because raw materials largely come from the government plantations. These findings are similar with the findings in a study by Chenga and Mganza (2016) who focused on timber trade dynamics, a preliminary review of Tanzania domestic trade in timber. Similar findings are also reported by UNIQUE (2017) who focused on Tanzania wood product market study, and Ngaga (2011) who focused on forest plantations and woodlots in Tanzania. All these studies reported a decrease in wood production due to the unavailability of raw materials and young plantations (UNIQUE, 2017; Chenga and Mganza 2016; Ngaga, 2011).

Table 9: Saw logs production from government plantations

SN	Name of Forest Plantation	Production m^3 Year									
		2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
1	Soa Hill	1 034 765 (86%)	1 000 000 (87%)	824 000 (84%)	807 000 (83%)	850 000 (85%)	834 435 (85%)	830 812 (84%)	738 450 (81%)	704 313 (80%)	538 034 (68%)
2	Matogoro	0	4 000	2 421	1 000	0	0	0	0	0	0
3	Shume	14 423	16 310	22 236	21 453	22 211	14 555	19 406	24 633	33 008	29 927
4	West Kilimanjaro	25 000	15 000	24 700	18 000	1 750	14 087	11 279	20 498	19 785	32 798
5	North Kilimanjaro	17 931	16 850	20 000	20 000	20 000	20 377	20 126	28 440	33 419	32 180
6	Ukaguru	24 155	0	0	0	0	0	0	0	0	7 009
7	Kiwira	4 964	6 000	5 000	144	2 000	715	953	21 815	31 115	17 111
8	Kawetire	15 000	0	8 940	1 500	10 425	6 955	6 293	11 204	11 074	13 581
9	Rondo	5 217	1 525	0	13 630	10 500	8 043	10 724	0	0	0
10	Rubya	7 585	0	4 895	6 473	6 900	4 458	5 944	0	0	16 790
11	Buhindi	30 360	25 000	22 770	22 770	24 270	15 680	20 907	16 357	20 134	43 896
12	Meru	0	15 000	10 000	24 000	21 000	24 625	23 208	34 480	22 216	32 226
13	Rubare	1 738	3 000	800	0	0	0	0	0	0	964
14	Mtibwa	18 459	24 400	23 955	25 508	15 689	27 457	22 885	6 861	0	14 748
15	Longuza	660	18 396	14 481	15 412	15 000	15 557	15 323	6 494	0	11 443
	Total	**1 200 257**	**1 145 481**	**984 198**	**976 890**	**999 745**	**986 944**	**987 860**	**909 232**	**875 065**	**790 708**

This implies that the current sawn timber supply would have been unable to meet the demand if that demand for sawn timber would have been high. About 88 % of the interviewed traders (Figure 8) reported that, sales of sawn timber have been decreasing for the past 5 to 10 years; and 65 % (Figure 9) of the traders reported that sawn timber was abundant. This implies that, despite the gradual decrease in the production of sawn timber, its supply exceeds the current demand, which has been decreasing as well. Additionally, during the period between 2009 and 2019, average contribution of the production from government plantations largely (83%) came from Sao Hill forest plantation while the remaining 17 % came from 14 forest plantations (Table 10). The significant contribution from other government plantations particularly in recent years (from 2016/2017 to 2018/2019) largely came from Buhindi (2.46%) North Kilimanjaro (2.33%), Shume (2.25%), Meru (2.10%), West Kilimanjaro (1.86%), and Mtibwa (1.83%).

4.1.3 Production of utility poles in Tanzania

4.1.3.1 Production trend of utility poles

The production of utility poles from 2015 to 2019 shows an increasing trend from 313 612 to 461 449 poles respectively (Figure 6).

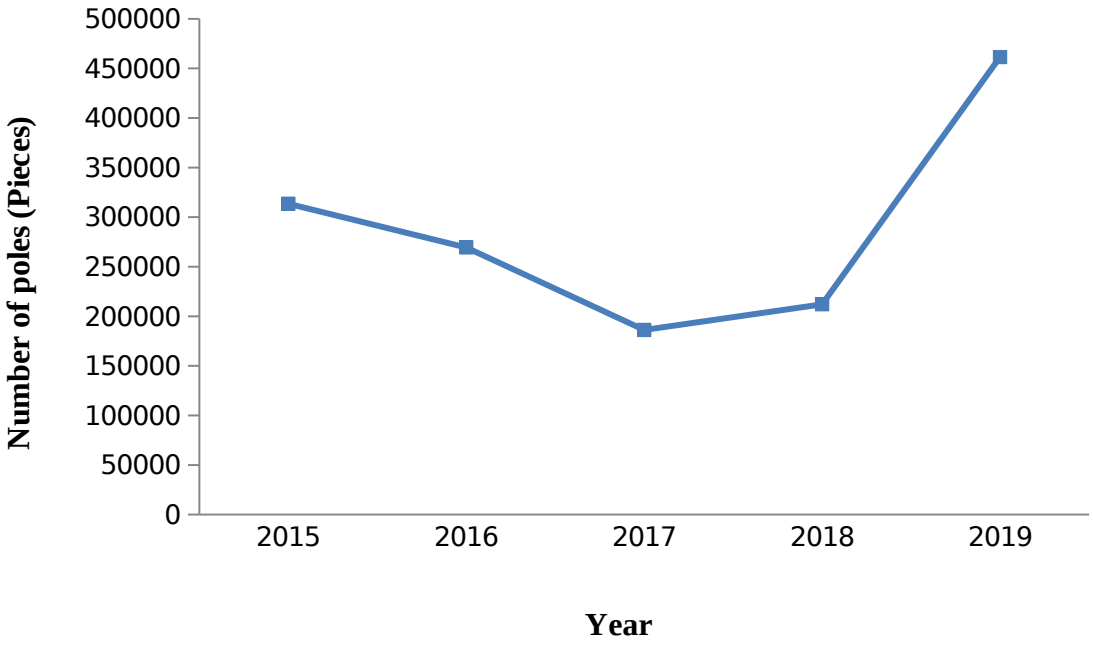

Figure 6: **Production trend of utility poles in Tanzania**

Source Author (2019)

Producers reported that, currently, there is a growing market for domestically produced poles as the government has banned poles importation from other countries. In addition, the growing market demand is due to an increase in customer connections from 100 000 to 250 000 annually in order to meet the government's target of 30 % connections in 2025 and at least 75 % in 2033 (PFP, 2016). However, producers argue that the main challenge is lack of enough quality raw materials. This observation is supported by a study by PFP (2016) on the value chain analysis of plantation wood from southern highlands which reported that on average, between 30 to 40 % of standing eucalyptus trees are suitable for poles, which is considered as a low yield from eucalyptus compartments. This means that for the poles sector to remain competitive and tape the growing domestic market there is a need of increasing production of quality eucalyptus trees, which are the raw materials for the utility poles production.

4.2 Assessment of domestic and export market of sawn timber and utility poles

4.2.1 Assessment of domestic market for sawn timber and utility poles

4.2.1.1 Categories of traders of sawn timber

The current study revealed that a large proportion of sawn timber traders are medium sized entrepreneurs (60%). Small trades comprised those with capital less than 5 million Tanzania shillings, medium traders included those with capital of between 5 and 10 million while larger traders were those with capital of above 10 million (Figure 7). This implies that sawn timber business is largely dominated by medium and small-scale entrepreneurs.

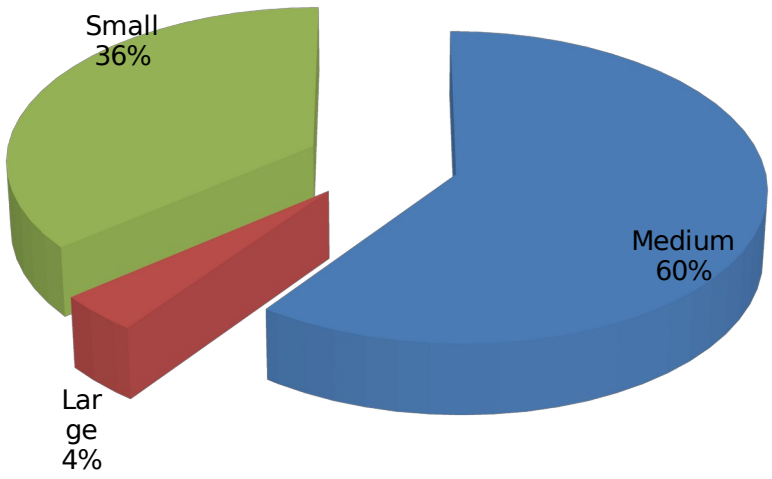

Figure 7: Categories of sawn timber traders

4.2.1.2 Surveyed traders of sawn timber products from Dar es Salaam, Dodoma and Arusha Regions

The study revealed further that majority of traders were found in Dar es Salaam, which accounts for 67 % of the surveyed/visited traders (Table 10). Similar findings are reported by Kapinga (2010) who revealed that majority of the sawn timber traders are found in Dar es Salaam and Arusha.

Table 10: **Surveyed traders of sawn timber product**

Region/Municipal Council	Total number of registered traders	Number of traders surveyed/visited	% of surveyed traders
Dar es Salaam	616	184	30
Arusha municipal Council	184	55	30
Dodoma Municipal Council	114	34	30
Total	914	273	30

Source: TFS (2019)

4.2.1.3 Traded volume of sawn timber from Dar es Salaam, Dodoma and Arusha in 2019

The results (Table 11) from interviewed traders show that a total of 263 042.93 m^3 of sawn timber was traded in the three major markets with Dar es Salaam consuming the bulk (83%) of the total (Figure 11). This is attributed to the reason that, Dar es Salaam is the business city for Tanzania and had the highest population of 4.36 million people followed by Dodoma 2.08 million and Arusha 1.6 million people in 2012 (TBS, 2013). Given the average population growth rates of Dar es Salaam (5.6%), Dodoma (2.1%), and Arusha (2.7%), it is projected that by 2019, Dar es Salaam had a population of 6.07 million followed by Dodoma 2.38 million and Arusha 2.01 million. According to Agwanda and Amani (2014), as the population grow so does the demand for the resources and social expenditure. In addition, when the economy improves, the construction and building activities increase as well as the consumption of sawn timber and wood-based panel products (Ngaga, 1991). The current move of shifting government activities from the commercial city of Dar es Salaam to the Capital City of Dodoma has increased construction activities and higher levels of sawn timber consumption in Dodoma as compared to Arusha.

Table 11: **Traded volume of sawn timber in major markets of Tanzania in 2019**

Region	Traded volume of sawn timber (m3)	**Percent (%)**
Dar es Salaam	217 422.33	83
Dodoma Municipal	32 242.42	12
Arusha Municipal	13 378.18	5
Total	263 042.93	100

4.2.1.4 Trend in sales of sawn timber

The study revealed that, majority (88%) of traders of sawn timber reported that their sales were decreasing when compared to the past 5 to 10 years (Figure 8). Many reasons were cited for this observation and competition was largely cited (41%) as the main cause (Table 12).

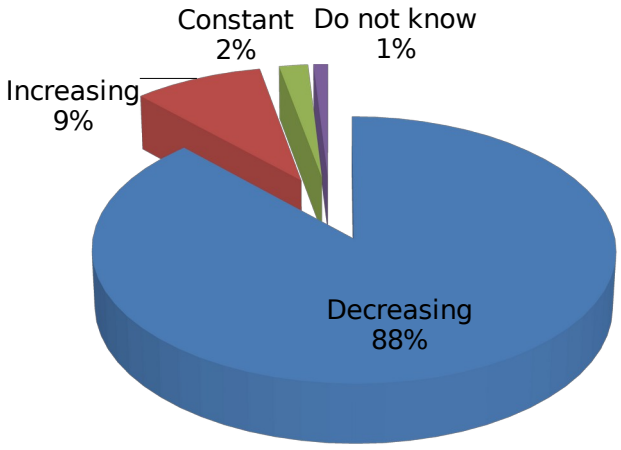

Figure 8: **Responses on sales trend of sawn timber for the past 5 to 10 years**

It was further mentioned that some of the sawn timber traders are tree growers and trucks owners who source some of the products from their own farms in the southern highlands. This in turn makes them lower the prices, which negatively affect the sales from other sellers since there is no common price for sawn timber.

Also due to higher demand of sawn timber in the past, many people have been attracted in this business, which in turn has increased competition. According to the respondents, middlemen have a tendence of increasing the price for them to get more profit causing variation in prices.

Table 12: **Reasons for decreasing sales of sawn timber**

Reasons for decreasing sales of sawn timber		Responses	
		N	Percent
Multiple Responses	Low income of the customers	116	33.7
	Competition from other traders of sawn timber	141	41.00
	Price variation among traders of sawn timber	51	14.80
	Problem caused by middlemen	16	4.70
	Presence of sawn timber substitute products	20	5.80
Total		**344**	**100.00**

a. Dichotomy group tabulated at value 1

These findings relate with the findings in a study by UNIQUE (2017) on Tanzania wood market study who found that, despite the increase in construction activities, most large-scale housing projects and commercial buildings in the urban areas are no longer using timber supported roof constructions. Currently, the commercial buildings in urban areas largely use concrete works requiring poles and plywood for scaffolding and shuttering, and these perhaps contribute to a decreasing demand for sawn timber. This means large-scale projects contractors are increasingly turning to non-wood scaffolding and shuttering systems. Also, the market is flooded with improperly treated products and reliable suppliers for large volumes of treated timber are limited to only large players such as Sao Hill Industries, NFC and TANWAT (UNIQUE, 2017). A study by Nyamoga *et al*. (2016) on sawn timber substitution in Dar es Salaam, Tanzania and its linkage to environmental conservation revealed that wooden window frames are

increasingly replaced by aluminium, which is readily available, fashionable, and cheaper than timber. Therefore, if the sawn timber market is not regulated in terms of prices, quality and importation of sawn timber substitute products including aluminium, the potential growth of sawn timber business would be in danger. According to Kotler (1985), price has great influence on the decision to buy a particular product and hence each price that the seller might charge might lead to a different level of demand and might therefore have a different impact on product marketing.

4.2.1.6 Sources and availability of sawn timber in Tanzania

About 65 % of the respondents from sawn timber traders depict that there is abundant availability of sawn timber in the Tanzania major markets (Dar es Salaam, Dodoma, and Arusha) and in the sources of production (Figure 9).

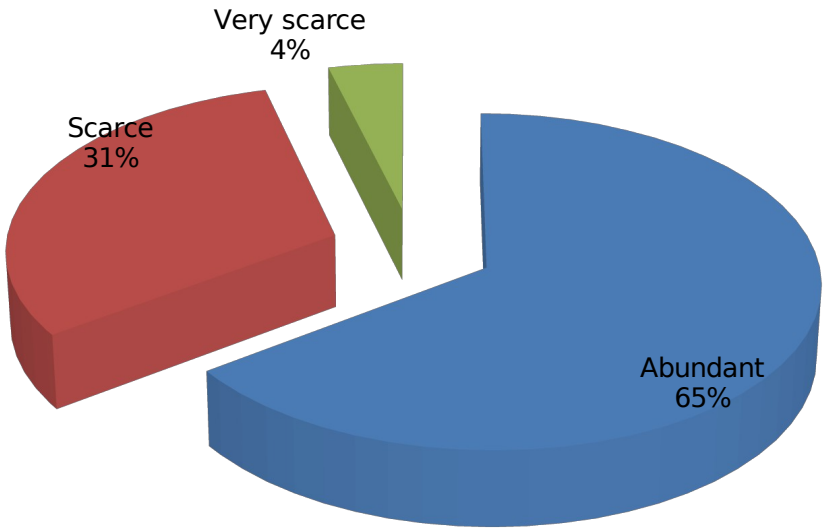

Figure 9: Responses on availability of sawn timber in Tanzania

Most of the respondents who said sawn timber was available abundantly were those dealing with softwood sawn timber mainly *Pinus spp* (Pines) and *Cupressus lusitanica* (Cypress). Other studies (Ngaga, 1991; Wells and Walls 2005 and Kapinga 2010) found that most of the sawn-soft woods come from Iringa region particularly from Sao Hill Forest Plantation and private farms. This is also reflected in this study that most (36.3%) of the respondents sourced their sawn timber products from Iringa region (Figure 10). This is mainly because majority (36% to 43%), which is equivalent to 210 000-250 000 hectares of the planted area in Tanzania are located in southern highlands (Mankinen *et al.*, 2016). Dar es Salaam has been mentioned as among the sources of sawn timber. This means that some small timber traders purchase sawn timber from medium and large traders at wholesale price and sell it in the distant markets particularly in the out-skirts of Dar es Salaam city.

Other regions have shown a significant contribution in the sawn timber supply, and these include Njombe (20.8%), Morogoro (6.3%), Mbeya (6.0%), Tanga (5.8%), and Lindi (5.5%). Njombe and Mbeya Regions are part of southern highlands, which are experiencing rapid increase in tree planting for commercial purposes (Ngaga 2011; Arvola *et al.,* 2019). Also according to the respondents, Morogoro, Tanga, and Lindi are the main sources of hardwood-sawn timber. This is reflected in the study by Salmi *et al.* (2000) on financing in forestry in Tanzania who reported that the main sources of common commercial timber species in Tanzania include costal forest (Tanga and Lindi) and Morogoro region. On the other hand, the neighbouring countries such as Malawi, Congo DRC, and Mozambique are sources of hardwood-sawn timber with Mozambique being the leading importer of hardwood-sawn timber among these countries (Figure 10).

The hard-wood sawn timbers which are traded the most include *Pterocarpus angolensis* (Mninga), *Afzelia quenzensis* (Mkola), *Cordia abyssinica* (Mringaringa), *Grevillea robusta* (Grevillea) *Olea welwitschii* (Loliondo), and *Chlorophora excelsa* (Mvule) whose availability falls in the categories of scarce and or very scarce. According to timber traders, scarcity or very scarce implies too expensive to obtain due cumbersome procedures and that most of the products are sourced in the remote areas or outside the country.

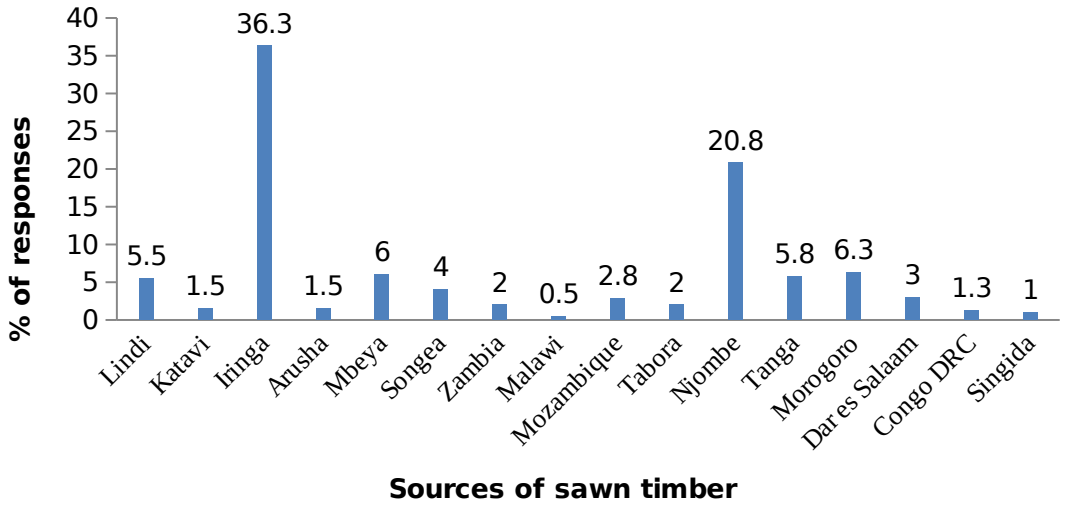

Figure 10: **Response on sources of sawn timber in Tanzania**

4.2.2 Assessments of export-import markets of sawn timber and utility poles

4.2.2.1 Assessment of export-markets of sawn timber

The results from the data collected from Tanzania Revenue Authority (TRA) revealed that, export of sawn timber from Tanzania exhibited a high-pitched increasing trend (by about 96%) in the period from 2005 to 2010 (Figure 11). This was because, there was large quantities of sawn timber imported from Malawi passing through Tanzania and later exported to Kenya (Indufor, 2011).

In addition, India imported over 2.5 million m^3 in 2010, which raised significantly Tanzania exports of sawn timber (Indufor, 2011). Though the data on 2011 were not available, the results show a significant drop in the export of sawn timber from 2010 to 2012.This sharp drop may have been caused by global economic crisis in 2007-2009, which affected markets including China, India, and Japan (Lukumbuzya and Sianga, 2017). Also, between 2009 and 2012, the export of sawn timber to Kenya which formerly was a major destination of Tanzanian sawn timber due to logging ban from Kenya's plantation from 2002 to 2012 declined steadily (UNIQUE, 2017). This implies that, after lifting the logging ban, Kenya's plantations supplied sawn timber to their local market hence lowering the imports from Tanzania.

The result show further that, the export volume of sawn timber between 2010 and 2019 accounted for only 4% of the total export from 2005 to 2019. This implies that massive (96%) export occurred in the period between 2005 and 2010 while small proportion of export (4%) occurred from 2010 to 2019. Though there was a significant drop in the export volume of sawn timber from 2010 to 2019 as compared to 2005 to 2010 period, the trend from 2010 to 2019 showed a gradual fluctuation of increasing and decreasing trend. A notable decrease in the exports could be attributed to the enforcement of restrictions on hardwood exports. The notable increase in the export in 2014 and 2018 was due to large export to India that amounted to 52 832 m^3 (51%) and 51 094 m^3 (49%) of all exports in 2014 and 2018 respectively.

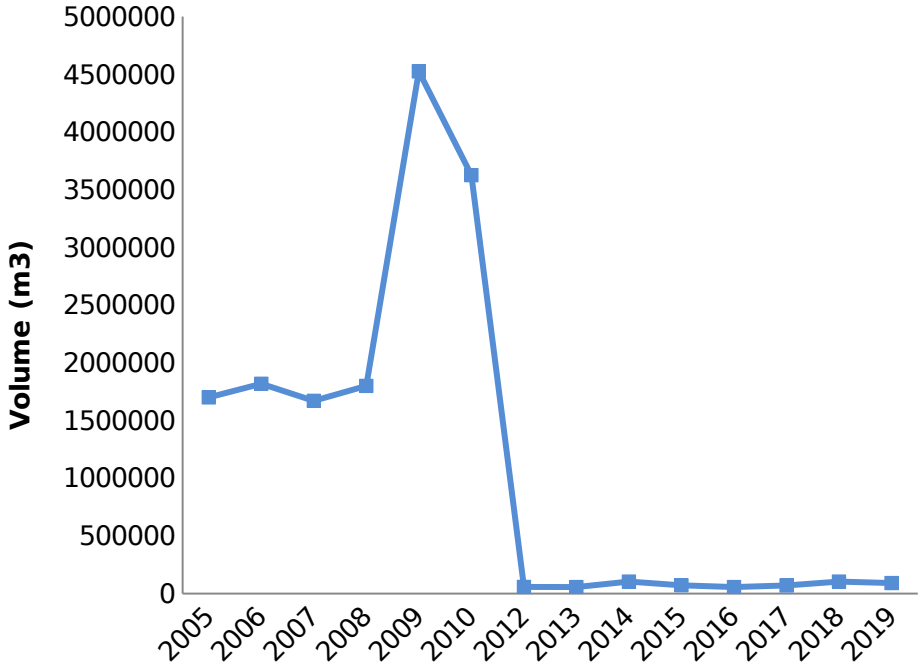

Figure 11: Export trend of sawn timber from 2005 to 2019

Source: TRA (2019)

Between 2012 and 2019, Tanzania exported her sawn timber product to 48 countries. Among them, the export to India alone was 379 128 m^3 which constituted 62 % of all the exports (Figure 12). The findings imply that India was Tanzania's major export destination for sawn timber. These findings are similar with the findings reported in a study by UNIQUE (2017) on Tanzanian wood product market. Similarly, a study by Lukumbuzya and Sianga (2017) on the overview of the timber trade in East and Southern Africa showed that India, China, and Kenya were the main export destinations of Tanzania's sawn timber in recent years.

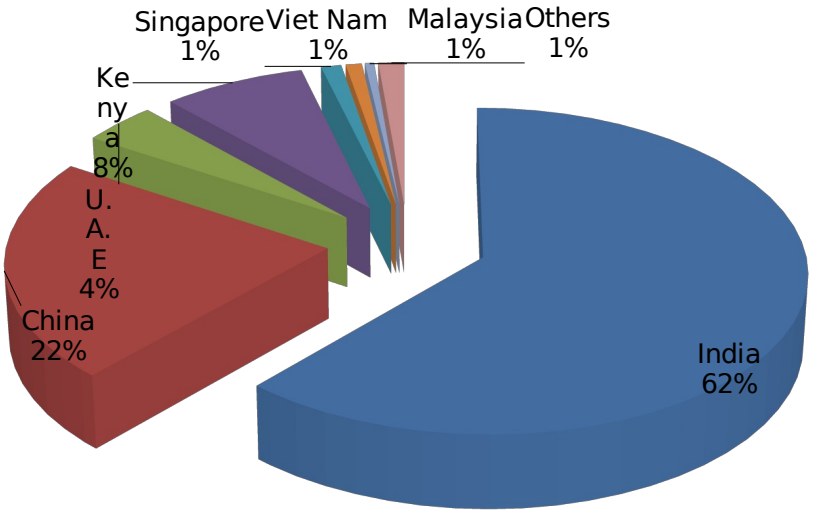

Figure 12: **Countries of destination for Tanzania sawn timber from 2012 to 2019**

Source: TRA (2019)

4.2.2.3 Assessment of import market of sawn timber

The results of import of sawn timber between 2012 and 2019 (Figure 13) exhibited a sharp increasing trend between 2012 and 2014, and steadily decreasing trend from 2015 to 2019. The sharp increasing trend observed between 2012 and 2014 was caused by large imports (90%) of sawn timber from Malawi which amounted to 87 618 m^3. The steady decrease in imports occurred from 2015 to 2017 and gradually increased between 2018 and 2019 because of substantial imports from Mozambique (41%) and Congo DRC (59%) in 2018 and 2019 respectively.

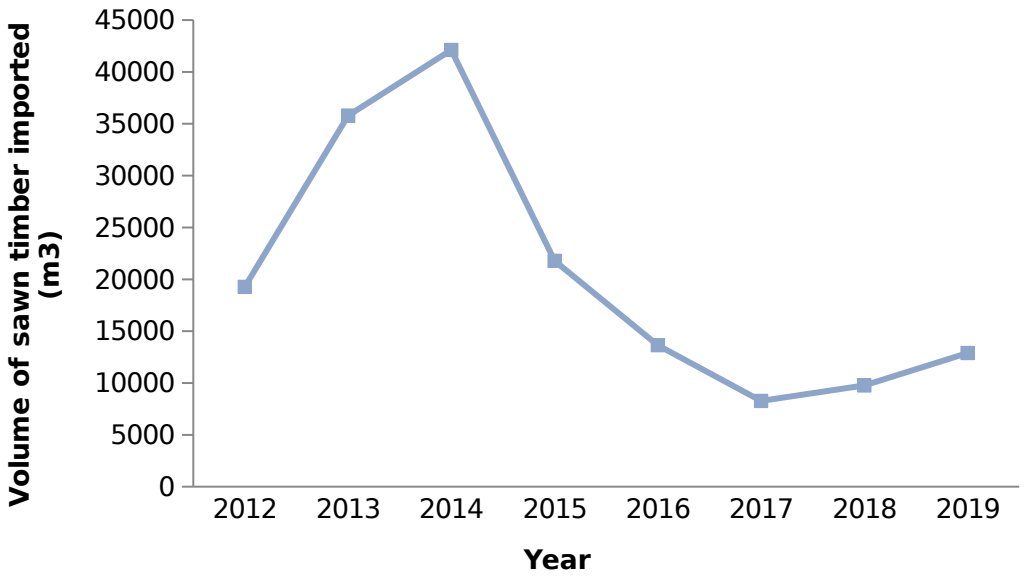

Figure 13: **Import of sawn timber from 2012 to 2019**

Source: TRA (2019)

Between 2012 and 2019, Tanzania imported her sawn timber product from 34 countries. Among them, imports from Malawi alone were 114 793 m^3 which constituted 70 % of all imports (Figure 14). The finding implies that Malawi, was Tanzania's major exporter of sawn timber having a significant share of import of sawn timber in the period between 2012 and 2019. These findings are similar with the findings in a study by UNIQUE (2017) on Tanzanian wood product market and a study by Lukumbuzya and Sianga (2017) on the overview of timber trade in east and southern Africa which found out that the major source of sawn timber to Tanzania included Malawi and Mozambique.

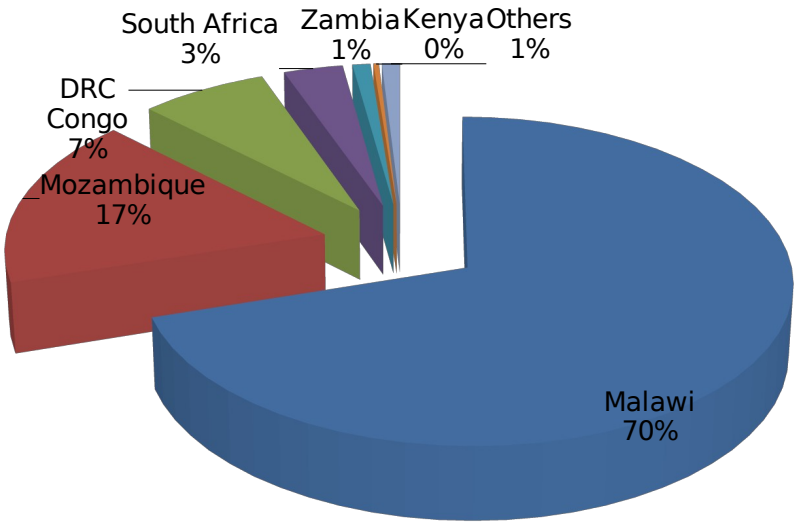

Figure 14: Countries of origin for Tanzania sawn timber from 2012 to 2019
Source: TRA (2019)

4.2.3 Assessment of domestic market for utility poles

The results show that the demand for utility poles in Tanzania is high as compared to the quantity supplied (Figure 15). For the period between 2014/2015 to 2018/2019, the demand increased from 222 828 to 419 610 poles respectively. Between 2014/2015 and 2017/2018, the quantity supplied increased gradually accounting for about 33% while the supply dropped sharply in 2018/2019 to about 18% causing an increase in the supply deficit from 67% between 2014/205 and 2017/2018 to about 82% in 2018/2019 (Figure 15). This increase in the supply deficit may have been caused by government ban of poles importation in 2018 and insufficient supply of quality poles from domestic producers to fill the gap. Before the ban, over 50% of utility poles were sourced from abroad due to low capacity of domestic production to fill TANESCO orders (PFP, 2016). The increase in the demand (Figure 16) is due to an increase in customers connection target from 100 000 to 250 000 annually in order to meet the government's connection target of at least 75 % by 2033.

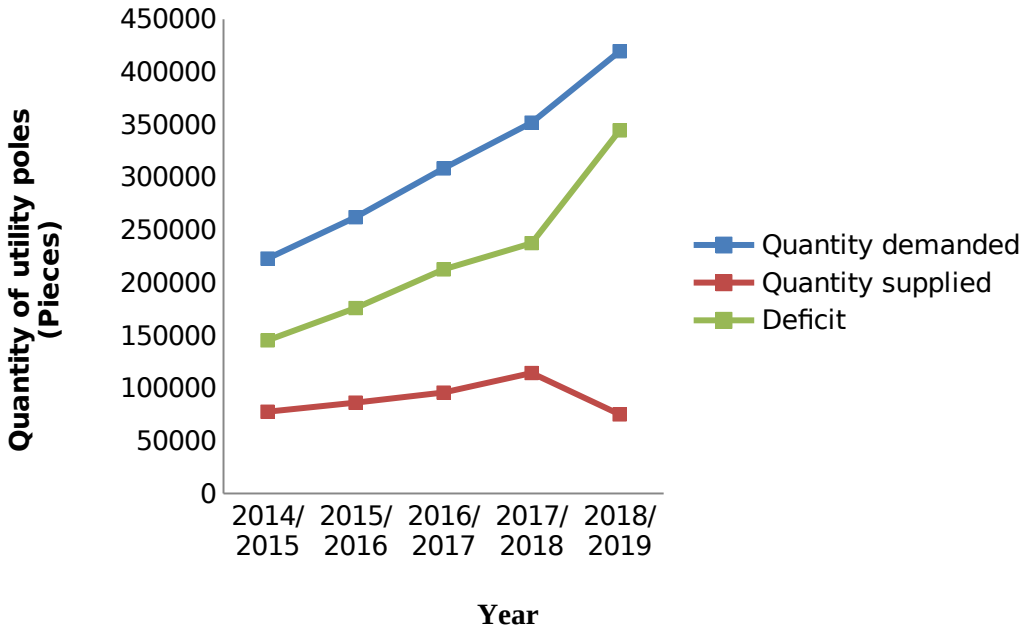

Figure 15: **Trend in demand and supply of utility poles by TANESCO from 2014 to 2018**

Source: TANESCO (2019)

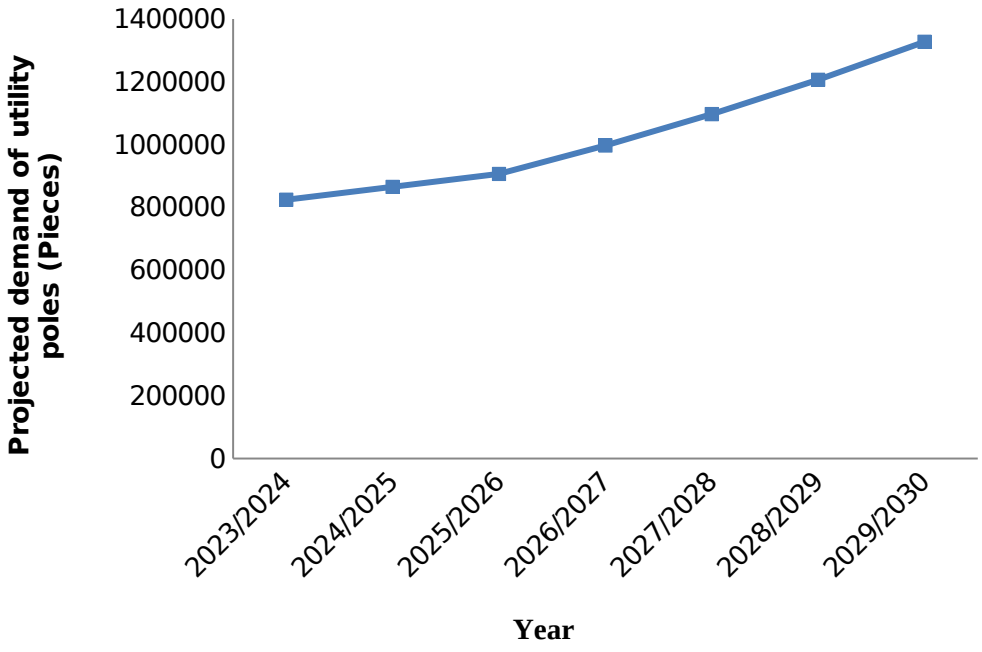

Figure 16: **TANESCO future demand for utility poles**

Source: TANESCO (2019)

4.2.4 Export and import market for utility poles

4.2.4.1 Export of utility poles from 2012 to 2019

The results revealed that the export of utility poles exhibited a sharp declining trend **(**Figure 17). The results show further that, the substantial quantities of the export of utility poles (610 000 poles) which accounted for 99 % occurred in the period between 2005 and 2009. The period between 2011 and 2019 showed a small proportion (5831 poles) accounting for only 1 % of the total export. Though the export statistics for the year 2011 was not available, the trend of the export could still be clearly identified from the available results (Figure 17). The sharp increase in the export of utility poles between 2005 and 2009 was possibly caused by high export to Kenya, which was formerly a key trading partner for utility poles from Tanzania with market share ranging from 55 to 98 % (Indufor, 2011). The high importation of poles by Kenya could be a result of saw log harvesting ban in public forests that lasted from 2002 to 2012 (Cheboiwo *et al*., 2018). This harvesting ban together with the high demand for pole created a supply gap, which facilitated more importation of utility poles from Tanzania.

On the other hand, the decreased export of utility poles which was observed between 2010 and 2019 could be attributed to the reason that, Kenya's plantation supply increased after lifting the 10 years harvesting ban which lasted from 2002 to 2012. According to a study by Cheboiwo *et al*. (2018) on public private partnerships opportunities for forest sector development in Kenya, the potential supply for utility poles was 3 028 907 m^3 which exceeded the potential demand estimated at 1 409 482 m^3. This implies that Kenya no longer required importing utility poles. On the other hand, Tanzania domestic market for poles has been growing since the beginning of the implementation of rural electrification programme by REA, which consequently necessitated the government's ban of the exportation of utility poles since 2018 in order

to feed the growing domestic demand. These in turn significantly reduced the export of utility poles from 2012 to 2019.

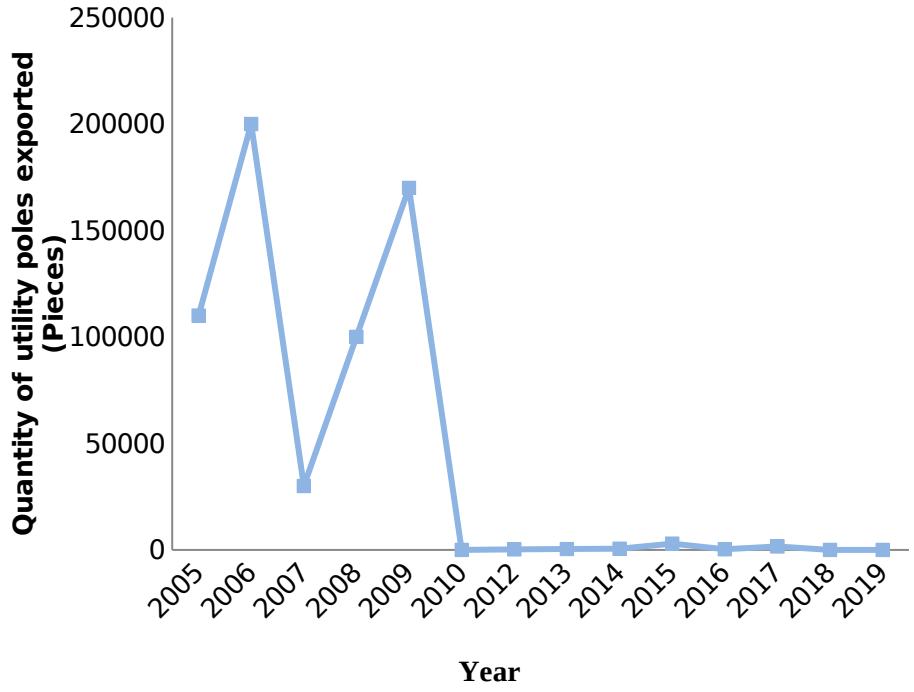

Figure 17: Trend in export of utility poles

Source: TRA (2019)

Between 2012 and 2019, Tanzania exported her utility poles product to 16 countries. Among them, the export to Kenya alone was 4357 poles, which constituted 75 % of all exports, followed by Denmark (16%) and Sudan (6%) (Figure 18). The finding implies that Kenya was a major export destination for utility poles with the greatest share (75%) of export in the period between 2012 and 2019.

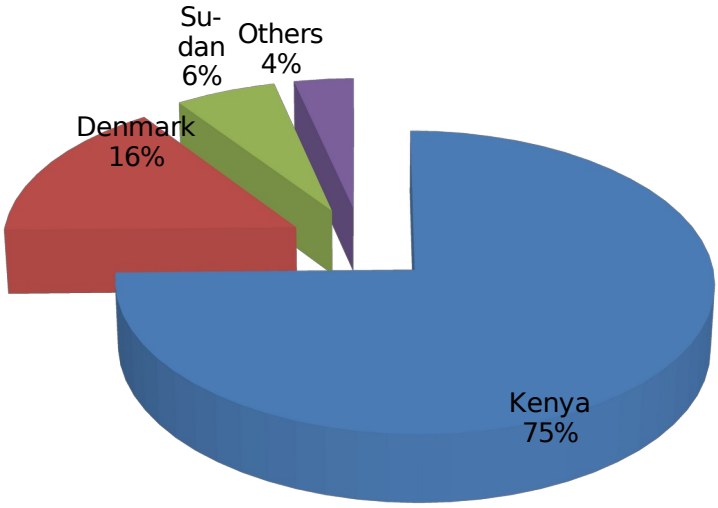

Figure 18: **Countries of destination for utility poles from 2012 to 2019**

Source: TRA (2019)

4.2.4.2 Import of utility poles

The results revealed that importation of utility poles increased sharply from 2012 to 2014 and decreased sharply from 2015 to 2019 (Figure 19). In 2017, the importation rose steadily and dropped significantly in 2018 and 2019 respectively (Fig. 20). Increased import in 2014 was attributable to higher demand by TANESCO, which could not be supplied by domestic producers (UNIQUE, 2017). In addition, in 2016 there was no poles import, while in 2017 about 14 720 poles were imported largely (88%) from South Africa. The government banned poles import in 2018 and 2019 with the aim of utilizing utility poles produced domestically.

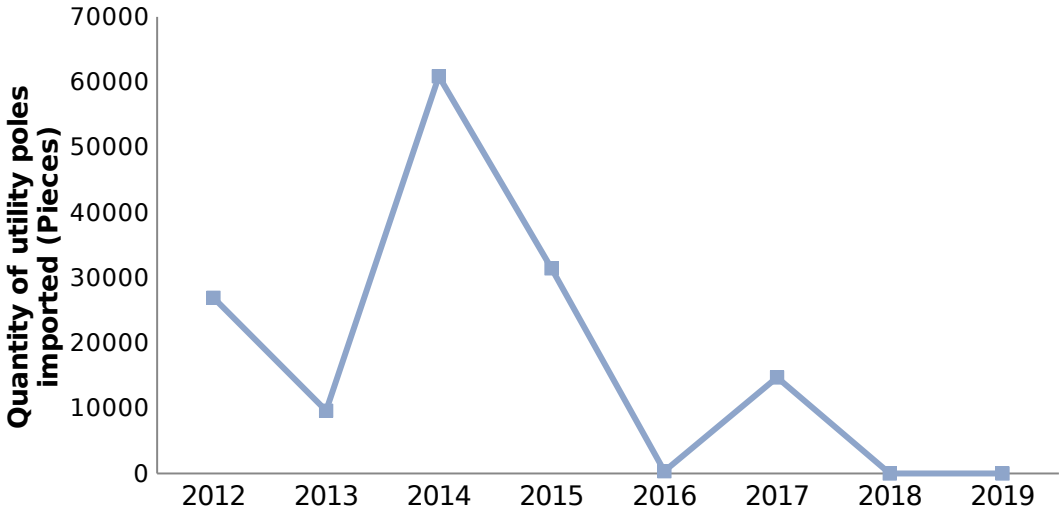

Figure 19: Import trend of utility poles from 2012 to 2019

Source: TRA (2019)

Between 2012 and 2019, Tanzania imported utility poles product from 13 countries. Among them, imports from South Africa amounted to 120 432 poles which is 82 % of all the imports (Figure 20). Other countries included Uganda (10%), Kenya (2%), and Zimbabwe (2%). This implies that South Africa was a major exporter for utility poles to Tanzania.

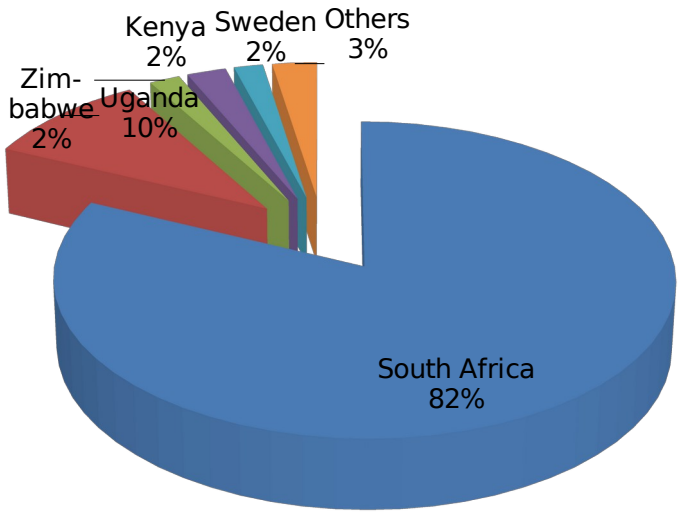

Figure 20: Countries of origin of imported utility poles from 2012 to 2019

Source: TRA (2019)

4.3 Comparison of prices of selected sizes of sawn timber in three major markets

Kruskal-Wallis Test revealed a significant difference in the prices of nine categories of timber sizes in the three major markets of Tanzania ($\chi^2_{(2)} = 46.8813$ $p < 0.0001$). The Wilcoxon scores for price (Figure 21) show that Arusha has the highest score for price compared to Dar es Salaam and Dodoma. This means that the prices of sawn timber in Arusha were higher than they were in Dar es Salaam and Dodoma (Table 13). However, this study found no significant difference in the price of 1x10 inches timber size ($p = 0.7184$) meaning that the price for 1x10 inches in Arusha, Dar es Salaam, and Dodoma was the same (Table 13). The range distribution of price for each category of timber size is shown in Appendix 3. These findings are similar to the findings reported in a study by UNIQUE (2017) on Tanzania wood product market, which revealed that the price of sawn timber in Arusha was high. Since majority of sawn timber is sourced from Iringa and Njombe regions, traders in Arusha claimed that transport costs were high. Also, the study by Kapinga (2010) on marketing chain analysis of sawn-wood from Mufindi District to Dar es Salaam city and Arusha Municipality revealed that distance from the source to the market place has a great influence in the price of sawn timber. This means that as the distance increases, so do the transportation costs leading to an increase in the price to the final consumer. Arusha has the highest distance (1000 km) from Mafinga (Iringa) and hence transportation cost is higher than is the case with Dar es Salaam (492 km) and Dodoma (264 km).

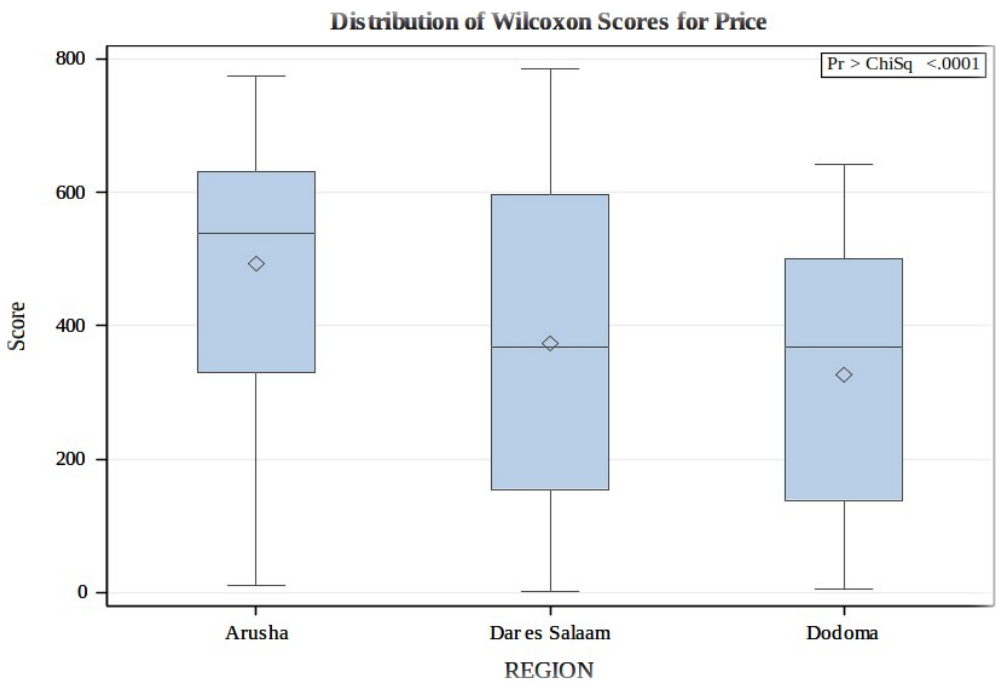

Figure 21: Price scores distribution for nine categories of timber size in Arusha, Dar es Salaam and Dodoma

Table 13: Mean price for nine categories of sawn timber in Arusha, Dar es Salaam and Dodoma

S/N	Timber size (Inch)	Mean price per piece (TZS)			DF	Chi Sq	p	Conclusion
		Arusha	Dar es Salaam	Dodoma				
1	2x2	5 833	3 273	2 375	2	17.5374	0.0002	***
2	1x10	18 000	14 106	16 639	2	0.6614	0.7184	NS
3	1x8	25 682	10 000	10 000	2	81.3188	<0.0001	****
4	2x3	8 500	2 850	3 600	2	25.9888	<0.0001	****
5	2x6	30 000	8 525	7 701	2	15.3947	0.0005	***
6	2x4	12 167	6 099	4 700	2	19.3791	<0.0001	****
7	1x4	4 500	2 611	2 125	2	15.3233	0.0005	***
8	1x6	8 750	4 875	4 750	2	33.9444	<0.0001	****
9	2x8	67 500	53 371	-	1	12.2327	0.0005	***

Note ****= Extremely Significant *** = Extremely significant NS= Not significant

4.4 Analysis of factors affecting production and marketing of sawn timber and utility poles

4.4.1 Factors affecting production of sawn timber and utility poles in Tanzania

4.4.1.1 Inadequate availability of raw materials

It was revealed during the interview with producers and in the literature that raw materials for both sawn timber and utility poles are inadequate. It was further noted that Sao Hills Forest Plantation (SHFP) is a major source but due to the existence of large number of producers, allocation given to each producer per season is not enough compared to the production capacity of the installed machines. For instance, the installed capacity for sawmills in Tanzania is 3 675 770 m^3 per year while the utilized capacity is 542 355 m^3 per year which is equivalent to about 15% of the installed capacity (MNRT, 2017). Also for the pole treatment, the installed capacity is 414 823 m^3 per year while the utilized capacity is 77 245 m^3 per year which is equivalent to about 19% of the installed capacity (MNRT, 2017). According to PFP (2016), only 30 to 40 % of standing eucalyptus trees is suitable for poles. This is a reflection that available sources of raw materials are not sufficiently satiating the requirement for production of sawn timber and utility poles based on the processing capacity of the industries.

4.4.1.2 Poor infrastructure

Poor infrastructure is another factor, which affects production of sawn timber and utility poles. It was found out that much of the production of sawn timber and utility poles are done in remote areas where roads are in poor condition and regular maintenances are rarely done. Producers admitted to face difficulties in the transportation of products from production site to the market. A study by Eskola (2005) pointed out that, improved roads network provides a more reliable supply of products from the production site to the market while poor roads network leads to increased transportation costs and market

delays. The interview with Mufindi Poles Ltd officials revealed that during rainy season production of poles drop by 30% because of difficulties in accessing the production site due to poor roads network.

4.4.1.3 Decreasing demand for sawn timber

The interviewed producers revealed that currently the demand for sawn timber in the market has declined compared to the past 5 to 10 years. It was further noted that some producers have closed their sawmills because of other reasons including decline of sales. This has been reflected in the study by MNRT (2017) which reported that among the 630 wood-based industries operating in Tanzania, only 44% were active, 45% sleeping and 11% were dormant.

4.4.1.4 Market price fluctuation

The interviewed producers revealed that currently there is no specific standard price for sawn timber in the market, hence causing each producer to have his/her own price based on the cost of production and other factors. UNIQUE (2017) reported that, there is no standard national price for wood products in Tanzania causing the prices for wood products to vary according to region and supplier.

4.4.2 Factors affecting marketing of sawn timber and utility poles in Tanzania

4.4.2.1 Competition

Interviewed timber traders revealed that currently timber business has attracted more people than was the case before. About 32 % of the respondents reported that competition is negatively affecting sales of their products since there are many timber yards within and at the peripheral areas of the cities. It was further noted that these traders almost sell similar products, which are sourced from similar areas with little product differentiation

(treated timber). The current survey revealed that registered timber traders in the surveyed regions were 914 (Table 14). From the registered timber traders in the surveyed regions, Dar es Salaam accounts for 67 % of the total. This means that Dar es Salaam not only represents a major market for sawn timber, but also shows higher market competition compared to Arusha and Dodoma.

Table 14: **Number of timber dealers in the surveyed regions**

Region/Municipal council	Number of registered timber dealers	Percent
Dar es Salaam	616	67
Arusha Municipal council	184	20
Dodoma Municipal council	114	13
Total	**914**	**100**

Source: TFS (2019)

4.4.2.2 Low income of the customers

The opinions of the traders show that a decline in the demand of sawn timber in the market has been contributed partly by low income of customers and the reduced house construction activities by many people. They noted further that it was possible in the past 5 to 10 years to sell one truck of timber (about 2000 - 3000 pieces) in one week but nowadays that is not possible since one truck of timber sourced from Iringa can be sold up to two months. This was revealed by 26 % of the interviewed traders of sawn timber.

4.4.2.3 Variation in prices of sawn timber

Another factor pointed out was the variation in the prices of sawn timber among sawn timber traders. It was reported that some sawn timber traders are also producers, meaning that they source products from their own farms or industries. In this regard, they can afford to set low price compared to those who purchase the products from producers.

Since many customers are attracted to products with low price then this force other traders to lower prices of their products resulting to lower profit than expected or even sustaining losses. This was revealed by 11 % of the interviewed sawn timber traders.

4.4.2.4 Presence of sawn timber substitute products

The increased use of various substitutes of sawn timber including aluminium and metal in the construction sector has been cited a cause of a shift in the demand of sawn timber by some customers. About 5 % of traders revealed that currently they face challenges since preferences of some customers are for the substitutes including metals for roofing and aluminium for doors and windows, which are cheaper and fashionable, compared to sawn timber equivalents. A study by Mgana (2013) on forecasting consumption and substitution of sawn timber products in the building industry in Dar es Salaam city revealed that by 2026, the per capita consumption of aluminium in story buildings would increase sharply by 88 % from 46.2 m^3 in 2011. On the other hand, the consumption of sawn timber would increase by only 23.4 % from 2.7 m^3. This implies that, sawn timber is highly substituted by aluminium and this perhaps contribute to low demand of sawn timber and hence low sales for sawn timber. According to Mgana (2013), the substitution of sawn timber in windows was higher compared to doors.

4.4.2.5 Tax and fees

About 10 % of the traders pointed out that there is a chain of fees and taxes which one need to pay when it comes to sawn timber trade. This discourages trade and when sales are poor, it leads to loss and capital damage. For instance, an interview with one of the traders who source his wood materials from Meru Forest Plantation showed the payments (Tax and fees) he made for 110.41 m^3 in 2019 accounted for about 40 % of the total costs excluding the royalty (Table 15).

Table 15: Fees and Tax paid by sawn timber traders

Payments	TZS	Percent
Total m^3 110.41		
Royalty	5 035 151	60.1
LMDA	1 965 298	23.4
CESS	251 758	3.0
VAT 18%	906 327	10.8
Application fee	5 000	0.05
NOFIA	210 013	2.5
Total	**8 373 547**	**100**

4.4.2.6 Poor infrastructure

The study findings revealed that, 12 % of the interviewed traders cited poor infrastructure as causing difficulties in the flow of products from the production site to the market place. According to the respondents, most of the roads to the production sites were rough and hence they were hardly accessible during rainy season. According to Eskola (2005), poor infrastructure leads to increased cost of transportation and market delays, which in turn leads to decreased profit.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

Production of sawn timber has been gradually decreasing for the past 10 years (from 2009 to 2019). The main causes being over harvest and slow replanting in the past, making the majority of the planted areas dominated by young plantations. This has therefore reduced the annual wood allowable cut for sawn timber production. This study also revealed that, despite the decrease in production of sawn timber, its supply is exceeding the quantity demanded. On the other hand, the production of utility poles has been increasing sharply for the past 5 years (from 2015 to 2019), however the demand for utility poles has increased as well because of importation ban imposed by the government so as to ensure that, utility poles are sourced from domestic producers. However, for the past five years (from 2014/2015 to 2018/2019), the quantity of utility poles supplied to TANESCO was 30 % compared to the quantity demanded.

The domestic market for sawn timber has been decreasing for the past 5 to 10 years since majority of respondents reported that, sawn timber is abundant as well as low trade resulted from low income of the customers and availability of sawn timber substitutes products such as metal and aluminium which are cheaper than sawn timber.

The study revealed that, export and import trend of sawn timber and utility poles has been decreasing sharply from 2005 to 2019. This means that, the current trade on sawn timber and utility poles with international markets is very low. The main countries of destination for the export of sawn timber were India, China, the United Arabs Emirates and Kenya, while the countries of origin for import of sawn timber were Malawi, Mozambique,

Congo DRC, and South Africa. On the other hand, the main countries of destination for the export of utility poles were Kenya, Denmark, and Sudan while the countries of origin for import of utility poles were South Africa and Uganda.

The prices of sawn timber were significantly different between Arusha, Dar es Salaam, and Dodoma. Depending on the size of sawn timber, Arusha had the highest price compared to Dar es Salaam and Dodoma. The average price for sawn timber in Arusha ranged between TZS 4500 and 30 000 per piece of soft wood sawn timber. In Dar es Salaam the prices ranged between TZS 2 600 and 14 000 while the prices in Dodoma were between TZS 2 000 and 16 700 per pieces. This is because, transportation cost is high for Arusha due to longer distance from the main source of production.

This study also revealed that, the main factors affecting production and marketing of sawn timber and utility poles included inadequacy of infrastructure, inadequacy of raw materials, decreasing demand of sawn timber, competition and high tax and fees.

5.2 Recommendations

Based on the aforementioned research results, discussion and conclusions, the following recommendations are made:

(i) The responsible authority should ensure sustainable availability of raw materials to the producers of sawn timber and utility poles. Small tree growers should also be given enabling environment in the production of quality raw materials so that the sawn timber produced domestically are of good quality to fetch good domestic and international markets.

(ii) Production and marketing strategy for sawn timber and utility poles need to be in place in order to act as a guide in controlling price, quality, import/export as well as ensuring sustainability of trade in sawn timber and utility poles.

(iii) It is also recommended that; the government and its responsible authority make revision of tax and fee structure in forest-based trade in order to create enabling environment for more entrepreneurs to engage in this business.

(iv) The average demand for utility poles in Tanzania is higher than the supply; this calls for investment for more production of utility poles from domestic producers or limited importation of utility poles from abroad so as to fill the increasing demand gap resulted from national electrification programme which is demanding thousands of utility poles annually.

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APPENDICES

Appendix 1: Questionnaire for producers of sawn timber and utility poles

A: General Information Date ——————

1. Name of producer ——————————————————————
2. Address——————————————————————————
3. Number of employee——————————————————————
4. Size of producer – Small ———— Medium ———————— Large ————————
5. Date when production started ————————————

B: Production of Sawn Timber

6. Can you give approximate (quantity) of sawn timber produced from 2000 to 2018?

Year	Sawn timber (Type)	Quantity produced

7. Can you give approximate (quantity) of utility poles produced from 2000 to 2018?

Year	Utility pole (Type)	Quantity produced

8. Availability of sawn timber

Abundant ————————————

Scarce ————————————

Very scarce ————————————

9. Availability of utility poles

Abundant————————————

Scarce————————————

Very scarce———————

10. Where do you sell your timber? And who are the major customers/buyers?———————————————————————————————————————

11. Where do you sell your utility poles? And who are the major customers/buyers

_____

12. Are the prices of timber fluctuating? If yes how often?———————————————————————————————————————

13. Are the prices of utility poles fluctuating? If yes how often?

_____

What could be the reason _____

_____

If not why? ———————————————————————————

14. What quantities of sawn timber and utility poles do you produce per day (on average)? (a) Sawn timber——————— (b) Utility poles ———————
15. What is the trend of demand of sawn timber : Rising———, declining ———, Constant ————
16. What is the trend of demand of utility poles: Rising_____, declining_____, constant_____
17. Do you always meet this demand? ———————
18. If not how much do you fall short? ———————
19. How do you rate the quality of sawn timber you produce:

Very good ———, Good ————, Fair ———— . Explain why you rate so _____

____

20. How do you rate the quality of utility poles you produce: Very good ———, Good ————, Fair ———— . Explain why you rate so ———————

21. What factors do you think influence/affect your business? _____

_____

22. Any other comments, (eg is it becoming difficult to get supplies? Is it worth doing this business?)

Appendix 2: Questionnaire for timber traders

A: General Information Date ——————

1. Name of trader/organization ——————————————————
2. Address——————————————————————
3. Number of employee ——————————————————
4. Business category: Small ———— Medium ————— Large————————
5. Date when the business started ——————————

B: Information on Selling Sawn Timber

6. Type and quantity of sawn timber sold per month

Sawn timber (type)	Quantity	Unity Price (TZS)	Revenue

7. Where do you get these sawn timber products?
8. How do you get sawn timber you sold?
9. Where are your customers coming from

(1) Inside the country
(2) Outside the country
(3) Both

10. Who determine the price of the sawn timber?——————————
11. Is this price fluctuating? Yes/No

If Yes what could be the reason (s) ——————————————————————————————————————

12. How can you rate your frequency for selling the products

(1) Daily
(2) Weekly
(3) Monthly
(4) Occasionally

13. Who are your customers?——————————————————

14. How do you get customers?———————————————————
15. Why have you decided to sell sawn timber forest products?———————————
16. Do you think forest products trade is profitable and why?———————————————————————————————————————
    ———————————————
17. In comparing with the past 5-10 years, how can you consider your sales of the products?
    (1) Increasing
    (2) Decreasing
    (3) Constant
    (4) Do not know
18. Are there problems of getting customers of your products? **Yes/No**

If Yes, List the problems———————————————————————————

19. Are the products satisfying your customers **Yes/No**

If No what are your suggestions?———————————————————————————————————————
———————————————————————————————

20. How can you rate the availability of sawn timber

Abundant ———————————

Scarce ———————————

Very scarce ———————————

21. What factors do you think influence/affect your business?
    ———————————————————————————————————————
    ———————————————
22. Any other comments, (eg is it becoming difficult to get supplies? Is it worth doing this business? Any current and future plans?)

Appendix 3: Box plots for price of sawn timber in Arusha, Dar es Salaam and Dodoma

Figures A1-A9 show price distribution for nine categories of timber size in which the dark horizontal line shows the mean price, the low and high line of the gray box show respectively the value of the 25% and 75% price quartiles, the two outer lines show the low and high price respectively (deviation from the mean), and the dotted circles shows all price values which are outside the range.

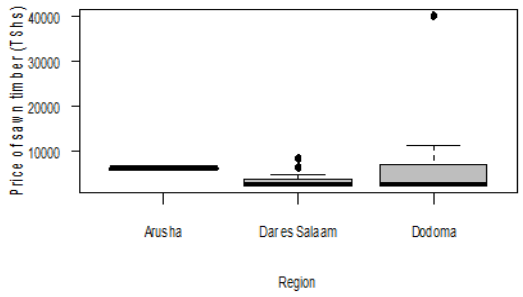


Figure A1: Price of sawn timber sized 2x2 inch in Arusha, Dar es Salaam and Dodoma

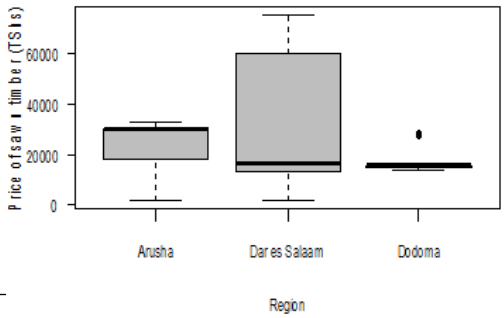


Figure A2: Price of sawn timber sized 1x10 inch in Arusha, Dar es Salaam and Dodoma

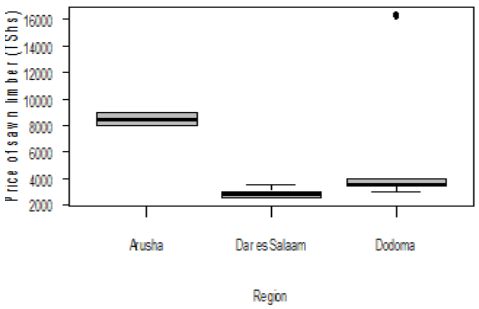
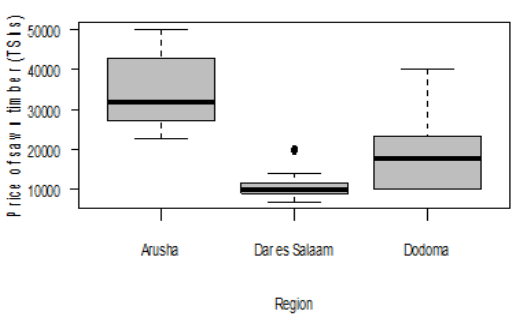


Figure A3: Price of sawn timber sized 1x8 inch in Arusha, Dar es Salaam and Dodoma

Figure A4: Price of sawn timber sized 2x3 inch in Arusha, Dar es Salaam and Dodoma


Price of sawn timber (TShs)
50000
40000
30000
20000
10000
Arusha
Dar es Salaam
Dodoma
Region

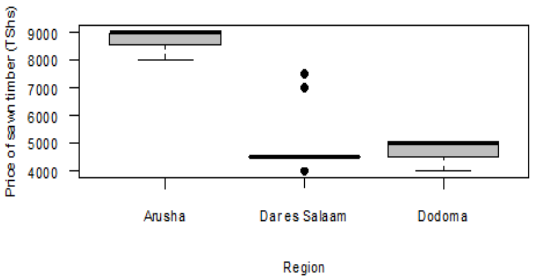


Figure A5: Price of sawn timber sized 2x6 inch in Arusha, Dar es Salaam and Dodoma

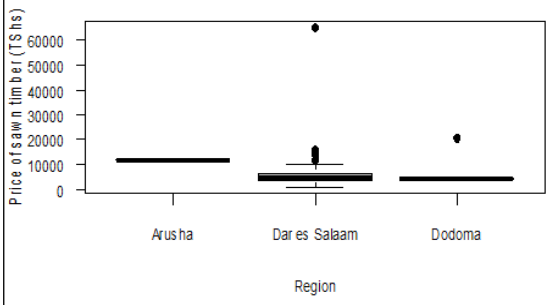


Figure A6: Price of sawn timber sized 2x4 inch in Arusha, Dar es Salaam and Dodoma

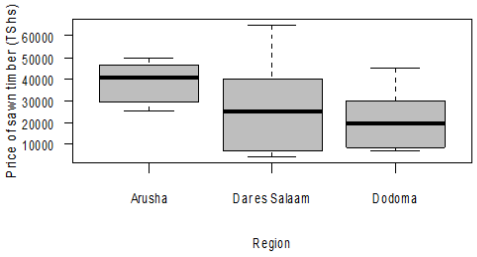


Figure A7: Price of sawn timber sized 1x6 inch in Arusha, Dar es Salaam and Dodoma

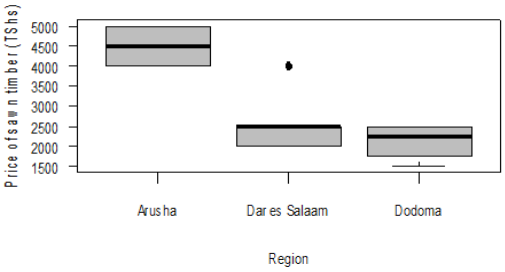
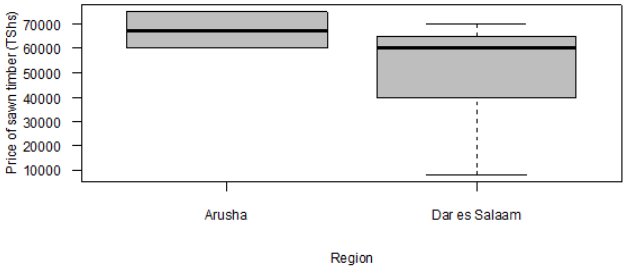


Figure A8: Price of sawn timber sized 1x4 inch in Arusha, Dar es Salaam and Dodoma



Appendix 4: Field photos

Hardwood sawn timber at Keko timber market, Dar es Salaam.

Source: Author (2019)

Soft wood sawn timber at Buguruni timber market, Dar es Salaam.

Source: Author (2019)

Pole treatment plant at Qwihaya General Company Ltd, Mafinga, Iringa.

Source: Author (2019)

Author interviewing sawn timber trader at Mwenge timber market, Dar es Salaam.

Source: Author (2019)

Production of sawn timber at Sao Hill Forest Plantation using Ding- dong saw mills.
Source: Author (2019)

Poles loading at Mufindi Poles Ltd production site, Mufindi, Iringa.

Source: Author (2019)

Truck loaded with poles at Mufindi Poles Ltd, Mufindi, Iringa.

Source: Author (2019)

Appendix 5: Production of soft wood sawn timber in Tanzania from 2009 to 2019

Year	57% Supply from government plantation (Sawlog m3)	43% Supply from STGs (Sawlog m3)	total annual wood supply (sawlog m3)	51% of production from government plantation is done Ding dong	37% recovery by Ding dong (Sawn timber m3)	49% of production from government plantation is advanced technology sawmills (sawlogs m3)	47% recovery by advanced technology sawmills(sawn timber m3)	100% of production from STGs is done by Ding dong sawmills with recovery rate 37%	Total sawn timber (m3)
	a	b	c = a + b	d = a*0.51	e = d*0.37	f = a*0.49	g = f*0.47	h = b*0.37	i =e + g + h
2009/2010	1200257	905457.04	2105714.04	612131.07	226488.50	588125.93	276419.19	335019.10	837926.79
2010/2011	1145481	864134.79	2009615.79	584195.31	216152.26	561285.69	263804.27	319729.87	799686.41
2011/2012	984198	742465.16	1726663.16	501940.98	185718.16	482257.02	226660.80	274712.11	687091.07
2012/2013	976890	736952.11	1713842.11	498213.90	184339.14	478676.1	224977.77	272672.28	681989.19
2013/2014	999745	754193.60	1753938.60	509869.95	188651.88	489875.05	230241.27	279051.63	697944.79
2014/2015	986944	744536.70	1731480.70	503341.44	186236.33	483602.56	227293.20	275478.58	689008.12
2015/2016	987860	745227.72	1733087.72	503808.60	186409.18	484051.4	227504.16	275734.26	689647.60
2016/2017	909232	685911.86	1595143.86	463708.32	171572.08	445523.68	209396.13	253787.39	634755.60
2017/2018	875064.5	660136.38	1535200.88	446282.90	165124.67	428781.61	201527.35	244250.46	610902.49
2018/2019	790708.21	596499.18	1387207.39	403261.19	149206.64	387447.02	182100.10	220704.70	552011.44
Total	7510641.71	5665922.69	13176564.4	3830427.27	1417258.09	3680214.438	1729700.79	2096391.40	5243350.27