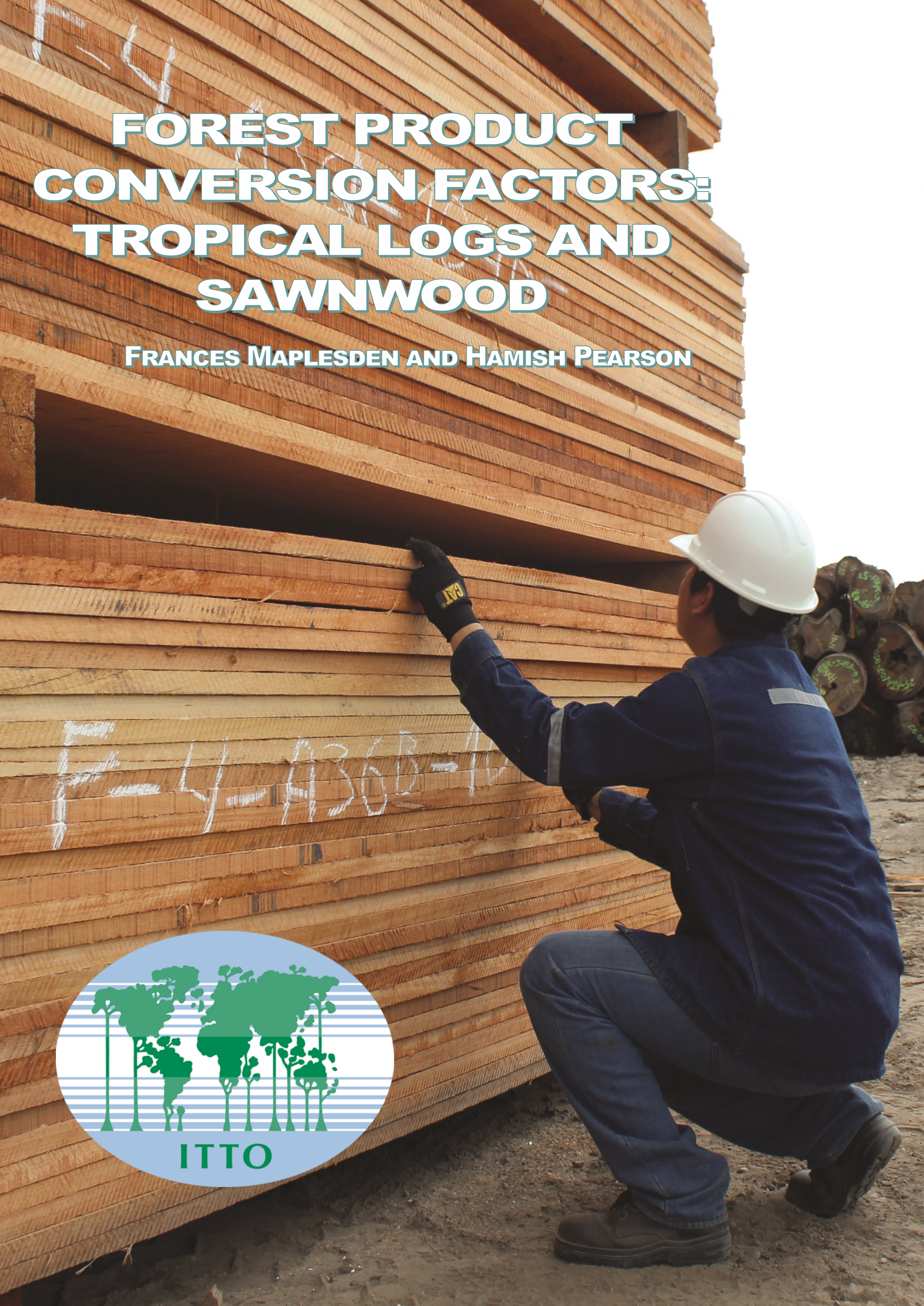
FOREST PRODUCT CONVERSION FACTORS: TROPICAL LOGS AND SAWNWOOD

Frances Maplesden and Hamish Pearson



ITTO

Frances Maplesden is a trade and market analyst at Maplesden Consulting, Rotorua, New Zealand.
Hamish Pearson is a research engineer, Rotorua, New Zealand.

Cover image: a worker at Empresa Maderera Marañon SRL in Pucallpa, Peru marks sawnwood bundles. Photo: E. Sangama

TABLE OF CONTENT

Figures and tables

Acknowledgements

The authors would like to acknowledge the assistance of Matt Fonseca, UNECE, for reviewing the report and providing valuable advice on methodology, and Jean-Christophe Claudon, ITTO, for recognising the value and importance of accurate conversion factors for analysis of the tropical wood products trade, and for provision of trade data used in this report.

1. Introduction

1.1 Background

The International Tropical Timber Organization (ITTO), the Food and Agriculture Organization of the of the United Nations (FAO), and the United Nations Economic Commission for Europe (UNECE) use conversion factors regularly to report and analyse trade and production data on forest products. ITTO regularly reports trade and production data in comparable units for all of its member countries (36 producer countries and 37 consumer countries). This data is derived from a number of sources including the Joint Forest Sector Questionnaire (JFSQ) and supplementary sources such as COMTRADE (the UN commodity trade database) and STIX (a joint ITTO/GTF initiative). Although country data is reported to the ITTO Secretariat via the JFSQ in standard units specified by ITTO, this data is often incomplete and other information sources are required. These sources may report data in non-standard units, requiring conversion to standardised international reporting units. In particular, trade data available in COMTRADE and STIX is frequently reported only by weight, whereas ITTO reports trade data for tropical primary wood products by volume.

Accurate trade volume estimates are important to enable transparency in the tropical wood products trade as they can be used to estimate national and international wood requirements and balances, and indicate illegally logged roundwood in the supply chain. Conversions from volume to weight are also used for determination of biomass and carbon production, which are quantified in weight units e.g., for calorific value content determination and for comparison with other sources of biomass.

Single, average weight to volume adjustments for tropical logs and for tropical sawnwood have been used since ITTO initiated reporting of tropical wood products trade in 1987. These adjustments are not specific to species or country of origin, although there is known to be substantial variation in conversion values between species and their environmental conditions (Rijsdijk and Laming 1994; CIRAD 2015; Dinwoodie 2000; USDA 2010). The mix of tropical species traded and the major tropical exporting and importing countries, have also changed considerably over that period (ITTO Trade Database).

The purpose of this analysis is to improve the accuracy of reported trade volumes of tropical primary wood products and therefore improve transparency in the tropical wood products trade by deriving conversion factors from weight to volume for tropical industrial roundwood (logs) and tropical sawnwood by major tropical exporting countries based on the weighted average of the species exported and known data on wood and bark density and wood moisture relationships.

1.2 Assumptions used in the study

In most intensive forest industries where accurate weight to volume conversion factors are required for log sales and stand reconciliation, forest growers use actual sample measurements to weigh and log-scale samples to develop proprietary weight to volume conversion factors (Ellis and Crawley 2014). Log weights are typically obtained directly from tared (net) log truck weights that are measured using weighbridges at check point stations prior to unloading at ports. In contrast, log volumes are calculated from log scaling equations that require input measurements of log dimensions such as length and diameter. An example of a cubic log volume scale is the Brereton formula which is one of the most commonly used methods for tropical hardwoods (FAO et al. 2020). However, as detailed in many trade standards, the use of specific log scaling formulations differs substantially between, and within, different countries. Given the lack of directly measured log conversion factors for the considerable number of tropical species traded, the relationship between weight and volume was determined in this study using published generic wood and bark basic density data and known theory on moisture content relationships for wood.

Volume data for sawnwood is also not readily available even though the volume estimation is easier to calculate than for logs because the volume of sawnwood equals the product of three uniform dimensions - thickness, width and length.

Assumptions have been used in this study to estimate CFs from relevant published information and theory. The transparency of these assumptions and calculation methods allows CF estimates to be updated if new information becomes available. For example, conversion factors for logs can vary by region, tree age, the temperature and climate logs were harvested and stored in, the amount of bark remaining, the storage period, and the log size. The conversion values presented here are intended to be used for international trade data reconciliation purposes and should therefore be used with caution for conversion estimates in smaller geographic areas and requiring more specific values for commercial purposes.

For most tropical species, reported wood density measurements are of small clearwood specimens of the heartwood of mature trees from natural stands. These values do not account for variations within species, or between wood that has been grown in different environments. Tree age is also not considered, and this may be an issue for species such as teak, for example, where production and exports are increasingly from young plantations in a number of countries around the world, rather than old-growth natural stands that are restricted to India and Southeast Asia. Younger trees usually contain a greater portion of sapwood compared to heartwood. Heartwood is typically denser in the dry state due to the presence of resins and extractives (Hoadley 2000).

Other key assumptions include the use of other species as a proxy, when wood properties are unavailable for a given species and/or growing location. In this case the wood properties of species of either the same genus or same species but different growth location are used. A number of important assumptions regarding wood moisture, shrinkage and density are specified in Section 3.1

2. Physical properties and moisture relationships of wood and bark

Wood is a biomaterial designed to meet the needs of a living tree. The main functions that wood performs are to support a living tree crown, conduct mineral solutions from the roots to the crown and store manufactured food until required (Dinwoodie 2000). Across its cross section wood must therefore be able to act as a hydrofluidic conduit as well as offer support and cellular growth (Dinwoodie 2000). The cross section of a tree typically grows outwards from the central pith as wood and bark are produced from a living cambium layer that exists between the outer layer of wood and the inner layer of bark. Bark is the outer part of a woody tree stem and provides sugar transport and protection from external influences such as insects. Both wood and bark are the two main types of tissue that exist across a tree stem and both tissue types are permanent in that they retain their predominant shape and size when mature. (Hoadley 2000; Jane 1956).

Wood from seed plants can be classified within the plant kingdom into hardwoods and softwoods. Hardwood trees are classified as angiosperms and softwood trees are classified as gymnosperms and the wood of both types of trees differ in their anatomical structure. Softwoods are relatively simple in their cellular structure and contain tracheid cells whose task is both hydrofluidic conduction and mechanical strength. In contrast, hardwoods contain a variety of different cell types including separate cells for hydrofluidic conduction called vessels, and separate cells for mechanical strength called libriform fibres (Jane 1956; Zimmermann & Brown 1971).

The wood of hardwoods and softwoods can be separated into sapwood and heartwood. Sapwood is the region of wood closest to the bark that performs sap conduction and storage, and can vary in width from species to species. The sapwood band of a tree moves outward from the pith as a tree grows whereas the heartwood band increases in volume over time. Heartwood is the region closest to the pith that was once sapwood but no longer fulfils the task of sap conduction and storage. Heartwood is characterised by the presence of extractives and resins that can protect the tree from decay and yield a greater density after moisture removal compared to sapwood. The dry-base density of the heartwood of hardwoods is usually greater than for softwoods and is regarded as a desirable material for structural building and woodworking due its strength and durability (Dinwoodie 2000; Hoadley 2000).

Wood is a hygroscopic material and contains moisture depending on the temperature and humidity of the environment and its service history. The moisture in wood exists in two basic forms: bound water, which is chemically bonded to cell wall material, and free water, which is situated in the voids within the wood. An equilibrium moisture content (EMC) can be established between the moisture content of wood and the temperature and relative humidity of the surrounding air to yield empty voids for humidities less than saturation (Siau 1995). EMC increases with increasing humidity and decreases with increasing temperature and can be calculated from suitable relationships (Hailwood and Horrobin 1946; Pearson et al. 2013; USDA 2010).

The maximum moisture content of wood relates to saturated cell wall material and full voids, as will theoretically occur in a freshly felled tree. However, the theoretical maximum moisture content is seldom achieved in living trees and actual green densities can be extremely variable due to geographic differences, season history, species differences and the location from which the wood was obtained across various portions of individual trees (Ellis 2016, Miles and Smith 2009, USDA 2010). The average MC of a freshly felled living tree provides a more accurate measure of green MC but such information is scarce for most wood species and can vary depending on different laboratory techniques that were used to record information.

Theoretical maximum moisture content of wood can be estimated by Equation 1 (USDA 2010) which is based on the fact that solid wood cell wall matter has a specific gravity (the density of wood relative to the density of water) of approximately 1.54 and can absorb moisture, in the form of bound water, up to the FSP (Kollmann and Côté 1968; USDA 2010; Siau 1995).

Equation 1

$$MC_{max} = \frac{100\ (1.54 - 0.001BD)}{0.00154\ BD}$$

Where: *MC* = moisture content (%); *BD* = basic density (kg/m^3).

The fibre saturation point (FSP) is defined as the moisture content at which the cell wall is saturated, but the voids are empty. The average FSP is approximately 30% MC for most species (Ross 2010) and is traditionally measured as the point at which physical properties such as elasticity begin to change for a decrease in MC (Siau 1995). Wood shrinkage occurs when bound water is lost or gained from the cell walls below the FSP and is generally linearly related to MC but differs for the three principal wood grain directions (tangential, radial and longitudinal). An overall shrinkage coefficient is a convenient way to express volumetric shrinkage as a function of MC between oven-dried material (0% MC) and the FSP (Rijsdijk and Laming 1994).

Wood density is calculated as the weight at a specific moisture content divided by the volume at a specific moisture content. Basic density is a commonly reported variable for most species and is based upon an oven-dry weight (zero MC) divided by a fully saturated (green) volume (wood only). Green and oven-dry densities include either saturated weights and volumes or totally dry weights and volumes. Densities at or below the FSP can be estimated for any moisture content provided the shrinkage coefficient, FSP and the oven-dry density is known (Rijsdijk and Laming 1994, USDA 2010). Densities at other moisture content combinations ranging from oven-dry to green can be estimated with knowledge of the shrinkage coefficient, and vice versa. Therefore, at least one density value and the shrinkage coefficient are commonly reported as the minimum amount of information to fully describe the relationship between density and moisture content up to the FSP for different wood species (Rijsdijk and Laming 1994).

Log and sawnwood conversion factors (CFs) are typically reported as cubic metres per tonne and are essentially the inverse of density as defined by mass per unit volume. Green log CFs typically include the mass of bark (bark on weight [BOW]) but exclude bark from the volume measurement (FAO et al. 2020). Therefore, an estimate of green bark density is required for theoretical calculations of log CFs. However, unlike the calculation of theoretical maximum moisture content for wood (equation 1), no relationship exists for the theoretical maximum moisture content of bark due to the complexity of bark compounds and green bark density must be estimated from average data. Bark density data is generally scarce and previous studies have usually concentrated on a few selected wood species (FAO et al. 2020, Miles and Smith 2009; Petráš et al. 2020; Poorter et al. 2014).

3. Methods

This study estimates weight to volume ratios for tropical industrial roundwood (logs) and tropical sawnwood by species, and by major tropical exporting country based on the weighted averages of the species exported, using the most recent data available.

Weight-volume conversion factors for tropical logs are based on estimates of the ratio of green weight (with bark) to green volume (wood only) by species.

Weight-volume conversion factors for tropical sawnwood are based on estimates of the ratio of weight (wood only) to volume (wood only) at 12% moisture content (the level frequently experienced of timber in service use) by species.

The volume of logs and sawnwood exported from major tropical producer countries by species is estimated from the latest data available from ITTO and official country sources.

Although the methods described can be applied to both softwoods and hardwoods, and ITTO's definition of tropical timber includes both softwoods and hardwoods grown in the tropical zone (ITTA 2006), this analysis does not include any tropical softwood species (other than *Agathis* spp.) as none were identified in the available trade data. However, softwood species could be included in the "Other" category.

3.1 Conversion factor calculation methods

In the absence of actual measured data on either weights or volumes of traded timber, estimations of conversion factors (CFs) based on known wood densities offer a method to determine volume or weight based on the other known variable.

In this study, 153 selected wood species, or species groups, were identified in Section 3.2 as being exported from tropical producer countries. CF values for each species were calculated from weight per unit volume density and reported as log or lumber volume divided by the green tonnage weight (m^3/1000 kg), for selected wood species and for the following four conditions:

1] Sawnwood weight wood only and volume wood only, both at 12% MC.

2] Log green weight with bark, and green volume wood only.

3] Log green weight with bark, and green volume wood only with a 5% moisture content (MC) loss.

4] Log green weight with bark, and green volume wood only with a 10% moisture content (MC) loss.

Sawn lumber CFs were calculated at 12% MC because kiln drying is usually tailored to meet the local equilibrium moisture content (EMC) to avoid unwanted wood shrinkage when in service. Published EMC values are generally available for individual countries (Simpson 1998). An EMC of 12% relates to an ambient temperature of 20°C and relative humidity of 65% which is common in temperate areas (Hailwood and Horrobin 1946; USDA 2010; Simpson 1998). By contrast, 12% EMC can also be obtained with a range of temperature and humidity combinations. For example, a higher temperature of 40°C and relative humidity of 69% also yields an EMC of 12% and may be more prevalent in tropical areas (Simpson 1998).

If the wood density at 12% MC was not reported it was calculated from a density at a known MC condition along with relevant shrinkage coefficients and FSP values. Volumetric shrinkage was either estimated from shrinkage values in the tangential, radial and longitudinal wood grain directions (Rijsdijk and Laming 1994), or from volumetric coefficient of shrinkage values and the FSP. Wood FSP was assumed to be 28% (USDA 2010) unless reported for individual species. Longitudinal shrinkage was assumed to be 0.1% from oven dry to FSP when data was unavailable in the literature. Some density data reported from the CIRAD database calculated basic density as being the density at 12% MC multiplied by 0.828 (CIRAD 2015). All wood shrinkage coefficients are assumed to have a linear relationship with moisture content unless stated otherwise.

To estimate green density for freshly felled lumber, green log CFs were calculated from bark-on-weight-wood-only-volume (BoW-WoV) density. This was calculated by combining the green bark density per unit volume with green wood density per unit volume. The average relative amount of bark to total log volume (wood & bark) was assumed to be 88.7% (FAO et al. 2020).

The density of freshly felled green wood was calculated by means of the maximum theoretical moisture content (Equation 1) which required published basic density data. For a few species where basic density was not reported, it was derived from other reported information such as volumetric shrinkage, FSP, and a known density at a specific MC including oven-dry density data (Rijsdijk and Laming 1994, USDA 2010).

Figure 1 indicates the considerable differences in wood basic densities among tropical species, which can range from 120kg/m^3 for balsa to 940kg/m^3 for congotali.

The maximum theoretical moisture content for each of the 153 selected wood species, or species groups, was adjusted to a more realistic value by comparing maximum moisture contents with the average reported moisture contents for 40 North American hardwood trees (USDA 2010, Miles and Smith 2009). The average reduction in moisture content from maximum theoretical to actual average for the 40 trees was 38%. This was reduced to 30% after a linearised estimation for moisture content based on the difference in average basic density between the 40 North American hardwood specimens (mean basic density = 0.51) compared to the average basic density of the selected 153 tropical species (mean basic density = 0.62). The actual green density for the 153 species was therefore assumed to have 30% less moisture compared to the maximum theoretical green density.

Green bark density was estimated from the average for the same 40 North American hardwoods as was used for estimation of the actual green wood moisture content (USDA 2010, Miles and Smith 2009).

Green log CFs were also calculated from a base green density for moisture loss estimates after felling of 5% and 10% MC to simulate logs that were partially dried due to unwanted exposure to ambient conditions such as wind, sun and humidity between felling and measuring (Nolan et al. 2003). Final average CF values were weighted based on traded volumes for selected geographical countries and/or regions.

Figure 1: Wood basic densities for some tropical wood species

Note: Basic density is the oven-dry weight of wood/ green volume (wood only).
The botanical names of the tropical wood species listed, and some alternative common names, are given in Appendix 1.

3.2 Major tropical wood species traded

The volume and percentage of logs and sawnwood exported from tropical producer countries by species are given in Appendices 3 and 4, for countries where data was available. Many tropical species are not listed in the Harmonized System (HS) nomenclature used in Customs classifications and international trade databases, with exports often recorded by weight in HS code 440399 (“*other*”) for non-coniferous tropical industrial roundwood and in HS code 440799 (“*other*”) for non-coniferous tropical sawnwood. Where tropical species are specified at the HS 6-digit level, they include a number of species which have a range of wood basic densities. This analysis was limited to data obtained from a range of international and in-country sources, using the latest data available for individual countries.

Log export data by species was available for the following countries: Central African Republic (CAR), Cameroon, Ghana, Liberia, Rep. of Congo, Mali, Benin, Guyana, Suriname, Cambodia, Malaysia, Papua New Guinea (PNG), Thailand and Vietnam. Sawnwood export data by species was available for the following countries: CAR, Cameroon, Côte d’Ivoire, Gabon, Ghana, Mali, Rep. of Congo, Brazil, Guatemala, Guyana, Suriname, Cambodia, Indonesia, Malaysia, Myanmar, PNG and Thailand. Regional estimates by species (for Africa, Asia-Pacific and Latin America/ Caribbean (LAC)) were based on the average volumes exported by countries in that region. This data will be used as an equivalent for countries where data was unavailable. There were 153 species (or species groups) identified for the analysis.

The quality of species export data available was not consistent between countries, with some countries having detailed species data available, while others had only a limited number of species specified and a significant proportion of the total volume in “other species” categories. This database will be able to be updated as new information comes to hand.

The most commonly traded log species in all the countries listed in Appendix 3, as a proportion of total log volume exported, were: acacia (7.7%); taun (6.7%), meranti, red (5.5%); okoumé (4.8%); tali (4.3%), kwila (3.9%), okan (3.5%), teak (3.4%), rosewood, African (kosso) (3.2%); sapele (3.9%) and malas (2.2%).

A significant number (144) of other identified species were traded in smaller volumes, and 15.7% of the total volume was unidentified by species and classified as “others”.

The most commonly traded sawnwood species in the countries listed in Appendix 4, as a proportion of total sawnwood volume exported, were: rubberwood (34.5%), meranti, dark red (12.3%), sapele (4.8%), kwila (4.4%), mixed light hardwoods (3.6%), ayous (2.7%) and keruing (2.4%). Similar to logs, there are a large number (148) of other species traded in relatively small volumes and about 11.6% unidentified by species.

It is important to note that the total volume of exports by species presented in Appendices 3 and 4 only represent the sum of volumes for the countries listed. The total volume of all species exported in Appendices 3 and 4 represent approximately 40% of world trade in tropical logs and approximately 57% of world trade in tropical sawnwood (ITTO 2019).

4. Results: Weighted average conversion factors

Conversion factors for both logs and sawnwood, in m^3/1,000 kg, were calculated as a weighted average for specific tropical producer countries based on the traded volume of the main reported species (as shown in Appendices 3 and 4) and appropriate density data by species (as shown in Appendix 2). Weighted average log CFs were also calculated for moisture content losses of 5% and 10% to show the effect of moisture loss on the CFs. The conversion factor estimates for tropical sawnwood and logs, by country, are shown in Table 1.

The determination of weighted averages for individual countries could be based on traded weights (kg) of the main reported species but this information was not able for this analysis. Weighted averages based on weight may be different to those based on volume, given the variation in wood densities between species. The accuracy of estimates may be further affected if either the weight or volume data has already been converted from the other variable, thereby compounding the additive errors. However, the method presented here is intended as a best method of estimating weighted trade averages based on the information available. The accuracy based on real data has not been determined.

The sawnwood CF estimates show significant variation between countries, from 1.144 m^3/1,000 kg (Guyana) to 4.239 m^3/1,000 kg (PNG). This variation reflects significant differences in the species traded and their corresponding wood properties. PNG’s exports constitute a large proportion (54%) of very low-density species (balsa). In contrast, there is a large proportion (87%) of high-density greenheart and purpleheart in Guyana's exports. There are also differences in shrinkage values between species from the green to the dried (12% MC) state. This indicates the inaccuracies in using a combined weight/volume single conversion factor for tropical sawnwood.

The estimated conversion factors for logs show less variation, ranging from 0.943 m^3/1,000 kg (Malaysia) to 0.807 m^3/1,000 kg (Guyana) for logs with 5% moisture loss. The differences again reflect the mix of species exported, with 73% of Guyana's log exports of high-density Guyana rosewood and greenheart, whereas Malaysia's exports comprise a mix of medium-density species. There is less variation in CF estimates for logs compared with sawnwood because there is no shrinkage for logs in the green state and considerably less shrinkage than sawnwood (dried to 12% MC) for logs with a 5 and 10% moisture loss.

Table 1: Weight/volume conversion factors for tropical sawnwood and logs, by country/region (m^3/1,000 kg)

	SAWNWOOD	LOGS		
	(12% MC)	(green)	(5% MC loss)	(10% MC loss)
Benin	NA	0.859	0.882	0.906
Central African Republic	1.681	0.865	0.889	0.913
Cameroon	1.696	0.836	0.856	0.877
Côte d'Ivoire	2.563	NA	NA	NA
Gabon	1.412	NA	NA	NA
Ghana	1.596	0.848	0.873	0.891
Liberia	NA	0.832	0.860	0.872
Mali	1.126	0.827	0.847	0.866
Rep. of Congo	1.488	0.902	0.930	0.960
AFRICA	**1.677**	**0.860**	**0.885**	**0.908**
Cambodia	NA	0.863	0.904	0.911
Indonesia	1.274	NA	NA	NA
Malaysia	1.556	0.914	0.943	0.975
Myanmar	1.250	NA	NA	NA
Papua New Guinea	4.239	0.865	0.895	0.913
Thailand	1.709	0.847	0.868	0.890
Viet Nam	NA	0.875	0.912	0.925
ASIA-PACIFIC	**1.614**	**0.882**	**0.911**	**0.934**
Brazil	1.203	NA	NA	NA
Guatemala	1.342	NA	NA	NA
Guyana	1.144	0.790	0.807	0.821
Suriname	1.153	0.848	0.875	0.891
LATIN AMERICA/CARIBBEAN	**1.203**	**0.841**	**0.868**	**0.883**
ALL COUNTRIES	**1.609**	**0.871**	**0.898**	**0.920**

NA: not available

References

Ashaari Z. 2017. *Low density wood. From poor to excellent*. Universiti Putra Malaysia Press. Available at: http://psasir.upm.edu.my/id/eprint/66859/1/20170725181150212_Prof_Zaidon_Low_Density_Wood_from_poor_to_excellent.pdf

Burgess, P.F. 1966. *Timbers of Sabah.* Sabah Forest Records No.6. Forest Department, The Government of Sabah. Sabah, Malaysia. 510pp.

CIRAD. 2015. *Tropix 7. The main technological characteristics of 245 tropical wood species*. Available at: https://tropix.cirad.fr/en/technical-sheets-available

COMTRADE. 2021. *UN COMTRADE Database*. Available at: https://comtrade.un.org/

Dinwoodie, J. M. 2000. *Timber: Its nature and behaviour. Chapter 3 – Mass volume relationships.* Second Edition. E&FN Son. 257pp.

Eddowes, P.J. 1977. *Papua New Guinea Timbers. The utilization of Papua New Guinea timbers*. PNG Forest Industry Association (Inc.). Available at: https://fiapng.com/UTILIZATION_TIMBER.pdf

Ellis, J. 2016. *Variability in JAS/tonne values*. NZ Journal of Forestry, February 2016, Vol. 60, No. 4. Available at: http://nzjf.org.nz/free_issues/NZJF60_4_2016/7C22E9AC-B95C-418e-9B4C-37C12058FEF3.pdf

Ellis, J. & Crawley D. 2014. *Practical log scaling guide*. C3 publication, Tauranga New Zealand, 146pp.

FAO, ITTO & United Nations. 2020. *Forest product conversion factors*. Rome. Available at: https://doi.org/10.4060/ca7952en

Hailwood, A. J. & Horrobin S. 1946. *Absorption of water by polymers: Analysis in terms of a simple model.* Trans. Faraday Soc., 42B, 84-102.

Hoadley, R. B. 2000. *Understanding wood: A craftsman's guide to wood technology*: The Taunton Press Inc. CT. USA.

ITTO. 2019. *Biennial Review and Assessment of the World Timber Situation 2017-2018*. International Tropical Timber Organization, Yokohama, Japan.

ITTO. 2017. *Tropical Timber Atlas. Technological characteristics and uses.* Available at: https://www.itto.int/files/itto_project_db_input/3028/Technical/E-TMT-SDP-010-12-R1-M-Tropical%20Timber%20Atlas.pdf

ITTO. *Lesser Known Species*. Available at: http://www.tropicaltimber.info/?s=. Accessed May 2021.

Jane, F. W. 1956. *The structure of wood*. Adam and Charles Black Ltd. London. pp 427.

Kollmann, F.& Côté, Jr. W. 1968. *Principles of Wood Science and Technology. 1 Solid Wood.* Springer-Verlag, Berlin. 592pp.

Malaysian Timber Council. *Wood Wizard*. Available at: http://www.mtc.com.my/resources-TechnicalInfo.php

Mbagou, J. 2017. *Variabilité intra-arbre des propriétés physico-mécaniques et chimiques du "Tessmania africana" en provenance du Gabon*. Available at: https://corpus.ulaval.ca/jspui/handle/20.500.11794/27968

Miles, P. D. & Smith W. B. 2009. *Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America*. US Department of Agriculture Forest Service. Northern Research Station. Research Note NRS-38. 35pp.

Ngoya-Kessy, A. M. 2019. *État des lieux des acteurs du secteur privé de la filière forêt-bois au Congo*. ATIBT. Available at: https://www.atibt.org/wp-content/uploads/2020/08/14-08-20-CONGO-Rapport-final-Etat-des-lieux-acteurs-fili%

C3%A8re-bois.pdf

Nolan, G., Innes, T., Redman, A. & McGavin, R. 2003. *Australian hardwood drying best practice manual. Part 1*: Forest and Wood Products Research and Development Corporation. Australian Government. Australia. Project no: PN01.1307.

Pearson, H., Gabbitas, B. & Ormarsson, S. 2013. *Equilibrium moisture content of radiata pine at elevated temperature and pressure reveals measurement challenges*. Journal of Materials Science, 48(1), 332-341.

Petráš, R., Mecko, J., Krupová, D. & Pažitný, A. 2020. *Aboveground biomass basic density of hardwoods tree species*. Wood research, 65(6), 1001-1012.

Poorter, L., McNeil, A., Hurtado, V., Prins, H. H. T. & Putz, F. E. 2014. *Bark traits and life-history strategies of tropical dry- and moist forest trees.* Functional Ecology, 28, 232-242.

Rijsdijk, J.F. & Laming, P.B. 1994. *Physical and Related Properties of 145 Timbers Information for practice.* TNO Building and Construction Research Centre for Timber Research. Kluwer Academic Publishers. 380pp.

Siau, J. F. 1995. *Wood: Influence of moisture on physical properties*. Department of Wood Science and Forest Products, Virginia Polytechnic Institute and State University, Blacksburg, VA, U.S.A. pp 379.

SGS. 2020. *Log Export Monitoring Monthly Report for December 2020 to the Papua New Guinea Forest Authority February 2021*. SGS PNG Ltd.

Simpson, W.T. 1998. *Equilibrium Moisture Content of Wood in Outdoor Locations in the United States and Worldwide.* Res. Note FPL-RN-0268.Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p. Available at: https://www.esf.edu/wus/documents/EMCofWoodFPL268.pdf

STIX. 2019. *Sustainable Timber Information Exchange*. Available at: https://stix.global/

Suriname Lumber. 2018. *Suriname Lumber*. Available at: http://surinamelumber.com/uploads/3/4/9/5/34957523/catalogue_suriname_lumber__2018_.pdf

The Wood Database. 2021. Available at: https://www.wood-database.com

TRADA. 1978. *Timbers of the world. Vol 8. Australasia*. Timber Research and Development Association. Hughenden Valley, High Wycombe, Buckinghamshire HP14 4ND, England

United States Department of Agriculture (USDA). 1992. *Wood densities of tropical tree species.* General Technical Report SO-88. Available at: https://www.srs.fs.usda.gov/pubs/gtr/gtr_so088.pdf

United States Department of Agriculture (USDA). 2010. *Wood Handbook - Wood as an Engineering Material*. General Technical Report FPL–GTR–190. Forest Products Laboratory, United States Department of Agriculture Forest Service, Madison, Wisconsin. 508pp.

Zimmermann, H. M. & Brown, C. L. 1971. *Trees: Structure and function*. Springer-Verlag, New York Inc. Printer in USA. pp 336.

Wagner Meters. *Wood Species Database*. https://www.wagnermeters.com/specific-gravity/

Appendix 1: selected tropical wood species by common and species names

Trade/common name	Genus and species name
abalé/ abing/ essia	*Petersianthus macrocarpus*
acacia	*Acacia mangium*
acajou d'Afrique/ khaya/ African mahogany	*Khaya ivorensis*
afrormosia/ asamela/ African teak	*Pericopsis elata*
ako/ antiaris	*Antiaris toxocaria*
alep	*Desbordesia glaucescens*
aningré/ asafina/ anigre/ aniégré	*Aningeria altissima*
andoung	*Monopetalanthas* spp.
angueuk	*Ongokea gore*
avodiré	*Turreanthus africanus*
apomé	*Cynometra ananta*
awoura	*Julbernardia pellegriniana*
ayous/ obéché/ wawa/ African whitewood	*Triplochiton scleronxylon*
azobe/ ekki/ ironwood	*Lophira alata*
bahia/ abura	*Hallea ciliata*
balau	*Shorea* spp.
balsa	*Ochroma lagopus*
basrolocus/ angelique	*Dicorynia guianensis*
beli/ awoura	*Julbernardia pellegriniana*
benzi-muténgé	*Guibourtia arnoldiana*
bété/ Mansonia/ African black walnut	*Mansonia altissima*
bilinga	*Nauclea diderrichii*
bindang/ damar minyak/ agathis/ kauri	*Agathis* dammara
bomanga/ ariella/ ekop evene/ zebrano	Brachystegia spp.
bosmahonie/ granadillo/ ebano	*Martiodendron parviflorum*
bossé	*Guarea cedatra*
bubinga/ African rosewood/ kevazingo	*Guibourtia tessmannii, G. pellegriniana, G. demeusei*
burckella	*Burckella* spp.
calophyllum/ bintangor	*Calophyllum* spp.
cedrella/ cedro	*Cedrela odorata*
congotali	*Letestua durissima*
dahoma-tagbema/ dabema/ odan	*Piptadeniastrum africanum*
darina/faveira	*Parkia pendula*
denya/ okan/ edoum	*Cylicodiscus gabunensis*
dibetou	*Lovoa trichilloides*
dillenia/ simpoh	*Dillenia papuana*
doussié	*Afzelia africana*
doussié blanc	*Afzelia pachyloba*
doussié rouge/ doussié bip	*Afzelia bipindensis*
ebiara	*Berlinia bracteosa*
ebèn/ African ebony/ ebony	*Diospyris crassifolia, Diospyris mespilliformis*
ekaba	*Tetraberlinia bifoliolata, Tetraberlinia tubmaniana*
erima/ benuang	*Octomeles sumatrana*
eveuss/ngon	*Klainedoxa gabonenesis*
eyek/ eyeck/ nieuk	*Fillaeopsis discophora*
eyong	*Eribroma oblongo*
eyoum	*Dalium* spp.
faro	*Daniellia* spp.
framire	*Terminalia ivorensis*
fromager	*Ceiba samauma*

Trade/common name	Genus and species name
ceiba-fromager	*Ceiba pentandra*
gindya-udu	*Terminalia guyanensis*
gmelina	*Gmelina arborea*
gombé/ ekop-gombé	*Didelotia* spp.
greenheart	*Chlorocardium rodiei/Chlorocardium rodiei/ Ocotea rodiei*
grey canarium	*Canarium oleosum*
gronfolo/ modio	*Qualea rosea*
hekakoro	*Gluta papuana*
iatandza/ West African albizia	*Albizia ferruginea*
imbuia	*Phoebe porosa/Ocotea porosa*
ilomba/ otie	*Pycanthus angolensis*
ipê	*Tabebuia* spp.
izombe	*Testulea gabonensis*
iroko/kambala/ odum	*Milicia excelsa/Clorophora excelsa*
jelutong	*Dyera costulata*
jongkong	*Dactylocladus stenostachys*
kabukalli/cupiúba	*Goupia glabra*
kapur	*Dryobalanops* spp.
kelat/ubah	*Syzgium buettnerianum*
kempas	*Koompassia malaccensis*
keranji	*Dialium cochinchinensi*
keruing	*Dipterocarpus* spp.
kopi/ cupiúba/ kabukalli	*Goupia glabra*
kosipo	*Entandrophragma candollei*
kotibe/ danta	*Nesogordonia papaverifera*
koto	*Pterygota macrocarpa*
kwila/ merbau	*Intsia bijuga*
lati	*Amphimas pterocarpoides*
limbali	*Gilbertiodendron* spp.
longhi	*Gambeya lacourtiana*
longhi blanc	*Gambeya subnuda*
longhi rouge	*Gambeya africana*
lotofa/ wawabima	*Sterculia rhinopetala*
louro	*Cordia* spp., *Nectandra* spp., *Ocotea* spp.
mahogany/ mogno/ caoba	*Swietenia macrophylla*
maka kabbes	*Hymenolobium falvum*
maka-grin	*Tabebuia capitata*
makore/ douka	*Tieghemella heckelii, Tieghemella africana*
malas/ gia	*Homalium foetidum*
mambodé/ amouk	*Detarium macrocarpum*
meranti, dark red/ alan	*Shorea albida*
meranti, light red	*Shorea* spp.
meranti, red	*Shorea* spp.
meranti, white/ lauan	*Shorea* spp.
mersawa	*Anisoptera thurifera*
moabi	*Baillonella toxisperma*
mora	*Mora excelsa*
movingui	*Distemonanthus benthamianus*
mukulungu/ elang/ bouanga	*Autranella congolensis*
naga	*Brachystegia* spp.
niangon	*Heritiera utilis*
niove	*Staudtia kamerunensis*
limba/ frake	*Terminalia superba*
oboto	*Mammea africana*

Trade/common name	Genus and species name
okan/ denya/ African greenheart	*Cylicodiscus gabunensis*
olon	*Fagara heitzii*
ofram/ fraké /limba/ white limba	*Terminalia superba*
ohia/ esa/ African celtis	*Celtis* spp.
okoumé	*Aucoumea klaineana*
ozouga	*Scaoglottis gabonensis*
onzambili	*Antrocaryon* spp.
ovèngkol	*Guibourtia ehie*
padouk, African/ padouk rouge	*Pterocarpus soyauxii*
pao rosa	*Bobgunnia fistuloides, Swartzia fistuloides* (synonymous)
papao/ penaga	*Mesua ferrea*
PNG walnut	*Dracontomelon mangiferum*
pencil cedar/ nyatoh	*Palaquium burckii*
perupok	*Lophopetalum javanicum*
purpleheart/ amarante	*Peltogyne paniculata*
ramin	*Gonystylus* spp.
red balau	*Shorea* spp.
red canarium	*Canarium indicum*
red planchonella	*Planchonella torricellenai*
resak	*Vatika rassak, Cotylelobium* spp.
river red gum/ eucalypts	*Eucalyptus camuldulensis*
rosewood, PNG	*Pterocarpus indicus*
rosewood, African/ kosso	*Pterocarpus erinaceus*
rubberwood	*Hevea brasiliensis*
safoukala	*Dacryodes* spp.
sapele/ sapelli	*Entandrophragma cylindricum*
pelawan/ selunsur	*Tristaniopsis obovata*
seraya, red	*Shorea* spp.
sipo	*Entandrophragma utile*
tali	*Erythrophleum ivorense*
taun/ matoa	*Pometia pinnata*
teak	*Tectona grandis*
terminalia (PNG), red brown	*Terminalia* spp.
terminalia (PNG), yellow	*Terminalia* spp.
tualang/ mengaris	*Koompassia excelsa*
tchitola	*Oxystigma oxyphyllum*
tiama	*Entandophragma angolense*
tola/ agba	*Gossweilerodendron balsamiferum*
virola	*Virola* spp.
wamara/ Guyana rosewood/ ironwood	*Swartzia* spp. *(S. benthamiana, S. leiocalycina)*
wamba	*Tessmania africana*
wengé	*Milettia laurentii*
wana/ louro verhelmo/ red louro	*Sextonia rubra, Nectandra rubra, Ocotea rubra*
white planchonella	*Planchonella kaernbachiana*
yellow meranti	*Shorea* spp.
zingana	*Microberlinia* spp.

Appendix 2: selected physical properties and volume: weight conversion factor data for selected tropical wood species

Trade/Common name	Basic Density (kg/m^3)	Green wood density (kg/m^3)	FSP (%)	Coefficient of volumetric shrinkage (%/%MC)	MAX_MC (%)	Wood Density (kg/m^3) at 12.0% MC	Green Density [bark_on_weight/ bark_off_vol], (kg/m^3)	Sawnwood CF, 12% MC (m^3/tonne)	Log CF, green (m^3/ tonne)	Log CF after 5% moisture loss (m^3/ tonne)	Log CF after 10% moisture loss (m^3/ tonne)	Reference
abalé	710	1249.0	30	0.45	75.91	800	1369.6	1.250	0.828	0.847	0.867	2,3
acacia	436	1152.7	25	0.37	164.67	520	1273.4	1.923	0.945	0.978	1.014	2
acajou d'Afrique	457	1160.2	28	0.35	153.88	540	1280.9	1.852	0.935	0.966	1.000	1,2
afrormosia	634	1222.3	28		92.79	744	1343.0	1.344	0.857	0.879	0.903	1
ako	430	1150.8	28		167.62	470	1271.5	2.128	0.948	0.981	1.017	3
alep	900	1315.6	28		46.18	1050	1436.3	0.952	0.762	0.775	0.787	
andoung	486	1170.3	28	0.46	140.93	590	1291.0	1.695	0.921	0.951	0.983	2
angueuk	770	1270.0	28		64.94	880	1390.7	1.136	0.806	0.823	0.840	3
aningré	510	1178.8	28		131.14	560	1299.5	1.786	0.910	0.939	0.969	2
apomé	830	1291.0	28		55.55	960	1411.7	1.042	0.785	0.800	0.815	3
avodiré	530	1185.8	28		123.74	580	1306.5	1.724	0.901	0.929	0.958	3
awoura	770	1270.0	28		64.94	890	1390.7	1.124	0.806	0.823	0.840	3
ayous	323	1113.3	28	0.32	244.66	380	1233.9	2.632	1.003	1.045	1.090	1,2
azobe	814	1285.4	28		57.92	994	1406.1	1.006	0.791	0.806	0.821	1
bahia/abura	520	1182.3	28		127.37	570	1303.0	1.754	0.906	0.934	0.963	3
balau	743	1260.5	28		69.65	875	1381.2	1.143	0.816	0.833	0.852	1
balsa	120	1042.1	28		768.40	150	1162.8	6.667	1.129	1.190	1.260	5
basrolocus	680	1238.4	28		82.12	760	1359.1	1.316	0.839	0.859	0.880	3
beli/awoura	690	1241.9	28		79.99	770	1362.6	1.299	0.835	0.855	0.876	3
benzi-muténgé	700	1245.5	28		77.92	790	1366.1	1.266	0.832	0.851	0.871	3
bété	590	1206.9	28		104.56	660	1327.6	1.515	0.875	0.900	0.925	3
bilinga	641	1224.8	28		91.07	762	1345.4	1.312	0.854	0.876	0.899	1
bindang	450	1157.8	28		157.29	520	1278.5	1.923	0.938	0.970	1.005	5

Trade/Common name	Basic Density (kg/m^3)	Green wood density (kg/m^3)	FSP (%)	Coefficient of volumetric shrinkage (%/%MC)	MAX_MC (%)	Wood Density (kg/m^3) at 12.0% MC	Green Density [bark_on_weight/ bark_off_vol], (kg/m^3)	Sawnwood CF, 12% MC (m^3/tonne)	Log CF, green (m^3/ tonne)	Log CF after 5% moisture loss (m^3/ tonne)	Log CF after 10% moisture loss (m^3/ tonne)	Reference
bomanga	510	1178.8	28		131.14	560	1299.5	1.786	0.910	0.939	0.969	3
bosmahonie	616	1216.0	28		97.40	750	1336.7	1.333	0.865	0.888	0.912	1,4
bossé	528	1185.1	28		124.46	630	1305.8	1.587	0.902	0.930	0.959	1
bubinga	687	1240.9	28		80.63	833	1361.6	1.200	0.837	0.856	0.877	1
burckella	700	1245.5	28		77.92	790	1366.1	1.266	0.832	0.851	0.871	3
calophyllum	471	1165.2	28		147.38	564	1285.8	1.773	0.928	0.959	0.992	1
cedrella	465	1163.1	28		150.12	555	1283.7	1.802	0.931	0.962	0.996	1
ceiba-fromager	310	1108.7	28		257.65	330	1229.4	3.030	1.010	1.053	1.099	3
congotali	940	1329.6	28		41.45	1100	1450.3	0.909	0.750	0.761	0.773	3
dahoma-tagbema	630	1220.9	28		93.80	700	1341.6	1.429	0.859	0.881	0.905	1
darina/faveira	480	1168.3	28		143.40	530	1289.0	1.887	0.924	0.954	0.987	4
denya/okan	880	1308.6	28		48.70	910	1429.2	1.099	0.769	0.782	0.795	1
dibetou	515	1180.6	28		129.24	616	1301.3	1.623	0.908	0.936	0.966	3
dillenia	600	1210.4	28		101.73	660	1331.1	1.515	0.871	0.895	0.920	3
doussié	627	1219.9	28		94.55	738	1340.5	1.355	0.860	0.883	0.906	1
doussié blanc	670	1234.9	28		84.32	750	1355.6	1.333	0.843	0.864	0.885	3
doussié rouge	659	1231.1	20	0.39	86.81	772	1351.8	1.295	0.847	0.868	0.891	1,2
ebèn	900	1315.6	28		46.18	1050	1436.3	0.952	0.762	0.775	0.787	2
ebiara	594	1208.3	28		103.42	707	1329.0	1.414	0.874	0.898	0.923	1
ekaba	520	1182.3	28		127.37	570	1303.0	1.754	0.906	0.934	0.963	3
erima	350	1122.7	28		220.78	380	1243.4	2.632	0.989	1.028	1.070	3
eveuss/ngon	890	1312.1	28		47.42	1040	1432.8	0.962	0.766	0.778	0.791	3
eyek	530	1185.8	25	0.42	123.74	580	1306.5	1.724	0.901	0.929	0.958	2,3
eyong	660	1231.4	28		86.58	740	1352.1	1.351	0.847	0.868	0.890	3
eyoum	890	1312.1	28		47.42	1030	1432.8	0.971	0.766	0.778	0.791	3
faro	470	1164.8	28		147.83	510	1285.5	1.961	0.928	0.959	0.992	3
framire	468	1164.1	28		148.74	551	1284.8	1.815	0.929	0.960	0.994	1
fromager	620	1217.4	28		96.36	690	1338.1	1.449	0.863	0.886	0.910	3
gindya-udu	740	1259.5	28		70.20	890	1380.2	1.124	0.817	0.834	0.853	2, 11

Trade/Common name	Basic Density (kg/m^3)	Green wood density (kg/m^3)	FSP (%)	Coefficient of volumetric shrinkage (%/%MC)	MAX_MC (%)	Wood Density (kg/m^3) at 12.0% MC	Green Density [bark_on_weight/ bark_off_vol], (kg/m^3)	Sawnwood CF, 12% MC (m^3/tonne)	Log CF, green (m^3/ tonne)	Log CF after 5% moisture loss (m^3/ tonne)	Log CF after 10% moisture loss (m^3/ tonne)	Reference
gmelina	410	1143.8	28		178.97	510	1264.4	1.961	0.958	0.992	1.030	3
gombé	590	1206.9	28		104.56	650	1327.6	1.538	0.875	0.900	0.925	3
greenheart	790	1277.0	28		61.65	954	1397.7	1.048	0.799	0.815	0.831	1
grey canarium	485	1170.1	28		141.25	573	1290.7	1.745	0.921	0.952	0.984	1
gronfolo	570	1199.9	28		110.50	630	1320.5	1.587	0.884	0.909	0.936	3
hekakoro	608	1213.1	28		99.58	739	1333.8	1.353	0.868	0.891	0.916	9
iatandza	550	1192.9	28		116.88	600	1313.5	1.667	0.892	0.919	0.947	3
ilomba	450	1157.8	28		157.29	490	1278.5	2.041	0.938	0.970	1.005	3
imbuia	610	1213.9	28		99.00	680	1334.6	1.471	0.867	0.890	0.915	3
ipê	819	1287.2	28		57.17	975	1407.9	1.026	0.789	0.804	0.819	1
iroko	530	1185.8	28		123.74	625	1306.5	1.600	0.901	0.929	0.958	1
izombe	650	1227.9	28		88.91	720	1348.6	1.389	0.851	0.872	0.895	3
jelutong	410	1143.8	28		178.97	440	1264.4	2.273	0.958	0.992	1.030	3
jongkong	540	1189.4	28		120.25	590	1310.0	1.695	0.897	0.924	0.952	3
kabukalli	710	1249.0	28		75.91	870	1369.6	1.149	0.828	0.847	0.867	4
kapur	624	1218.8	28		95.32	757	1339.5	1.321	0.861	0.884	0.908	1
kelat/ubah	880	1308.6	28		48.70	910	1429.2	1.099	0.769	0.782	0.795	3
kempas	790	1277.0	28		61.65	910	1397.7	1.099	0.799	0.815	0.831	3
keranji	870	1305.1	28		50.01	1010	1425.7	0.990	0.772	0.785	0.799	3
keruing	643	1225.5	28		90.59	792	1346.1	1.263	0.854	0.875	0.898	1
kopi	710	1249.0	28		75.91	870	1369.6	1.149	0.828	0.847	0.867	3
kosipo	530	1185.8	28		123.74	633	1306.5	1.580	0.901	0.929	0.958	1
kotibe	670	1234.9	28		84.32	760	1355.6	1.316	0.843	0.864	0.885	3
koto	540	1189.4	28		120.25	590	1310.0	1.695	0.897	0.924	0.952	3
kwila	719	1252.1	28		74.15	838	1372.8	1.193	0.825	0.843	0.862	1,2
lati	770	1270.0	28		64.94	880	1390.7	1.136	0.806	0.823	0.840	3
limba/frake	431	1151.1	28		167.08	507	1271.8	1.972	0.947	0.981	1.017	1
limbali	680	1238.4	28		82.12	765	1359.1	1.307	0.839	0.859	0.880	3
longhi	720	1252.5	28		73.95	650	1373.1	1.538	0.824	0.843	0.862	3
longhi blanc	680	1238.4	28		82.12	770	1359.1	1.299	0.839	0.859	0.880	3

Trade/Common name	Basic Density (kg/m^3)	Green wood density (kg/m^3)	FSP (%)	Coefficient of volumetric shrinkage (%/%MC)	MAX_MC (%)	Wood Density (kg/m^3) at 12.0% MC	Green Density [bark_on_weight/ bark_off_vol], (kg/m^3)	Sawnwood CF, 12% MC (m^3/tonne)	Log CF, green (m^3/ tonne)	Log CF after 5% moisture loss (m^3/ tonne)	Log CF after 10% moisture loss (m^3/ tonne)	Reference
longhi rouge	660	1231.4	28		86.58	740	1352.1	1.351	0.847	0.868	0.890	3
lotofa	661	1231.8	26	0.68	86.32	840	1352.5	1.190	0.847	0.867	0.889	2
louro	505	1177.1	28		133.08	606	1297.8	1.650	0.912	0.941	0.972	2
mahogany	473	1165.9	28		146.48	545	1286.5	1.835	0.927	0.958	0.991	1
maka kabbes	680	1238.4	28		82.12	760	1359.1	1.316	0.839	0.859	0.880	3
maka-grin	819	1287.2	28		57.17	974	1407.9	1.027	0.789	0.804	0.819	1,3
makore	610	1213.9	28		99.00	670	1334.6	1.493	0.867	0.890	0.915	3
malas	780	1273.5	28		63.27	890	1394.2	1.124	0.802	0.819	0.836	3
mambodé	600	1210.4	28		101.73	660	1331.1	1.515	0.871	0.895	0.920	3
meranti, dark red	541	1189.7	28		119.91	645	1310.4	1.550	0.896	0.923	0.952	1
meranti, light red	402	1141.0	28		183.82	480	1261.6	2.083	0.962	0.997	1.035	1
meranti, red	523	1183.4	28		126.27	620	1304.1	1.613	0.904	0.932	0.962	1
meranti, white	579	1202.9	33	0.58	107.85	720	1323.6	1.389	0.880	0.905	0.931	2
mersawa	403	1141.3	28		183.20	477	1262.0	2.096	0.961	0.996	1.034	3
MIXED HEAVY HARDWOODS	707	1247.9	28		76.51	811	1368.6	1.233	0.829	0.848	0.868	8
MIXED LIGHT HARDWOODS	410	1143.8	28		178.97	440	1264.4	2.273	0.958	0.992	1.030	8
MIXED MEDIUM HARDWOODS	643	1225.5	28		90.59	792	1346.1	1.263	0.854	0.875	0.898	8
moabi	637	1223.4	28		92.05	770	1344.0	1.299	0.856	0.878	0.901	1
mora	774	1271.4	28		64.26	965	1392.1	1.036	0.805	0.821	0.838	1
movingui	572	1200.6	28		109.89	675	1321.2	1.481	0.883	0.908	0.935	1
mukulungu	820	1287.5	28		57.02	940	1408.2	1.064	0.789	0.803	0.819	3
naga	480	1168.3	28		143.40	530	1289.0	1.887	0.924	0.954	0.987	3
niangon	546	1191.5	28		118.22	647	1312.1	1.546	0.894	0.921	0.949	1
niove	780	1273.5	28		63.27	890	1394.2	1.124	0.802	0.819	0.836	3
oboto	670	1234.9	28		84.32	750	1355.6	1.333	0.843	0.864	0.885	3
ofram	500	1175.3	28		135.06	540	1296.0	1.852	0.915	0.944	0.975	3
ohia	730	1256.0	28		72.05	830	1376.6	1.205	0.820	0.839	0.857	3

Trade/Common name	Basic Density (kg/m^3)	Green wood density (kg/m^3)	FSP (%)	Coefficient of volumetric shrinkage (%/%MC)	MAX_MC (%)	Wood Density (kg/m^3) at 12.0% MC	Green Density [bark_on_weight/ bark_off_vol], (kg/m^3)	Sawnwood CF, 12% MC (m^3/tonne)	Log CF, green (m^3/ tonne)	Log CF after 5% moisture loss (m^3/ tonne)	Log CF after 10% moisture loss (m^3/ tonne)	Reference
okan	765	1268.2	28		65.78	913	1388.9	1.095	0.808	0.825	0.842	2,3
okoumé	367	1128.7	28		207.54	443	1249.4	2.257	0.980	1.018	1.059	1,2
olon	480	1168.3	28		143.40	520	1289.0	1.923	0.924	0.954	0.987	3
onzambili	530	1185.8	28		123.74	580	1306.5	1.724	0.901	0.929	0.958	3
ovèngkol	613	1214.9	28		98.20	740	1335.6	1.351	0.866	0.889	0.913	1
ozouga	780	1273.5	28		63.27	890	1394.2	1.124	0.802	0.819	0.836	3
padouk, African	634	1222.3	28		92.79	739	1343.0	1.353	0.857	0.879	0.903	1
pao rosa	880	1308.6	28		48.70	1020	1429.2	0.980	0.769	0.782	0.795	2
papao	920	1322.6	28		43.76	1070	1443.3	0.935	0.756	0.768	0.780	3
pelawan	812	1284.8	28	0.53	58.16	1000	1405.5	1.000	0.791	0.806	0.822	3
pencil cedar	620	1217.4	28		96.36	690	1338.1	1.449	0.863	0.886	0.910	3
perupok	580	1203.4	28		107.48	640	1324.1	1.563	0.879	0.904	0.930	3
PNG walnut	500	1175.3	28		135.06	620	1296.0	1.613	0.915	0.944	0.975	5
purpleheart	710	1249.0	28		75.91	800	1369.6	1.250	0.828	0.847	0.867	3
ramin	540	1189.4	28		120.25	663	1310.0	1.508	0.897	0.924	0.952	1
red balau	665	1233.2	28		85.44	812	1353.9	1.232	0.845	0.866	0.888	1
red canarium	485	1170.1	28		141.25	573	1290.7	1.745	0.921	0.952	0.984	1
red planchonella	460	1161.3	28		152.46	550	1282.0	1.818	0.933	0.965	0.999	6, 10
resak	630	1220.9	28		93.80	700	1341.6	1.429	0.859	0.881	0.905	3
river red gum	670	1234.9	28	0.50	84.32	870	1355.6	1.149	0.843	0.864	0.885	13
rosewood, African	768	1269.3	28		65.27	888	1390.0	1.126	0.807	0.823	0.841	2, 3
rosewood, PNG	515	1180.6	28		129.24	593	1301.3	1.686	0.908	0.936	0.966	1
rubberwood	495	1173.6	28		137.09	585	1294.2	1.709	0.917	0.946	0.978	1
safoukala	600	1210.4	28		101.73	660	1331.1	1.515	0.871	0.895	0.920	3
sapelli/sapele	574	1201.3	28		109.28	690	1321.9	1.449	0.882	0.907	0.934	1, 2
seraya, red	500	1175.3	28		135.06	596	1296.0	1.678	0.915	0.944	0.975	1
sipo	544	1190.8	28		118.89	644	1311.4	1.553	0.895	0.922	0.950	1
tali	780	1273.5	28		63.27	890	1394.2	1.124	0.802	0.819	0.836	1
taun/matoa	617	1216.4	28		97.14	730	1337.0	1.370	0.864	0.887	0.911	2, 3
tchitola	590	1206.9	28		104.56	650	1327.6	1.538	0.875	0.900	0.925	3

Trade/Common name	Basic Density (kg/m^3)	Green wood density (kg/m^3)	FSP (%)	Coefficient of volumetric shrinkage (%/%MC)	MAX_MC (%)	Wood Density (kg/m^3) at 12.0% MC	Green Density [bark_on_weight/ bark_off_vol], (kg/m^3)	Sawnwood CF, 12% MC (m^3/tonne)	Log CF, green (m^3/ tonne)	Log CF after 5% moisture loss (m^3/ tonne)	Log CF after 10% moisture loss (m^3/ tonne)	Reference
teak	578	1202.7	28		108.08	671	1323.3	1.490	0.880	0.905	0.932	1, 2
terminalia, red brown	540	1189.4	28		120.25	657	1310.0	1.522	0.897	0.924	0.952	1
terminalia, yellow	452	1158.5	28		156.30	536	1279.2	1.866	0.937	0.969	1.003	1
tiama	540	1189.4	28		120.25	638	1310.0	1.567	0.897	0.924	0.952	1
tola/agba	443	1155.3	28		160.80	516	1276.0	1.938	0.941	0.974	1.009	1
tualang/mengaris	771	1270.4	28		64.77	910	1391.0	1.099	0.806	0.822	0.839	1, 4, 9
virola	408	1143.1	28		180.16	506	1263.7	1.976	0.959	0.994	1.031	1
wamara/ ironwood	920	1322.6	28	12.3	43.76	1080	1443.3	0.926	0.756	0.768	0.780	12
wamba	787	1276.0	28		62.13	695	1396.6	1.439	0.800	0.816	0.833	7
wana/red louro	570	1199.9	28		110.50	630	1320.5	1.587	0.884	0.909	0.936	3
wengé	766	1268.6	28		65.61	918	1389.3	1.089	0.807	0.824	0.842	1
white planchonella	770	1270.0	23	0.70	64.94	930	1390.7	1.075	0.806	0.823	0.840	2
yellow meranti	540	1189.4	25	0.46	120.25	535.248	1310.0	1.868	0.897	0.924	0.952	2
zingana	637	1223.4	28		92.05	770	1344.0	1.299	0.856	0.878	0.901	1
OTHERS	643	1225.5	28		90.59	792	1346.1	1.263	0.854	0.875	0.898	8

References:

1 Rijsdijk and Laming, 1994.
2 CIRAD, 2015
3 ITTO Lesser Used Species
4 MTC Wood Wizard
5 The Wood Database
6 Eddowes, 1997
7 Mbagou, 2017
8 Ashaari, 2017
9 Burgess, 1966.
10 TRADA, 1978
11 USDA, 1992
12 Suriname Lumber, 2021

Note: *Planchonella firma* was used as a substitute for *Planchonella kaernbachiana* (white planchonella).
OTHER species for both logs and sawnwood were assumed to be MIXED MEDIUM HARDWOODS.
MC=moisture content
FSP=fibre saturation point
CF=conversion factor

Appendix 3: log exports by country by selected tropical wood species (1,000 m³)

	Congo (1)	Guyana (2)	Malaysia (6)	PNG (3)	Ghana (4)	Suriname(2)	Liberia (2)	Cameroon (5)	CAR (5)	Viet Nam (4)	Cambodia (4)	Thailand (7)	Benin (2)	Mali (8)	Africa	Asia	LAC	TOTAL
abalé								0.3							0.3			0.3
acacia			558.5													558.5		558.5
acajou d'Afrique	2.4								2.1					6.7	11.2			11.2
afrormosia	0.8														0.8			0.8
ako/antiaris																		
alep								1.5							1.5			1.5
andoung								12.1							12.1			12.1
angueuk	6.2														6.2			6.2
aningré	0.5								0.1						0.6			0.6
apomé							7.0								7.0			7.0
avodiré	0.1														0.1			0.1
awoura								92.1							92.1			92.1
ayous/obéché	0.3							40.9	1.4						42.6			42.6
azobe/ekki	28.5						42.0	51.9	1.8						124.2			124.2
bahia/abura	0.1							0.1							0.2			0.2
balau			56.8													56.8		56.8
balsa																		
basrolocus						146.0											146.0	146.0
beli/awoura																		
benzi-muténgé	0.2														0.2			0.2
bété									1.5						1.5			1.5
bilinga	23.9							25.8	0.3						50.0			50.0
bindang			5.9													5.9		5.9
bomanga																		
bosmahonie						22.0											22.0	22.0
bossé	4.3								3.2						7.5			7.5
bubinga	2.0								8.1						10.1			10.1
burckella				36.6												36.6		36.6

	Congo (1)	Guyana (2)	Malaysia (6)	PNG (3)	Ghana (4)	Suriname(2)	Liberia (2)	Cameroon (5)	CAR (5)	Viet Nam (4)	Cambodia (4)	Thailand (7)	Benin (2)	Mali (8)	Africa	Asia	LAC	TOTAL
calophyllum				173.9												173.9		173.9
cedrella/cedro																		
ceiba-fromager																		
congotali	6.3														6.3			6.3
dahoma-tagbema	16.7						7.0	87.6							111.3			111.3
darina/faveira		5.0															5.0	5.0
denya/okan																		
dibetou	5.1						1.0		3.9						10.0			10.0
dillenia				95.3												95.3		95.3
doussie									9.2						9.2			9.2
doussié blanc	0.7														0.7			0.7
doussié rouge	2.8														2.8			2.8
ebèn/ebony	0.4														0.4			0.4
ebiara	1.3							3.2							4.5			4.5
ekaba								5.1							5.1			5.1
erima/benuang				42.1												42.1		42.1
eveuss/ngon								0.8							0.8			0.8
eyek/eyeck								33.1	0.3						33.4			33.4
eyong								13.8							13.8			13.8
eyoum								0.2							0.2			0.2
faro								2.3					5.0		7.3			7.3
framire																		
fromager																		
gindya-udu						21.0											21.0	21.0
gmelina													2.0		2.0			2.0
gombé								0.1							0.1			0.1
greenheart		8.0															8.0	8.0
grey canarium				25.8												25.8		25.8
gronfolo/modio						37.0											37.0	37.0
hekakoro				2.1												2.1		2.1

	Congo (1)	Guyana (2)	Malaysia (6)	PNG (3)	Ghana (4)	Suriname(2)	Liberia (2)	Cameroon (5)	CAR (5)	Viet Nam (4)	Cambodia (4)	Thailand (7)	Benin (2)	Mali (8)	Africa	Asia	LAC	TOTAL
iatandza								1.9							1.9			1.9
ilomba/otie																		
imbuia																		
ipê																		
iroko/odum	13.8						1.0		21.8						36.6			36.6
izombe	0.3														0.3			0.3
jelutong																		
jongkong																		
kabukalli/cupiúba		3.0															3.0	3.0
kapur			79.1													79.1		79.1
kelat/ubah																		
kempas																		
keranji			2.5													2.5		2.5
keruing			47.6									1.6				49.2		49.2
kopi/cupiúba						37.0											37.0	37.0
kossipo	15.0							16.4	4.3						35.7			35.7
kotibe/danta	0.01							0.4							0.4			0.4
koto								0.8							0.8			0.8
kwila/merbau			0.1	281.1												281.2		281.2
lati															0.003			0.0
limba/frake																		
limbali	0.1						19.0	31.3							50.4			50.4
longhi									0.2						0.2			0.2
longhi blanc	0.1														0.1			0.1
longhi rouge	0.1														0.1			0.1
lotofa								1.5							1.5			1.5
louro																		
mahogany																		
maka kabbes						33.0											33.0	33.0
maka-grin																		

	Congo (1)	Guyana (2)	Malaysia (6)	PNG (3)	Ghana (4)	Suriname(2)	Liberia (2)	Cameroon (5)	CAR (5)	Viet Nam (4)	Cambodia (4)	Thailand (7)	Benin (2)	Mali (8)	Africa	Asia	LAC	TOTAL
makore/douka	3.0														3.0			3.0
malas/ gia				158.1												158.1		158.1
mambodé								4.2	0.02						4.2			4.2
meranti, dark red			0.1													0.1		0.1
meranti, light red																		
meranti, red			403.0													403.0		403.0
meranti, white			0.2													0.2		0.2
mersawa			3.3	50.3												53.6		53.6
MIXED HEAVY HARDWOODS			29.3													29.3		29.3
MIXED LIGHT HARDWOODS			96.1													96.1		96.1
MIXED MEDIUM HARDWOODS			11.1													11.1		11.1
moabi	10.5														10.5			10.5
mora		1.0															1.0	1.0
movingui	3.1														3.1			3.1
mukulungu	13.6							4.9	24.5						43.0			43.0
naga							4.0	23.3							27.3			27.3
niangon							3.0								3.0			3.0
niové	9.9							8.3	0.1						18.3			18.3
oboto	0.4							0.0							0.4			0.4
ofram/ fraké	0.4							29.1							29.5			29.5
ohia/ esa								0.001							0.0			0.0
okan/denya	56.7							199.3							256.0			256.0
okoumé	349.6														349.6			349.6
olon	0.1														0.1			0.1
onzambili	0.01							5.1							5.1			5.1
OTHERS	6.6	4.0	11.9	723.0	83.2	144.0	51.0	12.6	7.5	68.7	31.1	0.1		1.2	162.2	834.8	148.0	1145.0
ovèngkol																		
ozouga																		

	Congo (1)	Guyana (2)	Malaysia (6)	PNG (3)	Ghana (4)	Suriname(2)	Liberia (2)	Cameroon (5)	CAR (5)	Viet Nam (4)	Cambodia (4)	Thailand (7)	Benin (2)	Mali (8)	Africa	Asia	LAC	TOTAL
padauk, African	31.7								14.2						45.9			45.9
pao rosa	2.5								1.5						4.0			4.0
papao/penaga																		
pelawan			1.2													1.2		1.2
pencil cedar			2.0	80.6												82.6		82.6
perupok				7.6												7.6		7.6
PNG walnut				36.2												36.2		36.2
purpleheart		3.0				22.0											25.0	25.0
ramin																		
red balau																		
red canarium				56.0												56.0		56.0
red planchonella				4.4												4.4		4.4
red river gum												91.3				91.3		91.3
resak			12.6													12.6		12.6
rosewood, PNG										44.7	6.9	5.8				57.4		57.4
rosewood/kosso					167.0								30.0	36.6	233.5			233.5
rubberwood																		
safoukala	0.1														0.1			0.1
sapelli/sapele	74.6								133.3						207.9			207.9
seraya, red			35.0													35.0		35.0
sipo	13.5								8.4						21.9			21.9
tali	57.7						1.0	232.7	24.7						316.1			316.1
taun/matoa				487.0												487.0		487.0
tchitola	0.1														0.1			0.1
teak	0.2				195.1			0.2	0.4	1.0			50.0		245.9	1.0		246.8
terminalia, red brown				118.6												118.6		118.6
terminalia, yellow																		
tiama/accuminata	8.2							1.6							9.8			9.8
tola/agba	0.04							0.1							0.1			0.1
tualang/mengaris																		

	Congo (1)	Guyana (2)	Malaysia (6)	PNG (3)	Ghana (4)	Suriname(2)	Liberia (2)	Cameroon (5)	CAR (5)	Viet Nam (4)	Cambodia (4)	Thailand (7)	Benin (2)	Mali (8)	Africa	Asia	LAC	TOTAL
virola																		
wamara/ironwood		36.0															36.0	36.0
wamba								17.6							17.6			17.6
wana/red louro						21.0											21.0	21.0
wengué/wenge	23.9														23.9			23.9
white planchonella				8.8												8.8		8.8
yellow meranti			0.01													0.01		0.01
zingana	0.4							0.1							0.5			0.5
TOTAL	**799**	**60**	**1356**	**2388**	**445**	**483**	**136**	**962**	**273**	**114**	**38**	**99**	**89**	**44**	**2747**	**3995**	**543**	**7285**

1 Ngoya-Kessy 2019 (2018 data).
2 ITTO Statistics Database (2017 data)
3 SGS 2020 (2020 data)
4 ITTO 5-year annual average (2016-2020)
5 ATIBT (2017 data)
6 ITTO (2019 data)
7 Thailand Forestry Statistics Data 2019
Note: Africa, Asia/Pacific and Latin America/Caribbean (LAC) data are estimated from the average available country data in these regions.

Appendix 4: sawnwood exports by country by selected tropical wood species (1,000 m³)

	Congo (1,2)	Ghana (5)	Cameroon (3)	CAR (3)	Mali (2)	Malaysia (4)	Guyana (4)	Suriname (4)	PNG (6)	Myanmar (2)	Brazil (7)	Guatemala (2)	Thailand (9)	Indonesia (8)	Côte d'Ivoire (2)	Gabon (2)	Africa	Asia/Pacific	LAC	TOTAL
abalé			10.8														10.8			10.8
acacia						2.0												2.0		2.0
acajou d'Afrique	4.0	3.0		0.2													7.2			7.2
afrormosia			7.6														7.6			7.6
ako/antiaris															7.5		7.5			7.5
alep																				
andoung																6.0	6.0			6.0
angueuk																				
aningré			0.5														0.5			0.5
apomé																				
avodiré																				
awoura			1.2														1.2			1.2
ayous/obéché	8.7	11.0	149.0	3.6											12.1		184.4			184.4
azobe/ironwood			33.9												4.5	9.0	47.4			47.4
bahia/abura			0.1														0.1			0.1
balau						43.1												43.1		43.1
balsa									27.8									27.8		27.8
basrolocus								2.0											2.0	2.0
beli/awoura																331.0	331.0			331.0
benzi-muténgé																				
bété			1.3														1.3			1.3
bilinga			1.3													5.0	6.3			6.3
bindang						2.0												2.0		2.0
bomanga																3.0	3.0			3.0
bosmahonie																				
bossé	1.0		4.1														5.1			5.1
bubinga			0.2	0.2												4.0	4.4			4.4
burckella																				
calophyllum																				

	Congo (1,2)	Ghana (5)	Cameroon (3)	CAR (3)	Mali (2)	Malaysia (4)	Guyana (4)	Suriname (4)	PNG (6)	Myanmar (2)	Brazil (7)	Guatemala (2)	Thailand (9)	Indonesia (8)	Côte d'Ivoire (2)	Gabon (2)	Africa	Asia/Pacific	LAC	TOTAL
cedrella/cedro		1.0									2.0						1.0		2.0	3.0
ceiba-fromager															106.7		106.7			106.7
congotali																				
dahoma-tagbema		1.0	2.2												15.4		18.6			18.6
darina/faveira							1.0												1.0	1.0
denya/okan		4.0															4.0			4.0
dibétou			11.8	1.1													12.9			12.9
dillenia/simpoh																				
doussié			0.8														0.8			0.8
doussié blanc			5.9	0.2													6.1			6.1
doussié rouge			7.0														7.0			7.0
ebèn/ebony				0.001													0.001			0.001
ebiara			0.1														0.1			0.1
ekaba			1.5														1.5			1.5
erima/benuang																				
eveuss/ngon			0.02														0.02			0.02
eyek/eyeck			0.8														0.8			0.8
eyong			0.7														0.7			0.7
eyoum			0.1														0.1			0.1
faro																				
framire			1.5												5.5		7.0			7.0
fromager			0.1														0.1			0.1
gindya-udu																				
gmelina																				
gombé			0.03														0.03			0.03
greenheart							10.0	1.0											11.0	11.0
grey canarium																				
gronfolo/modio								1.0											1.0	1.0
hekakoro																				
iatandza			1.3														1.3			1.3
ilomba/otie			0.4												10.8		11.2			11.2

	Congo (1,2)	Ghana (5)	Cameroon (3)	CAR (3)	Mali (2)	Malaysia (4)	Guyana (4)	Suriname (4)	PNG (6)	Myanmar (2)	Brazil (7)	Guatemala (2)	Thailand (9)	Indonesia (8)	Côte d'Ivoire (2)	Gabon (2)	Africa	Asia/Pacific	LAC	TOTAL
imbuia																				
ipê											55.0								55.0	55.0
iroko/odum	5.0	1.0	50.1	1.0											10.0		67.0			67.0
izombe																				
jelutong																				
jongkong																				
kabukalli/cupiúba																				
kapur						88.0												88.0		88.0
kelat/ubah						4.0												4.0		4.0
kempas						79.9												79.9		79.9
keranji						2.0												2.0		2.0
keruing						162.6												162.6		162.6
kopi																				
kossipo	4.0		9.2	0.9													14.1			14.1
kotibé/danta			0.1														0.1			0.1
koto		1.0	1.3														2.3			2.3
kwila/merbau						64.6			6.3					229.1				300.1		300.1
lati			0.0														0.0			0.0
limba/fraké			39.5												6.1		45.6			45.6
limbali			1.7														1.7			1.7
longhi			0.002														0.002			0.002
longhi blanc																				
longhi rouge																				
lotofa			5.5														5.5			5.5
louro											3.0								3.0	3.0
mahogany											1.0	2.0							3.0	3.0
maka kabbes								1.0											1.0	1.0
maka-grin								9.0											9.0	9.0
makoré/douka			0.1														0.1			0.1
malas/gia																				
mambodé/amouk			0.2														0.2			0.2

	Congo (1,2)	Ghana (5)	Cameroon (3)	CAR (3)	Mali (2)	Malaysia (4)	Guyana (4)	Suriname (4)	PNG (6)	Myanmar (2)	Brazil (7)	Guatemala (2)	Thailand (9)	Indonesia (8)	Côte d'Ivoire (2)	Gabon (2)	Africa	Asia/Pacific	LAC	TOTAL
meranti, dark red						845.2												845.2		845.2
meranti, light red																				
meranti, red						58.0								17.2				75.2		75.2
meranti, white						63.6								15.1				78.7		78.7
mersawa																				
MIXED HEAVY HARDWOODS						2.0												2.0		2.0
MIXED LIGHT HARDWOODS						244.0												244.0		244.0
MIXED MEDIUM HARDWOODS						2.0												2.0		2.0
moabi			13.2														13.2			13.2
mora							1.0												1.0	1.0
movingui			6.6														6.6			6.6
mukulungu			0.2	0.4													0.6			0.6
naga			3.4														3.4			3.4
niangon																				
niové			1.8														1.8			1.8
oboto																				
ofram/fraké		2.0															2.0			2.0
ohia/esa																				
okan/denya			4.5													5.0	9.5			9.5
okoumé	20.0															51.0	71.0			71.0
olon																				
onzambili			0.2														0.2			0.2
OTHERS	73.1	8.0	0.6			93.4		4.0		101.0	223.0	9.0	0.3	282.4			81.7	477.1	236.0	794.8
ovèngkol																				
ozouga																				
padauk, African			19.7	0.2												4.0	23.9			23.9
pao rosa			0.3														0.3			0.3
papao/penaga		1.0															1.0			1.0

	Congo (1,2)	Ghana (5)	Cameroon (3)	CAR (3)	Mali (2)	Malaysia (4)	Guyana (4)	Suriname (4)	PNG (6)	Myanmar (2)	Brazil (7)	Guatemala (2)	Thailand (9)	Indonesia (8)	Côte d'Ivoire (2)	Gabon (2)	Africa	Asia/Pacific	LAC	TOTAL
pelawan						2.0												2.0		2.0
pencil cedar																				
perupok																				
PNG walnut																				
purpleheart							3.0												3.0	3.0
ramin																				
red balau																				
red canarium																				
red planchonella																				
red river gum																				
resak						1.0												1.0		1.0
rosewood, African		4.0			2.0												6.0			6.0
rosewood, PNG									4.7				1.2	50.1				56.0		56.0
rubberwood						105.0							2264.3					2369.3		2369.3
safoukala																				
sapelli/sapele	133.5	1.0	182.6	9.8													326.9			326.9
seraya, red																				
sipo	9.8		13.8	0.4													24.0			24.0
tali	11.4		62.8	0.8												5.0	80.0			80.0
taun/matoa									12.6									12.6		12.6
tchitola			0.0														0.0			0.0
teak		49.0								7.0				8.1			49.0	15.1		64.1
terminalia, red brown																				
terminalia, yellow																				
tiama		1.0	1.9	0.3													3.2			3.2
tola/agba			0.3														0.3			0.3
tualang/mengaris						2.0												2.0		2.0
virola																				
wamara/ironwood																				
wamba																				

	Congo (1,2)	Ghana (5)	Cameroon (3)	CAR (3)	Mali (2)	Malaysia (4)	Guyana (4)	Suriname (4)	PNG (6)	Myanmar (2)	Brazil (7)	Guatemala (2)	Thailand (9)	Indonesia (8)	Côte d'Ivoire (2)	Gabon (2)	Africa	Asia/Pacific	LAC	TOTAL
wana/red louro																				
wengué/wenge	1.0		0.2														1.2			1.2
white planchonella																				
yellow meranti						8.0												8.0		8.0
zingana			2.5														2.5			2.5
TOTAL	**272**	**88**	**666**	**19**	**2**	**1874**	**15**	**18**	**51**	**108**	**284**	**11**	**2266**	**602**	**178**	**423**	**1648**	**4902**	**328**	**6878**

1 Ngoya-Kessy 2019 (2018 data).
2 ITTO Statistics Database (2017 data)
3 ATIBT (2017 data)
4 ITTO (2019 data)
5 ITTO (2020 data)
6 PNG Forest Industries Assoc. (pers. comm.), 2020 data
7 ITTO (2016 data)
8 ITTO (2015-2020 annual average)
9 Thailand Forestry Statistics Data 2019.
Note: Africa, Asia/Pacific and Latin America/Caribbean (LAC) data are estimated from the average available country data in these regions.

ITTO