CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Seventeenth meeting of the Plants Committee
Geneva (Switzerland), 15-19 April 2008

Timber issues

Bigleaf mahogany

VOLUMETRIC CONVERSION OF STANDING TREES TO EXPORTABLE MAHOGANY SAWN WOOD

1. This document has been prepared by the Chairman of the Plants Committee.

2. As part of the 2007 Workplan and within the framework of the commitments of the DR-CAFTA (Dominican Republic – Central America Free Trade Agreement) of the Central American Commission for Environment and Development (CCAD), a CITES regional implementation workshop was held on 'Improving International Trade in the Bigleaf Mahogany (*Swietenia macrophylla*)', (Nicaragua, August 2007).

3. The workshop was supported by the World Bank, and the CCAD organizers proposed an exchange of experiences among specialists from different countries with the goal of developing practical mechanisms to boost compliance with CITES.

4. Participants in the workshop included representatives from Belize, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Mexico as Chairman of the Mahogany Working Group, the Chairman of the Plants Committee, the CITES Secretariat and representatives from various NGOs.

5. The result of this workshop is a report on the *Methodology for developing national volume conversion tables (standing volume & export grade sawn wood)* and is provided at this meeting as document PC17 Inf. 3 (English and Spanish only). The key points of that document are compiled in the Annex to this present document.

6. The Chairman of the Plants Committee wishes to thank the CCAD and the World Bank for submitting the document for discussion at this meeting.

7. The Plants Committee is asked to:

   a) study, verify and debate the contents of the Annex;
   b) issue conclusions on the same and incorporate any relevant modifications, if necessary;
   c) determine how to proceed with regard to the method for volumetric conversion of standing trees to exportable mahogany sawn wood; and
   d) in line with Annex 3, paragraph 1. b), of the Decisions in effect after CoP14, advise range States of the methodology to follow.

VOLUMETRIC CONVERSION TABLE FOR MAHOGANY (*SWIETENIA MACROPHYLLA*) SAWN WOOD. METHODOLOGY FOR CREATING NATIONAL TABLES FOR VOLUMETRIC CONVERSION OF STANDING TREES TO EXPORT GRADE MAHOGANY SAWN WOOD. KOMETTER, R. AND E. MARAVI (2007).

1. Calculating the volume of export grade mahogany

One of the most common methods for laundering illegally harvested mahogany is the application of inaccurate conversion factors for calculating export grade sawn wood yields from standing timber volumes. In other words, the volumes estimated on CITES export permit applications are significantly higher than those actually produced by legally harvested trees. For this reason, in order to improve compliance with CITES, it is necessary to revise and standardize the conversion factors for standing timber and export grade mahogany wood volumes.

For example, when applying for export permits, some producing countries assume that 100 % of the standing volume is exportable. In other countries, this factor varies between 50 and 60 % of total standing volume. In a few exceptional cases, some countries have made efforts to determine conversion factors along the entire value chain. For example, dasometric analysis of data obtained during mahogany harvests in Peru and Brazil with statistical adjustments demonstrates that export grade sawn wood is approximately 20 % of the total standing volume. It is therefore estimated that between 30 and 80 % of the wood currently exported using conversion factors significantly greater than 20 % is most likely to be of illegal origin. Said timber would thus be categorized as of controversial origin. This situation has a highly detrimental impact on the sustainable use of the species, proper compliance with national and international law, the good governance of the forest sector in producer countries and the development of the forest industry in general.

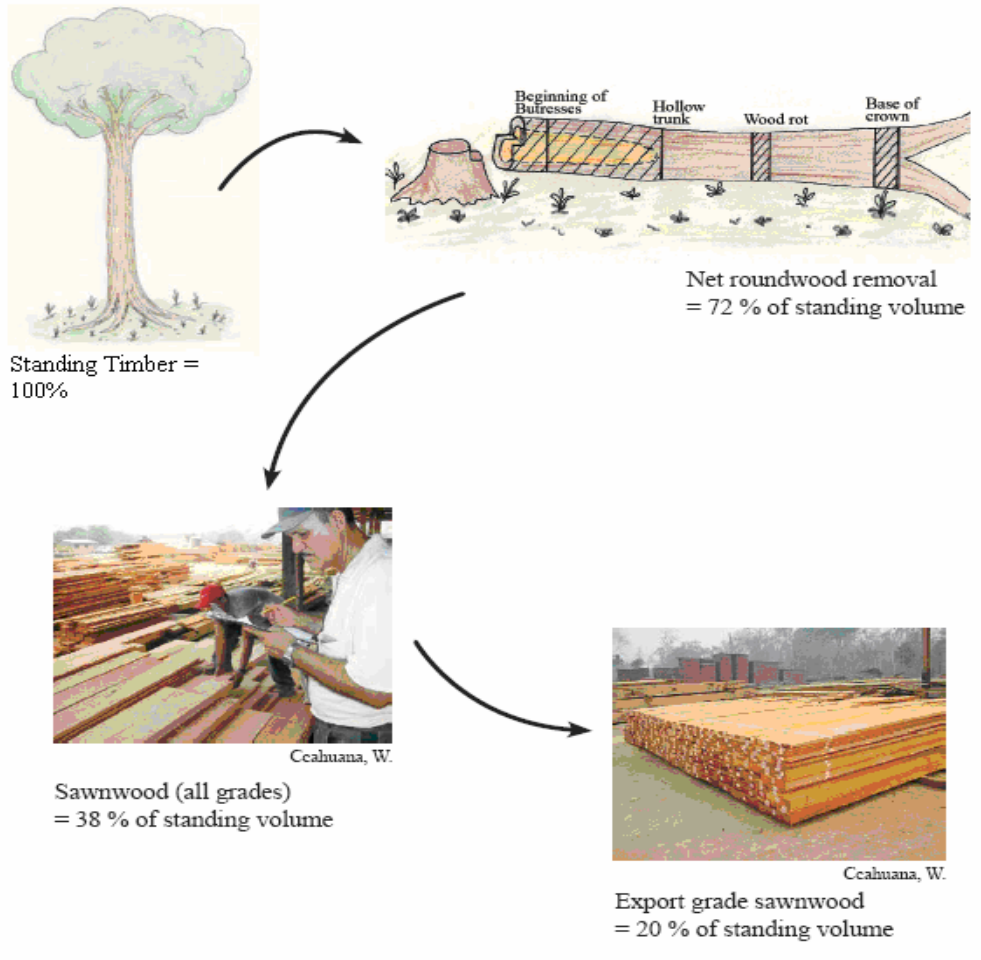


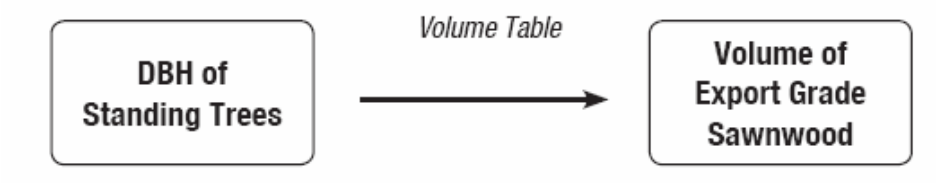
Figure 1. Relative volume reductions, forest to sawmill

2 Practical and effective options

Given the situation described, it is important to determine as accurately as possible the actual volume of exportable sawn wood produced by mahogany trees. This can be accomplished simply using dasometric principles and a volume conversion table. Based on the diameter measurement of the standing tree at breast height (DBH), the export volume of mahogany can be estimated using these tables.

This is based on the principle that in the case of the mahogany tree, there is a strong correlation between the DBH and the resulting volume of sawn wood. It is therefore possible to develop a very practical volume table in which the DBH measurement of the standing tree is sufficient to estimate immediately the volume of exportable sawn wood that can be obtained from any given tree.

Mahogany: Timber volume from standing to export volume



3. Development of national volume tables

Objective

To assist the CITES Authorities and forest management agencies of mahogany-producing countries in the region in developing national volumetric conversion tables (NVCT) for mahogany using the methodology described. The use of these simple, highly precise volumetric tables will prevent the export of greater volumes of mahogany sawn wood than can actually be produced by legally harvested trees. Once approved by the competent national authorities, these national tables will be used by stakeholders, operators, forest owners, auditors, forest management authorities and CITES Authorities.

National volume tables should be developed by following rigorously the methodology outlined below:

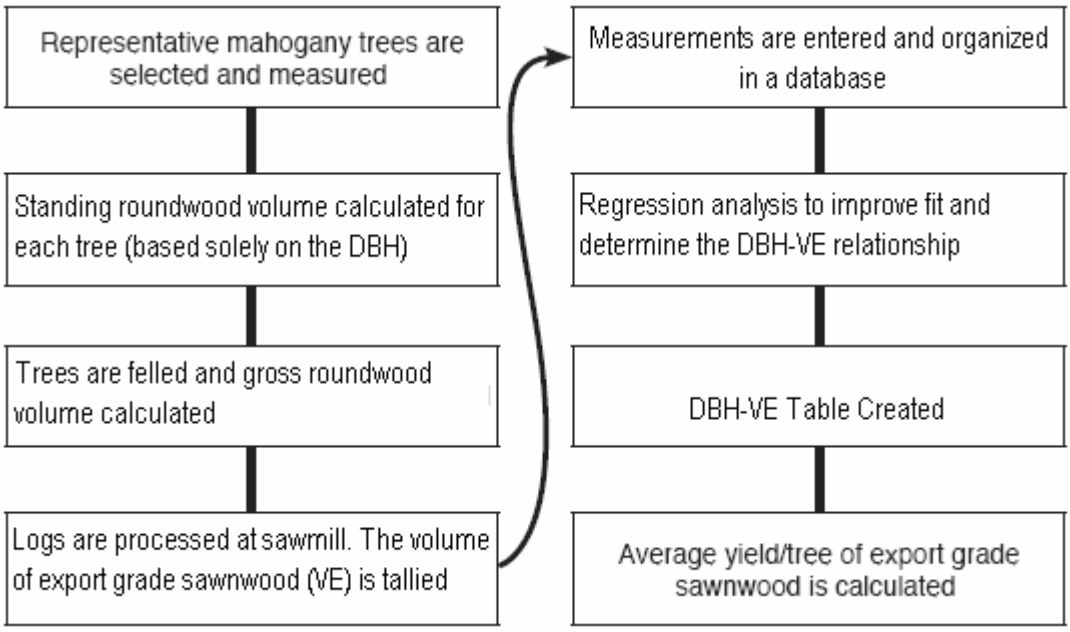


Figure 2. Methodology flowchart

Step I:

Sampling, measuring and calculating standing volume

1. Selection of mahogany trees for the preparation of volumetric conversion tables. Mahogany trees of varying diameters and dimensions should be selected at random to cover as thoroughly as possible the range of diameters, heights and shapes in the country. We recommend sampling at least 100 trees, proportionally selected from between 8 and 10 diameter classes (DC), each DC increasing 10 cm starting from the minimum allowable diameter. This sampling may be coordinated with authorized harvesting operations (forest concessions, community forests or private holdings). However, ideally the number of trees sampled should be determined statistically based on the conditions in each country.

2. Gathering the necessary data from each tree selected to calculate the real volume of each. Using a diameter tape, measure the diameter of the standing tree at 1.3 m above the ground (DBH) and at the merchantable height (MH). It is important to note that these are conventional guidelines; in practice field technicians should use their best judgment depending on the morphological characteristics of each tree.

3. Estimating the standing volume using the DBH.

Step II:

Calculating gross roundwood volume

Once the tree has been felled, take the necessary measurements to calculate the real volume of the tree, including:

- Stump diameter
- Log diameter at stump level and every two metres (d_1, d_2, d_3, ...)
- Diameter at the cut point of the felled shaft

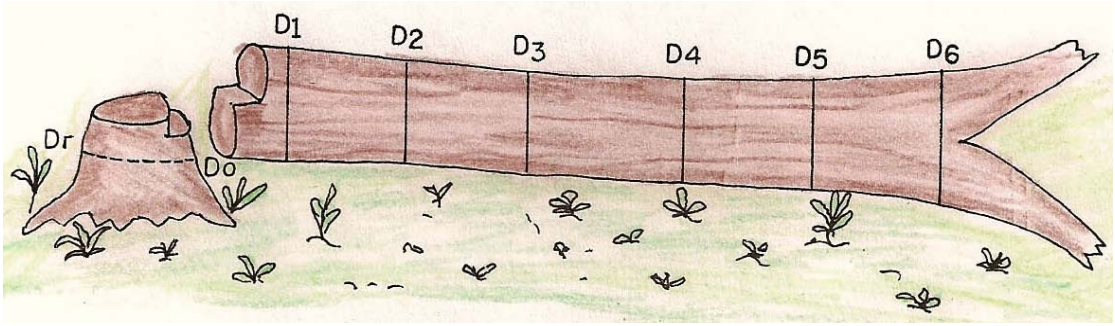


Figure 3. Log diameter measurements

4. Calculating the real volume of each mahogany tree sampled. The volume of each section is calculated using Smalian's formula. The section volumes are then added together to give the total volume of each tree.

$$V = \frac{Pi}{4}\left[\frac{D_1+D_2}{2}\right] L$$

V = Volume (m^3); Pi = 3.1416; D1 = Larger Diameter (m);
D2 = Smaller Diameter (m) and L = Log Length (m)

5. Measurement and deduction for defects. The magnitude (size) of any defects (hollow areas and rot) in each log section must be measured, calculating the total volume of the defects. It is important to

calculate accurately any defects (hollow areas and rot) so that the appropriate volume deductions can be made. In addition to the data and yield indices prepared by A. C. Sánchez and W. Ccahuana in Peru, we would like to acknowledge J. Grogan and J. Schulze's valuable work in the development of defect indices. Their work and studies done in Brazil have contributed significantly to the design of this methodology.

6. Eliminating unusable sections and measuring the logs from each mahogany tree that will be transported to the sawmill. Once the unusable portions have been discarded and the logs to be taken to the sawmill have been identified, they must be measured to determine the volume removed from the forest.

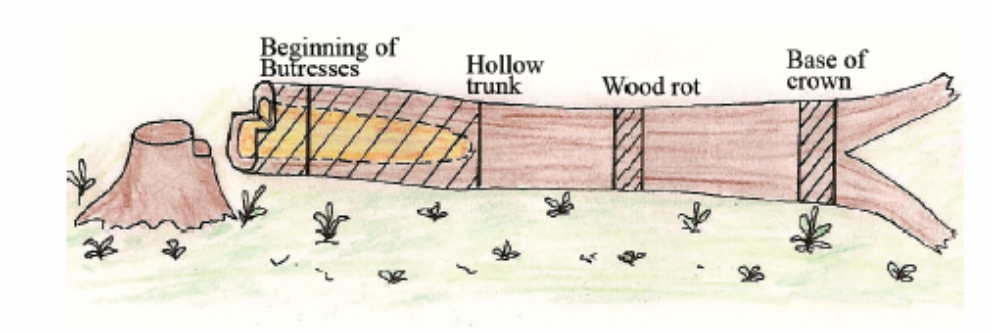


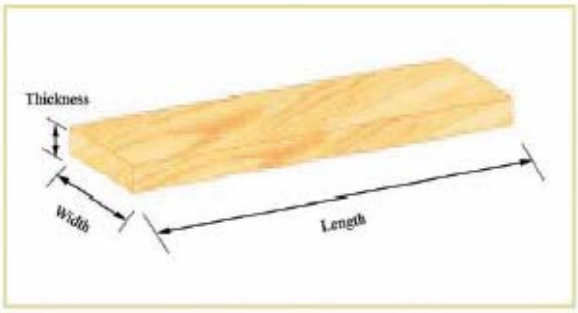
Figure 4. Volume deduction for log defects

7. Calculating the volume of each mahogany tree to be transported to the sawmill. The volume of each tree is the sum of the volumes of all logs sent to the sawmill.

Step III:

Mill processing and calculating exportable timber

8. Mill processing, grading and board measurement by grade for each mahogany tree processed.



$$V = \frac{T \times W \times L}{12}$$

Figure 5. Calculating sawn wood volume by grade where V = Volume of sawn wood (cubic feet); T = Board thickness (inches); W = Board width (inches); L = Board length (feet)

For the purpose of developing volumetric tables using this methodology, it is important to calculate accurately the volume of export grade timber.

Step IV:

Forest and sawmill data entry and organization

9. Entering and organizing data in a simple database. All data taken from selected trees in the forest and at the sawmill is organized in a database in accordance with the table below:

   DBH: Diameter at 1.30 m above the ground, measured in cm on standing trees. As remarked earlier, it is important to note that these are conventional guidelines; in practice field technicians should use their best judgment depending on the morphological characteristics of each tree.

   MH: merchantable height to the base of the crown, measured in metres on standing trees.

   Standing timber volume: this is the total estimated volume of the standing tree calculated using the DBH, MH and the factor 0.65 (truncated cone adjustment factor). This volume is expressed in m^3. The 0.65 factor was used in analysing the data from Peru. Each country may determine its own adjustment factor.

   Gross roundwood volume: the total wood volume (m^3) of the felled tree before it is bucked into logs and transported to the sawmill.

   Net roundwood volume: the volume (m^3) of the logs sent to the sawmill.

   Sawn wood volume: the total volume (m^3) of sawn wood obtained from the logs entering the sawmill.

   Volume of Export grade sawn wood (VE): volume of export grade sawn wood obtained from each mahogany tree.

   Volumetric Conversion Factor (VCF): the ratio of export grade sawn wood divided by the standing timber volume.

We recommend that the data entry and organization be performed by at least two members of the team responsible for preparing the national table. This will ensure higher quality data entry and organization.

By way of illustration, using real, practical examples, the following table was created from a sample of 255 mahogany trees. The trees measured and documented by Sánchez, A.C. (10) were selected for exploitation at a forest concession in Peru. The defect indices used were developed by Grogan, J. and Schulze, M. (6) in Brazil, and the yield indices by W. Ccahuana (3) in Peru.

Table 1. Merchantable height and estimated volumes. (*) VE = Standing roundwood volume (4) x VCF (9). The complete dataset for this table appears in Annex 2.

1	2	3	4	5	6	7	8	9
No.	DBH (cm)	MH (m)	**Standing Timber** Volume (m^3)	Gross Roundwood Volume (m^3)	Net Roundwood Volume (m^3)	Sawnwood Volume (m^3)	Exportable Volume (4 x 9)	Conversion Factor
1	75	12	3.446	3.951	3.6769	1.6381	0.8191	0.2377
2	75	14	4.020	3.933	3.7051	1.6868	0.8434	0.2098
	...	...		...	...	...	...	...
	.							
52	87	14	5.410	5.728	5.0903	2.3576	1.1788	0.2179
53	87	11	4.250	4.474	3.8343	1.8282	0.9141	0.2151
	...	...		...	...	...	...	...
81	93	16	7.065	7.318	6.1967	2.9462	1.4731	0.2085
82	93	13	5.740	5.354	4.8061	2.3138	1.1569	0.2015
	...	...		...	...	...	...	...
215	130	18	15.530	14.423	9.5138	5.4393	2.7196	0.1751
216	130	19	16.392	15.453	10.1351	5.8658	2.9329	0.1789
	...	...		...	...	...	...	...
	...	...		...	...	...	...	...
251	151	20	23.280	20.655	11.4272	6.9976	3.4988	0.1503
252	154	21	25.425	22.425	12.2670	7.4861	3.7430	0.1472
253	156	14	17.393	17.499	8.9404	5.6400	2.8200	0.1621
254	168	16	23.054	21.017	10.4485	6.8601	3.4301	0.1488
255	169	12	17.497	15.386	8.0448	5.2025	2.6013	0.1487

Step V:

Regression analysis and development of an export grade sawn wood volume table for mahogany based on DBH.

Regression analysis is a statistical technique that reduces the margin of error in calculations of the relationship between a quantitative variable called the *dependent variable* (in this case, the export volume) and one or more independent variables, called predictors (in this case the DBH). Regression analysis is very useful for the development of volume tables, primarily because tree volume is a difficult variable to measure using conventional methods. However, with regression analysis, it can be estimated based on another variable that is easier to measure, such as the DBH, and its relationship to the volume. This analysis can be done with programs, such as Microsoft Excel or MINITAB, that are available for ordinary computers. The steps are as follows:

10. Graph the correlation between the DBH and the export volume of mahogany to determine the trends and select the model (formula) that best matches those trends, for subsequent verification. The figure below shows the levels of dispersion of the volume of export grade sawn wood for 255 mahogany trees sampled.

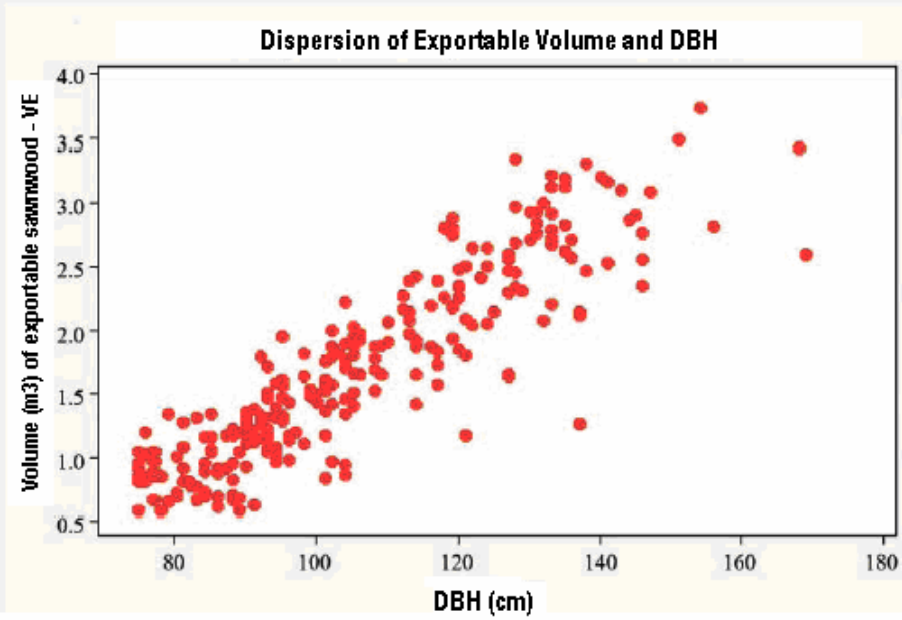


Figure 6. Dispersion of the relationship between export volume and DBH

As may be observed, the distribution of the exportable sawn wood volume per mahogany tree based on the DBH shows a marked tendency to increase. In other words, as the DBH increases, the volume also automatically increases, confirming the model recommended by Mayhew, J.E. & Newton (8). This is a single-entry model, in which only the DBH is needed to estimate the volume, as demonstrated in many studies and corroborated by Grogan, J. and Schulze, M. (6).

The following model was used for the regression analysis:

$Y = a + b\mathbf{DBH} + c\mathbf{DBH}^2$ [Mayhew, J.E. & Newton (8)]

Where a, b and c are coefficients.

11. Determining coefficients using least squares regression analysis

The resulting equation: $VE = -2.4403 + 0.046383*\mathbf{DBH} - 0.00006461*\mathbf{DBH}^2$

12. Analyzing the equation's goodness of fit with values and tests (using Excel or MINITAB). The goodness of fit of the equation to the available data may be determined using the following values and tests:

    R = Correlation coefficient, measures the strength of the relationship between two variables. The closer this value comes to 1, the greater the strength of the relationship between the DBH and the VE, and the better the equation represents said relationship.

    R^2 = Coefficient of determination, measures the goodness of fit of the equation used. The closer it comes to 1, the better the DBH functions as a variable with which to estimate the VE using the equation selected.

    F Test, determines whether the variable estimated with the equation (VE) has a normal variation or is influenced by the independent variable (DBH). If the calculated F value is greater than the F table value with a confidence interval of 99 %, it means the variability of the VE is highly influenced by the variability of the DBH.

    Residual analysis shows the distribution of the differences between the values estimated by the equation and the actual (measured) values. The closer these differences come to 0, the closer the estimated values come to the actual values, which shows that the equation produces good estimates.

R	R^2	F calculated	Residual dispersion
0.897	0.806	522.15	Good distribution

F table value for 99 % confidence interval = 4.69

The **R** value approaches 1, indicating that there is a strong correlation between the DBH and the exportable volume. This means a change in the DBH will automatically result in a change in the VE. It can be seen that the $\mathbf{R^2}$ value also approaches 1, meaning that the particular equation adequately expresses the correlation between the DBH and the VE. In other words, the value of VE estimated from the DBH is highly reliable.

If the calculated F value is greater than the F table value at the 99 % confidence interval, then the variability of the VE is strongly influenced by the variability of the DBH.

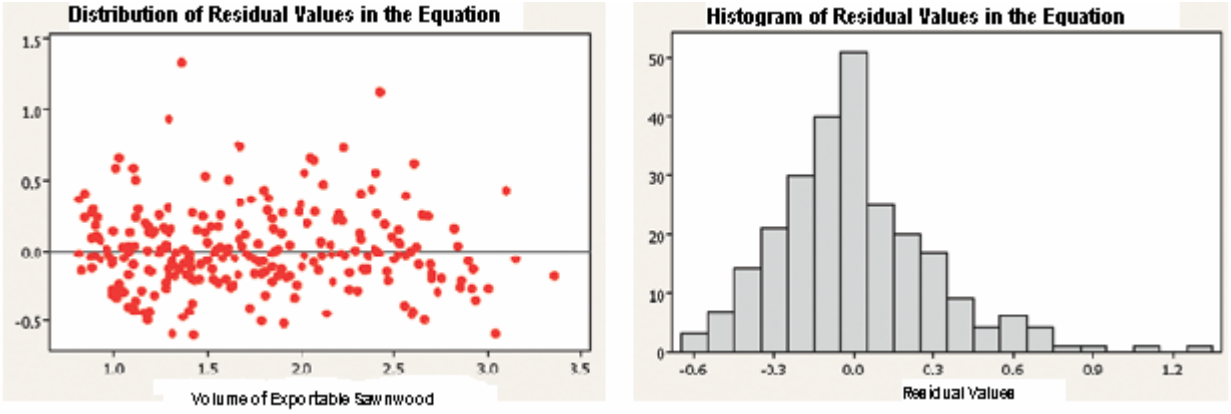


Figure 7. Distribution of residual values

Residual value = actual VE – VE estimated by the equation

It will be observed that the residual values are well distributed around zero. The histogram shows that the most frequent values are also concentrated around zero, once again demonstrating that the equation accurately predicts actual values. Graphing the two groups of values together allows us to observe objectively the goodness of fit between the values estimated by the equation and the real values.

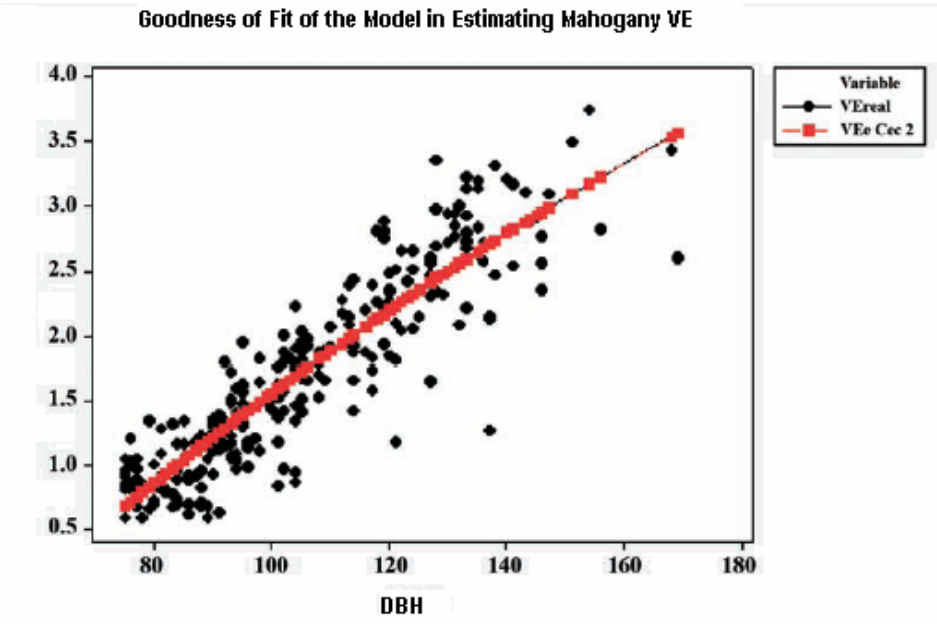


Figure 8. Goodness of fit of the model in estimating export volume

Figure 8 objectively demonstrates a good fit between the values estimated by the equation and the real (measured) values. Based on the results of these tests, we may conclude that the equation has a good fit with the observed values and we can therefore recommend its use in estimating the volume of exportable sawn wood based on the DBH. Consequently, based on these results and the regression analysis, this equation will be used to construct the volume table for determining exportable sawn wood volumes.

13. Development of the volume table for export grade mahogany sawn wood from the DBH using the selected equation (*)

    $VE = -2.4403 + 0.046383 * \mathbf{DBH} - 0.00006461 * \mathbf{DBH}^2$

Table 2. Volumetric table based on DBH

DBH (cm)	Volume (m^3) of export grade sawn wood per mahogany tree
75	0.675
80	0.857
85	1.035
90	1.211
95	1.383
100	1.552
105	1.718
110	1.880
115	2.039
120	2.195
125	2.348
130	2.498
135	2.644
140	2.787
145	2.927
150	3.063
155	3.197
160	3.327

Details of the calculation of these results will be found in the complete volume table in Annex 1.

(*) The equation selected for use will depend on the results of the analysis conducted in each country.

14. Estimating the average volume of export grade sawn wood per mahogany tree. The average is obtained by taking the average exportable volumes that was calculated in the preceding step by diameter class and the weighted average according to the proportion of trees in each diameter class.

Table 3. Volumetric table by diameter class

Diameter class	Percentage of population in each diameter class (taken from the AOP average)	Volume (m^3) of exportable sawn wood per mahogany tree
75 – 84	6.51	0.857
85 – 94	14.54	1.211
95 – 104	16.03	1.552
105 – 114	11.46	1.880
115 – 124	8.89	2.195
125 – 134	13.15	2.498
135 – 144	10.06	2.787
145 – 154	5.07	3.063
155 - +	14.28	3.327
Weighted average		2.131

As can be observed on the basis of the analysis of the data obtained from a total sample of 255 trees, the average volume of exportable wood per mahogany tree is 2.131 m^3. Such a national average will provide users with an immediate idea of the origin and legality of volumes of export grade sawn wood at management unit and national levels, based on the number of verified mahogany trees in the forest.

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Annex 1

VOLUME CONVERSION TABLE FOR MAHOGANY SAWN WOOD BASED ON THE DBH

$$VE = -2.4403 + 0.046383 * \mathbf{DBH} - 0.00006461 * \mathbf{DBH}^2$$

DBH (cm)	Volume (m^3) of export grade sawn wood per mahogany tree (VE)	DBH (cm)	Volume (m^3) of export grade sawn wood per mahogany tree (VE)
75	0.675	118	2.133
76	0.712	119	2.164
77	0.748	120	2.195
78	0.784	121	2.226
79	0.821	122	2.257
80	0.857	123	2.287
81	0.893	124	2.318
82	0.929	125	2.348
83	0.964	126	2.378
84	1.000	127	2.408
85	1.035	128	2.438
86	1.071	129	2.468
87	1.106	130	2.498
88	1.141	131	2.527
89	1.176	132	2.556
90	1.211	133	2.586
91	1.246	134	2.615
92	1.28	135	2.644
93	1.315	136	2.673
94	1.349	137	2.702
95	1.383	138	2.730
96	1.417	139	2.759
97	1.451	140	2.787
98	1.485	141	2.815
99	1.518	142	2.843
100	1.552	143	2.871
101	1.585	144	2.899
102	1.619	145	2.927
103	1.652	146	2.954
104	1.685	147	2.982
105	1.718	148	3.009
106	1.750	149	3.036
107	1.783	150	3.063
108	1.815	151	3.09
109	1.848	152	3.117
110	1.880	153	3.144
111	1.912	154	3.170
112	1.944	155	3.197
113	1.976	156	3.223
114	2.008	157	3.249

DBH (cm)	Volume (m^3) of export grade sawn wood per mahogany tree (VE)	DBH (cm)	Volume (m^3) of export grade sawn wood per mahogany tree (VE)
115	2.039	158	3.275
116	2.071	159	3.301
117	2.102	160	3.327

Annex 2

BASIC MAHOGANY DATA FOR PREPARATION OF VOLUME CONVERSION TABLES FOR EXPORTABLE SAWN WOOD

This table was constructed from field data taken by A.C. Sánchez (10) from mahogany trees harvested in Peru, defect indices determined by J. Grogan (6) and yield indices determined by W. Ccahuana (3)

1	2	3	4	5	6	7	8	9
No.	**DBH (cm)**	**MH (m)**	**Standing timber volume (m^3)**	**Gross roundwood volume (m^3)**	**Net roundwood volume (m^3)**	**Sawn wood volume (m^3)**	**Exportable sawn wood volume (m^3)**	**Volume conversion factor**
1	75	12	3.446	3.951	3.6769	1.6381	0.8191	0.2377
2	75	14	4.020	3.933	3.7051	1.6868	0.8434	0.2098
3	75	16	4.595	4.586	4.5146	2.0786	1.0393	0.2262
4	75	14	4.020	4.377	4.3427	1.9042	0.9521	0.2368
5	75	15	4.307	4.215	4.1433	1.9129	0.9564	0.2220
6	75	13	3.733	4.244	4.1382	1.8349	0.9175	0.2458
7	75	8	2.297	2.803	2.6099	1.1907	0.5953	0.2592
8	75	12	3.446	3.896	3.6684	1.6224	0.8112	0.2354
9	76	13	3.833	3.702	3.6851	1.6243	0.8122	0.2119
10	76	12	3.538	3.955	3.7396	1.6888	0.8444	0.2386
11	76	12	3.538	4.033	3.7564	1.6976	0.8488	0.2399
12	76	15	4.423	4.750	4.4787	2.0437	1.0219	0.2310
13	76	16.5	4.865	4.727	4.6740	2.0259	1.0129	0.2082
14	76	17	5.013	5.362	5.3475	2.4060	1.2030	0.2400
15	76	15	4.423	4.644	4.5529	2.0709	1.0355	0.2341
16	76	15	4.423	4.788	4.5079	2.0410	1.0205	0.2307
17	77	12	3.632	4.203	3.9093	1.7683	0.8842	0.2434
18	77	12	3.632	4.148	3.8983	1.6999	0.8499	0.2340
19	77	15	4.540	4.779	4.7485	2.0966	1.0483	0.2309
20	77	9	2.724	3.022	2.9531	1.3343	0.6671	0.2449
21	77	13	3.935	4.485	4.1751	1.9214	0.9607	0.2442
22	78	8	2.485	2.724	2.5598	1.1751	0.5875	0.2365
23	78	13	4.038	3.840	3.7723	1.7060	0.8530	0.2113
24	79	8	2.549	3.069	3.0491	1.3162	0.6581	0.2582
25	79	18	5.735	6.015	5.9069	2.6924	1.3462	0.2347
26	80	10	3.267	3.508	3.2597	1.4471	0.7236	0.2215
27	80	13	4.247	4.826	4.5260	2.0041	1.0020	0.2359
28	80	9	2.941	3.264	3.0702	1.3775	0.6887	0.2342
29	81	13	4.354	4.155	4.1207	1.8254	0.9127	0.2096
30	81	16	5.359	6.108	5.6781	2.5541	1.2771	0.2383
31	81	14	4.689	5.259	4.9201	2.1708	1.0854	0.2315
32	81	11	3.684	3.932	3.6945	1.6149	0.8075	0.2192
33	82	11	3.776	3.610	3.5614	1.5702	0.7851	0.2079
34	82	10	3.433	3.736	3.7090	1.6174	0.8087	0.2356
35	83	9	3.165	2.989	2.9483	1.3268	0.6634	0.2096
36	83	16	5.627	6.175	6.0588	2.6280	1.3140	0.2335
37	83	10	3.517	3.812	3.5528	1.5381	0.7690	0.2187
38	84	8	2.882	3.270	3.0812	1.3863	0.6932	0.2405

1	2	3	4	5	6	7	8	9
No.	**DBH (cm)**	**MH (m)**	**Standing timber volume (m³)**	**Gross roundwood volume (m³)**	**Net roundwood volume (m³)**	**Sawn wood volume (m³)**	**Exportable sawn wood volume (m³)**	**Volume conversion factor**
39	84	8	2.882	3.209	3.1907	1.4057	0.7029	0.2439
40	84	11	3.962	4.605	4.2940	1.8972	0.9486	0.2394
41	84	14	5.043	5.702	5.3368	2.3216	1.1608	0.2302
42	84	10	3.602	4.244	3.9888	1.7741	0.8871	0.2463
43	84	9.5	3.422	3.374	3.3109	1.4549	0.7274	0.2126
44	85	13	4.795	5.165	4.3944	2.1114	1.0557	0.2202
45	85	17	6.270	6.158	5.5475	2.6777	1.3388	0.2135
46	85	14	5.164	5.826	4.9836	2.3145	1.1572	0.2241
47	85	13	4.795	5.062	4.4662	2.0845	1.0422	0.2174
48	86	9	3.398	3.469	2.9846	1.3827	0.6913	0.2034
49	86	12	4.531	4.219	3.8720	1.8287	0.9143	0.2018
50	86	8	3.021	2.994	2.6287	1.2423	0.6212	0.2056
51	86	10	3.776	4.449	3.7946	1.7559	0.8780	0.2325
52	87	14	5.410	5.728	5.0903	2.3576	1.1788	0.2179
53	87	11	4.250	4.474	3.8343	1.8282	0.9141	0.2151
54	88	11	4.349	4.517	4.1027	1.9075	0.9538	0.2193
55	88	8.5	3.360	3.179	2.8245	1.3396	0.6698	0.1993
56	88	8	3.163	3.511	2.9993	1.4087	0.7043	0.2227
57	88	10	3.953	3.846	3.4614	1.6424	0.8212	0.2077
58	88	14	5.535	5.799	4.9696	2.3398	1.1699	0.2114
59	88	14	5.535	5.963	5.3113	2.4549	1.2275	0.2218
60	89	8	3.235	3.215	2.8239	1.3530	0.6765	0.2091
61	89	7	2.831	2.923	2.4757	1.1695	0.5847	0.2066
62	89	12	4.852	4.784	4.3489	2.0791	1.0395	0.2142
63	89	14	5.661	5.916	5.0703	2.3883	1.1941	0.2109
64	90	14	5.789	6.157	5.4031	2.5138	1.2569	0.2171
65	90	12	4.962	5.199	4.6675	2.2166	1.1083	0.2234
66	90	15	6.203	6.758	5.7432	2.7046	1.3523	0.2180
67	90	15	6.203	6.053	5.5156	2.6617	1.3309	0.2146
68	90	14	5.789	6.007	5.1543	2.4397	1.2199	0.2107
69	90	13	5.376	5.725	5.1217	2.3893	1.1947	0.2222
70	90	15.5	6.409	6.233	5.4732	2.6068	1.3034	0.2034
71	90	10	4.135	4.583	3.9092	1.8409	0.9205	0.2226
72	91	13	5.496	5.178	4.6658	2.2418	1.1209	0.2040
73	91	13	5.496	5.954	5.1084	2.4121	1.2061	0.2195
74	91	7	2.959	2.860	2.6221	1.2453	0.6226	0.2104
75	91	15	6.341	6.554	5.7996	2.7677	1.3839	0.2182
76	92	14	6.049	6.785	5.7459	2.6618	1.3309	0.2200
77	92	19	8.210	8.683	7.6203	3.5990	1.7995	0.2192
78	92	12	5.185	5.644	4.8768	2.3048	1.1524	0.2223
79	92	14	6.049	6.274	5.5701	2.5757	1.2879	0.2129
80	93	11	4.857	5.167	4.5642	2.1307	1.0654	0.2193
81	93	16	7.065	7.318	6.1967	2.9462	1.4731	0.2085
82	93	13	5.740	5.354	4.8061	2.3138	1.1569	0.2015
83	93	14	6.182	6.456	5.5470	2.6396	1.3198	0.2135

1	2	3	4	5	6	7	8	9
No.	**DBH (cm)**	**MH (m)**	**Standing timber volume (m³)**	**Gross roundwood volume (m³)**	**Net roundwood volume (m³)**	**Sawn wood volume (m³)**	**Exportable sawn wood volume (m³)**	**Volume conversion factor**
84	93	11	4.857	5.153	4.5208	2.0943	1.0472	0.2156
85	93	17	7.506	7.182	6.5063	3.0114	1.5057	0.2006
86	93	12	5.298	5.778	4.8945	2.3399	1.1699	0.2208
87	93	13	5.740	5.952	5.1981	2.4588	1.2294	0.2142
88	93	18	7.948	8.483	7.2768	3.4406	1.7203	0.2165
89	94	10	4.511	4.716	4.0988	1.9294	0.9647	0.2139
90	94	11	4.962	4.794	4.2403	2.0356	1.0178	0.2051
91	94	14	6.315	6.907	5.8699	2.7778	1.3889	0.2199
92	94	16	7.217	7.578	6.8565	3.1756	1.5878	0.2200
93	94	11	4.962	5.222	4.4889	2.0932	1.0466	0.2109
94	94	13	5.864	6.269	5.5480	2.6377	1.3189	0.2249
95	94	11	4.962	5.313	4.6613	2.1618	1.0809	0.2178
96	95	16.5	7.602	7.345	6.2084	3.1115	1.5557	0.2046
97	95	14.5	6.681	6.462	5.2979	2.5694	1.2847	0.1923
98	95	15	6.911	7.221	5.9749	2.9386	1.4693	0.2126
99	95	14	6.450	6.424	5.3719	2.6521	1.3261	0.2056
100	95	17.5	8.063	7.854	6.4392	3.2204	1.6102	0.1997
101	95	20	9.215	9.647	7.8805	3.8882	1.9441	0.2110
102	96	12	5.646	5.769	4.8141	2.3520	1.1760	0.2083
103	96	12	5.646	5.675	4.5652	2.2941	1.1471	0.2032
104	96	10	4.705	4.671	3.9179	1.9463	0.9731	0.2068
105	96	12	5.646	5.675	4.6896	2.2764	1.1382	0.2016
106	96	15	7.057	7.419	5.8297	2.8678	1.4339	0.2032
107	97	12	5.764	6.143	4.8372	2.3851	1.1926	0.2069
108	98	11	5.393	5.949	4.5950	2.2232	1.1116	0.2061
109	98	18	8.825	8.941	7.4711	3.6423	1.8211	0.2064
110	98	16	7.845	8.502	6.5926	3.2784	1.6392	0.2090
111	99	15	7.505	8.160	6.2438	3.0715	1.5357	0.2046
112	99	14	7.005	7.237	5.9068	2.9621	1.4811	0.2114
113	100	14	7.147	7.759	5.9452	2.9945	1.4973	0.2095
114	100	13	6.637	7.318	5.9037	2.8657	1.4329	0.2159
115	101	14	7.291	7.945	6.2292	3.0381	1.5191	0.2084
116	101	11	5.728	6.196	4.7409	2.3456	1.1728	0.2047
117	101	13	6.770	6.667	5.4463	2.7438	1.3719	0.2026
118	101	8	4.166	4.271	3.4378	1.6608	0.8304	0.1993
119	101	15	7.812	8.005	6.5335	3.2291	1.6145	0.2067
120	101	15	7.812	7.946	6.4733	3.1341	1.5670	0.2006
121	101	16	8.332	8.998	7.0450	3.5070	1.7535	0.2104
122	102	9	4.780	5.171	3.9678	1.9281	0.9640	0.2017
123	102	18	9.560	10.524	8.2784	4.0132	2.0066	0.2099
124	102	13	6.905	7.428	5.6837	2.8485	1.4242	0.2063
125	102	17	9.029	9.465	7.7042	3.7365	1.8682	0.2069
126	102	16	8.498	8.895	7.1694	3.6013	1.8007	0.2119
127	102	14	7.436	8.294	6.5050	3.1433	1.5716	0.2114
128	103	16	8.666	8.937	7.2942	3.6480	1.8240	0.2105

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129	104	8	4.417	4.439	3.7526	1.8909	0.9454	0.2140
130	104	13	7.178	7.393	5.9667	2.9151	1.4576	0.2031
131	104	19	10.491	11.057	9.0564	4.4560	2.2280	0.2124
132	104	15	8.282	8.629	7.2155	3.5086	1.7543	0.2118
133	104	16	8.835	9.015	7.1931	3.5672	1.7836	0.2019
134	104	16	8.835	8.826	6.9354	3.4845	1.7423	0.1972
135	104	12	6.626	6.751	5.4205	2.6728	1.3364	0.2017
136	104	16	8.835	8.258	6.8834	3.4027	1.7014	0.1926
137	104	17	9.387	8.974	7.0526	3.4531	1.7265	0.1839
138	104	7	3.865	4.361	3.4148	1.7110	0.8555	0.2213
139	104	18	9.939	9.280	7.6888	3.8041	1.9021	0.1914
140	105	13	7.317	7.111	5.2823	2.8137	1.4068	0.1923
141	105	16	9.005	9.180	6.7653	3.6171	1.8086	0.2008
142	105	18	10.131	10.290	7.7697	4.0530	2.0265	0.2000
143	105	18	10.131	9.907	7.3539	3.9079	1.9539	0.1929
144	105	17	9.568	9.648	7.1111	3.7341	1.8670	0.1951
145	105	14	7.880	7.597	5.6832	3.0093	1.5047	0.1910
146	105	15	8.443	8.574	6.2775	3.3432	1.6716	0.1980
147	106	17	9.751	10.165	7.5935	3.9603	1.9801	0.2031
148	106	17	9.751	10.149	7.4658	3.8490	1.9245	0.1974
149	106	15	8.604	8.539	6.1823	3.2964	1.6482	0.1916
150	108	13	7.741	7.845	5.8149	3.0418	1.5209	0.1965
151	108	16	9.527	9.766	7.4052	3.7353	1.8677	0.1960
152	108	15	8.932	9.243	7.0028	3.5522	1.7761	0.1989
153	108	14	8.336	8.675	6.5555	3.3886	1.6943	0.2032
154	109	14	8.491	8.633	6.1673	3.2929	1.6464	0.1939
155	109	16	9.705	9.808	7.0256	3.7592	1.8796	0.1937
156	110	18	11.119	11.047	8.1841	4.1317	2.0658	0.1858
157	110	16	9.883	10.407	7.4999	3.8138	1.9069	0.1929
158	112	18	11.527	11.336	8.3875	4.3471	2.1735	0.1886
159	112	18	11.527	12.051	8.6745	4.5405	2.2702	0.1970
160	113	15	9.778	10.287	7.5791	3.9599	1.9800	0.2025
161	113	16	10.430	10.798	8.0041	4.2837	2.1418	0.2054
162	113	18	11.734	11.957	9.0531	4.7747	2.3874	0.2035
163	113	16	10.430	10.870	8.1805	4.1616	2.0808	0.1995
164	114	11	7.298	7.630	5.5179	2.8459	1.4229	0.1950
165	114	14	9.288	9.464	7.0120	3.7535	1.8767	0.2021
166	114	13	8.625	8.557	6.3046	3.3106	1.6553	0.1919
167	114	15	9.952	10.023	7.6340	3.8508	1.9254	0.1935
168	114	19	12.606	12.680	9.3820	4.8723	2.4362	0.1933
169	116	16.5	11.335	11.598	8.1364	4.3938	2.1969	0.1938
170	116	15	10.304	9.605	6.7931	3.7347	1.8674	0.1812
171	117	18	12.579	12.200	8.6150	4.7807	2.3903	0.1900
172	117	13	9.085	8.797	6.2598	3.4678	1.7339	0.1909
173	117	14	9.784	9.562	6.7276	3.6711	1.8356	0.1876

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174	117	12	8.386	8.211	5.8332	3.1378	1.5689	0.1871
175	118	16.5	11.729	11.952	8.2227	4.5285	2.2642	0.1930
176	118	20.5	14.572	14.873	10.2327	5.5999	2.8000	0.1921
177	119	14	10.121	10.630	7.0940	3.8719	1.9359	0.1913
178	119	19	13.736	13.003	10.2777	5.6127	2.8064	0.2043
179	119	19.5	14.097	14.430	10.0912	5.5140	2.7570	0.1956
180	119	20	14.459	13.709	10.4793	5.7723	2.8862	0.1996
181	119	17	12.290	12.010	8.1405	4.3832	2.1916	0.1783
182	119	16	11.567	10.711	7.8847	4.3754	2.1877	0.1891
183	120	17	12.497	12.531	8.5716	4.7089	2.3545	0.1884
184	120	18	13.232	13.656	9.0857	4.9723	2.4861	0.1879
185	120	16	11.762	12.133	8.4227	4.5174	2.2587	0.1920
186	120	18	13.232	12.769	8.9897	4.9584	2.4792	0.1874
187	120	14	10.292	9.997	6.7584	3.6936	1.8468	0.1794
188	120	16.5	12.130	12.375	8.7131	4.6686	2.3343	0.1924
189	121	13	9.717	9.751	6.5244	3.6192	1.8096	0.1862
190	121	8	5.979	6.265	4.2580	2.3571	1.1785	0.1971
191	121	15	11.212	10.991	7.8260	4.1966	2.0983	0.1872
192	121	18	13.454	13.719	9.3560	5.0210	2.5105	0.1866
193	122	14	10.638	11.151	7.4024	4.0736	2.0368	0.1915
194	122	19	14.437	13.915	9.6542	5.2996	2.6498	0.1835
195	123	17	13.130	12.808	9.0156	4.8440	2.4220	0.1845
196	124	14	10.989	11.006	7.5595	4.1061	2.0530	0.1868
197	124	16.5	12.952	13.253	9.1615	5.0205	2.5102	0.1938
198	124	18	14.129	13.556	9.5334	5.2893	2.6447	0.1872
199	124	17	13.344	13.923	9.3842	5.0272	2.5136	0.1884
200	125	15	11.965	12.017	7.6361	4.3000	2.1500	0.1797
201	127	11.5	9.469	8.666	5.6375	3.3142	1.6571	0.1750
202	127	16	13.174	12.426	7.8699	4.5886	2.2943	0.1742
203	127	11	9.057	9.453	5.7892	3.2740	1.6370	0.1807
204	127	18	14.821	14.137	8.9848	5.1236	2.5618	0.1728
205	127	17	13.998	13.588	8.8216	4.9305	2.4653	0.1761
206	127	18	14.821	13.619	8.7833	5.1507	2.5754	0.1738
207	127	18	14.821	13.907	8.8271	5.1867	2.5933	0.1750
208	127	18	14.821	14.990	9.1875	5.1206	2.5603	0.1727
209	128	18	15.056	14.925	9.4023	5.3735	2.6868	0.1785
210	128	17	14.219	13.387	8.7706	4.9140	2.4570	0.1728
211	128	22	18.401	16.648	11.6344	6.7005	3.3503	0.1821
212	128	16	13.383	13.483	8.2957	4.6827	2.3414	0.1750
213	128	20	16.728	15.389	10.3069	5.9490	2.9745	0.1778
214	129	15	12.743	13.537	8.2970	4.6373	2.3187	0.1820
215	130	18	15.530	14.423	9.5138	5.4393	2.7196	0.1751
216	130	19	16.392	15.453	10.1351	5.8658	2.9329	0.1789
217	131	19	16.646	15.129	9.9688	5.8596	2.9298	0.1760
218	131	17.5	15.331	15.595	10.0327	5.6896	2.8448	0.1856

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219	131	18	15.770	15.593	9.9326	5.5348	2.7674	0.1755
220	132	14	12.453	11.089	7.1708	4.1494	2.0747	0.1666
221	132	19	16.901	15.848	10.3249	6.0071	3.0035	0.1777
222	133	14	12.643	12.026	7.6077	4.4158	2.2079	0.1746
223	133	20	18.061	18.255	11.1943	6.2496	3.1248	0.1730
224	133	17	15.352	15.880	9.7330	5.5932	2.7966	0.1822
225	133	20	18.061	17.636	11.5542	6.4530	3.2265	0.1786
226	133	17	15.352	14.586	9.4698	5.4529	2.7265	0.1776
227	133	17	15.352	14.818	9.4220	5.3443	2.6721	0.1741
228	133	17	15.352	15.531	9.6604	5.4399	2.7200	0.1772
229	133	17.5	15.803	16.039	10.1138	5.8396	2.9198	0.1848
230	135	18	16.747	15.480	9.5418	5.6637	2.8319	0.1691
231	135	17	15.817	14.560	8.8127	5.2614	2.6307	0.1663
232	135	20	18.608	17.323	10.6386	6.4018	3.2009	0.1720
233	135	20	18.608	17.105	10.4297	6.2673	3.1337	0.1684
234	136	15	14.164	14.547	8.6398	5.1573	2.5787	0.1821
235	136	17	16.052	15.234	9.0994	5.4422	2.7211	0.1695
236	137	14	13.414	11.933	7.1538	4.2876	2.1438	0.1598
237	137	14	13.414	12.326	7.1724	4.2498	2.1249	0.1584
238	137	7.5	7.186	7.364	4.2155	2.5389	1.2695	0.1766
239	138	20	19.444	18.390	11.0805	6.6142	3.3071	0.1701
240	138	15	14.583	13.446	8.2730	4.9305	2.4653	0.1690
241	140	19	19.011	17.443	10.5345	6.4122	3.2061	0.1686
242	141	19	19.284	18.149	10.5668	6.3498	3.1749	0.1646
243	141	14.5	14.717	14.923	8.5593	5.0733	2.5366	0.1724
244	143	17.5	18.269	18.773	10.5488	6.2160	3.1080	0.1701
245	144	16	16.937	16.070	9.7446	5.7318	2.8659	0.1692
246	145	17	18.247	17.103	9.3907	5.8185	2.9093	0.1594
247	146	14	15.235	14.557	7.5712	4.6935	2.3468	0.1540
248	146	15	16.323	15.749	8.3567	5.1296	2.5648	0.1571
249	146	15.5	16.867	17.348	9.0423	5.5334	2.7667	0.1640
250	147	18	19.857	18.366	9.8217	6.1722	3.0861	0.1554
251	151	20	23.280	20.655	11.4272	6.9976	3.4988	0.1503
252	154	21	25.425	22.425	12.2670	7.4861	3.7430	0.1472
253	156	14	17.393	17.499	8.9404	5.6400	2.8200	0.1621
254	168	16	23.054	21.017	10.4485	6.8601	3.4301	0.1488
255	169	12	17.497	15.386	8.0448	5.2025	2.6013	0.1487