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GOB/WB

**Forest Resources Management Project
Technical Assistance Component**



**Final Report: Forest Inventory
of the Natural Forest and Forest Plantations
(SYLHET Forest Division)**

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Tree Volume Equations Used in FDPP

Hereunder are the tree volume equations used in the Field Data Processing Program. These include the new equations for Akashmoni (*Acacia auriculiformis*) based on 219 observations with DBH data range from 3.9 to 32.8 cm, Mangium (*Acacia mangium*) based on 272 observations with DBH data range from 4.9 to 45.3 cm, and *Eucalyptus camaldulensis* with 550 observations with DBH range from 2.7 to 3.6cm. These new studies were done in collaboration with BFRI Researchers. The new equations were derived using a system of four simple (combined variable model) equations in each case. The equations provide consistent and very accurate tree volumes for the whole range of diameter classes for each of the three species.

The tree volume equations below also include the corrected equations for plantations of Dhakijam (*Syzygium grande*), Gamar (*Gmelina arborea*), Chapalish (*Artocarpus chapasha*) and Teligarjan (*Dipterocarpus turbinatus*) as well as Civit (*Swintonia floribunda*) and Bahera (*Terminalia belerica*) in natural stands.

Species		Species Code	Volume Equations and Conversion Factors
1.	Akashmoni (<i>Acacia auriculiformis</i>); Plantation	106	$V_{tob} = 0.000043645*(D-3)^2*H$ $V_{tub} = 0.85342*V_{tob}$ $V_{sub} = 0.99416*V_{tub}$ $V_{10ub} = 0.89330*V_{sub}$
2.	Mangium (<i>A. mangium</i>); Plantation	145	$V_{tob} = 0.000038834*(D-3)^2*H$ $V_{tub} = 0.85018*V_{tob}$ $V_{sub} = 0.99945*V_{tub}$ $V_{10ub} = 0.99970*V_{sub}$
3.	Minjiri (<i>Cassia siamea</i>); Plantation	146	$\ln(V_{sub}) = -10.1767 + 2.0642 \ln D + 0.8291 \ln H$
4.	Pine (<i>Pinus carribea</i>); Plantation	152	$\ln(V_{sub}) = -9.7505 + 1.9354 \ln D + 0.8517 \ln H$
5.	Gamar (<i>Gmelina arborea</i>); Plantation	126	$\ln V_{tob} = -8.46871 + 1.63502 * \ln D + 0.78487 * \ln H$ $F_{tub} = 0.74986 + 0.0031724 * D - 0.000024319 * D^2$ $F_{sub} = 1/(1.00001 + 0.93292 * e^{(-0.1894 * D)})$ $F_{10ub} = 0.99337 - 2.77683 * e^{(-0.14116 * D)}$ $F_{20ub} = 0.91606 * (1 - e^{(-0.20480 * D)})^{186.5}$
6.	Dhakijam (<i>Syzygium grande</i>); Plantation	122	$V_{tob} = 0.00018987 + 0.000029903 * D^2 + 0.00024887 * D * H + 0.000024466 * D^2 * H$ $F_{tub} = D / (-0.23531 + 1.28175 * D - 0.0028786 * D^2)$ $F_{sub} = 0.99798 * (1 - e^{(-0.30202 * D)})^{1.71151}$ $F_{10ub} = 0.98404 * (1 - e^{(-0.24184 * D)})^{16.65}$ $F_{20ub} = 0.94094 * (1 - e^{(-0.17372 * D)})^{66.244}$

7.	TeliGarjan (<i>Dipterocarpus turbinatus</i>); Plantation	108	$V_{tob} = 0.0025211 + 0.00010003 * D^2 + 0.00014779 * D * H + 0.000024065 * D^2 * H$ $F_{tub} = 0.75496 + 0.0030279 * D - 0.000019510 * D^2)$ $F_{5ub} = 0.99938 - 167.707 * D^{(-3.4686)}$ $F_{10ub} = 0.98176 * (1 - e^{(-0.35582 * D)})^{69.509}$ $F_{20ub} = 0.92806 * (1 - e^{(-0.27813 * D)})^{1156.116}$ Note: For DBH > 75 cm, use factor for DBH = 75 cm in all cases
8.	Chapalish (<i>Artocarpus chapasha</i>); Plantation	117	$\ln(V_{tob}) = -8.94495 + 1.82851 * \ln(D) + 0.73538 * \ln(H)$ $F_{tub} = 0.76539 + 0.0035766 * D - 0.000032305 * D^2; \text{ if } D > 50, F_{tub} = 0.864$ $F_{5ub} = 0.99939 - (72.8549 * D)^{(-3.14844)}$ $F_{10ub} = 0.99400 - (1556.2135 * D)^{(-3.23157)}$ $F_{20ub} = 0.92197 * (1 - e^{(-0.26753 * D)})^{604.5896}$
9.	Civit (<i>Swintonia floribunda</i>); Plantation	102	IF $D^2 H < 1200$, $V_{20ub} = 0.01059 + 0.00002887 D^2 H$ IF $D^2 H \geq 1200$, $V_{20ub} = 0.09790 + 0.00002499 D^2 H$
10.	Teak (<i>Tectona grandis</i>) Plantation	159	$\ln V_{Tob} = -9.4808 + 1.6212 \ln D + 1.1648 \ln H$ $V_{Sub} = 0.1217 + 0.2257 D^2 H$ $V_{10ub} = 0.0000465 D^{1.58} H^{1.601} (?)$ $V_{20ub} = 0.0645 + 0.2322 D^2 H$
11.	Eucalyptus <i>camaldulensis</i> ; Plantation	125	$V_{tob} = 0.000042692 * (D-3)^2 * H$ $V_{tub} = 0.83847 * V_{tob}$ $V_{5ub} = 0.95916 * V_{tub}$ $V_{10ub} = 0.89239 * V_{5ub}$
12.	Molluccana (<i>Paraserianthes falcataria</i>); Plantation	147	$\ln V_{tob} = -8.9942 + 1.4963 \ln D + 1.1461 \ln H$ $F_{tub} = 0.9130 - 0.6636 e^{-0.3401 D}$ $F_{5ub} = 0.9352 (1 - e^{-0.2742 D})^{244.88}$ $F_{20ub} = 0.9329 (1 - e^{-0.2313 D})^{502.64}$
13.	Kcora (<i>Sonneratia apetala</i>); Plantation	221	<u>Nonkhali/Bhola/Patunkhali</u> $V_{7ub} = 0.0041 + 0.00002463 D^2 H$ <u>Chittagong C/A</u> $V_{7ub} = -0.00088 + 0.0000297 D^2 H$
14.	Baen (<i>Avicenia officinalis</i>); Plantation	203	$V_{7ub} = -0.0012 + 0.00002580 D^2 H$

Natural Forests: Total volume, outside bark, excluding branches

15.	Pitraj (<i>Aphanamixis polystachya</i>)	154	$\ln V = -8.9863 + 1.9328 \ln D + 0.6992 \ln H$ $F_{vub} = 0.655 + 0.007937 D - 0.00005847 D^2$ if $D \leq 68\text{cm}$ otherwise $F_{vub}=0.924$ $F_{v10} = 1.0001 - 24.8498 D^{-2.4467}$ $F_{v20} = 0.9945 - 1.9156 e^{-0.09406 D}$
16.	Chapalish (<i>Artocarpus chapasha</i>)	117	$\ln V = -8.6639 + 2.1320 \ln D + 0.2946 \ln H$ (?) $F_{vub} = 0.9849 - 3.8652 D^{-0.9334}$ $F_{v10} = 1.0$ $F_{v20} = 1 / (1.000084 + 0.6980 e^{-0.05446 D})$
17.	Simul (<i>Bombax ceiba</i>)	162	$\ln V = -9.1013 + 1.9419 \ln D + 0.5276 \ln H$ (?) $F_{vub} = 0.9440 - 7.1054 D^{-1.1609}$ $F_{v10} = 1.0$ $F_{v20} = 0.9984 - 89452.6 D^{-3.865}$

18.	Garjan (NF) (<i>Dipterocarpus spp.</i>)	108	$\ln V = -9.1872 + 1.6485 \ln D + 1.1306 \ln H$ $F_{vub} = 0.8994 - 0.0004973 + 0.000006729D^2$ $F_{v10} = 1/(0.9997 + 0.1012e^{-0.06447D})$ $F_{v20} = 1.0002 - 1609.2425D^{-2.7472}$
19.	Dhali Garjan (<i>Dipterocarpus gracilis</i>)	168	$\ln V = -9.4406 + 1.8660 \ln D + 0.9648 \ln H$ $F_{vub} = 0.8493 + 0.001308D - 0.000007031D^2$ if $D \leq 92\text{cm}$ otherwise, $F_{vub} = 0.910$ $F_{v10} = 1.000 - 0.03310e^{-0.05676D}$ $F_{v20} = 0.9975 - 0.1477e^{-0.06433D}$
20.	Baita Garjan (<i>Dipterocarpus costatus</i>)	169	$\ln V = -9.1693 + 1.7651 \ln D + 1.0011 \ln H$ $F_{vub} = 0.9115 - 0.2543e^{-0.03883D}$ $F_{v10} = 1.0$ $F_{v20} = 0.9978 - 1.0016e^{-0.07374D}$
21.	Teli Garjan (<i>Dipterocarpus turbinatus</i>)	170	$\ln V = -9.1872 + 1.6485 \ln D + 1.1306 \ln H$ $F_{vub} = 0.8994 - 0.0004973 + 0.000006729D^2$ $F_{v10} = 1/(0.9997 + 0.1012e^{-0.06447D})$ $F_{v20} = 1.0002 - 1609.2425D^{-2.7472}$
22.	Banderholia (<i>Duabanga grandiflora</i>)	109	$V = -0.5127 + 0.0004129D^2 + 0.001298H + 0.0000247D^2H$ $F_{vub} = 0.8116 + 0.001650D - 0.000004651D^2$ if $D \leq 178\text{cm}$, otherwise $F_{vub} = 0.958$ $F_{v10} = 1.0$ $F_{v20} = 0.9986 + 0.9808e^{-0.07870D}$
23.	Uriam (<i>Mangifera sylvatica</i>)	167	$\ln V = -8.9048 + 2.0808 \ln D + 0.6926 \ln H$ $F_{vub} = 0.9556 - 16.5862D^{-1.4465}$ $F_{v10} = 1.0008 - 0.01859e^{-0.03721D}$ $F_{v20} = 0.9960 - 1.9569e^{-0.09610D}$
24.	Bonak (<i>Schima wallichii</i>)	114	$V = 0.05978 - 0.00003151D^2 + 0.01648H + 0.00002781D^2H$ $F_{vub} = 1/(1.1935 + 0.3931e^{-0.04512D})$ $F_{v10} = 1.0005 - 0.02896e^{-0.000531D}$ $F_{v20} = 1.0050 - 0.4304e^{-0.03969D}$
25.	Civit (<i>Swintonia floribunda</i>)	102	$\ln V = -8.8621 + 1.8148 \ln D + 0.8280 \ln H$ $F_{vub} = 0.8245 + 0.002289D - 0.00001045D^2$, if $D \leq 109$ otherwise $F_{vub} = 0.958$ $F_{v10} = 0.9997 - (2634.8723D)^{-0.3637}$ $F_{v20} = 1.004114 - 216.8436D^{-2.2260}$
26.	Dhakijam (<i>Syzygium grande</i>)	122	$V = 0.08566 + 0.0002378D^2 + 0.01194H + 0.00002365D^2H$ $F_{vub} = 1/(1.0740 + 0.2996e^{-0.03586D})$ $F_{v10} = 1.0$ $F_{v20} = 1/(1.003997 + 1.5662e^{-0.08216D})$
27.	Bahera (<i>Terminalia belerica</i>)	107	$\ln V = -8.3245 + 1.7826 \ln D + 0.6257 \ln H$ $F_{vub} = 1.0$ $F_{v10} = 1.0$ $F_{v20} = 0.9998 - 0.5266e^{-0.05224D}$
28.	Chundul (<i>Tetrameles nudiflora</i>)	121	$\ln V = -8.4925 + 1.8522 \ln D + 0.6879 \ln H$ $F_{vub} = 0.8316 + 0.002165D - 0.00001211D^2$, if $D \leq 89$, otherwise, $F_{vub} = 0.928$ $F_{v10} = 1.0$ $F_{v20} = 1/(0.9986 + 0.3712e^{-0.04786D})$
29.	Mixed species	199	$\ln V = -8.3367 + 1.5932 \ln D + 0.9400 \ln H$ $F_{vub} = 0.8401 + 0.002192D - 0.00001404D^2$, if $D \leq 80$, otherwise, $F_{vub} = 0.926$ $F_{v10} = 0.9899 + 0.0001877D - 0.0000008710D^2$, if $D \leq 110$, otherwise, $F_{vub} = 1.0$ $F_{v20} = 0.8438 + 0.003104D - 0.00001553D^2$, if $D \leq 100$, otherwise, $F_{vub} = 0.999$