RFRI Report 4

Duabanga grandiflora
Volume, Biomass and Carbon Tables for Meghalaya



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Photograph: *Duabanga grandiflora*

Duabanga grandiflora (Roxb. Ex DC.) Walp.

Volume, Biomass and Carbon Tables for Meghalaya

Introduction

Duabanga grandiflora is an evergreen tree growing up to 30 m tall with occasional specimens up to 40 m. The genus name *Duabanga* was coined by Francis Hamilton from the Bengali name, *Duyabanga*. In Meghalaya it is known as Dieng moloi or Diengbai. The trunk is erect and undivided with buttresses as support structures. The branches are long, slender, spreading, drooping from the trunk; loosely covered with large spreading leaves. The leaves are oppositely arranged, red when young, horizontal in two rows, one on each side of the branch, oblong in shape, shining above; dull beneath, over 25 cm long and 10 cm broad. Flowers are in panicles in leaf axils and at the end of branches. Each flower is 5-6 cm large, white in colour and ill-smelling. The fruit is rounded, leathery and capsule shaped.

Distribution

D. grandiflora is native to Cambodia, India, Laos, Malaysia, Myanmar, Thailand, and Vietnam, found in evergreen forests between 900-1500 m elevation. It is found in open forests, adjacent to river banks and in valleys. In India it is found in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Andaman Islands. In Meghalaya it is found between 800 and 1000 m above msl.

Uses of the tree

The heartwood of *D. grandiflora* is light yellow to light brown with light yellowish streaks; it is not demarcated from the sapwood. The texture is coarse and the grain is straight or interlocked. The wood is soft and light in weight, being susceptible to fungi, dry wood borers and termite attack. It seasons rapidly with only a slight risk of checking or distortion, however; the dry wood is moderately stable in service (Hoang et al. 2004). The wood is used for timber especially interior construction, preparation of furniture components, veneer, boxes, crates, tea boxes, block board, fibre boards and pulp The fruits are edible but sour. Timber is used for housing in Assam. (Lemmens et al., 1995; Haining et al. 2007).

Need for volume, biomass and carbon tables

Volume tables are used to estimate the quantity of wood/timber contained in the forest or plantation in terms of merchantable timber yield. The volume of trees is calculated either after felling the tree or in the standing form. For volume estimation of standing trees, mathematical models developed through multiple regression analyses are the most suitable methods which avoid felling of trees or destructive approach for volume, biomass and carbon stock estimation in the forest ecosystems. Once developed the volume and biomass tables can be used either by the owners of the tree or the buyer to decide on the value. The carbon tables are useful, if the trees are raised as a part of any project involving carbon trading. In Meghalaya, *D. grandiflora* is available in the forests owned by the Government as well as the communities, and used for different purposes. Therefore, a need was felt for volume, biomass and carbon tables of this species in Meghalaya.

Methodology (non destructive method)

The following parameters were recorded for development of volume/biomass equations

1. Girth at breast height (GBH) at 1.37 m above ground level for each individual tree was measured using measuring tape and converted into diameter at breast height (DBH) using the following formula:

   $$(\text{DBH}) = \frac{\text{Girth at 1.37 m above ground}}{3.14}$$

2. Girth at the base of trees were measured and converted into basal diameter.

   $$\text{Basal diameter} = \frac{\text{Girth at the base of tree}}{3.14}$$

Height of each individual tree was measured using **Nikon 550A Laser Range Finder**.

Diameter at each end point and at the centre portion of frustum (smaller logs) was measured in standing trees using **Haglof Mantax Black Calliper with Gator Eyes** and the height of the lower and upper ends of the frustum were measured using Nikon 550A Laser range finder, to arrive at the centre of frustum. Stem volume (m^3) of *D. grandiflora* was estimated using diameter class wise regression models developed in this study. The stem volume was

converted into biomass (kg/tree) using wood specific gravity (0.382 gm/cm^3) for preparation of regional biomass tables. The stem biomass was further converted into carbon content multiplying with 0.5 to prepare carbon tables (kg/tree).

Utilization of volume, biomass and carbon tables

Stem volume tables were prepared considering height and DBH as an independent variables and volume as a dependent variable in the form of ($V=d^2h$). Volume tables were also prepared using tree DBH as a single independent variable in the form of ($V=d^2$). The regional volume tables prepared for three diameter classes *viz.,* 10-30, 31-50 and >50 cm can be used by the Researchers, Academicians, Forest Officials and Farmers to estimate volume of standing trees for timber extraction from forest areas and community owned plantations (Table 1-3). Table 4-9 shows biomass and carbon values (kg/tree) of particular diameter and height classes (having diameter class interval of 1 cm and height class interval of 1 m). Table 10-11 shows the volume, biomass and carbon content estimated using regression models in the form of ($V=d^2$). The regional yield, carbon tables and best fit regression models can be used for forest biomass and carbon sequestration studies as well as developing projects under REDD+ activities, Clean Development Mechanism (CDM) and National Green House Gas inventories.

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Table 1 Volume table (m^3) for *Duabanga grandiflora* (10-30 cm diameter class)

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	0.035	0.038	0.042	0.045	0.048	0.051	0.054	0.058	0.061	0.064	0.067	0.070	0.074	0.077	0.080
11	0.043	0.046	0.050	0.054	0.058	0.062	0.066	0.070	0.074	0.077	0.081	0.085	0.089	0.093	0.097
12	0.051	0.055	0.060	0.065	0.069	0.074	0.078	0.083	0.088	0.092	0.097	0.101	0.106	0.111	0.115
13	0.059	0.065	0.070	0.076	0.081	0.087	0.092	0.097	0.103	0.108	0.114	0.119	0.124	0.130	0.135
14	0.069	0.075	0.082	0.088	0.094	0.100	0.107	0.113	0.119	0.125	0.132	0.138	0.144	0.151	0.157
15	0.079	0.086	0.094	0.101	0.108	0.115	0.122	0.130	0.137	0.144	0.151	0.158	0.166	0.173	0.180
16	0.090	0.098	0.106	0.115	0.123	0.131	0.139	0.147	0.156	0.164	0.172	0.180	0.188	0.197	0.205
17	0.102	0.111	0.120	0.129	0.139	0.148	0.157	0.166	0.176	0.185	0.194	0.203	0.213	0.222	0.231
18	0.114	0.124	0.135	0.145	0.156	0.166	0.176	0.187	0.197	0.207	0.218	0.228	0.238	0.249	0.259
19	0.127	0.139	0.150	0.162	0.173	0.185	0.196	0.208	0.219	0.231	0.243	0.254	0.266	0.277	0.289
20	0.141	0.154	0.166	0.179	0.192	0.205	0.218	0.230	0.243	0.256	0.269	0.282	0.294	0.307	0.320
21	0.155	0.169	0.183	0.198	0.212	0.226	0.240	0.254	0.268	0.282	0.296	0.310	0.325	0.339	0.353
22	0.170	0.186	0.201	0.217	0.232	0.248	0.263	0.279	0.294	0.310	0.325	0.341	0.356	0.372	0.387
23	0.186	0.203	0.220	0.237	0.254	0.271	0.288	0.305	0.322	0.339	0.355	0.372	0.389	0.406	0.423
24	0.203	0.221	0.240	0.258	0.276	0.295	0.313	0.332	0.350	0.369	0.387	0.406	0.424	0.442	0.461
25	0.220	0.240	0.260	0.280	0.300	0.320	0.340	0.360	0.380	0.400	0.420	0.440	0.460	0.480	0.500
26	0.238	0.260	0.281	0.303	0.324	0.346	0.368	0.389	0.411	0.433	0.454	0.476	0.498	0.519	0.541
27	0.257	0.280	0.303	0.327	0.350	0.373	0.397	0.420	0.443	0.467	0.490	0.513	0.537	0.560	0.583
28	0.276	0.301	0.326	0.351	0.376	0.401	0.426	0.452	0.477	0.502	0.527	0.552	0.577	0.602	0.627
29	0.296	0.323	0.350	0.377	0.404	0.431	0.458	0.484	0.511	0.538	0.565	0.592	0.619	0.646	0.673
30	0.317	0.346	0.374	0.403	0.432	0.461	0.490	0.518	0.547	0.576	0.605	0.634	0.662	0.691	0.720

(The values which are in darker region are within the range of observed data)

Table 2: Volume table for *Duabanga grandiflora* (31-50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	0.473	0.504	0.536	0.567	0.599	0.630	0.662	0.693	0.725	0.756	0.788	0.820	0.851	0.883	0.914	0.946
32	0.504	0.537	0.571	0.605	0.638	0.672	0.705	0.739	0.773	0.806	0.840	0.873	0.907	0.940	0.974	1.008
33	0.536	0.572	0.607	0.643	0.679	0.714	0.750	0.786	0.822	0.857	0.893	0.929	0.964	1.000	1.036	1.072
34	0.569	0.607	0.645	0.683	0.720	0.758	0.796	0.834	0.872	0.910	0.948	0.986	1.024	1.062	1.100	1.138
35	0.603	0.643	0.683	0.723	0.763	0.804	0.844	0.884	0.924	0.964	1.005	1.045	1.085	1.125	1.165	1.205
36	0.638	0.680	0.723	0.765	0.808	0.850	0.893	0.935	0.978	1.020	1.063	1.105	1.148	1.190	1.233	1.275
37	0.674	0.718	0.763	0.808	0.853	0.898	0.943	0.988	1.033	1.078	1.123	1.167	1.212	1.257	1.302	1.347
38	0.710	0.758	0.805	0.853	0.900	0.947	0.995	1.042	1.089	1.137	1.184	1.231	1.279	1.326	1.374	1.421
39	0.748	0.798	0.848	0.898	0.948	0.998	1.048	1.098	1.147	1.197	1.247	1.297	1.347	1.397	1.447	1.497
40	0.787	0.840	0.892	0.945	0.997	1.050	1.102	1.155	1.207	1.260	1.312	1.364	1.417	1.469	1.522	1.574
41	0.827	0.882	0.937	0.992	1.048	1.103	1.158	1.213	1.268	1.323	1.378	1.434	1.489	1.544	1.599	1.654
42	0.868	0.926	0.984	1.041	1.099	1.157	1.215	1.273	1.331	1.389	1.446	1.504	1.562	1.620	1.678	1.736
43	0.910	0.970	1.031	1.092	1.152	1.213	1.274	1.334	1.395	1.456	1.516	1.577	1.637	1.698	1.759	1.819
44	0.953	1.016	1.080	1.143	1.207	1.270	1.334	1.397	1.461	1.524	1.588	1.651	1.715	1.778	1.842	1.905
45	0.996	1.063	1.129	1.196	1.262	1.328	1.395	1.461	1.528	1.594	1.661	1.727	1.793	1.860	1.926	1.993
46	1.041	1.110	1.180	1.249	1.319	1.388	1.458	1.527	1.596	1.666	1.735	1.805	1.874	1.943	2.013	2.082
47	1.087	1.159	1.232	1.304	1.377	1.449	1.522	1.594	1.666	1.739	1.811	1.884	1.956	2.029	2.101	2.174
48	1.134	1.209	1.285	1.360	1.436	1.511	1.587	1.663	1.738	1.814	1.889	1.965	2.040	2.116	2.192	2.267
49	1.181	1.260	1.339	1.418	1.496	1.575	1.654	1.733	1.811	1.890	1.969	2.048	2.126	2.205	2.284	2.363
50	1.230	1.312	1.394	1.476	1.558	1.640	1.722	1.804	1.886	1.968	2.050	2.132	2.214	2.296	2.378	2.460

(The values which are in darker region are within the range of observed data)

Table 3: Volume table for *Duabanga grandiflora* (>50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	1.116	1.190	1.265	1.339	1.413	1.488	1.562	1.637	1.711	1.785	1.860	1.934	2.008	2.083	2.157	2.232	2.306	2.380	2.455	2.529	2.604
52	1.160	1.237	1.315	1.392	1.469	1.547	1.624	1.701	1.779	1.856	1.933	2.011	2.088	2.165	2.243	2.320	2.397	2.475	2.552	2.629	2.707
53	1.205	1.285	1.366	1.446	1.526	1.607	1.687	1.767	1.848	1.928	2.008	2.089	2.169	2.249	2.330	2.410	2.490	2.571	2.651	2.731	2.812
54	1.251	1.334	1.418	1.501	1.585	1.668	1.751	1.835	1.918	2.002	2.085	2.168	2.252	2.335	2.419	2.502	2.585	2.669	2.752	2.836	2.919
55	1.298	1.384	1.471	1.557	1.644	1.730	1.817	1.903	1.990	2.076	2.163	2.249	2.336	2.422	2.509	2.595	2.682	2.768	2.855	2.942	3.028
56	1.345	1.435	1.525	1.614	1.704	1.794	1.883	1.973	2.063	2.153	2.242	2.332	2.422	2.511	2.601	2.691	2.780	2.870	2.960	3.049	3.139
57	1.394	1.487	1.580	1.673	1.766	1.858	1.951	2.044	2.137	2.230	2.323	2.416	2.509	2.602	2.695	2.788	2.881	2.973	3.066	3.159	3.252
58	1.443	1.539	1.636	1.732	1.828	1.924	2.020	2.117	2.213	2.309	2.405	2.501	2.598	2.694	2.790	2.886	2.983	3.079	3.175	3.271	3.367
59	1.493	1.593	1.692	1.792	1.892	1.991	2.091	2.190	2.290	2.389	2.489	2.588	2.688	2.788	2.887	2.987	3.086	3.186	3.285	3.385	3.484
60	1.544	1.647	1.750	1.853	1.956	2.059	2.162	2.265	2.368	2.471	2.574	2.677	2.780	2.883	2.986	3.089	3.192	3.295	3.398	3.501	3.604
61	1.596	1.703	1.809	1.916	2.022	2.128	2.235	2.341	2.448	2.554	2.661	2.767	2.873	2.980	3.086	3.193	3.299	3.405	3.512	3.618	3.725
62	1.649	1.759	1.869	1.979	2.089	2.199	2.309	2.419	2.529	2.639	2.748	2.858	2.968	3.078	3.188	3.298	3.408	3.518	3.628	3.738	3.848
63	1.703	1.816	1.930	2.043	2.157	2.270	2.384	2.497	2.611	2.724	2.838	2.951	3.065	3.178	3.292	3.405	3.519	3.632	3.746	3.859	3.973
64	1.757	1.874	1.991	2.109	2.226	2.343	2.460	2.577	2.694	2.811	2.929	3.046	3.163	3.280	3.397	3.514	3.632	3.749	3.866	3.983	4.100
65	1.813	1.933	2.054	2.175	2.296	2.417	2.538	2.658	2.779	2.900	3.021	3.142	3.263	3.383	3.504	3.625	3.746	3.867	3.988	4.108	4.229
66	1.869	1.993	2.118	2.242	2.367	2.492	2.616	2.741	2.865	2.990	3.115	3.239	3.364	3.488	3.613	3.737	3.862	3.987	4.111	4.236	4.360
67	1.926	2.054	2.183	2.311	2.439	2.568	2.696	2.824	2.953	3.081	3.210	3.338	3.466	3.595	3.723	3.852	3.980	4.108	4.237	4.365	4.493
68	1.984	2.116	2.248	2.380	2.513	2.645	2.777	2.909	3.042	3.174	3.306	3.438	3.571	3.703	3.835	3.967	4.100	4.232	4.364	4.496	4.629
69	2.042	2.179	2.315	2.451	2.587	2.723	2.859	2.996	3.132	3.268	3.404	3.540	3.676	3.813	3.949	4.085	4.221	4.357	4.493	4.630	4.766
70	2.102	2.242	2.382	2.523	2.663	2.803	2.943	3.083	3.223	3.363	3.504	3.644	3.784	3.924	4.064	4.204	4.344	4.484	4.625	4.765	4.905

(The values which are in darker region are within the range of observed data)

Table 4 Biomass table (kg/tree) for *Duabanga grandiflora* (10-30 cm diameter class)

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	13.45	14.67	15.89	17.11	18.34	19.56	20.78	22.00	23.23	24.45	25.67	26.89	28.12	29.34	30.56
11	16.27	17.75	19.23	20.71	22.19	23.67	25.14	26.62	28.10	29.58	31.06	32.54	34.02	35.50	36.98
12	19.36	21.12	22.88	24.64	26.40	28.16	29.92	31.68	33.44	35.21	36.97	38.73	40.49	42.25	44.01
13	22.72	24.79	26.86	28.92	30.99	33.05	35.12	37.19	39.25	41.32	43.38	45.45	47.51	49.58	51.65
14	26.35	28.75	31.15	33.54	35.94	38.33	40.73	43.13	45.52	47.92	50.31	52.71	55.11	57.50	59.90
15	30.25	33.00	35.76	38.51	41.26	44.01	46.76	49.51	52.26	55.01	57.76	60.51	63.26	66.01	68.76
16	34.42	37.55	40.68	43.81	46.94	50.07	53.20	56.33	59.46	62.59	65.72	68.85	71.97	75.10	78.23
17	38.86	42.39	45.93	49.46	52.99	56.52	60.06	63.59	67.12	70.65	74.19	77.72	81.25	84.79	88.32
18	43.57	47.53	51.49	55.45	59.41	63.37	67.33	71.29	75.25	79.21	83.17	87.13	91.09	95.05	99.01
19	48.54	52.95	57.37	61.78	66.19	70.61	75.02	79.43	83.84	88.26	92.67	97.08	101.50	105.91	110.32
20	53.79	58.68	63.56	68.45	73.34	78.23	83.12	88.01	92.90	97.79	102.68	107.57	112.46	117.35	122.24
21	59.30	64.69	70.08	75.47	80.86	86.25	91.64	97.03	102.42	107.82	113.21	118.60	123.99	129.38	134.77
22	65.08	71.00	76.91	82.83	88.75	94.66	100.58	106.50	112.41	118.33	124.24	130.16	136.08	141.99	147.91
23	71.13	77.60	84.06	90.53	97.00	103.46	109.93	116.40	122.86	129.33	135.80	142.26	148.73	155.20	161.66
24	77.45	84.49	91.53	98.57	105.62	112.66	119.70	126.74	133.78	140.82	147.86	154.90	161.94	168.98	176.03
25	84.04	91.68	99.32	106.96	114.60	122.24	129.88	137.52	145.16	152.80	160.44	168.08	175.72	183.36	191.00
26	90.90	99.16	107.42	115.69	123.95	132.21	140.48	148.74	157.01	165.27	173.53	181.80	190.06	198.32	206.59
27	98.02	106.94	115.85	124.76	133.67	142.58	151.49	160.40	169.31	178.23	187.14	196.05	204.96	213.87	222.78
28	105.42	115.00	124.59	134.17	143.75	153.34	162.92	172.51	182.09	191.67	201.26	210.84	220.42	230.01	239.59
29	113.08	123.36	133.64	143.93	154.21	164.49	174.77	185.05	195.33	205.61	215.89	226.17	236.45	246.73	257.01
30	121.02	132.02	143.02	154.02	165.02	176.03	187.03	198.03	209.03	220.03	231.03	242.04	253.04	264.04	275.04

(The values which are in darker region are within the range of observed data)

Table 5 Biomass table (kg/tree) for *Duabanga grandiflora* (31-50 cm diameter class)

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	180.61	192.66	204.70	216.74	228.78	240.82	252.86	264.90	276.94	288.98	301.81	313.06	325.11	337.15	349.19	361.23
32	192.45	205.28	218.12	230.95	243.78	256.61	269.44	282.27	295.10	307.93	321.60	333.59	346.42	359.25	372.08	384.91
33	204.67	218.32	231.96	245.61	259.25	272.89	286.54	300.18	313.83	327.47	342.01	354.76	368.41	382.05	395.70	409.34
34	217.26	231.75	246.23	260.72	275.20	289.68	304.17	318.65	333.14	347.62	363.05	376.59	391.07	405.56	420.04	434.53
35	230.23	245.58	260.93	276.28	291.63	306.98	322.32	337.67	353.02	368.37	384.72	399.07	414.42	429.77	445.11	460.46
36	243.58	259.81	276.05	292.29	308.53	324.77	341.01	357.24	373.48	389.72	407.02	422.20	438.44	454.67	470.91	487.15
37	257.30	274.45	291.60	308.75	325.91	343.06	360.21	377.37	394.52	411.67	429.95	445.98	463.13	480.28	497.44	514.59
38	271.39	289.48	307.58	325.67	343.76	361.85	379.95	398.04	416.13	434.23	453.50	470.41	488.50	506.60	524.69	542.78
39	285.86	304.92	323.98	343.04	362.09	381.15	400.21	419.27	438.32	457.38	477.69	495.50	514.55	533.61	552.67	571.73
40	300.71	320.76	340.81	360.85	380.90	400.95	420.99	441.04	461.09	481.14	502.50	521.23	541.28	561.33	581.37	601.42
41	315.93	337.00	358.06	379.12	400.18	421.25	442.31	463.37	484.43	505.49	527.93	547.62	568.68	589.74	610.81	631.87
42	331.53	353.64	375.74	397.84	419.94	442.04	464.15	486.25	508.35	530.45	554.00	574.66	596.76	618.86	640.96	663.07
43	347.51	370.68	393.84	417.01	440.18	463.34	486.51	509.68	532.85	556.01	580.70	602.35	625.52	648.68	671.85	695.02
44	363.86	388.12	412.37	436.63	460.89	485.15	509.40	533.66	557.92	582.18	608.02	630.69	654.95	679.20	703.46	727.72
45	380.59	405.96	431.33	456.70	482.08	507.45	532.82	558.19	583.57	608.94	635.97	659.68	685.06	710.43	735.80	761.17
46	397.69	424.20	450.71	477.23	503.74	530.25	556.77	583.28	609.79	636.30	664.55	689.33	715.84	742.35	768.87	795.38
47	415.17	442.85	470.52	498.20	525.88	553.56	581.24	608.91	636.59	664.27	693.76	719.63	747.30	774.98	802.66	830.34
48	433.02	461.89	490.76	519.63	548.50	577.36	606.23	635.10	663.97	692.84	723.59	750.57	779.44	808.31	837.18	866.05
49	451.25	481.34	511.42	541.50	571.59	601.67	631.75	661.84	691.92	722.01	754.06	782.17	812.26	842.34	872.42	902.51
50	469.86	501.18	532.51	563.83	595.16	626.48	657.80	689.13	720.45	751.78	785.15	814.42	845.75	877.07	908.40	939.72

(The values which are in darker region are within the range of observed data)

Table 6 Biomass table (kg/tree) for *Duabanga grandiflora* (>50 cm diameter class)

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	426.25	454.66	483.08	511.50	539.91	568.33	596.75	625.16	653.58	681.99	710.41	738.83	767.24	795.66	824.08	852.49	880.91	909.33	966.16	966.16	994.58
52	443.13	472.67	502.21	531.75	561.29	590.83	620.38	649.92	679.46	709.00	738.54	768.09	797.63	827.17	856.71	886.25	915.79	945.34	1004.42	1004.42	1033.96
53	460.33	491.02	521.71	552.40	583.09	613.78	644.47	675.16	705.84	736.53	767.22	797.91	828.60	859.29	889.98	920.67	951.36	982.04	1043.42	1043.42	1074.11
54	477.87	509.73	541.58	573.44	605.30	637.16	669.02	700.87	732.73	764.59	796.45	828.30	860.16	892.02	923.88	955.74	987.59	1019.45	1083.17	1083.17	1115.03
55	495.73	528.78	561.83	594.88	627.93	660.97	694.02	727.07	760.12	793.17	826.22	859.27	892.32	925.36	958.41	991.46	1024.51	1057.56	1123.66	1123.66	1156.71
56	513.92	548.18	582.44	616.71	650.97	685.23	719.49	753.75	788.01	822.27	856.54	890.80	925.06	959.32	993.58	1027.84	1062.10	1096.37	1164.89	1164.89	1199.15
57	532.44	567.94	603.43	638.93	674.42	709.92	745.42	780.91	816.41	851.90	887.40	922.90	958.39	993.89	1029.38	1064.88	1100.38	1135.87	1206.86	1206.86	1242.36
58	551.29	588.04	624.79	661.54	698.30	735.05	771.80	808.55	845.30	882.06	918.81	955.56	992.31	1029.07	1065.82	1102.57	1139.32	1176.08	1249.58	1249.58	1286.33
59	570.46	608.49	646.52	684.55	722.58	760.61	798.64	836.67	874.70	912.73	950.77	988.80	1026.83	1064.86	1102.89	1140.92	1178.95	1216.98	1293.04	1293.04	1331.07
60	589.96	629.29	668.62	707.95	747.28	786.61	825.95	865.28	904.61	943.94	983.27	1022.60	1061.93	1101.26	1140.59	1179.92	1219.25	1258.58	1337.24	1337.24	1376.58
61	609.79	650.44	691.10	731.75	772.40	813.05	853.71	894.36	935.01	975.66	1016.32	1056.97	1097.62	1138.27	1178.93	1219.58	1260.23	1300.89	1382.19	1382.19	1422.84
62	629.95	671.94	713.94	755.94	797.93	839.93	881.93	923.92	965.92	1007.92	1049.91	1091.91	1133.90	1175.90	1217.90	1259.89	1301.89	1343.89	1427.88	1427.88	1469.88
63	650.43	693.79	737.16	780.52	823.88	867.24	910.60	953.97	997.33	1040.69	1084.05	1127.42	1170.78	1214.14	1257.50	1300.86	1344.23	1387.59	1474.31	1474.31	1517.67
64	671.24	715.99	760.74	805.49	850.24	894.99	939.74	984.49	1029.24	1073.99	1118.74	1163.49	1208.24	1252.99	1297.74	1342.49	1387.24	1431.99	1521.49	1521.49	1566.24
65	692.38	738.54	784.70	830.86	877.02	923.18	969.34	1015.50	1061.66	1107.82	1153.97	1200.13	1246.29	1292.45	1338.61	1384.77	1430.93	1477.09	1569.40	1569.40	1615.56
66	713.85	761.44	809.03	856.62	904.21	951.80	999.39	1046.98	1094.57	1142.16	1189.75	1237.34	1284.93	1332.52	1380.11	1427.71	1475.30	1522.89	1618.07	1618.07	1665.66
67	735.65	784.69	833.73	882.78	931.82	980.86	1029.91	1078.95	1127.99	1177.04	1226.08	1275.12	1324.17	1373.21	1422.25	1471.30	1520.34	1569.38	1667.47	1667.47	1716.51
68	757.77	808.29	858.81	909.33	959.84	1010.36	1060.88	1111.40	1161.92	1212.43	1262.95	1313.47	1363.99	1414.51	1465.03	1515.54	1566.06	1616.58	1717.62	1717.62	1768.13
69	780.22	832.24	884.25	936.27	988.28	1040.30	1092.31	1144.33	1196.34	1248.36	1300.37	1352.39	1404.40	1456.42	1508.43	1560.45	1612.46	1664.48	1768.51	1768.51	1820.52
70	803.00	856.54	910.07	963.60	1017.14	1070.67	1124.20	1177.74	1231.27	1284.80	1338.34	1391.87	1445.40	1498.94	1552.47	1606.00	1659.54	1713.07	1820.14	1820.14	1873.67

(The values which are in darker region are within the range of observed data)

Table 7 Carbon table (kg/tree) for *Duabanga grandiflora* (10-30 cm diameter class)

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	6.72	7.33	7.95	8.56	9.17	9.78	10.39	11.00	11.61	12.22	12.84	13.45	14.06	14.67	15.28
11	8.14	8.87	9.61	10.35	11.09	11.83	12.57	13.31	14.05	14.79	15.53	16.27	17.01	17.75	18.49
12	9.68	10.56	11.44	12.32	13.20	14.08	14.96	15.84	16.72	17.60	18.48	19.36	20.24	21.12	22.00
13	11.36	12.40	13.43	14.46	15.49	16.53	17.56	18.59	19.63	20.66	21.69	22.72	23.76	24.79	25.82
14	13.18	14.38	15.57	16.77	17.97	19.17	20.37	21.56	22.76	23.96	25.16	26.35	27.55	28.75	29.95
15	15.13	16.50	17.88	19.25	20.63	22.00	23.38	24.75	26.13	27.50	28.88	30.25	31.63	33.00	34.38
16	17.21	18.78	20.34	21.91	23.47	25.03	26.60	28.16	29.73	31.29	32.86	34.42	35.99	37.55	39.12
17	19.43	21.20	22.96	24.73	26.50	28.26	30.03	31.79	33.56	35.33	37.09	38.86	40.63	42.39	44.16
18	21.78	23.76	25.74	27.72	29.70	31.68	33.66	35.65	37.63	39.61	41.59	43.57	45.55	47.53	49.51
19	24.27	26.48	28.68	30.89	33.10	35.30	37.51	39.72	41.92	44.13	46.34	48.54	50.75	52.95	55.16
20	26.89	29.34	31.78	34.23	36.67	39.12	41.56	44.01	46.45	48.90	51.34	53.79	56.23	58.68	61.12
21	29.65	32.34	35.04	37.74	40.43	43.13	45.82	48.52	51.21	53.91	56.60	59.30	61.99	64.69	67.38
22	32.54	35.50	38.46	41.41	44.37	47.33	50.29	53.25	56.21	59.16	62.12	65.08	68.04	71.00	73.96
23	35.57	38.80	42.03	45.27	48.50	51.73	54.97	58.20	61.43	64.66	67.90	71.13	74.36	77.60	80.83
24	38.73	42.25	45.77	49.29	52.81	56.33	59.85	63.37	66.89	70.41	73.93	77.45	80.97	84.49	88.01
25	42.02	45.84	49.66	53.48	57.30	61.12	64.94	68.76	72.58	76.40	80.22	84.04	87.86	91.68	95.50
26	45.45	49.58	53.71	57.84	61.98	66.11	70.24	74.37	78.50	82.63	86.77	90.90	95.03	99.16	103.29
27	49.01	53.47	57.92	62.38	66.83	71.29	75.75	80.20	84.66	89.11	93.57	98.02	102.48	106.94	111.39
28	52.71	57.50	62.29	67.09	71.88	76.67	81.46	86.25	91.04	95.84	100.63	105.42	110.21	115.00	119.80
29	56.54	61.68	66.82	71.96	77.10	82.24	87.38	92.52	97.66	102.80	107.94	113.08	118.22	123.36	128.50
30	60.51	66.01	71.51	77.01	82.51	88.01	93.51	99.01	104.52	110.02	115.52	121.02	126.52	132.02	137.52

(The values which are in darker region are within the range of observed data)

Table 8 Carbon table (kg/tree) for *Duabanga grandiflora* (31-50 cm diameter class)

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	90.31	96.33	102.35	108.37	114.39	120.41	126.43	132.45	138.47	144.49	150.51	156.53	162.55	168.57	174.59	180.61
32	96.23	102.64	109.06	115.47	121.89	128.30	134.72	141.13	147.55	153.96	160.38	166.79	173.21	179.62	186.04	192.45
33	102.34	109.16	115.98	122.80	129.62	136.45	143.27	150.09	156.91	163.74	170.56	177.38	184.20	191.03	197.85	204.67
34	108.63	115.87	123.12	130.36	137.60	144.84	152.08	159.33	166.57	173.81	181.05	188.29	195.54	202.78	210.02	217.26
35	115.12	122.79	130.46	138.14	145.81	153.49	161.16	168.84	176.51	184.19	191.86	199.53	207.21	214.88	222.56	230.23
36	121.79	129.91	138.03	146.15	154.26	162.38	170.50	178.62	186.74	194.86	202.98	211.10	219.22	227.34	235.46	243.58
37	128.65	137.22	145.80	154.38	162.95	171.53	180.11	188.68	197.26	205.84	214.41	222.99	231.57	240.14	248.72	257.30
38	135.70	144.74	153.79	162.83	171.88	180.93	189.97	199.02	208.07	217.11	226.16	235.21	244.25	253.30	262.34	271.39
39	142.93	152.46	161.99	171.52	181.05	190.58	200.10	209.63	219.16	228.69	238.22	247.75	257.28	266.81	276.33	285.86
40	150.36	160.38	170.40	180.43	190.45	200.47	210.50	220.52	230.54	240.57	250.59	260.62	270.64	280.66	290.69	300.71
41	157.97	168.50	179.03	189.56	200.09	210.62	221.15	231.68	242.22	252.75	263.28	273.81	284.34	294.87	305.40	315.93
42	165.77	176.82	187.87	198.92	209.97	221.02	232.07	243.12	254.18	265.23	276.28	287.33	298.38	309.43	320.48	331.53
43	173.75	185.34	196.92	208.51	220.09	231.67	243.26	254.84	266.42	278.01	289.59	301.17	312.76	324.34	335.92	347.51
44	181.93	194.06	206.19	218.32	230.44	242.57	254.70	266.83	278.96	291.09	303.22	315.34	327.47	339.60	351.73	363.86
45	190.29	202.98	215.67	228.35	241.04	253.72	266.41	279.10	291.78	304.47	317.16	329.84	342.53	355.21	367.90	380.59
46	198.84	212.10	225.36	238.61	251.87	265.13	278.38	291.64	304.90	318.15	331.41	344.66	357.92	371.18	384.43	397.69
47	207.58	221.42	235.26	249.10	262.94	276.78	290.62	304.46	318.30	332.13	345.97	359.81	373.65	387.49	401.33	415.17
48	216.51	230.95	245.38	259.81	274.25	288.68	303.12	317.55	331.98	346.42	360.85	375.29	389.72	404.15	418.59	433.02
49	225.63	240.67	255.71	270.75	285.79	300.84	315.88	330.92	345.96	361.00	376.04	391.09	406.13	421.17	436.21	451.25
50	234.93	250.59	266.25	281.92	297.58	313.24	328.90	344.56	360.23	375.89	391.55	407.21	422.87	438.54	454.20	469.86

(The values which are in darker region are within the range of observed data)

Table 9 Carbon table (kg/tree) for *Duabanga grandiflora* (>50 cm diameter class)

Diameter at breast height (cm)	Height (m)																			
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	213.12	227.33	241.54	255.75	269.96	284.16	298.37	312.58	326.79	341.00	355.21	369.41	383.62	397.83	412.04	426.25	440.45	454.66	468.87	483.08	497.29
52	221.56	236.33	251.10	265.88	280.65	295.42	310.19	324.96	339.73	354.50	369.27	384.04	398.81	413.58	428.36	443.13	457.90	472.67	487.44	502.21	516.98
53	230.17	245.51	260.86	276.20	291.54	306.89	322.23	337.58	352.92	368.27	383.61	398.96	414.30	429.64	444.99	460.33	475.68	491.02	506.37	521.71	537.06
54	238.93	254.86	270.79	286.72	302.65	318.58	334.51	350.44	366.37	382.29	398.22	414.15	430.08	446.01	461.94	477.87	493.80	509.73	525.66	541.58	557.51
55	247.87	264.39	280.91	297.44	313.96	330.49	347.01	363.54	380.06	396.58	413.11	429.63	446.16	462.68	479.21	495.73	512.26	528.78	545.30	561.83	578.35
56	256.96	274.09	291.22	308.35	325.48	342.61	359.74	376.88	394.01	411.14	428.27	445.40	462.53	479.66	496.79	513.92	531.05	548.18	565.31	582.44	599.57
57	266.22	283.97	301.72	319.46	337.21	354.96	372.71	390.46	408.20	425.95	443.70	461.45	479.20	496.94	514.69	532.44	550.19	567.94	585.68	603.43	621.18
58	275.64	294.02	312.40	330.77	349.15	367.52	385.90	404.28	422.65	441.03	459.40	477.78	496.16	514.53	532.91	551.29	569.66	588.04	606.41	624.79	643.17
59	285.23	304.24	323.26	342.28	361.29	380.31	399.32	418.34	437.35	456.37	475.38	494.40	513.41	532.43	551.44	570.46	589.47	608.49	627.51	646.52	665.54
60	294.98	314.65	334.31	353.98	373.64	393.31	412.97	432.64	452.30	471.97	491.63	511.30	530.96	550.63	570.30	589.96	609.63	629.29	648.96	668.62	688.29
61	304.90	325.22	345.55	365.87	386.20	406.53	426.85	447.18	467.51	487.83	508.16	528.48	548.81	569.14	589.46	609.79	630.12	650.44	670.77	691.10	711.42
62	314.97	335.97	356.97	377.97	398.97	419.96	440.96	461.96	482.96	503.96	524.96	545.95	566.95	587.95	608.95	629.95	650.95	671.94	692.94	713.94	734.94
63	325.22	346.90	368.58	390.26	411.94	433.62	455.30	476.98	498.66	520.35	542.03	563.71	585.39	607.07	628.75	650.43	672.11	693.79	715.47	737.16	758.84
64	335.62	358.00	380.37	402.75	425.12	447.50	469.87	492.25	514.62	537.00	559.37	581.75	604.12	626.49	648.87	671.24	693.62	715.99	738.37	760.74	783.12
65	346.19	369.27	392.35	415.43	438.51	461.59	484.67	507.75	530.83	553.91	576.99	600.07	623.15	646.23	669.31	692.38	715.46	738.54	761.62	784.70	807.78
66	356.93	380.72	404.52	428.31	452.11	475.90	499.70	523.49	547.29	571.08	594.88	618.67	642.47	666.26	690.06	713.85	737.65	761.44	785.24	809.03	832.83
67	367.82	392.35	416.87	441.39	465.91	490.43	514.95	539.48	564.00	588.52	613.04	637.56	662.08	686.61	711.13	735.65	760.17	784.69	809.21	833.73	858.26
68	378.89	404.14	429.40	454.66	479.92	505.18	530.44	555.70	580.96	606.22	631.48	656.74	681.99	707.25	732.51	757.77	783.03	808.29	833.55	858.81	884.07
69	390.11	416.12	442.13	468.13	494.14	520.15	546.16	572.16	598.17	624.18	650.19	676.19	702.20	728.21	754.22	780.22	806.23	832.24	858.25	884.25	910.26
70	401.50	428.27	455.03	481.80	508.57	535.33	562.10	588.87	615.64	642.40	669.17	695.94	722.70	749.47	776.24	803.00	829.77	856.54	883.30	910.07	936.84

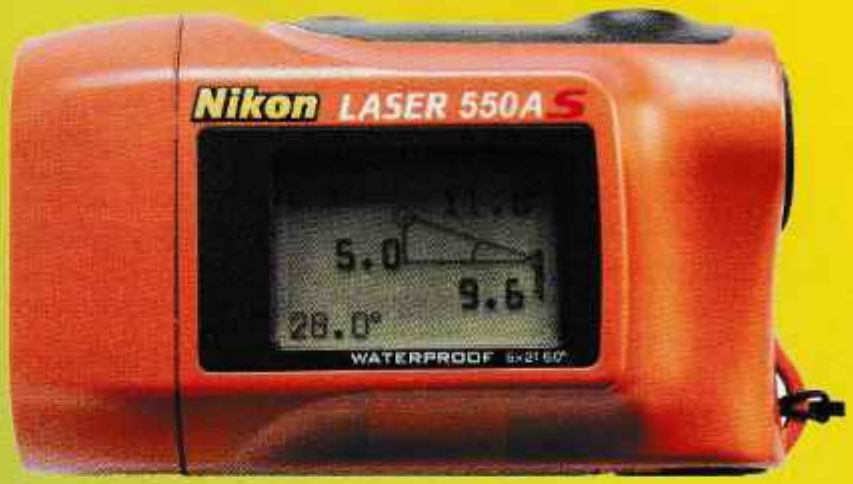
(The values which are in darker region are within the range of observed data)

Table 10 Volume, biomass and carbon table for *Duabanga grandiflora* (DBH 10 -51 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
10	0.049	18.82	9.41	31	0.690	263.47	131.73
11	0.060	22.77	11.38	32	0.735	280.74	140.37
12	0.071	27.10	13.55	33	0.782	298.56	149.28
13	0.083	31.80	15.90	34	0.830	316.93	158.47
14	0.097	36.88	18.44	35	0.879	335.85	167.92
15	0.111	42.34	21.17	36	0.930	355.31	177.66
16	0.126	48.17	24.09	37	0.983	375.33	187.66
17	0.142	54.38	27.19	38	1.036	395.89	197.94
18	0.160	60.97	30.48	39	1.092	417.00	208.50
19	0.178	67.93	33.97	40	1.148	438.66	219.33
20	0.197	75.27	37.63	41	1.206	460.87	230.43
21	0.217	82.98	41.49	42	1.266	483.62	241.81
22	0.238	91.08	45.54	43	1.327	506.92	253.46
23	0.261	99.54	49.77	44	1.389	530.78	265.39
24	0.284	108.39	54.19	45	1.453	555.18	277.59
25	0.308	117.61	58.80	46	1.519	580.13	290.06
26	0.333	127.21	63.60	47	1.585	605.62	302.81
27	0.359	137.18	68.59	48	1.654	631.67	315.83
28	0.386	147.53	73.76	49	1.723	658.26	329.13
29	0.414	158.25	79.13	50	1.794	685.40	342.70
30	0.443	169.36	84.68	51	2.052	783.84	391.92

Table 11 Volume, biomass and carbon table for *Duabanga grandiflora* (DBH 51-100 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
51	2.052	783.84	391.92	76	4.557	1740.65	870.33
52	2.133	814.88	407.44	77	4.677	1786.76	893.38
53	2.216	846.52	423.26	78	4.800	1833.47	916.74
54	2.300	878.77	439.38	79	4.924	1880.79	940.39
55	2.386	911.61	455.81	80	5.049	1928.70	964.35
56	2.474	945.06	472.53	81	5.176	1977.22	988.61
57	2.563	979.12	489.56	82	5.305	2026.34	1013.17
58	2.654	1013.77	506.89	83	5.435	2076.07	1038.03
69	2.746	1049.03	524.52	84	5.566	2126.39	1063.20
60	2.840	1084.90	542.45	85	5.700	2177.32	1088.66
61	2.935	1121.36	560.68	86	5.835	2228.86	1114.43
62	3.033	1158.43	579.21	87	5.971	2280.99	1140.50
63	3.131	1196.10	598.05	88	6.109	2333.73	1166.87
64	3.231	1234.37	617.18	89	6.249	2387.07	1193.54
65	3.333	1273.25	636.62	90	6.390	2441.01	1220.51
66	3.436	1312.72	656.36	91	6.533	2495.56	1247.78
67	3.541	1352.80	676.40	92	6.677	2550.71	1275.35
68	3.648	1393.49	696.74	93	6.823	2606.46	1303.23
69	3.756	1434.77	717.39	94	6.971	2662.82	1331.41
70	3.866	1476.66	738.33	95	7.120	2719.77	1359.89
71	3.977	1519.15	759.58	96	7.271	2777.33	1388.67
72	4.090	1562.25	781.12	97	7.423	2835.49	1417.75
73	4.204	1605.95	802.97	98	7.577	2894.26	1447.13
74	4.320	1650.25	825.12	99	7.732	2953.63	1476.81
75	4.438	1695.15	847.57	100	7.889	3013.60	1506.80



Nikon Laser 550A Range Finder : Used for measurement of total tree height, height at the occurrence of first branch of each individual tree and length of frustum.



Mantax Black Calliper with Gator Eyes, Make : Haglof Sweden : Used for measurement of diameter from a distance with laser beam (diameter measurement at different height of each tree)

Summary

Duabanga grandiflora is a tree commonly found in Meghalaya and extracted for commercial purpose. The report provides the volume tables and biomass tables of the utilizable stem portion, for use by the forest department, community and dealers in timber. The information on equivalent carbon content is also provided. This is a major component of the above ground biomass and can be used in projects related to carbon trading.

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