

LOCAL AND STANDARD VOLUME TABLES OF *EUCALYPTUS CAMALDULENSIS* DEHN. FOR IRRIGATED PLANTATIONS OF THE PUNJAB

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Data collection. At the time of layout of sample plots of the species in irrigated plantations of the Punjab, data were collected from 230 trees, ranging in diameter at breast height from 2 in. (5 cm) to 14 in. (36 cm). These trees were removed in thinnings. Data from about 1070 trees were made available by Genetics branch of Pakistan Forest Institute who felled some plots of this species last year. The latter group of data consisted of small sized trees. In order to get an adequate representative sample for each diameter class, random selection of 20-40 trees was made from each diameter class having more than 100 trees. Finally 343 trees were used in this study.

The distribution of trees by localities and diameter classes is given in Table 1.

Table 1

Distribution of trees by localities and diameter classes.

	Diameter class (inches)														
Locality	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	
	Number of trees														
P.F.I. Peshawar	17	19	16	26	36	33	19	12	2	2	1	—	—	183	
Jhelum	—	—	1	—	1	—	1	—	1	—	—	—	—	4	
Changa Manga	—	—	3	3	2	3	5	7	6	1	6	2	—	38	
Bhagat	—	—	—	—	—	—	—	1	1	—	—	—	—	2	
Shorkot	2	6	2	1	—	—	—	—	—	—	—	—	—	11	
Chichawatni	—	—	—	—	—	—	—	—	—	—	1	2	1	4	
Chak Katora	4	12	13	7	7	3	2	1	1	1	—	—	—	51	
Bahawalpur	16	10	7	8	—	1	—	—	—	—	—	—	—	42	
Abbasia	—	1	4	3	—	—	—	—	—	—	—	—	—	8	
Total	39	48	46	48	46	40	27	21	11	4	8	4	1	343	

Method and procedure. Each felled tree was divided into convenient size logs upto 2 inch diameter over bark at thin end of the stem and branches. Diameter overbark was measured at the middle point of each log. Using this diameter and log length, the volume

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of each log was calculated separately. Volumes of logs obtained from each tree were summed up to get the total volume of the tree. The data were summarised showing total volume against dbh and height of each tree.

Combined variable formula viz, $V = a + bD^2H$ was used for derivation of following regression equation to estimate volumes.

$$V = 0.5570 + 0.002079 D^2H \text{ where}$$

D = Diameter breast height in inches

H = Total height in feet.

The two important criteria for best fit of the above regression equation i.e., correlation coefficient (r) and standard error of estimate (SEE) were calculated. These were: correlation coefficient (r)=0.9005 and standard error of estimate (SEE)=1.19

Since value of 'r' is quite high (close to 1) and value of SEE is quite low the derived regression equation is suitable for estimation purposes and was thus selected for preparation of standard volume tables.

Standard volume tables. In British units the tables were prepared with 1 inch diameter class and 5 feet height interval for dbh from 1 inch to 20 inch and height classes ranging from 10 feet to 100 feet. The tables are given in Appendix I

To prepare the standard volume tables in metric units the above equation was converted to metric equation by changing regression constant 'a' and regression coefficient 'b' as follows:

$$a = 0.5570 \times 0.02832 = 0.015774$$

$$b = \frac{0.002079 \times 0.02832}{(2.54)^2 \times 0.3048} = 0.00002994$$

where

0.02832 is conversion factor for changing cubic feet into cubic metres. 2.54 is conversion factor for changing inches into centimetres and 0.3048 is conversion factor for changing feet into metres.

The metric equation thus developed is:

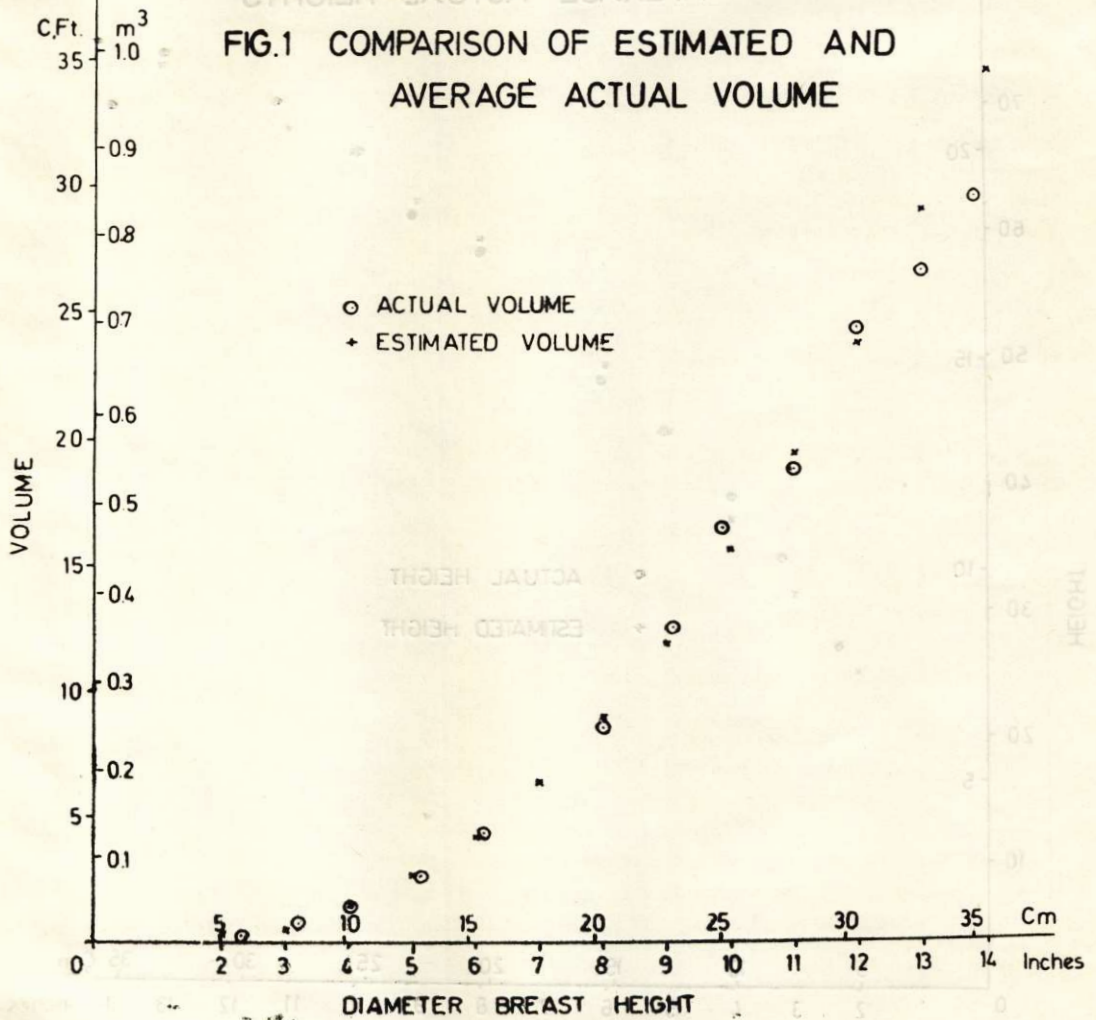
$$V = 0.015774 + 0.00002994 D^2H \text{ where}$$

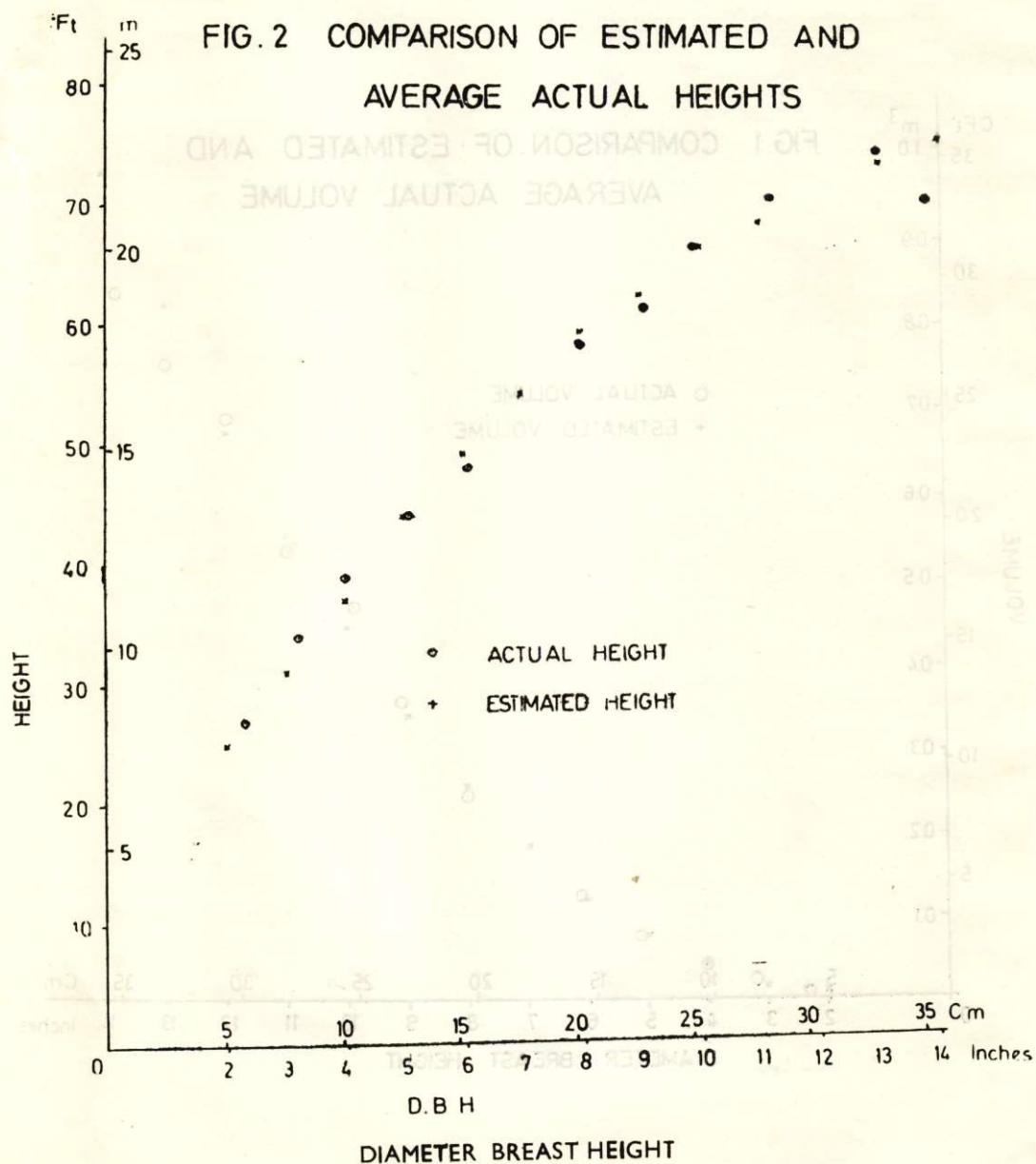
V = Volume in cubic metres.

D = Diameter breast height in centimetres.

H = Height in metres.

FIG. 1 COMPARISON OF ESTIMATED AND AVERAGE ACTUAL VOLUME





Standard Volume Table (British units) for *Eucalyptus camaldulensis* in the irrigated plantations of the Punjab.

dbh (inches)	Height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	
1	0.58	0.59	0.60	0.61	0.62	0.63	0.64	Volume cubic feet											
2	0.64	0.68	0.72	0.76	0.81	0.85	0.89	0.93	0.97										
3	0.74	0.84	0.93	1.02	1.12	1.21	1.30	1.40	1.49	1.59	1.68								
4		1.06	1.22	1.39	1.55	1.72	1.89	2.05	2.22	2.39	2.55	2.72							
5			1.60	1.86	2.12	2.38	2.64	2.89	3.15	3.41	3.67	3.93	4.19	4.45					
6			2.05	2.43	2.80	3.18	3.55	3.92	4.30	4.67	5.05	5.42	5.80	6.17	6.54	6.92			
7			2.59	3.10	3.61	4.12	4.63	5.14	5.65	6.16	6.67	7.18	7.69	8.20	8.71	9.22	9.72	10.23	
8				3.88	4.55	5.21	5.88	6.54	7.21	7.87	8.54	9.20	9.87	10.54	11.20	11.87	12.53	13.20	
9				4.77	5.60	6.45	7.29	8.13	8.98	9.82	10.66	11.55	12.34	13.19	14.03	14.87	15.71	16.56	
10				5.75	6.79	7.83	8.87	9.91	10.95	11.99	13.03	14.07	15.11	16.64	17.19	18.23	19.27	20.31	
11					8.10	9.36	10.62	11.88	13.13	14.39	15.65	16.91	18.17	19.42	20.68	21.94	23.20	24.46	
12					9.53	11.03	12.53	14.03	15.52	17.02	18.52	20.02	21.51	23.01	24.51	26.00	27.50	29.00	
13					11.10	12.85	14.61	16.37	18.12	19.88	21.64	23.39	25.15	26.91	28.66	30.42	32.18	33.94	
14							16.85	18.89	20.93	22.97	25.01	27.04	29.08	31.12	33.15	35.19	37.23	39.27	
15							19.27	21.61	23.94	26.28	28.62	30.96	33.30	35.64	37.98	40.32	42.66	44.99	
16									27.17	29.83	32.49	35.15	37.81	40.47	43.13	45.80	48.46	51.12	
17									30.60	33.60	36.61	39.61	42.61	45.62	48.62	51.63	54.63	57.64	
18											40.97	44.34	47.71	51.08	54.44	57.81	61.18	64.55	
19											45.59	49.34	53.09	56.84	60.60	64.35	68.10	71.85	
20											50.45	54.61	58.77	62.93	67.08	71.24	75.40	79.56	

Height (metres)

[illegible]

APPENDIX II (continued)

Standard Volume Table (Metric units) for *Eucalyptus camaldulensis* in the irrigated plantations of the Punjab.

dbh (cm)	Height (metres)														
	9.0	10.0	10.5	11.0	11.5	12.0	Cubic metres								
6	0.0260	0.0265	0.0271	0.0276	0.0281	0.0287	0.0292	0.0298	0.0303	0.0309					
8	0.0340	0.0349	0.0359	0.0368	0.0378	0.0387	0.0397	0.0407	0.0416	0.0426					
10	0.0442	0.0457	0.0472	0.0487	0.0502	0.0517	0.0532	0.0547	0.0562	0.0577	0.0592	0.0607	0.06		
12	0.0567	0.0589	0.0610	0.0632	0.0653	0.0675	0.0697	0.0718	0.0740	0.0761	0.0783	0.0804	0.08	0.10	
14	0.0715	0.0744	0.0774	0.0803	0.0832	0.0862	0.0891	0.0921	0.0950	0.0979	0.101	0.104	0.10	0.13	
16	0.0886	0.0924	0.0962	0.100	0.104	0.108	0.112	0.115	0.119	0.123	0.127	0.131	0.13	0.16	
18	0.108	0.113	0.118	0.122	0.127	0.132	0.137	0.142	0.147	0.152	0.156	0.161	0.16	0.20	
20	0.129	0.135	0.141	0.147	0.153	0.159	0.165	0.171	0.177	0.183	0.189	0.195	0.20	0.24	
22	0.153	0.161	0.168	0.175	0.182	0.190	0.197	0.204	0.211	0.219	0.226	0.233	0.24	0.28	
24	0.180	0.188	0.197	0.205	0.214	0.223	0.231	0.240	0.2493	0.257	0.266	0.274	0.28	0.32	
26	0.208	0.218	0.228	0.238	0.248	0.259	0.269	0.279	0.289	0.299	0.309	0.319	0.32	0.38	
28	0.239	0.250	0.262	0.274	0.286	0.297	0.309	0.321	0.333	0.344	0.356	0.368	0.38	0.43	
30						0.339	0.353	0.366	0.379	0.393	0.406	0.420	0.43	0.49	
32						0.384	0.399	0.414	0.430	0.445	0.460	0.476	0.49	0.55	
34											0.518	0.535	0.55	0.61	
36											0.578	0.598	0.61		

Standard Volume Table (Metric units) for *Eucalyptus camaldulensis* in the irrigated plantations of the Punjab.

dbh (cm)	Height (metres)															Cubic metres
	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0		
14	0.118	0.121	0.124	0.127	0.130	0.133	0.173	0.177	0.181	0.229	0.234	0.239	0.297	0.303		
16	0.150	0.154	0.158	0.161	0.165	0.169	0.173	0.219	0.224	0.229	0.234	0.239	0.297	0.303		
18	0.185	0.190	0.195	0.200	0.205	0.210	0.261	0.267	0.273	0.279	0.285	0.291	0.297	0.303		
20	0.225	0.231	0.237	0.243	0.249	0.255	0.261	0.267	0.273	0.279	0.285	0.291	0.297	0.303		
22	0.279	0.277	0.284	0.291	0.298	0.305	0.313	0.320	0.327	0.335	0.342	0.349	0.356	0.363		
24	0.318	0.326	0.335	0.343	0.352	0.361	0.369	0.378	0.386	0.395	0.404	0.412	0.421	0.430		
26	0.370	0.380	0.390	0.400	0.410	0.421	0.431	0.441	0.451	0.461	0.471	0.481	0.491	0.501		
28	0.426	0.438	0.450	0.462	0.473	0.485	0.497	0.509	0.520	0.532	0.544	0.556	0.567	0.579		
30	0.487	0.501	0.514	0.528	0.541	0.555	0.568	0.582	0.595	0.609	0.622	0.635	0.649	0.662		
32	0.552	0.568	0.583	0.598	0.614	0.629	0.644	0.660	0.675	0.690	0.706	0.721	0.736	0.752		
34	0.621	0.639	0.656	0.673	0.691	0.708	0.725	0.743	0.770	0.777	0.794	0.812	0.829	0.846		
36	0.695	0.714	0.734	0.753	0.772	0.792	0.811	0.831	0.850	0.869	0.889	0.908	0.928	0.947		
38		0.794	0.816	0.837	0.869	0.880	0.902	0.924	0.945	0.967	0.988	1.01	1.03	1.05		
40		0.878	0.902	0.926	0.950	0.974	0.998	1.02	1.04	1.07	1.09	1.12	1.14	1.16		
42		0.966	0.993	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20	1.23	1.26	1.28		
44		1.06	1.09	1.12	1.15	1.17	1.20	1.23	1.26	1.29	1.32	1.35	1.38	1.41		
46			1.19	1.22	1.25	1.28	1.31	1.35	1.38	1.41	1.44	1.47	1.50	1.54		
48			1.29	1.33	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.60	1.64	1.67		
50			1.40	1.44	1.47	1.51	1.55	1.58	1.62	1.66	1.70	1.74	1.77	1.81		
52			1.51	1.55	1.59	1.63	1.67	1.71	1.76	1.80	1.84	1.88	1.91	1.96		

Standard Volume Table (Metric units) for *Eucalyptus camaldulensis* in the irrigated plantations of the Punjab

dbh (cm)	Height (metres)												
	26.5	27.0	27.5	28.0	28.5	29.0	29.5	30.0	30.5	31.0	31.5	32.0	32.5
	Cubic metres												
24	0.473	0.481	0.490	0.499	0.507	0.516							
26	0.552	0.562	0.572	0.582	0.593	0.603							
28	0.638	0.649	0.661	0.673	0.650	0.696							
30	0.730	0.743	0.757	0.770	0.784	0.797	0.811	0.824					
32	0.828	0.843	0.859	0.874	0.889	0.905	0.902	0.935					
34	0.933	0.950	0.968	0.985	1.00	1.02	1.04	1.05					
36	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.26	
38	1.16	1.18	1.20	1.23	1.25	1.27	1.29	1.31	1.33	1.36	1.38	1.40	
40	1.28	1.31	1.33	1.36	1.38	1.40	1.43	1.45	1.48	1.50	1.52	1.55	
42	1.44	1.44	1.47	1.49	1.52	1.55	1.57	1.60	1.63	1.65	1.68	1.70	
44	1.55	1.58	1.61	1.64	1.67	1.70	1.72	1.75	1.78	1.81	1.84	1.87	1.90
46	1.69	1.73	1.76	1.79	1.82	1.85	1.88	1.92	1.95	1.98	2.01	2.04	2.07
48	1.84	1.88	1.91	1.95	1.98	2.02	2.05	2.08	2.12	2.15	2.19	2.22	2.26
50	2.00	2.04	2.07	2.11	2.15	2.19	2.22	2.26	2.30	2.34	2.37	2.41	2.45
52	2.16	2.20	2.24	2.28	2.32	2.36	2.40	2.44	2.48	2.52	2.56	2.61	2.65

APPENDIX III

Local volume table (British units) of *Eucalyptus camaldulensis* in the irrigated plantations of the Punjab.

dbh (inch)	Estimated height (feet)	Volume (cft)
2	25	0.377
3	31	0.494
4	37	1.52
5	44	2.71
6	49	4.25
7	54	6.31
8	59	8.94
9	62	11.8
10	66	15.5
11	68	19.3
12	70	23.6
13	73	28.9
14	75	34.4
15	76	40.0
16	81	48.5
17	83	56.0
18	84	63.6
19	86	72.5
20	88	82.2
21	89	91.6
22	90	102

APPENDIX IV

Local volume table (Metric units) of *Eucalyptus camaldulensis* in the irrigated plantations of the Punjab.

dbh (cm)	Estimated height (metre)	Volume	
		(cu.m)	(cft)
4	6.71	.00768	0.271
6	8.23	.0140	0.495
8	9.75	.0250	0.883
10	11.28	.0419	1.48
12	12.80	.0659	2.33
14	14.33	.0983	3.47
16	15.54	.138	4.86
18	16.76	.186	6.58
20	17.68	.241	8.52
22	18.90	.311	11.0
24	19.51	.381	13.5
26	20.12	.460	16.3
28	20.72	.549	19.4
30	21.34	.649	22.9
32	21.95	.758	26.8
34	22.55	.879	31.0
36	22.86	.998	35.2
38	23.45	1.14	40.3
40	24.38	1.31	46.4
42	24.99	1.48	52.4
44	25.30	1.65	58.2
46	25.91	1.84	65.1
48	26.21	2.03	71.7
50	26.52	2.23	78.7
52	26.82	2.44	86.1
54	27.13	2.86	93.9
56	27.43	2.89	102

Tables were prepared from 4 cm to 52 cm dbh classes and from 3.0 metre to 34.0 metre height classes. Diameter breast height classes were kept by 2 centimetres interval and height classes were kept at 1.5 metre interval. These tables are given in Appendix II.

Local volume tables. To prepare local volume tables heights were estimated graphically for different diameter classes from actual data. The heights estimated for each dbh class, shown in Appendix III, were used in the combined variable formula and the following regression equation was derived:

$$V = 0.144074 + 0.002331 D^2 H$$

The value of correlation coefficient (r) for this equation is 0.987 which is close to 1 indicating that equation gives accurate estimation. Similarly value of standard error of estimate (SEE) is also very low (1.69) pointing to accurate estimation of volumes with the help of above equation.

The local volume tables prepared in British units are given in Appendix III. In metric units these are given in Appendix IV.

The original data were categorised in one inch diameter classes and average total volume and height for each class was calculated. The total volume estimated from regression equation used for local volume tables was compared with the average measured values as shown in Fig. 1. Similarly Fig. 2 gives comparison between average measured values of heights and graphically estimated heights.

The figures show that estimated volumes and heights follow closely the trend of measured values and thus give precise estimates within the range of data.

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