VOLUME TABLES OF YOUNG KEORA *(SONNERATIA APETALA)* TREES FOR THE WESTERN COASTAL BELT OF BANGLADESH

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ABSTRACT

The one-way (volume-diameter) and two-way (volume-diameter-height) volume tables of young keora *(Sonneratia apetala)* trees have been computed for both Patuakhali and Bhola Coastal Afforestation Divisions. The two volume tables are prepared for each of the divisions on the basis of the best fitted models chosen through F, t, mean square error (MSE), R2 and Furnival Index (FI). The volume tables are also validated through statistical tests.

বস্তুসংক্ষেপ

পটুয়াখালী ও ভোলা উপকূলীয় বন অঞ্চলে অল্প বয়সী কেওড়া গাছের বুক সমান ব্যাস এবং বুক সমান ব্যাস উচ্চতা ভিত্তিক ভলিউম টেবিল প্রস্তুত করা হয়েছে। এই ভলিউম টেবিলগুলি F, t, MSE, R2. ও FI দ্বারা বাছাইকৃত উত্তম মডেল থেকে তৈরী করা হয়। এই টেবিলগুলি পরিসংখ্যান নিরীক্ষার মাধ্যমে মাঠ পর্যায়ে যাচাই করা হয়।

INTRODUCTION

The mangrove forest of Bangladesh is divided into two main areas. viz., the Sundarbans and the Coastal Afforestations. The Sundarban forest is spread over 0.58 million ha in the south-western region (Ali, 1989). The major species are sundri *(Heritiera fomes)*, gewa *(Excoecaria agallocha)*, goran *(Ceriops decandra)*, baen *(Avicennia officinalis)*, passur *(Xylocarpus mekongensis)* and keora *(sonneratia apetala)*. But the plantations cover an area of 100 thousand hectare up to 1990. The Coastal Afforestation Programme is now established along coastal belt and off shore islands of Patuakhali, Bhola, Noakhali and Chittagong. It was first initiated in 1966 with the objectives of protecting lives and properties against natural calamities and introducing natural land management system. The planted species are keora, kankra *(Bruguiera sexangula)*, baen, gewa, sundri. etc. Keora because of its fast growing character as well as adaptibility to newly formed land, occupies 67 per cent of the entire Coastal Plantation areas (Drigo *et al.* 1987)

Keora has been considered as principal species for coastal plantations. The planting spacing for the species was 1.2m x 1.2m and about 6900 seedlings were planted per ha. The timber of the species can be used as packing boxes, bobbin, joinery, doors, windows, pulpwood, hardboard. etc. The species is planted in major areas of Patuakhali and Bhola Coastal Afforestation Division where information on volume and yield is not adequate. Volume regressions for estimating volume at three height classes was first established for sundri, gewa, keora, passur, dhundul *(Xylocarpus granatum)* and kankra in the Sundarbans by Forestal (1960) which were modified from Curtis (1933). Volume regressions for estimating volume underbark to a 10 cm top diameter underbark were also established (Chaffey *et al.* 1985) for sundri, gewa, keora and other species in the Sundarbans at three different height classes. The volume tables for keora in both Forestal and ODA (Overseas Development Administration) reports are one-way tables. In ODA's report, graphical presentation of volume (m^3) vs. diameter (cm) shows that volume of keora trees are underestimated in comparison with Forestal. It is also observed that keroa trees of diameter more than 70 cm volume does not increase whereas the same has a tendency to increase in Forestal. The two-way volume tables for keora and baen for four Coastal Afforestation Divisions were prepared for the first time (Drigo *et al.* 1987) For keora separate regressions for four Coastal Divisions and for baen combined regression for all Coastal Divisions were derived. But no validation was done. Diameter growth, basal area growth and volume yield growth equations for the species were developed for use in four Coastal Afforestation Divisions (Latif and Del Castillo. 1990)

In view of review activities done above, it is obvious that information of volume, though old, are available for natural keora trees in the Sundarbans. On the other hand only Drigo *et al.* drived volume tables without validation for the species in all Coastal Divisions. But in recent years thinning is carried out and matured keora trees are to be harvested. Besides detection of stem borer infestation in keora plantation (Islam *et al.* 1989) prescribes felling of severely infested trees. Research activities are going on this important tree species. The thinned and harvested products are to be estimated with the help of a reliable volume table. But no validated volume table is available for this valuable mangrove species.

The present study is to establish best relation of volume vs. diamete (one-way volume table) and volume vs. diameter and height (two-way volume table) for young keora trees planted at western coastal belt (Patuakhali and Barisal) through multiple regression analysis.

MATERIALS AND METHODS

Volume Table Data :

A mechanical thinning was made over an area of 7.25 ha in 5, 7 and 9 years old plantations of keora at Golachipa Range of Patuakhali C/A Division. A similar thinning was also done over an area of 7.25 ha in 5, 7 and 9 years old plantations of keora at Char Kukri Mukri Range of Bhola C/A Division. During the thinning programme in 1987 a sample of 461 trees covering diameter range of 2 cm to 16 cm and height range of 5 m to 17 m was measured from Patuakhali C/A Division (table 1). A second sample of 464 trees covering diameter range of 2 cm to 18 cm and height range of 5 m to 16 m was also measured from Bhola C/A Division during thinning activity in 1988 (Table 2). Data on diameter at breast height (cm), total height (m) and mid diameter (cm) overbark of each log of 2 metre long of each sample tree were collected. Diameter and height measurements were taken by diameter tape and long tape respectively. Top section of stem was considered upto minimum diameter of 2 cm. Volume of each section was calculated by Huber's formula (v = L x b, V = volume overbark. L= length of a section, b = area of a mid-crossection). Total volume of all sections of a tree was calculated through computer. Thus the three characteristics of each sample tree namely, diameter at breast height (cm), total height (m) and volume (m^3) were computed through computer. The volume regressions were analysed separately for each C/A Division. The following regression equations were used for two C/A Divisions :

1. $V = a + bD$
2. $B = a + bD^2$
3. $\ln(V) = a + b\ln(D)$
4. $V = a + bD + cD^2$
5. $V = a + bD^2H$
6. $\ln(V) = a + b\ln(D) + c\ln(H)$
7. $V = a + bD^2 + cH + dD^2H$
8. $V = a + bD^2 + cDH + dD^2H$
9. $V/D^2H = a + bD^2H + c/H + d/D^2$
10. $V/D^2H = a + bD^2H + c/H + d/D$

Where V= volume (m^3) overbark, D= diameter (cm) at breast height. H = total height (m), a = regression constant and b, c, d = regression coefficients.

These regression equations were fitted and some selection criteria such as analysis of variance table, t= values for regression coefficients, coefficient of determination (R^2) and Furnival Index (F1) were computed separately for both Patuakhali and Bhola. Regression equations with serial number 1 to 4 were compared and best relation (eqn. 4) was selected on the basis of F-test, t-test, R^2. MSE (mean square error) and FI. The one-way volume table was computed on the basis of this best selected regression equation. Regression equations with serial number 5 to 10 were compared and best relation (eqn. 6) was also chosen on the basis of F-test, t-test, R^2. MSE and FI. The two-way volume table was computed on the basis of this best selected regression equation.

Validation Data

The best selected models for both Patuakhali and Bhola were validated with the sample trees felled during same thinning operation in 1987 and 1988. A sample of 69 trees (Table 3) and another sample of 80 trees (table 4) were considered for validation of the volume tables prepared for Patuakhali and Bhola respectively. Data on diameter at breast height (cm), total height (m) and mid-diameter of all logs of all sample trees were collected. Stem wood volume of each sample tree was computed by Huber's formula, The following statistical tools were used for validation of volume tables :

i) Mean Square Error (MSE) :

MSE = E $(A-E)^2/n$ (Cox, 1984)

Where, A = Actual volume
E = Estimated volume

The criterion of minimum MSE is considered.

ii) paired t- test

t = d/SE(D) (Dawkins, 1975)
With n-1 degrees of freedom at 0.05 level.

where. D = Average difference of the pairs of actual and estimated volume.

The criterion of insignificant difference is followed.

iii) Per cent Absolute Deviation (% AD);

% AD = D (A - E) /EA x 100

Where, A and E indicate actual and estimated volume respectively.

The criterion of minimum % AD is considered.

iv) Chi-square test :

Chi-square = $\Sigma(A -E)^2/E$ with n-1 degrees of freedom.

Where, A = Actual volume
E = Estimated volume

The criterion of insignificant Chi - square is considered.

v) A - E vs. E plot and A vs. E plot :

Where, A = Actual volume
E = Estimated volume

Criteria : If A-E vs. E plot indicates horizontal band, the model is adequate. Again if A vs. E plot indicate 45° angle to the x- axis. the model is adequate.

RESULTS AND DISCUSSIONS

Volume Tables Computation :

A number of 10 regression equations was fitted with the sample trees taken from both Patuakhali (appendix - I) and Bhola (appendix - II) C/A Divisions. A few statistics such as F., t., MSE, R^2, FI was also computed for selection of best fitted models. This four models were then finally chosen for Patuakhali and Bhola on the basis of significant F & t, smallest MSE, largest R^2 and smallest FI (appendix - I and appendix II). The one-way (appendix-III) and two-way (appendix IV) volume tables for Patuakhali were computed by the corresponding best fitted models (V= 0, 0052 - 0.22D + $0.0005D^2$ and ln V = 9.1937 + 1. 7683 ln D + 0.7385ln H). Similarly the one-way (appendix-V) and two-way (appendix-VI) volume tables for Bhola were computed by the corresponding best fitted models (V = 0.0042 - 0.0017D + $0.00049D^2$ and ln (V) = -9.2587 + 1.6463 ln (D) + 0.9138 ln (H). It is important to note that volume regressions for young keora trees have little difference for both Patuakhali and Bhola C/A Divisions. It indicates that a single volume table will serve the purpose of estimating volume for young keora trees in future. However, at present, as regression constants and coefficients in two regions vary a little separate volume tables may be used.

Validation :

Sometimes the best fitted models may not supply the expected results in the field, The volume tables computed through best fitted models may be overestimated or underestimated in comparison with actual standing volume in the field. The four models (selected for Patuakhali and Bhola) were tested statistically for validation under Null Hypothesis that the sample trees used for volume tables computation have come from the same population of keora plantations in both Patuakhali and Bhola. The test statistics like MSE and % AD show very small figures. Besides, Paired t and Chi-square show insignificant. The test statistics indicate that there is no difference between estimated volume and actual volume. The values of the test are summarized tn table 5. Moreover the plots A-E vs. E (Fig. I to 4) and the plots A vs E (Fig. 5 to 8) show horizontal band and 45° angle to x-axis which give the same indication of no difference between computed volume and actual volume, Therefore the four models are validated and the computed tables are recommended to use in the field.

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Table 1. Stand table of sample trees with respect to dia (cm)- ht (m) for volume table (Patuakhali).

D/H	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
2	14	9	4	1	1	1	-	-	-	-	-	-	-	30
4	30	28	7	9	2	-	-	-	-	-	-	-	-	76
6	15	27	17	21	13	2	-	-	-	-	-	-	-	95
8	23	10	9	18	18	14	3	-	-	-	-	-	-	95
10	18	10	8	11	6	14	10	2	-	1	-	-	-	80
12	6	3	5	4	2	8	7	6	5	7	1	-	-	54
14	1	-	-	1	2	3	-	3	5	3	3	6	-	27
16	-	-	-	-	-	-	-	-	-	2	1	-	1	4
TOTAL	107	87	50	65	44	42	20	11	10	13	5	6	1	461

Table 2 : Stand table of sample trees with respect to dia (cm) - ht (m) for volume table (Barisal)

D/H	5	6	7	8	9	10	11	12	13	14	15	16	Total
2	19	27	8	1	3	-	-	-	-	-	-	-	58
4	19	20	14	14	16	1	-	-	-	-	-	-	84
6	3	10	22	10	18	20	2	1	-	-	-	-	86
8	3	6	6	11	2	9	17	10	4	-	-	-	68
10	-	10	8	6	1	1	4	18	11	7	-	-	66
12	-	2	12	10	3	2	4	10	7	16	3	-	69
14	-	-	-	4	1	-	-	-	7	5	9	1	27
16	-	-	-	-	-	-	-	-	1	2	1	-	4
18	-	-	-	-	-	-	-	-	-	-	2	-	2
TOTAL	44	75	70	56	44	33	27	39	30	30	15	1	464

Table 3 : **Stand table of sample trees with respect to dia (cm) - ht (m) for validation table (Patuakhali).**

D/H	5	6	7	8	9	10	11	12	13	14	15	Total
5	4	5	6	1	1	-	-	-	-	-	-	17
7	5	-	6	5	1	3	-	-	-	-	-	20
9	3	1	2	-	1	4	2	1	-	-	-	14
11	3	1	-	2	-	3	1	4	-	-	-	14
13	-	-	-	-	1	-	1	-	-	1	1	4
TOTAL	15	7	14	8	4	10	4	5	0	1	1	69

Table 4 : **Stand table of sample trees with respect to dia (cm) - ht (m) for validation of volume table (Barisal)**

D/H	5	6	7	8	9	10	11	12	13	14	Total
4	7	7	6	3	1	2	-	-	-	-	26
6	-	4	2	3	2	6	2	-	-	-	19
8	-	-	4	1	3	2	3	2	-	-	15
10	-	2	1	3	-	2	1	5	1	1	16
12	-	-	-		-	-	1	-	2	1	4
TOTAL	7	13	13	10	6	12	7	7	3	2	80

Table 5 : **Test statistics of the best selected models for volume tables validation in Patuakhali and Barisal C/A Division**

C/A Div.	Validated models	MSE	%AD	Paired |t|	Chi-square
Patuakhali	4	0.000064	0	0.007	0.1313
	6	0.000033	2.1	0.748	0.0553
Barisal	4	0.000044	0.4	0.132	0.1221
	6	0.000025	1.3	0.503	0.0754

Appendix - I

The fitted regression equations with statistics for Patuakhali (n=461)

Sl. No:	Regression	MSE	R^2	F	|t| b	c	d	F I
1.	V= -0.0223+0.0058D	0.0001	0.79	1726.89	41.56	-	-	0.011
2.	V= -0.0028+0.0003D^2	0.00008	0.85	2660.89	51.58	-	-	0.009
3.	lnV=-8.6883+2.2403 lnD	0.1035	0.92	5510.10	74.23	-	-	0.005
*4	V= 0.0052-0.0022D +0.0005D^2	0.00008	0.86	1380.40	3.94	14.76	-	0.009
5.	V= 0.0046+0.00003D^2H	0.00004	0.93	5718.61	75.62	-	-	0.006
*6.	lnV=-9.1937+1.7683 lnD +0.7385lnH	0.0547	0.95	5413.09	55.26	20.26	-	0.003
7.	V= -0.0065+0.0001D^2 +0.0015H+0.000014	0.00003	0.94	2552.77	10.38	0.04	12.32	0.006
8.	V= -0.0034+0.00008D^2 +0.0003DH +0.00005D^2H	0.00003	0.95	2700.19	7.43	10.54	2.75	0.005
9.	V/D^2H=0.00003-0.000000001D^2H +0.00005/H +0.0002/D^2	0.0000000003	0.31	67.94	1.26	2.95	6.01	0.00002
10.	V/D^2H=0.00002+0.0002/D^2H +0.00003/H +0.00006/D	0.00000003	0.31	67.32	2.11	1.82	4.05	0.00002

* Indicate best fitted model.

Appendix - II

The fitted regression equations with statistics for Barisal (n=464)

Sl. No.	Regression	MSE	R^2	F	|t| b	c	d	F I
1.	$V= -0.0275+0.0070D$	0.0002	0.80	1878.87	43.35	-	-	0.0126
2.	$V= -0.0022+0.0004D2$	0.0001	0.85	2672.31	51.69	-	-	0.0110
3.	$\ln V=-8.1965+2.1028 \ln D$	-.1257	0.89	3769.60	61.39	-	-	0.0067
*4	$V= 0.0042-0.0017D +0.0005D^2$	0.0001	0.85	1352.90	2.41	12.81	-	0.0109
5.	$V= 0.0043+0.00003D^2H$	0.00006	0.92	5518.11	74.28	-	-	0.0079
*6.	$\ln V=-9.2587+1.6463 \ln D +0.9138 \ln H$	0.0744	0.94	3345.80	44.89	17.89	-	0.0051
7.	$V=-0.0072+0.001D^2 +0.0013H+0.00002D^2H$	0.00006	0.93	2035.94	5.69	6.07	11.11	0.0075
8.	$V=-0.0025+0.00007D^2 +0.0002DH +0.000001D^2H$	0.00006	9.93	2058.99	3.87	6.49	6.25	0.0075
9.	$V/D^2H=0.00002+0.000000002D^2H +0.00006/H +0.0004/D^2$	0.0000000002	0.41	107.92	1.93	2.39	12.76	0.00002
10.	$V/D^2H=0.00004+0.0034/D^2H -0.00005/H -0.00008/D$	0.0000000002	0.49	150.18	12.07	1.82	4.03	0.00001

* Indicate best fitted model.

APPENDIX-III

The one-way volume table for Patuakhali C/A Division.

¥ Volume equation :

V = .523843521D-02-.217596437D-02*D+.470396772D-03*D*D

Volume cu. m., Dia cm

Dia.	Volume
2	0.00
4	0.00
6	0.01
8	0.02
10	0.03
12	0.05
14	0.07
16	0.09
18	0.12
20	0.15
22	0.19
24	0.22
26	0.27
28	0.31
30	0.36
32	0.42
34	0.48
38	0.60
40	0.67
42	0.74
44	0.82
46	0.90
48	0.98
50	1.07
52	1.16
54	1.26
56	1.36
58	1.46
60	1.57
62	1.68
64	1.79
66	1.91
68	2.03
70	2.16
72	2.29
74	2.42
76	2.56
78	2.70
80	2.84

Appendix-IV

The two-way volume table for Patuakhali C/A Division Volume equation :
V=EXPt- .91365975D+01+.1768343570+01*LOG+.738549238D+00*LOG(H))

Volume Cu. m., Dia cm and Ht m

D / H	2	3	4	5	6	7	8	9	10	11	12	12	14	15
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
8	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
10	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
12	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06
14	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08
16	0.02	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.10	0.10
18	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.10	0.11	0.12	0.12	0.12
20	0.03	0.05	0.06	0.07	0.06	0.09	0.09	0.10	0.11	0.12	0.13	0.14	0.14	0.15
22	0.04	0.05	0.07	0.06	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18
24	0.05	0.06	0.08	0.09	0.11	0.12	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21
26	0.05	0.07	0.09	0.11	0.12	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.23	0.24
28	0.06	0.08	0.10	0.12	0.14	0.16	0.17	0.19	0.20	0.22	0.23	0.24	0.26	0.27
30	0.07	0.09	0.12	0.14	0.16	0.18	0.19	0.21	0.23	0.24	0.26	0.28	0.29	0.31
32	0.08	0.11	0.13	0.15	0.18	0.20	0.22	0.24	0.26	0.27	0.29	0.31	0.33	0.34
34	0.09	0.12	0.14	0.17	0.20	0.22	0.24	0.26	0.28	0.31	0.33	0.35	0.36	0.38
36	0.10	0.13	0.16	0.19	0.22	0.24	0.27	0.29	0.31	0.34	0.36	0.38	0.40	0.42
38	0.11	0.14	0.18	0.21	0.24	0.27	0.29	0.32	0.35	0.37	0.40	0.42	0.44	0.47
40	0.12	0.16	0.19	0.23	0.26	0.29	0.32	0.35	0.38	0.41	0.43	0.46	0.49	0.51
42	0.13	0.17	0.21	0.25	0.28	0.32	0.35	0.38	0.41	0.44	0.47	0.50	0.53	0.56
44	0.14	0.18	0.23	0.27	0.31	0.34	0.38	0.42	0.45	0.48	0.51	0.54	0.58	0.61
46	0.15	0.20	0.25	0.29	0.33	0.37	0.41	0.45	0.49	0.52	0.56	0.59	0.62	0.65
48	0.16	0.22	0.27	0.31	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.67	0.71
50	0.17	0.23	0.29	0.34	0.39	0.43	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76
52	0.18	0.25	0.31	0.36	0.41	0.46	0.51	0.56	0.60	0.65	0.69	0.73	0.77	0.81
54	0.20	0.26	0.33	0.39	0.44	0.50	0.55	0.60	0.64	0.69	0.70	0.78	0.83	0.87
56	0.21	0.28	0.35	0.41	0.47	0.53	0.58	0.64	0.69	0.76	0.79	0.83	0.88	0.93
58	0.22	0.30	0.37	0.44	0.50	0.56	0.66	0.65	0.73	0.83	0.84	0.94	1.00	1.05
60	0.24	0.32	0.39	0.47	0.53	0.60	0.66	0.72	0.78	0.83	0.89	0.94	1.00	1.05
62	0.25	0.34	0.42	0.49	0.56	0.63	0.70	0.76	0.82	0.88	0.94	1.00	1.06	1.11
64	0.27	0.36	0.44	0.52	0.60	0.67	0.74	0.81	0.78	0.93	1.00	1.06	1.12	1.17
66	0.28	0.38	0.47	0.55	0.63	0.71	0.78	0.85	0.92	0.99	1.05	1.12	1.18	1.24
58	0.30	0.40	0.49	0.58	0.66	0.74	0.82	0.90	0.97	1.04	1.11	1.18	1.24	1.31
70	0.31	0.42	0.52	0.61	0.70	0.78	0.86	0.94	1.02	1.09	1.17	124	1.31	1.38
72	0.33	0.44	0.54	0.64	0.74	0.82	0.91	0.99	1.07	1.15	1.23	1.30	1.37	1.45
74	0.34	0.46	0.57	0.67	0.77	0.86	0.95	1.04	1.13	1.21	1.29	1.37	1.44	1.57
76	0.36	0.48	0.60	0.71	0.81	0.91	1.00	1.09	1.18	1.27	1.35	1.43	1.51	1.59
78	0.38	0.51	0.63	0.74	0.85	0.95	1.05	1.14	1.24	1.33	1.41	1.50	1.58	1.67
80	0.39	0.53	0.66	0.77	0.89	0.99	1.10	1.19	1.29	1.39	1.48	1.57	1.66	1.74

Contd.
Volume table for Patuakhali
Volume Cu. m., Dia cm and Ht m

D / H	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
8	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
10	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07
12	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.10	0.10
14	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.13
16	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.16	0.17
18	0.13	0.14	0.14	0.15	0.15	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20	0.20	0.21
20	0.16	0.15	0.17	0.18	0.19	0.19	0.20	0.21	0.21	0.22	0.23	0.23	0.24	0.24	0.25
22	0.19	0.19	0.20	0.21	0.22	0.23	0.24	0.24	0.25	0.26	0.27	0.27	0.28	0.29	0.30
24	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35
26	0.25	0.26	0.27	0.128	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.40
28	0.29	0.30	0.31	0.32	0.34	0.35	0.36	0.37	0.39	0.40	0.41	0.42	0.43	0.44	0.45
30	0.32	0.34	0.35	0.37	0.38	0.39	0.41	0.42	0.44	0.45	0.46	0.47	0.49	0.50	0.51
32	0.36	0.38	0.39	0.41	0.43	0.44	0.46	0.47	0.49	0.50	0.52	0.53	0.55	0.56	0.58
34	0.40	0.42	0.44	0.46	0.47	0.49	0.51	0.53	0.54	0.56	0.58	0.59	0.61	0.62	0.64
36	0.45	0.47	0.49	0.51	0.53	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.67	0.69	0.71
36	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0./70	0.72	0.74	0.76	0.78
40	0.54	0.56	0.59	0.61	0.63	0.66	0.68	0.70	0.72	0.75	0.77	0.79	0.81	0.83	0.85
42	0.58	0.61	0.64	0.66	0.69	0.71	0.74	0.76	0.79	0.81	0.84	0.86	0.88	0.91	0.93
44	0.63	0.66	0.69	0.72	0.75	0.79	0.80	0.83	0.86	0.88	0.91	0.93	0.96	0.99	1.01
46	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.98	1.01	0.04	1.07	1.09
48	0.74	0.77	0.81	0.84	0.87	0.91	0.94	0.97	0.00	0.03	0.06	0.09	0.12	1.15	1.18
50	0.80	0.83	0.87	0.90	0.94	1.97	1.01	1.04	1.07	1.11	1.14	1.17	1.20	1.23	1.27
52	0.85	0.89	0.93	0.97	1.01	1.04	1.08	1.12	1.15	1.19	1.22	1.26	1.29	1.32	1.36
54	0.91	0.95	0.99	1.04	1.80	1.11	1.15	1.19	1.23	1.27	1.31	1.34	1.38	1.42	1.45
56	0.97	1.02	1.06	1.10	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43	1.47	1.51	1.55
58	1.03	1.08	1.13	1.17	1.22	1.27	1.31	1.35	1.40	1.44	1.48	1.52	1.56	1.61	1.65
60	1.10	1.15	1.20	1.25	1.30	1.34	1.39	1.44	1.48	1.53	1.57	1.62	1.66	1.70	1.75
62	1.16	1.22	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.67	1.71	1.76	1.81	1.85
64	1.23	1.29	1.34	1.40	1.45	1.51	1.56	1.61	1.66	1.71	1.76	1.81	1.86	1.91	1.96
66	1.30	1.36	1.42	1.48	1.53	1.59	1.65	1.70	1.75	1.81	1.86	1.91	1.97	2.02	2.07
68	1.37	1.43	1.50	1.62	1.62	1.68	1.73	1.79	1.85	1.91	1.96	2.02	2.07	2.13	2.18
70	1.44	1.51	1.57	1.64	1.70	1.76	1.83	1.89	1.95	2.01	2.07	2.12	2.18	2.24	2.30
72	1.52	1.59	1.65	1.72	1.79	1.85	1.92	1.98	2.05	2.11	2.17	2.23	2.29	2.35	2.41
74	1.59	1.67	1.74	1.81	1.88	2.95	2.01	2.08	2.15	2.21	2.28	2.34	2.41	2.47	2.53
76	1.67	1.75	1.82	1.89	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46	2.52	2.59	2.66
78	1.75	1.83	1.91	1.98	2.06	2.14	2.21	2.28	2.36	2.43	2.50	2.57	2.64	2.71	2.78
80	1.83	1.91	1.99	1.07	2.15	2.33	2.31	2.39	2.47	2.54	2.62	2.69	2.76	2.84	2.91

Contd ......

Volume table for Patuakhali

Volume Cu. m., Dia cm and Ht m

D / H	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
6	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04
8	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07
10	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10
12	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.14
14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.18
16	0.17	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.21	0.21	0.22	0.22	0.22	0.23
18	0.21	0.22	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.27	0.27	0.28	0.28
20	0.26	0.26	0.27	0.27	0.28	0.29	0.29	0.30	0.30	0.31	0.32	0.32	0.33	0.33	0.34
22	0.30	0.31	0.32	0.33	0.33	0.34	0.35	0.35	0.36	0.37	0.37	0.38	0.39	0.39	0.40
24	0.35	0.36	0.37	0.38	0.39	0.40	0.40	0.41	0.42	0.43	0.44	0.44	0.45	0.46	0.47
26	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54
28	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.51
30	0.53	0.54	0.55	0.56	0.58	0.59	0.60	0.61	0.62	0.62	0.65	0.66	0.67	0.68	0.69
32	0.59	0.60	0.62	0.63	0.64	0.66	0.67	0.68	0.70	0.71	0.72	0.74	0.75	0.76	0.78
34	0.66	0.67	0.69	0.70	0.72	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.86
36	0.73	0.74	0.76	0.78	0.79	0.81	0.83	0.84	0.86	0.88	0.89	0.91	0.92	0.94	0.96
36	0.80	0.82	0.84	0.85	0.87	0.89	0.91	0.93	0.95	0.96	0.98	1.00	1.02	1.03	1.05
40	0.87	0.90	0.92	0.94	0.96	0.98	1.00	1.02	1.04	1.06	1.07	1.09	1.11	1.13	1.15
42	1.95	1.98	1.00	1.02	1.04	1.06	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.26
44	1.03	1.06	1.08	1.11	1.13	1.16	1.18	1.20	1.23	1.25	1.27	1.30	1.32	1.34	1.36
46	1.12	1.15	1.17	1.20	1.22	1.25	1.28	1.30	1.33	1.35	1.38	1.40	1.43	1.45	1.47
48	1.21	1.24	1.26	1.29	1.32	1.35	1.38	1.40	1.43	1.46	1.48	1.51	1.54	1.56	1.59
50	1.30	1.33	1.36	1.39	1.42	1.45	1.48	1.51	1.54	1.57	1.59	1.62	1.65	1.68	1.71
52	0.39	0.42	0.46	1.49	1.52	1.55	1.58	162	1.65	1.68	1.71	1.74	1.77	1.80	1.83
54	0.49	0.52	1.56	1.59	1.63	1.66	1.69	1.73	1.76	1.79	1.83	1.86	1.89	1.93	1.96
56	0.59	1.62	1.66	1.70	1.73	1.77	1.81	1.84	1.88	1.91	1.95	1.98	2.02	2.05	2.09
58	1.69	1.73	1.77	1.81	1.84	1.88	1.92	1.96	2.00	2.04	2.07	2.11	2.15	1.18	2.22
60	1.79	1.83	1.88	1.92	1.96	2.00	2.04	2.08	2.12	2.16	2.20	2.24	2.28	2.32	2.36
62	1.90	1.94	1.99	2.03	2.08	2.12	2.16	2.21	2.25	2.29	2.33	2.37	2.42	2.46	2.50
64	2.01	2.06	2.10	2.15	2.20	2.24	2.29	2.33	2.38	2.42	2.47	2.51	2.56	2.60	2.64
66	2.12	2.17	2.22	2.27	2.32	2.37	2.42	2.46	2.51	2.56	2.61	2.65	2.70	2.75	2.79
68	2.23	2.29	2.34	2.39	2.44	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.89	2.94
70	2.35	2.41	2.46	2.52	2.57	2.63	2.68	2.73	2.79	2.84	2.89	2.94	3.00	3.05	3.10
72	2.47	2.53	2.59	2.65	2.70	2.76	2.82	2.87	2.93	2.98	3.04	3.09	3.15	3.20	3.26
74	2.59	2.66	2.72	2.78	2.84	2.90	2.96	3.02	3.07	3.13	3.19	3.25	3.30	3.36	3.42
76	2.72	2.78	2.85	2.91	2.98	3.04	3.10	3.16	3.22	3.28	3.34	3.40	3.46	3.52	3.58
78	2.85	2.92	2.98	3.05	3.12	3.18	3.25	3.31	3.37	3.44	3.50	3.56	3.63	3.69	3.75
80	2.98	3.05	3.12	3.19	3.26	3.33	3.39	3.46	3.53	3.60	3.66	3.73	3.79	3.86	3.92

Contd ......

Volume table for Patuakhali

Volume Cu. m., Dia cm and Ht m

D / H	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
6	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
8	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12
12	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.17
14	0.18	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.22	0.22	0.22
16	0.23	0.24	0.24	0.24	0.25	0.25	0.25	0.26	0.26	0.26	0.27	0.27	0.27	0.28	0.28
18	0.29	0.29	0.29	0.30	0.30	0.31	0.31	0.32	0.32	0.33	0.33	0.33	0.34	0.34	0.35
20	0.34	0.35	0.35	0.36	0.37	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.41	0.41	0.42
22	0.41	0.41	0.42	0.43	0.43	0.44	0.45	0.45	0.46	0.46	0.47	0.48	0.48	0.49	0.49
24	0.47	0.48	0.49	0.50	0.50	0.51	0.52	0.53	0.53	0.54	0.55	0.56	0.56	0.57	0.58
26	0.55	0.56	0.56	0.57	0.58	0.59	0.62	0.61	0.61	0.62	0.63	0.64	0.65	0.66	0.66
28	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.74	0.75	0.76
30	0.70	0.71	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.85	0.86
32	0.79	0.80	0.81	0.83	0.84	0.85	0.86	0.88	0.89	0.90	0.91	0.92	0.94	0.95	0.96
34	0.88	0.89	0.91	0.92	0.93	0.95	0.96	1.97	0.99	1.00	1.02	1.03	1.04	1.06	1.07
36	1.97	1.99	1.00	1.02	1.03	1.05	1.06	1.08	1.09	1.11	1.12	1.14	1.15	1.17	1.18
38	1.07	1.09	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.25	1.27	1.28	1.30
40	1.17	1.19	1.21	1.23	1.24	1.26	1.28	1.30	1.32	1.34	1.35	1.37	1.39	1.41	1.42
42	1.28	1.30	1.32	1.34	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.49	1.51	1.53	1.55
44	1.39	1.41	1.43	1.45	1.47	1.49	1.52	1.54	1.56	1.58	1.60	1.62	1.64	1.66	1.69
46	1.50	1.52	1.55	1.57	1.59	1.62	1.64	1.66	1.69	1.71	1.73	1.76	1.78	1.80	1.82
48	1.62	1.64	1.67	1.69	1.72	1.74	1.77	1.79	1.82	1.84	1.87	1.89	1.92	1.94	1.97
50	1.74	1.76	1.79	1.82	1.85	1.87	1.90	1.93	1.95	1.98	2.01	2.03	2.06	2.09	2.11
52	1.86	1.89	1.92	1.95	1.98	2.01	2.04	2.07	2.10	2.12	2.15	2.18	2.21	2.24	2.26
54	1.99	2.02	2.05	2.08	2.12	2.15	2.18	2.21	2.24	2.27	2.30	2.33	2.36	2.39	2.42
56	2.12	2.16	2.19	2.22	2.26	2.29	2.32	2.36	2.39	2.42	2.45	2.49	2.52	2.55	2.58
58	2.26	2.29	2.33	2.37	2.40	2.44	2.47	2.51	2.54	2.58	2.61	2.64	2.68	2.71	2.75
60	2.40	2.44	2.47	2.51	2.55	2.59	2.62	2.66	2.70	2.74	2.77	2.81	2.84	2.88	2.92
62	2.54	2.58	2.62	2.66	2.70	2.74	2.78	2.82	2.86	2.90	2.94	2.98	3.01	3.05	3.09
64	2.69	2.73	2.77	2.82	2.86	2.90	2.94	2.93	3.02	3.07	3.11	3.15	3.19	3.23	3.27
66	2.84	2.88	2.93	2.97	3.02	3.06	3.11	3.15	3.19	3.24	3.28	3.32	3.37	3.41	3.45
58	3.99	3.04	3.09	3.13	3.18	3.23	3.27	3.32	3.37	3.41	3.46	3.50	3.55	3.59	3.64
70	3.15	3.20	3.25	3.30	3.35	3.40	3.45	3.50	3.54	3.59	3.64	3.69	3.74	3.78	3.83
72	3.31	3.36	3.41	3.47	3.62	3.57	3.62	3.67	3.72	3.78	3.83	3.88	3.93	3.98	4.03
74	3.47	3.53	3.58	3.64	3.69	3.75	3.80	3.86	3.91	3.96	4.02	4.07	4.12	4.17	4.23
76	3.64	3.70	3.76	3.81	3.87	3.93	3.99	4.04	4.10	4.15	4.21	4.27	4.32	4.38	4.43
78	3.81	3.87	3.93	3.99	4.05	4.11	4.17	4.23	4.29	4.35	4.41	4.47	4.52	4.68	4.64
80	3.99	4.05	4.11	4.18	4.24	4.30	4.36	4.43	4.49	4.55	4.61	4.67	4.75	4.79	4.85

APPENDIX IX-V

The one-way volume table for Bhola C/A Division
Volume equation :
V : .421722989D-02-.166368812D-02*D+.490836340D-03*D*D

Volume cu. m., Dia cm

Dia.	Volume
2	0.00
4	0.01
6	0.01
8	0.02
10	0.04
12	0.05
14	0.08
16	0.10
18	0.13
20	0.17
22	0.21
24	0.25
26	0.29
28	0.34
30	0.40
32	0.45
34	0.52
36	0.58
38	0.65
40	0.72
42	0.80
44	0.88
46	0.97
48	1.06
50	1.15
52	1.24
54	1.35
56	1.45
58	1.56
60	1.67
62	1.79
64	1.91
66	1.03
68	2.16
70	2.29
72	2.43
74	2.57
76	2.71
78	2.86
80	3.01

APPENDIX-VI

The two-way volume table for Bhola C/A Division
Volume equation :
V=EXP(-.02587040+01 + .1646317360 + 01 *LOG(D) + .913826214D + 00 *LOG(H))
Volume Cu. m., Dia cm and Ht m

D / H	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
6	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
8	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
10	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05
12	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.07
14	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.08	0.09
16	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.10	0.11
18	0.02	0.03	0.04	0.05	0.06	0.07	0.07	0.08	0.09	0.10	0.11	0.12	0.12	0.13
20	0.02	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16
22	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.12	0.13	0.14	0.15	0.16	0.17	0.18
24	0.03	0.05	0.06	0.08	0.09	0.11	0.12	0.13	0.15	0.16	0.17	0.19	0.20	0.21
26	0.04	0.06	0.07	0.09	0.10	0.12	0.14	0.15	0.17	0.18	0.20	0.21	0.23	0.24
28	0.04	0.06	0.08	0.10	0.12	0.14	0.15	0.17	0.19	0.21	0.22	0.24	0.26	0.27
30	0.05	0.07	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.29	0.31
32	0.05	0.08	0.10	0.12	0.15	0.17	0.19	0.21	0.23	0.26	0.28	0.30	0.32	0.34
34	0.06	0.09	0.11	0.14	0.16	0.19	0.21	0.24	0.26	0.28	0.31	0.33	0.35	0.38
36	0.07	0.09	0.12	0.15	0.18	0.21	0.23	0.26	0.29	0.31	0.34	0.36	0.39	0.41
38	0.07	0.10	0.13	0.17	0.20	0.22	0.25	0.28	0.31	0.34	0.37	0.40	0.42	0.45
40	0.08	0.11	0.15	0.18	0.21	0.24	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.49
42	0.08	0.12	0.16	0.20	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50	0.53
44	0.09	0.13	0.17	0.21	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.50	0.54	0.57
46	0.10	0.14	0.18	0.23	0.27	0.31	0.35	0.39	0.43	0.47	0.50	0.54	0.58	0.62
48	0.11	0.15	0.20	0.24	0.29	0.33	0.37	0.42	0.46	0.50	0.54	0.58	0.62	0.66
50	0.11	0.16	0.21	0.26	0.31	0.35	0.40	0.44	0.49	0.53	0.58	0.62	0.67	0.71
52	0.12	0.17	0.23	0.28	0.33	0.38	0.43	0.47	0.52	0.57	0.62	0.66	0.71	0.76
54	0.13	0.18	0.24	0.29	0.35	0.40	0.45	0.50	0.56	0.61	0.66	0.71	0.76	0.81
56	0.14	0.20	0.26	0.31	0.37	0.43	0.48	0.54	0.59	0.64	0.70	0.75	0.80	0.85
58	0.14	0.21	0.27	0.33	0.39	0.45	0.51	0.57	0.63	0.68	0.74	0.79	1.85	0.91
60	0.15	0.22	0.29	0.35	0.41	0.48	0.54	0.60	0.66	0.72	0.78	0.84	0.90	0.96
62	0.16	0.23	0.30	0.37	0.44	0.50	0.57	0.63	0.70	0.76	0.82	0.89	0.95	1.01
64	0.17	0.24	0.32	0.39	0.46	0.53	0.60	0.67	0.74	0.80	0.87	0.93	1.00	1.06
66	0.18	0.26	0.33	0.41	0.48	0.56	0.63	0.70	0.77	0.84	0.91	0.98	1.05	1.12
68	0.19	0.27	0.35	0.43	0.51	0.59	0.66	0.74	0.81	0.89	0.96	1.03	1.10	1.18
70	0.20	0.28	0.37	0.45	0.53	0.62	0.69	0.77	0.85	0.93	1.01	1.08	1.16	1.23
72	0.21	0.30	0.39	0.47	0.56	0.64	0.73	0.81	0.89	0.97	1.05	1.13	1.21	1.29
74	0.21	0.31	0.40	0.50	0.59	0.67	0.76	0.85	0.93	1.02	1.10	1.19	1.27	1.35
76	0.22	0.32	0.42	0.52	0.61	0.70	0.80	0.89	0.98	1.06	1.15	1.24	1.33	1.41
78	0.23	0.34	0.44	0.54	0.64	0.73	0.83	0.90	1.02	1.11	1.20	1.29	1.38	1.47
80	0.24	0.35	0.46	0.56	0.67	0.77	0.87	0.96	1.06	1.16	1.25	1.35	1.44	1.54

Contd...

Volume table for Bhola

Volume Cu. m., Dia cm and Ht m

D / H	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
6	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
8	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07
10	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.09
12	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.13
14	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16
16	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17	0.17	0.18	0.19	0.19	0.20	0.20
18	0.14	0.15	0.16	0.16	0.17	0.18	0.19	0.19	0.20	0.21	0.22	0.23	0.23	0.24	0.25
20	0.17	0.18	0.19	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.30
22	0.19	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.34	0.35
24	0.22	0.24	0.25	0.26	0.28	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.39	0.40
26	0.26	0.27	0.29	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43	0.44	0.46
28	0.29	0.31	0.32	0.34	0.36	0.37	0.39	0.40	0.42	0.44	0.45	0.47	0.48	0.50	0.51
30	0.32	0.34	0.36	0.38	0.40	0.42	0.43	0.45	0.47	0.49	0.51	0.52	0.54	0.56	0.58
32	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64
34	0.40	0.42	0.44	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.64	0.66	0.69	0.71
36	0.44	0.46	0.49	0.51	0.54	0.56	0.59	0.61	0.63	0.66	0.68	0.71	0.73	0.75	0.78
38	0.48	0.51	0.53	0.56	0.59	0.61	0.64	0.67	0.69	0.72	0.75	0.77	0.80	0.82	0.85
40	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.75	0.78	0.81	0.84	0.87	0.90	0.93
42	0.56	0.60	0.63	0.66	0.69	0.72	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00
44	0.61	0.64	0.68	0.71	0.75	0.78	0.82	0.85	0.88	0.92	0.95	0.98	1.02	1.05	1.08
46	0.66	0.69	0.73	0.77	0.80	0.84	0.88	0.91	0.95	0.99	1.02	1.06	1.09	1.13	1.16
48	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.13	1.17	1.21	1.25
50	0.875	0.80	0.84	0.88	0.92	0.96	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.30	1.34
52	0.80	0.85	0.89	0.94	0.98	1.03	1.07	1.12	1.16	1.21	1.25	1.29	1.34	1.38	1.43
54	0.85	0.90	0.95	1.00	1.05	1.09	1.14	1.19	1.24	1.28	1.33	1.38	1.42	1.47	1.52
56	0.91	1.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61
58	0.96	1.02	1.07	1.12	1.18	1.23	1.28	1.34	1.39	1.44	1.50	1.55	1.60	1.65	1.71
60	1.02	1.07	1.13	1.19	1.25	1.30	1.36	1.42	1.47	1.53	1.58	1.64	1.69	1.75	1.80
62	1.07	1.13	1.19	1.25	1.31	1.37	1.43	1.49	1.55	1.61	1.67	1.73	1.79	1.85	1.90
64	1.13	1.19	1.26	1.32	1.39	1.45	1.51	1.57	1.64	1.70	1.76	1.82	1.88	1.94	2.01
66	1.19	1.26	1.32	1.39	1.46	1.52	1.59	1.66	1.72	1.79	1.85	1.92	1.98	2.05	2.11
68	1.25	1.32	1.39	1.46	1.53	1.60	1.67	1.74	1.81	1.88	1.95	2.01	2.08	2.15	2.22
70	1.31	1.38	1.46	1.53	1.61	1.68	1.75	1.82	1.90	1.97	2.04	2.11	2.18	2.25	2.33
72	1.37	1.45	1.53	1.60	1.68	1.76	1.83	1.91	2.99	2.06	2.14	2.21	2.29	2.36	2.44
74	1.43	1.52	1.60	1.68	1.76	1.84	1.92	2.00	2.08	2.16	2.24	2.31	2.39	2.47	2.55
76	1.50	1.58	1.67	1.75	1.84	1.92	2.01	2.09	2.17	2.25	2.34	2.42	2.50	2.58	2.66
78	1.56	1.65	1.74	1.83	1.92	2.01	2.09	2.18	2.27	2.35	2.44	2.52	2.61	2.69	2.78
80	1.63	1.72	1.82	1.91	2.00	2.09	2.18	2.27	2.36	2.45	2.54	2.63	2.72	2.81	2.90

Contd...

Volume table for Bhola

Volume Cu. m., Dia cm and Ht m

D / H	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
6	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06
8	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09
10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.14
12	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.17	0.17	0.17	0.18	0.18	0.18
14	0.17	0.17	0.18	0.18	0.19	0.19	0.20	0.20	0.21	0.21	0.22	0.22	0.23	0.23	0.24
16	0.21	0.22	0.22	0.23	0.24	0.24	0.25	0.25	0.26	0.27	0.27	0.28	0.28	0.29	0.30
18	0.26	0.26	0.27	0.28	0.29	0.29	0.30	0.31	0.32	0.32	0.33	0.34	0.35	0.35	0.36
20	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.38	0.39	0.40	0.41	0.42	0.43
22	0.36	0.37	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50
24	0.41	0.42	0.44	0.45	0.46	0.47	0.48	0.50	0.51	0.52	0.53	0.54	0.55	0.57	0.58
26	0.47	0.48	0.50	0.51	0.52	0.54	0.55	0.57	0.58	0.59	0.61	0.62	0.63	0.65	0.66
28	0.53	0.55	0.56	0.58	0.59	0.61	0.62	0.64	0.65	0.67	0.68	0.70	0.71	0.73	0.75
30	0.59	0.61	0.63	0.65	0.66	0.68	0.70	0.72	0.73	0.75	0.77	0.78	0.80	0.82	0.83
32	0.66	0.68	0.70	0.72	0.74	0.76	0.78	0.80	0.81	0.83	0.85	0.87	0.89	0.91	0.93
34	0.73	0.75	0.77	0.79	0.82	0.84	0.86	0.88	0.90	0.92	0.94	0.96	0.98	1.00	1.03
36	0.80	0.83	0.85	0.87	0.90	0.92	0.94	0.97	0.99	1.01	1.04	1.06	1.08	1.10	1.13
36	0.88	0.90	0.93	0.95	0.98	1.00	1.03	1.06	1.08	1.11	1.13	1.16	1.18	1.21	1.23
40	0.95	0.98	1.01	1.04	1.07	1.09	1.12	1.15	1.18	1.20	1.23	1.26	1.29	1.31	1.34
42	1.03	1.06	1.09	1.12	1.15	1.18	1.21	1.24	1.27	1.30	1.33	1.36	1.39	1.42	1.45
44	1.12	1.15	1.18	1.21	1.25	1.28	1.31	1.34	1.38	1.41	1.44	1.47	1.50	1.54	1.57
46	1.20	1.24	1.27	1.31	1.34	1.38	1.41	1.45	1.48	1.52	1.55	1.58	1.62	1.65	1.69
48	1.29	1.33	1.36	1.40	1.44	1.48	1.51	1.55	1.59	1.63	1.66	1.70	1.74	1.77	1.81
50	1.38	1.42	1.46	1.50	1.54	1.58	1.62	1.66	1.70	1.74	1.78	1.82	1.86	1.90	1.94
52	1.47	1.51	1.56	1.60	1.64	1.68	1.73	1.77	1.81	1.85	1.90	1.94	1.98	1.02	2.06
54	1.56	1.61	1.65	1.70	1.75	1.79	1.84	1.88	1.93	1.97	2.02	2.06	2.11	2.15	2.20
56	0.66	1.71	1.76	1.81	1.85	1.90	1.95	2.00	2.05	2.09	2.14	2.19	2.24	2.29	2.33
58	1.76	1.81	1.86	1.91	1.96	2.02	2.07	1.12	1.17	1.22	1.27	1.32	2.37	1.42	2.47
60	1.86	1.91	1.97	2.02	2.08	2.13	2.19	2.24	2.29	2.35	2.40	2.45	2.51	2.56	2.61
62	1.96	2.02	2.08	2.13	2.19	2.25	2.31	2.36	2.42	2.48	2.53	2.59	2.65	2.70	2.76
64	2.07	2.13	2.19	2.25	2.31	2.37	2.43	2.49	2.55	2.61	2.67	2.73	2.79	2.85	2.91
66	2.17	2.24	2.30	2.37	2.43	2.49	2.56	2.62	2.68	2.75	2.81	2.87	2.93	2.99	3.06
68	2.28	2.35	2.42	2.49	2.55	2.62	2.69	2.75	2.82	2.88	2.95	3.01	3.08	3.15	3.21
70	2.40	2.47	2.54	2.61	2.68	2.75	2.82	2.89	2.96	3.02	3.09	3.16	3.23	3.30	3.37
72	2.51	2.58	2.66	2.73	2.80	2.88	2.95	3.02	3.10	3.17	3.24	3.31	3.38	3.46	3.53
74	2.63	2.70	2.78	2.86	2.93	3.01	3.09	3.16	3.24	3.31	3.39	3.47	3.54	3.62	3.69
76	2.74	2.82	2.90	2.98	3.06	3.14	3.22	3.30	3.38	3.46	3.54	3.62	3.70	3.78	3.86
78	2.86	2.95	3.03	3.12	3.20	3.28	3.37	3.45	3.53	3.61	3.70	3.78	3.86	3.94	4.02
80	2.98	3.07	3.16	3.25	3.34	3.42	3.51	3.60	3.68	3.77	3.85	3.94	4.03	4.11	4.20

Contd...
Volume table for Bhola
Volume Cu. m., Dia cm and Ht m

D / H	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
6	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08
8	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12
10	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.18
12	0.19	0.19	0.20	0.20	0.20	0.21	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.24	0.24
14	0.24	0.25	0.25	0.26	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.30	0.30	0.30	0.31
16	0.30	0.31	0.31	0.32	0.33	0.33	0.34	0.34	0.35	0.36	0.36	0.37	0.37	0.38	0.39
18	0.37	0.37	0.38	0.39	0.40	0.40	0.41	0.42	0.43	0.43	0.44	0.45	0.45	0.46	0.47
20	0.44	0.45	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.51	0.52	0.53	0.54	0.55	0.56
22	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.65
24	0.59	0.60	0.61	0.62	0.64	0.65	0.66	0.67	0.68	0.69	0.71	0.72	0.73	0.74	0.75
26	0.67	0.69	0.70	0.71	0.73	0.74	0.75	0.77	0.78	0.79	0.81	0.82	0.83	0.84	0.86
28	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.91	0.92	0.94	0.95	0.97
30	0.85	0.87	0.89	0.90	0.92	0.94	0.95	0.97	0.99	1.00	1.02	1.04	1.05	1.07	1.09
32	0.95	0.97	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.13	1.15	1.17	1.19	1.21
34	1.05	1.07	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.29	1.31	1.33
36	1.15	1.17	1.20	1.22	1.24	1.26	1.29	1.31	1.33	1.35	1.38	1.40	1.42	1.44	1.47
38	1.26	1.28	1.31	1.33	1.36	1.38	1.41	1.43	1.46	1.48	1.50	1.53	1.55	1.58	1.60
40	1.37	1.39	1.42	1.45	1.48	1.50	1.53	1.56	1.58	1.61	1.64	1.66	1.69	1.72	1.74
42	1.48	1.51	1.54	1.57	1.60	1.63	1.66	1.69	1.72	1.74	1.77	1.80	1.83	1.86	1.89
44	1.60	1.63	1.66	1.70	1.73	1.76	1.79	1.82	1.85	1.88	1.92	1.95	1.98	2.01	2.04
46	1.72	1.76	1.79	1.82	1.86	1.89	1.93	1.96	1.99	2.03	2.06	2.09	2.13	2.16	2.19
48	1.85	1.88	1.92	1.96	1.99	2.03	2.07	2.10	2.14	2.17	2.21	2.25	2.28	2.32	2.35
50	1.97	2.01	2.05	2.09	2.13	2.17	2.21	2.25	2.29	2.33	2.36	2.40	2.44	2.48	2.52
52	2.11	2.15	2.19	2.23	2.27	2.31	2.36	2.40	2.44	2.48	2.52	2.56	2.60	2.64	2.69
54	2.24	2.29	2.33	2.37	2.42	2.46	2.51	2.55	2.60	2.64	2.68	2.73	2.77	2.81	2.86
56	2.38	2.43	2.47	2.52	2.57	2.62	2.66	2.71	2.76	2.80	2.85	2.89	2.94	2.99	3.03
58	2.52	2.57	2.62	2.67	2.72	2.77	2.82	2.87	2.92	2.97	3.02	3.07	3.12	3.17	3.21
60	2.67	2.72	2.77	2.82	2.88	2.93	2.98	3.03	3.09	3.14	3.19	3.24	3.30	3.35	3.40
62	2.81	2.87	2.93	2.98	3.04	3.09	3.15	3.20	3.26	3.31	3.37	3.42	3.48	3.53	3.59
64	2.96	3.02	3.08	3.14	3.20	3.26	3.32	3.37	3.43	3.49	3.55	3.61	3.66	3.72	2.78
66	3.12	3.18	3.24	3.30	3.37	3.43	3.49	3.55	3.61	3.67	3.73	3.79	3.85	2.92	2398
68	3.28	3.34	3.41	3.47	3.54	3.60	3.66	3.73	3.79	3.86	3.92	3.99	4.05	4.11	4.18
70	3.44	3.50	3.57	3.64	3.71	3.78	3.84	3.91	3.98	4.05	4.11	4.18	4.25	4.31	4.38
72	3.60	3.67	3.74	3.81	3.88	3.96	4.03	4.10	4.17	4.24	4.31	4.38	4.45	4.52	4.59
74	3.77	3.84	3.91	3.99	4.06	4.14	4.21	4.29	4.36	4.43	4.51	4.58	4.65	4.73	4,80
76	3.93	4.01	4.09	4.17	4.25	4.32	4.40	4.48	4.56	4.63	4.71	4.79	4.86	4.94	5.02
78	4.11	4.19	4.27	4.35	4.43	4.51	4.59	4.67	4.75	4.83	4.92	5.00	5.08	5.16	5.23
80	4.28	4.37	4.45	4.54	4.62	4.70	4.79	4.87	4.96	5.04	5.12	5.21	5.29	5.37	5.46

$$V = a + b*D + c*D*D$$

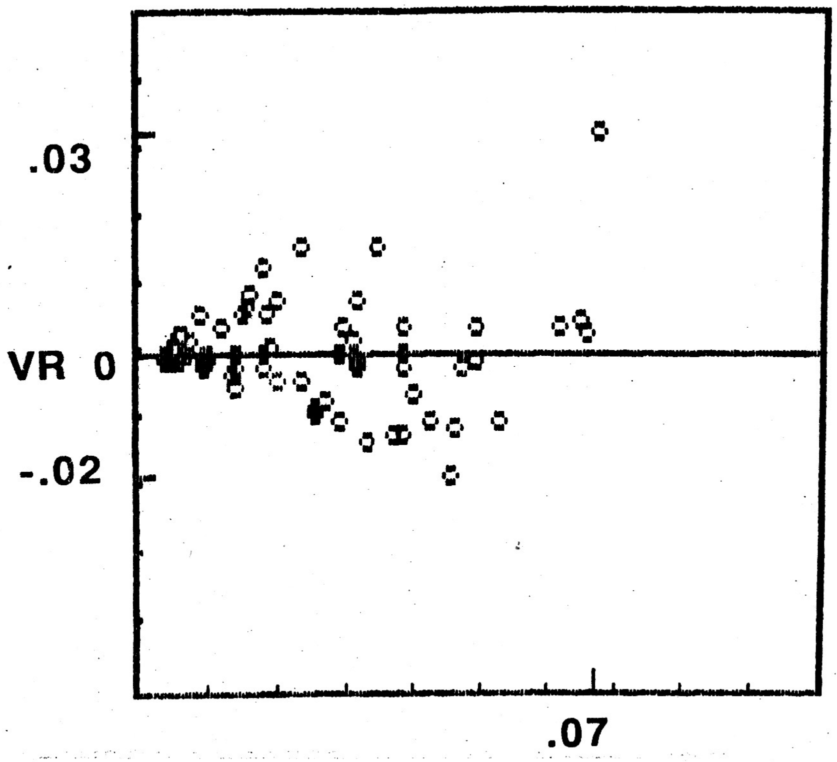

Fig. 1

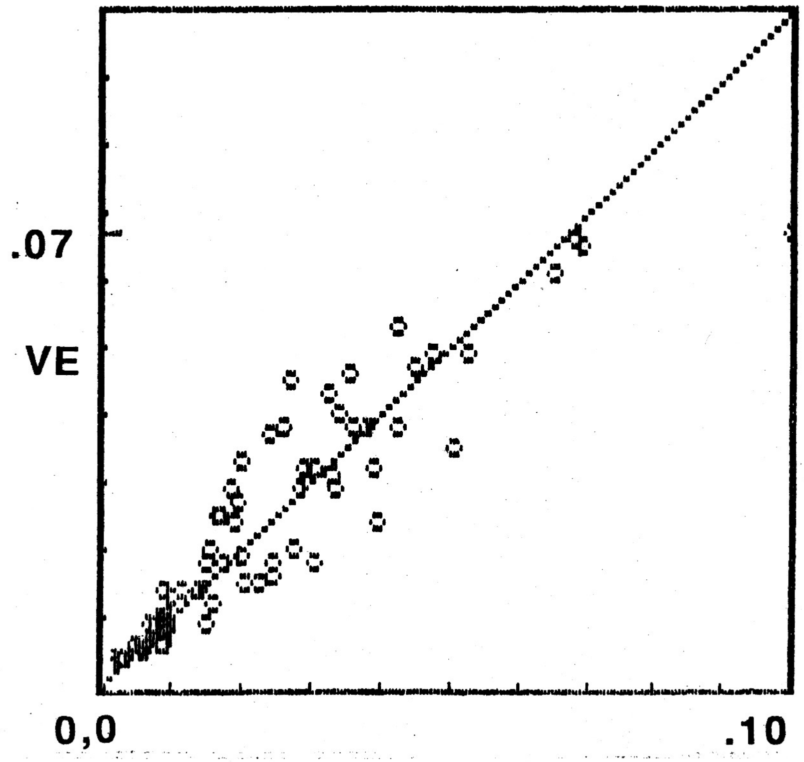

Fig. 2

PATUAKHALI SAMPLE DATA (69) VALIDATION TEST

VR= Residual volume, VE=Estimated volume, VO=Observed volume

$$\ln(V) = a + b*\ln(D) + c*\ln(H)$$

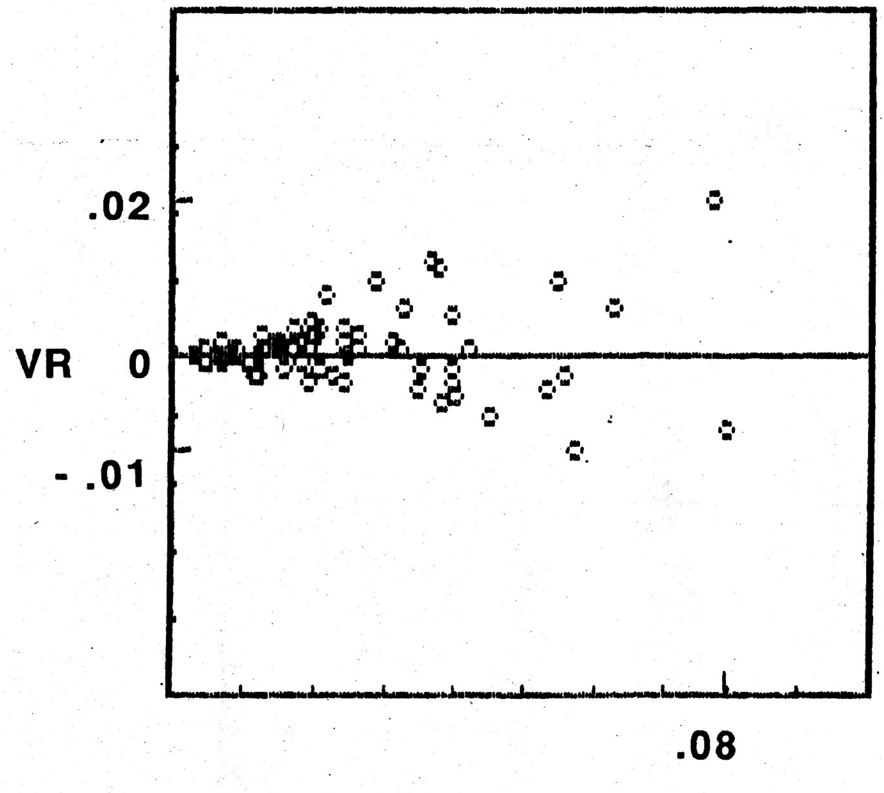

Fig. 3

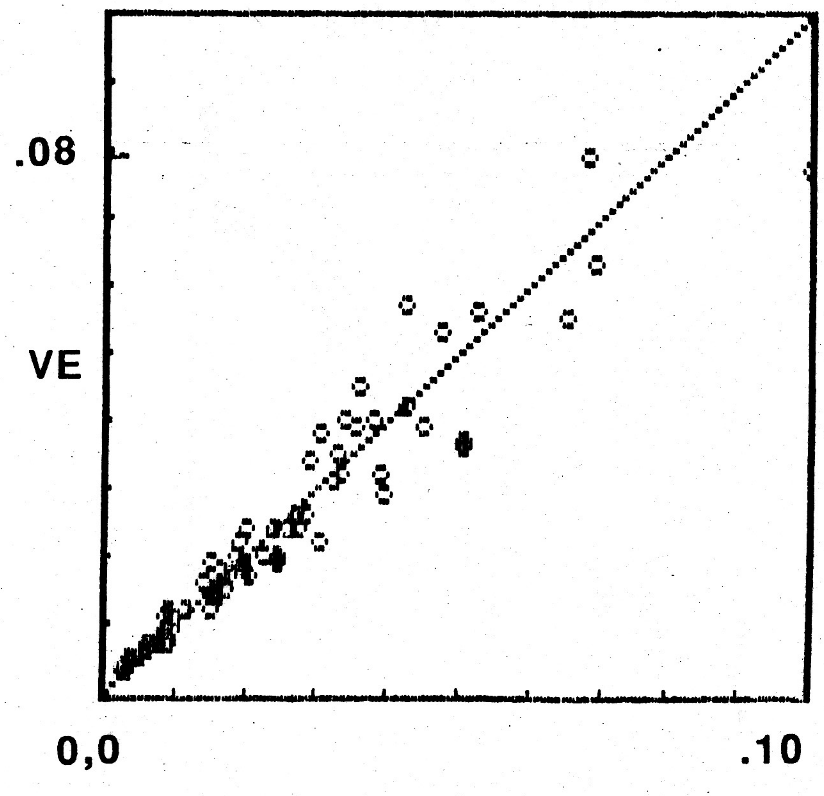

Fig. 4

PATUAKHALI SAMPLE DATA (69) VALIDATION TEST

VR= Residual volume, VE=Estimated volume, VO=Observed volume

V = a + b*D + c*D*D

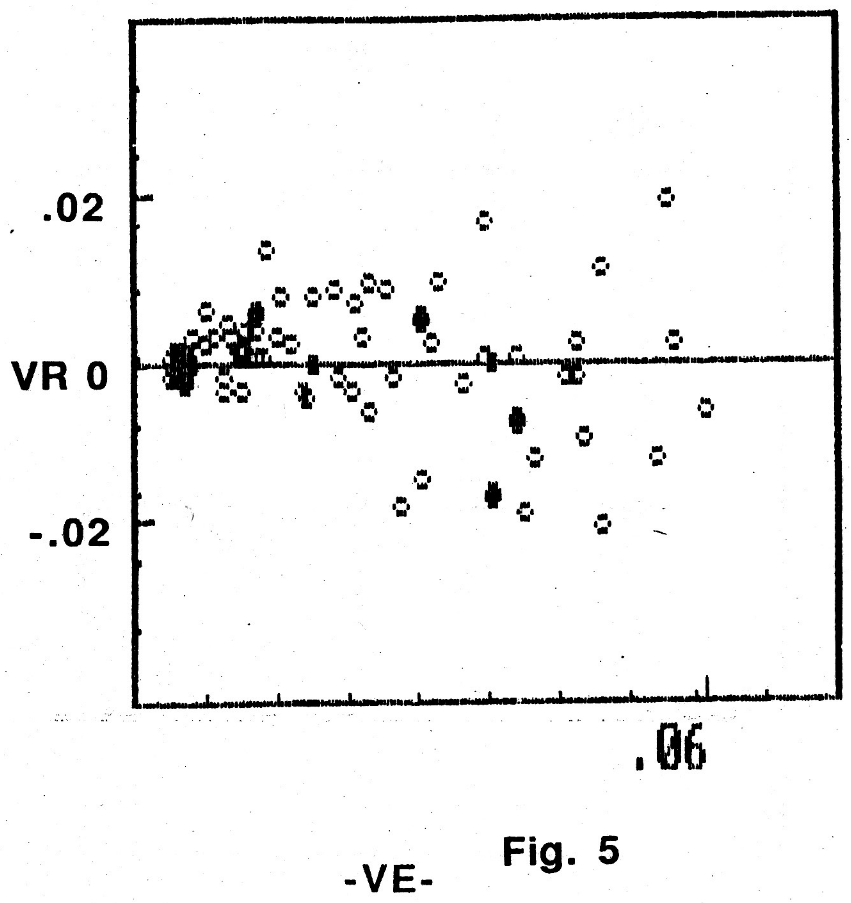

Fig. 5

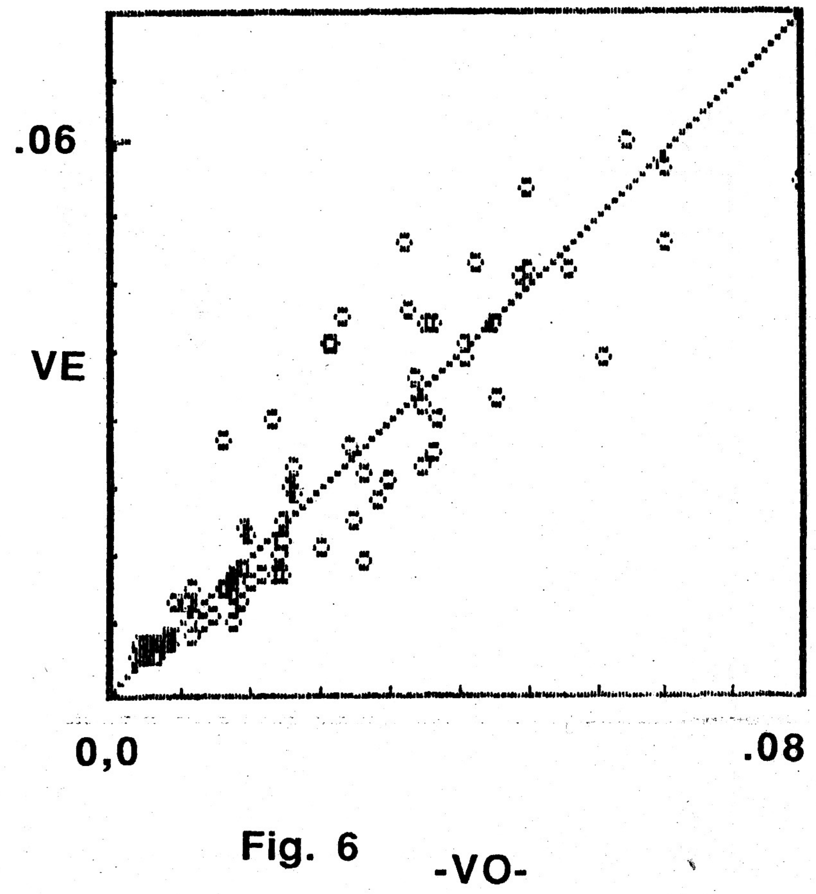

Fig. 6

BARISAL SAMPLE DATA (80) VALIDATION TEST

VR = Residual volume, VE= Estimated volume. VO=Observed volume

$$\ln(V) = a + b \ln(D) + c \ln(H)$$

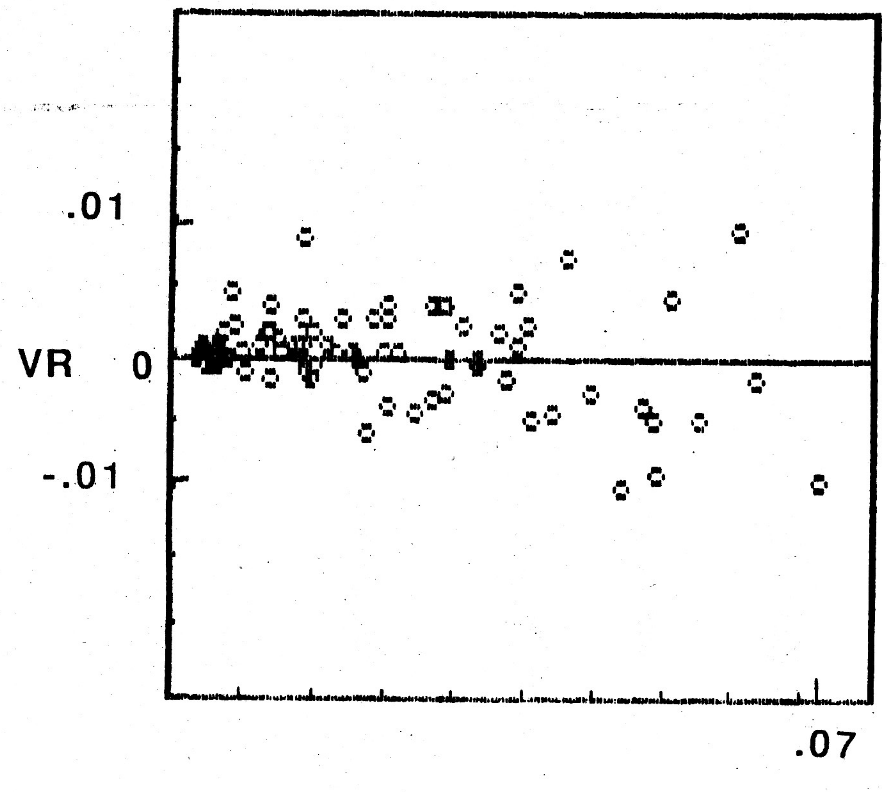

Fig. 7

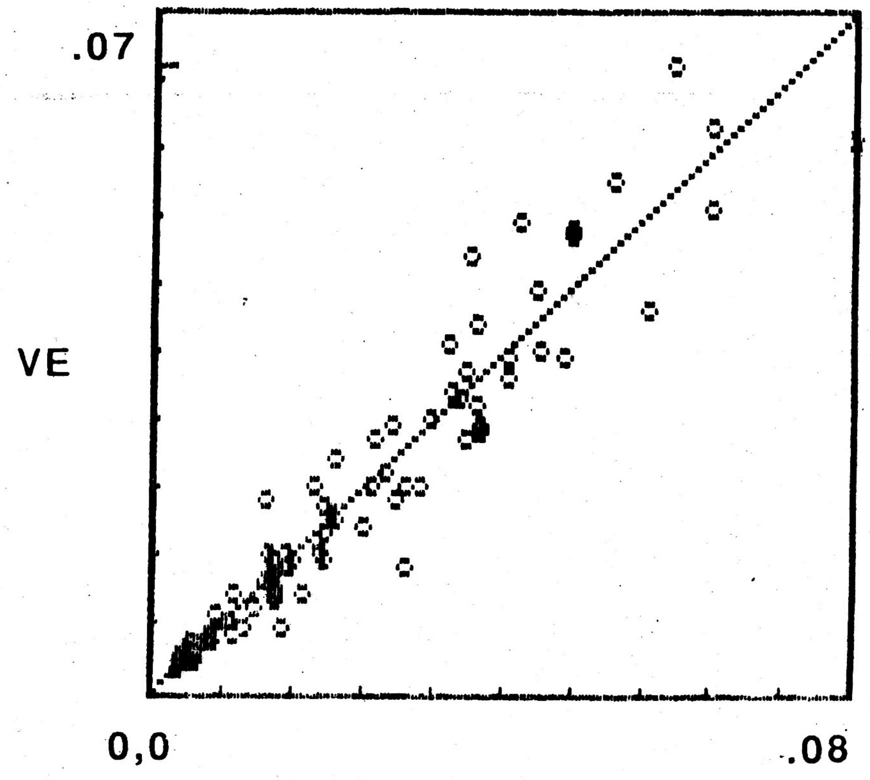

Fig. 8

BARISAL SAMPLE DATA (80) VALIDATION TEST

VR = Residual volume, VE= Estimated volume. VO=Observed volume

$\ln(V) = a + b \ln(D) + c \ln(H)$

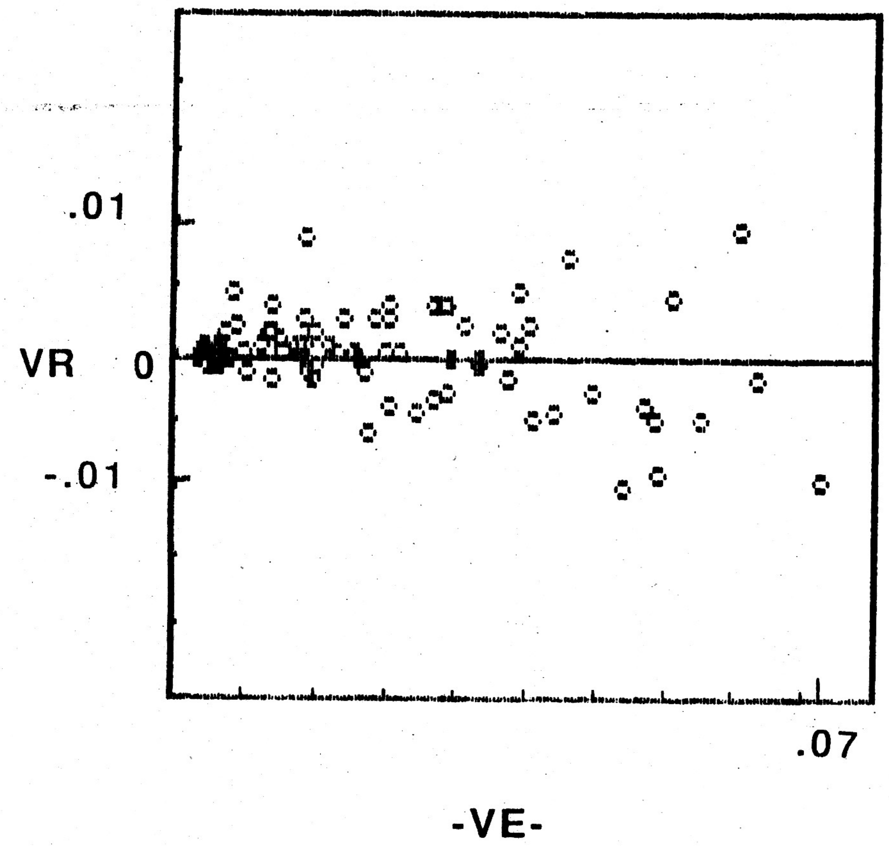

Fig. 7

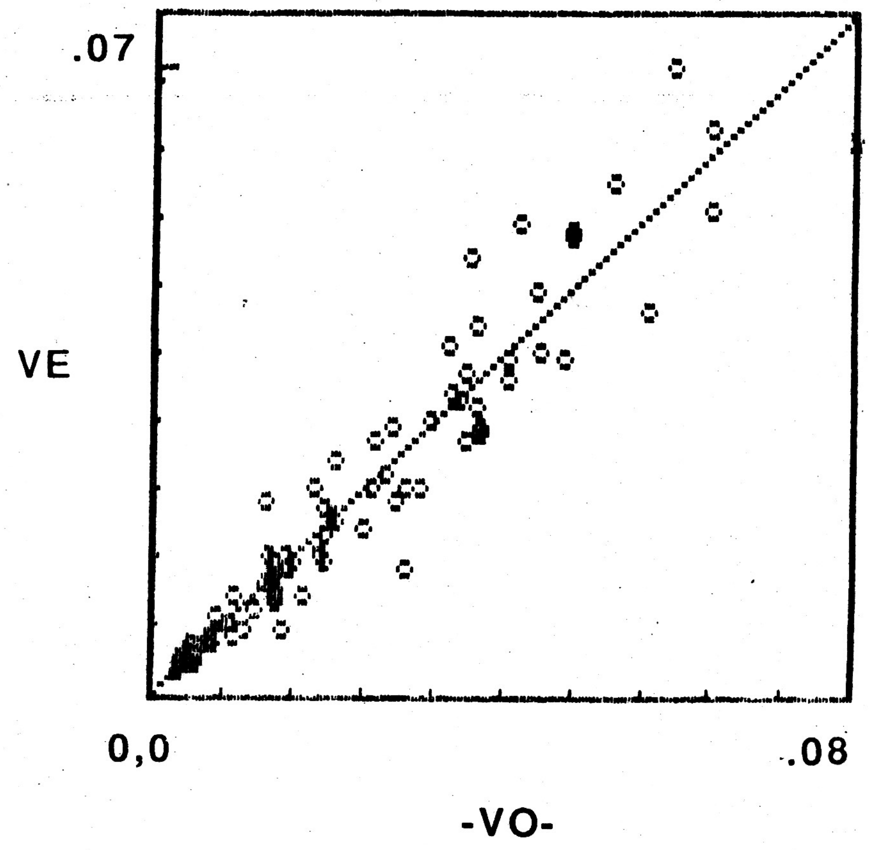

Fig. 8

BARISAL SAMPLE DATA (80) VALIDATION TEST

VR = Residual volume, VE= Estimated volume. VO=Observed volume