RELATIONSHIP OF STUMP DIAMETER TO DIAMETER AT BREAST HEIGHT FOR CHIR PINE (PINUS ROXBURGHII)

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Summary: *Diameters of Chir Pine (Pinus roxburghii) trees were measured at 6 inches (15 cms) interval from ground level up to 7.5 feet (2.28 metres). Each set of diameters had a strong linear correlation with diameter breast height. Separate straight line regression equations were developed using sets of diameters at different heights as independent variables and diameter breast height as dependent variable. Estimations of diameter breast height were done from these equations against diameters ranging from 0.5 to 47 inches (1 cm to 120 cms) at different height along the stem from ground level up to 7.5 feet (2.28 metres).*

Introduction. Cubical contents given in a local volume table of a species are shown against diameter breast height i.e. 4.5 feet (1.37 metres) above ground level. In case of illegal cutting of trees the stump is only left over part of the tree which can be used for estimation of volume of the cut tree (2,3). Stump heights may vary from tree to tree and in the original report framed in the guard-book of the Forest Guard the diameter of stump is recorded, but later on, while calculating the volume for determining the cost of the felled tree the stump diameter is considered equivalent to the diameter at breast height which gives over-estimates of the volume. Also due to faulty resin tapping, subsequent torch-wood extraction and other causes may Chir pine (Pinus roxburghii) trees cannot be measured accurately for diameter at breast height. This results in incorrect estimates of volume of such trees. Therefore, it became necessary to develop a relationship between diameter breast height and diameter at different heights along the stem of tree.

Basic Data. Diameter measurement overbark at 0.5' 1.0' 1.5' 2.0' 2.5' 3.0' 3.5' 4.0' 5.0' 5.5' 6.0' 6.5' 7.0' and 7.5' heights above ground level were recorded with calliper on 421 trees of Chir pine (Pinus roxburghii) ranging in diameter breast height from 6″ to 47″ in Mirpur, Kotli and Muzaffarabad Forest Divisions of Azad Kashmir. The extent of data and number of trees in each diameter class are given in Table 1 below:—

Method: Each set of diameters at different heights was separately correlated with the set of diameters at breast height. The results revealed that there was strong linear correlation between the two in each of 14 individual cases. This

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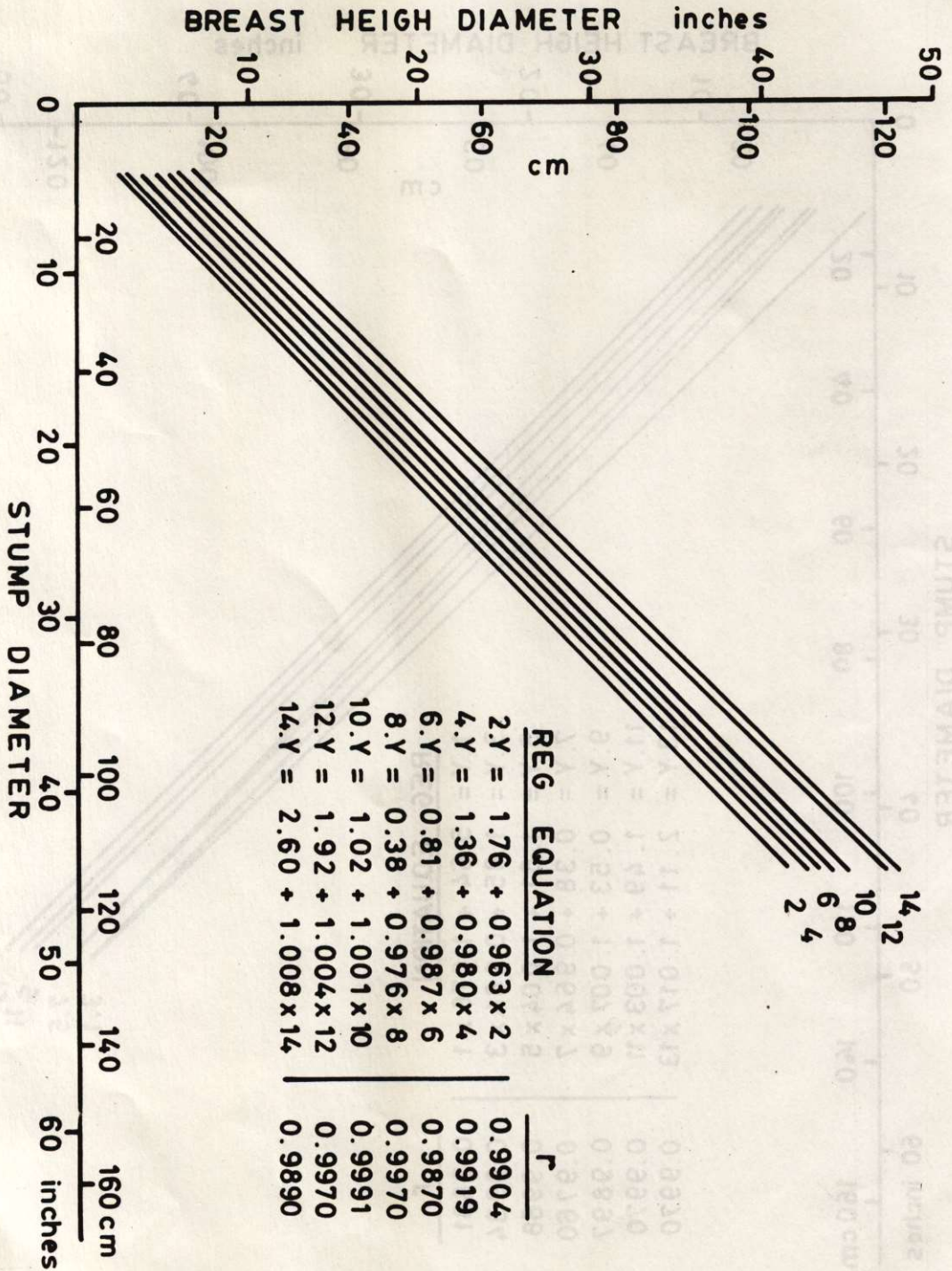**Forest Mensuration Officer, Pakistan Forest Institute, Peshawar.

Table 1

Frequency of Measured Trees in each Diameter Class

Dia. Class (inch)	No. of trees	Dia. Class (inch)	No. of trees
6	8	27	12
7	13	28	13
8	15	29	8
9	11	30	8
10	14	31	8
11	12	32	10
12	10	33	6
13	16		
14	15	34	8
15	10	35	11
16	15	36	8
17	11	37	8
18	8	38	10
19	11	39	5
20	11	40	8
21	15	41	8
22	14	42	9
23	16	43	8
24	8	44	8
25	10	45	6
26	10	46	4
		47	1
		Total:--	421

led to the derivation of simple linear equations by the least square method for each set of diameters keeping diameter breast height as dependent (Y) and diameter at 0.5, 1.0, 1.5 . . . . 7.5 feet above ground level as independent variable (XI where i varies from 1 to 14). The regression equations with respective correlation coefficients are given in Table-2 below:-

BREAST HEIGH DIAMETER inches

cm

STUMP DIAMETER

inches

cm

REG EQUATION	r
2. $Y = 1.76 + 0.963 \times 2$	0.9904
4. $Y = 1.36 + 0.980 \times 4$	0.9919
6. $Y = 0.81 + 0.987 \times 6$	0.9870
8. $Y = 0.38 + 0.976 \times 8$	0.9970
10. $Y = 1.02 + 1.001 \times 10$	0.9991
12. $Y = 1.92 + 1.004 \times 12$	0.9970
14. $Y = 2.60 + 1.008 \times 14$	0.9890

14 12 10 8 6 4 2

BREAST HEIGH DIAMETER   inches

cm

STUMP DIAMETER

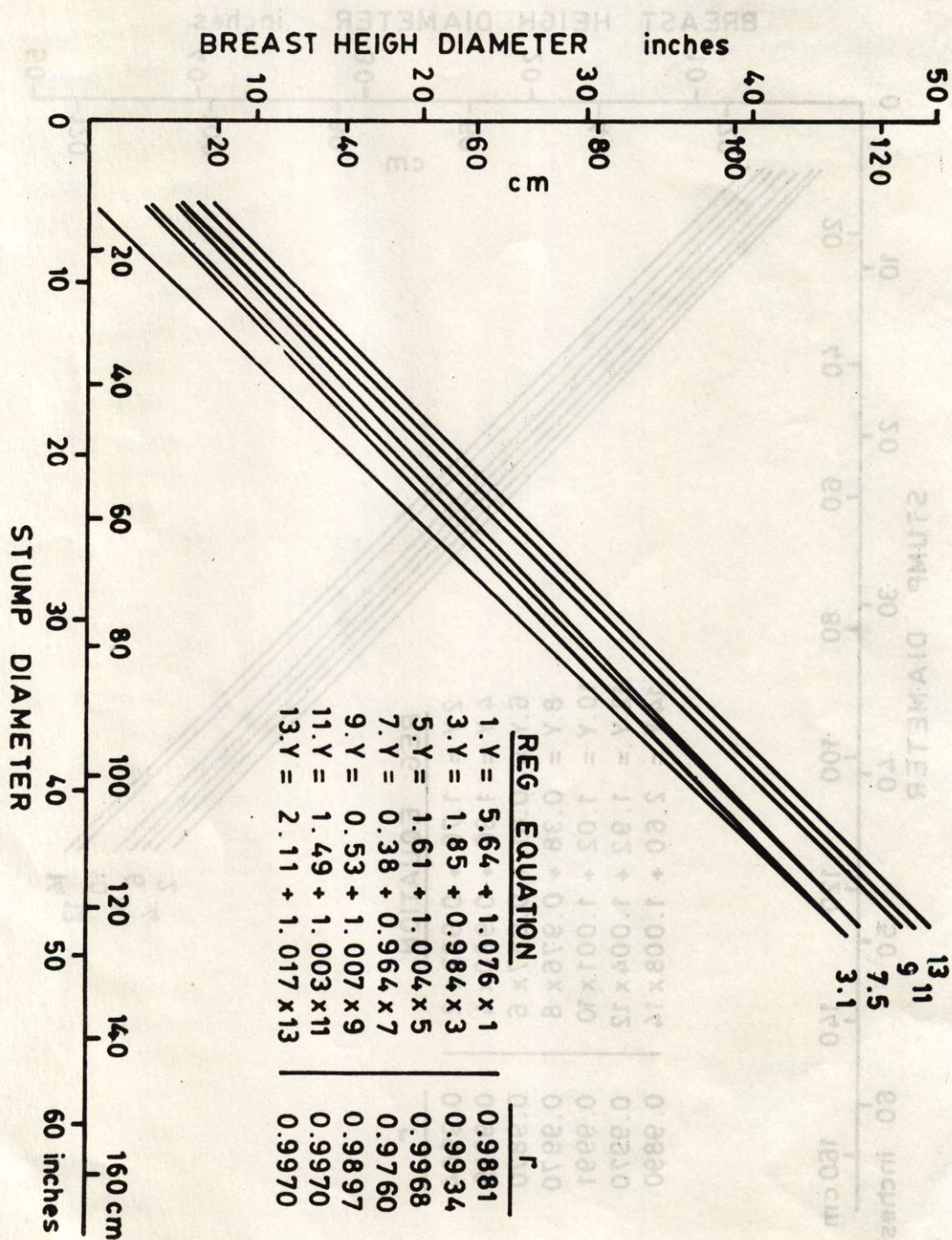| REG EQUATION	r
1. $Y = 5.64 + 1.076 \times 1$	0.9881
3. $Y = 1.85 + 0.984 \times 3$	0.9934
5. $Y = 1.61 + 1.004 \times 5$	0.9968
7. $Y = 0.38 + 0.964 \times 7$	0.9760
9. $Y = 0.53 + 1.007 \times 9$	0.9897
11. $Y = 1.49 + 1.003 \times 11$	0.9970
13. $Y = 2.11 + 1.017 \times 13$	0.9970

13
9 11
7.5
3.1

Table 2

Regresssion Equations for Estimation of DBH(Y) from Diameters Taken at Different Heights from Ground level (Xi, i = 1 to 14)

Sr. No.	Regression		Equation	Correlation Cofficients (r)
1.	$Y = -5.64$	$+$	$1.08 \, x\,1$	0.9881
2.	$Y = -1.76$	$+$	$0.96 \, x\,2$	0.9904
3.	$Y = -1.85$	$+$	$0.98 \, x\,3$	0.9934
4.	$Y = -1.36$	$+$	$0.98 \, x\,4$	0.9919
5.	$Y = -1.61$	$+$	$1.00 \, x\,5$	0.9968
6.	$Y = -0.81$	$+$	$0.99 \, x\,6$	0.9870
7.	$Y = -0.38$	$+$	$0.96 \, x\,7$	0.9760
8.	$Y = -0.38$	$+$	$0.98 \, x\,8$	0.9970
9.	$Y = -0.53$	$+$	$1.01 \, x\,9$	0.9897
10.	$Y = -1.02$	$+$	$1.00 \, x\,10$	0.9991
11.	$Y = -1.49$	$+$	$1.00 \, x\,11$	0.9970
12.	$Y = -1.92$	$+$	$1.00 \, x\,12$	0.9970
13.	$Y = -2.11$	$+$	$1.02 \, x\,13$	0.9970
14.	$Y = -2.60$	$+$	$1.01 \, x\,14$	0.9890

Where: x1:   Stands for diameter measured at 0.5 feet above ground level

          x2:   Stands for diameter measured at 1.0 feet above ground level

          x3:   Stands for diameter measured at 1.5 feet above ground level

          x4:   Stands for diameter measured at 2.0 feet above ground level

          x5:   Stands for diameter measured at 2.5 feet above ground level

          x6:   Stands for diameter measured at 3.0 feet above ground level

          x7:   Stands for diameter measured at 3.5 feet above ground level

          x8:   Stands for diameter measured at 4.0 feet above ground level

          x9:   Stands for diameter measured at 5.0 feet above ground level

        x10:   Stands for diameter measured at 5.5 feet above ground level

        x11:   Stands for diameter measured at 6.0 feet above ground level

        x12:   Stands for diameter measured at 6.5 feet above ground level

        x13:   Stands for diameter measured at 7.0 feet above ground level

        x14:   Stands for diameter measured at 7.5 feet above ground level

The relationship between diameter at different heights and dbh is also presented graphically.

The regression equations in metric units are given below :-

1.	$Y =$	-14.33	$+$	1.98	x 1
2.	$Y =$	-4.48	$+$	0.96	x 2
3.	$Y =$	-4.71	$+$	0.98	x 3
4.	$Y =$	-3.46	$+$	0.98	x 4
5.	$Y =$	-4.1	$+$	1.00	x 5
6.	$Y =$	-2.06	$+$	0.99	x 6
7.	$Y =$	0.97	$+$	0.96	x 7
8.	$Y =$	0.96	$+$	0.98	x 8
9.	$Y =$	1.36	$+$	1.01	x 9
10.	$Y =$	2.61	$+$	1.00	x 10
11.	$Y =$	3.78	$+$	1.00	x 11
12.	$Y =$	4.88	$+$	1.00	x 12
13.	$Y =$	5.36	$+$	1.02	x 13
14.	$Y =$	6.61	$+$	1.01	x 14

Application: Knowing diameter overbark of a stump and its height from ground level, the diameter breast height of the cut tree can be easily and accurately estimated by using the appropriate regression equation in respect of the Chir pine tree population of Azad Kashmir. The regression equations can also be used for the estimation of diameter at breast height in case of trees affected by other causes, e.g., faulty resin tapping, heavy blazing, debarking, scorching, torchwood removal, etc., and thus correct estimation of this damage by volume and money is possible.

References

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