OUTTURN VOLUME OF CHIR PINE IN GUZARA FORESTS OF DISTRICT MANSEHRA

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INTRODUCTION

The volume obtained after converting a standing tree into logs or scants is called outturn volume. On the other hand, standing volume is the total content of wood in the form of timber and smallwood including volume of stumpage. The out turn volume can also be expressed as percentage of the standing volume of the tree. In the process of harvesting and conversion into logs or scants a certain proportion of the standing volume is lost as smallwood, "Pharas", kurf or left as stump on the ground. The outtern volume of trees in logs or in scants primarily depends on parameters such as species, taper, site quality and density of the crop. At present there is no sound basis for accurate assessment of outturn volume in the form of logs and scants from trees marked for felling in a certain forest. As such forest officers do not have the estimates of the outturn from the marked trees.

Since volume of a tree depends on its size and site quality and will vary from site to site therefore, the outturn of each site will be different. The trees of same diameter class marked for felling over two different sites will give different outturn. The contractors usually accept upper limit of outturn irrespective of the size as well as site classifications. This creates management and administrative problems for the staff of Forest Department at different levels and hence the necessity of preparation of outturn tables for logs and scant was felt. The procedure adopted in the preparation of Chirpine (*Pinus roxburghii*) outturn volume table for site quality S_1 (1) provide guidelines to conduct similar studies on Chirpine of other site and other coniferous species growing at different sites and localities.

BASIC DATA

Data were collected from Chir pine 'Guzara' forests of known site quality in Agrore, Tanawal and Siran Forest divisions which are listed in Appendix I Data were available for 3-5 trees for each dbh class which were considered as adequate for site quality S_1 (1). Data of 97 individual trees from 5 coups of different societies of site quality S_1 (Appendix I) were also collected on the basis of this sample size for each dbh class. Tree No., dbh, tree height, tree age and logs diameters at thick and thin ends were recorded by actual measurements of converted logs.

METHOD AND PROCEDURE

The NWFP Forest Development Corporation and its felling contractors use quarter girth formula for calculation of volume in cubic feet. Therefore, mid girth over bark of each log against average diameter of its two ends diameters was calculated. Quarter girth formula was used to find out the over bark volume of each log. The total converted tree volume (o.b.) was obtained by adding all its logs volumes

(o.b). Under bark volume of a converted tree was obtained by subtracting bark volume of a tree (2) from its calculated over bark volume. Volume up to 8 inches diameter over bark at thin end of the stem including branches was taken as timber volume of the tree.

ANALYSIS OF DATA

The estimates of heights and timber volume in logs form against dbh classes were obtained using regression technique.

Following mathematical models were used for estimating height and timber volume in logs form.

$$\begin{aligned} \ln (H-4.5) &= a+b/D \\ H &= a+b \ln D \\ H &= a+bD+cD^2 \\ \ln H &= a+b\ln D+c(\ln D)^2 \\ V &= a+bD^2H+cD^3 \\ V &= a+bD+cD^2H \\ V &= a+bD+cD^2 \\ V &= a+bD+cD^2 \\ \ln V &= a+bD+cD^2 \\ \ln V &= a+b\ln D+c\ln H \end{aligned}$$

where

H stands for total height in feet

D stands for diameter at breast height in inches.

V stands for logs timber outturn volume in cft

ln stands for natural logarithms.

a.b.c. are regression coefficients.

The regression equations developed on the above models are given in Appendix-II alongwith their measures of precision.

i. Height estimation:

Regression equations for height estimation are presented in Appendix-II at serial No.1 to 4. On the basis of better measures of precision and estimates equation No.1 i.e.

$$\ln (H-4.5) = 4.61509-7.99737/D$$

was selected for the estimation of heights for different dbh classes. Estimated values were rounded to whole numbers (Appendix-III).

ii. Timber outturn volume in logs form:

Regression equations for timber outturn volume estimation are presented in Appendix-II at serial No.5 to 9. On the basis of measures of precision equation No.9 i.e.

$$\ln V = -6.96641+2.19339 \ln D+0.99671 \ln H$$

was selected for the estimation of timber outturn volume against dbh classes. Percentage of timber outturn volumes in log form against dbh classes with timber volume of standing trees (3) were calculated. The outturn volumes and corresponding percentage against dbh classes are given in Appendix-III.

iii. Timber outturn volume in scants form:

Timber outturn volumes in scants form against dbh classes were calculated by multiplying timber outturn volume in log form by a factor 0.64 (Appendix-IV). The calculated scants volumes and percentages of timber outturn volumes in scants form with timber volume of standing trees (3) are shown in Appendix-III.

RESULTS AND DISCUSSION

The results obtained are applicable only to the Chir pine 'Guzara' forests of Mansehra district of site quality S_1 for the dbh diameter

limits of 12 to 25 inches. Outturn volume obtained are based on quarter girth formula which is about 21% less than the volume based on full basal area formula. The volume and height calculations are in British units which can be changed to metric units by the use of corresponding conversions given in Appendix-III.

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REFERENCES

1. Khan, A.A. and M. Hanif Khan. 1978. Site assessment survey report of Hazara Forestry Pre-investment Project, NWFP. Forest Department.

2. Hussain, R.W. & M.A. Cheema. 1978. Bark volume tables of Chir pine (*Pinus roxburghii*) Pak. Journal of Forestry Vol.29(2):69-80.

3. Malik. M.A. 1970 Local volume table of coniferous species of Northern West Pakistan and Forestry Research series Forest record No.3, PFI, Peshawar.

APPENDIX-I

Distribution of the Chir zone forests of District Mansehra in different site classes

A = Reserve, Resumed and Protected Forests

NAME OF FOREST/COMPARTMENTS BY SITE CLASSES			
S_1	S_2	S_3	N
	Agrore Tanawal Forest Division		
Gali Badral	Kathai 1-3		Kala Pahar 1-8 (Shugarh side)
Naryala(disputed)1-2	Gidarpur 14-17		Nilbatha 1-8
Daru 1-3			Phagora
Kala Maira 5-8			Seregori 1-10
Shamdhara 4-7			Kala Maira 1-4
Seri Agrore range			Mohar 1-4
Gidarpur 1-3			Matserian 1-3
Gidarpur 18-23			Kathai 9-12
Gidarpur 41-45			Shamdhara 1-3
Kathai 4-12			Kala Pahar (Agrore side)
			Ghulandrian
			Khabbal
			Gidarpur 4-13
			Gidarpur 24-40
			Gidarpur 46-47
	Siran Forest Division		
Massar 2-4	Batrasi 1-4		Massar 1
Massar 8-16	Massar 5-7		Massar 17-18
Tanglai 1-11			
Baz Khan R.F. 1-3			
	B. Guzara Forests		
	Agrore Tanawal Forest Division		
Kala Maira 1-5	Trangri 4-6		Phagora
Jaba 1-2	Baffa 4-7		Shungli
Chiryali 3-6	Bajna 1-2		Bhirbhat
Sufeda guzara Agrore	Tanda 1-3		Bajna
Arbora guzara			Kala Maira 6-7
Susal 2-4			Jhangi Dhidal
Khaki 1-2			Bagrian
Shinia 1-2			Tatoli
Chowki 1-4			Chajjar

NAME OF FOREST/COMPARTMENTS BY SITE CLASSES			
S_1	S_2	S_3	N
Khanian 1-2			Dhara
Chinyali 1-2			Susal 1
Nilor 1			Paniali 1-2
Gulibagh 4-6			Tatar 1
			Trnagri 1-3
			Baffa 1-3
			Gulibagh 1-3
	Siran Forest Division		
Dharyal 1-7	Phagla 1	Utarishisha 1	Dharyal 10-13
Dharyal 8	Jaba 1-4		Sumali Mang 1-9
Ukhrela 1-2	Dhodyal 1-3		Karmang
			Tarla 4-6
Timri 1-2	Bedadi 1-2		
Ichrian 4-5	Shinkiari 1-6		
Kotli Tarli 4-5	Dharyal 9		
Kotli Tarli 1-4	Chandwal 1-2		
Kotli Bala 1-4	Timri 3-6		
Kund Tarla 1-2	Bhogarmang 1-4		
Karmang Tarla 1-3	Ichrian 1-3		
Ahle	Bhai Tarla 1-3		

S_1 = Highly suitable for Chir pine.
S_2 = Moderatly suitable for Chir pine.
S_3 = Margenally suitable for Chir pine.
N = Not suitable for Chir pine.

APPENDIX-II

Regression equations with their measures of precision

Sl. No.	Equations	Correlation coefficient (R)	Standard Error (SE)
1.	$l_n(H-4.5) = 4.61509-7.99737/D$	0.532	0.16 *
2.	$H = -14.83168+29.25172\ l_nD$	0.530	10.18
3.	$H = 54.42834+0.04308\ D^2$	0.510	10.35
4.	$l_n\ H = 3.60070+0.07480\ (l_nD^2)$	0.530	0.15 *
5.	$V = -1.43572+0.001611155\ D^2H +0.000410682\ D^3$	0.966	5.93
6.	$V = -7.73107+0.54811\ D+ +0.00157652\ D^2H$	0.966	5.93
7.	$V = -9.59804+0.14747\ D^2$	0.925	8.65
8.	$l_n\ V = 2.19788+0.003921369\ D^2$	0.917	0.24 *
9.	$l_n\ V = -6.96641+2.19339\ l_nD + 0.99671\ l_nH$	0.974	0.14 *

* Not in original units.

APPENDIX-III

Outturn volume table of Chir pine in logs and scants form

DBH (inc)	Height (ft)	St.Vol. (cft)	Outturn Logs Vol. (cft)	% outturn	Outturn Scants Vol. (cft)	% outturn
12	56	20	12.13	61	7.76	39
13	59	24	15.23	63	9.74	40
14	62	30	18.83	63	12.05	40
15	64	36	22.61	63	14.47	40
16	66	41	26.87	66	17.20	42
17	68	48	31.61	66	20.23	42
18	69	54	36.36	67	23.27	43
19	71	62	42.12	68	26.96	43
20	72	70	47.80	68	30.59	44
21	74	78	54.67	70	34.99	45
22	75	86	61.36	71	39.27	46
23	76	94	68.54	73	43.86	47
24	77	105	76.23	73	48.79	46
25	78	115	84.45	73	54.05	47

Derived from:

$$l_n (H-4.5) = 4.61509-7.99737/D$$
$$l_n V = -6.96641+2.19339\ l_n D+0.99671\ l_n H$$

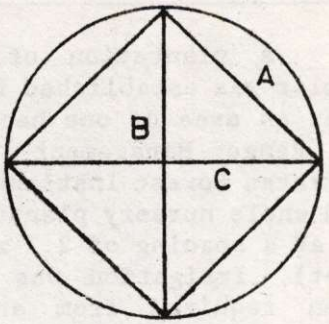
st.vol:standing volume (1).

conversions to metric unite:

1 inch	=	2.54 centimetres
1 foot	=	0.3048 metres
1 cubic feet	=	0.0283 cubic metres

APPENDIX-IV

Derivation of % outturn of scant from a log



Thin end of log

Since $A = \sqrt{B^2 + C^2}$ where A = Hypotinuse
B = Perpendicular
C = Base

Let B and C = 10 (radius of circle)

$A = \sqrt{10^2 + 10^2} = 14.14$

Area of square with side(A) $= A^2$
$= (14.14)^2$
$= 199.9$ or say
$= 200$

Full B.A. of circle $= \pi r^2$
$= 3.142 \times (10)^2$
$= 314.2$

Wastage of volume $= 314.2 - 200$
$= 114.2$

$$\% \text{ value of wastage} = \frac{114.2 \times 100}{314.2} = 36\%$$

Therefore, the wastage will be 36% and the net scants outturn will be 64% of the log volume.

If a log has a volume of 100 cft. the volume of scants obtained after sawing will be 100 x 0.64 = 64 cft. (64%).