DETERMINATION OF 't' AND 'z' OF SMYTHIES SAFEGUARDING FORMULA TO REGULATE YIELD OF *BOSWELLIA SERRATA* IN DALTONGANJ SOUTH FOREST DIVISION OF BIHAR

UPENDRA PRASAD* AND S N. TRIVEDI**

Introduction

Boswellia serrata, commonly known as salai, is an important tree of the natural forests of South Bihar. It is used mainly for the manufacture of packing cases A species of open dry deciduous forests, *Boswellia serrata* is a deciduous middle-sized tree with a spreading flat crown, and is generally found on the dry hill ridges and along hill slopes mainly in Kodarma, Gaya and Daltonganj South Forest Divisions of Bihar.

Boswellia serrata is presently being managed under Overlapping Selection System and its yield is determined through Smythies Safeguarding Formula according to which, the yield is given by

$$Y = \frac{f}{t} \text{ (II} - z \text{ \% of II)}$$

where Y is the yield in terms of number of trees, f is the felling cycle in years, t is the time taken by class II trees to move into class I and z is the mortality percentage during this period. In order to fix yield, it is thus necessary to estimate 't' and 'z'.

No estimate of 't' and 'z' for salai trees has been scientifically made so far anywhere in Bihar or in any other state of India (Troup, reprint 1986). The working plans prepared so far in Bihar have prescribed yield taking *guess estimate* of 't' and 'z'. This paper is an attempt to empirically estimate 't' and 'z' for salai trees on the basis of measurements recorded in Research plots in Daltonganj South Forest Division of Bihar.

Description of the research plot

For the diameter increment study of salai (*Boswellia serrata*) trees a Single Tree Increment plot was laid out in 1955 over an area of 0.15 hectares in Merwaj Kala P.F. in Chhipadohar range of Daltonganj South Forest Division. The plot area falls under the category of Northern Tropical Dry Deciduous Forests Type 5B according to Champion and Seth's classification 59 salai trees were marked in the plot and their diameters were recorded initially as well as after every five years. Trees that died during every 5 years interval were also recorded.

Regression Analysis

Considering *DBH* as an independent variable and the five-yearly *diameter increment* as a dependent variable a second degree quadratic equation of the following form was fitted :

$$Y = a + bx + cx^2$$

Where y is the five-yearly *diameter increment* in cm, x is the diameter in cm, and a, b and c are constant.

The equation obtained was :

$$Y = 5.012719 - 0.25738\ x + 0.004700\ x^2$$

* Conservator of Forests, Working Plan and Research Circle, Ranchi (Bihar).
** Forest Research Officer, Ranchi (Bihar).

The regression output is :

R squared	= 0.85
Standard Error of Y estimate	= 1.570473
Standard Error of Coeff b	= 0.112613
Standard Error of Coeff c	= 0.002026

An age-diameter table can be built up from the above-specified regression equation. At x = 0, Y=5.012719. This means that at the age of 5 yrs, the diameter is 5.012711 or say 5.01 cm. Putting this as 'x' in the specified regression equation we can calculate 'Y'. Adding this value of 'Y' to 'x', we get the diameter at the age of 10 years. This procedure can be repeated to generate 'age diameter' table. The table so generated is reproduced below :

Age (Yrs)	Diameter (cm)
5	5.01
10	8.86
15	11.97
20	14.58
25	16.86
30	18.90
35	20.75
40	22.49
45	24.13
50	25 12
55	27.28
60	28.84
65	30.41

Calculation of 't' and 'z'

The age diameter table (*Boswellia serrata*) shows that at the age of 35 and 65 years, it attains the diameter of 20.75 cm and 30.41 cm respectively. It can therefore be said that salai tree of 20 cm diameter would approximately reach 30 cm diameter within a period of 65-35 = 30 years.

In the current (1980-81 to 1989-90) working plan of Daltonganj South Forest Division, written by Shri S.N. Bhagat (1980), the diameter for class I and class II salai trees have been taken as 20 cm and 30 cm respectively and the time taken to move from class II to class I has been assumed to be 15 years.

This study shows that the time taken by salai trees to move from class II (diameter 20 cm) to class I (diameter 30 cm) is 30 years. Hence, this is value of 't' for salai trees in Daltonganj South Forest Division.

The primary data of the research plot also shows that during the first five-year interval 3 out of 20 salai trees in 20-30 cm diameter class died. At the end of this period only 12 salai trees were in the 30 cm- 30 cm diameter class. Among these trees the mortality was nil during the next five year interval. This means that out of a total of 32 class II salai trees, only 3 died while reaching class I. This gives the mortality per cent z = 9 38% or say 9%.

Application of results

The results of this study can be applied to fix yield in terms of number of trees in the Salai Overlapping working Circle of Daltonganj South Forest Division. The current working plan does not provide to regulate yield by number of trees but only provides for yield fixation by area. Taking felling cycle (f) to be 15 years it prescribes approximately 1/15 of the area of the felling series to be felled each year

With a precise estimate of 't' and 'z' a check on number of trees to be felled

every year may also be applied with the help of Smythies Safeguarding Formula.

Since 't' and 'f' (felling cycle) have been assumed to be the same (15 years) in the current working plan, all trees above 30 cm diameter have been prescribed for felling. This study now shows that 't' is actually double the value of 'f' Thus only half the number of trees above 30 cm diameter should be felled, otherwise, the number of trees felled during the felling cycle would be double the number moving from class II to class I during the felling cycle.

The current working plan also ignores the effect of the mortality per cent z. Since 9% of class II trees are not expected to reach class I, the number of trees to be felled annually should further be reduced on this account.

The exact number of class I salai trees to be felled every year can be determined through Smythies Safeguarding Formula after putting the value of 'f' 't' 'z' and total No. of class II trees in the felling series estimated in the working plan.

Now in the prescribed area of the felling cycle each year only one out of two silviculturally available trees of *Boswellia serrata* of 30 cm diameter and above will be felled from the year 1989-90 to 1999-2000.

SUMMARY

A precise estimate of parameters 't' and 'z' i e., the time taken to pass from class II to class I and the mortality per cent during this period respectively is needed to regulate yield according to Smythies Safeguarding Formula. No scientific estimate of 't' and 'z' for salai (*Boswellia serrata*) trees is available in Bihar. This paper specifies a quadratic regression equation between DBH and five-yearly increment in DBH, generates an 'age-diameter' table and estimates 't'= 30 years and 'z'=9% for salai trees in Daltonganj South Division of Bihar.

स्मिथिज सेफगार्डिंग के फार्मूला 'टी' एवं 'जैड' का संकलन बॉसवेलिया सेरेटा की नियमन प्राप्ति बिहार के डाल्टनगंज दक्षिण वन प्रभाग में

उपेन्द्र प्रसाद व एस०एस० त्रिवेदी

सारांश

स्मिथिज सेफगार्डिंग फार्मूला के अनुसार प्राप्ति निर्धारित करने के लिये 'टी' एवं 'जेड' प्राचलों, अर्थात क्रमशः व्यास श्रेणी द्वितीय से व्यास श्रेणी प्रथम में प्रवेश करने में लगा समय और इस अवधि में मृत्यु-प्रतिशत का सही आकलन आवश्यक है। बिहार में सलई (बॉस्वेलिया सेरेटा) वृक्षों के लिये 'टी' एवं 'जेड' का वैज्ञानिक आकलन नहीं किया गया है। यह पत्र बिहार के डाल्टनगंज दक्षिणी प्रमंडल में सलई वृक्षों के लिये व्यास एवं पांच-वर्षीय व्यास-वृद्धि के बीच द्विघात प्रतिपायतन समीकरण निर्दिष्ट करता है, उम्र-व्यास तालिका जनित करता है और 'टी' = 30 वर्ष तथा 'जेड' = 9% का आकलन देता है।

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