

Mathematical Model for Utilization of Forest Resources

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ABSTRACT

Presented herein are the studies of utilization of forest resources. The value of profit depends upon δ , t , C and $V(t)$. It is clear that the forest and replant have marginal profit. It is also clear that the marginal profit of forest product increases with increase of time and proper maintenance.

KEYWORDS: utilization, forest resources, forest product, fiber, maintenance.

I. INTRODUCTION

Forest utilization deals with the most advantageous and suitable method of harvesting converting and profitable disposal of forest produce to consumers. The most important forest products are wood used as timber and a host of other products such as bamboos, resin, lac, kattha, gums etc. For the most profitable utilization of various woods, it is necessary to know their structure and properties which determine their suitability for various purposes. A tree makes wood out of air and water. The basic chemical process called photo-synthesis is conducted in the leave.

Their arrangement and distribution are features used for purposes of identification of certain woods. For instance in *saj* they are terminal delimiting seasons growth. *Siris* from an eyelet round the pore and in *sal* they are diffused. On horizontal section they arranged cells, running radically. On the transverse section they appear as radial lines. On the tangential cut they are just visible as dark spindle-shaped structure.

More than 60% of the volume of wood is composed of hollow spaces. Wood is not too hard and can be worked into various forms with simple tools. Certain woods can even be bent after steaming. Woods are of various colors, white, yellow, pink, purple and black and some have dark and light streaks.

The strength of wood is its ability to resist external forces tending to alter its shape⁴. The

direction of application may be compressive, tensile and depending these forces. A timber strong in one respects another. *Babul* is stronger than *Dhaman* as a beam but weaker as struts. The most important strength of wood is its resistance to a force acting at right angles to the fiber direction. Timbers with long fibres free from knots and well seasoned are the best.

The suitability of a wood for making paper depends on the length of its fiber. Woods with long fiber are more suitable. There are 2000 over woody species in Indian forests. The right species has been used for a particular purpose must be devised to identify at least the most commonly used timbers to ensure⁴.

The season for felling on local weather conditions that feeling must be done towards the end of dormant season. In some forests for instance in M.P. feeling may be done even in rains. Feeling at the height of summer is avoided as too rapid drying. Feeling a tree without causing damage to the pole is an art comes by experience. Trees are felled so as to fall on clean ground. Trees of species which are regenerated from coppice. Sometimes trees are felled by digging the ground round. *Sandal* trees are so felled as it is the lower wood and roots which contain more oil. *Khair* is similarly felled. Large trees are held by guy ropes to control the direction of fall not its force.

Trees are converted into poles logs, rough-square. The converted material is removed from the forest. A well- designed system of paths, roads etc. connecting every part of the forest to the market⁴. Roads are specially designed to suit transport of large trees. The choice of the mode of transport depends on local condition.

Timber obtained from departmental operations in the forest is given ownership source, dimensions etc. Long of timber are converted into beams, planks, scantling. Saw mills are either erected permanently continuous supply of wood.

The source of power various machines, benches are carefully selected. Wood workshop have besides a small saw mill.

More than 2000 species of wood are found in Indian forests. When the demand rose and available supplies of good timbers like teak, Sissoo and deodar. A very large proportion of wood is used in firewood or charcoal. The heating value of wood in determined by a unit weight of wood in oxygen.

Timber is one of the oldest building materials, much older than steel or concrete. It has high strength and low weight, high resistance, against chemical and electrical influences⁵. It is easy to work comparatively cheap and is a renewable resource. Its demerits are non-homogeneous structure. When wood of various species were available in abundance in large size. He used only those wood which are readily available. Wood has been used in permanent structure in India.

It is of the utmost advantage to the forester to be able to convert and classify the wood in such a manner that the demands of market may be satisfied. Some time the best value may be obtained for the material disposed of. The best method of feeling trees, converting them into timber and firewood and bringing the material to the market.

This deals with the various methods of felling and converting wood. In carrying out the works of felling and conversion the primary considerations should be follow. Trees may be felled either by cutting above ground on by cutting the roots in such a way those tree in falling drags out the thick ends of the main roots and falls³.

Timer may be converted in the forest as well as outside after extraction. The general maxim to follow is that the method of conversion should involve as little waste as possible⁸. It may be carried out either in the forest or after the removal of the timber to more central place. Wood is widely used commodity and statics show that the world's consumption of wood is steadily increasing. Therefore the study of various principal uses of wood is necessary to foresters who are concerned in its production.

Non timber forest produce as minor forest produce includes all kinds of forest produce other than timber and firewood. It includes a large number of useful products obtained from the wood, bark and roots of trees and other plants as under.

Among mineral products of the forest may be mentioned building –stones, round metal, gravel, clay, state, limestone for burning ,mica ,laterite, sand and other mineral products. Revenue from minerals products may be obtained by leasing

on fix payment. Flowers are in great demand in western countries and a healthy export market exists.

Whole subject of forest utilization depends on the method employed in collecting and disposing of various articles of forest produce in such a way that forest yields the highest possible income compatible with the maintenance and improvement of the forest.

Some investigators have studied the problem of forest growth from various type^{1,2,7}. The problem has been studied by various authors by mathematical modeling^{2,7}. Some investigators have studied the uses of forest resources for new approaches. This is future of forest. The possibilities are challenging and intriguing. In this paper we have made an attempt to the study of utilization of forest resources.

II. FORMULATION OF THE PROBLEM

The bearing model considered for the present analysis of the configuration.

Let $V(t)$ be the value of usual timber at time (t) . Replant the forest at time

$t_1, t_2, t_3, t_4, t_5, t_6, \dots$

where

$$0 < t_1 < t_2 < t_3 < t_4 < t_5 < t_6 \dots \dots \dots (1)$$

Let C be the cost of felling tree,

The present value of profit as;

$$f(t) = e^{-\delta t_1} [V(t_1) - c] + e^{-\delta t_2} [V(t_2 - t_1) - c] + e^{-\delta t_3} [V(t_3 - t_2) - c] + e^{-\delta t_4} [V(t_4 - t_3) - c] (2)$$

Harvesting be done at time period $t, 2t, 3t, 4t, \dots$

III. SOLUTION OF THE PROBLEM

With help of Eq. (2) & (3), we have

$$f(t) = e^{-\delta t} [V(t) - c] + e^{-2\delta t} [V(t) - c] + e^{-3\delta t} [V(t) - c] \dots (3)$$

$$f(t) = [V(t) - c] (e^{-\delta t} + e^{-2\delta t} + e^{-3\delta t} \dots \dots \dots) (4)$$

$$f(t) = [V(t) - c] \frac{e^{-\delta t}}{(1 - e^{-\delta t})} = \frac{[V(t) - c]}{(e^{\delta t} - 1)} (5)$$

Taking logarithmic both sides, we get

$$\log f(t) = \log [V(t) - c] - \log (e^{\delta t} - 1) (6)$$

Differentiate equation (6) w.r.to t , we get,

$$f'(t) = f(t) \left[\frac{V'(t)}{V(t) - c} - \frac{\delta e^{\delta t}}{(e^{\delta t} - 1)} \right] (7)$$

If $f(t)$ is the maximum then $f'(t) = 0$ (8)

From equation (7), we have

$$V'(t) = \delta [V(t) - c] + \frac{\delta [V(t) - c]}{(e^{\delta t} - 1)} (9)$$

IV. RESULT AND DISCUSSION

The present paper proposes a more realistic model for utilization of forest resources.

The value of usual profit depends upon δ, t, c and $V(t)$. It is clear that the forest and replant have marginal profit. It is also clear that the marginal profit of forest product increases with increase of time and proper maintenance.

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