CHAPTER :: I

GENERAL INTRODUCTION AND REVIEW OF LITERATURE
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Forests play an important role in the national economy of our country. They cater for the requirement of the building industry, of defence as well as of an expanding range of industries in which wood forms the principal raw material. Indirectly they have a protective influence on soil fertility and an ameliorating influence on climatic factors. Finally, forests have a bio-aesthetic value in that they are the home of our rich and varied plant and wild life.

Indian forests account for twenty-two per cent of the total land area, the proportion varying from eleven per cent in the North-West to about forty-four per cent in the Central region (Madhya Pradesh). Judged as percentage the position is ostensibly satisfactory but truly speaking this is far from being the case. For one, they are unevenly distributed, being most scarce in areas where they are most needed, as for example, in the densely populated Gangetic Plains. Secondly, the productivity of valuable timber species per hectare is very low which is inherent in deciduous vegetation and heterogeneous
character of these forests in which only a few species are valuable; and this has been further aggravated by various forms of maltreatment through human and other biotic agencies.

1.1 GENERAL DISTRIBUTION, COMPOSITION AND GROWTH CONDITIONS:

The total geographical area of Sagar district is 10,231 sq Km, out of which about 3,000 sq km is under forest cover. The total geographical area of Gourjhamar Forest Range is 557.08 sq km of which forests occupy an area of 241.57 sq km. In other words, about 43 per cent of the total geographical area of Gourjhamar Range is covered by forest vegetation. On the basis of climatic conditions, the forests of Sagar in general, and of Gourjhamar Range in particular, can be classified as "Tropical Dry Deciduous" type after Champion and Seth (1968). These represent the climax vegetation of this area with teak as a dominant tree species in the top canopy in most of the areas. Gourjhamar forests are considered one of the most valuable teak forests of Sagar district. Broadly, two types of forest stand are distinguished from management point of view: (i) teak forests, (ii) miscellaneous forests (Saxena, 1974). Teak forests are spread over an area of 10,140 hectares and miscellaneous forests over an area of 9,166 hectares.

Though, the climatic data are not available from within the forest area, the data recorded in open areas in various parts
of Sagar district show that both the mean annual rainfall and temperature are practically the same or vary within a small range all over the tract. In spite of uniform climatic conditions the forests of Gourjhamar are very heterogeneous in composition and quality. The present state of vegetation appears to be the outcome of micro-climatic influences resulting from variation in geological formations, physiography and biotic interferences (Champion and Seth, 1968).

An examination of the forest map of this area clearly suggests the possibility of the entire land surface might have been covered by woody vegetation, but during the recent past clearing of the forests for converting them into agricultural lands due to increasing human population has resulted in the fragmentation of continuous forest ecosystem into discrete patches. At present, the forest patches are seen surrounded by grasslands, agricultural fields, waste lands and villages. The most dominant tree species in the 'teak forests' is *T. grandis* with main associates such as *I. tomentosa, A. latifolia, P. marsupium, D. dalbergioides, D. melanoxylon*, etc. The shrub layer consists of saplings and coppices of dominant tree species and many spiny plants indicating the heavy pressure of grazing.

Some of the characteristics of these forests, which have a direct bearing on silviculture and productivity are the deficient regeneration, the relatively short history of knowledge on growth and regeneration and uncertainty concerning the effects of
removal (fellings) on soil and climate. Fox (1968) considers that the impact of felling on the natural stand is akin to a natural catastrophe. At once, environments are changed, soils are exposed, light penetrates areas formerly dark and influx of species not able to survive the natural conditions, occurs. Future productivity forecasts vis-a-vis the ever increasing human needs can be visualized from study of the rate of growth, the ecological behaviour of the stand after exploitation like recruitment, mortality, establishment of regeneration, necessity of tending operations and consequent probable volume increment.

1.2 ESTABLISHMENT OF NATURAL REGENERATION IN RELATION TO DYING BACK:

Prominent natural agencies such as frost, drought, wind and soil aeration largely determine the success of natural regeneration. Frost has been found to produce bushy growth in young plants of I. tomentosa (Troup, 1921). Severe drought and factors like grazing and fire, etc. result in killing of leading shoot in young plants due to which a peculiar phenomenon of 'dying back' has been observed in almost all plant species of this area. Valuable informations are available on the phenomenon of dying back in Shorea robusta (Qureshi et al., 1968) but no scientific investigation has been undertaken on the study of dying back phenomenon in Tropical Dry Deciduous forests.
1.3 **DYNAMICS OF ORGANIC PRODUCTIVITY OF STAND (BIOMASS):**

The rapid increase in the number and needs of the human population of the world and their demands on the natural environment have made us seriously consider the ultimate limits of the biological resources. One of the constantly rising demands is for forest produce as an industrial raw material (Bruning, 1967). In view of a rising demand for wood and wood products and the reduction of the forest resources of the world, it is imperative that the maximum amount of timber and other products be produced from the land devoted to forestry (Ovington, 1957).

Productivity, being an attribute of community function (Odum, 1960; 1962) has attracted much attention in recent years (Odum and Odum, 1955; Ovington et al., 1963; Golley, 1965; Pearson, 1966; Westlake, 1966; Singh, 1968). However, most of these works on the productivity of forest stand have been confined to temperate zone (Loomis et al., 1966; Holland, 1969; Gabaev, 1969; Zukhova, 1969; Post, 1970; Nihlgord, 1972). Under the banner of I.B.F., works on productivity started appearing in many parts of the world. This programme gave an impetus to the Indian workers engaged in the bio-ecological research. First paper on tree biomass was that of Misra et al. (1967). Bandhu (1970) presented the results of investigations on productive structure of forest with an emphasis on *S. robusta*. Other works on the productivity of various tree species were that of Pandeya

1.4 LITTER PRODUCTION:

Bray and Gorham (1964) state "the study of the quantitative aspects of litter fall remains an important path of forest ecology dealing with a major pathway for both energy and nutrient transfer." The litter is the fuel for nutrient cycles in the upper soil horizons and is important particularly in the nutrition of woodlands on soils of low nutrient status where the trees rely to a great extent upon the recycling of litter nutrients.

In its ultimate analysis within a given frame of environmental factors, litter production in a community is a function of individual production capacities of constituent species. In India, although few records are available about the total litter production of various forest stands (Kuri, 1953; Upadhyay, 1955; Singh, 1962 a, b; Singh, 1967), but species were never examined separately for their individual contribution within the stands. Bhatnagar (1968) investigated the absolute (wt/ha) and relative production of different species in a mixed forest stand of Patharia hills (Sagar).
All these works concerning the tree productivity and litter output pertain to the total productivity of the various plant parts of individual tree species and no attempt was made to assess the total productivity of the stand as a whole which varies in structure, composition and quality depending upon the habitat conditions. Stand productivity is a function of individual production capacities of its constituent species. Micro-climatic differences due to geological formations, soil composition and biotic factors largely determine the distribution, composition, growth rate and stand productivity. Any attempt, therefore, to apply the results of organic productivity of an individual isolated tree is bound to give misleading results. Similarly, characteristics of the litter production of a particular stand is not governed by constituent species alone but to such factors as crop density, wind velocity and abundance of ground flora also. Ground flora, traps the outgoing leaf litter from the ecosystem. Likewise the wind velocity plays an important role in redistribution of leaf litter. With very high wind velocity the drain of organic sediments, both within and outside the system is very common. Thus, the present investigation envisages to correlate the structure and composition of stand with total organic productivity. The present work contemplates to explore the absolute (wt/ha) and relative production of different species in a 'teak forest'. All species down to seedling stage were taken into account for the
determination of organic productivity of the stand.

1.5 ROOT DISTRIBUTION:

The development and distribution of tree roots is of interest in several fields of forestry research. Ecologists, silviculturists, soil scientists and forest hydrobiologists are interested in rooting habits (Daniel, 1962). Few records are available on the root system of forest plants. Herbaceous, decorative and forest plants were studied first and then orchard trees and shrubs (Kolesnikov, 1971). More than two centuries ago the root system of herbaceous and forest plants was described by Hales in 1727 in his 'Statistical Essays' (Kolesnikov, 1971), and then studied by many other scientists in U.S.A., Japan, England, Germany, Italy, Hungry and Romania. Large-scale experiments on the root system of fruit plants conducted in various parts of world in general and USSR in particular have been reviewed by Kolesnikov (1971). Other notable works on root system of seedlings and saplings, forest plants were reported by Laifakari (1927), Gail and Long (1935), Horton (1958).

Most of these works pertained to young plants of temperate zone which were relatively easy to determine on account of shallow rooting. In Tropical Dry Deciduous forests the works of this nature are lacking. Only few records are available on the root system of tree seedlings but very little information is
available as to the root system after the seedling stage of tree crop is passed. However, only recently Kandya (1974) made a beginning in the study of rooting behaviour of important tree species of Sagar forests. In each tree species, three plants of each species representing small, medium and mature size were selected for the study. This was primarily done from the productivity point of view. The study did not provide a complete picture of root system in different growth phases from seedling to senile phase. There appeared to be lack of attempt to correlate the root spread with crown development which is so intimately related with volume production and total plant productivity. However, this study provided a basis for further research and showed the pathway for the search of hitherto hidden treasure.

The present study, therefore, envisages to investigate the root development from seedling to maturity. All other studies viz., crown spread, crown weight and trunk volume and total biomass were analysed in relation to root development for ultimate study of various growth phenomenon taking place in different growth phases. Study of root system and aboveground parts in seedling phase was used to explain the process of dying back in young plants; while root distribution in established plants and adult trees provide a basis for explaining the growth peaks in different plant organs and ultimate productivity of the stand. Effect of biotic and natural factors were studied in detail for their likely impact on the development of aboveground and root
system and establishment of natural regeneration. Organic matter dynamics at the time of main fellings provided a basis for evaluating the quantitative aspect of the underground and aboveground parts which ultimately become the part of forest floor.

In brief, the objects of the present investigation were:

(i) To determine the effects of various natural and biotic factors on the distribution, structure, composition and growth rate of important tree species in the teak forests of Gourjhamar Range.

(ii) To study the natural regeneration of tree and herbaceous ground flora species in relation to dying back.

(iii) To study the rooting behaviour of important tree species.

(iv) To study the litter production in the forest stand in relation to frequency, stand density and basal area.

(v) To study the organic matter production in above and underground parts of selected tree species of Gourjhamar forests and its ultimate contribution to the total productivity of the forest stand.