CHAPTER I

GENERAL INTRODUCTION AND REVIEW OF LITERATURE
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For a long time natural forest has been exploited, cleared, and suffered by man made damage and has gradually declined in extent. In some countries loss of forest has gone on steadily over thousands of years, in others it is a recent occurrence. Though forecasts vary, it is estimated that in developing countries forests are disappearing at a rate of 11.3 million ha. a\(^{-1}\) (UNEP/FAO, 1982). At present levels of demand, the remaining tropical forest will disappear in 60-80 years (Spears, 1979).

In historic times India was extensively covered with dense forests; today less than 23 per cent of the land is wooded.

The decline is still continuing, between 1947 and 1976, 4.15 million ha. of forest have been lost to agricultural crops, river valley projects and establishment of industry.

In India, destruction of forest has proceeded over thousands of years, but in Brazil it is of recent origin. Nevertheless, the loss of forest in some regions has been alarming.
In many instances, especially in mountainous regions and arid areas, soil erosion has followed loss of forest cover and land has become useless. Over the whole world, it is estimated that 12 million ha suffer serious soil degradation each year, and desert is said to be increasing annually by 6 million ha. (Anon., 1977).

The increasing importance of man-made forests as a component of world forestry was demonstrated at the 1967 Canberra Conference. At that time it was estimated that world total area of man-made forests had reached 80 million ha. It has been estimated from periodic progress report since then that by 1985 the area of man-made forest exceeds 160 million ha.

With the steep rise in population and the rapid fall in the area under forest due to deforestation and diversion to other so-called priority sectors, the gulf between the demand and supply of industrial woods has been widening year after year. The National Commission on Agriculture has projected a demand of 47 million cubic metres of industrial woods by the year 2000 A.D. As a result, the gap between the demand and supply which was about 5 million cubic metres, in 1970 would rise to about 26 million cubic metres by 2000 A.D. The National Commission on Agriculture has, therefore, highlighted the urgent need to raise extensive plantations (create man-made forests) of fast-growing industrial woods after clearfelling of existing inferior and low density
miscellaneous forest yielding poor financial returns, in areas where the site quality and productive potential of the soils is high.

From the purely economic viewpoint, the value of teak timber is so much greater than that of any other species, that relatively poor teak is almost always a sounder financial proposition than any other possible alternative. Expenditure is, therefore, justifiable to overcome the silvicultural difficulties of such, really exist. Native to India and southeast Asian region (Burma-Thailand-Lao), teak has long been recognized for its excellent wood properties, making it one of the most valuable many-purpose timber of the world. These properties include among others; strength with lightness; durability; dimensional stability; non-corroding properties; ease of working and seasoning; termite, fungus and weather resistance; attractiveness. In India, teak was planted in proper stands in the 1850's.

The problem presented by pure teak plantations were discussed in the silvicultural conference held at Dehra-Dun in March, 1929. The following important charges have been emphasized against pure teak, on ecological grounds.

1. The understorey vegetation of woody species do not appear under teak plantations. Thus, low species diversity leads to instability of ecological balance or vulnerability to environmental change.
2. Ground flora has been appeared to be very poor and sparse under teak plantations in comparison to natural forests and thus results into soil erosion.

3. Defoliation is more frequent and detrimental.

4. Soil deterioration takes place by clearfelling of mixed natural forest and then planting with teak.

However, no serious and scientific attempts seem to have been made to study the various ecological changes which are reported to follow the clearfelling of natural forests and consequent plantation of monoculture such as teak, especially in tropical dry deciduous forests. In the present study, some attempts have been made to compare the vegetational parameters and soil properties under different age of teak plantations and their adjoining natural mixed miscellaneous (non-teak species) forests.

The following parameters have been taken into consideration:

1. Phytosociology of tree vegetation under teak plantations of different ages and their adjoining natural forests.

2. Floristic composition of ground flora of teak plantations and natural forests.

3. Comparative studies on litter production of teak plantations and natural forests.

4. Comparative studies on chemical properties of soils of teak plantations and natural forests.
The present study covers the low-level dry deciduous mixed miscellaneous forests in the northern part of Bijawar-Chhatarpur, Central part-Mandla with high quality dry deciduous teak forests standing on alluvial and well drained and fertile soil derived from trap and gneisses to the Southern end of Madhya Pradesh (Raipur) which coincides with the southern extension of Sal Zone. Floristic diversity both at tree level and in the ground flora, its stability and productivity with the maturity of ecosystem in plantation and their adjoining natural forest have been studied. The changes in soil conditions as brought about by clearfelling and plantations have also been studied. Though, these parameters have been discussed in the appropriate chapters, this study in brief has exploded the common mystery that plantations disturb the ecological balance. In fact the plantations in the present context of socio-economic and political climate, are better managed, well protected than the natural forests. As a result the species diversity on account of micro-climatic changes, inherent coppicing power and adaptability to survive under light demanders have proved that plantations are ecologically more safe ecosystems than the natural forests.

With the increasing popularity in ecological studies, it has become fashionable to criticize plantation forests, which are often termed 'Monocultures' owing to the dominant planting of a single species, on ecological grounds.
Whitehead (1981, 1982) presented a review article on 'Ecological aspects of natural and plantation forests'. There were several papers which studied the ecological changes taking place after clearfelling of natural forest and planting with single tree species. However, most of the results have been reported from European and American forests. Very few literatures on this aspect are available from tropical dry deciduous forest ecosystem (Singh et al., 1980; Marballi, 1982). All these studies have been discussed under various subjects.

1.1 STRUCTURE AND COMPOSITION OF TREE VEGETATION:

It has often been stated that tropical forests are the most stable ecosystems because of their high diversity, but closer examination reveals that they are very sensitive to perturbations (Orians, 1974). Margalef (1974) explained that a system at low maturity has to cope with unpredictable environmental influences, but in a mature ecosystem most of the outside influences have been anticipated and are ignored since a reaction to them is no longer essential for the community survival. A mature ecosystem which is unstable, in species composition may be stable in energy flow terms. Whittaker (1974) suggested, in agreement with May (1974), that stability (in the sense of population, constancy and species survival) does not appear to depend on diversity. Goodman (1974) used evolutionary reasoning to argue that a variety of strategies are involved in adaptation to change and that adaptive instability is
possible one of these strategies. He explained that the diversity-stability theory seems to have been an attempt to define a concept which is not real.

Jacobs (1974) proposed that the concept of the positive correlation between diversity, stability and maturity is partly due to tentological arguments—maturity and stability are used to define each other. He quoted examples where diversity is lower in mature communities than it is during the younger stages of succession. Golley (1974) defined a community in the stage of succession as one which 'exhibits a sequence of states that appear directional towards a stable state at which time biological control becomes more important and the system becomes decoupled to an extent from the physico-chemical environment'. Way (1977) argued that the 'right quality of diversity' is likely to be important when considering stability.

Many of the world's ecosystems are low in species diversity and, often, 'monocultures' are found to occur naturally. In New Zealand, Chapman (1958) examined the structure of Nothofagus forests and showed that many of them are dominated by one species only. Borset (1976) showed that the number of species present in the Norwegian Coniferous forests was very low. Whittaker and Woodwell (1972) gave salt marshes as an example where diversity is low. Spurr and Barnes (1973) cite numerous examples of forests where diversity of species is low, including the dominance

A good example both of dominance of single species and of the relations between forest types and climate is shown by the forests of Washington and Oregon on the West Coast of America.

It is apparent, therefore, that high diversity is not always associated with high stability and there are many examples of natural ecosystems which are stable but exhibit low diversity, often being virtual 'monocultures'.

Plantation forestry is usually characterized by single species in uniform age classes which may be comparable to the structure of many natural communities.

Plantation forests are some time criticized for their low diversity and is often concluded that this leads to instability or vulnerability to environmental change or pathogens and insect attack. It is not true that diversity in natural communities is always positively correlated with stability, although clearly the terms themselves are difficult to define and measure (Whitehead, 1981).

The variation in species richness in the ecosystem of the world has long been the subject of interest and speculation. Golley (1974) viewed ecosystem's structure changes as directly attributable to environmental changes.
Walter (1973) stated that 'the less favourable the regional climate for plants the more closely they are dependent on a favourable habitat' in the formation of his 'ecological law of relative habitat constancy and changing biotype'. This hypothesis suggests that if the climate changes then the biotype will change in an attempt to compensate for the climatic alteration by a change in the local microclimate.

In the long term there is considerable evidence that the present forms of natural forests are the result of previous large scale climatic changes. Park (1972) considered that climatic changes modified soil structure in forests by the changes in water levels resulting in a change in species composition. Livingstone (1975) related long term changes in tropical forest structure to climatic changes.

Whereas climatic change is a strong influence in natural communities, it is unlikely to be as important in plantation forestry where rotation time is unusually short, of the order of a few decades. It is unlikely that species will become unsuited to the climate in such a short time.

In plantation forestry, management practices such as thinning, pruning, fertilizing and felling all change the ecological balance of the community. The difference between these operations and random changes occurring in natural forests is that the management practices are controlled to
maintain economic rates of production and timber quality. A lot of studies have been done in tropical as well as in temperate regions, in respect of influence of various factors on the structure of vegetation. White (1979) presented a review of the factors that cause severe changes in the patterns of North American Communities. Watt (1971) considered fire, hurricanes and avalanches to be the most important factors controlling disturbances and species composition in the midwest regions of America.

Other factors changing the structure of ecosystems include pathogens and insects (Graham, 1941).

Man's influence in ecosystems also induces changes in vegetational composition. Cunningham (1979) attributed recent changes in the structure of forests in the North Island of New Zealand chiefly to the introduction of animals. Connel and Slatyer (1977) cite the North American plains as an example where the vegetation has been changed by severe grazing from bison.

In addition of fertilizers changed the variety of pasture species in the long term park grass experiment at Rothamsted Experimental Station (Thurston, 1969).

Puri (1960), has discussed the various ways man has influenced the forests of India. He concluded that 'the activities of man, on the whole, acted against the normal development and succession of forest vegetation'.
Jagjevanlal (1982) has reported that man is one of the main biotic factors for destruction of forest ecosystem. Khare (1981) has studied the effect of fire on forest ecosystem.

Major contributions regarding the phytosociological analysis of Indian forests are of Bor (1938 a, b; 1942) in Nilgiris and Assam; Hawetson (1941) and Jaheed (1953) and Misra and Joshi (1952) in Madhya Pradesh; and Changapa (1944) in Andaman islands. Temperate forests of Himalayan region were extensively studied from the point of view of distribution of conifers with special reference to geology (Puri, 1950); Succession of forest communities in Oak-conifer forests of the Bashahar Himalayas and Punjab and Himachal Pradesh (Mohan and Puri, 1955, 1956).

Forests of western ghat region which perhaps represent the most complex vegetation type in the country, were investigated in details from floristic, phytosociological and successional point of view by Arora (1961; 1963 a, b; 1964).

1.2 FLORISTIC COMPOSITION OF FOREST GROUND FLORA:

Ground flora species form an important structural component of forest ecosystem and succession of ground flora species in a forest is of practical importance to forestry. The ground flora community not only indicates the fertility status of forest but also gives an idea of the growth and development of trees seedlings as it is intimately related
to it. For a detailed study of the ecological conditions of the site with respect to micro-climatic and micro-bioedaphic factors, the ground flora is the best index of site.

Most notable work on the 'influence of over storey vegetation on distribution of ground flora' are of Cajander (1926); Misra (1945); Krishnaswamy and Puri (1954); Ovington (1955), Bhatnagar (1968); Upadhyay (1955); Khan (1958) and Mishra and Kandya (1970).

1.3 LITTER PRODUCTION:

Green plants are the only primary producers of organic matter and potential energy through the process of photosynthesis on which all forms of life are dependent. Some of these primary organic materials are used for various metabolic activities and the rest accumulated in the plant body. A substantial proportion of the accumulated nutrients in the plant biomass is returned to the soil through litter fall and thus the study of quantitative aspect of litter production is important as it remains a major pathway for both energy and nutrient transfer in forest ecosystems.

Ecological studies of forest floor have earlier been made by many workers in different geographical areas. Some of the notable contributions are of Ovington (1957); Nye (1958); Heatwole (1959, 1961). Recently, importance of
forest floor is emphasized due to its intermediate role in nutrient cycling (Reiners and Reiners 1970; Dominski 1971; Wilde 1971; Goga et al., 1973).


Bhatnagar (1968) and Naik (1986) have made some comparative attempts on litter productivity of teak and non-teak stands of tropical dry deciduous forests of M.P.

1.4 SOIL CHARACTERISTICS:

It has long been recognized that vegetation exerts a decisive influence on morphological, physical and chemical properties of soils. Janny (1941), in his discussion on organisms as a soil forming factor, treated vegetation both as an independent variable, it should be possible to study the properties of soil as influenced by the vegetation while other soil forming factors such as climate, parent material, topography and time are maintained at any particular constellations. Heterogeneity has been observed in the chemical composition of forest soil even over a distance of few centimeters (Frankland et al., 1963).

It has been suggested that the soil gets deteriorated by clearfelling of natural forests followed by teak plantations
(Griffith and Gupta, 1947).

When there is disturbance in the ecosystem there may be a huge release of nutrients whether the disturbance is caused by fire (Waring and Franklin, 1979; Richards, 1963; Gillison, 1976). Park (1972) also reported the same conclusions for clearfelling of forest. Weetman (1974) studied the availability of nitrogen in the Canadian boreal forests and showed that when *Picea mariana* forests were clearfelled, the released nutrients were taken up by pioneer vegetation which later became the organic matter in the maturing forest. Vitousek et al., (1979) concluded that, although tree felling caused increased soil temperature and water availability, the loss of nitrogen compounds in run-off water might be controlled at three points in the cycle.

In Indian literature, notable work on teak soils are of Iroup (1921); Waheed (1927); Newetson (1940, 1941); Kulkarni (1951); Kadambi (1951); Sathe (1951); Bhatia (1954) and Seth and Yadav (1959).

Though valuable information are available on the physico-chemical properties of soils under monocultures of different species, yet no comparative attempts have been made with natural forests in tropical dry deciduous forests, especially of Madhya Pradesh.

In the present study, some comparative attempts have been made for teak plantation and natural forest soils.