The great civilizations as of Mohenjo-Daro and Harappan were ruined and their existence forgotten except for stray unearthed archaeological remains. There are many theories as to why these civilisations vanished, the most plausible among them being ruthless denudation and destruction of the forest which causes directly into the spread of desert, drought and floods.

With the growth of population and civilisation more and more forests were got converted into crop-lands, and of habitation, pastures, roads, railways, reservoirs and industries. Rapid depletion in the area of forest cover has led to the serious problems of erosion, floods, siltation and desertification. These degradations have affected the soil fertility consequently and the food production adversely.

According to the latest estimates, the global forest cover has decreased from above 7000 million ha in 1900 to 2890 million ha by 1985 and if the present trend of merciless felling continues then this would be reduced to around 2370 million ha by 2000 AD (Brewbaker, 1984). Whereas, latest official estimates (Central Forestry Commission, 1990) for India's forest cover is around 74.8 million hectare (22.7% of the total land mass) while according to the ministry of agriculture, Government of India, it is around 66.22 million hectare (22.1%). Recent studies conducted by National Remote Sensing Agency (NRSA) have revealed gradual degradation of forest cover over last twenty years (NRSA 1984). This reduction in forest area is resulting in the deterioration of the quality of the soil which in turn has lead to the formation of wastelands landuse statistics place
General Introduction

305 million ha of the land mass of India as usable land, of which 87 million hectare is lying unused in the form of cultural waste and unproductive waste (Puri et al, 1989). This unproductive land is liable to soil and water erosion.

There is a need for evolving a system of balanced and complementary land use, under which each type of land is allotted to that form of use under which it would produce most and deteriorate least.

The Government of India in their first five year plan (1951-56) took steps to overcome the menacing march of desert and accelerated soil erosion.

In the nineties the forest area of the country has considerably shrunk and hardly 20 to 22.7 percent of the country's land is under forest (Central Forestry Commission 1990) with erratic distribution and with vast area of tree covers. The country has only 2% forest area of the world but supports 15% of the world population with the decreasing per capita forest area of 0.11 ha in 1991.

To overcome the situation countrywide reforestation of high yielding species has been initiated to replace the low yielding natural forest. For optimizing the productivity of fuelwood, successful plantation is only possible when the proper fast growing species are selected for location conditions (Burley; 1980).

The selective approach to create healthy environment and to fulfill the qualitative and quantitative demands of people on application of fast growing trees plantation under a number of forestry practices as Short Rotation Forestry (SRF), Social Forestry (SF), Energy Plantation (EP) and Farm Forestry (FF) are the answer to counteract these emerging problems. Leguminous trees are a potential source of fuel, hard wood and other uses which equal that of fast growing non-leguminous trees (Brewbaker et. al., 1982). The nitrogen fixing tree species are of particular interest as their ability to support by N₂-fixation to raise the fertility and
nutrient pool of poor or impoverished soils (Falker and Bandurski, 1979; Poggiani et al., 1981). For these reasons woody legumes are receiving interest for agroforestry and reforestation programmes.

Leguminosae or Fabaceae is one of the largest family of the flowering plants with about 18,000 species in nearly 600 genera (Lim and Burton, 1982) of which nitrogen fixing trees (NFT) are predominantly present in the sub-families Mimosoideae and Caesalpinoideae. Our knowledge of nodulation status so far only about 3000 species for this family (Allen and Allen 1981).

*Acacia* constitutes an important genus of high economic utility. Soil conservation authorities have used its different species for many years for the stabilization of shifting sand (Roux and Middlemiss, 1963; Barr, 1965; Aveyard, 1963; Barr and Atkinson, 1970) and the landscape industry is becoming increasingly aware of its potential for rapid establishment of woody green cover by direct seeding techniques of *Acacia auriculiformis*, a native to Queensland and northern territory of Australia (Verdcourt, 1979) has got introduced into several countries in South and South-east Asia (Wiersum and Ramlon, 1982). This is an important species with several utilities, the principal one being a source of pulp. The wood has a high specific gravity and caloric value (Rierink, 1983; Drewes & Roux, Loc. cit.; Drewes & Roux, chem & Ind, 1965; Guha and Pant, Indian For, 1966, 1972; Banergee, loc. cit.; Firewood crops, 34). Its wood is also be used for furniture, firewood. Good quality charcoal and has shown promise for briquette production (Hartoyo and Roliaid, 1978). It is admirably suited for heavy construction but needs pretreatment when in contact with soil (Sastroamidjojo, 1964). The bark contains tannin (Nicholson, 1965) and a natural soya-dye (Kasmudjo, 1979). Research efforts on this species hardly matches the magnitude of its importance and wide ranging utility.
In a reclassification of the genus Acacia, the majority of the Australian Acacias including *Acacia auriculiformis* have been placed in a new genus called *Racosperma* (Padley, 1986), having chromosome no. of $2n = 26$ (Brewbaker, J. et. al., 1983). *Acacia auriculiformis*, a woody perennial belonging to the sub-family Mimosoideae and it has gained much attention for its exotic fast growing nature and manifold uses in recent years.

*Acacia auriculiformis* is one of the common species planted in Central Java (Anon, 1977) and is recommended for the humid tropics (Boland, D.J. and Turnbull, J.W. 1981). The species was introduced in India two or three decades back (P. Kumar, 1987), and is recognised for its ability to grow on poor soil and in areas with extended dry season. *A. auriculiformis* trees have been identified as one of the species which would be used for successful rehabilitation and greening of difficult sites (Anon, 1983). It is regarded as highly tolerant species (Aswathappa, N. et. al., 1987), that can grow well on acid soil (Turnbull, 1986) and saline-alkaline soils (Chaturvedi; A.N., 1986) with low annual rainfall of 750 mm. It can be used as a substitute for Babul bark (Drewes & Roux, Biochem J., 1966, 98, 493). It is also recommended as a suitable green manure for sandy soils (Alphen de veer, E.J. van, 1949) besides its current use for firewood farming in degraded lands (Chaturvedi, 1985). Its excellent quality as a firewood that burns without smoke or spark and with high calorific value in fuelwood and in charcoal (Anon, 1980; Chandrasiri, S. 1988) is now well recognized. It has a good biomass yield potential, adaptability to varying site conditions, pest and disease resistance, ease of establishment, nitrogen fixing potential (NFP), fuel value and susceptibility of combustion (Khanduja; S.D., 1987). In Ranchi, lac-incrustation had been observed on this tree, it may be cultivated as a lac-host (Singh, Bull. nat. bol. Gdn., Lucknow No. 69, 1961-62, 25). Young leaves (Phyllodes) of *A. auriculiformis* are more susceptible to powdery mildew (Odium. sp.) than older phyllodes (Cen. B. Zo., et. al. 1986). The best of production of unbleached pulp

For these multiple use, *Acacia auriculiformis* A. Cunn. ex. Benth was selected for the present investigation. A central issue in the study of ecosystem structure and functioning is the analysis of the processes governing the production of organic matter, and flow of energy and cycling of nutrients (Bourlier and Hadley, 1970).

Global productivity patterns have been shown by Whittaker (1970), Whittaker and Woodwell (1971), Golley (1972) and Leith (1975). In the nineteen sixties some important comparative interbiome works were carried out particularly on primary production (Olsen, 1963; Lieth, 1962,1963,1964,1965; Rodin and Bazilevich, 1967). Biomass data are a prerequisite for determining the status and flux of biological materials in ecosystems (Anderson, 1970). In India, the estimation of biomass and productivity has been made by Mishra (1970), Desh Bandhu (1971), Farooqui (1972), Singh (1979), Sharma (1985), Rana et. al. (1988), Sinha (1991), Srivastava (1992). Productivity is the key functional aspect of forest ecosystem and its maximum limit in a particular region is largely governed by the climate. The sharp changes in climate and vegetation type with change in altitude poses problem in estimating the total regional productivity. Net energy fixation is also a measure of net primary production. Lieth (1975) has shown the quantitative relationships on global basis between productivity and climatic parameters.

Evaluation of dry matter production is the most important aspect of ecological investigation in any ecosystem (Boysen-Jensen, 1932). Importance of organic matter production studies in all types of biomass has been well emphasised through the International Biological Programme, and Man and the Biosphere Programme. Dry matter production of plant always constitutes the
foundation of further research in production ecology (Lieth, 1968). Dry matter production of forest were estimated by many workers in temperate and rain forests (Ovington et. al., 1968; Satoo, 1968; Lieth, 1964, 1965; Johnson and Risser, 1974; Meier et. al.; 1985).

The biological nutrient cycling regulates the productivity of any forest ecosystem. Annual nutrient cycling within ecosystems provides the major source of nutrients for plant use. Nutrient concentration in different components of the plant and in soil and their uptake and standing state in tropical wet and moist forest have been studied in detail by Odum and Pigeon (1970), Golley et.al. (1975), Ewel et.al. (1981), Edwards and Grubb (1982). However, on tropical dry deciduous forests there are only a few work about nutrient concentrations and their uptake (Singh and Misra, 1979; Ponday, 1980; Sandhu, 1990).

The quantification of litterfall and its decomposition form major pathways of the transfer of organic matter and elements to the soil surface in forest ecosystems. Litter decomposition studies are important in the quantification of nutrient cycling. In India, litterfall pattern and its decomposition were studied by Pandey and Singh (1981), Sharma and Ambasht (1987) in temperate zone and by Singh (1968, 1969 a), Singh, Gupta (1977), Singh (1979), Singh and Ambashta (1980), Singh et.al. (1980) and Sandhu et. al. (1990) in tropical dry deciduous region.

In this thesis, work on different level of biomass, productivity, energy fixatation, litterfall pattern changes, resource quality affected decomposition rate and nutrient release from the decomposing litter in the monoculture plantation stands of *Acacia auriculiformis* is described and discussed.