CHAPTER - 2

REVIEW OF LITERATURE

2.1 BIODIVERSITY:

2.1.1. International status:

Acar & Var (2000) in their study stated that the components of species diversity have been recently integrated into, site classification in describing and mapping the landscape habitat in forest studies. The genetic diversity structures of most of the tree species have been studied for the need of in situ and ex situ nature conservation (Rubilar et al., 2005). Increase in species extinction rates due to anthropogenic activities has raised political and scientific concerns (Hubbell et al., 1999). There are many kinds of environmental changes that influences or determine processes that can both augment and erode diversity (Yamada et al., 2003).

The most remarkable feature of the globe is the existence of life and its diversity, topography, soil, climate and geographical location of a region, which influences the vegetation diversity of the forest ecosystem (Huang et al., 2003). The biodiversity study at landscape level with relevance to environment of northern Thailand and Sumatra as well as Indonesia was worked out by Gillison and Liswanti (2004).

Brown et al., (2006) observed the effects of an invasive tree community structure and diversity in a tropical forest in Puerto Rico and recorded potentially long-term changes in community structure and species composition. The tropical dry forests of Central America were examined by Gillespie et al., (2000) for their diversity, composition and structure. Species diversity and richness of tropical forest were found to be lower in mature forests than during regeneration phases as studies carried out by Berry, (2002). Gurevitch and Padilla (2004) suggested that invasive species have been considered as the largest threat to biodiversity on the earth after habitat destruction. Land-use changes, the result of increasing human population has, also been identified as one of the major drivers of future changes in biodiversity. Forest diversity is being lost because of rapid degradation, fragmentation, deforestation and conversion of dry forests into wet forests.
Kattan (2002) researched that the higher species diversity reached at intermediate succession stages, when there was a change in environmental conditions which allows a simultaneous occurrence of species typical of both early and late succession stages. The terrestrial environment provides evidence of functional importance of biodiversity to ecosystem processes, nutrient properties and ecosystem functioning (Giller et al., 2004; Tilman et al., 2006).

Stern et al., (2002) and Margaret et al., (2003) studied the changes in composition and structure of a tropical dry forest in north western Costa Rica and suggested that most tropical dry forests are less biologically diverse compared to tropical humid forests to their high endemism, their threatened status and elevate their conservation value.

Freeman et al (2014) reported that the conversion of tropical dry forest to agriculture lands continues with an increasing rate in different parts of the tropics and entails nearly total destruction of forest structure and composition. Restoration of severely degraded forest ecosystems is harder and species reintroduction is not an easy task.

Khamyong et al (2003) argued that richness should be highest at intermediate frequencies of disturbances when condition favours the competitive species and those that tolerate disturbance. Thus, the frequency and intensity of disturbance are most important source of plant species diversity in a community.

The ecosystem of tropical dry forests are preferentially settled and developed as they are easier to clear and maintain and they are in close to desirable resources such as fisheries, grazing pasture, beaches, coastal scenery and arable agricultural land Stephens & Wagner, 2007.

Singh et al (2011) explained that the tree seedling dynamics are affected by various environmental factors such as temperature, soil moisture, canopy cover micro-scale disturbance and deep leaf layers. Biotic factors such as fungal infection, herbivores and inter-species competition have also been reported to affect seedling demography (Condit et al., 2000).
The response of burst vegetation to human impact in tropical forest regions face several environmental constraints during their life cycle, like water limitation, a complex set of disturbance regimes, composition for light, mainly fire, herbivores and human exploitation (Villela et al., 2006).

Tilman et al., (2006) elucidated that the influence of canopy shrubs and trees on under storey herbs plant is complex and context-dependent. Canopy of plants can exert positive, negative or natural effects on production, composition and diversity of under storey vegetation, depending on local environmental conditions and nutrient status. Tripathi and Singh (2009) studied about higher plants, and their community structure, species biomass composition, physiognomy and total community heterogeneity, higher species richness, more variable species richness and lower rank consistency.

Giller et al., (2004) illustrated that the terrestrial environments provides evidence of functional importance of biodiversity to ecosystem processes and nutrient properties and ecosystem functioning. The high rate of extinction of tropical species is exasperate by the conversion of forest land for harvesting non timber forest products, extraction of mature trees, collecting fuel wood and agriculture which threatens to erode the biodiversity seriously (Laloo et al., 2006).

According to Stern et al., (2002) the effect of human disturbances on species diversity is an issue that has engaged the attention of ecologists both from theoretical and applied standpoints, it supports the hypothesis that ecosystems with high species diversity are more stable to environmental disturbances than those, which have low species diversity.

Kumar et al., (1998) explained the geographical variation in tropical tree diversity have taken the form of regression analyses that combine data from different ecosystems of forest to look for correlation between diversity and environmental variables like rain fall and soil fertility.

Freeman (2003) stated that the ecosystem alteration caused by human activities is most apparent in and around urbanizing landscapes that accounts for 2% of earth’s surface. As a result of rapid expansion of urban areas, due to increasing
human settlements, the species composition and richness of vegetation is getting changed (Margaret et al., 2003).

Species interfering have been considered as the largest risk to biodiversity globally after habitat destruction (Gurevitch and Padilla, 2004). Land-use changes, the resultant of increasing human population, has been recognized as one of the major drivers of future changes in biodiversity reported by Swamy et al., (2000).

2.1.2. National status:

India is one of the richest centers for biodiversity in the world with 63.7 million ha of forest cover. The tropical forests of Mudumalai Wildlife Sanctuary, Western Ghats, India were investigated by Reddy et al., (2008) for their quantitative structure and composition. The exploitation of natural resources by the local populations has resulted in depletion of the biodiversity of the forest communities Ramakrishnan (2003).

Padalia et al., (2004) studied phytosociological observations on tree species diversity of Andaman Islands, India and concluded that quantitative inventories help in identification of economically useful species as well as species of special concern, i.e. uncommon, rare, vulnerable species and thus to quantify conservation worthiness of the candidate sites.

Devi and Yadava (2006) studied the floristic diversity assessment and vegetation analysis of tropical semi-evergreen forest of Manipur, North-East India and concluded that the diversity index of shrubs and herbs were found to be higher than the tree species. The diversity and population characteristics of woody species exposed to cultural disturbances in subtropical humid forests of Meghalaya were worked out by Upadhaya et al., (2004) and results revealed that the disturbance of mild intensity of light, to which these forests were, enhanced species diversity and richness without altering tree population structure of the community.

Ram et al., (2004) studied the plant diversity in six forest types of Uttarakhand, Central Himalaya, India. The increasing population trend over the last decade’s dependence on plant products has led to the vast exploitation of natural flora and fauna of the forest ecosystem. Tripathi et al., (2004) analyzed the community
structure and species diversity of Saddle Peak forests of Andaman Island and concluded that size variation was more in foothill forest site showing the highest degree of asymmetry.

Sagar and Singh, (2005) studied the structure, diversity and regeneration of tropical dry deciduous forest of northern India, and point out that high anthropogenic pressures in the past several decades, the dry deciduous forest covering most parts of Central India is being transformed to dry deciduous scrub, dry Savannah and dry grasslands. The stand structure of a tropical dry deciduous forest in Badra Wild Life Sanctuary, Karnataka was studied by Prakasha et al., (2008) which supported the view that high species richness favors very good regeneration.

Kumar et al., (2006) recently studied the tree species diversity and distribution patterns in tropical forests of Garo Hills. They concluded that many tropical forests are under great anthropogenic pressure and require management practices for maintain the overall productivity, biodiversity and sustainability.

Rasingam and Parathasarathy (2009) studied the tree species diversity and population structure across major forest formations and disturbance categories in little Andaman Island, India. Kharkwal and Rawat (2010) studied the structure and composition of vegetation in subtropical forest of Kumaun Himalaya. The ecosystem function, the distribution and occurrence of species had been affected by human interventions. Among human influence, agricultural requirements, commercial exploitation, grazing pressure and forest fire are the important sources of disturbance.

Aggarwal et al., (2006) investigated ecological assessment of greening of Aravalli Mountain range through joint forest management in Rajasthan, India. Many studies have been carried out on tree species biodiversity, its loss and conservation in tropical forest of India. (Ayyappan & Parthasarathy, 1999; Chittibabu & Parthasarathy, 2000a; Khera et al., 2001; Sagar et al., 2003; Tripathi et al., 2004; Kumar et al., 2004; Panchal & Pandey 2004; Yadav & Yadav, 2005; Anitha et al., 2007; Reddy et al., 2008; Sharma et al., 2009 and Nirmal Kumar et al., 1999, 2000, 2001, 2002, 2010 and 2011).
2.1.3. Regional status:

Forest degradation is mainly accompanied by reduction in biodiversity, species extinction and decrease in primary productivity. Consequently, there is a growing interest in quantifying habitat characteristics like forest structure, floristic composition and species richness in Indian forests. The forest structure, diversity and soil properties in a dry tropical forest of Udaipur, Rajasthan was worked out by Nirmal Kumar et al., (2010).

The effect of human disturbance on the diversity of woody species in the Sariska Tiger Project, Rajasthan was carried out by Yadav and Gupta, (2006). Aisha Sultana et al., (2014) studied diversity of tree vegetation of Rajasthan, India and they point out that quantitative floristic inventory of forest ecosystems provide necessary context for planning, understanding and interpreting long-term ecological research. Chaudhary and Singh (2014) studied the phytodiversity of Mukundara hills National Park of Kota district, Rajasthan, India. Sharma et al., (2001), also studied the diversity and dominance studies of vegetation of polluted habitats around Sanganer, Jaipur, India.

2.2 DRY MATTER DYNAMICS:

2.2.1. International status:

The forest dry matter production studies have increased in the past decades as basic ecosystem data that are needed for the development of ecological land management and to predict the dynamics and productivity of the forests (Bauhus et al., 2000).

Pakeman et al., (2011) explained that in each environment nutrient concentrations vary between soil horizons, depending on the soil chemistry and may vary in time depending on temperature and moisture. Montagnini (2000) studied the nutrient concentration, above-ground biomass of tree tissues and soil nutrients in two young plantations of eight indigenous tree species grown in pure and mixed designs in a low fertility site in the humid lowlands of Costa Rica.
Zerfu (2002) described that the total immobilization of Nitrogen in wood biomass increases with an increase of age, but the content per unit biomass decreases as age increases. Regina et al., (1999) studied the biomass estimation and nutrient pools in four Quercus pyrenaica in Salamanca, Spain and he concluded that retranslocation of nutrients may satisfy a significant proportion of the demand for nutrients for the production of new biomass.

According to (Oneykwelu et al., 2006) conifers tend to have a higher proportion of leaf biomass than broadleaved trees and they point out that a major percentage of total nutrient content can be found in the leaves of conifers, although concentration of nutrient in the foliage of conifers is lower than in broad leaved trees (Gregory et al., 2006).

Nambiar et al., (2000) and Specht et al., (2003) in their study points out that forest floor biomass plays a significance role in structure and functioning of forest ecosystems by acting as a nutrient reservoir for the intra-system processes. Son and Kim (1998) studied the above-ground tree component biomass, leaf area, forest floor and soils for major nutrient elements (N, P, K, Ca and Mg) in a 15-year-old ginkgo (Ginkgo biloba) plantation in central Korea. Kimaro et al., (2007) and Anthony et al., (2007) studied the nutrient use efficiency and biomass production of tree species for rotational woodlot systems in semi-arid Morogoro, Tanzania and reported that nutrient use efficiency and biomass production criteria in tree selection for management minimized nutrient export through wood harvests while maintaining site productivity.

According to (Paton et al., 2002) mixed plantations may be composed of fast-growing species with high yields, while also containing moderate growing species that have higher economic value, thus providing a diversified source of income. Uri et al., (2002) studied the above-ground biomass production and nutrient accumulation in young stands of silver birch on abandoned agricultural land and Estonia. Montagnini et al., (1995) studied number of advantages over conifers on abandoned agricultural land and also improve soil conditions and better wood quality.

According to (Hibbard et al., 2003) woody vegetation in arid and Montana forest ecosystems was a potentially significant, but uncertain, Carbon sink reducing
uncertainty in these estimates requires quantification of change in forest biomass that leads to shifts towards woody plant within many arid plant communities. Biomass and turnover of fine roots are usually high, with up to 70% of assimilate allocated in the belowground biomass, and further added that coarse root biomass increased with the age and size of trees (Malhi et al., 2011; Becknell et al., 2012).

2.2.2. National status:

Lodhiyal et al., (1995a) and Lodhiyal and Lodhiyal (2003a) pointed out that the rising demand for energy from renewable sources has generated new ideas and turned to woody dry matter production systems. Singh and Singh (1999) studied the biomass; net primary production and impact of bamboo plantation on soil redevelopment in a dry tropical region were examined. They concluded that with increasing age of plantation, a greater proportion of soil C, N and P tend to be immobilized in soil microbial biomass.

Rana et al., (2001) studied the biomass production in 7 year old plantations of Casuarina equisetifolia on sodic soil. Swamy et al., (2003) also studied the growth, biomass, carbon storage and nutrient (N, P and K) variations in 1 to 6-year-old chrono sequence plantations of Gmelina arborea were studied in three degraded red lateritic sites in Central India.

Kumar et al., (2005) investigated the above-ground biomass production and nutrient uptake of thorny Bamboo in the Kerala. They suggested that nutrient export through harvest (N, P and K) varied among the tissue types with the highest in reproductive parts, followed by foliage and twigs.

According to (Clark & Clark, 2000) and (Mani & Parthasarathy, 2007) studied the above-ground biomass estimation in ten tropical dry evergreen forest sites of peninsular India and they point out that many factors can influence the accuracy of biomass estimation in tropical forests and are known to vary with soil type, soil nutrients, climate disturbance regime, succession status, topographic position, landscape scale and human impacts.
Divakara et al., (2001) studied the above-ground biomass production and nutrient uptake of thorny bamboo and they concluded that short rotation tropical plantations that couple intensive management and rapid growth rates are characterized by high rates of nutrient removal from the forest biomass.

Shanmughavel et al., (2001) studied about the associated high nutrient export potential, may deplete the site nutrient capital and this, in turn, raises concerns about long-term sustainable production and site quality. Singh et al., (2011) also studied the community structure, diversity, biomass and net production in a rehabilitated subtropical forest in North India.

2.2.3 Regional Status:

Above-ground biomass studies in Indian tropical forest area using multi frequency DLRESAR data were carried out by Nizalapur et al., (2010). Nirmal Kumar et al., (2009) also carried out quantification of nutrient content in the above-ground biomass of Teak plantation in a tropical dry deciduous forest of Udaipur, India. Sharma and Upadhyay (2002) studied phytosociology, primary production and nutrient retention in herbaceous vegetation of the forestry arboretum on the Aravalli hills at Jaipur.

2.3. NUTRIENT DYNAMICS:

2.3.1. International status:

According to (Valdespino et al., 2009) pointed out that trees take up large quantities of mineral nutrients from the soil system and is returned to the soil through litter fall, large amount of nutrients are also removed when trees are harvested (Cleveland et al., 2006 and John et al., 2007). Nutrient accumulation and distribution pattern in different plants are affected by climate and by the type and age of the species. In contrast to that, in nutrient cycling all nutrients moves upwards because some proportion of nutrients absorbed by plants are transported above-ground and the recycled to the soil surface by litter fall and through fall. (Jobbagy & Jackson, 2001) studied that most of the plants from low nutrient sites have a low nutrient requirement and they pointed out that nutrient availability is a major factor influencing the distribution of plant species.
According to (Schoenholtz et al., 2000) physical and chemical properties of soil play a role in forest soil scientists to play an important role in assessment and advancement of sustainable forest management by developing the concept of soil quality as an indicator of sustainability.

Joseph, (2000) suggested that on the basis of above-ground biomass production relative to N uptake, deciduous forests have lower Nutrient Use Efficiency (NUE) than evergreen forests. However, NUE did not differ with forest type across local N mineralization gradients in mixed-species sequences, and was poorly correlated with foliar life span across diverse ecosystems. Laclau et al., (2005), suggested that plants growing on nutritionally deficient sites minimize nutrient loss by retranslocating a greater fraction of N and P from senescing leaves and most plants from low nutrient sites have a low nutrient requirement.

Deans et al., (1999) studied the nutrient and organic-matter accumulation in Acacia senegal in semiarid region of UK and they suggested that soil improvement is linked to their growth of deep rooted trees and shrubs which recycle plant nutrients from depth.

Liski et al., (2003) and Zheng et al., (2008) indicated that the success of Mimosoid trees in dry/saline environments is more likely to be attributed to their deep roots.

According to (Palma et al., 2000) and (Zimmermann et al., 2002) seasonal variations in nutrient concentration and return are related to climatic fluctuations and changes in plant phenology, which in turn can affect later processes, such as decomposition, mineralization, and immobilization (Liu et al., 2000). Laclau et al., (2003) nutrient dynamics in Eucalyptus plantation in Congo, a small pool of nutrients circulating quickly in the ecosystem made it possible to produce high amount of biomass in poor soil.

(Kobe et al., 2005) investigated the evergreen and deciduous species share common functional relationships between senescence and green-leaf nutrient concentrations and simply occupy different ranges of the relationship.
Larissa and Deborah, (2003) emphasized in their work on resorption proficiency over efficiency because proficiency is not subject to temporal variation in nutrient concentration in green leaves and timing of sampling. Species potential resorption proficiency, the lowest concentration of nutrient in senesced leaves, should reflect biochemical limits of nutrient resorption, which may vary among species adapted to different soil fertilities Majdi et al., (2005).

According to (Owusu et al., 2006) the nutrient cycling in primary, secondary forests and Cocoa plantation in the, Africa and they suggested that nutrient cycling was better in the primary forest followed by the secondary forest and cocoa plantation.

Villella et al., (2006) studied the forest structure and nutrient cycling in a seasonally dry Brazilian Atlantic forest. An understanding of nutrient cycling processes is fundamental to the management of natural and disturbed vegetation growing on tropical soils of low fertility. Ma et al., (2007) studied the nutrient cycling and distribution in different-aged plantations of Chinese Fir (Cunninghamia lanceolata) in southern China and they reported that the evidence of productivity changes in successive rotations in tropical plantations is limited and often difficult to interpret due to confounding factors.

Maria Villella et al., (2006) and Merino et al., (2008) pointed out that nutrient status is related to the intensity of harvesting. Although the causes are uncertain, this negative effect may be due to a reduction in forest floor thickness, which implies the loss of preferred rooting space for trees.

Turner and Lambert (2008) studied the nutrient cycling in age sequences of two Eucalyptus plantation species in New South Wales Australia and they point out that Calcium is a key nutrient and there is a risk of significant depletion of this nutrient especially in forests of smooth-barked species.

Inagaki et al., (2010) nutrient dynamics through fine litter fall in three plantations in Sabah, Malaysia, in relation to nutrient supply to surface soil. The forest ecosystem below-ground C fluxes, since up to 75% of the annual net primary production can be allocated into fine roots.
According to (Leuschner & Hertel, 2003) the fine root are the most significant component contributing to the forest ecosystem below-ground C fluxes, since up to 75% of the annual net primary production can be allocated into fine roots.

Craine (2006) worked on nutrient resorption and efficiency of retranslocation has been considered the most important mechanism in nutrient conservation, and thus has been investigated and discussed in many recent studies and they reported that the growth rate of trees rather than the availability of nutrients in the soil, is the main factor controlling retranslocation (Van Cleve, 1991). Nutrient flows and stocks is an important step in the development of sustainable land use systems, especially on low-fertility soils of the humid tropics (Schroth et al., 2001; Hartemink, 2003).

Sinsabaugh et al., (2005) examined soil microbial activity in a Liquidambar styraciflua plantation unresponsive to CO₂-driven increases in primary production and they point out that the indirect response of soil micro biota triggers to the changes in plant physiology.

Christensen et al., (2002) studied the physical fractionation of soil particles emphasizes the importance of interactions between organic and inorganic soil components in the turnover of organic matter however, the role of soil organic matter in the retention of plant nutrients and emphasized the need for management strategies to maintain adequate levels of soil organic matter.

Witt et al., (2000) found that the maintenance requirements for microbial biomass equal the total carbon input under steady or near steady-state conditions in terrestrial ecosystems. Smith and Bradford (2003) reported that the biomass of soil fauna of earth is nearly twenty times more than the biomass of human beings living on earth.

2.3.2. National status:

Lodhiyal et al., (1995a) pointed out that the major macro nutrients limiting the production of a forest crop are N, P and K and the major macronutrients limiting the production of a forest crop are N, P and K. Uptake of nutrients was found to be much greater in deciduous plantations than in evergreen plantations. According to
Lodhiyal and Lodhiyal (1997b) the high NUE is largely the result of: (a) higher soil nutrient availability and (b) increased nutrient concentrations and amount of litter nutrient returned through litter fall to the soil.

Lodhiyal and Lodhiyal (2003a) studied the variation in biomass and net primary productivity in D. sissoo forest and they explained the quantity of tree biomass per unit area of land constitutes the primary data needed to understand the flow of materials and water through forest ecosystems. Sundaravalli and Paliwal (2002) studied the effect of Albizzia lebbeck plantation on the nutrient cycling in a semiarid grazing land in Madurai and they concluded that the nutrients return to the soil through root was lower than that of litter disappearance, however, forest trees can increase the nutrient content of under storey grasses by their rapid leaf turnover and decomposition of nutrient rich litter, which can result in significant increase in soil fertility.

According to (Lodhiyal and Lodhiyal, 2003b) survival of tree species and the rate of nutrient uptake depend upon the availability of water and they pointed out that trees take up large quantities of nutrients from the soil system and, although much of the nutrient uptake is returned to the soil through litter fall large amount of nutrients are also removed when trees are harvested (Bargali et al., 1992). Nutrient distribution in the vegetation and soil compartments will provide useful information on nutrient budgeting of the ecosystem (Shanmughavel & Francis, 1998; Swamy et al., 2003).

Dixit et al., (2008) worked out the effect of human-induced disturbance on fine roots and soil microbial biomass C, N and P dynamics in a tropical rainforest ecosystem of Northeast India. They point out that the soil microbial biomass and its activities are dependent on the quality, quantity and turnover of detritus organic matter in the forest floor.

The Microbial Biomass C, N and P in disturbed dry tropical forest soils of Vindhayan Plateau, India was carried out by Singh et al., (2010) and they revealed that the deforestation and land use practices caused the alterations in soil properties. Deb et al., (2008) carried out vegetation, soil and microbial biomass analysis of traditional agro forest and tropical forest in the foothills of Indian Eastern Himalaya. The Seasonal dynamics in soil microbial biomass C, N and P in a mixed-oak forest
ecosystem of Manipur, North-East India was examined by Devi and Yadava (2006) and they concluded that the contribution of microbial C, N and P to total soil organic C, total N and P indicates that microbial biomass is immobilized more in forest compared to plantation.

Nemecek et al., (1998) Soil microbial biomass, the living part of soil Organic matter functions as a nutrient sink and is responsible for releasing mineral nutrients from Organic matter for use by forest plants. It was shown that microbial Nitrogen biomass contributes to the primary Nitrogen source of potentially mineralizable Nitrogen in soil.

Chapin et al., (2001) worked on nutrient withdrawal from senescing leaves and nutrient immobilization in the microbial biomass and they suggested as nutrient conservation systems developed and thus microbial biomass constitutes the major mineral nutrient source for plant growth in the ecosystems. Soil microbes are typically C-limited; lower microbial biomass in soils from conventional agro ecosystems is often caused by reduced organic-C content in the soil.

2.3.3 Regional Status:

Sharma and Upadhyaya (2002) studied Phytosociology, primary production and nutrient retention in herbaceous vegetation of the forestry on the Aravalli hills at Jaipur. Yadav et al., (2011) evaluated the soil biological properties under different tree based traditional agro forestry systems in a semi-arid region of Rajasthan, India and they concluded that significant temporal variations in soil organic carbon, extractable P, NO$_3$-N and NH$_4$-N in an arid soil.

Somasundaram et al., (2013) studied soil properties under different land use systems in parts of Chambal Region of Rajasthan and they etched out that soil properties under different land systems will contribute greatly in identifying and planning for necessary precautions required for sustainable environment.
2.4 LITTER DYNAMICS:

2.4.1. International status:

Wang et al., (2000) and Dent et al., (2006) described in their research that decomposition is primarily driven by microbial activities and by environmental factors such as temperature and precipitation as well as litter quality, but physical conditions and soil chemistry can also affects the rate of litter decomposition (Moretto et al., 2001). As decomposer microbes require mineral nutrients from either litter mass or surrounding soils to maintain their life activities (Finzi et al., 2001). Soil nutrient availability has long been suggested as one of the controlling factors affecting the rate of litter decomposition (Hermansah et al., 2002).

Koukoura et al., (2003) studied controversial effects of increased soil Nitrogen and Phosphorous on the nutrient dynamics and rate of litter decomposition. They found that increased N and P values could stimulate litter decomposition and found a positive response to N in the initial decomposition phase but a negative response in the later stages.

Berg and Mc Claugherty (2002) studied that decomposition is a key process in the control of nutrient cycling and formation of soil organic matter. Litter decomposition rates are controlled by environmental conditions, the chemical composition of the litter, and by soil organisms. Terrell et al., (2001) decomposition of leaf litter is also an integral and significant part of food webs and nutrient cycling; this refers to both the physical and chemical breakdown of litter and the mineralization of nutrients.

Johnson et al., (2000) in their study described the changes in soil nutrient dynamics has proven useful in assessing the sensitivity of forest ecosystems to anthropogenic pressures and in ascertaining interactions between fertilizer and nutrient availability of forest soils. Alhamd et al., (2004) studied the decomposition of leaf litter of four tree species in a sub-tropical evergreen broad-leaved forest in, Japan. The decay rate of newly shed litter is controlled by several major factors, i.e. litter quality (Ribeiro et al., 2002) site conditions including microbial community (Liu et al., 2001) and plant type (Moretto et al., 2001). At a regional to global scale the process can be related mainly to climate and litter quality (Liski et al., 2003).
Bayala et al., (2005) evaluated the nutrient release from decomposing leaf mulches of Vitellaria paradoxa and Parkia biglobosa under semi-arid conditions in West Africa and they point out that the pattern of leaf litter mass loss was demonstrated by combining litter species or by using just one genus, but few comparisons have been made about differences in mass loss pattern among different foliar litter species.

Bationo et al., (2007) studied the soil organic carbon dynamics, functions and management in agro-ecosystems of West Africa. Moore et al., (2006) studied pattern of Carbon, Nitrogen and Phosphorous dynamics in decomposing foliar litter in Canadian forests. Long-term studies have indicated that the factors that best correlate with decay rates that relate to long-term decay (Jeffrey et al., 2001; Yang & Janssen, 2002). The different species have different mineral nutrient release patterns, which are related to quality, season, and environmental factors was examined by Sangha et al., (2006).

Daisy et al., (2006) studied the nutrient flux via litter fall and leaf litter decomposition across a gradient of soil nutrient supply in a lowland tropical rain forest of Malaysia they reported that the water availability may also limit nutrient cycling and species distributions, even in ever-wet seasonal forests, similar results were also supported by (Gibbons and Newbery, 2003). According to (Lemma, 2006) soil properties are influenced by tree species. The changes depend on stand age (Jaiyeoba, 2001; Binkley et al., 2004 and Zheng et al., 2008); biological factors (Mendham et al., 2002); and intensity of forest management (Shan et al., 2001 and Zhang et al., 2007).

Villela and Proctor (2002) suggested that variation in water availability can affect nutrient cycling via increased litter fall during wet periods and decreased decomposition rates during dry periods. Jennifer et al., (2009) studied that the importance of biotic factors may vary with litter position and climate. Litter having a high C/N ratio lignin content and lignin/N ratio; toughness/N ratio and tannin content show a slow decomposition rate (Lourens et al., 2009).
2.4.2. National status:

According to Tripathi and Singh (1992) in tropical environment, the climatic seasonality characterized by alternating dry and wet periods plays a vital role in regulating the rates of litter decomposition by changing the population of microbial community on decomposing organic matter.

Arunachalam et al., (1998) studied the decomposition dynamics and N and P mineralization patterns of leaf litter in forest in humid subtropical region of India. They have emphasized that tree and shrub leaf litter decomposition varies depending on species and type of soil. Singh et al., (1999) studied the litter fall, leaf litter decomposition and N and P release in four tree species i.e. Dalbergia sissoo, Azadirachta indica, Pongamia pinnata and Shorea robusta planted on a mine spoil habitat and they emphasized the suitable species to be planted and their possible impact on the reestablishment of nutrient cycling in a mine spoil habitat.

Sundaravalli and Paliwal (2002) reported that the choice of species may affect under storey colonization in different ways and differ in their canopy architecture and influence the under storey temperature, light and humidity regimes; litter decomposition, rates of leaf litter production and litter chemistry and influence on soil biological activity and other aspects of soil fertility. Pande et al., (2002) in their work investigated litter production and nutrient return in tropical dry deciduous forest of Central India and concluded that nutrient return to the forest floor as influenced by insect defoliation and other environmental disturbances.

Pragasan and Parthasarathy (2005) investigated the litter production in tropical dry evergreen forests of South India in relation to season, physiognomic groups, plant life forms and they point out that tropical ecosystem, maintenance of soil organic pool is achieved by the rapid and high circulation of mineral nutrients through the litter fall and litter decomposition.

Tripathy et al., (2006) carried out leaf litter fall and decomposition of different above and below-ground parts of birch trees and dwarf bamboo shrubs in young secondary forest of Japan. The amount and seasonal patterns of litter fall and decomposition are important determinants of overall recycling of nutrients and maintenance of soil fertility in terrestrial ecosystems. Singh and Kashyap (2007)
recently evaluated the variations in nitrification and soil N-mineralization in seasonally dry tropical forest and savanna ecosystems in Vindhyan region, India, and they reported that soil moisture as the important factor controlling N-mineralization and nitrification at sites.

Barbhuiya et al., (2008) studied the leaf litter decomposition of dominant tree species of Namdapha National Park, Arunachal Pradesh, Northeast India and suggested that early decomposition is regulated by nutrient concentrations whereas the litter decay rate is regulated by lignin concentration. Different species have different nutrient release patterns (Sangha et al., 2006) which are related to quality, season, and environmental factors (Arunachalam et al., 1998).

**2.4.3. Regional status:**

Nirmal Kumar et al., (2009) studied the seasonal changes in bioelements in litter and their potential returns to green leaves in five species of tropical dry deciduous forest of Western India and they suggested that the resorption of bioelements prior to leaf litter fall is one of the key processes to converse mineral nutrient by plants.

Nirmal Kumar et al., (2010) recently studied the wood and leaf litter decomposition and nutrient release from Tectona grandis in tropical dry deciduous forest of Rajasthan, India and concluded that nutrient return via litter fall represents a major pathway for element transfer from vegetation back to the soil. Sharma (2012) studied the litter pattern over sand dunes of Aravalli forest at Ajmer (Rajasthan), India. Litter fall which is limiting in sand dunes may be an important index to soil fertility for agriculture crops and has been shown to increase seedling survival in arid environments

Son et al., (2013) studied decomposition and Nitrogen release pattern of fruits, tree, and leaf litters in Arid western Rajasthan, they observed that biomass produced by tree species enhance soil fertility by reducing the nutrients through litter fall, pruning or importing nutrient through biomass transfer systems.