CHAPTER - II

LITERATURE REVIEW

2.1 PLANT DIVERSITY IN THE WORLD

The term biodiversity encompasses a broad spectrum of biotic scales, from genetic variation within species to biome distribution on the planet (Gaston, 1996; Purvis and Hector, 2000; Mooney 2002). Biodiversity is defined as the kind and numbers of organisms and their patterns of distribution (Barnes et al., 1998). The introduction of the term biological diversity is not a new one. It emerged some twenty years ago (McNeely et al., 1990; Chauvet and Oliver, 1993; Wilson and Peter, 1988), but the origins of the concept go far back in time. Generally, biodiversity measurement typically focuses on the species level and species diversity is one of the most important indices which are used for the evaluation of ecosystems at different scales (Ardakani, 2004). Palmer (1995) stated that species diversity appears to be the most straightforward concept of the components of biodiversity than the other two components namely the genetic diversity and community diversity. Biodiversity evaluation improves human perception about environment and its changes that is necessary for continuation of a human being's life, economical problems, consistency and application of ecosystems and environmental health in any region (Pourbabaei and Ahani, 2004; Wehenkel et al., 2006; Sohrabi et al., 2007; Mahmoudi, 2007; Esmaeilzadeh and Hosseini, 2007 and Ardakani, 2008). The first step for protection of biodiversity is determining and estimating in the natural resources field. According to Magurran (2004) the earliest reference of biological diversity was attempted by Gerbilskii and Petrunkevitch (1955) in the context of interspecies variation in behaviour and life history, and followed by Lovejoy (1980), Norse et al., (1986) and

regeneration in a moist semi-deciduous forest following anthropogenic disturbances and plant invasion. Abdul Hayat, *et al.*, (2010) studied the plant species diversity at Pasir Tengkorak Forest Reserve, Langkawi Island, Malaysia. Norhajar Eswani, *et al.*, (2010) analyzed the species diversity and study of quantitative analysis of medicinal plants in logged over forest in Tekai Tembeling Forest Reserve (TTFR). Sobuj and Rahman (2011) studied about the assessment of plant diversity in the Khadimnagar National Park in Bangladesh. Ghollasimood, *et al.*, (2011) has described the vascular plant species and diversity of a coastal hill forest in Sungai Pinang Permanent Forest Reserve in Pulau Pangkor in Perak, Malaysia. Fatheen Nabila *et al.*, (2012) has carried out in the assessment of floristic composition of Kilim Geoforest Park, Langkawi, Malaysia. Mangrove vegetation is supported to rich biodiversity and also used for commercial products to local fisherman communities (Bandaranayake, 2002). Several studies on mangrove diversity of the world have been made to find out the ecological status of this coastal environment. (Ashton and Macintosh, 2002; Sawaid Abbas *et al.*, 2013).

### 2.2 PLANT DIVERSITY IN INDIA

India is well known for significant geographical diversity which has favored the formation of different habitats and vegetation type. Floral diversity is the natural resource of a country, wealth of a country and acquiring knowledge of it is of immense scientific and commercial importance. Biodiversity hotspots are defined as areas featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat (Myers *et al.*, 2000). The vegetation and forest types have been analyzed by Champion and Seth (1968) and National Remote Sensing Agency (NRSA, 1979). In India there are a number of ecological studies on floristic and biodiversity. Ghate,
et. al., (1997) assessed the plant diversity in the Western Ghats, while Joshi and Suresh (1997) have carried out diversity analysis in the Nilgiri Biosphere Reserve. Adhikari, et al., (1991) investigated the species composition and diversity in the high altitude forest of the Kumaon region in Western Himalaya. Singh and Mudgal, 1998; Saxsena and Singh, 1982 have studied the ecological system of the forest of Meghalaya in the 1980’s. Further studies on forest ecosystem of north east India were carried out by Rao and Hajra (1986); Khan, et al., (1987); Rao et al., (1990); Barik et al., (1992); Rao, (1992). Barik, et al., (1992) studied the species diversity in the sub-tropical forest of Meghalaya. Ganesh, et al., (1996) studied plant diversity in mid-elevation evergreen forest of the Western Ghats. More studies have been reported on the plant diversity of different zones of India. (Kumar, 1997; Aparajita et.al., 2002; Kumar, et.al., 2006; De, 2007). Singh, et.al., (2010) studied the floristic diversity and taxonomic profile of the vegetation of Achanakmar-Amarkantak Biosphere Reserve, Central India. Shameem and Irfana (2011) studied the comparative assessment of edaphic features and phytodiversity in lower Dachigam National Park, Kashmir Himalaya, India. Vediya and Kharadi (2011) studied the herbs, shrub and trees at Megharj range forest District Sabarkantha, North Gujarat, India. Kaladharan, et.al., (2011) have described the assessment of floral biodiversity along the Karnataka coast. Vidyasagar et.al., (2011) described the phytosociological analysis of Mangrove vegetation of Kannur District, Kerala. Prerna, et. al., (2012) reported the assessment of disturbance level and analyzed its effect on species composition and diversity in the Phakot watershed of Central Himalaya and also studied the comparison between species richness, diversity and composition of Anogeissus latifolius mixed forests in Phakot and Pathri Rao watersheds of Garhwal Himalaya. Kaiser Iqbal, et.al. (2012) studied the structure and composition of plant species around Khoh river of Garhwal Himalaya, India. Similar studies have
been carried out by Shrikant Gunaga, et. al.,(2013); Durga Prasad Behera and Lakshman Nayak, (2013); Rathod Mulchand, (2013) in different regions of India.

2.3 PLANT DIVERSITY IN TAMIL NADU

Coastal areas are highly dynamic and undergoing rapid change. The knowledge of land use/land cover change is very important to understand the natural resources, their utilization, conservation and management. Land use is obviously constrained by environmental factors such as soil characteristics, climate, topography and vegetations. But, it also reflects the land as a key and finite resource for most human activities including agriculture, industry, forestry, energy, production, settlement, recreation and water catchments and storage. Many studies have been reported on the quantitative plant biodiversity and inventories of various forests of Tamil Nadu (Sukumar et al., 1992; Ganesh et al., 1996; Ghate et al., 1997; Parthasarathy and Karthikeyan, 1997; Parthasarathy, 1999; Ayyappan and Parthasarathy, 1999) and on the coromandal coast (Parthasarathy and Karthikeyan, 1997a; Muthuramkumar et al., 2006; Mani and Parthasarathy, 2009), but the Eastern Ghats is poorly studied in these aspects, except those of Kadavul and Parthasarathy (1999a) in the Shervarayan hills and Kadavul and Parthasarathy (1999b) in the Kalrayan hills. Parthasarathy et al., (2008) investigated on plant biodiversity in Tropical Dry Evergreen Forests (TDEFs) occur as patches along the coromandel coast of peninsular India. A number of authors have worked on the patterns of plant species diversity in the tropical forests of India (Roy et al., 2002; Sagar et al., 2003; Jha et al., 2005). Parthasarathy (1999, 2001) studied the tree species diversity and distribution in tropical evergreen forests of the Western Ghats in South India and identified anthropogenic disturbance and competitive interaction among trees as major factors influencing the diversity (Roy et al., 2002). One of the
important aspects of diversity investigated so far has been the species area relationship (Leps and Stursa 1989; May and Stumpf, 2000). Ganesh et. al., (1996) assessed the plant biodiversity in undisturbed area of mid elevation evergreen forest of the Western Ghats. Parthasarathy (2001) studied the changes in forest composition and structure in three sites of tropical evergreen forest around Sengaltheri, Western Ghats. Sudhakar Reddy, et. al., (2008) carried out the assessment of quantitative structure and floristic composition of tropical forests of Mudumalai Wildlife Sanctuary, Western Ghats, India. Pitchairamu, et. al., (2008) have worked out on floristic inventory and quantitative vegetation analysis of tropical dry deciduous forest in Piranmalai Forest, Eastern Ghats, Tamil Nadu, India. Chittibabu and Parthasarathy (2000) reported the tree diversity in undisturbed and non human-impacted tropical evergreen forest sites were investigated in the Kolli Hills, Eastern Ghats. Anitha et. al., (2009) compared the understory plant diversity and community composition in two sites at different disturbance levels and these study was carried out on the Anaikatty hills, Western Ghats. Tropical dry evergreen forests are distributed on the eastern (Coromandel) coast of India (Parthasarathy and Sethi 1997) and extend 50 km landward from the coast (Mani and Parthasarathy 2005). Mohandass and Priya Davidar, (2009) studied floristic structure and diversity of a tropical montane evergreen forest (shola) of the Nilgiri Mountains, Southern India. Jayakumar et. al., (2009) compared the floristic diversity of evergreen forest inferred from different sampling approaches in the Eastern Ghats of Tamil Nadu, India. Philomena George, et. al., (2011) reported the biodiversity survey of trees and ornamental plants in Karunya University, Coimbatore, India. Balakrishnan, (2012) reported on the angiosperm diversity in the island of Rameshwaram coastal region, Gulf of Mannar Biosphere reserve. Gangatharan Ramesh and Krishnasamy
Muthuchelian (2012) have studied and reported on plant diversity in the Suruli sacred grove of the Cumbum valley of southern Western Ghats, Tamil Nadu.

2.4 PHYTO-SOCIOLOGICAL ANALYSIS OF PLANT DIVERSITY

Phytosociological surveys are important tools of ecologists to assess and evaluate the vegetation types of a given ecosystem. These surveys ultimately help in planning, management and exploitation of natural resources since important components of food chain viz., human, livestock, wildlife and soil fauna are closely associated with specific plant assemblages of the area. Fujiwara, (1987) says that, the phytosociology is the study of vegetation and its internal "social" relationships, not only classifications of plant communities but also analysis of their structure, composition, successional relations, relationship with environmental factors, as well as the comparison of different communities. Phytosociological works in Kerala are rather scanty with some of the important publications are Singh et.al., (1984) for Silent Valley and Basha (1987) for the evergreen forests of Silent Valley, Attappadi. Pascal (1988) for evergreen forests of Western Ghats. KFRI (1980) conducted a phytosociological study in Attappadi reserved forests. Menon and Balasubramanyan (1985) for Trichur Forest Division and Pascal and Pelissier (1996) for tropical evergreen forests of southwest India. Singh et.al., (1986) analysed vegetation of woody species of some forests of Chakrata Himalayas. Singhal and Soni (1989) analysed woody species of Mussoori. Laxmi et al., (1987) studied in phytosociology of Machhla sub watershed of Pauri Garhwal, UP. Singhal and Sharma (1989) worked on phytosociology of high level alluvial sal forests and Gangetic tropical moist deciduous forests of Doon Valley. Ralhan et al., (1982); Singh and Singh (1987) have studied on phytosociological analysis of forest vegetation in Kumaun Himalaya. Some important contributions on,
phytosociology, vegetation analysis and community structure in certain Himalayan forest types are those by Sharma and Kumar 1992; Verghese and Menon 1998; Pande et al., 2002; Ilorkar and Khatri 2003; Negi and Nautiyal 2005; Naithani et al., 2006; Sanjeev et al., 2006. Similar studies have been carried out by Kumar (1987), Kumar (1997), Kour (2001), Singh (2002), Kesar (2002), Sharma (2003), Jhangir (2004), Dutt (2005), Kumar (2007), Kumar (2007) in different regions of India. Sharma and Kavita Sharma (2011) have carried out phytosociololgical analysis on the vegetation of sand dunes and sandy plains of Ajmer, Rajasthan. Several researchers (Mishra et al., 1993; Awasthi et al., 2001; Bhadra et al., 2010; Misra and Sharma, 2010; Das and Menon, 2011; Hegde et al., 2011; Jaykumar and Nair, 2012; Bajpai et al., 2012; Ahmed, 2012; Sahu et al., 2012) have worked on phytosociology in different parts of the country.

2.4.1 Quantitative analysis of sampling methods

Quantitative sampling methods in small areas or quadrats were introduced in a few of the earlier studies of American vegetation (Pound and Clernents, 1898). Quadrat sizes for different vegetation types vary accordingly. The minimal area of quadrat was standardized by species/area curve method (Cain, 1938). The increase in the number of species with the increase in the area was first scientifically treated by Jaccard (1912) followed by Cain (1938); Oosting (1956); Misra (1968); Singh et al., (1984); Bash (1987); Subhash et al., (1987); Ray (1993) and Pascal (1988). The degree of presence of a species in a unit area (quadrat) is termed as constancy (Du Rietz, 1930). Distribution of species is one of the most important aspects of vegetation that has attracted many ecologists (Fracker and Brischle, 1944; Whitford, 1948; Ashby, 1948 and Cole, 1949). Raunkiaer (1934) developed the frequency analysis, based on the presence or absence of species in a number of quadrats. Density, frequency, abundance,
IVI etc. were worked out by Phillip (1959) and Muller-Dombois and Ellenberg (1974). Quantitative floristic inventories based on small sized permanent plots (1 - 2 ha) have been used in recent years to characterize the vegetation in different tropical forests by documenting their structure, composition and diversity (Sukumar et.al.,1992; Smith and Killeen 1995; Strasberg 1996; Ganesh et.al., 1996; Pascal and Pelissier,1996; Ghate et.al., 1998; Parthasarathy,1999; Parthasarathy and Karthikeyan, 1997a; Ayyappan and Parthasarathy, 1999; Parthasarathy,2001; Sagar et.al., 2003) and on the Coromandal coast (Parthasarathy and Karthikeyan, 1997; Parthasarathy and Sethi, 1997), but the Eastern Ghats is poorly studied in these aspects, except those of Kadavul and Parthasarathy (1999a) in the Shervarayan hills and Kadavul and Parthasarathy (1999b) in the Kalrayan hills. A few studies specifically related to quantitative analysis, species richness their population density and dispersion pattern are available for the Himalayan tract (Relhan, et. al., 1982; Chowdhery and Wadhwa 1984; Singh et. al., 1986; Nath et.al., 2000; Singh and Rawat 2000; Pande et. al., 2001 and 2002; Phillips et. al. 2003; Singh and Kaushal 2006; Dash et. al., 2009; Tynsong and Tiwari 2011; Shameem et. al., 2011 and Baithalu et. al. 2013).

Species diversity is known equally to the biodiversity that is limited to diversity in local or regional surface (Krebs, 1998). Species diversity is one of the important specifications of bio-societies, that are measured in different ways (Krebs, 1998). Diversity of organisms, measurement of diversity and examining of some hypothesis about reasons of diversity are some cases that have been favoured by ecologists for a long time (Barnes et.al., 1998). Diversity index derived from information theory has been widely used in the recent work of ecologists. Shannon Weiner equation (1949) has been widely applied to quantify anything that came to hand particularly species diversity. (Simpson, 1949) proposed another index to study the floristic diversity and
concentration of dominance. Diversity and dominance in manmade forests were worked out by Srivastava (1986). Pande et al., (1988) had conducted a comparative vegetation analysis of forest area. Diversity of a community can be assessed by the proportional species abundance data either by using statistical sampling theory (Fischer et al., 1943; Preston, 1948; 1962) or by a variety of nonparametric measures (Simpson, 1949; Shannon, 1963). Due to the complex nature and lack of theoretical justification for a statistical sampling theory, the nonparametric measures have gained a great deal of popularity in the recent past (Magurran, 1988 a and b; Krebs, 1989). If the relative abundance of species in a particular plant or animal group in a given community is somehow measured, there will be some common species, and some rare species and many species of varying degree of rareness (May, 1975).

One of the key goals of ecology is to explain the distribution and abundance of the species (Harte et al., 1999; Kunnin et al., 2000). Geographical variation in patterns of species richness and distribution has intrigued biologists for centuries. Much early work focused on large-scale, cross-continental patterns were pioneered by botanists such as de Candolle (1874) and Copeland (1939). Modern interest has focused on distributions along latitudinal and elevational gradients and the processes that control these patterns (Scheiner and Reybenayas, 1994; Vetaas and Grytnes, 2002; Willig et al., 2003; Bachman et al., 2004; Colwell et al., 2004b; Kattan and Franco, 2004). Such studies have furthered understanding of the spatial patterns of species richness and the mechanisms behind these patterns. More recent interest in species richness has focused on structurally complex tropical forests. Besides comparisons of species numbers, several studies have attempted to understand how richness patterns vary among different structural or functional groups such as trees, vines, shrubs, and herbs.
(Gentry, 1982, 1988; Condit et al., 1996; Vazquez and Givnish, 1998; Tuomisto and Poulsen, 2000; Kessler, 2001b; Cardelus et al., 2006).

General nature of vegetation such as density, frequency, abundance and constancy have been analyzed for major forest divisions viz, Gir, Girnar, Bhavnager and Rajkot Jamnagar divisions of Saurashtra by Menon and Shah (1982). Influence of forests on various environmental aspects such as rainfall, soil erosion, watershed management, air pollution, wind, climate, energy and recreational aspects were reviewed by Menon (1982) In addition to these, many studies have been made on phytosociological aspects of forest vegetation (Joshi and Behera, 1991; Sushi Kumar et al., 1991; Room Singh et al., 1991; Lata and Bisht, 1991 and Dani et al., 1991) Several studies have described the composition of vegetation, in this includes the works of Singh and Kachroo (1994); Kumar (1997); Kour (2001); Singh (2002); Kesar (2002); Sharma (2003); Jhangir (2004); Dutt (2005) and Kumar (2007).

2.4.2 Assessment of anthropogenic disturbance in the study area

The conversion of primary ecosystems into anthropogenic ecosystems as a result of human activities is most apparent in and around urbanizing landscapes (Alberti et al., 2003), which account for 2% of the earth’s surface (Grimm et al., 2000). These urban landscapes have been greatly disregarded by naturalists and conservationists for reportedly attracting cosmopolitan weedy flora that threatens surrounding natural habitats (Turner et al., 2005). Disturbance has been widely recognized as one of the major factors influencing variations in species diversity (Connell, 1978; Huston, 1994; Noss, 1996 and Brooks and Berry, 2006). Sala et al., (2000) says that, land-use changes, the result of increasing human population, is one of the major drivers of future changes in biodiversity. Many scientists believe that vegetation destruction in
rangeland is because of the increment of the grazing pressure and soil deterioration in the same time (Blackburn, 1982; Leck et.al., 1989). The natural resource is in imminent danger due to adverse abiotic and biotic stresses resulting from population explosion, industrial development, agriculture and global warming (Bawa and Dayanandan, 1998). With increase in human activity in and around forest ecosystem, biodiversity in terms of number of species has decline (Swaine et.al.,1987; Abdulhadi et.al., 1987). High percentage of biodiversity favours ecological stability, whereas accelerating species loss could lead to disintegrate the ecosystem. Human dominance on the biosphere markedly reduces the diversity of species with many habitats worldwide, which leads to species extinction (Vitousek et.al., 1997). The biodiversity of the present forest area is over time, often heavily influenced by the cycles of human activity such as fire, agriculture, technology and trade (McNeely 1994). Over and excessive exploitation may result in alteration of natural ecosystem balance. Hence, if the natural ecosystem and their function are to be kept in equilibrium conditions then there is a need to have a correct assessment of natural resource availability. The destruction of vegetation has been continuing at an alarming pace due to a variety of causes (Prance et.al., 2000). Disturbance influences species diversity in much landscape and a better understanding of the interaction between spatial pattern and disturbances is needed (Roberts and Gilliam 1995). Several authors have studied disturbance in the Himalayan region (Abugov, 1982; Khan., et.al., 1987; Ramirez-Marcial, et.al.,2001; Bhuyan, et.al., 2003; Sagar, 2003; Mishra, et.al., 2004; Kumar and Jeet Ram 2005; Pooja Uniyal, et.al., 2010 and Dangwal, et.al., 2012) Disturbance to an ecosystem means any discrete event that disrupts the ecosystem, community or population structure, or the physical environment (Pickett and White, 1985). Species composition, community dynamics and human welfare services of forest ecosystems become adversely affected by
disturbances of both natural and anthropogenic origin (Sousa, 1984). Whitemore and Burslem (1996) classified disturbance into large scale or community wide (landslides, volcanoes, drought, lighting, forest fire and various human activities) and small-scale disturbances such as mortality of the few trees. In fact many kinds of disturbances both natural and anthropogenic are amenable to scientific experimentation and immeasurable directly. Most of the studies on forest ecosystems in relation to disturbance were focused on species-rich tropical rain forests (Ashton 1993; Whitemore and Burslem 1996; Aravind et.al., 2001; Bhuyan et.al., 2001) or temperate forests (Gilliam 2002; Schumann et.al., 2003). Dry deciduous forests of tropical areas are under constant disturbances of both climatic and anthropogenic origin. In India, habitat destruction, over exploitation, environmental pollution and anthropogenic pressure are the major disturbances to forest ecosystems (UNEP, 2001). The dry tropical forest accounts for 38.2% of the total forest cover of India (MoEF, 1999), which is largely disturbed by lopping, burning, overgrazing and clearing for cultivation. Such disturbances lead to their conversion into species-poor forest ecosystems. Habitat destruction is the leading cause of species extinction and biodiversity loss in natural ecosystems (Pimm and Raven, 2000; Koh et.al., 2004). Studies on tropical dry deciduous forests in relation to disturbances were much limited in India (Puyravaud et.al., 1995; Khera et.al., 2001) particularly, on Eastern Ghats in South India (Rajan et.al., 1995). Understory plant diversity and community composition in two sites at different disturbance levels were studied on the Anaikatty hills, Western Ghats, (Anitha et.al., 2009). Many authors have studied the effect of disturbances on experimental (Armesto and Pickett 1985; McCabe and Gotelli 2000; Hooper et.al., 2004), theoretical (Huston 1979; Wilkinson, 1999) and observational conditions (Abugov 1982; Huston 1994; Townsend et.al., 1997; Slik et.al., 2002; Hooper et.al.,
2004). The disturbance plays a central role in shaping the species composition in forests (Pickett and White 1985).

2.5 ANALYSIS OF SOIL WITH PLANT RELATIONSHIP

Soil and vegetation have a complex interrelationship. Soil properties influence the vegetation and *vice versa*. Selective and absorption of nutrients by different tree species and their capacity to return these to the soil brings about changes in the soil properties (Rawat, 2005). Soil-vegetation relationship of saline localities has been documented in Australia (Crowley, 1994; Bui and Henderson, 2003), China (Li, 1993; Toth *et al.*, 1995), Egypt (Serag and Khedr, 2001; Abd El-Ghani and Amer, 2003; Abd El-Ghani and El-Sawaf, 2005), USA (Ungar, 1976; Skougard and Brotherson, 1979; Gul *et al.*, 2001; Omer, 2004), Iran (Jafari *et al.*, 2003; 2004), Italy (Silvestri *et al.*, 2005) and Spain (Rogel *et al.*, 2001). Results generally indicated that the salinity gradient, moisture and available nutrient in soil are the important factors in controlling the distribution of vegetation (Rogel *et al.*, 2001). Soil degradation is one of the serious environmental problems in the world (Middleton and Thomas, 1992). Especially, soil degradation proceeds rapidly in arid and semiarid region, resulting in desertification in these areas. It is estimated that most of desertification has been caused by human activity (Koizumi *et al.*, 2000) and the desertification in grazing lands are widely accelerated by overgrazing (Dregne *et al.*, 1991; Kadamura, 1996). Ecosystem biogeochemistry may be strongly influenced by plant species acting in concern with abiotic factors (Hobbie, 1992). As a result, changes in vegetation composition can produce substantial changes in carbon and nitrogen dynamics and accelerate or constrain future changes (Chapin, 1993; Hooper and Vitousek, 1997; Tilman *et al.*, 1997). In arid and semiarid regions, trees and shrubs affect the spatial distribution and
cycling of nutrients by altering soil structure, microbial biomass, soil moisture, and microclimate and by concentrating organic matter beneath their canopies (Binkley and Giardina, 1998; Schlesinger and Pilmanis, 1998). The result is the formation of ‘‘fertile islands’’ (Pauker and Seastedt, 1996) for contrasting processes in alpine tree islands. This phenomenon has been widely described in cold desert scrub (Burke et al., 1989), hot desert scrub (Schlesinger et al., 1990; Kieft et al., 1998), temperate woodlands (Padien and Lajtha, 1992), and tropical (Scholes and Archer, 1994) and temperate savannas (McPherson, 1997).

Buckman and Brady (1967) explained that chemical and physical properties of soils are controlled largely by clay and humus as it acts as the center of activity around which reactions and nutrient exchange occurs. Similarly, Dar et al., (2001) say that, the vegetation in turn influences the physical and chemical properties of soil to a great extent. It improves the soil structure, infiltration rate and water holding capacity.

Soil texture and density are important for soil water and air condition (Landon, 1984). Soil texture is the most fundamental attribute of soil fertility. Soil fertility increases with clay content, but high clay-soil are prone to drought in dry areas and to flooding in wet areas. Clay soils lowers the production of the plant than sandy soil in arid areas; the plant production is higher in wet areas due to the interacting effect of clay on soil water and nutrient status. Clay content has a controlling influence on the soil water retention (Scholes, 1990). Moreover, it is negatively related to the mineralization of nitrogen (Cote et al., 2000). The structure of the soil influences organic matter turnover and fertility of soil and plays an important key role in the ability of soil to store organic matter (Balabane, 1996).
The temperature of the soil is one of the most important factors for the growth of the plant particularly that of the surface layers by its effect during germination (Richardson, 1958). The single most powerful control on the rate of chemical and biological processes of the soil is the soil water content. It is the medium in which most transport of elements and particles occurs within the ecosystem e.g., on the root surface and across its boundaries (Scholes et.al., 1994). According to Singh and Datta (1987) the hill soils are acidic and is confirmed with several other works (Toky and Ramakrishnan, 1981; Andresse and Koopmans, 1984; Okigbo, 1984; Kumada et.al., 1985). Hydrogen ion concentration (pH) characterizes soil acidity and is strongly correlated with base saturation, organic carbon, total nitrogen and cation exchange capacity (CEC) that are important parameters to characterize soil fertility for plant production (Landon, 1984).

Soil organic carbon is the largest carbon reservoir in many terrestrial ecosystems including grasslands, savannas, boreal forests, tundra, some temperate forests and cultivated systems, comprising as much as 98% of ecosystem carbon stocks in some systems (Schlesinger, 1977). Globally, the amount of carbon stored in the soil is equal to the amount stored in vegetation and in the atmosphere combined (Schimel, 1995). A substantial portion of carbon fixed by vegetation is transferred to the soil annually (Raich and Nadelhoffer, 1989), a portion of which is a refractory material with long turnover times (Paul et.al., 1997; Falloon and Smith, 2000); the rest decomposes relatively rapidly and is returned to the atmosphere as CO₂. Thus soil carbon is a large, relatively dynamic component of terrestrial carbon stocks.

Soil organic matter is an important determinant of the cation exchange capacity of soils, particularly in coarse textured soils and so called ‘low activity’ clay soils. It
also plays an important role in retention of non-ionic organic compounds and pesticides in soils (Chiou, 1990). According to Russell (1980) the ‘soil organic matter consists of a whole series product which range from undecayed plant and animal tissues through ephemeral products of decomposition to fairly stable amorphous brown to black material bearing no trace of anatomical structure of the material from which it was derived’. Similarly, Schnitzer (1991) defined soil organic matter as the sum total of all organic carbon containing substances in the soils which consists of ‘a mixture of plant and animal residues in various stages of decomposition, of substances synthesized microbiologically and/or chemicals from the breakdown products and of the bodies of live and dead microorganisms and small animals and their decomposing products’.

Major environmental controls of organic matter decomposition in soil are moisture status, soil temperature, oxygen supply, clay content and mineralogy (Eijsackers and Zehnder, 1990; Anderson and Flanagan, 1990; Alexander, 1977). Cultivation tends to increase the rate of organic matter loss in soils primarily by accelerating microbial decomposition (Seybold et al., 1999). Soil organic matter increases the absorption of Zn, Cu and Mn in soil (Borah et al., 1992). Organic matter is responsible for most desirable soil structure, increases soil porosity, reduces soil erosion by wind and water and it is the reservoir of nitrogen. The nature of soil organic matter in a range of forest soils has been affected by tree species and soil physico-chemical condition (Howard et al., 1997).

The ability of plants to take up and assimilate inorganic nitrogen is lowered or curtailed both in early spring and after defoliation (Clement et al., 1978; Ourry et al., 1990; Thornton and Millard, 1993). The plant demand for nitrogen is met by the nitrogen uptake from the soil after the restoring of positive carbon balance of the whole plant (Clement et al., 1978). Thus, the availability and mobilization of nitrogen reserves
must be considered as an important factor in survival and competitive ability of perennial plants.

Nitrogen is primarily stored as storage proteins, free amino acids and nitrate ions (Chapin et.al., 1990 and Millard, 1988). However, it is not a much suitable nitrogen source for growth when the rate of photosynthesis is limited because reduction and assimilation of nitrate have a high requirement for the energy and carbon skeletons. Many plant species accumulate amino acids and amides in their vegetative tissues in large quantities (Millard, 1988). The content of these compounds in pertaining organs usually rise in late autumn and remains high until late spring (Volenec et.al., 1996). The marked increase in amino acid content in the autumn is closely connected with remobilization of nitrogen from senescing plant parts (Millard, 1988) but may also reflect the temporary higher availability of nitrogen in soil.

Phosphorus (P) is one of the key elements necessary for the growth of plants and animals. Phosphorus exists in soils and minerals, living organisms, and in the water column of lakes and wetlands. Although wetlands generally accumulate nutrients, they sometimes become net exporters of nutrients that had previously been taken up by plants (Mitsch and Gosselink, 1993). Phosphorus occurs in a sedimentary cycle with no significant gaseous loss mechanism, so it tends to accumulate in wetland systems. Retention of phosphorus is regulated by sedimentation and uptake and release by vegetation, periphyton, and microorganisms. Phosphorus occurs as soluble and insoluble compounds in both organic and inorganic forms (Faulkner and Richardson, 1989). The vast majority of phosphorus is tied up in organic matter and inorganic sediments and is also rendered unavailable to plants and microorganisms through precipitation of insoluble phosphate and the absorption of phosphate onto clay particles,
peat, and Iron (Fe) and Aluminum (Al) hydroxides (Mitsch and Gosselink, 1993). Conversely phosphorus can be released from sediments by diffusion, desorption, and re-suspension.

Potassium is found in soils in three different forms and a three way dynamic equilibrium exists between them. Non-exchangeable potassium ↔ Exchangeable potassium ↔ Soil solution potassium. Potassium is taken up by plants from the soil solution, and the concentration in solution will be replenished by the exchangeable fraction. Some of non-exchangeable potassium can also be released into the soil solution and may thus be taken up by plants (McLean, 1961; Blanchet and Bosh, 1967; Prasad and Power, 1997 and Havlin et.al., 1999). The capacity of soils to supply plants with potassium does not depend only on the amount of potassium reserve in the soil, but also on the rate of availability of plants. The latter can be estimated only with suitable experiments in pots (Grimme and Nemeth, 1978). Some soils can provide enough for many years, but the release of potassium is slow to meet the need of crops (Arnold and Close, 1958; McLean and Watson, 1985; Johnston and Goulding, 1990). Considerable research has been done on soil-vegetation relationship in saline soils of China but the work has been mainly confined to inland areas like Songnen plain and Xinjiang (Pan et.al., 1998; Xin et.al., 1999; Yan et.al., 2001; Qu and Guo, 2003; Li and Yang, 2004). The studies identifying the major environmental factors associated with vegetation patterns in coastal salt marshes are scarce (Li, 1993; Wu et.al., 1994; Wang et.al., 1994; Hu and Wang, 1997; Toth et.al., 1995; Liu et.al., 2003).
2.6 VEGETATION COVER ANALYSIS USING REMOTE SENSING APPROACH

A general overview of vegetation of India was obtained through the forest type map prepared initially by Champion (1936) and subsequently revised by Champion and Seth (1968). They classified the vegetation based on bioclimatic attributes. This map prepared at a scale of 1:14,000,000 approximately is undoubtedly of immense significance for perceiving the climatic relationships, properties and spatial distribution of different vegetation types in the country. Preservation of the same thematic information on a larger scale of 1: 10,00,000 was then brought out in Forest Atlas of India (1973). Vegetation/land cover classification and mapping along these lines have been attempted for southern pan of the country by French Institute of Pondicherry joint by with Government Department (Legris and Meher-Homji, 1968). The main map at a scale of 1:1,000,000 depicts, important features of natural vegetation and introduced / transformed land cover types like, agriculture and plantations. It is accompanied by six inset maps (at 1:5,000,000 scale) showing other environmental features, like relief geology, bioclimatic, land use, agricultural region and potential of vegetation types. Such maps provide more information than the earlier ones mentioned but the scale is too small to provide detailed information for planning and management. Meher Homji (1978) prepared the forest map of Peninsular India in 1:1,000,000 scale along this line.

The applications of satellite imagery for forestry related purpose are relatively new. The era of satellite remote sensing began with the launching of Landsat I in July 1972 by NASA, United States. The first Indian Remote Sensing satellite (IRS 1A) was launched in April 17, 1986. Recent research indicates that optical mechanical scanning is applicable to the identification of forest tree species (Olson, 1970).
In 1983, the forest cover maps of India were prepared by NRSA for the period of 1972-75 and 1980-82. Lal et al. (1990) assessed the extent and location of deforestation in Kodagu district, Karnataka using 1 :250,000 Landsat MSS data. The application of IRS IA data in forestry was discussed by Madhavanunni et al., (1991). Porwal and Roy (1992) used 1:50,000 Landsat TM Fee for delineation and mapping of heterogeneous, DUS forests of Western Ghats, Kerala and estimated as overall accuracy as 88.33 percent. Roy et al., (1992) used 1:50,000 Landsat TM Fee for mapping Chaneka Wildlife Sanctuary, compared it with an aerial photo map. Application of remote sensing for rattan resources survey was done by Nandakumar and Menon (1992). Roy et al., (1993) mapped tropical forests of Andaman Islands using Lands at TM FCe of 1:50,000 scale and identified nine land cover classes. Habitat assessment of Kaziranga National Park using remote sensing was studied by Parihar Panigrahi and Lahar in (1986). The Spectral relationship of grasslands to its biomass in Kanha National Park (MP) has been evaluated by Roy et al., (1991). New remote sensing tool called imaging spectrometer (Airborne visible/infra red imaging spectrometer AVIRIS) and its application in ecology, geology and oceanography were described by Greggynae and Goetz, (1993). Suraj et al., (1996) prepared a land cover map of a part of Chimmony Wildlife Sanctuary, Kerala. Mapping of high altitude Shola grasslands of some part of the Eravikulam National Park was carried out by Sureshbabu et al., (1997).

For digital mapping Landsat data were used by Dodge and Bryant in 1976. The area of hardwood/soft wood and total forested area were compared with existing records. Bryant et al., (1980) used Landsat digital data for forest mapping and compared it with aerial photographs. Computer classification of data from Landsat to resulted in measurements and maps of forest types tor two New Hampshire Countries
Studies on the spectral separability of cover classes were done by many researchers. Spectral separability analysis of various tropical forest cover classes as recorded on Landsat MSS data were carried out in two test areas of Northeastern India (Ashbind Singh, 1987). Adeneyi (1985) prepared land cover map of a semi arid area of Nigeria using Landsat digital data. Skidmore et.al., (1987) used digital Landsat data for forest mapping in Australia. In India, digital mapping was carried out by several workers. Kachhwaha (1983) used Landsat digital data for forest mapping. Singh and Khan (1989) used digital data for change detection studies. Ashbindu Singh (1990) integrated digital data with ancillary data to improve supervised classification. Vegetation indices from AVIRS data were used to evaluate spatial patterns of vegetation type, productivity and potential physiological activity by John et.al., (1993).

2.6.1 Vegetation mapping and changes

Vegetation mapping plays a fundamental role in providing relevant information and therefore becomes a precondition for the effective management of natural resources, especially for the conservation of biodiversity (Stoms, 1992) and is surrogate for ecosystems in conservation evaluations (Blasco, et.al., 1996) Remote sensing technology can play a vital role in providing accurate and reliable landscape details with lower cost and lesser time compared to other methods. Use of GIS in decision-making and that tool in environmental problems is well established and they are for resource mapping, spatial analysis and decision-making has been widely reported by many researchers.( GSI, 1976; Porwal, and Pant, 1989; Roy et.al., 1991; Porwal, and Roy, 1992; Pant et.al., 1992; Martin, et.al., 1988; Jha et.al., 2000 and Jaganathan and Davi Datt Chauniyal, 2000).
Remote sensing is used as a tool for monitoring vegetation changes, especially in forests, because the hilly or swampy terrain is inaccessible and vast in area. It provides relatively accurate information regarding the status of vegetation in the forest and is cost-effective and time saving. Efforts to manage coastal vegetation require wide scale monitoring to track changes in areal extent, health, and ecological functioning. Remote sensing techniques offer a wide range of possibilities in the study of various ocean related parameters. The unique capabilities of satellite based sensors in providing a wide spectrum of information available through the electromagnetic spectrum in repetitive and synoptic coverage over inaccessible and larger areas in frequent intervals made the remote sensing technology an effective tool in the sustainable development and management of our environment and resources (Kasturirangan et.al., 1997). Satellite remote sensing is an efficient tool that have been adopted increasingly for the detection, description, and quantification and monitoring of the Earth’s natural resources (Green et. al., 2000; Kovacs et.al., 2004, 2005; Chauhan and Dwivedi, 2008). Satellite remote sensing techniques with reasonably high spatial and temporal resolution could be used as potential tools for monitoring changes in different surface and subsurface features on spatial and temporal scales (Jayakumar et.al. 2000). In fact, remotely sensed data have been applied by many investigators in order to illustrate forest changes over time (Green and Sussman 1990; Hall et.al., 1991, 1988; Sader and Joyce 1988; Iverson et.al., 1989). Klemas (2011) has described the use of Remote sensing techniques for studying coastal ecosystems.

Remote sensing data were very well used to classify forest types and cover density and to estimate the aerial extent and changes. Using Shuttle Radar Topography Mission (SRTM) and National Elevation Dataset (NED) along with Landsat Thematic Mapper (TM) data, Heo et.al., (2006) has attempted to estimate age of a loblolly pine
plantation. Although Van-Aardt and Wynne (2001) have demonstrated the discrimination of tree species through remote sensing in temperate forests, it is still at the developmental stage (Foody and Cutler 2003) because it is very difficult in the tropics, where heterogeneous forest covers with a variety of species (Boyd and Danson 2005). Hence, the details, such as the species composition and stand density of the forests, could be obtained only through field floristic sampling studies. There have been many floristic studies carried out in India (Saxena and Singh 1982; Pascal and Pelissier 1996; Kadavul and Parthasarathy 1999a, b; Parthasarathy 2001; Padalia et al., 2004; Sagar and Singh 2005; Devi and Yadava 2006; Behera and Kushwaha 2007) and other parts of the world (Lieberman and Lieberman 1987; Heaney and Proctor 1990; Campbell and others 1992; Kalacska and others 2004 and Marin et al., 2005) using plot sampling methods to identify the structure and species composition of forests. In this context, a combination of remote sensing and ground-truth measurements, analysed within a geographic information system (GIS) platform, is found to be highly advantageous (Dahdouh-Guebas et al., 2005a, b; Souza Filho et al., 2006).

Quantitative changes in forest cover and effects of fire were successfully using satellite remote sensing techniques with special reference to Bandipur National Park and Mudumalai Wildlife Sanctuary, (Madhavanunni et al., 1986). The changes in the mangrove forests therefore need continuous monitoring through research on spatial–temporal dynamism in the coastal land-use/cover patterns (Souza Filho et al., 2006; Chauhan and Dwivedi 2008). Land use/land cover change is a key driver of global change (Vitousek, 1992) and has significant implications for many international policy issues (Nunes and Auge, 1999). In particular, land use/land cover (LULC) changes in tropical regions are of major concern due to the widespread and rapid changes in the distribution and characteristics of tropical forests (Myers 1993;
Houghton 1994). However, changes in land cover and in the way people use the land have become recognized over the last 15 years as an important global environmental changes in their own right (Turner, 2002). To understand how land use and land cover change affects and interacts with global earth systems, information is needed on what changes occur, where and when they occur, the rates at which they occur, and the social and physical forces that drive those changes (Lambin, 1997). The information needs for such a synthesis are diverse. Remote sensing has an important contribution to make in documenting the actual change in land use/land cover on regional and global scales from the mid-1970s (Lambin et al., 2003).

Earlier, many researchers have carried out forest cover change detection through visual interpretation of satellite data. (Unni et al., 1985; Porwal and pant 1989; Kushwaha 1990; Roy et al., 1991a, b; Sukumar et al., 1991; Porwal and Roy 1992; Sudhakar et al., 1992; Unni 1992; Pant and Roy 1994; Pant and Jalal 1996; Das et al., 1997; Batista et al., 1998; Birniel 1998; Luque 2009; Imbernon and Branthomme 2001; Young et al., 2001; Boyd et al., 2002; Larsson 2002; Roy and Joshi 2002; Rogan et al., 2002; Le Hegarat Mascle et al., 2006; Reis and Yomralioglu 2006 and Panigrany et al., 2010).

However, the following researchers Wickware and Howarth (1981); Williams and Nelson (1986); Yool et al., (1986); Franklin and Wilson (1991); Forgham (1994); Macleod and Congalton (1998); Igbokwe (1999); Jessica et al., (2001); Dymond et al., (2002); Larsson (2002); Bouma and Kobryn (2004); Camacho-De Coca (2004); Ingram (2005) and Okeke and Karnieli (2006) have made the forest cover change detection through computer assisted Digital Image Processing (DIP) techniques. The basic principle of change detection through remote sensing is that the changes in spectral
signatures commensurate with the change in land cover. The detailed procedure is to superimpose two period maps to find the change (Jessica et.al., 2001). Moreover, the process of change detection is premised on the ability to measure temporal impacts (Sabins, 1987). According to Singh (1989), change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (multi-temporal variations). Meanwhile, it is evident that change detection can be precisely calculated using GIS technology and because of its high volume spatial and spatial data handling capability. It would also help us to do overlay process with two or multi vector layers under single umbrella. (Lo and Shipman, 1990 and Bhaduri et. al., 2001). Some of the researchers have identified that the increase in vegetation cover has resulted in increased rainfall (Sarma, 2001; Dengiz et. al., 2009) and decrease in forest cover has direct relationship with socioeconomic status / marginal worker force (Murali, 2002).

Conservation of forests calls for a clear understanding of the details, such as forest type, cover density, species composition and their changes (Jayakumar et.al., 2002b). With the advent of the remote sensing technique, Forest Survey of India (FSI) prepared a countrywide forest cover map by visual interpretation on a 1:1 million scale using a Landsat Multi Spectral Scanner (MSS) during 1987 (FSI 1987). Mapping the areal extent, type, and cover density of forests through remote sensing data has advantages over conventional ground survey methods (Tiwari et.al., 1996). Mapping of vegetation through satellite images can be performed using visual interpretation of images (Beaubren, 1986) or through computer-aided digital classification methods such as supervised classification, unsupervised classification (Jensen 2000), hybrid classification (Behera et.al., 2000; Hoffer, 1986), onscreen visual interpretation (Jayakumar et.al., 2002a), or expert classification (Ramachandran et.al., 2007). Indian
coastal vegetation have been studied using remote sensing technology since the last
decade for mangrove vegetation assessment, restoration, coastal management and
estimating mangrove loss in Pitchavaram (Selvamet et.al. 2003), Bhitarkanika (Reddy
et al. 2007), and in Godavari delta region (Ramasubramanian et al.2006 and Satapathy
et al. 2007). The comparative vegetation cover assessment of the forest area in
Bangalore using high resolution satellite imagery (Malini, et.al. 2013). Plant diversity
assessment at landscape level in Jamnagar district, Gujarat using satellite remote
sensing and geographic information system (Ganesh Datt Bhatti, 2013).