CHAPTER 1
GENERAL INTRODUCTION

The ability to have a permanent record of what we observe was first possible due to photography which is dated from 1826. Thus photography may be considered as the first step towards modern remote sensing. The inquisitiveness to get a ‘bird’s eye’ view prompted man to take photographs of earth from elevated platforms. Indian space effort had its modest beginning in 1962 with the establishment of rocket launching station at a place in the southern part of India through which the geomagnetic equator passes. The conceptualization of Remote Sensing Satellite Programme started with the launch of 1st Remote Sensing Satellite IRS-1A at 1988. In remote sensing, the characteristic expression of an object or feature distinguishes it from surroundings, which enable the object to be identified or recognized is called signature. It can be achieved through the difference in the reflectance/emittance characteristics with respect to wavelength and it is called spectral signature.

Vegetation either as agriculture or other forms of flora like forest cover, bushes, shrubs etc are vital for human existence. In addition, it plays an important role in regularizing carbon di-oxide through photosynthesis and in balancing radiation in atmosphere, which affects the weather and overall climate. Therefore monitoring vegetation is one of the most important applications of remote sensing technology (Joseph, 2005). Remote sensing provides a means for obtaining a synoptic view of the status and condition of
forests on a real-time basis. The information help for better planning by forest managers.

The vegetative cover reflectance observed by a sensor is a mixture of reflectance from the vegetation, soil underneath and the shadow. At low values of vegetation cover, back ground reflectance could be quite important in affecting canopy reflectance. The relative contribution of the shadow will play a role in modifying the reflectance spectra. The important parameters in determining the reflectance of a vegetation canopy includes transmittance of leaves, amount and arrangement of leaves, characteristics of vegetation canopy such as stalks, trunks, limbs etc., characteristics of background (soil reflectance), solar zenith angle, look angle and azimuth angle. The spectral reflectance data of vegetation are related to plant parameters such as leaf area index, biomass etc and the plant status such as stress, disease etc. The spectral properties of vegetation, vegetation types, growth and energy conditions provide valuable information about biomass and productivity.

Biomass is one of the very important parameter affecting biosphere-atmosphere interaction. It is an important attribute of a vegetation community. About 80% of the global biomass is contained in forest, which are the most valuable ecological source of global interest. Estimation of biomass and primary productivity is a pre-requisite to understanding of ecosystem properties and functioning. Information of on primary productivity of ecosystems, particularly in relation to species composition and environment, and amount, stratification and utilization of biomass is not only important from the stand point of fundamental ecology, but is also relevant to planning for
ecologically sustainable development of a region. (Singh, 1987). Sustainable forest management requires reliable information on the type, density and extent of forest cover, wood volume and biomass etc. So it is important to estimate the forest biomass and its net primary productivity using remote sensing parameters. Mapping and estimation of regional forest biomass constitutes a valuable resource inventory. It is an important attribute of a vegetation community and can help in understanding the spatial patterns of plant species distribution (available energy/productivity hypothesis (Wright 1983, Currie 1991, Hall et al. 1992, Wright et al. 1993 and Rosenzweig 1995)). Forest type is defined as a unit of vegetation, which possesses (broad) characteristics in physiognomy and structure sufficiently pronounced to permit the differentiation from other such units (Champion and Seth, 1968). Management prescriptions in any region are based upon forest type in that region. Hence distinguishing different forest types is very essential for judicious management of forests (Joseph, 2005). Forest density refers to crown cover classes.

important tools for understanding landscape processes. Knowledge of the amount of solar radiation at various geographic locations is very much needed for application in such diverse fields as agriculture, forestry, meteorology, environmental assessment, ecological research etc. Topography is the major factor modifying the distribution of insolation. Variability in elevation, surface orientation (slope and aspect) and shadow cast by topographic features creates strong local gradients of insolation. This leads to high spatial and temporal heterogeneity in local energy and water balance, which determines micro-environmental factors such as air and soil temperature regime, evapo-transpiration, snow melt patterns, soil moisture, and light available for photosynthesis. These factors in turn affect the spatial patterning of natural processes and human endeavour. Accurate solar radiation maps are desired for many applications.

Vegetation pattern is significantly associated with slope, exposure and calculated monthly solar radiation. The role of forests within a global carbon cycle is, for instance, uncertain as basic information on forest extent and biophysical properties are relatively poorly known (DeFries and Townshend, 1994). Remote sensing is the only feasible means of acquiring information on such variables at appropriate spatial and temporal scales.

The study site has been selected keeping in view of the area covering different forest types, structure and undergrowth conditions. The terrain of the area is irregular and undulating. The summer temperature varies from 38.5°C to 16.7°C and in winters it ranges from 23.6°C to 5.4°C. Precipitation varies from 175cm to 228.6cm per annum. The slope ranges from moderate to little
bit steep towards the streamlines. The climate is relatively moist tropical. The forests types are mainly North Indian tropical moist Sal forest, North Indian tropical dry deciduous forest, khair and sissoo dominated riverine forest, scrub and degraded forests.

Solar radiation, temperature and available water affect photosynthesis, plant respiration and composition and thus climate change can lead to changes in productivity. The present study gives a relationship between spectral reflectance and forest biomass, and it's Net Primary Productivity, which would be useful for assessing the effects of factors such as air pollution, and climate change and also provides a tool for resolving different environmental controls on ecosystem. The algorithm for the relative solar insolation factor can be applied in forestry, ecology, biology and agriculture where spatial variation of solar radiation is more important than calibrated values. Using this one can compute the potential solar radiation at any slope and aspect and at any latitude.

The present study is documented in 8 chapters. Each chapter has introduction, materials and methods, results and discussion. Chapter 2 includes the description of the study area, with information on location, climate, soil and geology. Chapter 3 describes the spatial analysis of landuse and vegetation through the digital image processing of IRS-P6 AWIFS satellite data. Chapter 4 describes the mapping of various biophysical parameters such as forest type, forest crown cover, tree height, girth, slope, aspect, elevation, solar insolation etc. The spectral modeling of total above ground biomass is described in chapter 5 and spectral modeling of Net
Primary Productivity is established in chapter 6. Chapter 7 and chapter 8 describe the general discussion and summary, respectively.