Forests are ecosystems; a dynamic, constantly changing community of living things, interacting with non-living components. Tropical, temperate and boreal forests offer a diverse set of habitats for plants, animals and micro-organisms. A forest ecosystem is one major ecological unit that exists as "home" for a community of both native or introduced, classified organisms. The structural components of forest ecosystem are flora, fauna, microbes, soil and the atmosphere. Topography and microclimate are also important ecosystem features. The functional aspects of ecosystems are biomas, nutrient cycling and carbon sequestration. Forest ecosystem are continually changing. This change, initiated by external disturbance factors but largely determined by internal ecosystem processes, is vital for the maintenance of many aspects of biological diversity. In many types of forests it is essential for the long term sustainability of the ecosystem. However these biologically rich systems are increasingly threatened, largely as a result of human activity.

In the present study structural and fuctional aspects of dry deciduous forests and plantation of Aravally region, Westren India, namely Mixed Dry Deciduous Tropical Forest (MTDF) and Mixed Acacia Plantation (MAP) were worked out in relation to biodiversity, biomass, nutrient dynamics and carbon sequestration.

The biodiversity data collected from both study area MTDF and MAP were studied for quantification of species, stand density and basal area. The species diversity was calculated using Shannon-Weiner index, the concentration of dominance using Simpson index and the Species richness index was computed using Margalef index. The quantitative analysis of frequency, density, abundance, dominance and their relative values of frequency, density and basal area were calculated and summed up to get Importance Value Index (IVI).

The findings revealed higher biodiversity and stem density in MTDF than MAP . A total of 35 families with 62 species were recorded in MTDF whereas 15 families and 27 species were detected in MAP. Both study are recorded maximum number of plants from Fabaceae family. The MTDF is dominated by *B. monosperma* and *A. squamosa*and while MAP is dominated by *A. nilotica* and *A. leucophloea*. The diversity indices were worked out. The higher values of Margalef index and Shannon-Weiner index represented higher biodiversity and higher value of Simpson index indicated low diversity.

The MTDF study area showed higer biomass than MAP which may be due to stem density and age of forest. In both the study area higher biomass was obesreved in tree layer followed by shrub and herb layer. The biomass was devided in two parts aboveground and belowground biomass. The abovegoround biomass in tree layer was utmost in bolewood followed by branch, bole bark, foliage and reproductive parts whereas in the belowground biomass, maximum was in stump root, followed by lateral root and fine root. In the shrub layer, the biomass values were in order stem < foliage < root. The regression coefficient was calculated for all above ground and below ground components of trees using different parts of the tree as variables (bole wood, bole bark, branch, foliage, reproductive parts, stump root, lateral root and fine root). The allometric equations were developed for estimation of shrub biomass (stem, foliage and root) on the basis of the basal diameter. The regression coefficient values of trees and shrubs for above and below ground components were significant at $P < 0.05$

The higher forest floor biomass was observed in MTDF than MAP because of climatic conditions, age of forest, leaf size etc. Forest floor biomass was categorized into fresh leaf litter, partially and more decomposed litter, wood litter, miscellaneous litter and herbaceous litter. The variation of forest floor biomass in different seasons showed the following trend: winter > monsoon > summer. The total annual litter fall of MTDF was found to be higher than MAP.

The NPP (Net Primary Productivity) was higher in MTDF than MAP. The highest NPP was observed in aboveground components of the tree layer in the order: bole wood > branch > bole bark > foliage > reproductive part. The maximum NPP among the below ground component was reported in stump root followed by lateral root and fine root. The NPP of herb layer was higher than shrub layer because NPP is directly propotinal to biomass of herbs. NPP is a key ecosystem variable and an important component of the global carbon cycle. It plays a key role in our understanding of carbon exchange between biota and atmosphere, both currently and under climate change conditions caused by the human-induced increase in atmospheric CO_2 concentration.

The Biomass Accumulation Ratio (BAR) was found higher in MAP than MTDF and it has been used to characterize the production efficiency study area. BAR expresses the quantity of biomass retained in per unit of net production of trees. The highest BAR was detected in above ground components in the order - bolewood followed by branch, bole bark, foliage and reproductive parts. In the belowground components, highest BAR was observed in stump root followed by lateral root and fine root. A significant ($P < 0.01$) regression equation was found between biomass and NPP, FSC and NPP, litter fall and NPP, photo and non-photosynthetic components , root and shoot components of MTDF and MAP.

The pattern of plant nutrient concentration in different life forms was in the order: herbs > shrubs > trees. In the present study, the nutrient concentration was the highest in the reproductive parts followed by foliage, branch, bole bark and bole wood in aboveground components. In the belowground components the order was: fine root > lateral root > stump root. In the shrub layer the maximum nutrient concentration was observed in foliage followed by stem and root. The utmost nutrient concentration was recorded in the aboveground parts followed by below ground parts in the herb layer. Various macronutrients were found in following order : N > S > Ca > K > Mg >Na > P in tree layer. In the shrub layer, the nutrient concentration was in the order N > S > K > Ca > Mg > Na > P whereas that of in herb layer was in the order: N > Ca > S > K > Mg > Na > P in MTDF where as Ca > S > Mg > N > K > Na > P in tree layer. In the shrub layer the nutrient concentration was in the order Ca > N > K > Mg > S > Na > P and the nutrient concentration in herb layer was in the order: Ca > N > S > Mg > K > Na > P in MAP. The soil nutrient concentration was higher in 0-10 cm depth in both study area MTDF and MAP. The level of nutrients in a given soil is the net outcome of input to and output from the system. The soil organic matter and that deposited above it, with numerous constituents is acted upon by a variety of micro-organisms, transferring the nutrients contained in it to the soil. In general, a greater proportion of nutrients occurred in the surface soil, reflecting the massive input of nutrients to the soil through the litter fall. The average microbial biomass C, N and P at varying depths ranged from 185.2 to 1479.5 $\mu g\ g^{-1}$; 82.3 to 112.7 $\mu g\ g^{-1}$ and 27.8 to 53 $\mu g\ g^{-1}$ respectively

The C, N and P value were found to be maximum during the rainy season and minimum during winter season. The analysis of variance (ANOVA) indicated a significant difference in microbial biomass C between the different sampling months i.e. summer, rainy, winter and annual. The significant difference in microbial biomass N and P between the different sampling months during summer ($P < 0.001$), rainy ($P < 0.001$), winter ($P < 0.001$) and annual ($P < 0.001$) was recorded. The highest positive correlation was observed among all soil parameters whereas the negative correlation existed between C_{mic} and Mg; C_{mic} and S; P_{mic} and Mg; P_{mic} and S; K and Na ($P < 0.05$) **.**

The relative contribution to standing state of nutrients in tree layer, aboveground components was in the order : bole > branch > foliage > reproductive parts whereas the belowground components showed higher concentration as stump root > lateral root > fine root. In the shrub layer, it followed the order as stem > foliage > root. The nutrient storage in tree, shrub and herb layer was reported as 96-98 %, 0.5-2 % and 0.7-2.6 % respectively. The nutrient content in different components differed considerably on account of variation in biomass and nutrient concentration. The standing state of nutrients in different components increased with the increase in their biomass and the role of concentration was minimized. The highest nutrient content was observed in MTDF followed by MAP.

Nutrient re-translocation is based on the range of different physiological and biochemical processes, utilization of mineral nutrients stored in vacuocles, breakdown of storage proteins or breakdown of cell structure and enzyme proteins thereby transforming structurally bound mineral nutrients into a mobile form. Nutrient translocation during the ageing of tissues is an important mechanism for maintaining tree growth in infertile soil. The maximum nutrient retranslocation was reported in the MTDF for K and in the MAP for P.

The soluble fraction of nutrients present in soil solution (water) and not held on the soil fractions flow to the root as water is taken up. This process is called mass flow. Nutrients such as nitrate-N, calcium and sulfur are normally supplied by mass flow. Nutrients such as phosphorus, potassium, magnesium and sodium are absorbed strongly by soils and are only present in small quantities in the soil solution. These nutrients move to the root by diffusion. As uptake of these nutrients occurs at the root level, the concentration in the soil solution in close proximity to the root decreases. This creates a gradient for the nutrient to diffuse through the soil solution from a zone of high concentration to the depleted solution adjacent to the root. Diffusion is a key process for uptake of the majority of the nutrients (P, K, Mg and Na) to roots. The nutrient uptake level in case of both study areas is different because of difference of nutrient availability in soil and climatic conditions. The retention value (i.e. net nutrient uptake and return of litter nutrients) influences the nutrient cycling of vegetation. The higher the retention value the greater the nutrient availability to the plant.

Standing vegetation nutrients turnover time reflects the rate of nutrient cycling in an ecosystem. In MAP the maximum turnover time was recorded for Na followed by P, N, K, Mg, S and Ca whie in MTDF utmost turnover time for noted for Mg followed by Ca, P, N, Na, S and K.

Litterfall comprises of dead plant material including dry leaves, bark, needles and twigs, that have fallen to the ground. This detritus or dead organic material and its constituent nutrients are added to the top layer of soil, commonly known as the litter layer or O horizon ("O" - Organic). Litter has occupied the attention of ecologists at length for the reason that it is an instrumental component in ecosystem dynamics, it is indicative of ecological productivity, and may be useful in predicting regional nutrient cycling and soil fertility. In the present study, the maximum litterfall was observed in MTDF followed by MAP.The highest litter fall production was observed in winter followed by summer and monsoon. The leaf litter fall occurred almost throughout the year except in the month of June. However, the litter fall was markedly seasonal and more than two third litter fall was recorded in cool and dry period (from December to March).

Net primary production and litterfall are intimately connected. In every terrestrial ecosystem, the largest fraction of all net primary production is lost to herbivoresand litterfall. Ecologists account for this effect by subtracting the accumulated litterfall from the net primary production, resulting in what is called the true increment of net primary production. Due to their interconnectedness, global patterns of litterfall are similar to global patterns of net primary productivity. The turnover time for P and Na in MAP as well as for Mg and Ca in MTDF was little longer than other elements. The Pottasium (K) is soluble and is more rapidly leached from the organic matter and, therefore, recycles faster than structurally bound elements like Ca, N, Mg, S, P which are sequestered and often immobilized by micro-organisms. The slower turnover of P and Na in the litter layer also appears to be due to re-translocation in the plant before senescence, thereby reducing the relative amounts of these nutrients in litter fall.

Nutrient Use Efficiency (NUE) may be defined as yield per unit input. The NUE is often expressed as fresh weight or product yield per content of nutrient. Improvement of NUE is an essential pre-requisite for expansion of crop production into marginal lands with low nutrient availability. The nutrients most commonly limiting plant growth are N, P, K, Na, Ca, Mg and S. NUE depends on the ability to efficiently take up the nutrient from the soil, but also on transport, storage, mobilization, usage within the plant, and even on the environment. The NUE of P was observed the highest and the lowest was N among the nutrients in MTDF. Similarly, in the MAP the highest NUE value was reported for P and the lowest for Ca.

The litter layer is quite variable in its thickness, decomposition rate and nutrient content and is affected in part by seasonality, plant species, climate, soil fertility, elevation, and latitude. In present study, litter weight loss and leaf biomass decomposition percentage was observed for a period of one year and these values were different for both study areas. The biomass remained after one year was higher in MAP and lower in MTDF. Analysis of variance revealed significant ($P < 0.001$) difference in decomposition rate due to leaf litter and incubation time and litter and incubation time interaction. The leaflitter showed a slow loss in the initial period of incubation (January to May), rapid loss during intermediate phase (June to mid August) and again slow loss during the end of the year (mid August to December).

The highest carbon stock and energy storage was observed in MTDF followed by MAP. C inventory leads to estimations of ton of CO_2 emissions avoided by halting deforestation and fossil fuel substitution or, alternatively, estimation of ton of C sequestered in biomass and soil as a result of enhancement of sinks through afforestation, reforestation and grassland reclamation activities. Efforts are to be made for expansion of carbon pool on a sustainable growth model by planting the under-stocked forests and optimum utilization of over-stocked forests with due consideration to the needs of people**.**

In the present study MTDF showed good productivity and nutrient dynamics followed by MAP. MTDF had a higher annual increment rate of aboveground biomass, litterfall production, rate of litter decomposition and soil fertility than MAP. This might be due to location as MTDF was on a more suitable site for tree growth. This enabled the rate of nutrient dynamics and mineral element fluxes for MTDF to be faster than MAP. However, much variation was not recorded between two study area which might be due to the fact that MAP was well maintained man made forest ecosystem. So, both the study sites produced good results in terms of dry matter dynamics, nutrient dyanmics, litter decomposition, carbon and energy storage than other dry tropical forests.