CHAPTER II

REVIEW OF LITERATURE

The earlier work done on the ecology of grasslands mainly pertains to phenomenon of succession, nature of climax and factors governing the growth and composition of grassland communities. Important contributions of this nature were made by Clements (1905, 1920, 1934 and 1936), Clements and Shelford (1939), Carpenter (1940) etc. Hanson (1950) has reviewed the work done up to 1950 in greater details. Other notable contributions to grassland ecology are by Coupland (1950, 1961), Anthony et al. (1955), Troughton (1957), Ivins (1959). With the elaboration of ecosystem concept and its application in ecological researches new trends in grassland ecology have developed. Studies like measurement of organic matter production and turn-over, circulation of minerals and effect of environmental and biotic stresses on productivity were started. Notable works in this direction are those of Odum (1960), Odum et al. (1962), Bray (1962), Colley (1960, 1961, 1965), Kucera and Ehrenreich (1962), Ovington et al. (1963), Iwaki et al. (1964), Dehlman and Kucera (1965), Porter (1967), Coupland (1968), Daubenmire (1968) and Van Dyne et al. (1970).
Indian contributions to grassland ecology are comparatively less and even to this date major portion of our grasslands is unworked for various ecological aspects. The earlier studies done in this country are related mostly to grassland types of small areas. Some important works are those of Mehta and Dave (1930), Champion (1936), Bor (1940, 1947), Bharucha and Dave (1952), Bharucha and Shankarnarayan (1953), Pandeya (1952, 1954), Tiwari (1954), Whyte et al. (1969), Shankarnarayan and Dabadghao (1970), Dabadghao and Shankarnarayan (1973) etc. The work on successional studies is done by Burns, Kulkarni and Godbole (1925, 1928 and 1931), Garland (1932), Mohi (1942), Pandeya (1953, 54) and Shankarnarayan (1956) etc. Taxonomic studies were done by Bor (1940, 1947 and 1960) and Acharyar (1921). The contributions towards other aspects of grassland ecology such as grass-legume association, chemical analysis, grazing conditions were made by Lander (1937), Bharucha (1938), Dabadghao (1951), Dabadghao and Patil (1962), Tiwari (1952), Patil (1954), Bharucha and Shankarnarayan (1957–58) and Albertson (1959).

A good amount of work has been done on the grasslands of Saugar. Pandeya (1952, 1954, 1961, 1967 and 1969), Tiwari (1952, 1954, 1955) and Jain (1967) have studied the structure, composition and distribution of local grasslands. Balapure (1964) has studied the reproductive capacity of six common grasses of Saugar. Many
workers have studied autecological aspects of grasses and some common forage plants, (Mall 1953, 1956, 1957; Pandeya 1951, 1953; Kaul 1956; Mall and Raina 1957; Ramkrishna 1960; Pandey 1963). Recently production studies in local grasslands are also initiated. The important works so far done are those of Mishra and Bajpai (1970), Jain (1971) and Jain and Mishra (1972).

Aspects of exchange of chemical elements between soil and vegetation, and cycling of minerals appears to be untouched for Indian grasslands and the same to be nearly true for the grasslands of other countries. Such studies seem to have been restricted to forest and watershed ecosystems. Only a few papers are available where complete mineral circulation is traced with inputs and outputs in some forests. Majority of the work done is fragmentary and deals with various phases of mineral circulation such as leaching, through fall, chemical composition of rain water, litter fall, chemical composition of the litter, bark etc., and seasonal variation in mineral content of plants and soil. Some work is also done where nutrient cycling is traced with the help of radio active tracers. A brief review of the work done on various aspects of mineral circulation and mineral nutrition is given below.

Studies on exchange of chemical elements between vegetation and soil are not new, as Bennie's (1955)
summary of nutrient composition data for natural temperate forests includes many references to pre-1900 studies. However, the concept of biological cycling in specific ecosystem compartments and the role of each compartment in whole ecosystem is more recent. According to Kornev (1959) the knowledge of the behaviour of elements in natural ecosystems is essential for the efficient management of the forest productivity.

Many studies have involved inventories of forest nutrient composition. Lutz and Chandler (1946) have summarized the work done on the amount and composition of litter fall for a number of temperate forest types. Scott (1955) has compiled a summary which lists amounts and chemical composition of organic matter contributed by above-ground and under-story vegetation. Ovington (1953 a,b; 1959 a,b) has studied nutrient levels in soils and vegetation in a number of forest types. Generalizations which can be made about the return to the soil, of nutrients through fallen litter, twigs, branches, bark and fruits have been presented by Stenlid (1953).

Russian workers have contributed much towards the exchange of elements between soil and vegetation. These workers have stressed the specific nature of biological cycles in various genetic soil groups. Masilevich (1966) traced the cycles of nitrogen and ash elements in the process of steppe soil formation. Vinokurov and

Nye (1961) has studied the nutrient cycles in tropical forests of Ghana. Miller (1963) has studied the immobilization, seasonal variation and cycling of nutrients in a hard beach in New Zealand. Cole et al. (1967) have studied the distribution and cycling of nitrogen, phosphorus, potassium and calcium in the second growth Douglas-fir ecosystem. Stark (1971) has studied the seasonal variation and cycling of minerals in tropical forests of Amazon.

Most of the earlier studies of mineral circulation and nutrient return to the soil from vegetation considered only nitrogen and ash elements leached from litter on the ground, although existing literature contained many indications that rain leaches elements from living trees. Many factors such as species, age of leaves, temperature, position of leaves, quality and quantity of applied moisture and pathological conditions have been found to influence the amount of nutrient loss (Witherspoon, 1964). Nye (1961) measured the amount and composition of litter and rain wash and added with timberfall, thus establishing rates of nutrient loss from the vegetation. Similarly Tamm (1951), Mes (1954) and Will (1955) conducted field experiments in
which they collected rain water below tree crown and chemically analyzed it. They showed the loss of base elements from tree crowns. In general the losses were in decreasing order Na > K > Mg > Ca. Keinins (1972) studied the canopy throughfall in three Minnesota forests.

Atmospheric deposition of nutrients is also receiving increasing attention as an input of ecosystem nutrient budgets. Studies of Carlisle et al. (1966), Cole et al. (1967), Liken et al. (1967) and Fisher et al. (1963) indicate the importance and variability of such nutrient input into various ecosystems. Nutrients deposited on foliar surfaces through rain fall or dry fall-out may be carried down ward in through fall or may be absorbed or adsorbed by plants. (Carlisle et al. 1966). Nutrients may also be leached from foliar surfaces by precipitation (Stenlid 1968) and together with atmospheric input, deposited as enriched solutions of through fall on the forest floors (Tanner 1951). Canopy through fall therefore, represents an important nutrient pathway in terrestrial ecosystems, combining the input of new nutrients with the cycling of old nutrients, which had been carried up to crowns to be subsequently leached down.

Attwill (1963) studied the loss of elements from decomposing litter in mature Eucalyptus obliqua forests in southern Australia. According to him the loss of
elements follow the order Na > K > Ca > Mg > P, and can be largely explained by the behaviour of these elements in terms of both mobility within the living biomass and leaching from the forest canopy. Boyd (1970) studied the accumulation and uptake of N, P, K and Ca. According to him net accumulation of these constituents per square meter usually continued during the period of dry matter increase, even though tissue concentrations were diminishing uptake rates for macronutrients were not proportional to the productivity rates. The most rapid uptake of several nutrients occurred earlier than the maximum growth rates. Goss et al. (1972) have studied the nutrient content of litter fall in a watershed forest. According to him nutrient content of the litter contained 140.4 Kg/ha per year. Nitrogen, calcium and potassium accounted for 30.6% of the total.

Likens and his associates are studying nutrient budgets and nutrient cycling in small forested watershed ecosystems at Hubbard Brook experimental station, New Hampshire. A good amount of literature dealing with input through rains, output through run off, seasonal variations in nutrient composition etc. has been produced at this centre. Some of the important works are those of Likens et al. (1967, 1969, 1970).

Radioactive tracers of nutrient elements are now a days used to study the cycling of minerals with the
help of this technique losses of trace elements have been demonstrated by Witherspoon (1964). He has studied the cycling of Cesium - 134 in white oak trees. Kimmins (1972) has studied the contribution of leaching, litterfall and insect defoliation to the removal of Cesium - 134 from Red- Pine.