

GENERAL INTRODUCTION

Ecological ideas may be traced back to the pre-historic man who utilised environmental information for food, shelter and survival. It can be traced in the great mythological epics of most religions including 'Ramayana' and 'Mahabharata'. It can also be traced in the remains of the great pre historic civilizations which flourished thousands of years before Christ, such as Mesopotamian civilization (4000 B.C. - 740 B.C.), Indus valley civilization (3000 B.C. - 1500 B.C.), Nile valley civilization (3000 B.C. - 526 B.C.) and the Chinese civilization (1700 B.C. - 1000 B.C.).

Nevertheless, it is hard to state that scientific use of ecological ideas started prior to 19th century and more strictly before 20th century. In the recent past there have been rapid development of ecological thoughts and ideas almost in geometric proportion; to the extent that now it is no longer a prerogative of the academicians but very much an involvement of the Governments, developmental organisations, industrialists, common people, news papers and periodicals throughout the World. Notable 19th century ecologists include Cooper (1859), Haeckel (1869), Mobius (1877), Forbes (1887), Warming (1895) and Cowles (1899); their main contributions amounted to coining of the word 'ecology' and providing some preliminary ideas about plant and animal communities.

Major breakthrough in ecological principles and ideas had to wait until 20th century when various distinct branches and sub-branches of ecology came into existence. Adams (1905, 1909), Shelford (1913), Elton (1927), Clements & Shelford (1939), Margalef (1963, 1968), MacArthur (1966), MacArthur & Connell (1966), MacArthur & Wilson (1967), worked on integrated concepts of plant and animal communities. Merriam et al (1910), Dice (1943), Allee & Schmidt (1951), worked on geographical ecology. Pearl (1925), Lotka (1925), Volterra (1931), Nicholson (1933), Gause (1935), Andrewartha & Birch (1954), Southwick (1955a, 1955b, 1958), Slobodkin (1961) worked on population dynamics.

After the introduction of the term 'ecosystem' by Tansley (1935), started the era of ecosystem approach to ecology. This led to the development of the concepts of productivity and energy relations in ecology, which is sometimes referred to as the 'bioenergetic approach'. The relevance and scope of this type of study may be expressed in the words of Park (1946) as "probably the most important ultimate objective of ecology is an understanding of community structure and function from the view point of its metabolism and energy relationships". Notable contributions in this direction have been made by Transeau (1926), Juday (1940), Lindeman (1942), Odum & Odum (1955), Odum (1960,

1962, 1963), Golley (1960, 1965), Ovington et al (1963), Westlake (1963, 1966), Pearson (1965). Whittaker (1970); Golley & Leith (1972), Leith (1964, 1972, 1973, 1974, 1975), Jones & Gore (1974), Leith & Whittaker (1975), Murphy (1975), Whittaker & Likens (1975), Menaut (1977, 1979, 1983); Menaut & Cesar (1979).

Unlike other disciplines of science plant ecology is not lagging much behind in India mainly due to the efforts of two outstanding ecologists i.e. Prof. R. Misra and Prof. G.S. Puri. Misra (1952-1970) established a strong School of ecology while Puri came out with an important publication i.e. Indian Forest Ecology in 1960. Their ideas are being perpetuated by their worthy followers in different branches of plant ecology.

Since the inception of International Biological Programme (IBP, 1964-1972) to study the structure and function of different ecosystems in different climatic zones of the World; biomass and productivity studies have attracted the attention of many Indian ecologists. The notable Indian workers in this field are Choudhury (1967), Singh (1968), Singh & Misra (1969), Jain & Misra (1969), Tripathi (1970), Pandeya & Jayan (1970), Ambasht et al (1972), Singh & Yadav (1972), Vyas et al (1972), Gupta et al (1972), Jain & Misra (1972), Shanker et al (1973), Pandeya et al (1973), Harsh & Sen (1975), Das & Sahai (1975), Naik & Misra (1974), Singh &

Yadav (1974), Misra & Misra (1979).

This spurt of activities on production ecology and some other allied field is illustrated by successful organisation of a Symposium by International Society for Tropical Ecology which culminated in two volumes entitled Recent Advances in Tropical Ecology edited by Misra & Gopal in 1968.

Grassland production studies in India are important in at least two respects: (i) they provide natural pastures and fodder for grazing animals whose population in this country is the highest in the world, (ii) they cover a very large proportion of the land surface. Besides they play a crucial role in the prevention of soil erosion and in the improvement of soil structure and fertility. Grassland areas in India fall roughly under two categories: cultivable waste and forest lands. The areas under grassland is decreasing owing to the increasing human population pressure for more and more agricultural land, and this process is likely to be accelerated in the future.

In recent years, the demand for ever increasing live-stock population on limited fodder resources is increasing at a rapid pace. In the process of meeting this demand people have naturally turned to the forest as production in grassland and available fodder from other sources is not sufficient to

meet the demand. Not only the forest-edge livestock owners but also others from far off areas collect fodder from forests. Mass cattling in the forests is destroying the balance in the forest ecosystem and subsequently creating tremendous pressure upon wildlife.

In India the total number of water buffalo (Bubalus bubalis) and cattle (Bos indicus) exceeds the total number of humans in the United States. The population of cattle alone is over 175 million (Food and Agricultural Organization, 1970). These large number of cattle population press upon the inadequate supplies of fodder. When the total livestock population (including sheep, goat and ponies) is considered the situation is more and more critical.

At the rate of growth of 1971; human population in West Bengal is to double itself in about 30 years. So during the last decade there has been a significant increase in human population resulting in:

- 1) Increase in livestock population
- ii) Increase in agricultural land area
- iii) Decrease in grassland area
- iv) Increase in cattling and fodder collection in the forests much above the level of 1971.

According to our estimate at least about 25% demand of the livestock was met from the forests in 1971. The immediate and long term effects of the above situation may be listed as follows:

- i) The balance of forest ecosystem is upset
- ii) The wildlife is forced to compete with man and livestock for fodder
- iii) Invasion of cropland and rural settlements by wildlife in search of fodder
- iv) Wildlife are forcibly exposed to the diseases usually predominant in the domestic cattle, such as, deadly reinderpest, foot and mouth disease, etc.
- v) The valuable top soil is lost due to over grazing and subsequent erosion over vast stretches of land areas.

Livestock management in India is in a very critical situation; semistarvation is the rule, milk production per animal is steadily decreasing and is one of the poorest in the World. Any attempt to improve livestock must be based on development of grassland and fodder resources, by scientific management and utilization of grasslands in order to increase production of fodder. According to Whyte (1964), "If the basic problem of surplus cattle population can be solved by

India itself, the grass cover of India should be able to play its correct role of feeding an appropriate class of livestock and at the same time of ensuring optimal conservation of soil and water".

In short grassland management in our country is intimately associated with at least three important aspects: (i) Prevention of soil erosion (ii) Proper livestock management and (iii) Wildlife management.

Although there have been comprehensive production studies in other parts of India, no such endeavour is known in this part of the country particularly in North Bengal. Accordingly, a study on grassland productivity was undertaken during the period 1979-83, which forms parts of a larger enquiry into the carrying capacity of this region in relation to ungulates both domestic and wild. North Bengal in general and Darjeeling district in particular is characterised by: (i) Vast stretches of rocky and mountainous land, (ii) only a small portion of the land is cultivable, (iii) a large portion of land is occupied by forest harbouring important wildlife of the country, and (iv) a rather large population of livestock. As such, the study was conducted at three representative sites situated at different altitudinal zones in the district of Darjeeling. For convenience, the study

have been divided into three major chapters. Chapter I deals with seasonal variations of biomass and net production of grasslands lying at three different altitudes viz. North Bengal University Campus (110 m), Dowhill (1850 m) and Tigerhill (2615 m). Chapter II deals with the effects of grazing on production of grasslands at North Bengal University Campus. While the effects of burning on production of grasslands at North Bengal University Campus are discussed in Chapter III.