SECTION - I
INTRODUCTION AND REVIEW
INTRODUCTION

India has the largest cattle population i.e. 1/6th of the world strength. Animal husbandry is an important part of the Indian economy. It is integrated with rural economy. It accounts for a tenth of the national economy. India's livestock resources have considerable traits of adaptability to withstand environmental stress. As per 1982 census, livestock population consist of 19.2 crore cattle (cow, ox), 7 crore buffaloes, 9.5 crore goats, 4.9 crore sheep, 21 crore poultry, thus India has the largest and most varied animal resources in the world.

With an increasing cattle population, the supply of fodder for domestic animals is also getting more and more difficult every year. Therefore, the condition of this enormous cattle population is very poor. It is, therefore, obvious that the future of Indian livestock can not be satisfactory if the adequate steps are not taken in good time for augment the fodder resources of the country.
Because of insufficient fodder, results in poor cattle, it not only impoverishes the farmer but also lowers national wealth and productivity and 80% of concentrate. Thus, overall the present availability of animal feed and fodder is estimated to be around 40% of the present need.

Fodder requirements depend upon a number of factors such as method of rearing and feeding, density and kind of livestock, socio-economic status of the people and the climatic conditions prevailing. Therefore, estimates worked out on the requirements of feeds and fodders also vary widely. On the basis of National Commission on Agriculture (1976) the requirement of projected livestock population by 2000 A.D. has been worked as 70.10, 590.1 and 373.0m tonnes as concentrates, green fodders and dry fodders respectively. This is the maintenance requirement in relation to body weight of the animal. However, the fodder for livestock is also required for productive purposes. Taking the projected population of cattle and buffaloes by 2000 A.D. as 218
and 100m heads respectively and for sheep and goats as 55 and 132m heads respectively, the fodder requirement at 2% as done by National Commission on Agriculture (N C A) has been worked out to be 796m tonnes on dry matter basis by 2000 A.D. To ensure higher productivity and economic returns from livestock the fodder requirement can be taken as 1233m tonnes dry matter by 2000 A.D.

The availability and consumption of fodder depends upon the available areas, climatic and edaphic factors, livestock growing pattern, as well as the socio-economic conditions of the area. Normally cattle and buffaloes are fed on cultivated fodders, grazing supplemented with some harvested grasses and fodder foliage while the donkies, ponies, mules depend mostly on grazing and harvested grasses. Camels live mostly on the browsings and loppings of fodder trees and shrubs.

The real information about the agricultural crop residues, green fodders, sugarcane tops, edible weeds from
cultivated fields, grasses and grazings in the forest areas and grasslands as well as fodder foliage obtained from the trees is greatly lacking and varies on the extent of forest and grazing areas as well as their proximity of habitations.

According to N.C.A. (1976) the projected availability for 2000 A.D. will be 356.80, 695.00, 77.50m tonnes dry and green fodders and concentrates respectively. The committee on fodder grasses (1986) worked out the availability of 236m tonnes of straw (stovers) of cereal crops like wheat, paddy, barley, maize, sorghum, pearl millet as crop residues as well as nearly 137m tonnes as grasses and herbs from grazing areas, besides 250m tonnes of dry grass annually from the forest areas.

Green fodder is only limited to 4% of the cultivated area. Inspite of all importance of the livestock in the economy of the farmer, the area is rather decreasing due to increasing human population of the country. Thus, it appears that the green fodder is
much in shortage than the dry fodder. Besides due to further deterioration of the grazing lands and forest areas with the ever increasing animal population and continuous and constant grazing, the availability of forage is going to decrease, while the requirement is likely to increase regularly. This gap between demand and supply of fodder will continue to widen if fodder production is not increased especially, the improvement of grazing lands and suitable grazing policies for livestock are not promulgated at the earliest possible.

Bundelkhand is extended over about 59.52 thousand sq km area. The climatic condition of this region is remarkably different than other areas as evident from the physiographic nature and development of soil and agriculture systems. Presently about 11.4 thousand sq km is available for livestock grazing. The total requirement of dry matter for the present existing livestock is about 98.11 lac tons but availability through the grazing resources is hardly capable of producing only 25% of the total requirements.
The forage and grasses produced in this tract are very poor in their production and the nutritional quality showing enormous deficiency in crude protein, vitamin, mineral etc. which leads to poor health of livestock and various animal production.

In view to keep pace at rising cattle population, there is an urgent need to increase and maximise our fodder resources manifold through efficient and judicious use of water (irrigation) fertilizer and introduction of legumes in grassland communities to overcome the above problems.

Besides extensive studies on grassland, observations in ecological and applied perspective are not so far. It is in this text the present investigation has been undertaken to plan and to attain self sufficiency in the area to meet out the forage requirement to increase animal products so as to improve the socio-economic condition of the people in this region.
The present investigation has been done to increase the fodder production of grassland community in Bundelkhand Region as underling the specific points:

(i) Determination of the needs and level of nitrogen for optimum forage production under present soil condition.

(ii) Determination of the needs and level of phosphorus for optimum forage production under present soil condition.

(iii) Determination of the effect of legume introduction for optimum production of forage.

(iv) Determination of the needs and level of nitrogen on forage quality (i.e. crude protein, fat, crude fibre (A D F) and carbohydrate content) under present soil condition.
(v) Determination of the needs and level of phosphorus on forage quality (i.e. crude protein, fat, crude fibre, and carbohydrate content) under present soil condition.

(vi) Determination of the effect of legume introduction on forage quality (i.e. crude protein, fat, crude fibre and carbohydrate content) under present soil condition.
REVIEW

Grasses are the chief source of fodder in our country. The nature of grasses and grasslands, has become a matter of great importance in view of the great demand of fodder. In India productivity of grasslands has been studied by several workers (Gupta and Shankernarayan, 1962; Choudhary, 1968; Singh, 1968; Singh 1972; and Gupta and Mishra, 1981).

Nitrogen is the single nutrient limiting the forage yield of grasses. Earlier studies carried out at Jhansi had clearly indicated that forage yield of grass can be increased by the application of nitrogen (Gill et al. 1980). Urea is the major source of nitrogen fertilizer used in grasses. Gill and Patil (1988) have shown that application of nitrogen increased the green and dry matter yield significantly. The same response to nitrogen in different grasses has also been reported by several workers (Faroda 1974; Dabadghao et al. 1965; and Gill et al. 1983).
Addition of fertilizer not only maintain the fertility of the soil but also increases the yields of grasses. Dabadghao et al. (1965) reported an increase of 24 to 47% in forage yield in different grasses by application of 22.4 kg/ha of nitrogen. Application of 60 kg N/ ha increased the yield of Sehima - Heteropogon grassland to 7.9 tons / ha as control (Rai et al. 1973). Application of same dose in Chrysopogon fulvus increased 95% forage yield (Kanodia et al. 1974).

Kaul and Sood (1986) recorded significant increase in forage yield with increasing level of nitrogen i.e. 90 kg N/ha which was recorded for the highest yield. They also reported increase in crude protein and decrease in crude fibre content with increasing level of nitrogen.

Gill and Patil (1986) while conducting the field experiment found that application of nitrogen significantly increased the forage yield of grasses under rainfed condition.
Application of ammonium sulphate was found to increase the botanical composition of desired species. According to Rai et al. (1979) third week of July was found more suitable for fertilizer application as compared to second week of August and first week of September at Jhansi and a decrease in dry matter yield was 8.5 and 13.7% respectively while the reverse was true in case of crude protein content (Rai and Kanodia, 1981).

There was significant increase in dry matter yield with increasing level of nitrogen during all the years, similar response to nitrogen was reported in Heteropogon contortus grassland by Shanker, 1973; Bhaid and Bahl, 1970 and Erasmus, 1970 in natural grassland of M.P. and Chandigarh.

Phosphorus is one of the essential nutrient elements for plant growth, however, its concentration in plant tissues is lower than that of the nitrogen. Phosphorus in general constitutes about
0.2 to 0.8% of the total dry weight of plants (Black, 1968) and is second in importance to nitrogen.

Phosphorus participates in the composition of several organic compounds including phytin, phospholipids, nucleic acids and phosphoproteins. In the form of Adenosine triphosphate (ATP) it is an 'universal fuel' of living organism. It is ecologically significant as the most likely limiting or regulating element in productivity.

Role of nutrient particularly of phosphorus in increasing fodder production of grasses and legumes is well established. Increasing level of phosphorus up to 30 kg $P_2O_5$/ha increased forage yield of pasture legumes significantly (Gill et al. 1988). Bizic (1984) reported beneficial effect of phosphorus (45-90 kg $P_2O_5$/ha) on seed and forage production of hairy vetch (Vicia villosa). Sood et al. (1969) observed that phosphorus fertilizer increased the green and dry fodder yield significantly.
Studies at Jhansi in different grassland communities revealed that application of phosphorus increase the forage yield but was of a lower order as compared to the nitrogen.

In tropical rangelands the role of perennial legumes with high palatability becomes more imperative when we consider the majority of annual and perennial weeds while several species of Stylosanthes have found wider preference on various types of climoedaphic situation in many countries including India of the world.

In India though the species of Stylosanthes (S. mucronata) was reported to be naturally occurring in the peninsular region, the recent introduction has proved their suitability for the improvement of the forage production and forage quality in degraded habitats like Bundelkhand region.

It should be ensured that heldover after the monsoon, grazing contain necessary legumes to make it acceptable to cattle
during winter and summer. It contains half legume during autumn, it will provide feed to the best quality readily acceptable to cattle. Protein content of grasslands could be raised from 2% in pure grass cover to 6% in herbage mixed legumes (Shankernarayan, 1974).

Introduction of Siratro and Kulthi legumes raised the protein content of mixed hay cut at ripe stage over 6% compared to about 2% of the pure hay (Dabadghao, 1972).

Potentiality of different grasses was evaluated when growing under mixture with range legume at Jhansi. Rai and Kanodia (1982) observed increase in mixed green and dry matter yield although nonsignificant.

At Jodhpur Chauhan and Faroda (1979) found that intercropping of legumes in Cenchrus ciliaris was beneficial for forage production. Singh et al. (1983) observed that due to intercropping of Stylosanthes hamata in Cenchrus ciliaris, the mixed herbage yield increased by 29.3%.
Comparative study on introduction of range legume viz. Clitoria, Phaseolus, S. hamata and S. scabra with and without phosphate fertilizer on forage production and crude protein yield in Dichanthium annulatum and C. ciliaris revealed that introduction of S. hamata was found more suitable (Rai, 1986, 87).

Studies on the introduction of legumes with and without application of phosphorus in the established pasture of Cenchrus ciliaris and Dichanthium annulatum revealed that due to introduction of Stylosanthes hamata the dry matter yield and crude protein yield increased over control (Rai and Pathak, 1985). Similarly due to introduction of S. scabra in C. ciliaris and D. annulatum, the forage production and crude protein increased significantly over control (Rai, 1983, 84).

Dwivedi et al. (1985) by introduction of various strains of Stylosanthes as well as application of nitrogen showed appreciable increase in forage production and crude protein yield as compared to control (Chrysopogon fulvus alone). Singh et al.
(1983) also reported similar increase in crude protein in *C. ciliaris* when introduced with *S. hamata*. Similar findings have been reported by Rai et al. (1980) and Singh et al. (1981) in natural grasslands.

Singh et al. (1961), Sood (1981) and Rai and Kanodia (1982) reported better quality of produce as a result of higher crude protein and low fibre content following grass legume introduction. Sood and Sharma (1994) in an experiment on the introduction of velvet bean (*Schizobium deeringianum*) using three rows spacing proved advantageous from production and quality point of view. They observed qualitatively the produce with legume component was superior to the produce without legume as indicated by higher crude protein, cell content and in vitro dry matter digestibility and lower neutral detergent fibre (N D F) and acid detergent fibre (A D F), lignin and silica content. Sood et al. (1989) have also observed better quality produce through legume introduction in the grasses.