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# LIVESTOCK DEVELOPMENT IN HIMACHAL PRADESH: RESTROSPECT AND PROSPECT

Dr. G. C. Negi

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International Centre for Integrated Mountain Development

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# PREFACE

ICIMOD's approach to problem oriented research involves both knowledge reviews and field studies. The focused reviews and field studies conducted by the Mountain Farming Systems Division cover various aspects of agricultural development. Since early 1988, a series of 'state of the art' reviews of agricultural policies and programmes were sponsored by ICIMOD in different countries of the HKH Region. The purpose of these studies and the subsequent National Workshops in different countries was to understand some of the constraints and prospects of Mountain area development. These exercises were also aimed at acquiring comparative perspectives of development approaches and strategies in different countries.

This paper was a part of this series of studies, commissioned by ICIMOD, and was also presented at the Workshop on "Agricultural Development Experiences in Himachal Pradesh, India," jointly held by ICIMOD and the Agro-economic Research Centre, Himachal Pradesh University, Shimla, India, 11-13 April 1988, at Manali. This paper is a comprehensive overview of the status of animal husbandry in Himachal Pradesh.

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# I. INTRODUCTION AND BACKGROUND

## Historical Role of Livestock in India

India is principally an agricultural country with a very large livestock population. It accounts for about 15 per cent of the livestock population of the world inhabiting 2 per cent of the world's total geographical area. Livestock are an important component of the rural economy. They constitute about 12 per cent of the agricultural economy. This contribution is made in the form of milk, milk by-products, meat, wool, hides, bones, etc. For centuries, however, livestock has been basically raised for milk, manure, and draft power. Indian literature is full of references to high yielding cows and bullocks with excellent draft power. *Nandi* and *Kamdhenu* are household words in India. The importance of livestock is better summed up in the word *Pashu-dhan*, i.e. cattle wealth. This term connotes the social standing of a person in the rural areas: the more the livestock and the better the cattle, the richer the person. It is also significant that whenever *Rajas* and Kings were pleased with warriors, courtiers, thinkers, or social workers, the latter were rewarded with livestock rather than gold or precious jewels. In fact, they were rewarded with high yielding cows, good riding ponies, and even elephants. The early literature of the country contains many references stressing the importance of livestock, especially cows and bullocks, so much so that the cow came to be worshipped as a mother symbol and as a progenator of bullock power.

After the reign of King Ashoka in the fifth century B.C., no significant efforts seem to have been made for the improvement of cattle up to the end of the last century. It appears that a village became a unit in the field of animal breeding, and livestock were intensely inbred. Deterioration in the quality seems to have increased the numbers immensely, so that today the livestock population in India has gone up to 378.5 million (FAO 1985) apart from the 161 million poultry.

Even with this huge population, this country is not in a position to meet the requirements for milk and meat. Per capita availability of milk in India is estimated to be 148g against the recommended requirement of 300g per day. Similarly, per capita availability of meat (3.7 g/day) and eggs (18 eggs/annum) is far below the required level. India has 12.8 per cent of the world's milch cows which produce only about 7 per cent of the world's total milk. Production of milk per cow is 511 kg/lactation in India, as against 5510 kg in the U.S.A. and 5104 kg in Holland.

It is estimated that about 90 per cent of the livestock population in India subsists on natural grasslands. Of a total area of 320 million ha of the Indian Union, 8.80 million ha are classified as grazing lands, i.e. permanent pastures and meadows. In addition to this, 43 million ha of cultivable and non-cultivable land also serves as grazing land for Indian livestock.

## Importance of Livestock to Himachal Pradesh

*Role in the Economy*

The State of Himachal Pradesh as indeed the whole of India, is principally an agricultural State with 94 per cent of its inhabitants depending for their livelihood on agriculture and allied professions. In fact, the farmer's dependence on livestock has increased so much

that in H.P. the livestock population exceeds the human population. While the country supports 15 per cent of the world's livestock on 2 per cent of the world's geographical area; Himachal Pradesh supports 5,000,000 livestock on 55.673 $km^2$. Density per $km^2$ works out to be 77 for human beings and 89 for livestock.

The rearing of livestock is an integral part of the State's economy, providing a source of livelihood to most of the people, especially those inhabiting the border districts of Lahaul-Spiti, and Kinnaur, and Pangi and Bharmour sub-divisions of Chamba District. In the remaining areas, livestock rearing is practised, generally, within the framework of mixed farming. The total livestock population of the State, according to the 1982 Census, is estimated to be 5 million scattered throughout 12 districts.

The livestock provide wool, meat, milk, hides, skins, motive-power for agricutlural operations and transport, manure etc. and are of immense economical value to the farmers of the State, besides providing gainful employment to a large section of the population all the year round. The mechanised system of cultivation is not of much use in the Himachal Pradesh, because of terraced fields and limited holdings, and, thus, the bulk of the power requirement in these hilly terraced fields is provided by bullock-power. In most of the remote and inaccessible areas, situated in the far-flung corners of the State, vehicular traffic is still unknown and most of the commodities of consumption are still transported on pack animals such as ponies, yaks, mules, sheep, goats, etc.

The importance of livestock to the State economy is equally significant. In 1984/85, livestock along with agriculture contributed Rs. 1,379 million to the State income which accounted for 35.11 per cent of the total State domestic income at 1970/71 price levels. At current price levels, the contribution works out to be Rs. 3,738.4 million. No other segment of the State economy contributes as much as the livestock industry.

The necessity for planned development arose out of the principle that better management of such an important sector of the State economy will yield much better returns to the farmers and also to the State. The ultimate objective of this planning is to attain a level of development where each citizen can be provided with 300 g. milk, 90 g. meat, and one egg per day as recommended by the Indian Council of Medical Research (ICMR). This responsibility of the State stems from the directive principles enshrined in the Constitution and further stressed in point 4 of the 20-Point Economic Programme.

*Composition of Livestock Population*

Average land holdings being very small, Himachal Pradesh is mainly suited for mixed farming. Such a farming system cannot support a very large population of livestock which is still increasing.

From the figures in Table 1, it is evident that there had been a 19 per cent increase in the livestock population during the 1966-82 period. The breeding of cattle had been indiscriminate without proper selection. Due to various religious susceptibilities and orthodox concepts, our farmers are not prepared to follow scientifically acceptable methods of disposal of uneconomic cattle, with the result that the quality of even our good milch breeds has gradually deteriorated in the country as a whole. Any further increase in number will adversely effect the productivity of cattle, sheep, etc and this is already very low.

**Table 1: Livestock Population of Himachal Pradesh According to the Quinquennial Census**

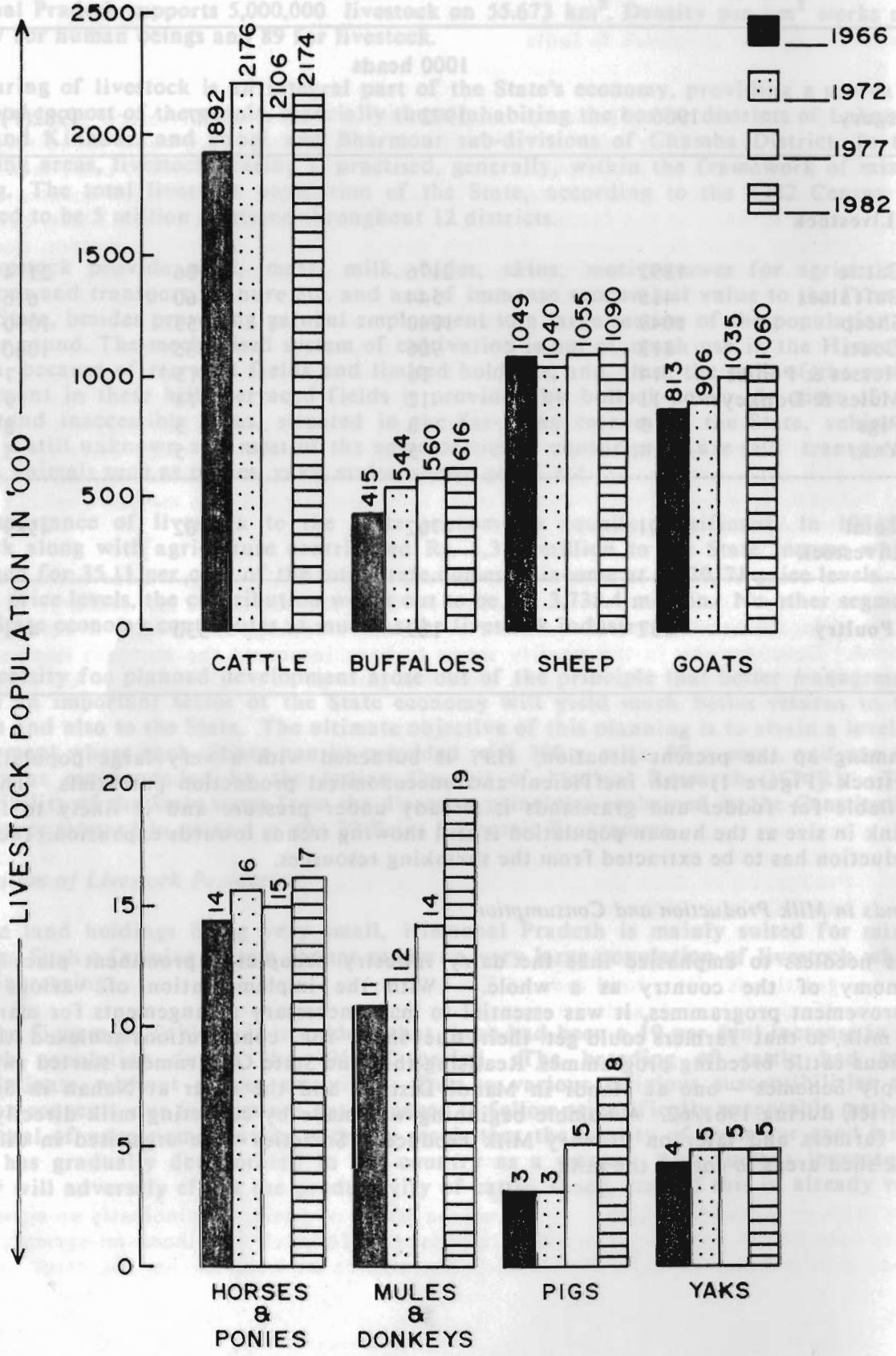
| Category | 1966 | 1972 | 1977 | 1982(P) |
|---|---|---|---|---|
| | | 1000 heads | | |
| **A. Livestock** | | | | |
| Cattle | 1892 | 2176 | 2106 | 2174 |
| Buffaloes | 415 | 544 | 560 | 616 |
| Sheep | 1049 | 1040 | 1055 | 1090 |
| Goats | 813 | 906 | 1035 | 1060 |
| Horses & Ponies | 14 | 16 | 15 | 17 |
| Mules & Donkeys | 11 | 12 | 14 | 19 |
| Pigs | 3 | 3 | 5 | 8 |
| Yaks | 4 | 5 | 5 | 5 |
| Total Livestock | 4201 | 4702 | 4702 | 4989 |
| **B. Poultry** | 207 | 189 | 330 | 461 |

Summing up the present situation, H.P. is burdened with a very large population of livestock (Figure 1) with inefficient and uneconomical production potentials. The area available for fodder and grasslands is already under pressure and is likely to further shrink in size as the human population is still showing trends towards expansion. Increased production has to be extracted from the shrinking resources.

*Trends in Milk Production and Consumption*

It is needless to emphasize that the dairy industry occupies a prominent place in the economy of the country as a whole. With the implementation of various cattle improvement programmes, it was essential to make necessary arrangements for marketing the milk, so that farmers could get their due share for contributions achieved through various cattle breeding programmes. Realising this, the State Government started two Milk Supply Schemes - one at Mandi in Mandi District and the other at Nahan in Sirmour District, during 1961/62. A humble beginning was made by collecting milk directly from the farmers and later on Primary Milk Producers' Societies were organised in different milk shed areas to collect the milk.

# FIG I: CHANGING PATTERNS OF LIVESTOCK POPULATION IN H.P.




Source: Dept. of Animal Husbandry Government of Himachal Pradesh.

With growing awareness amongst the farmers, the quantity of milk collected daily increased at a faster pace necessitating the installation of Chilling and Dairy Plants for processing the milk. These Milk Supply Schemes were introduced with an initial daily milk collection of 100 ltrs on one route which rose to approximately 5000 ltr per day in course of time. It was in 1972/73 that a modern Dairy Plant was commissioned at Mandi to process 10,000 ltrs of milk in one shift in collaboration with the West German Government. Two more Milk Supply Schemes were also started - one at Shimla during 1972/73 and the other at Kangra in 1973/74.

Modern Dairy Plants with sophisticated equipment have also been installed in both these places to handle 10,000 ltr of milk per shift (1975/76 at Shimla and 1986 at Dagwar near Kangra). Thus, at present, there are four Dairy Plants functioning in the State which can handle 80,000 ltr of milk per day. In order to feed these four Dairy Plants, twenty Chilling Plants (all of 2000 ltr capacity) have been installed in the milk shed areas where intensive cattle development work has been taken up.

So far, 136 Anand Pattern Primary Milk Producers' Societies have been registered in H.P. There are 13,000 producers in these Societies and they collect 11,000 ltr of milk daily. The State has registered a progressive increase in milk production during the last two Five Year Plan periods. The total milk production was estimated to be 240.3 thousand tons in 1974 and it increased to 404.13 thousand tons in 1984/85. Figure 2 shows the percentage of milk production in Himachal Pradesh by different species.

## II. LIVESTOCK DEVELOPMENT BY SUB-SECTORS

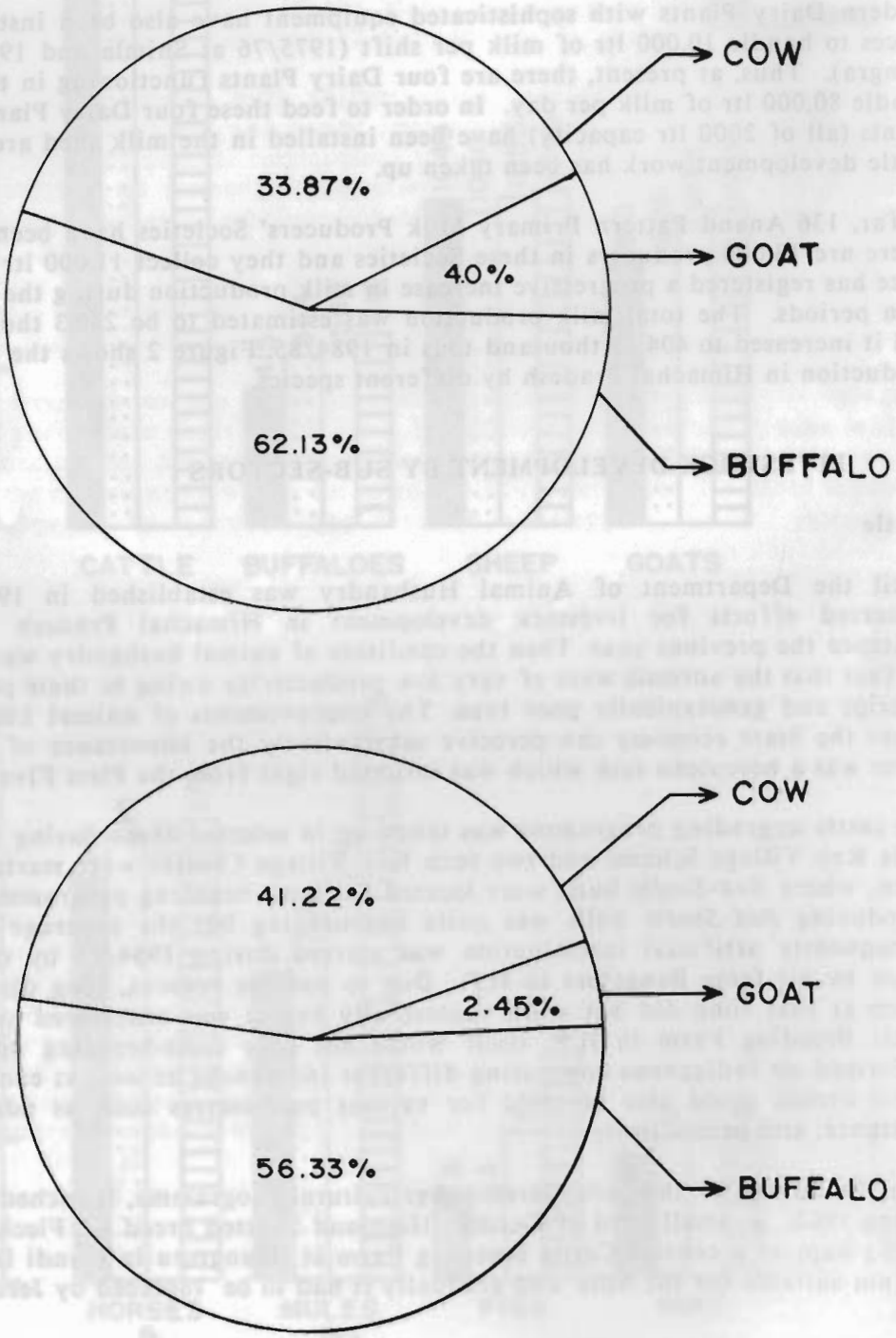
### Cattle

Until the Department of Animal Husbandry was established in 1949 there were no concerted efforts for livestock development in Himachal Pradesh which came into existence the previous year. Then the condition of animal husbandry was deplorable due to the fact that the animals were of very low productivity owing to their phenotypically non-descript and genotypically poor type. The improvements of animal husbandry to a level where the State economy can perceive substantively the importance of the livestock sub-sector was a herculean task which was initiated right from the First Five Year Plan.

The cattle upgrading programme was taken up in selected areas during 1951 under the All India Key Village Scheme and two such Key Village Centres were started at Kotgarh and Solan, where *Red-Sindhi* bulls were located for cross-breeding programmes. The impact of introducing *Red-Sindhi* bulls was quite encouraging but the coverage was very limited. Subsequently artificial insemination was started during 1954/55 by transporting Jersey semen by air from Bangalore to H.P. Due to various reasons, long distance transport of semen at that time did not work successfully and it was considered expedient to have a Cattle Breeding Farm in H.P. itself where not only cross-breeding operations could be performed on indigenous cows using different indigenous as well as exotic bulls, but some exotic breeds could also be tried for various para-metres such as adaptability, disease resistance, and productivity.

With the advent of the Indo-German Agricultural Programme, launched in Mandi District during 1962, a small herd of German Highland Spotted breed i.e. Fleckvieh, was brought in and kept at a central Cattle Breeding Farm at Bhangrotu in Mandi District. This breed was not suitable for the hills and gradually it had to be replaced by Jersey animals which

# FIG 2: MILK PRODUCTION BY DFFERENT SPECIES IN HIMACHAL PRADESH



were imported from Denmark under the aegis of the Indian Dairy Corporation. In course of time, a new Cattle Breeding Farm was established at Kothipura in Bilaspur District which obtained the Jersey animals from Denmark. During this period quite a few Jersey bulls were arranged through the Government of India and some farm born male progeny became available which helped the Department in accelerating the pace of cross-breeding programmes through artificial insemination.

The real break-through in the cattle breeding programme however was achieved with the implementation of the Indo-New Zealand Livestock Improvement Project under which 175 pure Jersey animals were brought from New Zealand in 1974, and this formed the nucleus foundation stock of the Jersey herd at Palampur in the University Campus. Besides, a Frozen Semen Laboratory was also established in collaboration with the New Zealand Government. During this period one more Deep Frozen Semen Laboratory was also established at Bhangrotu with the assistance of the West German Govt. Both these Laboratories acted as a pace setter for intensifying the artificial insemination programme in H.P. Simultaneously, steps were taken to develop human manpower by providing them training within the country, and abroad.

Cross-breeding experiments were conducted at the Cattle Breeding Farm, Kamand in Mandi District to find a suitable breed adaptable to local climatic conditions. Trials were conducted by introducing various breeds like *Red Sindhi*, Jersey, *Tharparkar*, and *Haryana*. Jersey cross-breds gave by far the best results amongst all the cross-breds. Results obtained from the trials of cross-breeding of indigenous cows with *Red Sindhi* and Jersey breeds are shown in Appendix 1. The results obtained clearly showed that upgrading of hill cattle with *Red Sindhi* and Jersey bulls improved their productivity. Performance of Jersey cross-breds was, however, much better than *Red Sindhi* cross-breds in all respects i.e. age at maturity, lactation yield, calving interval, and breeding efficiency.

A new turn was given to cattle breeding policy following the deliberations of the 'High Powered Cattle Breeding Committee' of Indo-New Zealand Livestock Improvement Project (INLIP). The Committee was of the view that since the general cattle population of the State lacked definable genetic make-up, sire evaluation by contemporary comparison using cattle population available with farmers, was impossible in H.P. The expert opinion favoured continuous exploitation of hybrid vigour with Jersey as the exotic breed and stepwise substitution of non-descript inheritance with Jersey and *Sindhi* in the lower hills. For high altitudes, use of Jersey and selected Jersey cross-bred bulls with indigenous cows was prescribed. Jersey was selected out of the exotic breeds for the following reasons:

- It is a small sized breed and is suitable for producing smaller animals, which can graze well under mountainous terrain.

- Its feed requirements in terms of maintenance rations are less as compared to larger breeds. Therefore, less feed and fodder is needed for this breed and also for its cross-breds. Its feed conversion/utilization per unit kg of body weight is much more efficient than that of other breeds.

- It has a moderate yield and therefore, matches our resources.

- Jersey has the highest butter fat rate among exotic breeds and therefore, its cross-breds would also have higher butter fat content in milk.

Keeping these advantages in view, Jersey bulls were imported from different countries Australia, New Zealand, Denmark etc under various schemes. These herds have been located at different farms which have been serving as distribution centres of superior germplasm for upgrading of local cattle. The main thrust had been to improve genetic potentials of cattle through:

- Hill Cattle Development Scheme.
- Intensive Cattle Development Project (ICDP).
- Key Village Schemes.
- Indo-New Zealand Livestock Improvement Project (INLIP).
- Indo-German Dhauladhar Project (IGDP).

The INLIP has been successful in popularising the artificial insemination (A.J.) technique. Presently, nearly 1,50,000 cows are inseminated every year in Himachal Pradesh. The encouraging results have been due to standardization of the technique of freezing semen and zero deterioration during transport and storage. The number of institutions providing breeding facility is now 526.

The Indo-German Dhauladhar Project (IGDP) on the other hand has adopted an integrated approach to livestock improvement using frozen semen technique as a means. Realising the importance of balanced nutrition during pregnancy, subsidised feed is made available as late pregnancy ration. The calf is given calf-starter at subsidised rates till the development of rumen takes place and this intensive care is continued till the heifers are bred and begin to yield milk. An intensive effort by way of subsidy is necessary because the cross-bred calf possesses genetic potential of fast growth which the dam with limited milk yield cannot support. This project effort has yielded amazing results by achieving good conception rates, better birth weights, faster calf growth, and very low calf mortality rate.

The Intensive Cattle Development Project (ICDP) adopts a nearly similar approach by providing inputs on breeding, feeding and disease control in the operational area of the project and covers about fifty thousand cows and buffaloes. Over the period of the first five years about 10,000 cows were inseminated under the project. Since 1977/78 the number of inseminations carried out has been increasing in each successive year. A similar trend was noticed under INLIP where the number of cows inseminated has, on an average, been showing an increase of 34.7 per cent per year. During the year 1986/87, about 62,000 inseminations were recorded in the four districts covered by the Project. The total number of inseminations performed in H.P. annually was nearly 160,000 in 1986/87 as against 42,000 during 1977/78.

The phenominal popularity gained by Jersey and Jersey cross-bred animals, in the areas of intensive cattle development enumerated above, is the result of the application of latest technology, on the one hand, and about 200 percent increase in milk production recorded in the first generation cross-breds, on the other. This high increase in milk is due to the huge difference in production traits/potentials of the parents viz 450 kg. per year in local cows and 3000 kg. in Jerseys. These differences find reflection in the first generation giving an average 4.5 kg. per day as recorded under INLIP and 2.9 kg. per day as recorded under ICDP. This factor alone acted as a big booster to the cross-breeding programme.

Thus, during the last three decades of planned development, a base for future cattle improvement has been built-up. There is growing consciousness amongst the farmers to own and rear cross-bred Jersey animals and they are prepared to buy good milch cattle of

this breed at any cost. In the milk-shed areas the farmers are deriving full benefit of the facilities provided by the Animal Husbandry Department in terms of artificial insemination, disease control, milk collection, and even distribution of agricultural inputs. The cross-bred animals are vaccinated against different contagious diseases prevalent in the area. Although exact figures are not yet available, according to rough estimates, cross-bred animals constitute 6 per cent of the total cattle population in H.P.

**Buffaloes**

According to the 1982 livestock census, H.P. had 616,000 buffaloes. Out of these 360,000 were of fertile age. The annual milk yield has been estimated at about 450 kg to 500 kg per buffalo, per lactation in the ICDP areas where 29 per cent of buffaloes were observed to be Murrah or Murrah graded types. The importance of buffaloes as producers of milk with high butter fat content is widely appreciated by the farmers and efforts are afoot to improve this species. In fact, many people are not aware of the relative contribution of buffaloes towards the total milk production in the State. This has been brought out very clearly in the figures given earlier.

The decline of 5.80 per cent in the overall share of milk produced by buffaloes over a period of ten years shows that:

- there has been an appreciable increase in milk production from cows,
- there has not been a corresponding increase in milk production from buffaloes, and
- in absolute terms, increase in milk production from buffaloes has been 52.46 per cent compared to 104.64 per cent from cows during the twelve year period from 1974-85.

Although late maturity and a longer calving interval tend to make buffaloes an uneconomical milk producer, there is no doubt that the buffalo utilizes the roughages better and makes a significant contribution to the farm economy. It deserves more attention than it has been given so far.

There is no doubt that for quite some time, cattle received better attention than buffaloes in the departmental activities, and this is clearly reflected by the above figures. The work on buffalo breeding until 1980 was initiated only in a few pockets. Because of the lack of technical know-how in the preservation of buffalo semen, breeding was performed through natural services by locating 92 Murrah bulls (1980) at different places in the State. A limited effort to introduce artificial insemination with liquid semen using *Glucosa-Soda* bicarb and CME dilutor did not prove very fruitful. Later, however, *Tris* used as diluent for deep freezing of Murrah semen gave good results and was introduced in a few institutions in Kangra District on an experimental basis. The utility of this diluent and the successful preservation of buffalo semen in a frozen state has also been confirmed by the researches conducted at Palampur Laboratory. The technique has now gained popularity to such an extent that demand for Murrah semen straws far exceeds the production. Artificial insemination facilities for buffaloes has now been extended to 190 institutions in the four districts of the State under the Intensive Livestock Improvement Programme, and, during the last three years, 27,969 buffaloes were inseminated with the semen process at the Palampur Laboratory.

**Yaks**

The Yak is a native of Tibet, but presently it is found in Jammu and Kashmir, Arunachal Pradesh, Bhutan, Sikkim, Uttar Pradesh Hills, and Himachal Pradesh. It is the only species of animal that produces milk, meat, hide, and wool, and it is also used for transport at higher altitudes where no other ruminant can thrive economically. Its ability to withstand low temperatures, a snowy environment, and to survive on coarse fodder is unique. It is primarily an animal of the cold deserts and high lands. Its scientific name is *Poephagus grunniens* and it is a close relative of our domestic cattle 'Zebu'-*Bos indicus*. It is a massive short-legged animal with thick hair. The tail is very bushy and reaches down to the hocks. In winter, a secondary coat develops underneath the primary coat and this gives warmth to the animal during extremely cold weather. In comparison to other domestic animals, the heart and the vascular system of this animal are more developed. The aorta is heavily built and thus makes the animal physiologically capable of withstanding the rigours of high altitudes, which make greater demands on the blood circulation. This animal has comparatively thinner lips and strong and well jacketed incisors which enable it to graze upon soft grass as well as to chew hard vegetation.

Yaks can eke out a living from stubs and can dig out vegetation roots buried under blankets of snow as deep as 15-20 cm. It is a high climber and can plough through snow in winter. They thrive well at an altitude of around 10,000 ft above msl, but in summer they may go in search of food beyond 17,000 ft. The hooves, which are cup-shaped, enable this animal to get a better grip and it can, therefore, conveniently trek along steep slopes at high speed. It can also swim through streams very easily. These qualities of the Yak have functional comparisons with those of the camel and it can be safely called the 'Ship of the high land' or 'Camel of the cold desert'. These qualities have made this animal a favourite of the inhabitants of the high plateaus of Tibet, the U.S.S.R., Mongolia, Central Asia, and Canada. The Yak plays a very important role in the economy of the inhabitants of these regions. It provides draft power to meet the requirements of agricultural operations, serves as a beast of burden, and it can be ridden. Yak meat is considered to be quite delicious and is relished by the inhabitants of these countries. Yak hair is generally used to make mattresses, rugs, ropes, tents, and the bushy tail is used as *Chaunri* in religious places.

Yaks are regular breeders and may live up to an age of 40 years. The female Yak locally called *Breme* may give birth to 20 or even more offspring. Yak milk is rich in fat and SNF, but the total yield is less than 200 ltr. The female, being more sensitive than the male, loses its fecundity at lower altitudes or in a warmer climate. This thermo-sensitive species, therefore, poses a problem in terms of maintenance and retention of fertility in places other than its natural habitat.

The population of Yaks, both domesticated and wild, in India is estimated to be about 25,000 head. According to the statistical information available, the total number of Yaks in H.P. is nearly 5,000. They are mainly located in Pangi and Bharmour sub-divisions of Chamba District, in Lahaul-Spiti District, and in Kinnaur District. There is scant information available in the literature about the physiological norms of this animal. Limited efforts in this direction were made by the Department of Animal Husbandry at the Yak Breeding Farm, in Sangla of Kinnaur District. The general physiological observations recorded are stated below.

- Age of maturity 43 months
- Age at first calving 52 months

| | | |
|---|---|---|
| o | Conception rate | 40-50% |
| o | Gestation period | 252 days |
| o | Calving interval | 14 months |
| o | Body temperature | 90.90 F $\pm$ 0.3 |
| o | Oestrus Cycle | 17 days |
| o | Average lactation | 5-6 months (171 days) |
| o | Average milk yield per lactation | 200 ltrs. |
| o | Respiratory rate | 23 per minute |

These observations have been made on a very limited number of animals and as such more research and in-depth studies are required in this direction. There is no account available about the development of Yak breeds in our country, but, certainly, different strains are available in different regions. For improving the species, it is imperative to create a genetic pool of superior animals and to further carry on the work of selective breeding. Yaks have a capacity to inter-breed with cattle and to produce a commercial animal with adequate adaptability and productivity. It will be appropriate to introduce well-known breeds of exotic origin, such as the Jersey, to serve the purpose of hybridization. The work has been started recently, and the scheme has been sanctioned by the Indian Council of Agricultural Research under which studies will be made on various economic traits of the pure Yak and its cross-breeds. In addition, studies will also be made on reciprocal crosses i.e. Jersey bull X Yak *Breme*.

Some studies were conducted by the Department of Animal Science of H.P. *Krishi Vishva Vidyalaya* on the yield and composition of Yak milk and its crosses with indigenous cows.

**Sheep**

Sheep contribute greatly to food, clothing, rural employment, and gross state and national income. This species is of special economic importance in the arid and semi-arid areas and in dry land agriculture where dairy farming is not economical. In H.P., however, sheep are raised in sub-tropical, temperate and cold desert regions where they constitute the main livestock species. These different eco-environmental systems have given rise to different management and husbandry practices and the breeds/strains under each of these systems are distinctly different.

In H.P., sheep are generally owned by nomadic and semi-nomadic people who belong to the tribal belt of Lahaul-Spiti District, Kinnaur District, and the Bharmour and Pangi regions of Chamba District. Due to the lack of adequate grazing facilities they are compelled to resort to the practice of migration from the upper region to the lower hills during winter and vice-versa during summer. Sheep farming is a hereditary occupation with these people. The size of their flocks varies from a few head to more than 500 sheep. In certain cases, the flock size may even exceed 1,000 when two or three sheep breeders cluster together for the convenience of grazing and management. Amongst the stationary flock owners, sheep are generally raised as an adjunct to a cropping system, where they can make use of natural vegetation in the orchards and crop residues supplemented by tree leaves. Generally, sheep are raised as an extra investment without a major labour input, based on grazing facilities available during the course of migration and also in the alpine pastures. The husbandry practices are mostly primitive with a few exceptions. There has hardly been any change in the system of management of flocks during the last three decades, ever

since the overall development programme was started in this State. These nomads are, generally, illiterate and are unaware of the modern improved scientific technology for sheep and wool production. Some nomadic families of the tribal belt of Bharmour *Tehsil* of Chamba District migrate to the plains entirely during winter, along with their sheep, goats, and other belongings. They take advantage of the lush green pastures in the summer, by reaching high peaks of the temperate Himalayan region where highly nutritious grasses are available for grazing after the melting of snow. They lead a very arduous life and, generally, remain in the open without any shelter for more than six months in a year. Due to restrictions imposed by the Forest Department on the grazing rights of these people in the name of soil conservation measures, more land brought under cultivation as a result of *nautor* granted to the landless people, closure of the forests under the umbrella of various hydro-electric projects, and various other administrative reasons, the number of migratory families is fast decreasing. Also with the fast expansion of education, the children of nomadic tribes are now hesitant to pursue the same profession as their forefathers.

Sheep population in H.P., according to the 1962 census, was 660,000 and the average annual wool production per head was recorded at 684 g. Compared to this, the total sheep population, as recorded in 1982, was nearly 1,100,000 and the average annual wool production per head was recordeded at 1.095 kg. Thus, there was an increase of 60 per cent in greasy wool yield per head per year over the last 20 years. This is a result of cross-breeding. According to rough estimates, the proportion of improved sheep in H.P. having different levels of exotic blood, is 23 per cent as compared to 50 per cent of the total sheep population in Jammu and Kashmir.

The local breed has great potential for improving the quality and quantity of wool by cross-breeding. However, a programme to improve the existing breeds of sheep, through selection procedures carried out on the native village sheep population, has not produced satisfactory results.

A number of experiments were carried out by the Animal Husbandry Department to improve the indigenous non-descript type of sheep. Several exotic breeds were tried for cross-breeding purposes under different agro-climatic conditions starting with the Polwarth breed imported from Australia in 1956, the Scottish Black Face from U.K. in 1960/61, the Spanish Merino from Spain in 1961/62, the German Land Merino from West Germany in 1963/64, Down from Australia in 1968/69, and Rambouillet from the U.S.A. in 1980/81. After various cross-breeding trials, it has been found that the progeny born of Rambouillet are better than the progeny born out of Soviet or other Merinos. They possess a large body surface and produce more wool per annum, whereas the cross-bred born out of Soviet Merinos are small in size, and their annual wool production is low. Compared to 1 kg of wool in the indigenous sheep, the cross-breds born out of Soviet Merinos yield nearly 2 kg of wool per year against 2.50 kg to 2.75 kg in the case of cross-breds born out of Rambouillets.

According to the breeding policy, postulated by the Sub-committee on Sheep and Goats, constituted by the Planning Commission of the Government of India, for the high temperate zone, the introduction of fine wool sheep of Rambouillet and Soviet Merinos has been recommended, whereas, for mutton production in the hills, Dorsethorn sheep have been recommended. Wherever feeding conditions are satisfactory, even Corriedales have done well as dual purpose sheep. The performance of Corriedale sheep in Srinagar Valley is reported to be quite satisfactory.

Artificial insemination in sheep has somehow not received the attention it deserves. Introduction of artificial insemination amongst farmers' flocks can play a big role in improving the non-descript types of sheep in a relatively shorter time. Artificial insemination in sheep is very popular in the U.S.S.R. where breeding operations are mainly carried out through this technique. In Australia, however, artificial insemination is confined to the stud flocks. With better organisation this technique can also be introduced amongst sheep in H.P. To start with, a beginning can be made amongst the flocks belonging to the migratory sheep breeders. Their period of migration coincides with the breeding season. The technique of artificial insemination can be practised amongst these flocks in a place where they can congregate in sizeable numbers and stay for 4-5 days at a time depending upon the availability of grazing facilities.

After conducting a series of cross-breeding experiments on the Government Farms with the Soviet Merino and Rambouillet rams, the existing farms have now been converted into pure exotic farms, where only Soviet Merinos and Rambouillet sheep are maintained. Annually more than 500 pure bred exotic male hoggets are distributed to the farmers and, as a result of the continuous distribution of superior germplasm, the total wool production has increased by 100 per cent during the last 20 years. There is tremendous demand for these pure bred exotic male hoggets, both by stationary and nomadic sheep breeders. The cross-bred sheep have adapted very well to the local conditions and the average production in the cross-breds has doubled. Simultaneously, the price of the cross-bred wool, which the farmers now get, is almost double compared to the price of wool produced by the native sheep. Thus, a sheep farmer is now getting four times more income compared to 20 years ago.

Though the climate of H.P. is congenial for the rearing of exotic breeds of sheep, due to the scarcity of fodder and the shrinkage of grazing land, the entire pattern of sheep rearing may have to be changed. From the existing practice of letting sheep loose, grazing them on common pasture land, or resorting to migration, one may have to build up the size of stationary sheep flocks, especially with the orchardists who can maintain these sheep in their orchards without any deterrent effect to the production of fruits. The sheep being close graziers, very little or no harm to the fully grown fruit trees will occur if a proper system of pruning the branches above 3 ft on the main trunk is practised. By doing so, while the flock of sheep is being built up the manure can be used for the fruit trees as farmyard manure and the wool for cottage industry; besides extra lamb production for meat consumption. This will also reduce the incidence of grazing on common pasture land. Some beginning has been made in this direction and the concept only needs to be propagated. This concept, however, must have some research backing to work-out the costs and benefits. The future of sheep and wool development in the hills, which is mainly in the hands of nomadic sheep graziers is not encouraging unless we build up the size of stationary flocks in the villages, wherever it is possible, as a part of the mixed farming economy.

**Goats**

Goats are generally considered to be the poor man's cow and one can find one or two milch goats tethered in each household, especially among the small and marginal farmers and even agricultural labourers. Goats possess intrinsically valuable traits such as foraging versatility, wide adaptability, utilitarian multiplicity, high fecundity and prolificity, cheap maintainability, trekking manoeuvrability, and easy domesticability. These unique features of the goat qualifies it as the choicest amongst domestic animals, especially in the underdeveloped and developing countries of the world. It is the favourite animal

amongst small farmers and the landless, under diverse geographical conditions of climate and topography. It can survive and thrive under adverse climatic conditions, such as extreme hot and cold, humid and dry, and in inhospitable topographies such as deserts and mountains. Undoubtedly, no other domestic animal can match the attributes of goats. Goats are mainly browsiers and are generally descried for their fiery mouth. Once young shoots are browsed by goats, they rarely regenerate or they take a long time to revive. Goats are recognised universally as the most efficient converter of nature's green into milk and meat. They make better use of the undergrowth comprising of shrubs, bushes, vines, grasses, and tree foliage. Despite all these considerations, the population of goats world-wide has shown steady increase alongside its companion animal, the sheep. Valued both for its milk and meat, the goat has carved out a conspicuous niche for itself in the world economy, more so in India.

The population of this versatile animal recorded an increase of 60 per cent over a period of a quarter century after independence, as against 4.6 per cent in the case of sheep. In H.P. the goat population has increased from 0.813 million in 1966 to 1.06 million in 1982, an increase of nearly 30 per cent. They perform better in terms of kidding percentage, growth rate, maturity, and body-weight gain compared to sheep under the same village feeding conditions. In H.P. the main breeds are White Himalayan goats which possess long hairy protective coats and are generally reared for meat purposes; in the high hills they are even used as means of transport. In the lower hills, however, mixed breeds of milch animals mainly derived from *Beetal*, *Barbari*, *Jamnapuri*, and *Alwari* are maintained. These milch goats are mixtures of all these types which are generally brought from the plains. However, *Beetal* goats predominates over other breeds. The age at first kidding in the goats is around 20 to 25 months with a kidding interval of one year compared to the period of 25 to 35 months for first lambing in the case of sheep. There is high twinning rate in the case of goats, thus, the average kidding percentage even in hill goats comes to nearly 120 to 130 per cent against 70 to 80 per cent in the case of lambing percentages. The carcass weight at six months varies from 5 to 10 Kg and the dressing percentage from 45 to 50 per cent in both sheep and goats. These attributes are too low and need to be increased for profitable economic returns.

Goat milk constitutes about 1.5 per cent of the world's total milk production and 2.7 to 3.0 per cent of India's total milk production. Goat milk is considered to be very good for infants, old people, and convalescents as it is easily digested; being close to mother's milk. The lactation period of goats varies from 120 to 180 days with a lactation yield of 150 ltr. Mortality amongst the young is much more in the pre-weaning stage than in the post-weaning period. In fact, no precise records are available nor has any scientific study been conducted so far under hill conditions.

**Rabbits**

The rabbit is a relatively new animal in terms of commercial use. It is reared for meat, wool, fur, and as a pet and laboratory animal. People have been rearing rabbits for a long time, but their utility for the production of meat and wool has been realised only recently. Rabbit production involves limited capital and small pieces of land, but more professional skill in comparison to other livestock species. Rabbit farming can easily be adopted by small and marginal farmers.

In Himachal Pradesh there are many suitable places for commercial rabbit production. The woolly types of rabbit require cold and dry climates whereas broiler types can be reared in any climate; preferably dry weather conditions.

The first Angora Rabbit Farm was established in 1962 in Kullu Valley and stock was imported from West Germany. On the basis of the success achieved on this farm, two more farms were started in Palampur during the late seventies and early eighties. These farms were established in the private sector. The success achieved on these farms encouraged many small farmers to start rearing Angora Rabbits in Kullu Valley and around Palampur in Kangra District. By and large, these small rabbit farming units have made good progress.

Taking into consideration the need for providing a research and development base for rabbit keeping, the Central Sheep and Wool Research Institute, Malpura (ICAR), established the Division of Fur Animal Breeding at Garsa, in Kullu Valley. Simultaneously, the Himachal Pradesh Government also established an Angora Wool Rabbit Breeding Farm recently at Kandbari in Kangra District to cater to the needs of farming communities. This farm is being run under the auspices of the Indo-German Dhauladhar Project, Palampur.

The Himachal Pradesh *Krishi Vishva Vidyalaya*, Palampur, has established its own rabbit farm near its campus for producing broiler rabbits and also to conduct research on various aspects of rabbit farming such as litter size, growth rate, nutrition, incidence of diseases and their control, and marketing. Rabbits have a number of attributes for superior wool and meat production.

Young rabbits have recorded a growth rate of 30 to 40 gm per day. But in tropical countries, such as India, the growth rate is in the range of 15-20 gm per day. They attain maturity quickly compared to other livestock raised in this environment. The growth rates of rabbits compare favourably with those of broiler chickens. The period taken to reach slaughter weight is much less than in other livestock such as cattle, sheep, and goats. The reproductive capacity of rabbits is legendary. They, rebreed within 24 hours of kindling, and in fact, this is the normal breeding behaviour of wild rabbits. A female rabbit attains puberty at an age of 5-6 months and can be bred at about six months of age with a gestation period is 30-31 days. Kids are along with their mothers for a period of 4-5 weeks. During this period the mother may be provided with an ample quantity of feed and grass. She can be bred again after 4 weeks from the previous kindling.

Rabbit milk contains a very high proportion of fat (14.8%) with 12.7 per cent protein. Rabbit meat is reported to have a very low content of cholesterol and fat. This meat is better suited for patients suffering from high blood pressure and heart ailments.

Rabbits can be successfully raised on feeds that are non-competitive with human foods such as forages and grain milling by-products. Rabbits can be raised on legumes such as *berseem* or alfalfa, tropical grasses, leaves, aquatic weeds, and by-products such as wheat bran, rice bran, maize bran or mollasses. Small animals need small quantities of forage per day. Rabbits can produce the maximum amount of meat per unit area compared to any other species of livestock. Rabbits have simple housing requirements and are particularly suited to backyard production.

**Poultry**

Considerable progress has been recorded in poultry production since the inception of H.P. as a State. The poultry population has grown from about 200,000 birds in 1966 to 461,000 birds in 1982.

With the advent of various Five Year Development Plans, 14 Poultry Farms were established in different districts of the State from where birds of White Leg Horn (WLH) and Rhode Island Red (RIR) breeds were distributed to farmers who were given financial help through subsidies and also training in health care and management. Due to the concerted efforts of the Department of Animal Husbandry in the form of extension services and supply of improved varieties of birds, and due to a change in the eating habits of the people, this sector has made significant progress, with the result that poultry production now makes a substantial contribution to the State's economy. Poultry farms having 100 to 12,000 birds have come into existence and the annual egg production was estimated at 294 million during the year 1983/84. There are approximately 600 Poultry Farms registered with the Department.

Earlier, meat-type birds were not available. Now, with the introduction of broiler breeds, the farmers are maintaining broiler farms and the estimated broiler production in the State is about 200,000 broilers per annum.

The State has two central hatcheries; one at Sundernagar with an installed hatching capacity of 300,000 chicks per annum and the other at Nahan for broilers with hatching capacities up to 125,000. In addition, there are three private hatcheries with a total hatching capacity of 600,000 chicks.

The problems of the supply of assured quality poultry feed have been ameliorated considerably. The State Agro-Industries Corporation has taken up the task of supplying poultry feed to the State and private poultry farms. Poultry feed is also available from private agencies such as Godrej, Hind Lever, Nandi, Golden Friends, etc.

Efforts are being made to organize the systematic marketing of poultry products. For instance, the poultry farmers of Kangra District have formed two Cooperative Societies; one at Kangra and the other at Palampur. The Society at Kangra has more than 200 members and is running quite successfully. There is a need for organizing similar Societies in the other areas of the State. All these efforts have resulted in raising the per capita availability of eggs from 4 to 8 eggs and of poultry meat to 0.2 kg per annum. This is still very much below the recommended requirement. There is, therefore, an urgent need to pursue poultry production activities at a much faster pace.

## III. FEED AND FODDER DEVELOPMENT

The utility and usefulness of various species of livestock in Himachal Pradesh cannot be fully manifested and exploited, unless and until the feed and fodder resources are also fully developed and properly utilised. In H.P., we do not have large cultivable areas, which could be spared for the production of fodder and fodder seeds; besides this the irrigation facilities are limited. Due to over-grazing over generations, nutritive grasses have been depleted considerably. This is, perhaps, the situation practically all over the country. Alpine pastures in the northern part of the country have also suffered the same fate. Milk production is one of the most important activities for the fulfillment of the Prime Minister's 20 Point Economic Programme for rural areas, and its impact on the small and marginal farmers and agricultural labourers has been spectacular. However, milk production depends primarily on the availability of proper nutritive feeds and fodder.

The area under fodder crops being small and the possibility of any significant increase, being remote, livestock have to depend for their sustenance on the grassland resources of the country. The most pertinent component of the cattle development programme is the provision of proper and balanced feed. Howsoever superior the germ-plasm that is introduced, its intrinsic inherent characteristics cannot be fully manifested unless the genetic merit is fully exploited by proper/scientific feeding and management. The age-old system of feeding animals on straw and fibrous grasses needs to change. Presently, the fodder resources of the State are limited to natural grasslands/*ghasnis*, shrubs, fodder trees, residues of crops, straw/agricultural by-products, and some leguminous fodder cultivated in the fields; mainly in the milch pockets located in the valley areas. At present, the level of dry matter production from our natural grasslands and meadows has been found to vary from 25 to 52 quintals/ha. Thus, the availability of dry fodder in the form of roughages, which are of very low nutritive value, has been estimated by the Forest Department to be around 7 million tons in the State. The whole of this quantity is not being properly/fully utilized. H.P. is very deficient in concentrates and the availability of green fodder is scarce. It is estimated that H.P. is deficient in concentrates by 80 per cent and in green and dry fodder it falls short by 50 per cent. At present, it is estimated that only 7,500 ha is under fodder cultivation in H.P., and thus is 0.74 per cent of the total cultivated area.

**The Present Situation and Prospects**

*Area under Permanent Pastures and Grasslands*

Of the total physical area (5,567,300 ha) in Himachal Pradesh about 1,185,930 ha and 2,132,400 ha are under permanent pastures and grasslands and forests respectively. However the net area available for grazing is estimated at 2,728,250 ha which constitutes 49 per cent of the total area.

*Vegetative Zones and their Grasses and Legumes*

Himachal Pradesh can be broadly divided into three major vegetative zones. (Anon 1976).

(i) Sub-Tropical Zone: This zone is also further classified into foothills and valleys (up to 1000 m) and mid-hills (1000-2100 m) where arundinella, bothriochloa, chrysopogon, digitaria, imperata, medicago, paspalum, and sorghum species are some of the common grasses that are available. For detail see appendix 2, table - 1.

(ii) Humid/Sub-Temperate Zone: This zone includes high hills with the elevation ranging from 2100 m to 3200 m. Some of the important grass species that are commonly available are: agropron, bromus, chrysopogon, dactylis, festuca, lolium, lotus, medicago, poa, stipa, trifolium, etc. For detail see appendix 2, table - 2.

(iii) Dry Temperate and Alpine Zone: Areas at and above 3,200 m fall under this category of vegetative zone. Some of the easily available grasses include: agrotis, agropyron, bromus, dactylis, festuca, lolium, poa, and trifolium species. For detail see appendix 2, table - 3.

*Grazing Incidence*

Based on Anon's (1970) assumption (e.g. body weight, feeding habits of animals) there are altogether 15.26 million units of livestock in H.P.[1/] Hence the intensity of grazing comes to 0.18 ha/per unit as against 0.5 ha/per unit considered necessary as per the recommendation of the Grazing Advisory Committee constituted by the Himachal Pradesh Government. During the past two decades the grazing incidence has decreased from 0.25 ha/per unit in 1969 to 0.21 ha/per unit in 1972 and 0.18 ha/per unit in 1982. The reasons for this decrease in the grazing areas are the increasing livestock population, increase in area under cultivation and horticulture, and prohibition of grazing by the Forest Department, as a soil conservation measure in the catchment areas of hydro-electric projects to protect the dams, and also due to different afforestation programmes. The increase in the grazing incidence has a detrimental effect not only on the quality and quantity of the grass cover but also on soil fertility. This fact is amply evident from the state of affairs of the village grazing lands which are denuded of top surface vegetation and are severely affected by soil erosion. The migratory livestock owners, who have been rearing sheep and goats for generations, are the worst affected by the drastic reduction and closure of their grazing areas for which they had grazing rights. They are compelled to sneak into the DPF and UDPF, thus causing colossal damage to the vegetation. If this situation continues, it is feared that the reserve and protected forests will also be depleted, further aggravating the fodder problem in the State.

**Improvement of Grasslands and Pastures**

Since the present grass cover available in Himachal Pradesh, especially in the lower hills, is of a very poor quality, and the alpine pastures are also deteriorating, some suitable remedies and methods are urgently required to prevent their further depletion. For the improvement of pastures and grasslands which form the main source of fodder production, general principles of improvement such as reseeding; controlled grazing; reduction in the grazing incidences; application of inputs; removal of weeds, bushes, and obnoxious plants will have to be adopted (Whyte 1964), although on a limited scale because of the peculiar topographical and other inherent hazards. Reseeding of legumes on the pastures can be done by laying contour channel/terraces. Transplantation of roots of improved grasses and legumes in the pre-monsoon period is quite successful. Grasses and legumes can also be introduced in orchards besides growing them on the pasture lands. Lucerne can be grown along the streams and small water channels where adequate moisture is available.

*Cultivation of Fodder*

Cultivation of legumes is the cheapest way of providing nitrogen for the animal and associate pasture grasses. Therefore, priority should be given to the introduction of high quality grasses, as well as legumes, into the native pastures.

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1/ Conversion coefficients

| | | | |
|---|---|---|---|
| one buffalo | = 6.0 units | one equino | = 4.0 units |
| one cattle | = 4.0 units | one pig | = 4.0 units |
| one sheep | = 1.0 unit | | |
| one goat | = 1.5 units | | |

Apart from the grasses some fodder crops can also be propagated in this zone, especially the *Napier-bajra* hybrid which can be planted along the banks of small streams, river beds, bunds, and wastelands. It will help to check soil erosion in addition to providing green and nutritive fodder. Wherever some land can be set apart for forage production, the following rotations can be followed:

For Irrigated Areas

i) Maize + Cowpeas (June-September) - *Berseem* + Japanese Sarson (October-May)

ii) Maize + Cowpeas (April-June) - Maize + Cowpeas (June-September)- Turnip (September-November) - Oat + Vetch (December-April)

iii) Sorghum/*Bajra* (April-June) - Maize + Cowpeas (July-September) - Oats + Pea (October-March)

iv) Maize + Cowpeas (April-June) - Sorghum (June-September) - Oats + Vetch (October - March/April)

v) Sorghum (June-September) - Berseem + Oats (October-May)

For Non-irrigated Areas

i) Maize + Cowpeas (Kharif) - Oats + Vetch (Rabi)

ii) Maize + Cowpeas (Kharif) - Barley + Vetch (Rabi)

iii) Sorghum (Kharif) - Oats + Vetch (Rabi)

On an average, dry matter production of 160 and 100 quintals/ha can be obtained from irrigated and non-irrigated areas, respectively.

The following fodder crops can be grown in the humid temperate zone (Narayanan and Dabadghao 1972):

Kharif season

i) Maize + Cowpeas
ii) Maize + Soyabeans

Rabi season

i) Lucerne (can be cultivated as perennial)
ii) Oats + Vetch
iii) Barley + Vetch
iv) Turnip
v) Fodder beets and Mangels
vi) Kales
vii) Swedes
viii) Rape

*Bush Control*

This implies, the eradication of bushes, thistles, thorns, and obnoxious and ordinary weeds, by different means. In Himachal Pradesh, especially in the lower hills, bushes such as *Zarberi*, *Lantana*, and *Aegeratum* have become a nuisance for the pastures and grasslands. The carrying capacity of the existing land where such weeds predominate, has been considerably reduced. Its eradication by application of herbicides is cost prohibitive. The most effective and practical method for removal of such weeds seems to be the manual cutting of the aerial portion of the plant and then applying some chemical herbicide to the stump so as to check its further growth. Research work has been taken up by the scientists of Himachal Pradesh *Krishi Vishva Vidyalaya*, but, so far, no definite recommendations at low cost have been made to eradicate these obnoxious plants.

*Controlled Grazing*

It is true that controlled grazing provides sufficient time for the regeneration of grass cover, but is not easy to practice in Himachal Pradesh where already existing grasslands are shrinking due to the various reasons mentioned above. However, the village grasslands and pastures can be divided into plots and fenced wherever possible. Grazing should be done in these areas by rotation. In the alpine pastures, however, grazing is automatically controlled with adequate recess as the area remains under snow for a period of six months. For successful implementation of rotational grazing, the cooperation of local right holders, migratory graziers, and departmental agencies, is of vital importance for exercising control.

*Reduction in Grazing Incidence*

It has been mentioned earlier that the incidence of grazing in the existing pasture lands is increasing gradually. On one hand, the livestock population is increasing, and, on the other hand, the grazing area is decreasing. There is no straight forward and easy solution to this problem. However, attempts at reducing the livestock population by persuading and educating the farmers to maintain fewer animals by stall feeding practices should perhaps become essential.

**Proper Conservation and Utilisation of Forage**

*Preparation of Silage*

The available forage supplied from the grassland/pastures is of poor quality, as it is harvested by the farmers, at a time when the foliage is shed and only fibre is left and the stalk has lost its nutritive value. Significant decreases in crude protein and increases in crude fibre have been reported in most of the indigenous grasses of the mid-hills, when harvested after September (Dogra et al. 1979). While the grass should normally be cut before flowering, this is not done so because the grass cut at this stage does not dry up quickly and invariably gets spoiled by the rain. If it is harvested at a later stage, it clashes with their normal harvesting season. One solution to this problem appears to be conversion of surplus grass into silage. However, a proper technique for silage-making has to be evolved and farmers provided with necessary training in this technique. Silage facilitates utilisation of palatable fodder in much greener form with most of its nutrients preserved. However, it has to be decided what type of silo pit suits our conditions; whether to have a *kacha* silo pit or to adopt a surface tower silo.

*Hay Making and Baling*

As mentioned earlier, the grasses are generally cut at a later stage of growth when plants are fibrous and highly lignified. In order to get good quality fodder, grasses need to be harvested before flowering and then baled after drying. The practice of hay baling is helpful in setting up fodder banks from where fodder can be transported to deficit areas. Some light and portable type of hay baling-machines have to be designed to suit the local hill conditions and the fodder banks need to be built up at various places where there are vast *ghasnis* both under the private and government sectors. Under the present conditions of successive droughts in the country, the building-up of fodder banks is very essential.

**Fodder Trees and Silvipastures Arrangements**

In the hills, certain fodder trees, both deciduous and non-deciduous, provide a source of green fodder; especially during the lean period. These fodder trees are being destroyed by improper and heavy lopping. These fodder trees are also a source of energy supplied in the form of fuelwood. Fodder plants can be planted on the periphery of agricultural land where they can serve as wind-breakers, as well. Certain species of fodder trees have been identified in Himachal Pradesh which need to be propagated at a fast pace. The fodder trees, grown in Himachal Pradesh under different agro-climatic conditions, are presented in appendix 3 table - 1. On the basis of chemical composition, *Beul* (Grewia optiva), *Tut* (Morus alba), *Robinia* (Robinia pseudoacacia), *Khiak* (Celtis australis), *Dheu* (Artocarpus lakoocha), and *Siris* (Albizzia lebbeck) were found to be superior fodder trees. Mixing tree foliage with dry roughages, such as hay or straw, improves its palatability and nutritive value.

## IV. RECOMMENDED FUTURE STRATEGIES AND PROGRAMMES

**General Strategy for Cattle Development**

The aim of cattle development is to create a population of animals showing improved production in each successive generation. In other words, every daughter born should yield more milk than its dam. Attempts have been made to achieve this objective by adopting cross-breeding programmes with Jersey cows throughout the State, as first choice, and Holstein Friesian in selected valley areas. By adopting improved breeding, feeding, and disease control practices, it has been possible to record an overall 200 per cent increase in milk production during the last 11 years.

The increase in milk production that has been recorded in the cross-bred progeny has not made a significant difference to the total per capita availability of milk which has only marginally increased. This is due to the fact that increase in milk production, unfortunately, has not kept pace with the rate of increase in human population, and, unless some bold and large scale measures are taken to increase the milk production at a faster rate, investment in dairy development will not pay corresponding dividends. Himachal Pradesh, fortunately, has a good temperate climate and next to horticulture, the livestock industry is bound to play a pivotal role in the rural economy. Livestock farming can easily be blended with horticulture in the mixed farm economy. In the lower hills, where the population is sparse and where large areas of grassland are available, some areas can be developed into potential milk zones. Here the pastures will have to be improved along with facilities for baling and chaffing, as well as silage making.

**Accelerated Cattle Breeding Programme**

A tremendous consciousness concerning livestock keeping has grown amongst the farmers. Artificial insemination is practised with frozen semen and necessary facilities, such as door service for animal treatment and artificial insemination, are being provided with nominal service charges.

With all these efforts, however, it has only been possible to cover approximately 150,000 cows out of a breeding population of 670,000. This accounts for only 22.5 per cent of breeding cows. To achieve the target of making available the required per capita amount of milk to the human population of the Himachal, the cattle development programme needs to be accelerated considerably.

To provide 100 per cent coverage to the breeding population of cows, an almost three-fold increase in the number of insemination centres would be required, in addition to establishment of bull centres in the remote and inaccessible areas.

**Subsidisation of Cross-bred Calf Rearing**

The major problem faced by farmers in rearing cross-bred calves calls for greater attention and adoption of remedial measures on a priority basis. An average cross-bred calf weighs 15 kg at birth and its daily requirement of milk for proper growth is 1.5 kg which is more than the total milk produced by an average hill cow. Further, this requirement increases with the weight of the animal and the hill cow is in no way capable of providing the required nutrition to the growing calf. As a result, the calf becomes a victim of malnutrition, remains stunted in growth, has late maturity, and is not bred at the appropriate age, thus becoming very uneconomical. While rich farmers generally overcome these problems by providing supplementary feeding, poor farmers are unable to do this for lack of finance.

In order to facilitate that poor farmers also benefit from cross-breeding, a feeding subsidy scheme has been operated under the Dhauladhar Project. A cow pregnant through artificial insemination, is provided with late pregnancy rations, at subsidised rates, during the last three months of gestation. The female calf born, is provided with calf starter and later on growth rations up to the age of one year, at subsidized rates. This support, in the form of growth rations, is given for the first cross-bred female calf in a unit of one family.The scale of financial support per animal is given below.

| | Qty. (kg) | Total Cost (Rs) | Subsidy Amount (Rs) |
|---|---|---|---|
| 1. Late pregnancy ration | 150 | 292.50 | 219.30 |
| 2. Calf starter | 100 | 205.00 | 221.00 |
| 2. Calf growth ration | 100 | 102.50 | 153.70 |
| Total | 350 | 690.00 | 594.00 |

The above arrangement has been successful in bringing down calf mortality and in recording optimum growth and maturity ages and it has been recommended that the scheme be extended to other areas. The State Government can achieve a break-through in milk production if this programme is launched initially in a few areas where there is an Intensive Cattle Development Programme, viz, Key Village Blocks, ICDP, and INLIP areas and later extended to other areas depending upon the experience gained. The stress should be on increasing the per cow milk production and decreasing the numbers; especially of scrub animals.

**Proposed Buffalo, Sheep and Goat Development**

Development efforts similar to those for cattle with emphais on A.I., should also be made for buffaloes since these animals utilize the rough fodder types better and can make significant contribution to farmers' economy.

The concept of sheep raising combined with horticultural crop farming should be propagated and should be given research back-up. The sheep being close graziers hardly damage the fully grown fruit trees if a proper system of pruning the branches is practised. By doing so, the manure can be used for fruit production, the wool for cottage industry, and the extra lamb production for meat consumption. In addition this practice will reduce the pressure on pastureland. However, the full benefit of the concept cannot be realised unless stationary flocks are established replacing at least part of the present nomadic flocks.

**Evaluation of Artificial Breeding Programmes**

"The Sire is half the herd" is as true today as it ever was and in fact much more so. The definition of the herd has changed from 50-100 females to about 100,000 females. This is so, because, with the frozen semen straw-technique, every selected bull is capable of providing 100,000 inseminations in a year and will sire thousands of offsprings transmitting desirable as well as undesirable characteristics. Milk production being a polygenic trait, there is always a danger of the transmission of undesirable traits. It is, therefore, of utmost importance that only the best bulls are used for breeding. The increase in milk production over each generation will also depend upon the genetic capabilities of the bull. Further, conception rate and susceptibility to disease have been correlated to inheritance. It will thus be desirable to start bull improvement schemes in Agricultural Universities.

Pending sire evaluation, which might take a very long time, the best policy would be to guard against transmission of undesirable characteristics, and this is possible by physical examination of the offsprings (female) of a particular bull. At least 50 off springs (female) of each bull must be inspected for various important economic traits to be meaningful. Simultaneously, herd recording and progeny testing programmes should also be conducted in the Intensive Cattle Development areas where sufficient numbers of cross-bred progeny are available. Wherever the exotic inheritance has exceeded 75 per cent, the exotic blood level should be brought down to 50 per cent by back-crossing, for which a sufficient number of cross-bred bulls will be needed.

**Feeds and Fodder Development**

With land being very scarce, the possibility of increasing fodder production substantially on private land is very slim in the future. Therefore the improvement of public grasslands is very necessary. Priority should be given to the introduction of high quality grasses and legumes - cheapest source of nitrogen - into the pastures. In addition, reseeding of legumes, controlled grazing, reduction in the grazing incidence should be implemented in order to check further degradation of pastures and grazing land. Fodder crops can also be propagated wherever possible e.g. - banks of small streams, bunds and wastelands. Forage crops cultivation along with cereals is another possible option for increasing fodder supply.

Attempts at conservation and better utilization of forage should be linked to the efforts of increasing feed and fodder production. In this context, hay making and baling, as well as silage making, could be effective operational measures among others.

**Marketing and Support Services**

Production should be effectively integrated with the marketing of produced outputs. The state is running milk supply schemes (MSS) in various districts under which procurement of milk produced by farmers at fixed prices is guaranteed. In order to increase the milk production in the State, milk producers should be provided good incentives in the form of favourable prices for their fluid milk. Appropriate pricing policy for milk and milk products is therefore essential; in addition new milk collection centres should be established in areas which are accessible to the producers.

Efforts to improve livestock research and extension, provision of better animal health services, increasing accessibility to formal credit are some of the other areas that are equally important for overall livestock development in Himachal Pradesh.

**Table 1: Productive and Reproductive Performance of Various Cross-breds**

| Performance Parameter | Hill Cow | F1 Red Sindhi | F1 Jersey | F2 Jersey |
|---|---|---|---|---|
| Age at 1st service (months) | 42 | 38 | 28 | 22 |
| Age at 1st calving (months) | 51 | 47 | 37 | 31 |
| Average milk yield/lactation (lts.) | 298 | 236 | 1258 | 1478 |
| Fat Percentage | 3.9 | 4.2 | 4.4 | 4.4 |
| Peak-yield of milk (Lts.) | 3.2 | 4.2 | 10.9 | 11.0 |
| Average daily milk yield (lts.) | 0.73 | 2.2 | 3.9 | 5.5 |
| Average lactation length (days) | 212 | 300 | 300 | 300 |
| Dry period (days) | 432 | 15 | 120 | 100 |
| Calving interval (days) | 644 | 450 | 420 | 400 |

Appendix 2

**Table 1: Grasses and Legumes Species Available in Sub-Tropical Zone of Himachal Pradesh**

| Sr. No. | Botanical Name | English Name | Local Name |
|---|---|---|---|
| 1. | *Apluda mutica* | Apluda | Not recorded |
| 2. | *Arthraxon sp* | - | - |
| 3. | *Arundinella nepalensis* | Arundinella | *Bhangrola* |
| 4. | *Arundinella setosa* | Arundinella | - |
| 5. | *Atylosia scarabaeoides* | - | *Bankulthy* |
| 6. | *Bothriochloa pertusa* | - | *Sunehra* |
| 7. | *Bothriochloa intermedia* | - | - |
| 8. | *Cymbopogon martinii* | Centronella grass | *Makora* |
| 9. | *Cymbopogon jwarancusa* | - | - |
| 10. | *Cynodon dactylon* | Bermruda grass | *Doob* |
| 11. | *Chrysopogon gryllus* | - | *Chota Dholu* |
| 12. | *Chrysopogon fulvus (montanus)* | - | *Bara Dholu* |
| 13. | *Dichanthium annulatum* | - | *Marvel* |
| 14. | *Desmodium sp.* | - | - |
| 15. | *Digitaria marginata* | - | - |
| 16. | *Digitaria longiflora* | - | - |
| 17. | *Eulaliopsis binata* | - | *Bagar* |
| 18. | *Eragrostis curvula* | Love grass | - |
| 19. | *Heteropogon contortus* | Spear grass | *Kumri/Lamb* |
| 20. | *Imperata cylindrica* | - | *Chhiz* |
| 21. | *Medicago polymorpha* | - | *Khukani* |
| 22. | *Medicago denticulata* | - | - |
| 23. | *Pennisetum orientale* | - | *Bari jhan* |
| 24. | *Paspalum orbiculare* | - | *Kodri* |
| 25. | *Paspalum scrobiculatum* | - | - |
| 26. | *Phaseolus sp.* | - | - |
| 27. | *Poa annua* | - | - |
| 28. | *Sorghum nitidum* | - | *Chota Baru* |
| 29. | *Sorghum halepense* | John-son grass | *Bara Bru* |
| 30. | *Saccharum spontaneum* | - | *Kash* |
| 31. | *Saccharum bengalensis* | - | *Munja* |
| 32. | *Setaria glauca* | - | *Choti jhan* |
| 33. | *Themeda nathera* | - | *Lungi* |

**Table 2: Grasses and Legume Species Available in Sub-Temperate Zone of Himachal Pradesh**

| Sr. No. | Botanical Name | English Name | Local Name |
|---|---|---|---|
| 1. | *Arundinella setosa* | Arundinella | - |
| 2. | *Agrostis canina* | - | - |
| 3. | *Agropyron longaristatum* | Wheat grass | - |
| 4. | *Agropyron semicastatum* | Wheat grass | - |
| 5. | *Arthraxon sp.* | - | - |
| 6. | *Bothriochloa intermedia* | - | - |
| 7. | *Bromus catharticus* | Brome grass | - |
| 8. | *Bromus inermis* | Smooth brome grass | - |
| 9. | *Chrysopogon gryllus* | - | *Chota Dholu* |
| 10. | *Chrysopogon echinulatus* | - | - |
| 11. | *Cymbopogon jwarancusa* | - | - |
| 12. | *Cymbopogon martinii* | - | *Makora* |
| 13. | *Cynodon dactylon* | Bermuda grass | *Doob* |
| 14. | *Chloris montana* | - | - |
| 15. | *Digitaria sp.* | - | - |
| 16. | *Danthonia jacquemontii* | - | - |
| 17. | *Dactylis glomerata* | Cocksfoot | Orchard grass |
| 18. | *Festuca kashmiriana* | Fescue grass | - |
| 19. | *Festuca arundinacea* | Fescue grass/Tall Fescue | - |
| 20. | *Heteropogon contortus* | Spear grass | *Lamb/Kumri* |
| 21. | *Koeleria cristata* | - | - |
| 22. | *Lolium perenne* | Rye grass | - |
| 23. | *Lotus corniculatus* | Birds, foot trefoil | - |
| 24. | *Microstegium ciliatum* | - | - |
| 25. | *Muhlenbergia duthianan* | - | - |
| 26. | *Medicago falcata* | Lucerne (Yellow flower) | - |
| 27. | *Medicago denticulata* | - | - |
| 28. | *Onobrychis viciifolia* | Sain-foin | - |
| 29. | *Phleum pratense* | Timothy grass | - |
| 30. | *Pennisetum orientale* | - | *Baria jhan* |
| 31. | *Poa bulbosum* | Blue grass | - |
| 32. | *Poa pratense* | Kentuky blue grass | - |
| 33. | *Poa annua* | - | - |
| 34. | *Phaseolus sp.* | - | - |
| 35. | *Stipa coccinna* | Stipa grass | - |
| 36. | *Themeda anathera* | - | *Alungi* |
| 37. | *Trifolium repens* | White Clover | - |
| 38. | *Trifolium pratense* | Red Clover | - |

**Table 3. Grasses and Legume Species Available in Dry Temperate and Alpine Zone of Himachal Pradesh**

| Sr. No. | Botanical Name | English Name | Local Name |
|---|---|---|---|
| 1. | *Agrostis stolonifera* | - | - |
| 2. | *Agrostis canina* | - | - |
| 3. | *Agrostis alba* | Bent grass | - |
| 4. | *Agrostis myriantha* | - | - |
| 5. | *Agropyron congnatum* | Wheat grass | - |
| 6. | *Agropyron repena* | Wheat grass | - |
| 7. | *Bromus inermis* | Smooth brome grass | - |
| 8. | *Bromus oxyolon* | Brome grass | - |
| 9. | *Chrysopogon gryllus* | - | *Chota Dholu* |
| 10. | *Dactylis glomerata* | Cocks foot | Orchard grass |
| 11. | *Deyeuxia scabrisucs* | - | - |
| 12. | *Deschempsi causipitosa* | - | - |
| 13. | *Festuca valesiaca* | - | - |
| 14. | *Helictotrichon virescens* | - | - |
| 15. | *Irisetum micans* | - | - |
| 16. | *Lolium perenne* | Perennial Rye grass | - |
| 17. | *Phleum alpinum* | Timothy grass | - |
| 18. | *Poa bulbosa* | Blue grass | - |
| 19. | *Poa alpine* | - | - |
| 20. | *Poa stirilis* | Blue grass | - |
| 21. | *Poa pratense* | Kentuky blue grass | - |
| 22. | *Phalaris minor* | - | *Guli Danda* |
| 23. | *Themeda anathera* | - | *Alungi* |
| 24. | *Trifolium repens* | White Clover | - |
| 25. | *Trifolium fragiferum* | Stawberry Clover | - |
| 26. | *Trifolium pretense* | Red Clover | - |

**Table 1 : List of Fodder Trees Grown Under Different Agro-Climatic Condtions of Himachal Pradesh**

| Sr. No. | Botanical Name | Local Name | Altudinal limits (Metres) |
|---|---|---|---|
| 1. | *Acacia arabica* | *Kikar, Babul* | upto 1000 |
| 2. | *Cedrela toona* | *Tun* | upto 1000 |
| 3. | *Celtis australis* | *Khirak* | 800 to 2700 |
| 4. | *Dendrocalamus hamiltonii* | *Bans* | 600 to 1000 |
| 5. | *Dendrocalamus strictus* | *Bans* | upto 1000 |
| 6. | *Moringa pterygosperma* | *Suanjana* | upto 1000 |
| 7. | *Ougeinia dalbergioidies* | *Sandan* | upto 1000 |
| 8. | *Terminalia arjuna* | *Arjun* | upto 1000 |
| 9. | *Terminalia bellirica* | *Bahera* | upto 1000 |
| 10. | *Ziziphus xylopara* | *Kath Ber* | upto 1000 |
| 11. | *Acacia catechu* | *Khair* | upto 1300 |
| 12. | *Albizzia procera* | *Safed siris* | upto 1300 |
| 13. | *Albizzia stipulata* | *Ohi* | upto 1300 |
| 14. | *Anogeissus latifolia* | *Bakli* | upto 1300 |
| 15. | *Bauhinia purpuria* | *Kachnar* | upto 1300 |
| 16. | *Bauhinia variegata* | - | upto 1300 |
| 17. | *Butea monosperma* | *Palas* | upto 1300 |
| 18. | *Salix tetrasperma* | *Buns* | upto 1300 |
| 19. | *Salmalia malabarica* | *Simla* | upto 1300 |
| 20. | *Terminalia tomentosa* | *Sain* | upto 1300 |
| 21. | *Acer oblongum* | *Maple* | 1300-2000 |
| 22. | *Albizzia lebbeck* | *Siris* | upto 1600 |
| 23. | *Cedrela serrata* | *Dauri* | 1300 to 2600 |
| 24. | *Morus serrata* | *Kemo* | 1300 to 3000 |
| 25. | *Quercus incana* | *Ban* | 1300 to 2600 |
| 26. | *Morus alba* | *Tut* | upto 1500 |
| 27. | *Grewia optiva* | *Beul* | upto 2000 |
| 28. | *Olea cuspidata* | *Kahu* | 800 to 2000 |
| 29. | *Grewia elastica* | *Dhaman* | upto 2000 |
| 30. | *Ziziphus jujuba* | *Ber* | upto 2000 |
| 31. | *Robinia pseudo-acacia* | *Robinia* | 1000 to 3300 |
| 32. | *Quercus dilatata* | *Moru* | 2000 to 3000 |
| 33. | *Salix alba* | *Beuns* | 2000 to 3000 |
| 34. | *Salix elegans* | *Beuns* | 2000 to 3500 |
| 35. | *Salix dephnoides* | *Beuns* | 2000 to 3500 |
| 36. | *Acer caesium* | *Kanju* | 2300 to 3300 |
| 37. | *Quercus semecarpifolia* | *Kharsu* | 2500 to 4000 |

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