LIVESTOCK-CROP PRODUCTION SYSTEMS ANALYSIS FOR SUSTAINABLE PRODUCTION (SUB PROJECT IN HIMACHAL PRADESH)

(NATP MISSION MODE PROJECT)

Lead Centre: National Dairy Research Institute, Karnal

RANVEER SINGH
ANSHUMAN KAROL
PRATAP SINGH

AGRO-ECONOMIC RESEARCH CENTRE
HIMACHAL PRADESH UNIVERSITY
SHIMLA-171005 (INDIA)

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EXECUTIVE SUMMARY

Relevance of the study

It is well realized now a days that monoculture involving either agricultural crops or animal husbandry do not give the maximum profits on farms. Mixed farming systems involving a mixture of agricultural crops, pastures, and livestock provide maximum production, as they are able to tap the rural resources efficiently. Income from crop cultivation in India in general and Himachal Pradesh in particular, where sizes of land holdings are very small, is not sufficient to meet the family and farm expenditure of the households. Besides, income from crop cultivation is highly instable due to climatic variations. To generate additional and regular cash income throughout the year some subsidiary occupation is needed by the farmers. Commercial livestock rearing is one of the most suitable enterprises, which could be adopted by farmers in hilly areas. This study would attempt to understand and analyse interactions, between different components of farming systems so as to make recommendations to improve the productivity and efficiency of the livestock- crop production systems in different agro-climatic zones of Himachal Pradesh with the following specific objectives:

Objectives of the study

1. To identify the various livestock-crop production systems in the different agro-climatic regions of Himachal Pradesh.
2. To identify the constraints in practicing various livestock-crop production systems in different agro-climatic regions of the state.
3. To study the resource structure and socio-economic profile of the farmers practicing various livestock-crop production systems in different agro-climatic regions of the state.
4. To study the economic characteristics and productivity level of various livestock maintained and crops grown in different parts of the country in different systems.
5. To study the various breeding, feeding and management practices followed by the farmers.
6. To ascertain the practices involved and the constraints faced in the marketing of crops, livestock and livestock products.

7. To ascertain the input-output relationship for the various livestock-crop production systems in the different agro-climatic regions of the state.
8. To ascertain the potential for increasing the income and employment through adoption of improved technology in various livestock-production systems.

Methodology

In order to achieve above mentioned objectives, four districts were selected purposively from each NARP zone in Himachal Pradesh i.e. district Hamirpur from low hill sub- tropical zone, district Solan from Mid hill sub- humid zone, district Shimla from High hill temperate wet zone and district Kinnaur from high hill temperate dry zone. In each district a typical representative village cluster was selected purposively for the detailed investigation for the project. The sample village clusters were surveyed and information obtained on village schedule. In the low hill zone Bhota block of Hamirpur, in the mid hill zone Solan block of Solan district, in high hill wet zone Tikker block of Shimla district, and in high hill dry zone, Sangla block of Kinnaur district were selected for the study. In each block 150 households were surveyed. Thus, the study based on total sample of 600 households in Himachal Pradesh.

In order to examine the socio-economic structure and livestock crop production analysis, simple tabular analysis consisting of averages, percentages etc. were extensively used. In order to study the cost and returns of various crops, Cost A_1 was used.

To obtain input-output relationship for various livestock and crops log-linear form of production function was used.

In order to study the various livestock-crop production systems (LCPS), various combinations of LCPS were identified from each zone and analysis was done accordingly for the two major LCPS in each zone.

Main findings

Resource structure and socio-economic profile of sampled farmers

Average family size in Kinnaur is 7.07 persons with the sex ratio of 994, being highest in the districts under study followed by Hamirpur (6.39), Solan (6.20) and Shimla (5.65). Occupational distribution of households reveals that, crop farming is the main occupation of sampled households in all the four zones, followed by dairying. Kinnaur,

though almost every household reared bovine, but the output is generally used for their home consumption. Average operational holding was 1.09, 1.89, 1.75 and 1.25 hectares in district Hamirpur, Solan, Shimla and Kinnaur respectively. Cropping intensity in these districts was 191.65, 128.36, 107.02 and 91.70 percent respectively. Maize and Wheat are the major crops of Hamirpur and Solan districts. In Solan district farmers also grow cash crops like, tomato, peas and capsicum extensively. In Shimla, maize and barley are the major cereals, apple and potato are the major cash crops. In Kinnaur, again apple is the major fruit crop. Peas, potato, maize, wheat, barley, ogla, fafra, rajmash and kidney beans are also grown by the farmers in Kinnaur. Composition of bovine reared by the farmers in different agro-climatic zones reveals that buffalo is the main bovine followed by Crossbred cattle in Hamirpur. In Solan, crossbred cattle are major bovine, followed by Local cattle and Buffalo. In Shimla and Kinnaur Crossbred cattle are the major bovines followed by local cattle. Besides, goat, sheep and yak are reared on large scale by people in Kinnaur district. Fixed investment in crop farming is Rs. 1033, 2133, 9362 and 9339 per household and in case of bovine fixed investment is Rs. 56232, 64824, 30926 and 47565 per household in district Hamirpur, Solan, Shimla and Kinnaur respectively.

Breeding, Feeding and Management practices followed in bovine husbandry on sampled farm households

The study reveals that AI is more prevalent in case of local and crossbred cow in all the four zones but in case of buffalo, Natural Service is preferred by the farmers. Jersey breed is more preferred in case of crossbred cow in all the zones. This breed is most suitable in agro-climatic conditions prevailing in Himachal Pradesh. Pregnancy diagnosis is given after 90 days in Hamirpur and Solan and after 60 days in Shimla and Kinnaur. Feeding system adopted by majority of farmers in Hamirpur and Solan is of individual type whereas in case of Shimla and Kinnaur feeding is done both individually and in group. Both dry and green fodder is fed to the bovines in all zones except Kinnaur where about 11 percent farmers fed dry fodder, due to inadequate availability of green fodder. Method of feeding adopted by majority of farmers is stall-fed as well as grazing in open fields. But in case of buffaloes it is 100 percent stall-fed. This is due to heavy weight of animal and difficulty to move along hilly terrain. Both home made and compound feed is fed to bovines. Similar is the case of feeding supplementary ration/concentrate during late pregnancy in all zones. Recommended practices are

followed in case of milking of animals, animal health and calf rearing except in case of Kinnaur where practice of washing of udders before milking and vaccination against preventive diseases is poor. In all the zones majority of farmers tied diseased animals together with healthy animals and deworming of calves was also not done. In case of marketing of milk consumer is the first choice of farmers in Solan and milk vendors in Hamirpur and Shimla. Milk is not sold in Kinnaur and entirely used for home consumption in one form or another.

Economic Characteristics and Productivity of various Livestock and Crops

Delayed maturity of milch animals is one of the major factors responsible for the uneconomic nature of dairying. Age at first calving in case of crossbred cow ranges between 2.56 to 3.61 years whereas it is 3.92 to 4.21 in buffalo. Age at first calving ranges between 3.8 to 4.7 years in local cow. The calving interval of crossbred cow varies between 315 to 420 days out of which for 205 to 274 days it remains in milk and rest of the days in dry period. Contrary to this, calving interval in local cow varies between 450 to 485 days out of which for 218 to 284 days it remains in milk and rest of the days in dry period. It is observed that crossbred cow has the longest lactation period, shortest dry period, as well as short inter calving period and lowest age at first calving as compared to local cow. The calving interval in case of buffaloes is 310 and 350 days in Hamirpur and Solan respectively out of which for 191 and 208 days it remains in milk and rest of the days in dry period. The milk yield in crossbred cow ranges between 2.89 litres to 5.03 litres per day which is much higher than that of local cow yield of 2.07 to 2.22 litres per day. In case of buffalo, the milk yield is 4.86 and 4.09 lts./day in Hamirpur and Solan respectively. Total lactation yield is much higher in case of crossbred cow followed by buffalo and local cow. Direct sale of milk to the consumers is the best scenario in Solan and Milk vendor in Hamirpur and Shimla. Village Dairy Co-operative are non-functional in all the zones under study. Per capita milk consumption is highest in Solan whereas in other zones, it is much lower than State average of 401 gms per capita per day.

Input-output Relationship for various Livestock-Crop Production Systems in Himachal Pradesh

In Hamirpur district of low hill zone, cost of production was Rs 119.67 per quintal in maize, Rs 248.38 in wheat, Rs 361.20 in barley, Rs 67.77 in barseem, Rs 19.41 in chari, Rs 148.66 in paddy, Rs 76.71 in oat. In Solan district of mid hill zone, per quintal cost of cultivation comes out for different crops as; Maize (Rs 102.76), Wheat (Rs 338.53), Barley (Rs 324.20), Chari (Rs 28.17), Pea (Rs 128.81), Tomato (Rs 231.26) and Capsicum (Rs 794.78). In Shimla district of high hill zone, per quintal cost of cultivation comes out for different crops as; Maize (Rs. 113.35), Wheat (Rs. 522.69), Barley (Rs. 229.50), Potato (Rs. 143.80), Rajmash (Rs. 898.59) and Apple (Rs. 605.87). In case of Kinnaur district of high hill dry zone, per quintal cost of cultivation comes out for different crops as; Maize (Rs. 170.40), Wheat (Rs. 292.76), Barley (Rs. 221.86), Ogla (Rs. 123.39), Fafra (Rs. 90.00), Rajmash (Rs. 534.45), Kidney bean (Rs. 419.83), Potato (207.77), Apple (Rs. 199.63) and Pea (Rs. 113.77).

Cost of production per litre of milk in case of crossbred cow ranges between Rs 6.81 to 12.02. Whereas in case of local cow it varies between Rs. 8.17 to 13.66 per litre. In case of buffalo it comes out to be Rs. 9.69 and 8.98 per litre in Hamirpur and Solan. Cost of production of mutton is Rs. 23.75 per Kg. in case of goat and Rs. 18.74 per Kg. in case of sheep. Cost of wool production is Rs. 106.22 per Kg. It is revealed from the analysis that rearing of goat and sheep is very remunerative enterprise for the people of Kinnaur district.

The results of input- output analysis revealed that in Hamirpur in case of cross-bred cow green fodder and concentrate are the major components of cost whereas in case of buffalo, dry fodder and concentrate are the main components of cost. The coefficient of multiple determination (R^2) indicated that all the explanatory variables collectively explained about 97 percent variation in milk production in case of crossbred cow and 88 percent in case of buffalo. In Solan, in case of local cow green fodder is the major cost component. The elasticity coefficient of dry fodder is negative. All the explanatory variables collectively explained about 50 percent variation in milk production and is statistically non-significant. Similar is the case with crossbred cow and buffalo. In case of Shimla, green fodder and concentrate are the major components of cost whereas the

response of output to dry fodder is negative. In case of meat of goat and sheep value of dry fodder and human labour are the major components of cost. R^2 indicated that all the explanatory variables collectively explained about 85 percent variation in meat production in case of sheep and 82 percent in case of goat. In wool production human labour is the major cost component followed by value of dry fodder. R^2 indicated that all the explanatory variables collectively explained about 89 percent variation in wool production in case of sheep.

Input-output relationship in crop production revealed that for maize crop in Hamirpur, labour, seed and fertilizer contributed positively and significantly towards maize production, similar is the case with wheat. But in case of barley and paddy, fertilsers had negative impact. Farmers can increase gross returns by increasing the use of human labour and seed in the production of maize, wheat & paddy. In Solan, value of seed in case of maize, wheat, barley, pea and tomato contributed positively and significantly towards production. In case of pea and capsicum labour and plant protection chemicals are also contributed significantly towards production. Use of fertilizers in maize, wheat, barley and pea had negative impact but it may be due to underutilization of other inputs. In Shimla, human labour and fertilizers has a positive and significant effect on the production of maize, wheat, barley, potato and apple. Use of seed in wheat and barley had negative impact but it may be due to underutilization of other inputs. Plant protection chemicals are contributed significantly towards the production of potato and apple. In Kinnaur, human labour is the major factor of production for all the crops and contributed positively and significantly, followed by seed and fertilizers except in case of pea and kidney bean. Plant protection chemicals are contributed significantly towards the production of pea and apple. Except other crops, in case of ogla and fafra all the explanatory variables collectively explained about less than 50 percent variation in crop production and is statistically non-significant.

Income and Employment Generation from Livestock

Analyses of income and employment generation from various livestock activities revealed that crossbred cow and buffalo are contributed significantly towards the net income and employment in all zones. Net income from local cow is relatively more in case of Solan and less in Shimla. Similarly, in case of crop production, cultivation of

maize, paddy, pea, tomato, capsicum, potato, rajmash, ogla, fafra, kidney bean and apple offered remunerative returns and employment to the farmers.

Potential income and employment generation from different LCPS

The analysis of potential income and employment generation in different agro-climatic zones reveals in district Hamirpur, LCPS 1 has vast potential for increasing income and employment for the farmers. The gaps in potential and existing level of gross income, net income, family labour income and employment are 32.29, 46.13, 13.19 and 9.35 percent respectively. The gaps in LCPS 2 are relatively lesser than that of LCPS 1. In case of Solan district, there is a potential to increase income and employment in LCPS 2 as compared to LCPS 1. In district Shimla and Kinnaur, LCPS 1 has greater potential for increasing the income and employment of the farmers as gaps are higher than that of LCPS 2.

Constraints in Marketing of Crops and Livestock Products

Production and Financial constraints in case of crop production faced by farmers in Hamirpur are high incidence of insects/ pests in HYVs, high cost of credit and lack of credit availability from institutional sources. Lack of knowledge about recommended package of practices also affect the productivity of various crops and increase the cost of production. In Solan, inadequate irrigation facilities, high cost of credit and lack of agricultural labour in peak seasons are the major constraints. High cost of credit, inadequate irrigation facilities, lack of knowledge about recommended package of practices and poor communication and extension facilities are the major constraints in crop production in Shimla and Kinnaur district. Lack of marketing facilities at village level is the major constraint followed by low price of farm produce in Hamirpur and Solan. Whereas, high prices of plant protection chemicals is the major constraint in the crop production in Solan and Shimla. Low price of farm produce and lack of storage facilities are the major marketing constraints in Kinnaur district.

In case of livestock farming, low productivity of animals is the major constraint in Hamirpur, Shimla and Kinnaur followed by lack of availability of green fodder round the year and high costs of feeds and fodders. Low rate of conception through AI followed by lack of availability of green fodder round the year and high costs of feeds

and fodders are the major production and financial constraint in Solan. Lack of organized market and low price for crossbred milk are the major constraints in all the four zones in the State.

For promotion of livestock- crop production system following approach is suggested:

Sustainable increase in food grain production through extension of improved crop varieties, particularly in agro- pastoral areas, improving marginal croplands and improving water use and irrigation system – including promotion of water harvesting and efficient use technologies. The croplands should also provide more opportunities for livestock development through processing of feed from agricultural by- products and production of more forage and hay. The crop- livestock production system cannot progress unless a productive crop farming system is established. Ensuring sufficient food grain means developing a potential supply of concentrated feed with a high quality grain base. Increasing the productivity of major cropland also means that more marginal areas can be devoted to developing artificial grassland and cultivating perennial forage integrated with crops.

Executive table of main findings of the study

Particulars		Agro-climatic zones			
		Low hills	Mid hills	High hill wet	High hill dry
Per household No. of Livestock	Cross bred cows	1.00	1.40	1.33	1.00
	Local cows	-	1.10	1.16	1.00
	Buffaloes	1.35	1.06	-	-
Age at first calving (years)	Cross bred cows	2.56	3.35	3.61	2.85
	Local cows	-	4.70	4.70	3.80
	Buffaloes	3.92	4.21	-	-
Lactation length (days)	Cross bred cows	205	224	213	274
	Local cows	-	284	236	218
	Buffaloes	191	208	-	-
Milk yield (liters/day)	Cross bred cows	4.71	5.03	5.00	2.89
	Local cows	-	2.09	2.22	2.07
	Buffaloes	4.86	4.09	-	-
Milk sold (%)		62.51	22.66	39.39	-
Per capita milk consumption (grams/day)		318	713	375	223
Cost of production of milk (Rs/litres)	Crossbred cows	8.77	6.81	8.36	12.02
	Local cows	-	8.17	9.11	13.66
	Buffaloes	9.69	8.98	-	-
Net income (Rs)*	LCPS 1	11813 (46.13)	23857 (13.42)	8745 (10.40)	8827 (2.46)
	LCPS 2	10073 (42.44)	68060 (37.49)	7907 (9.35)	2890 (0.81)
Employment (man days)*	LCPS 1	63 (9.35)	54 (6.01)	12 (1.72)	45 (4.23)
	LCPS 2	16 (2.58)	3 (0.30)	11 (1.48)	34 (3.04)

* Gaps in potential and existing income and employment

Figures in parenthesis are the percentages of potential over the existing for the LCPS in the zone

Chapter-1

INTRODUCTION

1.1 Introduction

India is an agricultural country with very large livestock population. Animal husbandry in India is closely interwoven with agriculture and obviously plays an important role in the rural economy. Livestock are the main source of draught power in agricultural operations and rural transportation. They provide essential food items like milk and meat. Several other animal products obtained are hides and skins, bones, blood, wool, etc. Animal husbandry and dairying so far have been treated as rural occupations and only ancillary to crop farming. Little emphasis has been laid on developing them as commercial ventures. The major problem being faced by this sector includes lack of adequate feed and near absence of processing and marketing infrastructure in rural areas.

In Himachal Pradesh livestock are largely raised on pastures. Cattle of this area are non-descript, short statured and of low productivity. Sheep and goats are as important as cattle. The sheep reared in this state yield good quality wool. Temperate hilly regions, of the Pradesh are ideally suited for the exotic high yielding milch cattle and Merino sheep.

The rearing of livestock is an integral part of the State's economy, providing source of livelihood to most of people. Livestock rearing is practiced generally within the framework of mixed farming. The livestock provide wool, mutton, milk, hides, skins, motive power for agricultural operations and transport, manure, etc. and is of immense economical value to the framers of the State, besides gainful employment to a large section of population all the year round. The mechanized system of cultivation is prevalent in the state, because of terraced fields and smallholdings. Thus, the bulk of draft power requirements are provided by the bullocks. In most of the villages vehicular traffic is not possible, therefore, most of the commodities are still transported by the pack animals like ponies, yaks, mules, sheep, goats, etc.

Mixed farming systems involving a mixture of agricultural crops, pastures, and livestock provide maximum production, as they are able to tap the rural resources efficiently. In different agro-climatic zones of the country a number of combinations of livestock and agricultural crops have been developed by the farmers through their past experiences under the influence of resource constraints. However, very few investigations were undertaken to study the structure and dynamics of these systems and to quantify their contribution to food security and agricultural development.

Income from crop cultivation in India in general and Himachal Pradesh in particular, where sizes of land holdings are very small, is not sufficient to meet the family and farm expenditure of the households. Besides, income from crop cultivation is highly instable due to climatic variations. To generate additional and regular cash income throughout the year some subsidiary occupation is needed by the farmers. Commercial livestock rearing is one of the most suitable enterprises which could be adopted by farmers in hilly areas. Animal husbandry not only provides regular income and employment to the households but also make tiny unviable farms economically viable by diversifying and integrating farm activities.

Livestock provide draught power for agriculture, rural transport, food in the form of milk and meat, raw materials in the form of wool, hair, hides, skins, bones etc., and animal dung for use as crop manure as well as fuel for cooking and heating. Thus, livestock play a vital role in providing employment and income in a predominantly agrarian economy like India. Household member including children and women are found to be involved in this labour intensive activity, whose work is evenly spread over all days of the year.

Unfortunately livestock sector has received very little attention in the development plans. The vital role of livestock in rural economy and the problem of improving their productivity have not been properly recognized. Although reasonable success has been achieved in providing veterinary cover and crossbreeding of indigenous livestock has achieved limited success, but nothing has been achieved in the case of fodder development. There is, thus an imperative need for larger investment in livestock development, particularly in those programmes which improve animal nutrition and management.

1.2 Need for the Study

The livestock sector information research has not received adequate attention as there is no provision for regular collection and analysis of data on livestock except their number enumerated through the Livestock Census. Efforts were limited to a few small scale and ad-hoc surveys here and there. Only for the purposes of estimating production of milk and other products. As a result very little is reliably known about many aspects of livestock economy in different agro-climatic zones of the country, particularly about the milk yield, meat output, feed consumption by various categories of animals, work output of working animals, availability of various type of feed, morbidity and mortality of animals, etc. Neither is the information available on income and employment generated by various livestock activities. In short, absence of statistics on several aspects operates as a constraint on a comprehensive analysis and understanding of the livestock economy. The present study will try to fill-up this research and information gap in the livestock sector of Himachal Pradesh.

The complex roles of trees, pastures, and other components in the household farming systems have not yet been quantitatively analysed from the livestock rearing point of view. In the absence of applied scientific investigations, so far no serious efforts have been made for livestock policy recommendations, and to provide institutional and policy support for strengthening and improving the existing livestock management systems, and to draw lessons from indigenous knowledge. The proposed project is intended to bridge this research gap.

In this study an attempt has been made to understand and analyse interactions, between different components of farming systems so as to make recommendations to improve the productivity and efficiency of the livestock- crop production systems in different agro-climatic zones of Himachal Pradesh with the following specific objectives:

1.3 Objectives

9. To identify the various livestock-crop production systems in the different agro-climatic regions of the country.

10. To identify the constraints in practicing various livestock-crop production systems in different agro-climatic regions of the country.

11. To study the source structure and socio-economic profile of the farmers practicing various livestock-crop production systems in different agro-climatic regions of the country.

12. To study the economic characteristics and productivity level of various livestock's maintained and crops grown in different parts of the country in different systems.

13. To study the various breeding, feeding and management practices followed by the farmers.

14. To ascertain the practices involved and the constraints faced in the marketing of crops, livestock and livestock products.

15. To ascertain the input-output relationship for the various livestock-crop production systems in the different agro-climatic regions of the country.

16. To ascertain the potential for increasing the income and employment through adoption of improved technology in various livestock-production systems.

Chapter-2

AGRO-CLIMATIC AND SOCIO-ECONOMIC DESCRIPTION OF THE ZONES IN HIMACHAL PRADESH

Himachal Pradesh is situated in the western Himalayan region in north-west of India. The State is bordered by Jammu- Kashmir in the north, Punjab in the west and south-west, Haryana in the south, Uttranchal in the south-east and Tibet in the east. Himachal Pradesh is situated between 32° $12^{/}$ $40^{//}$ north latitude and 75° $47^{/}$ $55^{//}$ to 79° $4^{/}$ $22^{//}$ east longitude. Its altitude ranges from 450 mts. to 6500 mts above mean sea level. There is a general increase in elevation from west to east and from south to north. There is a great variation in the climatic conditions of the State due to variation in elevation and aspect. The State is divided into four agro-climatic zones.

2.1 Agro- Climatic zones in Himachal Pradesh

The NARP has divided the state into the following four agro-climatic zones on the basis of altitude, temperature, topography, rainfall and humidity: (a) Sub-mountain and Low Hills sub-Tropical Zone, (b) Mid hills Sub-Humid Zone, (c) High Hills Temperate Wet Zone, and (d) High Hills Temperate Dry Zone

(a) Sub-Mountain and Low Hills Sub-Tropical Zone

The area in this zone is situated up to 650 meters above mean sea level with an average rainfall of 1000 mm. This zone is located in the Shiwalik belts of Himachal Pradesh and occupies approximately 25 per cent of the geographical area and 38 per cent of the cultivated area of the state. The population pressure is the highest in this zone. The main crops cultivated in this zone are wheat, paddy, maize, soyabean, pulses, oilseeds and barley. Citrus, mango and litchi are important fruit crops. Cattle dominate in the total livestock population of 2.63 million. Out of total livestock population 41 per cent are cattle and 25 per cent are buffaloes. Buffaloes are the main dairy animals reared in this zone.

(b) Mid Hills Sub-Humid Zone

The elevation of this zone varies from 651 meters to 1800 meters above mean sea level. The annual precipitation in this area varies from 1500 mm to 3000 mm, 70 per cent of which is received during monsoon season. This zone comprises 41 per cent of the total cultivated area. The texture of soils of this zone varies from loam to clay loam. These are deficient in nitrogen and phosphorus with poor water and nutrient holding capacity. Soils are acidic in reaction and respond to liming. Soil conservation and water management are the main problems in this zone. Although this zone receives the maximum rainfall, the agriculture still suffers from losses every now and then due to low water holding capacity of the soils and erratic distribution of rainfall. The main crops cultivated in this zone are wheat, paddy, maize, seed potato, sugarcane, pulses and oilseeds. Stone and citrus fruits also occupy considerable area. Forestry and pastures constitute an important component in this zone. This zone is milk shed area wherein a number of chilling plants and milk processing plants have been installed. Out of total livestock population of 1.26 million 50.7 per cent are cattle and 6.1 per cent are buffaloes.

(c) High Hills Temperate Wet Zone

The altitude of this zone ranges from 1801 meters to 2200 meters above mean sea level and covers 18.4 per cent of the total cropped area of the State. The soils are shallow in depth, acidic in reaction and silt loam to loam in texture. The soils are deficient in nitrogen and phosphorus. Terraced farming is practised in this zone. The main crops are wheat, maize, paddy, barley, pulses and oilseeds. Mostly rain fed farming is practised. Soil erosion, low fertility and inadequate water management are the main problems. The average rainfall is about 1000 mm which is mainly received during monsoon months. This zone is suitable for raising off-season vegetables and seed production of temperate vegetables. Apples, other temperate fruits and nuts are important horticultural crops grown in this zone. Sheep and milch cattle dairying also supplement the income of the farmers in this zone. Cattle are the main milch animals accounting for 50 per cent of total livestock. Sheep and goats constituted about 47 per cent of total livestock population of 4.39 million.

(d) High Hills Temperate Dry Zone

The area in this zone is situated above 2201 meters above mean sea level. This zone remains covered with snow for nearly 5-6 months a year i.e. from December to April. The rainfall is very low (about 25 cm) and the temperature remains low throughout the year. The soils are sandy loam in texture and neutral to alkaline in reaction and low in fertility. Practically no crop can be raised without irrigation. Gravitational channels (*kuhls*) are the only source of irrigation in this zone. The soil erosion and water management are the main problems in this zone. Potato, barley, wheat, buck wheat, peas, minor millets, temperate vegetables and dry fruits are the main crops. Sheep and goat rearing is the main source of income. The flocks migrate to low hills in winter due to snowfall in this zone. About 66 percent of total livestock population of 0.76 million are sheep and goats.

2.2 Agro- Climatic description

Table 2.1 reveals that average annual rainfall in these zones varies from 250 to 3000 mm. Temperature also ranges from maximum 39° C in sub-mountain & low hill sub-tropical zone to -8.0° C in high-hill temperate dry zone. Soil type in these zones varies from sandy in sub-mountain & low hill sub-tropical zone, clay loam in mid-hill sub humid zone, silt loam in high-hill temperate wet zone and sandy loam in high-hill temperate dry zone. These variations allows rearing of different types of livestock and suitable for growing variety of agricultural crops.

Table 2.1: Characteristics of Various Agro-Climatic Zones in Himachal Pradesh

Name of NARP Zone	Selected District	Annual rainfall (MM)	Temperature (^{0}C)		Soil type	Major Livestock	Principal Crops
			Min.	Max.			
Sub-mountain & low hill sub-tropical zone	Hamirpur	1000	-0.5	39	Sandy	Buffaloes	Maize, Wheat
Mid-hill sub humid zone	Solan	1500-3000	-1.0	37	Clay loam	Cattle	Maize, Wheat, Vegetables
High-hill temperate wet zone	Shimla	1000	-1.0	34	Silt loam	Cattle	Maize, Wheat, apple
High-hill temperate dry zone	Kinnaur	250	-8.0	29	Sandy loam	Sheep, Goat	Millets, fruits

From each agro-climatic zone one district is selected for the present study. Demographic profile of these districts is given in Table 2.2. Due to varied climatic and geographical conditions there is a negative correlation between area and population of these districts. Percentage of rural population to total population is also varies accordingly.

Table 2.2: Area and Population of Selected Districts in Different Agro-Climatic Zones of Himachal Pradesh (2001)

Particulars		Name of the districts				Himachal Pradesh
		Hamirpur	Solan	Shimla	Kinnaur	
Area (sq. km.)		1118	1936	5131	6401	55673
Population ('000)		412.7	500.557	722.502	78.334	6077.900
Sex Ratio (Female/1000 Male)		1102	853	898	884	970
Density of population (per sq. km.)		369	258	141	12	109
Literates to total population (%)	Males	90.86	85.35	87.72	84.44	86.02
	Females	76.41	67.48	70.68	64.77	68.08
	Total	83.16	77.16	79.68	75.27	77.13
Rural population as %age to total population		6.29	6.73	9.14	100.0	90.20
Percentage to total population of 2001	SC	24.08	32.84	28.80	26.87	24.30
	ST	0.04	0.68	0.62	55.57	4.49
	OBC	NA	NA	NA	NA	NA
Total working force ('000)	Rural	195.502	221.373	305.590	46.618	2771.978
	Urban	10.094	41.802	63.848	-	219.470
Main Workers as %age to total population		29.29	34.48	42.15	49.93	32.32
In the total working force %age of	Cultivators	70.15	54.38	64.64	66.67	65.55
	Agril. labourers	1.43	2.68	2.52	2.20	3.10

Sources: Statistical Outline of HP, Department of Economics & Statistics (2001-02); Economic Survey (HP) - 2003/04, DE & S

2.3 Land use pattern

Land use pattern of selected districts is given in Table 2.3, wherein it may be seen that Hamirpur district of low hill zone has 47 percent of its geographical area under cultivation. Area under forests is 18 percent. Area under pastures and grazing land is negligible. In Solan district net sown area accounts for 22 percent of geographical area. Forests and pastureland account for 11.1 percent and 43.6 percent, respectively. In the high hill wet zone's Shimla district the net sown area account for 16.6 percent of total geographical area. The pastureland and forest land account for 46 percent and 26 percent, respectively. In Kinnaur district of high hill dry zone, net sown area is only 2.4 percent of the total geographical area. Pasture land and forest land account for 59 percent and 11.7 percent of the total geographical area, respectively. Since the net sown area is lesser, farmers generally do not grow any fodder crop on farm land. Under such a situation

pasture land and forest land assume added importance from the animal husbandry point of view. It could be seen in the Table 2.3 that as one moves from low hills towards high hill zones, the area under common pasture and grazing lands increases. And this affects the number and types of animals kept on the farms. The population density decreases as the elevation of districts increases.

2.4 Demographic profile

Demographic profiles of households in the selected villages of different agro-climate zones are given in Table 2.8 and 2.9. Average family size in sampled villages of district Hamirpur of low- hill sub- tropical zone is ranges from 5.41 to 6.81 persons. In district Solan of mid-hill sub humid zone average family size ranges from 6.00 to 6.56. The average family size in district Shimla of high hill temperate dry zone and district Kinnaur of high-hill temperate dry zone ranges from 4.55 to 5.37 and 5.76 to 6.50 persons respectively. Literacy status of the head of household in sampled villages revealed that Hamirpur district has highest literacy rate, ranges from 81.33 to 85.94 percent followed by Kinnaur, 78.15 to 80.2 percent, Solan 65.67 to 83.14 and Shimla 61.50 to 70.05 percent.

2.5 Operational holdings

As revealed from Table 2.4 average size of land holding in the State as a whole is low (1.5 hectares). In Hamirpur district (low hill zone) average holding size is 1.24 hectares, in Solan district 1.94 hectares, in Shimla district 1.45 hectares, and in Kinnaur district it is 1.42 hectares. The marginal and small farms together account for 84 percent of total holdings in the State. The large farms above 10 hectares are rare. Irrigation facilities are meagre. In the dry zone, cultivation is done mainly on irrigated fields. Average land holding size in villages selected for the study is presented in Table 2.9. In district Hamirpur it ranges from 0.57 to 1.97 hectares, whereas in district Solan average land holding size ranges from 0.47 to 1.67 hectares. In Shimla and Kinnaur, it ranges from 0.95 to 1.87 and 0.86 to 1.07 hectares respectively.

2.6 Cropping pattern

In low and mid hill zones cultivation is generally done under rain-fed conditions. Farmers do not grow fodder crops on their farms. They devote their land to cereals,

pulses oilseeds, and fruits and vegetable crops (see Table 2.5). Not only the farm size is smaller, the yields of various crops grown in various zones are also generally lower in the state. Table 2.6 presents important indicators of agricultural development in different agro- climatic zones.

2.7 Livestock economy

The livestock economy in the State is mainly bovine based in the low and mid hill zones, where as it is goat/sheep based in the high hill dry zone (see Table 2.7). The pressure of animals on grazing land is quite high. The density of livestock per sq. km is higher in low hills and lower in high hill zones. The yield of crossbred cow is significantly higher than local cow. Per capita milk availability is higher in Solan district and low in Kinnaur district.

Table 2.3: Land Use Pattern of Selected Districts in Different Agro-climatic Zones of Himachal Pradesh

Classification	Hamirpur		Solan		Shimla		Kinnaur		HP	
	Area (ha.)	%age to total	Area (ha.)	%age to total	Area (ha.)	%age to total	Area (ha.)	%age to total	Area (ha.)	%age to total
Area according to village papers	110	2.64	180.6	4.34	438.1	10.53	322.9	7.76	4161.3	100.0
2. Area under forests	20	18.18	20.1	11.13	114.6	26.16	37.9	11.74	1084.6	26.08
3. Land put to non-agril. Uses	17.9	16.27	10.7	5.92	7.7	1.75	51.2	15.85	769.9	18.50
Barren and Uncultivable land	20.0	18.18	11.9	6.59	16.9	3.86	26.6	8.23	172.1	4.13
Not available for Cultivation (3+4)	37.9	34.45	22.6	12.51	24.6	5.61	77.8	24.10	942.0	22.63
4. Permanent pastures & other grazing lands	0.1	Neg.	78.8	43.63	200.8	45.83	190.7	59.06	1290.7	31.02
Land under misc. trees & groves (not included in NSA)	0.1	Neg.	1.7	Neg.	1.8	Neg.	0.7	Neg.	97.8	2.35
8. Cultivable but barren land	6.0	5.45	12.8	7.08	10.9	2.48	6.4	1.98	106.2	2.55
9. Uncultivable land (6+7+8)	6.2	5.64	93.3	51.67	213.5	48.74	197.8	61.25	1494.7	35.92
10. Fallow land other than current fallow	0.2	Neg.	0.8	Neg.	1.4	Neg.	0.1	Neg.	21.7	0.52
11. Current fallow	8.6	7.81	3.3	1.82	11.3	2.57	1.7	0.52	50.8	1.22
12. Fallow land (10+11)	8.8	8.0	4.1	2.27	12.7	2.90	1.8	0.58	72.5	1.74
13. Net area sown	37.1	33.73	40.5	22.42	72.7	16.59	7.6	2.35	567.5	13.63
14. Cultivable area (9+12+13)	51.9	47.18	57.4	31.78	96.3	21.98	15.8	4.89	746.2	17.93
15. Cultivated area (12+13)	45.9	41.72	44.6	24.69	85.4	19.49	9.4	2.91	640.0	15.37
16. Area sown more than once	34.7	31.54	23.8	13.18	32.5	7.42	1.9	0.58	403.2	9.69
17. Total cropped area (15+16)	71.8	65.27	64.3	35.6	105.2	24.01	9.5	2.94	970.7	23.32
18. Cropping intensity	193	-	158	-	144	-	125	-	171	-

Source: Annual crop season report (1999), Directorate of Land Records, Himachal Pradesh

Table2.4: Distribution of Operational Holdings and Area Operated in different Agro-climatic Zones of Himachal Pradesh

Land holding category	Name of the Districts												Himachal Pradesh		
	Hamirpur			Solan			Shimla			Kinnaur					
	No. of holding	Area (ha.)	Average area per holding (ha.)	No. of holding	Area (ha.)	Average area per holding (ha.)	No. of holding	Area (ha.)	Average area per holding (ha.)	No. of holding	Area (ha.)	Average area per holding (ha.)	No. of holding	Area (ha.)	Average area per holding (ha.)
Marginal (<1.0 ha)	41617 (63.19)	17798 (21.79)	0.42	19557 (41.66)	9461 (10.36)	0.48	44455 (53.87)	19833 (16.46)	0.44	5221 (54.0)	2329 (16.95)	0.44	555891 (64.38)	230304 (23.05)	0.41
Small (1.0-2.0)	13859 (21.05)	19736 (24.14)	1.42	11778 (25.09)	17035 (18.66)	1.44	19350 (23.45)	27392 (22.74)	1.42	2345 (24.25)	3382 (24.61)	1.44	173466 (20.09)	240483 (24.07)	1.38
Semi-medium (2.0-4.0)	7581 (11.52)	20699 (25.32)	2.72	9946 (21.19)	27872 (30.53)	2.80	12925 (15.66)	35747 (29.67)	2.67	1534 (15.87)	4217 (30.69)	2.75	94957 (11.0)	255195 (25.54)	2.68
Medium (4.0-10.0)	2587 (3.93)	19357 (23.68)	7.48	5106 (10.88)	29124 (31.90)	5.70	5276 (6.39)	30138 (25.02)	5.71	470 (4.86)	2625 (19.10)	5.58	34377 (3.98)	194782 (19.50)	5.66
Large (Above 10)	207 (0.31)	4145 (5.07)	20.02	549 (1.18)	7805 (8.55)	14.21	515 (0.63)	7358 (6.11)	14.87	98 (1.02)	1189 (8.65)	12.13	4746 (0.55)	78334 (7.84)	16.5
Total	65851 (100.0)	81735 (100.0)	1.24	46936 (100.0)	91297 (100.0)	1.94	82521 (100.0)	120468 (100.0)	1.45	9668 (100.0)	13742 (100.0)	1.42	863437 (100.0)	999099 (100.0)	1.51

Table 2.5: Area and Yield of Major Crops in Different Agro-Climatic Zones of Himachal Pradesh

Name of the crops		Name of the Districts									
		Hamirpur		Solan		Shimla		Kinnaur		Himachal Pradesh	
		Area (ha.)	Yield (q./ha.)	Area (ha.)	Yield (q./ha.)	Area (ha.)	Yield (q./ha.)	Area (ha.)	Yield (q./ha.)	Area (ha.)	Yield (q./ha.)
Cereal Crops	Rice	2487	1610.7	3481	1851	2923	1140.2	30	1500.4	80221	1500.4
	Maize	32036	1856.7	24189	2162.9	16685	2304	404	2272.1	299906	2272.1
	Wheat	34993	1208	23857	1679.1	19758	1138.6	371	1608.1	370587	1574
	Barley	130	1254.7	1710	1070.7	4574	966.8	1420	1308.4	25901	1254.7
	Total Cereals	69650	-	53238	-	50512	-	4683	-	791957	-
Pulse Crops	Gram	22	347	485	942	65	1102	-	-	1691	861
	Black Gram (Urd)	115	469	1378	110	2755	315	7	1530	14612	490
	Peas	-	-	1131	1329	-	-	-	-	5046	1817
	Total Pulses	239	-	3513	-	5544	-	985	-	32556	-
Total Food grains		69889	-	56751	-	56056	-	5668	-	824513	-
Oil seed Crops			-		-		-		-	14627	-
Cash Crops/ Plantation	Apple	-	-	-	-	22308		1187		34047	
	Total fresh fruits	61	-	375	-	22683	-	1194	-	56474	
	Vegetables										
	Potato	11		126		5502		1637		14373	-
	Tomato	-		2513		187		2		4267	-
	Cabbage & Cauliflower	9		79		2186		23		2975	-
	Total vegetables	202	-	3444	-	13135	-	844	-	34675	-
Total Food Crops		70280	-	61899	-	98486	-	8949	-	923939	-
Fodder Crops	Barseem	181		181		2		-	-	4747	
	Chari	-	-	1154		-	-	-	-	5019	
	Others	31		22		-	-	-	-	567	
Total Non-Food Crops		468	-	2973	-	1134	-	110	-	32828	-

Source: Annual Crop Season Report (1999-2000), Commissioner, Revenue, HP Govt. Shimla

Table 2.6: Important Indicators of Agriculture Development in different Agro-Climatic Zones of Himachal Pradesh

Particulars		Districts				Himachal Pradesh
		Hamirpur	Solan	Shimla	Kinnaur	
Net sown area (000 ha.)		37.1	40.5	72.7	7.8	567.5
Total cropped area (000 ha.)		71.8	64.3	105.2	9.5	970.7
Cropping intensity (%)		193	158	144	125	171.0
Percentage of net irrigated are to net sown area		4.76	24.30	6.36	56.03	17.53
No. per thousand hectares of net area sown	Tubewells / pumpset	-	-	-	-	-
	Tractors	57	250	-	-	2061
Net sown area per tractor		17.54	4	-	-	-
Net sown area per tube well / pumping set		-	-	-	-	-
Fertilizer consumption (nutrition) per cropped area (Tonnes 2000-01)	N	1831	1836	2504	60	24418
	P	264	373	1441	16	6540
	K	132	187	1838	18	4594
	Total	2227	2396	5783	94	35552
Consumption of pesticides (Tonnes)		-	-	-	-	232039
Percentage of gross area sown under foodgrains crops to total cropped area		97.2	89.1	59.8	64.2	83.2
Area under HYVs (%)	Rice	-	80.6	43.6	-	42.1
	Wheat	82.7	100.0	39.9	4.6	61.0
	Maize	-	77.5	39.2	-	61.6
Average (1996-2001) normal rainfall (mm)		1156.2	1318.5	1252.6	816.4	1460.3

Source: Annual Crop-Season Report (1999-2000), Commissioner Revenue, HP

Table 2.7: Major Indicators of Livestock Economy in different Agro-Climatic Zones of Himachal Pradesh

Particulars		District				Himachal Pradesh
		Hamirpur	Solan	Shimla	Kinnaur	
Number per square Kilometer of area of	Livestock	180	151	99	17	82
	Cattles	44	63	59	3	36
	Buffaloes	79	45	3	-	12
	Sheep	28	6	21	9	16
	Goats	26	34	14	4	17
Bovine: livestock ratio		1:1.6	1:1.53	1:1.70	1:5.20	1:1.8
Number of livestock per 1000 persons		667	877	969	1614	1018
Number of bovines per 100 persons		42	57	57	31	56
Number of livestock per 100 ha. of net area sown		664	828	823	1514	927
Number of bovines per 100 ha. of net area sown		372	513	437	288	468
Area under fodder crops		212	1357	-	-	10333
Grazing & pasture land to total geographical area (%)		Neg	43.33	45.83	59.03	31.02
Average daily milk yield	Indigenous cows	1987	2100	2039	2022	1940
	Crossbred cows	5009	3842	3192	3459	3559
	Buffaloes	2731	3622	3825	-	3357
	Goats	510	456	375	328	431
Annual milk production (000 tonnes)		61.572	73.873	79.250	6.389	762.864
Per capita availability of milk (gms./day)		401	441	301	209	344

Table 2.8: Profile of Households in the Selected Villages of Different Agro-Climate Zones

Zones	District	Name of Villages	Total no. of households	Total no. of farming households	Distribution of farming households across land size					
					Landless	Marginal (<1ha)	Small (1-2ha)	Semi-Medium (2-4ha)	Medium (4-10ha)	Large (>10ha)
Sub-mountain & low hill sub-tropical zone	Hamirpur	Nihalwin	61	60	1	31	19	10	-	-
		Morsu Patti	20	20	-	16	4	-	-	-
		Morsu Galian	20	20	-	19	1	-	-	-
		Sidhpur	73	73	-	28	40	4	1	-
		Total	**174**	**173**	**1**	**94**	**64**	**14**	**1**	**-**
Mid-hill sub humid zone	Solan	Anji	111	90	21	86	4	-	-	-
		Shamlech	35	18	17	8	5	1	4	-
		Ghatti	19	17	2	4	8	5	-	-
		Kothi	36	30	6	14	5	5	6	-
		Sanjara	14	12	2	5	3	3	1	-
		Berti	40	37	3	18	13	4	2	-
		Total	**255**	**204**	**51**	**135**	**38**	**18**	**13**	**-**
High-hill temperate wet zone	Shimla	Tikkari	63	57	6	28	21	8	-	-
		Koti	113	108	5	77	17	8	6	-
		Sajar	18	18	-	4	7	5	2	-
		Ferkoti	56	56	-	38	12	2	4	-
		Total	**250**	**239**	**11**	**147**	**57**	**23**	**12**	**-**
High-hill temperate dry zone	Kinnaur	Sangla	100	96	4	58	24	9	5	-
		Voning-Shering	38	38	-	26	10	2	-	-
		Kamroo	45	45	-	23	20	2	-	-
		Total	**183**	**179**	**4**	**107**	**54**	**13**	**5**	**-**

Table 2.9: Vital Statistics of the Selected Villages in Different Agro-Climatic Zones

Particulars		Name of the Districts									
		Hamirpur				Solan					
		Nihalwin	Morsu Patti	Morsu Galian	Sidhpur	Anji	Shamlech	Ghatti	Kothi	Sanjara	Berti
Total no. of households		61	20	20	73	111	35	19	36	14	40
Average family size (No.)		6.52	5.41	5.53	6.81	6.18	6.00	6.56	6.27	6.30	6.20
Literacy of head of household (%)		84.04	81.33	82.20	85.94	82.15	65.67	72.05	83.14	74.11	80.27
Average size of operational holding (ha.)		0.82	0.58	0.57	1.97	0.47	1.67	1.09	1.11	1.03	1.05
Total no. of adult livestock per household		1.70	1.85	1.25	2.08	1.57	2.10	2.12	2.10	1.90	2.15
Total no. of milch bovine per household		0.89	0.93	0.78	1.05	0.86	1.10	1.15	1.10	1.0	1.15
Average daily milk production per household (lts)		5.13	6.19	6.40	5.10	7.15	6.45	6.00	5.80	6.35	7.05
Purpose of rearing other livestock (Goat/ Sheep/ Yak)	Milk	10	-	-	5	17	-	-	-	-	-
	Meat	10	-	-	14	5	-	-	-	-	-
	Wool	-	-	-	9	18	-	-	-	-	-
	Draught	-	-	-	-	-	4	-	-	-	
Percent share of different crops	Cereals	96.30	92.50	93.20	92.18	54.17	61.17	57.45	59.24	63.25	56.27
	Fodders	0.40	1.15	1.45	3.67	0.69	0.83	0.42	0.59	0.38	0.73
	Cash crops	-	-	-	-	45.14	38.0	42.13	40.17	36.37	43.00
	Pulses	1.60	2.87	2.65	1.75	-	-	-	-	-	-
	Oil seeds	1.70	3.48	2.70	2.40	-	-	-	-	-	-
	Cropping Intensity (%)	184.15	189.10	191.71	186.50	127.30	128.72	121.17	126.11	129.85	127.50

Table 2.9: Contd.

Particulars			Name of the Districts						
			Shimla				Kinnaur		
			Tikkari	Koti	Sajar	Ferkoti	Sangla	Voning-Shering	Kamroo
Total no. of households			63	113	18	56	100	38	45
Average family size (No.)			5.08	4.67	5.37	4.55	5.76	5.81	6.50
Literacy of head of household (%)			61.50	64.13	70.05	63.45	80.20	78.15	78.67
Average size of operational holding (ha.)			1.23	0.95	1.87	1.14	1.07	0.86	1.02
Total no. of adult livestock per household			2.0	1.90	2.30	2.15	3.10	3.0	3.10
Total no. of milch bovine per household			0.85	0.76	1.0	0.95	1.20	1.17	1.22
Average daily milk production per household			6.0	5.70	5.84	6.25	4.45	3.10	3.27
Purpose of rearing other livestock (Goat/ Sheep/Yak)		Milk	20	-	-	14	426	117	26
		Meat	20	40	-	39	1775	675	796
		Wool	-	40	-	25	1361	562	574
		Draught	-	21	-	-	20	9	14
Percent share of different crops	Cereals		14.47	17.23	17.15	13.67	46.94	44.11	47.09
	Fodders		-	-	-	-	-	-	-
	Cash crops		83.06	81.09	79.25	86.09	44.63	41.63	45.17
	Pulses		2.47	1.68	3.60	0.24	8.43	14.26	7.74
	Oil seeds		-	-	-	-	-	-	-
	Cropping Intensity (%)		113.57	109.05	106.10	110.15	93.45	94.10	91.00

Chapter-3

METHODOLOGY

3.1 Sampling Plan

A district representing characteristics of zone was selected purposively from each NARP zone i.e. district Hamirpur from low hill sub- tropical zone, district Solan from Mid hill sub-humid zone, district Shimla from High hill temperate wet zone and district Kinnaur from high hill temperate dry zone. In each district a typical representative village cluster was selected purposively for the detailed investigation for the project. The sample village clusters were surveyed and information obtained on village schedule. In the low hill zone Bhota block of Hamirpur, in the mid hill zone Solan block of Solan district, in high hill wet zone Tikker block of Shimla district, and in high hill dry zone, Sangla block of Kinnaur district were selected for the study. In each block 150 households were surveyed.

All the households of the sample village clusters were classified into six categories, i.e. landless, marginal farmer (holding below one hectare), small farmer (holding 1-2 ha.), semi-medium farmer (2-4 ha.), medium farmer (4-10 ha.), and large farms (holding size above 10 hectares). The names of villages and the number of households surveyed are given in Table 3.1.

3.2 Tabulation and Analysis

In order to examine the socio-economic structure and livestock crop production analysis, simple tabular analysis consisting of averages, percentages etc. was extensively used. In order to study the cost and returns of various crops, Cost A_1 was used.

Cost A_1 = Value of hired-in labour + Value of Bullock labour (owned + hired in) + Value of seeds (home grown + purchased) + Value of FYM (owned + purchased) + Value of chemical fertilizers + Value of plant protection chemicals + Irrigation charges + Tractor / machinery charges (owned + hired in) + Depreciation charges + Interest on working capital + Miscellaneous charges

To study the cost and returns of various livestock products, following method is used,

Cost = Depreciation charges + Interest on working capital + Value of green fodder + Value of dry fodder + Value of concentrate + Value of human labour (Owned + hired in) + Miscellaneous charges – Value of dung

To obtain input-output relationship for various crops log-linear form of production function was used in the form of following equation:

$$\log y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5$$

where,

y = Gross value of output respective crop (in Rs)

X_1 = Value of Seed / Seedling (in case of respective crop)

X_2 = Value of manures/ fertilizers (in case of respective crop)

X_3 = Value of Labour (in case of respective crop)

X_4= Value of Plant protection chemicals (in case of respective crop)

X_5 = Miscellaneous expenses (in case of respective crop)

b_1 to b_5 = represents the elasticity coefficients of respective factor inputs.

To obtain input-output relationship for various livestock log-linear form of production function was used in the form of following equation:

$$\log y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5$$

y = Gross value of output w.r.t. Milk, meat, wool (in Rs)

X_1 = Value of Green Fodder

X_2 = Value of Dry Fodder

X_3 = Value of Concentrate

X_4= Value of Labour

X_5 = Miscellaneous expenses

b_1 to b_5 = represents the elasticity coefficients of respective factor inputs.

Further in order to study the various livestock-crop production systems (LCPS), various combinations of LCPS were identified from each zone and analysis was done accordingly for the two major LCPS in each zone.

Table 3.1: List of Selected districts and villages in different Zones of Himachal Pradesh

Sr. No.	Zone	District	Block	Villages	Total number of households	Households surveyed
1	Low hills zone	Hamirpur	Bhota	1. Nihalwin	61	57
				2. Morsu Patti	20	14
				3. Morsu Galian	20	15
				4. Sidhpur	73	64
				Total	*174*	*150*
2	Mid hills zone	Solan	Solan	1. Anji	111	71
				2. Shamlech	35	21
				3. Ghatti	19	11
				4. Kothi	36	19
				5. Sanjara	14	8
				6. Berti	40	20
				Total	*255*	*150*
3	High hills wet zone	Shimla	Tikkar	1 .Tikkari	63	41
				2 .Koti	113	65
				3. Sajar	18	10
				4. Ferkoti	56	34
				Total	*250*	*150*
4	High hills dry zone	Kinnaur	Sangla	1.Shangla	100	78
				2.Voning- Shering	38	35
				3. Kamroo	45	37
				Total	*183*	*150*
				Grand total	***862***	***600***

3.3 Reference period

The reference period for the study is agricultural year 2001-02.

Chapter-4

RESOURCE STRUCTURE AND SOCIO-ECONOMIC PROFILE OF SAMPLED FARMERS

Demographic, economic and social characteristics of the sampled households form the subject matter of this chapter. The LCPS wise analysis of these characteristics is also done and presented here.

4.1 Demographic profile

It may be seen from Table 4.1 that the average family size of sampled households in district Kinnaur of high-hill temperate dry zone is 7.07 persons with the sex ratio of 994, being highest in the selected districts followed by district Hamirpur of low- hill sub- tropical zone, where the average family size is 6.39 persons and sex ratio is 967. In district Solan of mid- hill sub humid zone, the average family size is 6.2 persons and the sex ratio is 986. In district Shimla of high- hill temperate wet zone, the average family size is 5.65 persons and the sex ratio is 868. Percentage of earning members to the total family members is relatively higher in Shimla district (57.43), percent followed by Kinnaur (51.84), Solan (51.83) and Hamirpur (35.28 percent).

4.2 Educational status

Education plays a positive role in development of economy of any region. Educated people are generally innovative and receptive to new technologies. Literacy status of the head of household is given in Table 4.2. The Table reveals that Hamirpur has highest literacy rate (88.67) followed by Solan (82.0), Shimla (81.33) and Kinnaur (80.0) percent. But the results could not be generalized for the development or backwardness of the area, as head of the household is older and older generation is by and large illiterate in these rural areas. The younger age group heads of households are generally literate across all the sizes of farms.

4.3 Occupational distribution

Occupational distribution of households reveals that, crop farming is the main occupation of sampled households in all the four zones, followed by dairying in Solan and Shimla, in district

Kinnaur, though almost every household retains livestock, but the main occupation is crop farming (Table 4.3).

4.4 Operational holdings

Average size of operational holding is 1.09, 1.89, 1.75 and 1.25 hectares in district Hamirpur, Solan, Shimla and Kinnaur respectively. Operational holdings of sampled farmers in Hamirpur and Shimla districts are un- irrigated. In Kinnaur and Solan district cultivation of crops are carried out in irrigated land.

Table 4.1: Family Size, Sex Ratio and Earning Members on sampled farm households in Different Agro-Climatic Zones

Zones	Districts	Average family size (No. of persons)					Sex ratio (Females Per '000' Males)	Earning members (%)
		Adult		Children		Total		
		Male	Female	Male	Female			
Sub-mountain & low hill sub-tropical zone	Hamirpur	1.97	1.95	1.27	1.19	6.39	967	35.28
Mid-hill sub humid zone	Solan	2	1.97	1.15	1.08	6.2	986	51.83
High-hill temperate wet zone	Shimla	1.98	1.95	0.86	0.86	5.65	868	57.43
High-hill temperate dry zone	Kinnaur	2.37	2.36	1.18	1.27	7.07	994	51.84
Overall		2.08	2.03	1.11	1.10	6.33	981	48.91

Table 4.2: Distribution of Head of Household According to Literacy Status in Different Agro- Climatic Zones *(percent of total household)*

Zones	Districts	Educational Status						
		Illiterate	Primary	Middle	High School	Inter-mediate	Graduate & above	Total No. of HH
Sub-mountain & low hill sub-tropical zone	Hamirpur	11.33	28.67	20.0	26.67	7.33	6.0	150
Mid-hill sub humid zone	Solan	18	22	46.7	3.3	0.7	9.3	150
High-hill temperate wet zone	Shimla	18.67	50.67	13.33	11.33	1.33	4.67	150
High-hill temperate dry zone	Kinnaur	20.0	24.67	22.67	20.0	3.33	9.33	150
Overall		17.0	31.5	25.67	15.33	3.17	7.33	600

Table 4.3: Occupational Distribution of Households in Different Agro- Climatic Zones

(% of total HH)

Districts	Occupation	Crop Farming	Dairying	Farm Labour	Service	Business	Rural Artisan	Others	Total NO. of HH
Hamirpur	Main	52.0	0.67	3.33	35.33	8.67	-	-	150
	Subsidiary	22.0	-	1.33	-	-	-	-	-
Solan	Main	47.3	-	18.7	22.7	-	-	11.3	150
	Subsidiary	-	72.81	-	-	15.3	-	-	-
Shimla	Main	64.67	-	14.67	16.67	4.0	-	-	150
	Subsidiary	16.55	30.93	-	-	-	-	-	-
Kinnaur	Main	89.0	-	1.33	7.0	2.0	0.67	-	150
	Subsidiary	8.0	-	31.7	-	-	-	-	-
Total	Main	68.24	0.17	9.51	17.0	2.10	0.18	2.8	600
	Subsidiary	8.50	42.86	7.92	-	3.82	-	-	-

Table 4.4: Average Size of Operational Holding in Different Agro-Climatic Zones

(ha/ farm.)

District	Owned		Operational		Total		
	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Total
Hamirpur	-	1.09	-	1.09	-	1.09	1.09
Solan	0.51	1.38	0.50	1.38	0.51	1.38	1.89
Shimla	-	1.75	-	1.75	-	1.75	1.75
Kinnaur	1.09	0.16	1.09	0.16	1.09	0.16	1.25
Total	0.80	1.09	0.80	1.09	0.80	1.09	1.49

4.5 Cropping pattern and Productivity

Maize and Wheat are the major crops of Hamirpur, though in Solan also wheat and maize are the major cereal crops but cash crops like, tomato, peas and capsicum are also grown extensively by the farmers. In Shimla, maize and barley are the major cereals, but more area is under the Apple plantations and Potato crop. In Kinnaur, again Apple is the major fruit crop, but more extensive form of agriculture is done by the people and several crops were grown, ranging from cash crops like peas and potato to cereals like maize, wheat, barley, ogla, fafra and pulses like Rajmash and Kidney beans. Cropping intensity in these districts is 191.65, 128.36, 107.02 and 91.70 percent respectively (Table 4.5). The yield of maize is higher in Shimla while farmers harvested higher yield of wheat in Hamirpur district. The yields of major cereals are lesser in Kinnaur as compared to other districts under study.

Table 4.5: Cropping Pattern and Cropping Intensity in Different Agro-Climatic Zones

(area in hectares)

Particulars	Hamirpur	Solan	Shimla	Kinnaur	Himachal Pradesh
Kharif					
Maize	150.49	41.62	17.54	6.20	215.85
Pea	-	-	-	3.91	3.91
Chari	0.16	0.81	-	-	0.97
Paddy	3.08	-	-	-	3.08
Tomato	-	39.19	-	-	39.19
Capsicum	-	3.24	-	-	3.24
Potato	-	-	65.94	12.94	78.88
Apple	-	-	118.77	63.73	182.50
Ogla	-	-	-	31.45	31.45
Fafra	-	-	-	30.46	30.46
Rajmash	-	-	6.09	7.53	13.62
Kidney Bean	-	-	-	1.65	1.65
Oat	0.02	-	-	-	0.02
Arbi	0.61	-	-	-	0.61
Turmeric	0.02	-	-	-	0.02
Rabi					
Wheat	148.36	25.62	2.99	5.19	182.16
Barley	2.61	3.36	20.11	6.10	32.18
Barseem	3.36	-	-	-	3.36
Pea	-	13.58	-	-	13.58
Gross Cropped Area (GCA)	308.71	127.42	231.44	169.16	836.73
Net Cropped Area (NCA)	161.08	99.27	216.26	184.46	761.07
Cropping Intensity (%)	191.65	128.36	107.02	91.70	109.94

Table 4.6: Productivity of Major Crops in Different Agro-Climate Zones

(*Yield in q/ha.*)

Particulars	Hamirpur	Solan	Shimla	Kinnaur	Himachal Pradesh
Kharif					
Maize	19.90	22.74	24.04	13.19	19.97
Pea	-	-	-	54.35	54.35
Chari	148.26	100.07	-	-	124.16
Paddy	14.29	-	-	-	14.29
Tomato	-	231.58	-	-	231.58
Capsicum	-	63.59	-	-	63.59
Potato	-	-	111.81	57.03	84.42
Apple	-	-	41.08	105.63	73.35
Ogla	-	-	-	16.32	16.32
Fafra	-	-	-	17.41	17.41
Rajmash	-	-	3.91	10.15	7.03
Kidney Bean	-	-	-	16.67	16.67
Oat	44.48	-	-	-	44.48
Arbi	11.38	-	-	-	11.38
Turmeric	7.15	-	-	-	7.15
Rabi					
Wheat	14.48	11.20	7.70	10.85	11.06
Barley	12.35	10.19	11.26	8.67	10.62
Barseem	95.92	-	-	-	95.92
Pea	-	62.27	-	-	62.27

Livestock composition

Analysis of composition of bovine maintained in different agro-climatic zones reveals that Buffalo and Crossbred cattle are reared in Hamirpur. In Solan, the livestock herd includes Crossbred cattle as major bovine followed by Local cattle and Buffalo. In Shimla and Kinnaur Crossbred cattle are the major livestock followed by Local cattle. Besides, Goat, Sheep and Yak are also reared by people in Kinnaur. The details of different livestock are presented in Table 4.7 and 4.8.

Table 4.7: Average Size and Composition of Bovine Maintained in Different Agro-Climatic Zones

(Number / household)

District/Species		In Milk	Dry	Value of Milch animals	Heifers	Young Stock	Draught animals	Total (Adult)	Standard Animal units	Total Value
Hamirpur	Local cattle	-	-	-	-	-	-	-	-	-
	CB Cow	1.0	1.5	8292	1.0	1.0	2.0	15	44	317525
	Buffalo	1.35	1.0	14829	1.04	1.2	-	202	307	2301950
	Total	190	27	2071800	41	138	24	217	351	2619475
Solan	Local cattle	1.1	1.1	2775	1.0	1.0	1.9	37	88	152500
	CB Cow	1.4	1.3	14015	1.5	1.0	2.0	159	281	1875020
	Buffalo	1.06	1.1	13076	1.0	1.0	-	51	59	539870
	Total	192	55	1873570	19	100	112	247	428	2567390
Shimla	Local cattle	1.16	1.07	1911	1.25	1.20	1.47	72	85	91700
	CB Cow	1.33	1.17	8076	1.06	1.16	1.78	219	291	1195585
	Buffalo	-	-	-	-	-	-	-	-	-
	Total	172	42	948900	33	170	44	291	376	1287285
Kinnaur	Local cattle	1.0	1.0	1959	1.0	1.0	2.0	196	221	223400
	CB Cow	1.0	1.0	11796	1.0	1.0	2.0	288	328.5	1861300
	Buffalo	-	-	-	-	-	-	-	-	-
	Total	167	99	1161600	6	131	212	484	549.5	2084700
Himachal Pradesh	Local cattle	1.09	1.06	2215	1.08	1.07	1.79	305	394	467600
	CB Cow	1.18	1.24	10545	1.14	1.04	1.94	681	944.5	5249430
	Buffalo	1.20	1.05	13952	1.02	1.10	-	253	366	2841820
	Total	721	223	6055870	99	539	392	1239	1704.5	8558850

Table 4.8: Other Livestock Kept in Sampled Household in Different Agro-Climatic Zones

(Number / household)

Particulars			Hamirpur	Solan	Shimla	Kinnaur	Himachal Pradesh
Goat	Adult	No.	-	-	-	14.92 (194)	14.92 (194)
		Value	-	-	-	28730.77 (373500)	28730.77 (373500)
	Young	No.	-	-	-	4.92 (64)	4.92 (64)
		Value	-	-	-	7538.46 (98000)	7538.46 (98000)
Sheep	Adult	No.	-	-	-	15.69 (251)	15.69 (251)
		Value	-	-	-	29675.00 (474800)	29675.00 (474800)
	Young	No.	-	-	-	5.75 (92)	5.75 (92)
		Value	-	-	-	8343.75 (133500)	8343.75 (133500)
Yak	Adult	No.	-	-	-	1.00 (10)	1.00 (10)
		Value	-	-	-	7200.00 (72000)	7200.00 (72000)
	Young	No.	-	-	-	-	-
		Value	-	-	-	-	-

4.7 Fixed investment in Crop farming

Fixed investment in crop farming includes investment made by the household on irrigation structure, bullock drawn equipments, other equipments, hand tools etc. On an average, fixed investment in crop farming is Rs. 1033, 2133, 9362 and 9339 per household in low hill sub-tropical zone, mid-hill sub humid zone, high-hill temperate wet zone and high-hill temperate dry zone respectively.

4.8 Fixed investment in Bovine Enterprises & Other Livestock

Fixed investment in bovine enterprises includes investment made by household on milch animals, cattleshed, storage structure, chaffcutter shed, bullockcart, chaffcutter and other equipments etc. Fixed investment in bovine enterprises is Rs. 56232, 64824, 30926 and 47565 per household in low hill sub-tropical zone, mid-hill sub humid zone, high-hill temperate wet zone and high-hill temperate dry zone respectively. Fixed investment in other livestock enterprises in high-hill temperate dry zone is of the tune of Rs 60079 per household in Sheep, Rs 58505 per household in Goat and Rs 19200 per household in Yak rearing (Table 4.10 and 4.11).

Table 4.9: Fixed Investment in Crop Farming in Different Agro-Climatic Zones

(Rs./household)

Particulars		Hamirpur	Solan	Shimla	Kinnaur	Himachal Pradesh
Irrigation structure		-	-	-	-	-
Tractor		-	-	-	-	-
Power D. Equipments		-	-	-	-	-
Bullock drawn Equipments	Plough	-	-	-	-	-
	Desi	165.56	147.50	112.06	95.17	130.07
	Improved	243.18	248.97	220.95	200.68	228.44
	Planker	87.78	72.56	72.00	-	77.45
	Yoke	54.29	56.89	53.53	211.90	94.15
Other equipments	Manual sprayer	-	983.03	1520.53	1369.39	1290.98
	Power sprayer	-	-	6441.00	6490.48	6465.75
	Pruning scissor	-	-	355.90	374.96	365.43
Hand tools & Others	Spade	40.23	57.32	55.45	81.97	58.75
	Hand hoe/Kasala	50.69	96.33	158.70	-	101.91
	Sickles	140.32	137.00	140.22	221.70	159.81
	Khurpa	32.24	68.46	119.63	74.00	73.58
	Drat	80.16	109.84	-	-	95.00
	Axe	69.55	69.79	61.81	-	67.05
	Gainti	69.40	85.00	50.00	97.50	75.47
	Kilta	-	-	-	120.91	120.91
Total		**1033.40**	**2132.69**	**9361.78**	**9338.66**	**9404.75**

Table 4.10: Fixed Investment in Bovine Enterprise in Different Agro-Climatic Zones

(Rs/Household)

Particulars		Hamirpur	Solan	Shimla	Kinnaur	Himachal Pradesh
Milch animals						
Buffalo		14829.00	13076.00	-	-	13952.50
Local Cattle		-	2775.00	1911.00	1959.00	2215.00
Crossbred Cattle		8292.00	14015.00	8076.00	11796.00	10544.75
Cattle shed		11378.38	10808.00	9099.00	21696.00	13245.35
Storage for fodder/feed		8142.00	11523.00	10972.00	10978.00	10403.75
Chaff cutter shed		3620.00	8500.00	-	-	6060.00
Bullock Cart		163.85	-	-	-	163.85
Equipments	Buckets	162.30	209.20	141.03	223.03	183.89
	Water cans	199.20	201.76	202.14	348.33	237.86
	Milk cans	86.96	75.51	65.98	105.33	83.44
Chaff cutter	Manual	2240.28	552.00	-	-	1396.14
	Power Driven	6602.00	2580.00	-	-	4591.00
Any others	Ropes	96.49	128.40	111.20	165.80	125.47
	Tasala	83.33	69.09	-	86.19	79.54
	Sickles	140.32	121.90	140.22	-	134.15
	Basket	126.00	123.70	146.07	207.13	150.73
	Axe	69.55	65.00	61.81	-	65.45
Total		**56231.66**	**64823.56**	**30926.45**	**47564.81**	**63632.87**

Table 4.11: Fixed Investment in other Livestock Enterprises in Different Agro-Climatic Zones

(Rs./household)

Particulars		Hamirpur	Solan	Shimla	Kinnaur
Sheep	Animal	-	-	-	40079
	Sheds	-	-	-	20000
	Others items	-	-	-	-
		-	-	-	-
	Total	-	-	-	60079
Goat	Animal	-	-	-	38505
	Sheds	-	-	-	20000
	Others items	-	-	-	-
		-	-	-	-
	Total	-	-	-	58505
Yak	Animal	-	-	-	7200
	Sheds	-	-	-	12000
	Others items	-	-	-	-
		-	-	-	-
	Total	-	-	-	19200

4.9 Livestock- Crop productions System

One of the major objectives of the present study is to identify the various livestock- crop production systems in the different agro-climatic zones of Himachal Pradesh. Table 4.12 reveals the various combinations of livestock-crop production systems followed in different agro-climatic zones by the sampled households. There are 4 sub-systems in low-hill sub tropical zone, 12 sub-systems in mid- hill sub humid zone, 7 sub-systems in high-hill temperate wet zone and 12 sub-systems were identified including bovines and 4 sub-systems were identified excluding bovines in high-hill temperate dry zone.

Table 4.12: Major Livestock–Crop Production Systems Identified in Different Agro-Climatic Zones of Himachal Pradesh

NARP Zones	Production Systems Identified
Sub-mountain & low hill sub-tropical zone HAMIRPUR	➢ Landless + Buffalo (1)
	➢ Buffalo (137) + Maize (135) + Wheat (135) + Barseem (76) + Paddy (8) + Barley (10) + Chari (2) + Oat (2) + Arbi (4) + Turmeric (1)
	➢ Crossbred cow (8) + Maize (8) + Wheat (8) + Barseem (4) + Paddy (1)
	➢ Crossbred cow + Buffalo (4) + Maize (4) + Wheat (4) + Barseem (1) + Paddy (1)
Mid-hill sub humid zone SOLAN	➢ Local cow (22) + Wheat (12) + Maize (15) + Barley (2) + Tomato (12) + Pea (5) + Capsicum (1)
	➢ Crossbred Cow (75) + Wheat (28) + Maize (42) + Barley (5) + Tomato (42) + Pea (34) + Capsicum (6) + Chari (1)
	➢ Buffalo (11) + Wheat (3) + Maize (5) + Barley (1) + Tomato (5) + Pea (3) + Capsicum (1)
	➢ Local Cow + CB Cow (10) + Wheat (7) + Maize (8) + Barley (2) + Tomato (7) + Pea (6)
	➢ Local Cow + Buffalo (4) + Wheat (1) + Maize (1) + Tomato (4) + Pea (1)
	➢ Local Cow +CB Cow + Buffalo (5) + Wheat (3) + Maize (5) + Barley (1) + Tomato (5) + Pea (4) + Capsicum (1)
	➢ CB Cow + Buffalo (22) + Wheat (10) + Maize (21) + Barley (6) + Tomato (20) + Pea (18) + capsicum (8) + Chari (2)
	➢ Without livestock (1) + Wheat (1) + Maize (1) + Tomato (1)
	➢ Landless + Local Cow (4)
	➢ Landless + CB Cow (30)
	➢ Landless + Local Cow + CB Cow (1)
	➢ Landless + CB Cow + Buffalo (1)
High-hill temperate wet zone SHIMLA	➢ Landless + Local cow (1)
	➢ Landless + Crossbred cow (5)
	➢ Landless + Local Cow + CB Cow (4)
	➢ Landless + No Livestock (1)
	➢ Local cow (27) + Maize (25) + Wheat (3) + Barley (17) + Potato (25) + Rajmash (8) + Apple (24)
	➢ Crossbred cow (91) + Maize (73) + Wheat (9) + Barley (69) + Potato (89) + Rajmash (41) + Apple (85)
	➢ Local cow + Crossbred cow (21) + Maize (17) + Wheat (1) + Barley (14) + Potato (20) + Rajmash (11) + Apple (21)

High-hill temperate dry zone KINNAUR	➢ Landless + CB Cow (3)
	➢ Local cow (30) + Ogla (29) + Potato (21) + Pea (3) + Rajmash (10) + Apple (30) + Fafra (29) + Maize (3) + Wheat (3) + Barley (2) + Kidney bean (2)
	➢ Crossbred cow (71) + Ogla (70) + Potato (53) + Pea (10) + Rajmash (25) + Apple (71) + Fafra (69) + Maize (28) + Wheat (11) + Barley (15) + Kidney bean (6)
	➢ Local cow + Crossbred cow (30) + Ogla (28) + Potato (19) + Pea (4) + Rajmash (11) + Apple (30) + Fafra (28) + Maize (9) + Wheat (3) + Barley (2) + Kidney bean (1)
	➢ Crossbred cow + Sheep + Goat + Yak (5) + Ogla (5) + Potato (4) + Pea (4) + Rajmash (2) + Apple (5) + Fafra (5) + Maize (4) + Wheat (4) + Barley (4)
	➢ Local cow + Crossbred cow + Sheep + Goat (1) + Ogla (1) + Potato (1) + Rajmash (1) + Apple (1) + Fafra (1)
	➢ Crossbred cow + Sheep (1) + Ogla (1) + Potato (1) + Pea (1) + Apple (1) + Fafra (1) + Maize (1) + Wheat (1) + Barley (1)
	➢ Local cow + Crossbred cow + Sheep + Yak (1) + Ogla (1) + Rajmash (1) + Apple (1) + Fafra (1) + Barley (1)
	➢ Local cow + Crossbred cow + Sheep + Goat + Yak (2) + Ogla (2) + Potato (2) + Pea (2) + Rajmash (1) + Apple (2) + Fafra (2) + Maize (1) + Wheat (1) + Barley (2)
	➢ Crossbred cow + Sheep + Goat (2) + Ogla (2) + Potato (1) + Rajmash (1) + Apple (2) + Fafra (2) + Maize (1) + Wheat (1) + Barley (1)
	➢ Local cow + Sheep + Goat + Yak (1) + Ogla (1) + Rajmash (1) + Apple (1) + Fafra (1) + Barley (1)
	➢ Crossbred cow + Sheep + Yak (1) + Ogla (1) + Potato (1) + Pea (1) + Apple (1) + Fafra (1) + Maize (1) + Wheat (1) + Barley (1)
	EXCLUDING BOVINES
	➢ Sheep + Goat + Yak (8) + Ogla (8) + Potato (6) + Pea (3) + Rajmash (3) + Apple (8) + Fafra (8) + Maize (6) + Wheat (5) + Barley (7)
	➢ Sheep + Goat + (5) + Ogla (4) + Potato (3) + Rajmash (2) + Apple (5) + Fafra (5) + Maize (2) + Wheat (1) + Barley (1)
	➢ Sheep + Yak (2) + Ogla (2) + Potato (1) + Pea (1) + Rajmash (1) + Apple (2) + Fafra (2) + Maize (1) + Wheat (1) + Barley (2)
	➢ Sheep (1) + Ogla (1) + Potato (1) + Pea (1) + Apple (1) + Fafra (1) + Maize (1) + Wheat (1) + Barley (1)

Socio-economic analysis of two major LCPS from each agro-climatic zone was done and the results are discussed as under.

4.10 Family composition

Household profile of two major LCP systems of each zone is discussed in Table 4.13. In low hill sub-tropical zone, LCPS 1 has better situation than the average for the whole sample, but, in case of LCPS 2, not only the average family size is higher, sex ratio is also very low. Similar is the situation for earning members in the family.

In Solan district of mid- hill sub humid zone, the average family size in LCPS 1 and LCPS 2 is 6.16 and 6.77 persons and sex-ratio is 933 and 1069 respectively. Percentage of earning members to total family members is 49 and 54 percent respectively. On comparing the results with whole sample, LCPS 2 is in better situation. In district Shimla of high- hill temperate wet zone, average family size is 5.50 and 7.12 with the sex ratio of 956 and 1060 in LCPS 1 and LCPS 2 respectively. Percentage of earning members to total family members is 58 and 54 percent respectively. In district Kinnaur of high- hill temperate dry zone, average family size is 6.41 and 7.93 with the sex ratio of 1061 and 1052 in LCPS 1 and LCPS 2 respectively. Percentage of earning members to total family members is 52 and 51 percent respectively.

Table 4.13: Family Size, Sex Ratio and Earning Members in LCPS in Different Agro-Climatic Zones

Zones	Districts	Average family size (No.)					Sex ratio (Females Per '000' Males)	Earning members (%)
		Adult		Children		Total		
		Male	Female	Male	Female			
Sub-mountain & low hill sub-tropical zone **Hamirpur**	LCP 1	1.84	1.83	1.43	1.40	6.00	995	32.23
	LCP 2	3.75	3.50	2.50	3.00	12.0	920	25.00
Mid-hill sub humid zone **Solan**	LCP 1	1.96	1.99	1.48	1.48	6.16	933	48.92
	LCP 2	2.09	2.27	1.53	2.08	6.77	1069	53.69
High-hill temperate wet zone **Shimla**	LCP 1	2.03	1.93	1.33	1.38	5.50	956	57.95
	LCP 2	2.43	2.38	1.69	1.94	7.12	1060	53.80
High-hill temperate dry zone **Kinnaur**	LCP 1	2.15	2.16	1.52	2.00	6.41	1061	51.83
	LCP 2	2.50	2.40	1.78	2.38	7.93	1052	51.26

Hamirpur

LCP 1- Buffalo (137) + Maize (135) + Wheat (135) + Barseem (76) + Paddy (8) + Barley (10) + Chari (2) + Oat (2) + Arbi (4) + Turmeric (1)

LCP 2- Crossbred cow + Buffalo (4) + Maize (4) + Wheat (4) + Barseem (1) + Paddy (1)

Solan

LCP 1- Crossbred Cow (75) + Wheat (28) + Maize (42) + Barley (5) + Tomato (42) + Pea (34) + Capsicum (6) + Chari (1)

LCP 2- CB Cow + Buffalo (22) + Wheat (10) + Maize (21) + Barley (6) + Tomato (20) + Pea (18) + capsicum (8) + Chari (2)

Shimla

LCP 1- Crossbred cow (91) + Maize (73) + Wheat (9) + Barley (69) + Potato (89) + Rajmash (41) + Apple (85)

LCP 2- Local cow + Crossbred cow (21) + Maize (17) + Wheat (1) + Barley (14) + Potato (20) + Rajmash (11) + Apple (21)

Kinnaur

LCP 1- Crossbred cow (71) + Ogla (70) + Potato (53) + Pea (10) + Rajmash (25) + Apple (71) + Fafra (69) + Maize (28) + Wheat (11) + Barley (15) + Kidney bean (6)

LCP 2- Local cow + Crossbred cow (30) + Ogla (28) + Potato (19) + Pea (4) + Rajmash (11) + Apple (30) + Fafra (28) + Maize (9) + Wheat (3) + Barley (2) + Kidney bean (1)

4.11 Educational status

Educational status of sampled households is given in Table 4.14. In district Hamirpur of low hill sub-tropical zone, literacy rate of the head of the household among LCPS 1 is 88.43 and in LCPS 2 is 75 per cent, being lower than the average of whole sample. In Solan district of mid-hill sub humid zone, the literacy rate in LCPS 1 and LCPS 2 is 82.67 and 86.36 per cent respectively, which is higher than the average. In district Shimla of high- hill temperate wet zone, the literacy rate in LCPS 1 and LCPS 2 is 82.28 and 91.67 per cent respectively, which is again higher than the average. In district Kinnaur of high- hill temperate dry zone, the literacy rate in LCPS 1 and LCPS 2 is 79.73 and 80 per cent respectively, which is almost similar to the average literacy rate for the zone.

4.12 Occupational distribution

Occupational distribution of sample households in two major sub-systems in different agro-climatic zones is presented in Table 4.15.

In district Hamirpur of low hill sub-tropical zone, crop farming, followed by service is the main occupation of sampled farmers in both sub-systems. Whereas dairy farming is the major

subsidiary occupation. In Solan district of mid- hill sub humid zone, among LCPS 1, crop farming, followed by service and farm labour is the main occupation while dairy farming is the major subsidiary occupation. Similar situation is observed among households comprise the sub-system LCPS 2. But, in LCPS 2 percentage of farmers engaged in dairy farming are relatively more.

Table 4.14: Distribution of Head of Household According to Literacy Status in Different Agro-Climatic Zones *(% of total HH)*

Zones	LCP System	Educational Status						
		Illiterate	Primary	Middle	High School	Inter-mediate	Graduate & above	Total HH
low hill sub-tropical zone **Hamirpur**	LCP 1	11.57	32.23	18.18	26.46	5.78	5.78	137
	LCP 2	25.00	50.00	-	25.00	-	-	4
Mid-hill sub humid zone **Solan**	LCP 1	17.33	20.0	28.0	22.67	2.67	9.33	75
	LCP 2	13.64	18.18	22.73	36.36	-	9.09	22
High-hill temperate wet zone **Shimla**	LCP 1	17.72	46.87	18.75	12.50	1.04	3.12	91
	LCP 2	8.33	66.67	12.50	4.17	-	8.33	21
High-hill temperate dry zone **Kinnaur**	LCP 1	20.27	24.33	18.92	20.27	4.05	12.16	71
	LCP 2	20.00	33.33	16.67	20.00	6.67	3.33	30

Table 4.15: Occupational Distribution of Households in Different Agro-Climatic Zones

(% of total HH)

Districts	Occupation	LCP System	Crop Farming	Dairying	Farm Labour	Service	Business	Rural Artisan	Others	Total HH
Hamirpur	Main	LCP 1	48.76	-	4.13	38.85	8.26	-	-	137
		LCP 2	75.00	-	-	25.00	-	-	-	4
	Subsidiary	LCP 1	-	22.63	-	-	-	-	-	-
		LCP 2	-	25.00	-	-	-	-	-	-
Solan	Main	LCP 1	36.0	-	20.0	24.0	-	-	20.0	75
		LCP 2	77.27	-	9.09	13.64	-	-	-	22
	Subsidiary	LCP 1	-	68.0	-	-	-	-	-	-
		LCP 2	-	73.50	-	-	-	-	-	-
Shimla	Main	LCP 1	71.88	-	8.33	15.62	4.17	-	-	91
		LCP 2	66.67	-	20.83	8.33	4.17	-	-	21
	Subsidiary	LCP 1	13.54	23.96	-	-	-	-	-	-
		LCP 2	9.52	18.36	-	-	-	-	-	-
Kinnaur	Main	LCP 1	55.41	-	1.35	41.89	-	1.35	-	71
		LCP 2	50.00	-	-	50.00	-	-	-	30
	Subsidiary	LCP 1	9.41	-	22.97	-	-	-	-	-
		LCP 2	6.15	-	18.23	-	-	-	-	-

In district Shimla of high- hill temperate wet zone, crop farming is the main occupation followed by service and farm labour in LCPS 1. While in LCPS 2, crop farming is the main occupation followed by farm labour and service. Dairy farming is the major subsidiary occupation in both sub- systems.

In district Kinnaur of high- hill temperate dry zone, again crop farming followed by service is the main occupation of sampled farmers in both the sub-systems. Whereas, crop farming followed by farm labour is the major subsidiary occupation of sampled farmers in both the sub-systems. Dairy faming is not an economic enterprise of farmers here because they generally kept the bovine to fulfil their household needs and not from the business point of view.

4.13 Operational holdings

Average size of operational holding in district Hamirpur of low hill sub-tropical zone, under LCPS 1 is 1.11 hectares and under LCPS 2 is 1.42 hectares, which is higher than the average for the sampled farmers for whole zone (Table 4.16). In Solan district of mid- hill sub humid zone, average size of operational holding under LCPS 1 is 1.81 hectares and under LCPS 2 is 2.11 hectares. Holding size is higher under LCPS 2 than the average for the sampled farmers for whole zone but less in case of LCPS 1. In district Shimla of high- hill temperate wet zone, average size of operational holding under LCPS 1 is 1.79 hectares and under LCPS 2 is 1.86 hectares, which is higher than the average for the sampled farmers for whole zone. In district Kinnaur of high- hill temperate dry zone, average size of operational holding under LCPS 1 is1.21 hectares and under LCPS 2 is 1.32 hectares. Holding size is higher under LCPS 2 than the average for the sampled farmers for whole zone but less in case of LCPS 1.

4.14 Cropping pattern and Productivity

The cropping pattern, cropping intensity and productivity of crops on sampled farms of LCPS are summarized in Tables 4.17 and 4.18. Maize followed by Wheat is the major crop of LCPS 1 while wheat followed by maize is the major crop of LCPS 2 in district Hamirpur. Agricultural diversification is high in case of LCPS 1 which is also revealed by its cropping intensity of 190.64 percent as compared to 185.05 percent in LCPS 2. Paddy, oat, barley, barseem etc are the other major crops of sub-system LCPS 1. The yield of crops is relatively higher in case of LCPS 2 as compared to LCPS 1.

In Solan also wheat and maize are the major cereal crops but cash crops like, tomato, peas and capsicum are also grown extensively by the farmers in both sub- systems LCPS 1 and LCPS 2. Chari is the major fodder crop of these sub- systems. Cropping intensity is 123.59 and 127.02 in LCPS 1 and LCPS 2 respectively. The productivity of crops is comparatively higher in case of LCPS 1 than that of LCPS 2.

In Shimla, maize and barley are the major cereals, but more area is under the Apple plantations and Potato crop in both sub- systems LCPS 1 and LCPS 2. Cropping intensity is 115.64 and 91.62 in LCPS 1 and LCPS 2 respectively. The yield of maize is more in LCPS 1 than that of LCPS 2. However, productivity of wheat is relatively higher in case of LCPS 2 than that of LCPS 1.

In Kinnaur, again Apple is the major fruit crop, but more extensive form of agriculture is done by the farmers and several crops were grown, ranging from cash crops like peas and potato to cereals like maize, wheat, barley, ogla, fafra and pulses like Rajmash and Kidney beans in both sub- systems LCPS 1 and LCPS 2. Cropping intensity is 93.96 and 116.09 in LCPS 1 and LCPS 2 respectively. Generally, yields of crops are more in case of LCPS 2 than that of LCPS 1.

Table 4.16: Average Size of Operational Holding under different LCPS in Different Agro-Climatic Zones

(In ha.)

District	LCP System	Owned		Operational		Total		
		Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Total
Hamirpur	LCP 1	-	1.11	-	1.11	-	1.11	1.11
	LCP 2	-	1.67	-	1.42	-	1.42	1.42
Solan	LCP 1	0.48	1.33	0.48	1.33	0.48	1.33	1.81
	LCP 2	0.60	1.51	0.60	1.51	0.60	1.51	2.11
Shimla	LCP 1	-	1.79	-	1.79	-	1.79	1.79
	LCP 2	-	1.86	-	1.86	-	1.86	1.86
Kinnaur	LCP 1	1.06	0.15	1.06	0.15	1.06	0.15	1.21
	LCP 2	1.14	0.18	1.14	0.18	1.14	0.18	1.32

Table 4.17: Cropping Pattern and Cropping Intensity under different LCPS in different Agro-Climatic Zones

(area in hectares)

Particulars (ha)	Hamirpur		Solan		Shimla		Kinnaur	
Kharif	**LCP 1**	**LCP 2**	**LCP 1**	**LCP 2**	**LCP 1**	**LCP 2**	**LCP 1**	**LCP 2**
Maize	141.19	5.31	17.58	10.20	14.51	2.75	3.54	1.51
Pea	-	-	-	-	-	-	2.11	0.83
Chari	0.16	-	0.32	0.40	-	-	-	-
Paddy	2.20	0.05	-	-	-	-	-	-
Tomato	-	-	20.07	10.38	-	-	-	-
Capsicum	-	-	1.13	1.46	-	-	-	-
Potato	-	-	-	-	44.82	13.96	6.87	2.62
Apple	-	-	-	-	87.95	22.36	27.16	15.12
Ogla	-	-	-	-	-	-	14.90	7.24
Fafra	-	-	-	-	-	-	14.54	6.64
Rajmash	-	-	-	-	4.43	1.38	4.60	1.50
Kidney Bean	-	-	-	-	-	-	1.20	0.15
Oat	0.02	-	-	-	-	-	-	-
Arbi	0.61	-	-	-	-	-	-	-
Turmeric	0.02	-	-	-	-	-	-	-
Rabi								
Wheat	136.61	6.63	14.57	4.77	2.35	0.12	2.56	0.60
Barley	2.61	-	1.05	0.97	14.75	2.63	3.69	0.22
Barseem	3.09	0.02	-	-	-	-	-	-
Pea	-	-	6.62	3.88	-	-	-	-
Gross Cropped Area (GCA)	286.51	12.01	61.34	32.06	168.81	43.20	81.17	36.43
Net Cropped Area (NCA)	150.29	6.49	49.63	25.24	145.98	47.15	86.39	31.38
Cropping Intensity (%)	190.64	185.05	123.59	127.02	115.64	91.62	93.96	116.09

Table 4.18: Productivity of Major Crops under different LCPS in Different Agro-Climate Zones

(Yield in q/ha.)

Particulars (ha)	Hamirpur		Solan		Shimla		Kinnaur	
Kharif	**LCP 1**	**LCP 2**	**LCP 1**	**LCP 2**	**LCP 1**	**LCP 2**	**LCP 1**	**LCP 2**
Maize	19.91	22.22	23.41	21.75	24.55	23.80	2.17	2.55
Pea	-	-	-	-	-	-	9.27	11.01
Chari	150.00	-	112.50	98.20	-	-	-	-
Paddy	20.91	20.00	-	-	-	-	-	-
Tomato	-	-	230.53	232.40	-	-	-	-
Capsicum	-	-	27.43	35.50	-	-	-	-
Potato	-	-	-	-	110.00	112.15	10.15	12.19
Apple	-	-	-	-	45.75	40.20	22.39	16.03
Ogla	-	-	-	-	-	-	2.91	2.71
Fafra	-	-	-	-	-	-	3.07	3.22
Rajmash	-	-	-	-	2.90	4.15	1.48	1.82
Kidney Bean	-	-	-	-	-	-	2.09	4.94
Oat	44.48	-	-	-	-	-	-	-
Arbi	11.38	-	-	-	-	-	-	-
Turmeric	7.15	-	-	-	-	-	-	-
Rabi								
Wheat	14.89	11.16	8.44	12.00	6.35	7.80	1.60	2.01
Barley	12.35	-	8.73	8.65	11.10	11.45	1.57	3.31
Barseem	92.60	98.50	-	-	-	-	-	-
Pea	-	-	67.98	61.56	-	-	-	-

4.15 Livestock composition

Analysis of composition of bovine maintained among different livestock- crop production systems in different agro-climatic zones reveals that Buffalo is the main bovine followed by Crossbred cattle in LCPS 2 and only buffalo is kept by the farmers among LCPS 2 in district Hamirpur (see Table 4.19).

In district Solan, the Crossbred cattle is the major bovine kept by farmers in LCPS 1, while crossbred cow and buffalo are the bovines kept by farmers in LCPS 2. In district Shimla

and Kinnaur Crossbred cattle are the major livestock reared in LCPS 1 while the livestock cartel includes both Local and crossbred cattle in LCPS 2.

Table 4.19: Average Size and Composition of Bovine maintained under different LCPS in different Agro-Climatic Zones

(Number / household)

District		Species	In Milk	Dry	Value of Milch animals	Heifers	Young Stock	Draught animals	Total (Adult)	Standard Animal units	Total Value
Hamirpur	LCP 1	Buffalo	1.36	1.0	14874	2.02	1.11	-	198	299.5	4454763
	LCP 2	CB Cow	1.0	-	10750	-	1.0	-	4	5.5	59125
		Buffalo	1.0	-	13375	1.0	1.0	-	4	7.0	93625
Solan	LCP 1	CB Cow	1.42	1.17	14440	1.5	1.02	2.0	164	187	2700280
	LCP 2	CB Cow	1.32	2.0	13500	1.0	1.1	2.0	49	56.5	762750
		Buffalo	1.06	1.0	13309	1.0	1.0	-	27	30.5	405924
Shimla	LCP 1	CB Cow	1.35	1.12	8200	1.14	1.16	1.71	162	216	1771200
	LCP 2	Local cattle	1.0	1.0	1000	1.5	1.0	1.14	12	14.5	14500
		CB Cow	1.25	1.40	6740	1.0	1.1	2.0	37	48.5	326890
Kinnaur	LCP 1	CB Cow	1.0	1.0	11534	1.0	1.0	2.0	182	209	2410606
	LCP 2	Local cattle	1.0	1.0	1500	-	1.0	2.0	70	76.5	114750
		CB Cow	1.0	1.0	11152	1.0	1.0	2.0	49	56	624512

4.16 Fixed investment in crop farming

An analysis of fixed investment in crop farming under major livestock- crop production systems in each zone is presented in Table 4.20.

In district Hamirpur of low hill sub-tropical zone, under LCPS 1 fixed investment is Rs. 1102 per household, while it is Rs. 1115 per household under LCPS 2. In Solan district of mid-hill sub humid zone, fixed investment is Rs. 2136 and Rs. 2193 per household under LCPS 1 and LCPS 2 respectively. This is higher than Hamirpur, because of the use of manual sprayer on crops like pea, tomato and capsicum. In district Shimla of high- hill temperate wet zone, fixed investment is Rs. 9693 and Rs. 8693 per household under LCPS 1 and LCPS 2 respectively. The fixed investment is higher due to the reason that farmers use power sprayer for spraying plant protection chemicals on their apple plantations. In district Kinnaur of high- hill temperate dry zone, again fixed investment is on higher side i. e. Rs. 9410 and Rs. 9381 per household under LCPS 1 and LCPS 2 respectively. High value of fixed investment is again due to the use of power sprayer by the farmers in their apple plantations.

Table 4.20: Fixed Investment in Crop Farming under different LCPS in Different Agro-Climatic Zones

(Rs./household)

Particulars		Hamirpur		Solan		Shimla		Kinnaur	
		LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2
Land		-	-	-	-	-	-	-	-
Irrigation structure		-	-	-	-	-	-	-	-
Tractor		-	-	-	-	-	-	-	-
Bullock drawn Equipments	Plough								
	Desi	150.50	152.45	150.00	146.00	111.25	121.25	209.56	204.00
	Improved	257.14	263.50	265.91	220.36	223.40	210.42	275.00	256.25
	Planker	88.00	85.94	69.00	70.56	74.44	66.67	-	-
	Yoke	56.50	55.65	53.00	61.33	57.14	42.00	197.14	247.33
Other equipments	Manual sprayer	-	-	980.47	1082.40	1700.21	1706.92	1290.62	1285.23
	Power sprayer	-	-	-	-	6545.56	5500.00	6450.00	6455.00
	Pruning scissor	-	-	-	-	345.65	433.33	360.00	355.80
Hand tools & Others	Spade	53.00	61.00	57.24	75.00	57.50	56.50	88.11	85.69
	Hand hoe/Kasala	56.95	54.36	94.08	99.71	171.54	166.90	-	-
	Sickles	141.52	148.54	136.37	155.00	149.07	134.29	224.00	237.20
	Khurpa	63.33	62.50	62.96	73.18	136.11	141.46	85.00	100.00
	Drat	82.28	92.75	114.03	134.38	-	-	-	-
	Axe	80.15	77.58	72.80	75.00	67.46	72.86	-	-
	Gainti	73.58	60.56	80.00	-	53.33	40.00	110.25	60.00
	Kilta	-	-	-	-	-	-	120.00	95.00
Total		**1102.45**	**1114.83**	**2135.86**	**2192.94**	**9692.66**	**8692.60**	**9409.68**	**9381.50**

4.17 Fixed investment in bovine enterprises

An analysis of fixed investment in bovine enterprises under major live-stock crop production systems in each zone is presented in Table 4.21.

In district Hamirpur of low hill sub-tropical zone, under LCPS 1 fixed investment is Rs. 47633 per household, while it is Rs. 49520 per household under LCPS 2. In Solan district of mid- hill sub humid zone, fixed investment is Rs. 49680 and Rs.62391 per household under LCPS 1 and LCPS 2 respectively. Fixed investment in bovine enterprise under LCPS 2 is higher, because it includes both crossbred cattle and buffalo.

In district Shimla of high- hill temperate wet zone, fixed investment is Rs. 31432 and Rs. 23748 per household under LCPS 1 and LCPS 2 respectively. The fixed investment is high in case of LCPS 1 due to the high fixed cost of store for feed and fodder. In district Kinnaur of high- hill temperate dry zone, again fixed investment is on higher side i. e. Rs. 44954 and Rs. 47235 per household under LCPS 1 and LCPS 2 respectively. High value of fixed investment is due to the higher fixed cost of cattle shed and store for feed and fodder.

Table 4.21: Fixed Investment in Bovine Enterprise under different LCPS in Different Agro-Climatic Zones

(Rs/Household)

Particulars		Hamirpur		Solan		Shimla		Kinnaur	
		LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2
Milch animals									
Buffalo		14874	13375	-	13309	-	-	-	-
Local Cattle		-	-	-	-	-	1000	-	1500
Crossbred Cattle		-	10750	14440	13500	8200	6740	11534	11152
Cattle shed		11243	7250	10443	13032	10583	8067	21470	21867
Store for fodder/feed		8081	6000	10872	10406	11738	6950	10754	11517
Chaff cutter shed		3467	5000	10000	7000	-	-	-	-
Bullock Cart		165.34	70.00	-	-	-	-	-	-
Equipments	Buckets	166.15	150.00	215.47	305.91	152.53	147.62	158.52	170.33
	Water cans	199.28	-	218.18	200.00	189.58	273.85	360.07	379.14
	Milk cans	90.40	60.00	75.88	68.09	70.41	56.67	109.93	108.45
Chaff cutter	Manual	2292	2500	545.50	580.45	-	-	-	-
	PD	6551	4167	2350	3500	-	-	-	-
Any others	Ropes	96.28	136.67	115.87	190.91	116.87	144.52	215.90	161.80
	Tasala	80.40	61.25	87.60	65.71	-	-	141.38	143.37
	Sickles	130.00	-	116.35	120.00	149.07	134.29	-	-
	Basket	125.50	-	136.15	113.08	165.01	160.71	210.14	235.71
	Axe	71.65	-	64.00	-	67.46	72.86	-	-
Total		**47633**	**49520**	**49680**	**62391**	**31432**	**23748**	**44954**	**47235**

Chapter-5

BREEDING, FEEDING AND MANAGEMENT PRACTICES ON SAMPLED FARM HOUSEHOLDS

5.1 Feeding practices

Farmers have adopted a variety of strategies for feeding their animals. Depending on their access to feed resources these strategies have varied across regions and also across different size groups of producer households. The type of feed resources available to the farmers is roughage, concentrates, compounded feed, crop residues and some amount of leguminous fodder cultivated in the fields. Feeding practices followed in case of bovine husbandry are presented in Table 5.1and Table 5.2 for each zone under different LCPS.

5.1.1 Feeding system Feeding system adopted by majority of farmers in Hamirpur and Solan is of individual type. In Hamirpur, 86 percent farmers in case of crossbred cow and 95 percent in case of buffalo fed their animals individually. In district Solan, 67 percent farmers fed their crossbred cow and 94 percent fed buffalo individually, whereas in case of local cow only 54 percent farmers fed them individually. In district Shimla, 61 percent farmers in case of local cow and 45 percent in case of crossbred cow fed their animals both individually as well as in group. Whereas in district Kinnaur, about 48 percent farmers in case of local cow and 34 percent in case of crossbred cow fed their animals in group. Feeding system under different LCPS shows that 95 percent farmers under LCPS 1 and LCPS 2 fed their buffalo individually in Hamirpur. Whereas, 83 percent farmers of LCPS 2fed their crossbred cow individually. In district Solan, under LCPS 1 and LCPS 2, 71 and 68 percent farmers respectively fed their crossbred cow individually and in case of buffalo 94 percent farmers fed them individually under LCPS 2. In district Shimla, 44 and 47 percent farmers respectively fed their crossbred cow individually as well as in group under LCPS 1 and LCPS 2. Whereas, 62 percent farmers fed their local cow individually as well as in group under LCPS 2. In district Kinnaur, 35 and 34 percent farmers respectively fed their crossbred cow individually, and 34 percent farmers fed their crossbred cow individually as well as in group under LCPS 1 and LCPS 2. Whereas, 46 percent farmers fed their local cow in group under LCPS 2.

5.1.2 Type of roughages fed Both dry and green fodder is fed to the bovines in all zones except Kinnaur where about 11 percent farmers fed dry fodder, due to non-availability of green fodder. Roughages fed are generally chaffed in district Hamirpur, whereas in district Solan, only 35 percent farmers in case of cattle and 65 percent in case of buffalo fed chaffed roughages to their animals. In districts Shimla and Kinnaur, farmers fed un-chaffed roughages to their cattle. In district Kinnaur, in case of crossbred cow only 5 percent farmers fed chaffed roughages to the animals. Similar is the case under LCPS 1 and LCPS 2 in different agro- climatic zones.

5.1.3 Type of feeding Method of feeding adopted by majority of farmers is stall-fed as well as grazing in open fields. In district Hamirpur, 72 percent farmers follow stall-feeding of their crossbred cattle. Whereas in case of buffalo, it is 100 percent stall-feeding, because grazing decreases the milk yield in buffalo. Under LCPS 2, 70 percent farmers follow stall-feeding of their crossbred cattle. In district Solan, again in case of buffalo, 100 percent stall feeding is observed, while in case of local and cross bred cow, it is 69 and 71 percent respectively. Under LCPS 1 and LCPS 2, in case of crossbred cow, 84 and 74 percent respectively are stall-fed. In district Shimla, 76 percent farmers in case of local cattle and 67 percent in case of crossbred cattle fed their cattle in stalls while others follow grazing in open fields as well as stall feeding. Whereas under LCPS 1, in case of crossbred cow, 93 percent farmers follow stall feeding as compared to 58 percent farmers in case of LCPS 2. All the sampled farmers in Kinnaur district follow both the methods of grazing as well as stall feeding to feed their animals.

5.1.4 Type of concentrate fed The components of concentrates feed given to livestock mostly consist of cottonseed/oilcakes, wheat bran, gram, *taramira*, barley and other grains. Wheat bran was the most important item of concentrate and cotton seed/oil cakes followed it. Feeding of *taramira* and grain was also observed in majority of sampled households. *Gur* (Jaggary) is also fed to cow and buffaloes at the time of delivery. Both home made and compound feed is fed to bovines but majority of farmers are not feeding min-mix to their bovines. This is higher in case of cattle as compared to buffalo in district Hamirpur and Solan. But, in district Hamirpur about 22 percent farmers fed min- mix to their crossbred cattle. In district Kinnaur also, 18 and 47 percent farmers fed min- mix to local and crossbred cow respectively. Similar is the case of feeding supplementary ration/concentrate during late pregnancy in all zones, which is a matter of concern. Results of concentrates and min- mix fed to bovines under different LCPS do not differ widely from the average of the zone as a whole.

Table 5.1: Feeding Practices Followed in Bovine Husbandry in Different Agro–Climatic Zones

(In percent)

Particulars		Hamirpur			Solan			Shimla			Kinnaur		
		Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo
Feeding													
Feeding system	Individual	-	85.60	95.27	54.24	66.67	93.54	9.67	36.00	-	30.25	32.88	-
	Group	-	6.75	2.70	-	1.33	1.60	28.95	18.67	-	47.67	33.56	-
	Both	-	7.65	2.03	45.76	32.0	4.86	61.38	45.33	-	22.08	33.56	-
Type of roughages fed	Green fodder	-	-	-	-	-	-	-	-	-	-	0.68	-
	Dry fodder	-	-	-	-	-	-	-	-	-	10.85	11.64	-
	Both	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	89.15	87.68	-
Rough-ages	Chaffed	-	83.50	85.55	35.33	35.33	64.52	-	-	-	-	4.79	-
	Unchaffed	-	16.50	14.45	64.67	64.67	35.48	100.0	100.0	-	100.0	95.21	-
Type of feeding	Grazing	-	27.60	-	5.70	2.0	-	-	-	-	-	0.68	-
	Stall fed	-	72.40	100.0	68.94	71.33	100.0	76.34	67.11	-	-	-	-
	Both	-	-	-	25.36	26.67	-	23.66	32.89	-	100.0	99.32	-
Period of grazing	< 4 hrs	-	82.85	-	72.36	65.12	-	93.60	69.39	-	100.0	100.0	-
	> 4 hrs	-	17.15	-	27.64	34.88	-	6.40	30.61	-	-	-	-
Type of concentrate fed	Home made	-	-	-	9.14	8.78	-	12.45	20.80	-	25.22	26.39	-
	Compound feed	-	2.50	1.37	15.60	12.16	6.87	5.90	4.70	-	5.25	4.17	-
	Both	-	97.50	98.63	75.26	79.06	93.13	81.65	74.50	-	69.53	69.44	-
Concentrate fed as	Dry	-	18.35	2.04	16.34	31.08	11.25	-	-	-	21.25	13.19	-
	After wetting in water	-	81.65	97.96	83.66	68.92	88.75	100.0	100.0	-	78.75	86.81	-
Feeding of mineral mixture	Yes	-	21.60	24.14	5.50	4.70	38.16	-	-	-	18.22	47.22	-
	No	-	78.40	75.86	94.50	95.30	61.84	100.0	100.0	-	81.78	52.78	-
Supplementary ration/concentrate during late pregnancy	Yes	-	23.69	45.83	27.58	34.23	57.65	39.20	58.67	-	15.94	29.17	-
	No	-	76.31	54.17	72.42	65.77	42.35	60.80	41.33	-	84.06	70.83	-

Table 5.2: Feeding Practices Followed under different LCPS in Different Agro–Climatic Zones

(In percent)

Particulars		Hamirpur			Solan			Shimla			Kinnaur		
		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2	
Feeding		Buffalo	CB Cow	Buffalo	CB Cow	CB Cow	Buffalo	CB Cow	Local cow	CB Cow	CB Cow	Local cow	CB Cow
Feeding system	Individual	94.85	82.60	95.06	70.67	68.35	94.00	42.86	7.65	33.37	35.27	31.55	34.08
	Group	2.94	5.25	2.82	2.66	1.75	1.33	13.19	30.27	20.11	31.00	46.33	32.28
	Both	2.21	12.15	2.12	26.67	29.90	4.67	43.95	62.08	46.52	33.73	22.12	33.64
Type of roughages fed	Green fodder	-	-	-	-	-	-	-	-	-	-	-	1.25
	Dry fodder	-	-	-	-	-	-	-	-	-	14.33	12.19	12.98
	Both	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	85.67	87.81	85.77
Rough-ages	Chaffed	83.21	85.67	84.38	28.00	32.67	65.37	-	-	-	3.21	-	4.00
	Unchaffed	16.79	14.33	15.62	72.00	67.33	34.63	100.0	100.0	100.0	96.79	100.0	96.00
Type of feeding	Grazing	-	30.12	-	-	5.33	-	-	-	-	-	-	1.25
	Stall fed	100.0	69.88	100.0	84.00	73.67	100.0	93.33	78.45	58.33	-	-	-
	Both	-	-	-	16.00	21.00	-	6.67	21.55	41.67	100.0	100.0	98.75
Period of grazing	< 4 hrs	-	83.57	-	83.33	60.23	-	73.67	95.27	66.33	-	100.0	100.0
	> 4 hrs	-	16.43	-	16.67	39.77	-	26.33	4.73	33.67	-	-	-
Type of concentrate fed	Home made	-	-	-	-	13.75	-	5.49	12.21	23.37	27.50	27.20	26.95
	Compound feed	1.47	3.25	1.39	13.51	11.23	7.11	-	4.67	10.67	3.37	4.40	3.77
	Both	98.53	96.75	98.61	86.49	75.02	92.89	94.51	83.12	65.96	69.13	68.40	69.28
Concentrate fed as	Dry	0.75	17.67	3.62	29.33	32.67	12.37	-	-	-	14.75	20.75	13.97
	After wetting in water	99.25	82.33	96.38	70.67	67.33	87.63	100.0	100.0	100.0	85.25	79.25	86.03
Feeding of mineral mixture	Yes	23.88	22.67	24.05	6.67	3.37	39.55	-	-	-	48.75	15.37	47.98
	No	76.12	77.33	75.95	93.33	96.63	60.45	100.0	100.0	100.0	51.25	84.63	52.02
Supplementary ration/concentrate during late pregnancy	Yes	46.62	21.50	46.23	37.33	31.33	57.67	70.33	40.33	49.75	31.27	16.40	30.22
	No	53.38	78.50	53.77	62.67	68.67	42.33	29.67	59.67	50.25	68.73	83.60	69.78

5.2 Breeding Practices

In order to understand the existing breeding practices followed by the farm households, the data collected from the sample survey has been used. Farmers can build their animal herd either by raising calves (male/female)/ offspring in their own farms or by purchasing animals or by getting animals on exchange and lease arrangements.

The transformation of the breeding practice depends, on the one hand, on the extent and distribution of infrastructure and the supply of input for AI and, on the other, in the degree of utilization of the AI facility by the breeders. Breeding practices followed in case of bovine enterprises are presented in Table 5.3 for each zone and Table 5.4 for different LCPS.

5.2.1 Breeding system Results of the analysis reveals that AI is more prevalent in case of Local and Crossbred cow in all the four zones. In case of buffalo, 76 percent farmers in Hamirpur and 64 percent in Solan preferred natural service. Similar results are obtained under LCPS 1 and LCPS 2 in these districts. In district Kinnaur, 39 percent farmers adopted natural service for breeding of crossbred cows, while under LCPS 1 and LCPS 2 the percentage is 35 and 40 percent respectively. Nearly 90 percent farmers of Shimla district adopted AI for local cow and 75 percent in case of crossbred cows.

5.2.2 Period of heat Period of heat at which animals are inseminated is very crucial for the breeding of animals. In district Hamirpur, 78 percent farmers inseminated their bovine in mid heat period, while others in late heat period in case of crossbred cow as well as buffalo. But in case of buffalo under LCPS 1, 76 percent farmers prefer mid heat period, which is slightly less than a percentage for the zone. In district Solan, 67, 72 and 92 percent farmers prefer mid heat period for insemination in local cow, crossbred cow and buffalo respectively. Similar results are obtained under LCPS 1 and LCPS 2. In district Shimla, in case of local cow, 95 percent farmers prefer mid heat period for insemination, whereas in case of crossbred cow, 68 percent farmers prefer late heat period for insemination. This is mainly due to the reason that the animals are not fed properly. Similar situation is observed under LCPS 1 and LCPS 2. In district Kinnaur, about 5.4 percent farmers inseminated their crossbred cow in early heat period. While majority of farmers prefer mid heat in case of both local as well as crossbred cow.

5.2.3 Preference for exotic breed Preference for exotic breed in case of crossbred cow in all the zones is Jersey, which is 100 percent in case of district Hamirpur, 93 percent in district Solan, 70 percent in district Shimla and 95 percent in district Kinnaur. Whereas, local breeds are preferred by farmers in case of local cows in all the four zones of Himachal Pradesh. Similar results are obtained in case of LCPS 1 and LCPS 2.

5.2.4 Number of AI and Service after calving Number of artificial inseminations for successful conception are generally two, as revealed by 88 percent farmers in case of crossbred cow and 80 percent in case of buffalo in district Hamirpur. In district Solan, the percentage of such farmers is 71, 62 and 84 percent in case of local cow, crossbred cow and buffalo respectively. In Shimla, 80 percent farmers in case of local cow inseminated twice, whereas in case of crossbred cow, one AI is done for conception in 27 percent, two AI's in case of 53 percent, three in case of 19 percent and five in case of 1.37 percent crossbred cows. Under LCPS 1 and LCPS 2, one AI is done for conception in case of 12 and 23 percent crossbred cows, while percentage of two AI's is higher than the average for the zone. In district Kinnaur, again in case of local cow, two AI's is done in 83 percent cows, while, in case of crossbred cow, one AI in 16 percent, two AI's in 29 percent, three AI's in 39 percent, four in 15 percent and five AI's in 1.38 percent cows is done for successful conception.

5.2.5 Pregnancy diagnosis Pregnancy diagnosis was given after 90 days in case of 86 percent farmers to crossbred cow and 93 percent to buffalo in Hamirpur. In district Solan, 85, 70 and 94 percent farmers gave pregnancy diagnosis to local cow, crossbred cow and buffalo respectively. Whereas in district Shimla, 69 and 57 percent farmers gave pregnancy diagnosis after 60 days to local and crossbred cow respectively, while remaining farmers gave the diagnosis after 90 days. This percentage is higher in case of district Kinnaur, where 92 and 82 percent farmers gave pregnancy diagnosis after 60 days to local and crossbred cow respectively. The similar results are obtained under livestock- crop production systems LCPS 1 and LCPS 2 and are presented in Table 5.4.

Table 5.3: Breeding Practices Followed in Bovine Husbandry in Different Agro–Climatic Zones

(In percent)

Particulars		Hamirpur			Solan			Shimla			Kinnaur		
		Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo
Breeding													
Breeding	Natural Service	-	12.68	76.35	15.75	19.33	64.30	9.75	25.33	-	5.50	38.73	-
	A I	-	87.32	23.65	84.25	86.0	35.70	90.25	74.67	-	94.50	61.27	-
Period of heat at which animals are inseminated	Early Heat	-	-	-	-	-	-	-	-	-	-	5.40	-
	Mid Heat	-	78.00	77.62	67.35	72.0	92.00	95.00	32.43	-	86.70	85.82	-
	Late Heat	-	22.00	22.38	32.65	26.67	8.00	5.00	67.57	-	13.30	8.78	-
Preference for exotic breed	H F	-	-	-	-	-	-	-	-	-	-	-	-
	Jersey	-	100.00	-	-	92.67	-	-	70.27	-	-	95.08	-
	Any other	-	-	-	100.0	7.33	-	100.0	-	-	100.0	4.92	-
No. of AI for successful conception	1	-	-	13.11	-	24.03	-	-	26.71	-	7.80	15.86	-
	2	-	88.50	80.33	72.60	62.02	83.50	80.25	52.74	-	82.65	28.97	-
	3	-	11.50	4.92	18.36	13.95	16.50	15.70	19.18	-	7.30	38.62	-
	4	-	-	1.64	9.04	-	-	4.05	-	-	2.25	15.17	-
	5	-	-	-	-	-	-	-	1.37	-	-	1.38	-
Service/AI after calving	60–90 day	-	17.58	13.14	73.50	83.89	10.55	45.60	30.00	-	27.50	33.79	-
	After 90 days	-	82.42	86.86	26.50	16.11	89.45	54.40	70.00	-	72.50	66.21	-
Pregnancy diagnosis	After 60 days	-	13.50	7.43	15.20	30.20	6.25	68.75	56.67	-	91.60	82.15	-
	After 90 days	-	86.50	92.57	84.80	69.80	93.75	31.25	43.33	-	8.40	17.85	-

Table 5.4: Breeding Practices Followed under different LCPS in Different Agro–Climatic Zones

(In percent)

Particulars		Hamirpur			Solan			Shimla			Kinnaur		
		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2	
Breeding		Buffalo	CB Cow	Buffalo	CB Cow	CB Cow	Buffalo	CB Cow	Local cow	CB Cow	CB Cow	Local cow	CB Cow
Breeding	Natural Service	77.20	87.18	75.42	12.67	15.95	63.81	21.49	10.15	26.84	35.27	7.67	40.49
	A I	22.8	12.82	24.58	87.33	84.05	36.19	78.51	89.85	73.16	64.73	92.33	59.51
Period of heat at which animals are inseminated	Early Heat	-	-	-	-	-	-	-	-	-	3.67	-	6.67
	Mid Heat	75.73	77.64	78.23	68.00	74.62	92.00	31.87	94.25	32.61	78.91	83.00	81.00
	Late Heat	24.27	22.36	21.77	32.00	25.38	8.00	68.13	5.75	67.39	17.42	17.00	12.33
Preference for exotic breed	H F	-	-	-	-	-	-	-	-	-	-	-	-
	Jersey	-	100.00	-	97.14	94.50	-	84.61	-	68.22	95.00	-	96.03
	Any other	-	-	-	2.86	5.50	-	-	100.0	-	5.00	100.0	3.97
No. of AI for successful conception	1	11.25	-	14.56	16.22	19.35	-	12.22	-	23.20	13.35	7.23	16.30
	2	82.14	88.50	79.69	44.60	58.54	81.27	62.22	81.36	57.67	31.20	80.25	27.22
	3	5.36	11.50	4.14	28.38	22.11	18.73	24.45	14.68	17.58	39.67	10.09	36.67
	4	1.25	-	1.61	-	-	-	-	3.96	-	14.13	2.43	16.15
	5	-	-	-	-	-	-	1.11	-	1.55	1.65	-	3.66
Service/AI after calving	60–90 day	13.60	17.06	13.07	90.67	85.50	11.36	32.45	47.53	28.25	35.00	26.88	31.50
	After 90 days	86.40	82.94	86.93	9.33	14.50	88.64	67.55	52.47	71.75	65.00	73.12	68.50
Pregnancy diagnosis	After 60 days	9.53	12.87	5.92	34.67	31.15	5.97	52.50	65.24	58.61	80.91	89.95	81.75
	After 90 days	90.47	87.13	94.08	65.33	68.85	94.03	47.50	34.76	41.39	19.09	10.05	18.25

5.3 Management practices

Results of Management practices followed in bovine husbandry are presented in Table 5.5 for each zone and management practices followed under different LCPS are presented in Table 5.6.

5.3.1 Milking of animals In all districts under study, recommended practices are followed in case of milking of animals. In district Hamirpur, Solan and Shimla, all the sampled farmers reported that the udders are washed before milking of animals. In case of district Kinnaur, only 62 percent farmers in case of local cow and 60 percent farmers in case of crossbred cow washed udders before milking. Similar results are obtained under LCPS 1and LCPS 2 for all. In district Shimla under LCPS 2, 96 percent farmers in case of crossbred cow washed the udders before milking.

Milking of animals is done inside as well as outside the cattleshed. In district Hamirpur, milking is done outside the cattleshed by 52 and 79 percent farmers in case of crossbred cow and buffalo respectively. Whereas this percentage is 48, 51 and 88 percent in case of local cow, crossbred cow and buffalo respectively in district Solan. The percentage of milking animals outside the cattleshed is very high in case of district Shimla and it is 96 and 95 percent in case of local and crossbred cow respectively. In district Kinnaur, around 53 percent farmers done milking of their animals inside the cattle shed. Similar results are obtained under LCPS 1and LCPS 2.

Milking is generally done two times a day during morning and evening in case of cattle in all the four zones. But in case of local cow, significant number of farmers done milking thrice a day, while in crossbred cow 25, 16, 33 and 14 percent farmers milk their animals three times a day in district Hamirpur, Solan, Shimla and Kinnaur respectively. In case of buffalo in district Hamirpur and Solan, milking is done two times a day. Calves are allowed to suckle by the farmers in all the four zones except 11 and 5 percent in case of crossbred cow in district Hamirpur and Solan respectively.

5.3.2 Housing In district Hamirpur and Shimla, bovine are generally kept in a room which is a part of residential building. As 74 percent farmers in Hamirpur and 97 percent farmers in Shimla responded that housing arrangements of animals are done in the ground floor of their

residential building. In district Solan and Kinnaur, 53 and 56 percent farmers made separate stalls for keeping their bovines. Type of stall where animals are kept is generally *kuchha*, but it depends upon whether it is separate or a part of residential building. Majority of the farmers in all the four zones kept their bovine tied in stalls. Stall cleaning is done by majority of the farmers once a day except in case of Hamirpur, where about 62 percent farmers done stall cleaning twice a day. Similar results are obtained under LCPS 1and LCPS 2.

5.3.3 Animal health In district Hamirpur and Solan majority of farmers vaccinated their bovines against preventive diseases. But in case of district Shimla only 75 and 84 percent farmers vaccinated local and crossbred cow respectively against preventive diseases. In case of district Kinnaur, the situation is further worsened and only 36 and 41 percent farmers vaccinated local and crossbred cow respectively against preventive diseases. Diseased animals are generally tied together with other animals in all the four zones. Cleaning was done after calving in all the four districts of respective zones.

5.3.4 Calf rearing In district Hamirpur, in case of crossbred cow dehorning of calves is done by 82 percent farmers, while in case of buffalo it was 1.49 percent. In district Solan, 77 and 72 percent farmers in local and crossbred cow respectively dehorn calves. In Shimla district, 88 and 77 percent farmers do dehorning of calves in case of local and crossbred cow respectively. Whereas the percentage of farmers dehorning calves in district Kinnaur is very low, and only 43 and 32 percent farmers in local and crossbred cow follow the practice. Deworming is an important process to prevent calves from various diseases, but it was not done by majority of farmers in all the districts and is a matter of concern. Vaccination against preventive diseases is done in calves except in district Kinnaur, where only 35 percent farmers in case of local cow and 41 percent in case of crossbred cow vaccinated their calves against preventive diseases.

5.3.5 Marketing In case of marketing of milk consumer is the first choice of farmers in Solan and milk vendors in Hamirpur and Shimla. Milk is not sold in Kinnaur and used for home consumption in one form or another. Similar results are obtained under LCPS 1and LCPS 2.

Table 5.5: Management Practices Followed in Bovine Husbandry in Different Agro- Climatic Zones

(In percent)

Practices		Hamirpur			Solan			Shimla			Kinnaur		
		Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo
Milking of animals													
Udders are washed before milking	Yes	-	100.0	100.0	100.0	100.0	100.0	100.0	98.67	-	62.32	59.86	-
	No	-	-	-	-	-	-	-	1.33	-	37.68	40.14	-
Place of milking	Stall	-	48.30	20.55	51.65	49.33	12.35	3.67	5.37	-	53.21	53.21	-
	Outside cattle shed	-	51.70	79.45	48.35	50.67	87.65	96.33	94.63	-	46.79	46.79	-
No. of times of milking	Once	-	-	-	-	-	-	-	-	-	-	-	-
	Twice	-	74.52	100.0	71.25	83.89	100.0	54.55	66.67	-	69.55	86.24	-
	Thrice	-	25.48	-	28.75	16.11	-	45.45	33.33	-	30.45	13.76	-
Calves are allowed to suckle	Yes	-	89.44	100.0	100.0	95.27	100.0	100.0	100.0	-	100.0	100.0	-
	No	-	10.56	-	-	4.73	-	-	-	-	-	-	-
Housing													
Stall	Separate	-	25.68	25.68	53.33	53.33	53.33	3.33	3.33	-	56.46	56.46	-
	Part of residential building	-	74.32	74.32	46.67	46.67	46.67	96.67	96.67	-	43.54	43.54	-
Type of stall	Kuchcha	-	94.56	94.56	64.0	64.0	64.0	99.33	99.33	-	64.82	64.82	-
	Pucca	-	5.44	5.44	36.0	36.0	36.0	0.67	0.67	-	35.18	35.18	-
Type of housing	Loose	-	-	2.03	-	-	-	-	-	-	-	-	-
	Tied	-	100.0	97.97	100.0	100.0	100.0	100.0	100.0	-	100.0	100.0	-
Stall cleaning	Once/day	-	37.84	37.84	66.0	66.0	66.0	96.67	96.67	-	93.50	93.50	-
	Twice/day	-	62.16	62.16	34.0	34.0	34.0	3.33	3.33	-	6.50	6.50	-
	Once in 2 days	-	-	-	-	-	-	-	-	-	-	-	-

Table 5.5: Contd.

(In percent)

Practices		Hamirpur			Solan			Shimla			Kinnaur		
		Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo	Local Cow	CB Cow	Buffalo
Animal health													
Vaccination for preventive diseases	Yes	-	100.0	92.28	95.67	98.0	100.0	74.67	83.89	-	35.67	41.22	-
	No	-	-	7.72	4.33	2.0	-	25.33	16.11	-	64.33	58.78	-
Diseased animals are tied	Separately	-	13.65	7.69	32.74	35.33	27.52	8.20	3.33	-	27.45	31.72	-
	Together with others	-	86.35	92.31	67.26	64.67	72.48	91.80	96.67	-	72.55	68.28	-
Cleaning done after calving	Yes	-	100.0	97.97	100.0	99.33	100.0	100.0	99.33	-	100.0	100.0	-
	No	-	-	2.03	-	0.67	-	-	0.67	-	-	-	-
Calf rearing													
Dehorning	Yes	-	82.37	1.49	77.25	71.81	-	88.33	76.67	-	43.45	31.97	-
	No	-	17.63	98.51	22.75	28.19	100.0	11.67	23.33	-	56.55	68.03	-
Deworming	Yes	-	59.27	48.89	-	2.03	77.67	5.25	2.67	-	22.50	29.45	-
	No	-	40.73	51.11	100.0	97.97	22.33	94.75	97.33	-	77.50	70.55	-
Vaccination	Yes	-	93.25	94.12	78.57	61.74	96.75	80.00	78.00	-	34.67	41.01	-
	No	-	6.75	5.88	21.43	38.26	3.25	20.00	22.00	-	65.33	58.99	-
Suckling	Yes	-	89.44	100.0	100.0	93.92	100.0	100.0	100.0	-	100.0	100.0	-
	No	-	10.56	-	-	6.08		-	-	-	-	-	-
Marketing													
Sale of milk	Cooperative	-	-	-	-	-	-	-	-	-	-	-	-
	Milk Vendor	-	56.27	81.58	2.45	4.17	12.45	53.67	63.64	-	-	-	-
	Consumer directly	-	43.73	16.67	97.55	92.5	87.55	46.33	36.36	-	-	-	-
	Others	-	-	1.75	-	3.33	-	-	-	-	-	-	-

Table 5.6: Management Practices Followed under different LCPS in Different Agro- Climatic Zones

(In percent)

Particulars		Hamirpur			Solan			Shimla			Kinnaur		
		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2	
Milking of animals		Buffalo	CB Cow	Buffalo	CB Cow	CB Cow	Buffalo	CB Cow	Local cow	CB Cow	CB Cow	Local cow	CB Cow
Udders are washed before milking	Yes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	95.85	62.27	60.33	57.25
	No	-	-	-	-	-	-	-	-	4.15	37.73	39.67	42.75
Place of milking	Stall	19.12	47.67	19.83	53.33	47.33	13.28	6.59	4.21	4.87	59.30	55.28	51.37
	Outside cattle shed	80.88	52.33	80.17	46.67	52.67	86.72	93.41	95.79	95.13	40.70	44.72	48.63
No. of times of milking	Once	-	-	-	-	-	-	-	-	-	-	-	-
	Twice	100.0	73.25	100.0	73.33	88.67	100.0	56.04	57.33	71.25	86.31	68.27	86.33
	Thrice	-	26.75	-	26.67	11.33	-	43.96	42.67	28.75	13.69	31.73	13.67
Calves are allowed to suckle	Yes	100.0	91.33	100.0	94.67	95.90	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	No	-	8.67	-	5.33	4.10	-	-	-	-	-	-	-
Housing													
Stall	Separate	24.26	25.21	25.21	50.67	54.67	54.67	2.20	3.95	3.95	48.67	57.33	57.33
	Part of residential building	75.74	74.79	74.79	49.33	45.33	45.33	97.80	96.05	96.05	51.33	42.67	42.67
Type of stall	Kuchcha	94.07	93.27	93.27	64.0	64.0	64.0	100.0	99.33	99.33	62.75	65.50	65.50
	Pucca	5.93	6.73	6.73	36.0	36.0	36.0	-	0.67	0.67	37.25	34.50	34.50
Type of housing	Loose	2.21	-	2.18	-	-	-	-	-	-	-	-	-
	Tied	97.79	100.0	97.82	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Stall cleaning	Once/day	36.76	38.52	38.52	69.33	65.50	65.50	96.70	96.33	96.33	95.00	91.27	91.27
	Twice/day	63.24	61.48	61.48	30.67	34.50	34.50	3.30	3.67	3.67	5.00	8.73	8.73
	Once in 2 days	-	-	-	-	-	-	-	-	-	-	-	-

Table 5.6: Contd.

(Percent)

Particulars		Hamirpur			Solan			Shimla			Kinnaur		
		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2		LCP 1	LCP 2	
Animal health		Buffalo	CB Cow	Buffalo	CB Cow	CB Cow	Buffalo	CB Cow	Local cow	CB Cow	CB Cow	Local cow	CB Cow
Vaccination for preventive diseases	Yes	97.04	100.0	89.22	98.67	97.33	100.0	95.56	71.21	75.25	38.11	36.25	42.67
	No	2.96	-	10.78	1.33	2.67	-	4.44	28.79	24.75	61.89	63.75	57.33
Diseased animals are tied	Separately	6.87	14.28	9.67	34.67	36.08	28.67	2.20	7.37	4.25	32.50	28.10	32.33
	Together with others	93.13	85.72	90.33	65.33	63.92	71.33	97.80	92.63	95.75	67.50	71.90	67.67
Cleaning done after calving	Yes	97.79	100.0	98.05	100.0	99.00	100.0	100.0	100.0	99.05	100.0	100.0	100.0
	No	2.21	-	1.95	-	1.00	-	-	-	0.95	-	-	-
Calf rearing													
Dehorning	Yes	1.63	81.73	1.10	93.33	62.25	-	84.50	82.33	82.56	35.65	41.00	28.47
	No	98.37	18.27	98.90	6.67	37.75	100.0	15.50	17.67	17.44	64.35	59.00	71.53
Deworming	Yes	49.60	58.25	47.50	4.00	1.33	75.20	1.10	5.25	3.45	31.45	25.67	28.50
	No	50.40	41.75	52.50	96.00	98.67	24.80	98.90	94.75	96.55	68.55	74.33	71.50
Vaccination	Yes	95.20	94.75	94.05	64.00	60.25	97.60	95.60	79.10	71.56	43.50	36.00	40.75
	No	4.80	5.25	5.95	36.00	39.75	2.40	4.40	20.90	28.44	56.50	64.00	59.25
Suckling	Yes	100.0	87.67	100.0	96.00	91.67	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	No	-	12.33	-	4.00	8.33	-	-	-	-	-	-	-
Marketing													
Sale of milk	Cooperative	-	-	-	-	-	-	-	-	-	-	-	-
	Milk Vendor	81.55	58.75	81.67	5.71	3.27	12.05	-	-	-	-	-	-
	Consumer directly	16.50	41.25	16.25	90.00	94.56	87.95	58.82	56.00	65.75	-	-	-
	Others	1.95	-	2.08	4.29	2.17	-	41.18	44.0	34.25	-	-	-

Chapter-6

ECONOMIC CHARACTERISTICS AND PRODUCTIVITY OF VARIOUS LIVESTOCK AND CROPS

6.1 Production Traits

The production traits of dairy animals are apparently closely inter-woven with the success of dairy enterprise. Therefore, the production traits such as age at first calving, lactation length, dry period, inter-calving period, average lactation yield and average daily milk yield per milch animal of different breeds have been studied. Besides this, some ancillary parameters viz. breed wise number of in milk/milch animals, conception rate, which have a crucial role in the economics of milk production, have also been worked out. Delayed maturity of the animals is one of the major factors responsible for the uneconomic nature of dairying. Earlier an animal attains the age of maturity and calves, the repayment for unproductive period form date of birth to the age at first calving begins earliest. The production traits of cows and buffaloes reared in different agro-climatic zones of Himachal Pradesh are analysed and revealed in Table 6.1. It is found that, age at first calving in case of crossbred cow is 2.56, 3.35, 3.61 and 2.85 years in Hamirpur, Solan, Shimla & Kinnaur respectively. It is much earlier than in case of buffalo, which is 3.92, 4.21 in Hamirpur & Solan respectively, followed by local cow, 4.7, 4.7, 3.8 years in Solan, Shimla & Kinnaur respectively. The calving interval of crossbred cow is estimated as 315, 380, 410 and 420 days in Hamirpur Solan, Shimla & Kinnaur respectively, out of which for 205, 224, 213 and 274 days it remains in milk and rest of the days in dry period. Contrary to this, calving interval in local cow is 450, 480 and 485 days in Solan, Shimla & Kinnaur respectively out of which for 284, 236 and 218 days it remains in milk and rest of the days in dry period. It is observed that crossbred cow has the longest lactation period, shortest dry period, as well as short inter calving period and lowest age at first calving as compared to local cow. The calving interval in case of buffaloes is 310 and 350 days in Hamirpur and Solan respectively out of which for 191 and 208 days it remains in milk and rest of the days in dry period. Similarly the analysis of the production traits of dairy animals under different livestock- crop production systems in different agro-climatic zones is revealed in Table 6.2.

Table 6.1: Production Traits of Dairy Animals in Different Agro-Climatic Zones

Particulars		Hamirpur	Solan	Shimla	Kinnaur	HP
Age at First Calving (Years)	Local Cow	-	4.7	4.7	3.8	4.4
	Crossbred Cow	2.56	3.35	3.61	2.85	3.09
	Buffalo	3.92	4.21	-	-	4.06
Lactation Length (days)	Local Cow	-	284.0	236.0	218.0	246.0
	Crossbred Cow	205.14	224.3	213.33	274.18	229.24
	Buffalo	190.66	208.14	-	-	194.40
Dry Period (days)	Local Cow	-	110	105	120	112
	Crossbred Cow	119	142	88	90	91
	Buffalo	87	90	-	-	89
Calving Interval (days)	Local Cow	-	450	480	485	472
	Crossbred Cow	315	380	410	420	381
	Buffalo	310	350	-	-	450
Milking Average (Lit./day)	Local Cow	-	2.09	2.22	2.07	2.13
	Crossbred Cow	4.71	5.03	5.00	2.89	4.41
	Buffalo	4.86	4.09	-	-	4.47
Lactation Yield (Lit.)	Local Cow	-	593.56	523.92	451.26	522.91
	Crossbred Cow	966.21	1128.23	1066.65	792.38	988.37
	Buffalo	723.02	706.34	-	-	714.68
Peak Yield (Lit.)	Local Cow	-	2.93	3.14	2.75	2.94
	Crossbred Cow	5.90	7.37	7.25	4.04	6.14
	Buffalo	6.00	6.51	-	-	6.25

Table 6.2: Production Traits of Dairy Animals under different LCPS in Different Agro-Climatic Zones

Particulars		Hamirpur		Solan		Shimla		Kinnaur	
		LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2
Age at First Calving (Years)	Local Cow	-	-	-	-	-	4.61	-	3.71
	CB Cow	-	2.97	3.41	3.30	3.77	3.54	2.86	2.84
	Buffalo	3.85	4.01	-	4.06	-	-	-	-
Lactation Length (days)	Local Cow	-	-	-	-	-	231	-	221
	CB Cow	-	210.0	224.33	224.27	218	209	281.53	276
	Buffalo	191.52	187.50	-	192.00	-	-	-	-
Dry Period (days)	Local Cow	-	-	-	-	-	110	-	120
	CB Cow	-	90	137	148	85	90	90	92
	Buffalo	89	94	-	95	-	-	-	-
Calving Interval (days)	Local Cow	-	-	-	-	-	450	-	470
	CB Cow	-	295	381	390	410	420	410	420
	Buffalo	310	315	-	365	-	-	-	-
Milking Average (Lit./day)	Local Cow	-	-	-	-	-	2.25	-	2.05
	CB Cow	-	4.74	5.10	5.00	5.36	5.15	2.61	2.80
	Buffalo	4.91	4.75	-	4.69	-	-	-	-
Lactation Yield (Lit.)	Local Cow	-	-	-	-	-	519.75	-	453.05
	CB Cow	-	995.40	1144.08	1121.35	1168.48	1076.35	734.79	772.80
	Buffalo	940.36	890.62	-	900.48	-	-	-	-
Peak Yield (Lit.)	Local Cow	-	-	-	-	-	3.20	-	2.81
	CB Cow	-	6.00	7.63	7.45	7.79	7.10	4.00	4.05
	Buffalo	6.15	6.08	-	6.75	-	-	-	-

6.2 Production of Milk on Sampled Farms

As revealed from Table 6.1, the milk yield in crossbred cow is 4.71, 5.03, 5 and 2.89 litres per day in Hamirpur Solan, Shimla & Kinnaur respectively, which is much higher than that of local cow yield of 2.09, 2.22 and 2.07 litres per day in Solan, Shimla & Kinnaur respectively. In case of buffalo, the milk yield is 4.86 and 4.09 lts/day in Hamirpur and Solan respectively. Total lactation yield is much higher in case of crossbred cow followed by buffalo and local cow. Table 6.3 reveals average productivity of lactating and milch animals in different agro- climatic zones of Himachal Pradesh. Perusal of the results reveals that the crossbred cow is the most promising bovine kept by the farmers in all the zones. Similar is the case of different livestock- crop production systems as revealed in Table 6.4.

Table 6.3: Average Productivity of Lactating and Milch Animals in Different Agro-Climate Zones

Zones/ District	Lactating Animals			Milch Animals			Goat	
	Buffalo	Crossbred Cow	Local Cow	Buffalo	Crossbred Cow	Local Cow	Lactating	Milch
Hamirpur	892.62	1210.33	-	723.02	966.21	-	-	-
Solan	1124.28	1653.09	832.12	706.34	1128.33	593.56	-	-
Shimla	-	1546.64	741.04	-	1066.65	523.92	-	-
Kinnaur	-	1107.69	599.5	-	792.38	451.26	135.00	-
Himachal Pradesh	1004.52	1407.53	723.24	718.51	1010.95	523.98	135.00	-

Table 6.4: Average Productivity of Lactating and Milch Animals under different LCPS in Different Agro-Climate Zones

Zones/ District	LCP SYSTEM	Lactating Animals			Milch Animals		
		Buffalo	Crossbred Cow	Local Cow	Buffalo	Crossbred Cow	Local Cow
Hamirpur	LCP 1	934.80	-	-	940.36	-	-
	LCP 2	860.32	1260.00	-	890.62	995.4	-
Solan	LCP 1	-	1711.64	-	-	1144.08	-
	LCP 2	1093.50	1670.81	-	900.48	1121.35	-
Shimla	LCP 1	-	1698.22	-	-	1168.48	-
	LCP 2	-	1483.90	739.20	-	1076.35	519.75
Kinnaur	LCP 1	-	1126.12	-	-	734.79	-
	LCP 2	-	1117.80	621.01	-	772.80	453.05

6.3 Production, consumption and marketed surplus of milk

The quantity of milk produced and its consumption pattern in different agro- climatic zones are analysed in Table 6.5. Per capita milk consumption is highest in Solan whereas in other zones, it is much lower than State average. This can be positively correlated to the milk sold as the percentage of total production, which is highest in district Hamirpur followed by Shimla and Solan. In district Kinnaur the total production of milk is utilized by the households. Still, the per capita consumption of milk in Kinnaur is very low, 223.48 gms daily. This is due to the low productivity of milch animals. Table 6.6 reveals the quantity of milk produced and its consumption pattern under different livestock- crop production systems in different agro- climatic zones. On an average, per capita availability of milk is relatively higher in LCPS 1 than that of LCPS 2 except in Solan district, where LCPS 2 has higher per capita availability of milk.

6.4 Marketing of milk

Distribution of milk to marketing agencies is given in Table 6.7. The analysis indicates that direct sale of milk to the consumers is the best scenario in Solan and Milk vendor in Hamirpur and Shimla. Village Dairy Co-operatives are non- functional in all the zones. There is a slight variation in the price paid by different agencies. Distribution of milk to various marketing agencies under different livestock- crop production systems in different agro- climatic zones is revealed in Table 6.8.

Table6.5: Production, Consumption and Marketed Surplus of Milk in Different Agro-Climatic Zone/District

(Qty. in litres/day)

Zone/ District	Total Milk Production			Milk utilized in the household (lts.)		Milk Sold			Sale price of milk (Rs.)			Milk Sold as %age to total production	Per capita milk consumption (gm.)
	Cow	Buff.	Total	As fluid	For product	Cow	Buff.	Total	Cow	Buff.	Mix		
Hamirpur	4.27	4.88	9.15	2.03	1.40	2.20	3.52	5.72	9.75	15.00	-	62.51	317.68
Solan	6.42	5.10	11.52	4.42	4.49	1.50	1.11	2.61	10.0	12.75	-	22.66	712.90
Shimla	5.56	-	5.56	2.12	1.25	2.19	-	2.19	10.94	-	-	39.39	375.22
Kinnaur	3.82	-	3.82	1.58	2.24	-	-	-	-	-	-	-	223.48
Himachal Pradesh	5.02	2.49	7.51	2.54	2.34	1.47	1.16	2.63	10.23	13.87	-	35.02	401.26

Table 6.6: Production, Consumption and Marketed Surplus of Milk under LCPS in Different Agro-Climatic Zone/District

(Qty. in litres/day)

Zone/ District	LCP SYSTEM	Total Milk Production			Milk utilized in the household (lts.)		Milk Sold			Sale price of milk (Rs.)			Milk Sold as %age to total production	Per capita milk consumption (gm.)
		Cow	Buff.	Total	As fluid	For product	Cow	Buff.	Total	Cow	Buff.	Total		
Hamirpur	LCP 1	-	5.35	5.35	1.67	0.95	-	2.73	2.73	-	15.00	15.00	51.03	278.33
	LCP 2	4.12	4.91	9.03	2.00	1.32	2.19	3.52	5.71	9.75	15.00	12.38	63.23	166.67
Solan	LCP 1	7.29	-	7.29	2.59	3.41	1.29	-	1.29	10.40	-	10.40	17.69	420.45
	LCP 2	6.58	5.72	12.30	4.38	4.08	1.97	1.87	3.84	9.80	12.75	11.27	31.22	646.97
Shimla	LCP 1	6.75	-	6.75	2.80	1.67	2.28	-	2.28	12.00	-	12.00	33.77	509.09
	LCP 2	5.10	-	5.10	1.80	1.45	1.85	-	1.85	8.50	-	8.50	36.27	252.81
Kinnaur	LCP 1	4.35	-	4.35	1.90	2.45	-	-	-	-	-	-	-	296.41
	LCP 2	3.40	-	3.40	1.62	1.78	-	-	-	-	-	-	-	204.29

Table 6.7: Distribution of Milk Marketing Agencies and Price Offered in Different Agro-Climatic Zone/District

(Qty. in litres/day)

Zone/ District	No. of household			Price paid by agencies				Qty. of milk supplied to agencies				Agencies preferred by Farmers(%)			
	Selling milk	Not selling milk	Total HH	Co-op.	Milk vendor	Halwai/ Tea Shop	Consu-mers	Co-op.	Milk vendor	Halwai/ Tea Shop	Consu-mers	Co-op.	Milk vendor	Halwai/ Tea Shop	Consumers
Hamirpur	97	53	150	-	12.50	13.50	15.0	-	382.40	4.88	167.56	-	68.92	0.88	30.20
Solan	92	57	149	-	-	12.0	12.0	-	2.66	15.27	222.18	-	1.11	6.36	92.53
Shimla	79	70	149	-	8.50	-	10.50	-	101.47	-	71.54	-	58.65	-	41.35
Kinnaur	-	150	150	-	-	-	-	-	-	-	-	-	-	-	-
Himachal Pradesh	268	330	598	-	10.50	12.75	12.50	-	486.53	20.15	461.28	-	42.89	2.41	54.70

Table 6.8: Distribution of Milk Marketing Agencies and Price Offered under LCPS in Different Agro-Climatic Zone/District

(Qty. in litres/day)

Zone/ District	LCP SYSTEM	No. of household			Price paid by agencies				Qty. of milk supplied to agencies				Agencies preferred by Farmers(%)			
		Selling milk	Not selling milk	Total HH	Co-op.	Milk vendor	Halwai/ Tea Shop	Consu-mers	Co-op.	Milk vendor	Halwai/ Tea Shop	Consu-mers	Co-op.	Milk vendor	Halwai/ Tea Shop	Consu mers
Hamirpur	LCP 1	88	49	137	-	15.00	-	15.00	-	346.91	-	152.00	-	71.25	-	28.75
	LCP 2	4	-	4	-	9.75	13.50	15.00	-	16.00	4.88	7.00		75.00	0.88	24.12
Solan	LCP 1	61	14	75	-	-	10.00	11.0	-	-	10.12	147.31	-	-	6.10	93.90
	LCP 2	15	7	22	-	-	12.0	14.0	-	-	2.50	36.22	-	-	4.67	95.33
Shimla	LCP 1	48	43	91	-	10.00	-	12.00	-	62.00	-	44.50	-	59.67	-	40.33
	LCP 2	11	10	21	-	8.50	-	12.00	-	14.25	-	10.00	-	55.33	-	44.67
Kinnaur	LCP 1	-	71	71	-	-	-	-	-	-	-	-	-	-	-	-
	LCP 2	-	30	30	-	-	-	-	-	-	-	-	-	-	-	-

Chapter-7

INPUT-OUTPUT RELATIONSHIP FOR VARIOUS LIVESTOCK-CROP PRODUCTION SYSTEMS IN HIMACHAL PRADESH

7.1 Economics of milk, meat and wool production

Economics of Milk, Meat and Wool production in different Agro–climatic zones has been worked out and presented in Table 7.1. Cost of production per litre of milk in case of crossbred cow is Rs 8.77, Rs. 6.81, Rs. 8.36 and Rs. 12.02 in Hamirpur, Solan, Shimla & Kinnaur respectively. Whereas in case of local cow it comes out to be Rs. 8.17, Rs. 9.11 and Rs. 13.66 per litre in Solan, Shimla & Kinnaur respectively. In case of Buffalo it comes out to be Rs. 9.69 and Rs. 8.98 per litre in Hamirpur and Solan. In Kinnaur, milk is not sold by the sample households and used entirely for home consumption. For this zone cost of production of meat and wool is worked out for sheep and goat and found to be Rs. 23.75 per Kg. in case of Goat and Rs. 18.74 per Kg. in case of Sheep. Cost of wool production in case of Sheep comes out to be Rs. 106.22 per Kg. It is revealed from the analysis that rearing of goat and sheep is relatively higher profitable enterprise for the farmers of this zone. Among the cost component, value of fodder & feed and human labour are the major costs incurred in rearing animals.

7.2 Economics of crop production

In order to study the returns, it is essential to study the input structure and cost of production and have an idea about the share of various input factors in total cost. For determining the cost structure, cost A_1 has been estimated for various crops in each zone. In case of Hamirpur, per quintal cost of production estimated to be Rs. 119.67 in maize, Rs. 248.38 in wheat, Rs. 361.20 in barley, Rs. 67.77 in barseem, Rs. 19.41 in chari, Rs. 148.66 paddy, Rs. 76.71 in oat. In case of Solan, cost of production per quintal comes out for different crops as; Rs.102.76 in maize, Rs. 338.53 wheat, Rs. 324.20 barley, Rs. 28.17 chari, Rs. 128.81 in pea, Rs. 231.26 in tomato and Rs. 794.78 in capsicum. In case of Shimla, per quintal cost of production is, Maize Rs. 113.35, Wheat Rs. 522.69, Barley Rs. 229.50, Potato Rs. 143.80, Rajmash Rs. 898.59 and Apple Rs. 605.87. In case of Kinnaur, cost of production of Maize is Rs. 170.40, Wheat

is Rs. 292.76, Barley is Rs. 221.86, Ogla is Rs. 123.39, Fafra is Rs. 90.00, Rajmash is Rs. 534.45, Kidney bean is Rs. 419.83, Potato is Rs. 207.77, Apple is Rs. 199.63 and Pea is Rs. 113.77.

7.3 Input- output relation in milk, meat and wool production

To obtain input-output relationship for various livestock-crop production systems log-linear form of production function was used. Results (Table 7.3) revealed that in Hamirpur in case of crossbred cow green fodder and concentrate are the major components of cost. Production elasticity of green fodder is 0.325 and is significant at 1 percent level of probability, thus, hereby, indicating that if use of green fodder is increased by 1 percent then on an average output of milk will increase by 0.32 percent at geometric mean level. Whereas in case of buffalo, dry fodder and concentrate are the main components of cost. Production elasticity of dry fodder is 0.421 and is significant at 1 percent level of probability, thus, hereby, indicating that if use of dry fodder is increased by 1 percent then on an average output of milk will increase by 0.42 percent at geometric mean level. Production elasticity of concentrate is 0.251 and is significant at 10 percent probability level. The coefficient of multiple determination (R^2) indicated that all the explanatory variables collectively explained about 97 percent variation in milk production in case of crossbred cow and 88 percent in case of buffalo.

In Solan, in case of local cow greenfodder is the major cost component and the response of output to dry fodder is negative. Production elasticity of green fodder is 1.152 and is significant at 1 percent level of probability, thus, hereby, indicating that if use of green fodder is increased by 1 percent then on an average output of milk will increase by 1.15 percent at geometric mean level. Whereas in case of crossbred cow, dry fodder and human labour are the main components of cost. Production elasticity of dry fodder and human labour is 0.535 and 0.398 respectively and is significant at 1 percent level of probability, thus, hereby, indicating that if use of dry fodder and human labour is increased by 1 percent then on an average output of milk will increase by 0.53 and 0.40 percent respectively at geometric mean level. Production elasticity of green fodder and miscellaneous expenses is 0.220 and 0.434 respectively and is significant at 10 percent level of probability. High production elasticity of miscellaneous expenses is

due to better management service of crossbred cow. The coefficient of multiple determination (R^2) indicated that all the explanatory variables collectively explained about 50, 54 and 21 percent variation in milk production in case of local cow, crossbred cow and buffalo respectively.

In case of Shimla, green fodder and concentrate are the major components of cost whereas the response of output to dry fodder is negative. In case of local cow, production elasticity of green fodder is 0.419 and is significant at 5 percent probability level, thus, hereby, indicating that if use of green fodder is increased by 1 percent then on an average output of milk will increase by 0.42 percent at geometric mean level. All other variables are not significant. In case of crossbred cow, production elasticity of green fodder and concentrate is 0.492 and 0.184 and is significant at 10 percent level of probability.

In Kinnaur, in case of local cow production elasticity of dry fodder and concentrate is 0.721 and 0.361 and is significant at 10 percent level of probability. In case of crossbred cow production elasticity of green fodder is 0.161 and is significant at 10 percent level of probability, whereas production elasticity of concentrate and human labour is 0.329 and 0.411 respectively and is significant at 5 per cent probability level. The coefficient of multiple determination (R^2) indicated that all the explanatory variables collectively explained about 80 and 85 percent variation in milk production in case of local cow and crossbred cow respectively. In case of mutton value of dry fodder and human labour are the major components of cost. R^2 indicated that all the explanatory variables collectively explained about 85 percent variation in meat production in case of sheep and 82 percent in case of Goat. In wool production human labour is the major cost component followed by value of dry fodder. R^2 indicated that all the explanatory variables collectively explained about 89 percent variation in wool production in case of sheep.

7.4 Input- output relation in crop production

Input-output relationship in crop production is worked out for each crop in each zone. Results (Table 7.4) revealed that in Hamirpur, in case of maize crop labour, seed

and fertilizer contributed positively and significantly towards production, similar is the case with wheat. In case of maize, production elasticity of seed, fertilisers and labour is 0.452, 0.434 and 0.609 and is significant at 1 percent level of probability. In case of wheat production elasticity of seed, fertilisers and labour is 0.629, 0.227 and 0.537 and is significant at 1 percent level of probability, thus hereby indicating that 1 percent increase in seed, fertilisers and labour would increase production of maize and wheat by 0.45, 0.43, 0.60 and 0.63, 0.23 and 0.54 percent respectively at their geometric mean level. In case of barley and paddy, fertilsers has negative impact and also non-significant. In case of barley, production elasticity of human labour is 0.781 and is significant at 10 percent level of probability. Production elasticity of seed in case of paddy is 1.875 and is significant at 1 percent level of probability. R^2 indicated that all the explanatory variables collectively explained about 58, 81, 79 and 96 percent variation in the production of maize, wheat, barley and paddy respectively.

In Solan, in case of maize, production elasticity of seed & fertilizers is 1.127 and -0.163 respectively, and is significant at 1 percent level of probability. Production elasticity of value of fertilizers indicates negative impact. In case of wheat production elasticity of seed & human labour is 0.729 and 0.057 respectively, and is significant at 10 percent level of probability. Production elasticity of seed and labour in case of barley is 0.587 and 0.594 respectively and is significant at 1 percent level of probability. In case of pea, production elasticity of seed, plant protection chemicals and human labour is 0.577, 0.668 and 0.251 respectively and is significant at 1, 1 and 10 percent level of probability, meaning, 1 percent increase in the use of seed, plant protection chemicals and human labour would increase the production of peas by 0.58, 0.67 and 0.25 percent respectively at their geometric mean level. High use of fertilizers in pea indicates negative production elasticity. Tomato is one of the major cash crop of this zone. Production elasticity of seed, fertilizers and plant protection chemicals in case of tomato is 0.891, 0.744 and 0.078 respectively and is significant at 10, 1 and 1 percent level of probability. In case of capsicum, production elasticity of seed, fertilizers and plant protection chemicals is 0.086, 0.356 and 0.461 respectively and is significant at 1, 10 and 10 percent level of probability. R^2 indicated that all the explanatory variables

collectively explained about 73, 79, 91, 69, 50 and 73 percent variation in the production of maize, wheat, barley, pea, tomato and capsicum respectively.

In Shimla, value of seed and human labour has a positive and significant affect on the production of maize and wheat. Value of seed and human labour has a production elasticity of 0.318 & 0.397 and 1.031 & 0.912 respectively and is significant at 10 and 1 percent level of probability. Human labour has production elasticity 0.998 in case of barley and is significant at 10 percent level of probability. In case of potato value of seed, human labour and plant protection chemicals has production elasticity of 0.801, 0.597 and 0.315, which is significant at 10 percent level of probability. Seed and fertilizers have production elasticity of 0.415 and 0.747, significant at 10 and 1 percent level of probability, in case of Rajmash. Apple is an important crop of this zone. Manures & fertilizers, human labour and plant protection chemicals show significant effect on the production of Apple. Production elasticity of these inputs is 0.318, 0.865 and 0.461 respectively and is significant at 10, 1 and 1 percent level of probability. R^2 indicated that all the explanatory variables collectively explained about 96, 88, 84 and 92 percent variation in the production of wheat, potato, rajmash and apple respectively.

In Kinnaur, human labour is the major factor of production for all the crops except potato and contributed positively and significantly. In case of maize, barley and kidney bean, value of seed and human labour has production elasticity of 0.239 (10 percent level) & 0.427 (1 percent level), 0.439 & 0.715 (10 percent level) and 0.562 (5 percent level) & 0.764 (1 percent level) respectively. In case of wheat, ogla, rajmash and fafra value of seed, fertilizers and human labour has production elasticity of 0.099, 0.221 & 0.056 (significant at 5, 10 and 1 percent level), 0.225, 0.392 & 0.776 (significant at 5, 10 and 1 percent level), 0.361, 0.107 & 0.481 (significant at 10, 1 and 10 percent level) and 0.233, 0.369 & 0.604 (significant at 1, 10 and 1 percent level) respectively. Potato followed by pea is one of the important cash crop of this zone. Seed, fertilizers and plant protection chemicals has production elasticity of 0.213, 0.224 & 0.108 respectively and is significant at 1, 1 and 5 percent level of probability. In case of pea, human labour and plant protection chemicals have production elasticity of 0.737 & 0.888 respectively and is significant at 10 percent probability level. But manures and

fertilizers have negative impact on output. Manures & fertilizers, human labour and plant protection chemicals show significant effect on the production of Apple. Production elasticity of these inputs is 0.068, 0.807 and 0.513 respectively and is significant at 10, 1 and 5 percent level of probability. R^2 indicated that all the explanatory variables collectively explained about 68, 53, 85, 87, 99, 91, 82 and 90 percent variation in the production of maize, wheat, barley, rajmash, kidney bean, potato, pea and apple respectively.

Table 7.1: Economics of Milk / Meat / Wool Production in Different Agro–Climatic Zones

(Rs./annum/animal)

Particulars	Hamirpur		Solan			Shimla		Kinnaur				
	Buffalo	CB Cow	Local cow	CB Cow	Buffalo	Local cow	CB Cow	Local cow	CB Cow	Goat	Sheep	Yak
Depreciation (animal, building & machinery)	196.51	265.29	207.29	162.87	215.11	393.30	343.03	1696.04	1696.04	8.71	6.76	169.60
Interest on fixed capital	9.37	56.46	25.73	10.46	48.84	16.13	5.98	9.71	8.33	14.75	10.51	115.20
Total fixed cost	205.88	321.75	233.02	173.33	263.95	409.43	349.01	1705.75	1704.37	23.46	17.27	284.80
Green fodder	2472.87	2691.87	1551.25	2545.87	2089.62	1195.37	2609.75	730.00	1186.25	105.25	90.00	800.00
Dry fodder	1697.25	1825.00	1343.20	1843.25	2507.45	1255.60	2197.30	1564.93	3577.00	175.25	71.40	1850.50
Concentrate	3285.00	2677.27	1551.25	2792.25	2892.52	1916.40	3874.37	2007.50	3011.25	190.00	100.00	2100.00
Total feed cost	7455.12	7194.15	4445.70	7181.37	7489.59	4367.37	8681.42	4302.43	7774.50	470.50	261.40	4750.50
Human labour	4037.62	3993.75	2330.22	4079.82	4125.00	2054.87	3927.62	2174.00	4185.25	50.00	25.00	1480.00
Miscellaneous expenses	115.50	180.00	110.40	150.65	105.15	90.50	125.75	80.65	110.00	20.00	15.00	100.00
Total variable cost	11608.24	11367.90	6886.32	11411.84	11719.74	6512.74	12734.79	6557.08	12069.75	540.50	301.40	6330.50
Gross cost	11814.12	11689.65	7119.34	11585.17	11983.69	6922.17	13083.80	8262.83	13774.12	563.96	318.67	6615.30
Value of dung	3985.00	2150.00	1293.50	2120.60	3760.00	1160.50	2155.50	1085.00	2350.00	-	-	500.00
Net Cost (Gross cost-value of dung)	7829.12	9539.65	5825.84	9464.57	8223.69	5761.67	10928.30	7177.83	11424.12	563.96	318.67	6115.30
Yield (Kgs.)	807.82	1088.27	712.84	1390.71	915.31	632.48	1306.65	525.38	950.03	135* 25@	17@ 3*	-
Cost of production (Rs. / Kg.) (Net cost / Yield)	9.69	8.77	8.17	6.81	8.98	9.11	8.36	13.66	12.02	4.18* 23.75@	18.74@ 106.22*	-
Market price of milk/meat/ wool/kg	15.00	9.75	9.80	10.40	12.75	9.89	12.00	-	-	100.00@	70.00@ 150.00*	-

*GOAT: *Cost of Milk production/kg @ Cost of meat production/ kg; SHEEP: @ Cost of meat production/ kg *Cost of Wool production/kg*

Table 7.2 (a): Economics of Crop Production in district Hamirpur of Low hill zone

(Rs. / Ha)

Particulars		Maize	Wheat	Barley	Barseem	Chari	Paddy	Oat	Arbi	Turmeric
Depreciation (Building, farm equipment)		15.50	17.60	11.50	8.75	8.80	12.75	10.50	11.00	10.50
Interest on fixed capital		181.98	195.70	160.00	90.55	88.75	80.00	65.55	62.50	30.55
Land rent		-	-	-	-	-	-	-	-	-
Total fixed cost		197.48	213.30	171.50	99.30	97.55	92.75	76.05	73.50	41.05
Seed		181.43	911.50	912.58	1111.95	667.17	177.91	889.56	445.00	1550.00
Manure and fertilisers		1469.15	1423.82	1280.75	3159.00	617.75	236.23	855.57	380.00	958.50
Irrigation		-	-	-	-	-	-	-	-	-
Human labour		1592.50	1680.50	1560.80	1580.50	1150.75	1510.00	1180.00	950.00	1150.00
Bullock / Tractor Labour		291.00	335.60	250.00	150.00	150.00	228.00	175.00	-	-
Plant protection chemicals		-	-	-	-	-	-	-	-	-
Interest on working capital		212.04	261.08	240.25	360.09	155.14	129.13	186.00	106.50	219.51
Miscellaneous		50.00	50.00	45.00	40.00	40.00	50.00	50.00	40.00	80.00
Total variable cost		3796.12	4662.50	4289.38	6401.54	2780.81	2331.27	3336.13	1921.50	3958.01
Gross cost		3993.60	4875.80	4460.88	6500.84	2878.36	2424.02	3412.18	1995.00	3999.06
Value of by-product		1612.20	1279.20	-	-	-	299.60	-	-	-
Net Cost (Gross cost – value of by-product)		2381.40	3596.60	4460.88	6500.84	2878.36	2124.42	3412.18	1995.00	3999.06
Yield (Quintals)	**Main product**	19.90	14.48	12.35	95.92	148.26	14.29	44.48	11.38	7.15
	By-product	26.87	21.32	7.36	-		7.49	-	-	-
Cost of production (Rs. / Qtl.) (Net cost/Yield of main product)		119.67	248.38	361.20	67.77	19.41	148.66	76.71	175.31	559.31
Market price of main product (Rs. /Qtl.)		496.00	604.00	600.00	-	-	550.00	-	-	-

Table 7.2 (b): Economics of Crop Production in district Solan of Mid hill zone

(Rs. / Ha)

Particulars		Maize	Wheat	Barley	Chari	Pea	Tomato	Capsicum
Depreciation (Building, farm equipment)		18.75	21.50	19.75	12.50	22.75	27.80	25.00
Interest on fixed capital		127.96	135.50	127.00	90.00	130.50	135.50	135.00
Land rent		-	-	-	-	-	-	-
Total fixed cost		146.71	157.00	146.75	102.50	153.25	163.30	160.00
Seed		194.07	819.95	584.26	650.00	722.23	42515.00	41837.50
Manure and fertilisers		2240.55	1620.09	646.78	744.70	2580.00	3823.25	2917.22
Irrigation		-	-	-	-	50.00	65.00	50.00
Human labour		1480.50	1525.00	1450.00	980.00	3580.00	3750.00	2780.00
Bullock / Tractor Labour		350.00	350.00	250.00	150.00	-	-	-
Plant protection chemicals		-	-	-	-	1550.00	2015.50	1580.00
Interest on working capital		255.91	258.90	175.86	151.48	508.93	1123.37	1115.50
Miscellaneous		60.00	50.00	50.00	40.00	100.00	100.00	100.00
Total variable cost		4581.03	4623.94	3156.90	2716.18	9091.76	53392.12	50380.22
Gross cost		4727.74	4780.94	3303.65	2818.68	9245.01	53555.42	50540.22
Value of by-product		1891.25	989.40	-	-	1223.50	-	-
Net Cost (Gross cost – value of by-product)		2336.87	3791.54	3303.65	2818.68	8021.51	53555.42	50540.22
Yield (Quintals)	**Main product**	22.74	11.20	10.19	100.07	62.27	231.58	63.59
	By-product	30.26	16.49	14.14	-	16.47	-	-
Cost of production (Rs. / Qtl.) (Net cost/Yield of main product)		102.76	338.53	324.20	28.17	128.81	231.26	794.78
Market price of main product (Rs. /Qtl.)		494.00	598.75	600.00	-	680.42	660.00	1082.00

Table 7.2 (c): Economics of Crop Production in district Shimla of High hill wet zone

(Rs. / Ha)

Particulars		Maize	Wheat	Barley	Potato	Rajmash	Apple
Depreciation (Building, farm equipment)		21.50	27.00	18.00	35.50	21.00	41.00
Interest on fixed capital		125.00	131.50	115.50	140.00	110.50	318.00
Land rent		-	-	-	-	-	-
Total fixed cost		146.50	158.50	133.50	175.50	131.50	359.00
Seed		169.88	667.17	555.97	7283.85	693.00	-
Manure and fertilisers		1890.00	1750.00	780.00	3422.57	1150.00	5200.00
Irrigation		-	-	-	-	-	-
Human labour		1650.50	1725.00	1260.00	2590.00	1300.00	6500.00
Bullock / Tractor Labour		175.00	175.00	150.00	200.00	-	-
Plant protection chemicals		-	-	-	2126.00	-	11280.00
Interest on working capital		233.12	259.03	164.76	180.00	189.00	1350.00
Miscellaneous		40.00	40.00	40.00	100.00	50.00	200.00
Total variable cost		4158.50	4616.20	2950.73	15902.42	3382.00	24530.00
Gross cost		4305.00	4774.70	3084.23	16077.92	3513.50	24889.00
Value of by-product		1580.00	750.00	500.00	-	-	-
Net Cost (Gross cost – value of by- product)		2725.00	4024.70	2584.23	16077.92	3513.50	24889.00
Yield (Quintals)	**Main product**	24.04	7.70	11.26	111.81	3.91	41.08
	By-product	26.30	11.50	13.65	-	1.88	-
Cost of production (Rs. / Qtl.) (Net cost/Yield of main product)		113.35	522.69	229.50	143.80	898.59	605.87
Market price of main product (Rs. /Qtl.)		475.00	610.00	570.00	349.00	1921.00	1560.00

Table 7.2 (d): Economics of Crop Production in district Kinnaur of High hill dry zone

(Rs. / Ha)

Particulars		Maize	Wheat	Barley	Ogla	Fafra	Rajmash	Kidney Bean	Potato	Pea	Apple
Depreciation (Building, farm equipment)		18.07	16.75	16.50	18.22	18.30	19.50	19.00	25.08	21.20	50.00
Interest on fixed capital		80.40	75.20	75.20	78.00	78.00	82.06	81.50	83.60	82.25	110.50
Land rent		-	-	-	-	-	-	-	-	-	-
Total fixed cost		98.47	91.95	91.70	96.22	96.30	101.56	100.50	108.68	103.45	160.50
Seed		349.25	862.90	640.33	1126.29	700.31	3435.10	3800.00	4554.00	2311.92	-
Manure and fertilisers		1260.40	1575.00	750.67	966.14	984.14	1025.50	1227.53	2745.00	2186.90	4887.00
Irrigation		25.00	25.00	25.00	25.00	25.00	25.00	25.00	37.00	30.00	-
Human labour		1455.00	1510.00	1120.00	1225.50	1260.00	1580.50	1585.00	2260.00	3040.00	7190.00
Bullock / Tractor Labour		-	-	-	-	-	-	-	-	-	-
Plant protection chemicals		-	-	-	-	-	-	-	1850.00	910.00	8500.00
Interest on working capital		154.48	198.64	126.80	167.15	148.47	203.05	210.50	215.60	200.15	250.00
Miscellaneous		50.00	50.00	50.00	50.00	50.00	50.00	50.00	75.00	75.00	100.00
Total variable cost		3294.13	4221.54	2712.80	3560.08	3167.92	6319.15	6898.03	11736.60	8753.97	20927.00
Gross cost		3392.60	4313.49	2804.50	3656.30	3264.22	6420.71	6998.53	11845.28	8857.42	21087.50
Value of by-product		1145.00	1137.00	881.00	1642.50	1697.50	996.00	-	-	2677.80	-
Net Cost (Gross cost – value of by-product)		2247.60	3176.49	1923.50	2013.80	1566.72	5424.71	6998.53	11845.28	6179.62	21087.50
Yield (Quintals)	**Main product**	13.19	10.85	8.67	16.32	17.41	10.15	16.67	57.03	54.35	105.63
	By-product	22.90	22.74	17.62	32.85	33.95	19.92	-	-	89.26	-
Cost of production (Rs. / Qtl.) (Net cost/Yield of main product)		170.40	292.76	221.86	123.39	90.00	534.45	419.83	207.70	113.70	199.63
Market price of main product (Rs. /Qtl.)		480.00	550.00	580.00	1449.35	1000.00	2857.00	3000.00	594.00	1267.00	1692.00

Table 7.3: Input Output Relationship in Milk / Meat / Wool Production in Different Agro–Climatic Zones

Zone	Species	N	Intercept (a)	Value of Green Fodder (X_1)	Value of Dry Fodder (X_2)	Value of Concentrate (X_3)	Value of Labour (X_4)	Miscellaneous Expenses (X_5)	R^2
H.PUR	Crossbred Cow	12	1.872	0.325* (0.088)	0.147*** (0.141)	0.087*** (0.045)	0.174 (0.165)	0.370 (0.213)	0.973
	Buffalo	142	2.036	0.051*** (0.031)	0.421* (0.127)	0.251*** (0.147)	0.191 (0.163)	0.0769 (0.097)	0.876
SOLAN	Local Cow	46	0.326	1.152* (0.279)	-0.078 (0.106)	0.311*** (0.271)	0.169 (0.186)	0.063 (0.131)	0.497
	Crossbred Cow	144	0.699	0.220*** (0.120)	0.535* (0.123)	0.005 (0.084)	0.398* (0.089)	0.434*** (0.366)	0.542
	Buffalo	43	4.218	0.251*** (0.142)	0.210*** (0.110)	-0.038 (0.131)	-0.042 (0.159)	-1.801 (1.838)	0.210
SHIMLA	Local Cow	53	2.039	0.419** (0.207)	-0.014 (0.319)	0.487 (0.561)	0.215 (0.218)	-0.187 (0.165)	0.625
	Crossbred Cow	121	7.204	0.492*** (0.281)	-0.508 (0.328)	0.184*** (0.102)	0.012 (0.130)	-0.276 (0.365)	0.033
KINNAUR	Local Cow	65	1.073	0.059** (0.026)	0.721*** (0.383)	0.361*** (0.153)	0.165 (0.051)	0.071 (0.069)	0.801
	Crossbred Cow	117	1.319	0.161*** (0.082)	0.801 (0.639)	0.329** (0.139)	0.411** (0.201)	0.083 (0.072)	0.850
	Sheep (Wool) Sheep (Meat)	16 16	4.812 4.327	0.023* (0.0086) 0.016 (0.019)	0.306** (0.120) 0.327** (0.131)	0.031 (0.071) 0.027 (0.065)	0.486* (0.097) 0.523* (0.106)	0.002 (0.005) 0.011*** (0.008)	0.892 0.852
	Goat (Meat)	13	5.772	0.014*** (0.006)	0.352** (0.128)	0.041 (0.430)	0.418* (0.109)	0.003 (0.004)	0.820

Figures in the parentheses indicate standard error of the respective regression coefficients. *Significant at one percent level; ** significant five percent levels: *** significant ten percent level

Table 7.4: Input Output Relationship in Crop Production in Different Agro–Climatic Zones

Zone	Crops	N	Intercept (a)	Value of Seed / Seedling (X_1)	Value of manures and fertilisers (X_2)	Value of Labour (X_3)	Value of Plant Protection Chemicals (X_4)	Miscellaneous Expenses (X_5)	R^2
HAMIRPUR	Maize	147	4.011	0.452* (0.088)	0.434* (0.063)	0.609* (0.245)	-	-0.079 (0.429)	0.581
	Wheat	147	1.991	0.629* (0.050)	0.227* (0.051)	0.537* (0.056)	-	0.273** (0.137)	0.815
	Barley	10	0.647	0.332 (0.467)	-0.227 (0.573)	0.781*** (0.316)	-	0.657 (0.357)	0.792
	Paddy	10	-0.333	1.875* (0.305)	-0.449 (0.325)	0.108 (0.158)	-	0.570 (0.349)	0.960
SOLAN	Maize	98	4.587	1.127* (0.081)	-0.163* (0.043)	0.207 (0.184)	-	-0.007 (0.161)	0.726
	Wheat	65	3.096	0.729*** (0.365)	-0.011 (0.42)	0.057*** (0.048)	-	0.159 (0.73)	0.786
	Barley	17	0.570	0.587* (0.150)	-0.213 (0.214)	0.594* (0.185)	-	0.487** (0.170)	0.908
	Pea	71	1.948	0.577* (0.092)	-0.074*** (0.039)	0.251*** (0.129)	0.668* (0.107)	0.689 (0.471)	0.685
	Tomato	96	2.297	0.891*** (0.510)	0.744* (0.089)	0.190 (0.173)	0.078* (0.021)	0.240 (0.175)	0.504
	Capsicum	17	0.679	0.0862* (0.0304)	0.356*** (0.195)	0.231 (0.327)	0.461*** (0.176)	0.236 (0.230)	0.733
SHIMLA	Maize	115	2.221	0.318*** (0.180)	0.189 (0.213)	0.397*** (0.221)	-	0.350 (0.263)	0.228
	Wheat	13	-3.185	1.031* (0.264)	-0.153 (0.168)	0.912* (0.176)	-	0.129 (0.113)	0.960
	Barley	100	6.572	-0.179 (0.387)	0.044 (0.168)	0.998*** (0.554)	-	0.131 (0.474)	0.011
	Potato	134	1.315	0.801*** (0.461)	0.489 (0.373)	0.597*** (0.341)	0.315*** (0.177)	0.078 (0.051)	0.876
	Rajmash	60	1.951	0.415*** (0.241)	0.747* (0.219)	0.050 (0.801)	-	0.137 (0.128)	0.839

	Apple	130	2.081	-	0.318*** (0.176)	0.865* (0.142)	0.461* (0.154)	0.023 (0.016)	0.921
KINNAUR	Maize	48	2.065	0.239*** (0.120)	0.105 (0.147)	0.427* (0.066)	-	0.072** (0.035)	0.681
	Wheat	25	4.580	0.099** (0.047)	0.221*** (0.125)	0.056* (0.021)	-	0.037 (0.091)	0.531
	Barley	30	1.213	0.439*** (0.216)	0.207 (0.168)	0.715*** (0.408)	-	0.203*** (0.112)	0.847
	Ogla	141	3.714	0.225** (0.098)	0.392*** (0.210)	0.776* (0.199)	-	0.048 (0.034)	0.212
	Fafra	140	3.328	0.233* (0.081)	0.369*** (0.205)	0.604* (0.168)	-	0.241* (0.088)	0.266
	Rajmash	53	1.513	0.361*** (0.274)	0.107* (0.039)	0.481*** (0.281)	-	0.069 (0.042)	0.871
	Kidney Bean	10	0.312	0.562** (0.199)	-0.110 (0.092)	0.764* (0.137)	-	0.219 (0.150)	0.990
	Potato	103	1.629	0.213* (0.048)	0.224* (0.056)	0.153 (0.115)	0.108** (0.049)	0.304 (0.242)	0.913
	Pea	25	3.459	-0.177 (0.311)	-0.378*** (0.200)	0.737*** (0.420)	0.888*** (0.497)	0.068 (0.217)	0.816
	Apple	145	1.183	-	0.068*** (0.047)	0.807* (0.129)	0.513** (0.231)	0.061*** (0.035)	0.904

Figures in the parentheses indicate standard error of the respective regression coefficients.

Significant at one percent level; ** significant five percent level: * significant ten percent level*

7.5 Incomes and Employment Generation from Livestock

Analyses of income and employment generation from various livestock are given in Table 7.5. Crossbred cow and buffalo are contributed significantly towards the net income and employment in all zones. Net income from local cow is significant in case of Solan but very less in Shimla. In Kinnaur, cattle are generally reared by the people for their own needs only. Returns from Goat and Sheep made their rearing, a profitable enterprise for the people of this zone.

Table 7.5: Income and Employment Generation from Livestock in Different Agro–Climatic Zones

(Rs/animal)

Particulars		Hamirpur	Solan	Shimla	Kinnaur
Local Cow	Gross income (Rs)	-	8146.33	7415.73	-
	Net income (Rs)	-	1260.01	493.56	-
	Family labour income (Rs)	-	2330.22	2054.87	2174.00
	Employment (man days)	-	52	46	54
Crossbred cow	Gross income (Rs)	12760.63	14463.38	17835.30	-
	Net income (Rs)	1070.98	4992.64	4751.50	-
	Family labour income (Rs)	3993.75	4079.82	3927.62	4185.25
	Employment (man days)	100	91	87	105
Buffalo	Gross income (Rs)	16102.30	15430.20	-	-
	Net income (Rs)	4288.18	3710.46	-	-
	Family labour income (Rs)	4037.62	4125.00	-	-
	Employment (man days)	90	92	-	-
Sheep	Gross income (Rs)	-	-	-	1640.00
	Net income (Rs)	-	-	-	1321.33
	Family labour income (Rs)	-	-	-	25.00
	Employment (man days)	-	-	-	-
Goat	Gross income (Rs)	-	-	-	2500.00
	Net income (Rs)	-	-	-	1936.04
	Family labour income (Rs)	-	-	-	50.00
	Employment (man days)	-	-	-	-
Yak	Gross income (Rs)	-	-	-	-
	Net income (Rs)	-	-	-	-
	Family labour income (Rs)	-	-	-	1480.00
	Employment (man days)	-	-	-	37

7.6 Income and Employment Generation from Crop Production

In case of crop production, cultivation of maize, paddy, pea, tomato, capsicum, potato, rajmash, ogla, fafra, kidney bean and apple offered handsome returns and employment generation.

Table 7.6: Income & Employment Generation from Crop Production in Different Agro–Climatic Zones

(Rs/ ha.)

Particulars		Hamirpur	Solan	Shimla	Kinnaur
Maize	Gross income (Rs)	11482.6	13124.81	12999.00	7476.20
	Net income (Rs)	7489.00	8397.07	8694.00	4083.60
	Family labour income (Rs)	7740	7920	6840	6900
	Employment (man days)	129	132	114	115
Wheat	Gross income (Rs)	10025.12	7695.40	5447.00	7104.50
	Net income (Rs)	5149.32	2914.46	672.30	2791.01
	Family labour income (Rs)	5880	6060	4920	4980
	Employment (man days)	98	101	82	83
Barley	Gross income (Rs)	7410.00	6114.00	6918.20	5909.60
	Net income (Rs)	2949.12	2810.35	3833.97	3105.10
	Family labour income (Rs)	4260	4560	3660	3840
	Employment (man days)	71	76	61	64
Barseem	Gross income (Rs)	-	-	-	-
	Net income (Rs)	-	-	-	-
	Family labour income (Rs)	3420	-	-	-
	Employment (man days)	57	-	-	-
Chari	Gross income (Rs)	-		-	-
	Net income (Rs)	-		-	-
	Family labour income (Rs)	2340	2220	-	-
	Employment (man days)	39	37	-	-
Paddy	Gross income (Rs)	8159.10	-	-	-
	Net income (Rs)	5735.08	-	-	-
	Family labour income (Rs)	8820	-	-	-
	Employment (man days)	147	-	-	-
Oat	Gross income (Rs)	-	-	-	-
	Net income (Rs)	-	-	-	-
	Family labour income (Rs)	2580	-	-	-

	Employment (man days)	43	-	-	-
Pea	Gross income (Rs)	-	50391.26	-	71539.25
	Net income (Rs)	-	41146.25	-	62681.83
	Family labour income (Rs)	-	9240	-	8880
	Employment (man days)	-	154	-	148
Tomato	Gross income (Rs)	-	152842.80	-	-
	Net income (Rs)	-	99287.38	-	-
	Family labour income (Rs)	-	10380	-	-
	Employment (man days)	-	173	-	-
Capsicum	Gross income (Rs)	-	68804.38	-	-
	Net income (Rs)	-	18264.16	-	-
	Family labour income (Rs)	-	8040	-	-
	Employment (man days)	-	134	-	-
Potato	Gross income (Rs)	-	-	39021.69	33875.82
	Net income (Rs)	-	-	22943.77	22030.54
	Family labour income (Rs)	-	-	5820	5520
	Employment (man days)	-	-	97	92
Rajmash	Gross income (Rs)	-	-	7511.11	29994.55
	Net income (Rs)	-	-	3997.61	23573.84
	Family labour income (Rs)	-	-	3660	3840
	Employment (man days)	-	-	61	64
Apple	Gross income (Rs)	-	-	64084.80	178725.96
	Net income (Rs)	-	-	39195.80	157638.46
	Family labour income (Rs)	-	-	11640	11820
	Employment (man days)	-	-	194	197
Ogla	Gross income (Rs)	-	-	-	25295.89
	Net income (Rs)	-	-	-	21639.59
	Family labour income (Rs)	-	-	-	3900
	Employment (man days)	-	-	-	65
Fafra	Gross income (Rs)	-	-	-	19107.50
	Net income (Rs)	-	-	-	15843.28
	Family labour income (Rs)	-	-	-	3780
	Employment (man days)	-	-	-	63
Kidney Bean	Gross income (Rs)	-	-	-	50010.00
	Net income (Rs)	-	-	-	43011.47
	Family labour income (Rs)	-	-	-	4020
	Employment (man days)	-	-	-	67

Chapter-8

INCREASING INCOME AND EMPLOYMENT THROUGH ADOPTION OF IMPROVED TECHNOLOGY IN LIVESTOCK-CROP PRODUCTION SYSTEMS

8.1 Income and employment generation from different LCPS

Income and employment generation from different livestock- crop production systems is revealed in Table 8.1. This is calculated by adding gross, net and family labour income from different crops and bovine enterprises in each zone. Similarly, employment generation is worked out in each LCPS.

Table 8.1: Income & Employment Generation from different LCPS in Different Agro–Climatic Zones

(/HH/annum)

Particulars	LCPS	Hamirpur	Solan	Shimla	Kinnaur
Gross income (Rs)	Local cow	-	307118	143398	436395
	Crossbred cow	49838	313435	153817	442340
	Buffalo	53179	314402	-	-
	Local + CB cow	-	-	161233	449695
	CB cow + buffalo	65940	328865	-	-
	Local + CB cow + buffalo	-	337011	-	-
Net income (Rs)	Local cow	-	174078	79832	356577
	Crossbred cow	22393	177811	84090	358280
	Buffalo	25610	176528	-	-
	Local + CB cow	-	-	84584	358458
	CB cow + buffalo	26681	181521	-	-
	Local + CB cow + buffalo	-	182761	-	-
Family labour income (Rs)	Local cow	-	50750	38595	59744
	Crossbred cow	39029	52500	40468	61755
	Buffalo	39068	52545	-	-
	Local + CB cow	-	-	42523	63929
	CB cow + buffalo	43062	56625	-	-
	Local + CB cow + buffalo	-	58955	-	-
Employment (man days)	Local cow	-	859	655	1012
	Crossbred cow	684	898	696	1063
	Buffalo	674	899	-	-
	Local + CB cow	-	-	742	1117
	CB cow + buffalo	774	990	-	-
	Local + CB cow + buffalo	-	1042	-	-

**Hamirpur LCPS 2 (CB cow + buffalo): Gross income (Rs) 58530; Net income (Rs) 23732; Family labour income (Rs) 33892; Employment (man days) 621*

8.2 Potential income and employment generation from different LCPS

Potential income and employment generation in different agro-climatic zones under different livestock- crop production systems is calculated by identifying farmers having maximum yield of milk and different crops. This may be largely due to the use of improved technology and mix of recommended package of practices. Results are revealed in Table 8.2.

In Hamirpur district of low hill sub-tropical zone under LCPS 1, gross income, net income, family labour income and employment days generated are Rs. 53179, Rs. 25610, Rs. 39068 and 674 days respectively, whereas potential income and employment days are Rs. 70349, Rs. 37423, Rs. 44220 and 737 days respectively. Under LCPS 2, gross income, net income, family labour income and employment days generated are Rs. 58530, Rs.23732, Rs. 33892 and 621 days respectively, whereas potential income and employment days under this system comes out to be Rs. 67393, Rs. 33805, Rs. 37200 and 637 days respectively.

In Solan district of mid hill sub-humid zone, under LCPS 1, gross income, net income, family labour income and employment days generated are Rs. 313435, Rs. 177811, Rs.52500 and 898 days respectively, whereas potential income and employment days are Rs. 370990, Rs. 201667, Rs. 57120 and 952 days respectively. Under LCPS 2, gross income, net income, family labour income and employment days generated are Rs. 328865, Rs.181521, Rs. 56625 and 990 days respectively, whereas potential income and employment days under this system comes out to be Rs. 402757, Rs. 249581, Rs. 59580 and 993 days respectively.

In Shimla district of high hill wet zone under LCPS 1, gross income, net income, family labour income and employment days generated are Rs. 153817, Rs.84090, Rs. 40468 and 696 days respectively, whereas potential income and employment days are Rs. 166227, Rs.92835, Rs. 42480 and 708 days respectively. Under LCPS 2, gross income, net income, family labour income and employment days generated are Rs. 161233, Rs.84584, Rs. 42523 and 742 days respectively, whereas potential income and employment days under this system comes out to be Rs. 172633, Rs. 92491, Rs. 43980 and 753 days respectively.

In Kinnaur district of high hill dry zone under LCPS 1, gross income, net income, family labour income and employment days generated are Rs. 442340, Rs. 358280, Rs. 61755 and 1063 days respectively, whereas potential income and employment days are Rs. 467915, Rs. 367107, Rs. 62819 and 1108 days respectively. Under LCPS 2, gross income, net income,

family labour income and employment days generated are Rs. 449695, Rs.358458, Rs. 63929 and 1117 days respectively, whereas potential income and employment days under this system comes out to be Rs. 470893, Rs. 361348, Rs. 65408 and 1151 days respectively.

Table 8.2: Potential Income & Employment Generation from Different Livestock Crop Production Systems in Different Agro–Climatic Zones *(/ Household / annum)*

Particulars		Hamirpur	Solan	Shimla	Kinnaur
LCPS 1	Gross income (Rs)	70349	370990	166227	467915
	Net income (Rs)	37423	201668	92835	367107
	Family labour income (Rs)	44220	57120	42480	62819
	Employment (man days)	737	952	708	1108
LCPS 2	Gross income (Rs)	67393	402757	172633	470893
	Net income (Rs)	33805	249581	92491	361348
	Family labour income (Rs)	37200	59580	43980	65408
	Employment (man days)	637	993	753	1151

Hamirpur

LCP 1- Buffalo (137) + Maize (135) + Wheat (135) + Barseem (76) + Paddy (8) + Barley (10) + Chari (2) + Oat (2) + Arbi (4) + Turmeric (1)
LCP 2- Crossbred cow + Buffalo (4) + Maize (4) + Wheat (4) + Barseem (1) + Paddy (1)

Solan

LCP 1- Crossbred Cow (75) + Wheat (28) + Maize (42) + Barley (5) + Tomato (42) + Pea (34) + Capsicum (6) + Chari (1)
LCP 2- CB Cow + Buffalo (22) + Wheat (10) + Maize (21) + Barley (6) + Tomato (20) + Pea (18) + capsicum (8) + Chari (2)

Shimla

LCP 1- Crossbred cow (91) + Maize (73) + Wheat (9) + Barley (69) + Potato (89) + Rajmash (41) + Apple (85)
LCP 2- Local cow + Crossbred cow (21) + Maize (17) + Wheat (1) + Barley (14) + Potato (20) + Rajmash (11) + Apple (21)

Kinnaur

LCP 1- Crossbred cow (71) + Ogla (70) + Potato (53) + Pea (10) + Rajmash (25) + Apple (71) + Fafra (69) + Maize (28) + Wheat (11) + Barley (15) + Kidney bean (6)
LCP 2- Local cow + Crossbred cow (30) + Ogla (28) + Potato (19) + Pea (4) + Rajmash (11) + Apple (30) + Fafra (28) + Maize (9) + Wheat (3) + Barley (2) + Kidney bean (1)

8.3 Gaps in Potential and Existing Income and Employment

Gaps in potential and existing income and employment under different livestock- crop production systems are worked out by subtracting the existing gross, net & family labour income and employment generation in man days from the potential income and employment.

Similarly, percentages of potential over the existing income and employment are worked out and given in parentheses. The results are presented in Table 8.3.

In district Hamirpur, LCPS 1 has vast potential for increasing income and employment for the farmers. The gaps in potential and existing level of gross income, net income, family labour income and employment are 32.29, 46.13, 13.19 and 9.35 percent respectively. The gaps in LCPS 2 are relatively lesser than that of LCPS 1. In case of Solan district, there is a potential to increase income and employment in LCPS 2 as compared to LCPS 1. In district Shimla and Kinnaur, LCPS 1 has greater potential for increasing the income and employment of the farmers as gaps are higher than that of LCPS 2.

Table 8.3: Gaps in Income and employment generation under different LCPS

Particulars	LCPS	Hamirpur	Solan	Shimla	Kinnaur
Gross income (Rs)	LCPS 1	17170 (32.29)	57555 (18.36)	12410 (8.07)	25575 (5.78)
	LCPS 2	8863 (15.14)	73892 (22.47)	11400 (7.07)	21198 (4.71)
Net income (Rs)	LCPS 1	11813 (46.13)	23857 (13.42)	8745 (10.40)	8827 (2.46)
	LCPS 2	10073 (42.44)	68060 (37.49)	7907 (9.35)	2890 (0.81)
Family labour income (Rs)	LCPS 1	5152 (13.19)	4620 (8.80)	2012 (4.97)	1064 (1.72)
	LCPS 2	3308 (9.76)	2955 (5.22)	1457 (3.43)	1479 (2.31)
Employment (man days)	LCPS 1	63 (9.35)	54 (6.01)	12 (1.72)	45 (4.23)
	LCPS 2	16 (2.58)	3 (0.30)	11 (1.48)	34 (3.04)

Figures in parenthesis are the percentages of potential over the existing for the LCPS in the zone

Chapter-9

CONSTRAINTS IN MARKETING OF CROPS AND LIVESTOCK PRODUCTS

9.1 Production and Financial constraints in crop production

Production and Financial constraints in case of crop production as reported by the farmers of Hamirpur district are high incidence of insects/ pests in HYVs followed by high cost of credit and lack of credit availability from institutional sources. Lack of knowledge about recommended package of practices is the reason of lower productivity of various crops and higher cost of production. Though constraints like lack of timely availability of good quality seeds, poor communication & extension facilities, lack of capital resources and inadequate irrigation facilities are rated low on scale by the farmers but their combined impact hampers the crop production in the zone.

In Solan, inadequate irrigation facilities, high cost of credit and lack of availability of agricultural labour during peak seasons are the major constraints reported by the farmers in production of cash crops like pea, tomato and capsicum. High incidences of insects, pests and diseases in vegetable crops made them less remunerative to the farmers and require proper attention of the concerned authorities.

High cost of credit, inadequate irrigation facilities, lack of knowledge about recommended package of practices and poor communication and extension facilities are the major constraints faced by the farmers in crop production in district Shimla.

In district Kinnaur, inadequate irrigation facility is the major constraint faced by the farmers in crop farming. Other constraints faced by the farmers in production of crops are lack of knowledge about recommended package of practices, lack of timely availability of good quality seeds, poor communication and extension facilities etc.

Constraints faced in crop production under different livestock- crop production systems in different agro- climatic zones are presented in Table 9.2.

9.2 Marketing constraints in crop production

Lack of marketing facilities at village level is the major constraint reported by the farmers in district Hamirpur. The farmers are also reported the constraint of low price of farm output, high prices of plant protection chemicals. Similar results are revealed in case of various livestock- crop production systems in this zone (see Table 9.2).

In district Solan again high prices of plant protection chemicals and lack of marketing facilities at the village level are the major constraints reported by the farmers in crop production followed by the low price of farm produce and lack of storage facilities like cold storage. In Shimla district, high prices of plant protection chemicals followed by low price of farm produce and lack of storage facilities are the major constraints, especially in the production of Apple and off- season vegetables. Low price of farm produce and lack of storage facilities followed by high prices of plant protection chemicals are the major marketing constraints in Kinnaur district.

Table 9.1: Constraints Faced in Crop Production in Different Agro–Climatic Zones

(Rank)

Particulars	Hamirpur	Solan	Shimla	Kinnaur
Production & Financial constraints				
Lack of timely availability of good quality seeds	5	7	6	3
Inadequate irrigation facilities	8	1	2	1
High incidence of diseases	10	4	7	5
High incidence of insects pests in HYVs	1	4	5	6
Lack of knowledge about recommended package of practices	4	6	3	2
Poor communication and extension facilities	6	9	4	4
Lack of capital resource	7	5	8	7
Lack of credit availability from institutional sources	3	8	9	8
High cost of credit	2	2	1	2
Lack of agricultural labour in peak seasons	9	3	10	9
Marketing Constraints				
High prices of plan protection chemicals	3	1	1	3
Lack of marketing facilities at village level	1	1	4	5
Low price of farm produce	2	2	2	1
Lack of storage facilities	5	3	3	2
Lack of cheap and efficient transport	4	4	5	4
Delayed payment by marketing agencies	6	5	6	6

Table 9.2: Constraints Faced in Crop Production under different LCPS in Different Agro–Climatic Zones

(Rank)

Particulars	Hamirpur		Solan		Shimla		Kinnaur	
	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2
Production & Financial constraints								
Lack of timely availability of good quality seeds	5	5	7	8	6	5	3	3
Inadequate irrigation facilities	8	9	1	1	2	2	1	1
High incidence of diseases	10	10	4	4	7	6	5	5
High incidence of insects pests in HYVs	1	1	4	5	5	7	6	6
Lack of knowledge about recommended package of practices	4	4	6	7	3	3	2	2
Poor communication and extension facilities	6	7	9	10	4	4	4	4
Lack of capital resource	7	6	5	6	8	8	7	7
Lack of credit availability from institutional sources	3	3	8	9	9	10	8	8
High cost of credit	2	2	2	2	1	1	2	2
Lack of agricultural labour in peak seasons	9	8	3	3	10	9	9	9
Marketing Constraints								
High prices of plan protection chemicals	3	2	1	1	1	1	3	3
Lack of marketing facilities at village level	1	1	2	3	4	4	6	5
Low price of farm produce	2	3	3	2	2	2	1	1
Lack of storage facilities	5	5	3	4	3	3	2	2
Lack of cheap and efficient transport	4	4	4	5	5	5	4	4
Delayed payment by marketing agencies	6	6	5	6	6	6	5	6

9.3 Production and Financial constraints in livestock farming

In case of livestock farming, low productivity of animals is the major constraint reported by the sample farmers of Hamirpur, Shimla and Kinnaur district. This is followed by lack of availability of green fodder round the year and high costs of feeds and fodders. Low rate of conception through AI followed by lack of availability of green fodder round the year and high costs of feeds and fodders are the major production & financial constraint reported by the sample farmers in Solan district. Similar ranks of these constraints are also observed in case of LCPS under study.

9.4 Marketing constraints in livestock farming

Ranks of different constraints as reported by the samples farmers in different zones and LCPS in marketing of livestock products are presented in Table 9.3 and 9.4. It

may be seen from these table that, lack of organized market and low price for crossbred milk are the major constraints in all the four zones. Similar is the case in different livestock- crop production systems.

Table 9.3: Constraints Faced in Livestock Farming in Different Agro–Climatic Zones

(Rank)

Particulars	Hamirpur	Solan	Shimla	Kinnaur
Production & Financial constraints				
Low productivity of animals	1	7	1	1
Poor quality of bulls at village	6	6	5	7
Problem of heat detection	5	9	7	5
Lack of AI and veterinary facilities	9	6	3	3
Low rate of conception through AI	7	1	6	6
Non-availability of land for fodder cultivation	4	4	8	4
Lack of availability of green fodder round the year	2	2	4	2
Low availability of dry fodder	8	5	10	3
High costs of feeds and fodders	3	3	2	10
Inadequate knowledge about balanced feeding	11	8	11	9
Improper housing facilities	10	10	9	8
Marketing Constraints				
Lack of organized market	1	1	2	-
Low price for crossbred milk	2	2	1	-
Lack of cold storage facilities	3	3	3	-

Table 9.4: Constraints Faced in Livestock Farming under different LCPS in Different Agro–Climatic Zones

(*Rank)*

Particulars	Hamirpur		Solan		Shimla		Kinnaur	
	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2	LCP 1	LCP 2
Production & Financial constraints								
Low productivity of animals	1	1	7	7	1	1	1	1
Poor quality of bulls at village	6	6	6	6	5	5	7	7
Problem of heat detection	5	5	9	9	7	7	5	5
Lack of AI and veterinary facilities	9	10	6	6	3	4	3	3
Low rate of conception through AI	7	7	1	1	6	6	6	6
Non-availability of land for fodder cultivation	4	4	4	5	8	9	4	4
Lack of availability of green fodder round the year	2	2	2	2	4	3	2	2
Low availability of dry fodder	8	9	5	4	10	10	3	3
High costs of feeds and fodders	3	3	3	3	2	2	9	10
Inadequate knowledge about balanced feeding	11	11	8	8	11	11	10	9
Improper housing facilities	10	8	10	9	9	8	8	8
Marketing Constraints								
Lack of organized market	1	1	1	1	2	2	-	-
Low price for crossbred milk	2	2	2	2	1	1	-	-
Lack of cold storage facilities	3	3	3	3	3	3	-	-

Chapter 10

CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

In Himachal Pradesh livestock are largely raised on pastures. Cattle of this area are non- descript, short statured and of low productivity. Sheep and goats are as important as cattle. The sheep reared in this State yield good quality wool. Temperate hilly regions of Himachal Pradesh are ideally suited for the exotic high yielding milch cattle and Merino sheep. Livestock rearing is practised generally within the framework of mixed farming. The mechanized system of cultivation is not prevalent in the State, because of terraced fields and smallholdings. Thus, the bulk of draft power requirements are provided by the bullocks. In most of the villages vehicular traffic is not possible, therefore, most of the commodities are still transported by the pack animals like ponies, mules, sheep, goats etc.

Since the net sown area is lesser, farmers generally do not grow any fodder crop on farmland. Irrigation facilities are meagre. In the dry zone, cultivation is done mainly on irrigated fields. While in low and mid hill zones cultivation is generally done under rain fed conditions.

The livestock economy in the State is mainly bovine based in the low and mid hill zones, whereas it is goat, sheep based in the high hill dry zone. The density of livestock per sq. km is higher in low hills and lower in high hill zones.

Out of the various LCPS identified in different zones, it was found that rearing of Buffalo combined with farming of different crops including cereals, vegetable etc. has a vast potential for increasing income and employment in low- hill sub tropical and mid- hill sub humid zone. On the other hand, rearing of crossbred cow combined with farming of cash crops like fruits and vegetables has a good potential for increasing income and employment of the farmers in high- hill temperate wet and dry zone of Himachal Pradesh.

The production traits such as age at first calving, lactation length, dry period, inter-calving period, average lactation yield and average daily milk yield in milch animals in all the four zones are below optimum level. This results in higher cost of

production of milk and milk products and the profit margin for the farmers is on lower side, which makes dairy farming a less remunerative enterprise.

Input- output relation in milk, meat and wool production indicated that the feeding of animals with green fodder, dry fodder and concentrates should be increased in a balanced way to increase the productivity of milch animals.

The resource use efficiency indicated that there is a scope to increase crop output by efficient use of inputs in the cultivation of different crops. It may be concluded that the farmers should use more of HYV seeds, labour and plant protection chemicals in the crops. Use of manures and fertilisers should also be increased in certain crops like tomato, capsicum, potato, apple etc. Whereas manures and fertilizers in case of maize, wheat, paddy, barley, pea can be turned into positive and used efficiently if proper irrigation arrangements would be done.

Crossbred cow and buffalo are contributed significantly towards the net income and employment generation in all zones. Net income from local cow is relatively more in case of mid hill zone and less in high hill dry zone. Production of maize, paddy, pea, tomato, capsicum, potato, rajmash, ogla, fafra, kidney bean and apple offered remunerative returns and employment to the farmers.

High cost of credit, inadequate irrigation facilities, lack of knowledge about recommended package of practices, lack of marketing facilities at village level and low price of farm produce are the major constraints in crop production as reported by the farmers.

In case of livestock farming, low productivity of animals, low rate of conception through AI, high costs of feeds and fodders, lack of organized market and low price for crossbred milk are the major constraints.

10.2 Recommendations

The following recommendations are emerged from the study for improving the livestock- crop production systems in Himachal Pradesh:

- For obtaining higher returns from dairy animals proper breeding, feeding and weaning of livestock is urgently required. These are presently lacking due to hilly terrain and inaccessible villages.

- The concentration of buffaloes is higher in low hill areas whereas cows are predominant in mid and high hill areas. The development strategy should address this particular fact.

- The cultivation of fodder crop on farm is negligible. Farmers are dependent on CPRs and own grasslands for obtaining fodder for the livestock. It is suggested that the agro- forestry on degraded CPR lands for both soil and water conservation and enhancing green leaf fodder supply is very essential. The programme for improving the fodder production efficiency on private land by providing seed/ sapling should be taken on large scale. Rotary chaff- cutter should be popularised in the rural areas.

- The quality of cattle feed available in the market is poor and priced high. As a result the use of cattle feed is very low. This results in poor milk yield and animal health. This problem required intervention of the concerned government agencies.

- Lack of veterinary facilities especially at village level requires urgent attention.

- To improve efficiency of milk marketing system, there is a need for training and advocacy of co- operative principles.

- In remote areas of the State, there is a considerable quantity of milk available for sale, but cannot be disposed off, as there are no marketing facilities. The dairy farmers in such areas do not have the knowledge of co- operative milk marketing.

- Training programmes related to breeding, feeding and management practices should be organised at village level for the farmers including men and women.

For promotion of livestock- crop production system following approach is suggested:

Sustainable increase in food grain production through extension of improved crop varieties, particularly in agro- pastoral areas, improving marginal croplands and improving water use and irrigation system – including promotion of water harvesting and efficient use technologies. The croplands should also provide more opportunities for livestock development through processing of feed from agricultural by- products and production of more forage and hay. The crop- livestock production system cannot

progress unless a productive crop farming system is established. Ensuring sufficient food grain means developing a potential supply of concentrated feed with a high quality grain base. Increasing the productivity of major cropland also means that more marginal areas can be devoted to developing artificial grassland and cultivating perennial forage integrated with crops.

Sustainable development of livestock farming in crop dominated areas, made possible by giving priority to the production of animal feed and the development of markets for livestock products. In order to increase the production of feed, it is very important to improve the forage production technologies associated with cropland. Developing multiple cropping systems for forage production and using barley and wheat straw for livestock feed are the most promising options. The focus should be on optimising the agricultural production structure, achieving sustainable increases in productivity, improving the quality of agro- products, promoting the income generating capability of agricultural production and conserving environment.

Appendix 1: Input-Output Levels in Milk/ Meat Production in Different Agro-Climate Zones

(Milch Animals/Day)

Input-Output		Species / Breed of Animals					
		Local Cow	CB Cow	Buffalo	Goat	Sheep	Yak
HAMIRPUR	Green Fodder (kg.)	-	14.75	13.55	-	-	-
	Dry Fodder (kg.)	-	5.00	4.65	-	-	-
	Concentrates (kg.)	-	2.00	1.63	-	-	-
	Human Labour (Man days)	-	7.50	6.45	-	-	-
	Milk (Litres)	-	4.71	4.86	-	-	-
	Meat (kg.)	-	-	-	-	-	-
SOLAN	Green Fodder (kg.)	8.50	13.95	11.45	-	-	-
	Dry Fodder (kg.)	3.68	5.05	4.13	-	-	-
	Concentrates (kg.)	1.00	1.80	1.22	-	-	-
	Human Labour (Man days)	8.15	7.00	6.20	-	-	-
	Milk (Litres)	2.09	5.03	4.09	-	-	-
	Meat (kg.)	-	-	-	-	-	-
SHIMLA	Green Fodder (kg.)	6.55	14.30	-	-	-	-
	Dry Fodder (kg.)	3.20	5.60	-	-	-	-
	Concentrates (kg.)	1.00	1.50	-	-	-	-
	Human Labour (Man days)	6.25	7.00	-	-	-	-
	Milk (Litres)	2.22	5.00	-	-	-	-
	Meat (kg.)	-	-	-	-	-	-
KINNAUR	Green Fodder (kg.)	4.00	6.50	-	1.00	1.00	9.50
	Dry Fodder (kg.)	3.50	8.00	-	1.50	1.00	8.00
	Concentrates (kg.)	1.00	1.50	-	0.50	0.25	1.00
	Human Labour (Man days)	6.00	7.00	-	15.00	15.00	3.00
	Milk (Litres)	2.07	2.89	-	1.50	-	-
	Meat (kg.)	-	-	-	25.00	17.00	-
	Wool (Kg)	-	-	-	-	3.00	-

Appendix 2: Prices of Inputs, Outputs and Animals in Different Agro-Climatic Zones.

Particulars	HAMIRPUR	SOLAN	SHIMLA	KINNAUR
Green fodder (Rs/kg)	1.00	1.00	1.25	1.35
Dry fodder (Rs/kg)	2.00	2.00	2.15	2.45
Concentrate (Rs/kg)	9.00	8.50	10.50	11.00
Male Labour (Rs/day)	80.00	100.00	100.00	80.00
Female Labour (Rs/day)	65.00	80.00	80.00	60.00
Local cow (Rs/animal)	-	2775	1911	1959
Crossbred cow (Rs/animal)	8292	14015	8076	11796
Buffalo (Rs/animal)	14829	13076	-	-
Bullock pair (Rs/pair)	4500	5700	4250	4000
Sheep (Rs/animal)	-	-	-	1892
Goat (Rs/animal)	-	-	-	1925
Yak (Rs/animal)	-	-	-	7200
Cow Milk (Rs/litre)	9.75	10.00	9.89	-
Buffalo Milk (Rs/litre)	15.00	12.75	-	-
Beef (Rs/kg)	-	-	-	-
Mutton (Rs/kg)	-	-	-	100.00
Pork (Rs/kg)	-	-	-	-
A I (Rs / dose)	10.00	10.00	10.00	10.00
Dung (Rs / kg)	1.50	1.50	1.00	2.00