CHAPTER 4

The State of Mountain Agriculture in India

Introduction

The Indian Himalayas cover an area of 53.8 million ha, approximately 16% of the total geographical area of the country. About 15% of the area is permanently covered with snow and provides a perennial flow of water, 1,200 cu km annually, to the vast Indo-Gangetic plains (Chandra 1994). The Himalayan hill and mountain agro-ecosystem has been classified into five agroecological zones. They represent wide variations in climate from cold arid to warm and humid. Annual rainfall in the region varies from <150 mm to 2,600 mm, and the mean annual temperature from 8°C to 22°C. The growing period for different crops ranges from 90 to >270 days in a year. The major soil groups are skeletal, calcareous to brown forest podzolic, and brown red and red yellow, and are all alkaline.

Socioeconomic characteristics and land-use patterns

The Himalayan region of India is home to 33.8 million people. The region is sparsely populated with an overall population density of 627 per 1,000 ha. Agriculture is the main occupation of the mountain population, providing direct employment to about 71% of the working population. Agriculture is the primary sector of the economy, contributing 45% to the total regional income of the inhabitants. The net cultivated area is higher in the western Himalayan region (15.8% of the total geographical area) than in the north-eastern part (9.8%). The net cultivated area varies from 2.7% in Arunachal Pradesh to 40.9% in the Darjeeling District of West Bengal. Forest is the major land use and accounts for nearly 59% of the total area of the Indian Himalayas.

Himachal Pradesh covers four different physiographic regions (outer, lower, higher, Himalayas). Uttar Pradesh (UP) is predominantly flat but includes the hilly and mountainous region of Uttarakhand which covers an area of 5930 sq. km and is inhabited by 5.93 million people (1991). Approximately 981,000 ha of HP, and 970,000 ha of the U.P. hills, Uttar Pradesh (UP) are cultivated; 17%, and 19% of the total geographical area of each state, respectively.

Table 4.1 shows the average size of landholdings classified into marginal, small, semi-medium, medium, and large. The great majority of the farming households in the Himalayan states are marginal subsistence farmers with landholdings of less than 0.5 ha or small landholders with farms of 0.5 to 1.0 ha.

Table 4.1
Status of landholdings in the Western Himalayas

Size of holding (ha)	Farm category	Percentage of operational holdings		
		J&K	HP	UP hills
Below 0.5	Marginal	45.68	39.4	53.0
0.5-1.0	Small	24.51	22.2	18.0
>1.0-2.0	Semi medium	17.00	20.6	16.0
>2.0-5.0	Medium	11.39	14.3	11.0
>5.0-0	Large	1.42	3.5	2.0

Source: Khosla and Raina (n.d.)

The average landholding size in the HP is estimated to be about 1.2 hectares. The great majority of the farmers have scattered marginal or small landholdings. The main crops are maize, wheat, rice, pulses, and vegetables. The average landholding size in the UP hills is 0.97 ha. The main crops are paddy and millet (small) in summer and wheat and barley in the winter.

In the north-eastern Indian Himalayas the predominant land-use system is shifting cultivation or 'jhum', which supports 1.6 million tribal people over an area of 426 million hectares (Partap and Watson 1994) (Table 4.2). In Nagaland State, an estimated 1,000 sq. km of sloping land is brought under shifting cultivation every decade. As a result of the increased population, the fallow period has dropped from 14 to 5 years.

Table 4.2
Area under shifting cultivation in the Eastern Himalayan states

State	Area under Shifting Cultivation	No. of Families	% of population
Arunachal Pradesh	70,000	54,000	57.69
Assam	69,600	58,000	NA
Manipur	90,000	70,000	27.95
Meghalaya	53,000	52,290	34.58
Mizoram	63,000	50,000	80.74
Nagaland	19,000	116,046	27.95
Tripura	22,300	43,000	6.92

Source: ENVIS BULLETIN (1994)

Cropping Systems

The main cropping systems in the different agro-climatic zones of the western Himalayan states are shown in Table 4.3. The major food crops grown in the area are food grains (rice, wheat, maize, millets, barley, and buckwheat), pulses (beans, peas, kidney beans, black gram, horsegram, black soybean, lentils, green gram, and bengal gram), oil seeds (rapeseed, mustard, sesame seed, and linseed), potatoes and other vegetables, and sugarcane. These are intra and intercropped in various combinations.

Agriculture in the north-east Himalayan region (NEHR) is dominated by shifting cultivation which occupies 85% of the total cultivated area. A diverse mix of 8 to 10 crops is grown, but the productivity and production levels have been declining over the years. The economy is predominantly rural with a low yielding, rice-based farming system followed by wheat, maize, and millet.

Table 4.3
Cropping systems in the Western Himalayan states

Cropping systems	Low Hills Sub-tropical zone	Mid hills Sub humid zone	High hills Temperate zone
Himachal Pradesh			
Dry farming area	Maize-wheat Maize–gram Maize-mustard Sugarcane	Maize –wheat Maize-buckwheat-gram/barley Ginger-wheat/barley Maize-vegetables	Maize-wheat/barley Potato-fallow/potato Potato-peas/fallow
Irrigated area	Maize–mustard/wheat Maize-potato-wheat Paddy-wheat/clover Maize-vegetables Vegetables-wheat	Paddy-wheat Vegetables-wheat Potato-peas/wheat Maize-vegetables/wheat	Beans-cabbage Cabbage-peas Barley-buckwheat-fallow
Jammu and Kashmir			
Dry area	Maize/bajra-wheat Paddy/maize-Mustard/potato-wheat Rice-wheat-moong	Maize-wheat	
Irrigated area	Rice-wheat	Rice-wheat (summer vegetables, chillies, and summer pulses also grown)	Millets, wheat, fodder, pulses barley, oilseeds, and fruit are grown (only one cropping season)
UP Hills	Rice-wheat-barnyard millet-barley Minor millet-fallow-rice-wheat Soyabean-Black gram-horsegram-lentil-rice-wheat-tomato-potato Barnyard millet-mustard	Barnyard millet-wheat-minor millet-fallow Soyabean-Black gram-horsegram-barley-ard millet-wheat Rice-wheat Rice-potato Barnyard millet-lentil/mustard Tomato-barley	Frenchbean-potato-minor millet-fallow Barnyard millet-wheat-Black gram-soyabean Peas (vegetables)-potatoes-cabbage Rice-wheat French beans+amaranth-peas (vegetables) Peas-potatoes Tomatoes-cabbage

Compiled from Khosla and Raina (n.d..). Himalayan Farming Systems – R & D Support for Sustainable Agro-Economy. Dr. YS Parmar Univ. of Horticulture and Forestry, Solan. Himachal Pradesh

Food Grain Crops

In the Himalayan region, 76% of the gross cropped area is under food grain crops. The proportion is highest in Manipur (88%) and lowest in Meghalaya (55%). The remaining area is used to grow vegetable crops, fruit, and oil seeds. Nearly three quarters of the total area under food crops is occupied by grain species. The two Himalayan regions show distinct crop preferences. In the north-east, rice is the staple food and occupies 81% of the total area under food grains followed by maize (12.7%). Wheat is cultivated in small areas in Arunachal Pradesh, Meghalaya, Sikkim, and Tripura. This is in sharp contrast to the western Himalayan region where wheat is the principal crop (36.4% of the area) followed by rice (30.7%) and maize (26.3%).

Valley bottoms and river basins with assured irrigation water are used for growing rice and wheat as summer and winter crops, respectively. Maize is cultivated on upland slope terraces under rain-fed conditions. Millet is confined to the hill region of UP. The cultivation of pulses and

oil seeds is restricted to small areas only. There has been a sharp decline in the area of these crops as a result of outbreaks of pests and diseases and lack of availability of suitable varieties. The hill farmers are adopting more diversified agriculture with a high cropping intensity, ranging from 150 to 170%, as a result of the limited amount of land available for cultivation.

Table 4.4 shows the average yields of food grain crops in the three western regions in 1988-89 compared to the values for India as a whole. The productivity of rice, wheat, and barley in all three Himalayan states was below or well below the national average with the exception of rice in J&K. The yield of maize was somewhat lower than the national average in J&K and the UP hills, but considerably higher than the national average in HP.

Table 4.4
Average yields of food grain crops (Kg /ha) (1988-89)

Crop	Himachal Pradesh	J&K	UP Hills	All India
Rice	963	1599	1049	1541
Wheat	1176	889	1050	2053
Maize	1590	1018	1190	1237
Barley	1100	N/A	940	1460

Source: Compiled from Agricultural Situation in India, various issues, Ministry of Agriculture, GOI, New Delhi

Economic analysis

The general trend in major food grain crops was analysed by estimating the average annual growth rates in the area under cultivation, total production, and average yield per hectare of paddy, wheat, and maize in three states selected as examples—Himachal Pradesh (HP), Uttarakhand, and Meghalaya—using time series' data: the aim was to provide comparative economic indicators of the state of food grain crops over a ten-year period (up to 1991 or 1993) in the Himalayan states. The results are shown in Table 4.5.

Table 4.5
Average annual growth rates (%)of selected food grain crops
In three Indian Himalayan States

Crop	Himachal Pradesh (1981-1991)			Uttarakhand (1980-1993)			Meghalaya (1984-1991)		
	Area	Prod	Yield	Area	Prod	Yield	Area	Prod.	Yield
Paddy	-0.38	0.14	0.53	-0.13	1.35	1.48	-0.64	-1.62	2.30
Wheat	0.17	2.28	2.10	0.01	1.22	2.35	2.17	0.70	-1.38
Maize	-0.19	1.13	1.32	-0.94	-1.21	-0.26	0.05	-0.31	-1.46

The area under paddy and maize declined or remained nearly constant in all three states, and the area under wheat remained virtually constant in two—only increasing in Meghalaya. This reduction in area may have reflected a shift towards cultivation of cash crops such as fruit and vegetables. The yields of all three food grain crops increased in HP as did those of paddy and wheat in Uttarakhand, and of paddy in Meghalaya. But the yields of maize in Uttarakhand, and of wheat and maize in Meghalaya, actually declined.

Horticultural and Cash Crops

The Himalayan ecosystem has a sub-tropical to temperate climate favourable for growing a wide range of fruit, vegetables, and other cash crops. Small areas with their own micro-climatic

conditions can provide suitable sites for growing particular crops. The products include fruit such as apples, citrus crops, walnuts, plums, peaches, bananas, mangoes, and pineapples; vegetables such as tomatoes, radishes, potatoes, peas, cabbages, and cauliflower; other cash crops such as ginger, chillies, cardamom, and saffron; and flowers such as orchids, gladioli, marigolds, and chrysanthemums. The total area under fruit and vegetables in the Indian Himalayan states is estimated to be around 16% of the gross cropped area, which is much higher than the all India average of 4%, but it is not evenly distributed. The proportion of land under horticultural crops is much higher in the western Himalayan states (20% of net cultivated area) than in the north-east (5.0% of net cultivated area).

Himachal Pradesh has witnessed a phenomenal increase in fruit production over the last two decades. Table 4.6 shows the average annual growth rates in the area, production, and crop yield of various fruits and vegetables between 1981 and 1992. The total area cultivated for fruit increased from only 792 ha in 1950-51 to 190,000 ha in 1994-95. During the 20 years from 1974-75 to 1993-94 the area on which fruit crops are grown has increased by about 6% per annum, and that of apple orchards, the main fruit crop, by 6.9% per annum. Most of this growth was in the first decade.Fruit crop areas were as of 1997/98 reported to occupy 4.4% of the total geographical area of the state, with apple orchards about 40% of this. As much as 75 to 80% of the apple crop is exported to other parts of India and other countries. The production of fruit increased from 1,200 MT in 1950-51 to 532,000 MT in 1992.

Table 4.6
Average annual growth rates in the area, production and yield of various fruit and vegetable crops in Himachal Pradesh (1981-1992) (%)

	Area	Production	Yield
Apple	1.6	2.0	0.4
Temp. Fruits.	1.7	0.8	-0.9
Dry Fruits	2.4	3.3	0.9
Citrus	3.4	1.0	-2.3
Potato	-0.4	0.7	1.1
Vegetables	2.5	2.5	0.0
Dry Ginger	3.3	7.0	3.6

During the ten years from 1981 to 1992, the largest annual growth rate in terms of area was for citrus followed by dry ginger (3.3%) and vegetables (2.5%). The area of all other horticultural crops also increased with the exception of potatoes, which showed a slight decline. Dry ginger showed the highest growth rate in total production followed by dry fruits (3.3%) and vegetables (2.5%). Similarly, ginger showed the greatest growth rate in yield. The yields of temperate fruits and citrus dropped somewhat, although in both cases overall production increased slightly as a result of the increase in area cultivated.

The climate of the UP hills (Uttarakhand) is suitable for growing a range of temperate, subtropical, and tropical fruits as well as vegetables, flowers, ornamental plants, mushrooms, and medicinal plants. Table 4.7 shows the values for and growth rates in the area under cultivation, total production, and yield of various fruits and vegetables from 1984 to 1994. There were considerable shifts of land resources towards the growing of fruits and vegetables in this period.

Table 4.7

Area and production of fruits and vegetables in Uttarakhand ('000 hectares and '000 tonnes)

Items	Unit	1984/85	1989-90	1993/94	% Growth 1984-85 to 1989-90	% Growth 1989-90 to 1993-94
Fruit						
Area	'000 ha	142	166	179	16.90	7.26
Production	'000 tonnes	330	398	470	20.61	18.09
Yield	ha/tonne	2.32	2.40	2.63	3.45	9.58
Vegetables						
Area	'000 ha	34	49	65	44.12	32.65
Production	'000 tonnes	130	239	326	83.85	36.40
Yield	ha/tonne	3.82	4.88	5.02	27.75	2.87
Potatoes						
Area	'000 ha	12	16	19	33.33	18.75
Production	'000 tonnes	149	304	392	104.03	28.95
Yield	ha/tonne	12.42	19.00	20.63	52.98	8.58

Source: Mehta (1997)

Different vegetable crops are grown in the area lying between 300 and 1,400 masl. The land used for the production of various vegetables in the region increased from 34,000 ha in 1984-85 to 65,000 ha in 1993-94, 13% of the net area sown. The total production increased from 130,000 to 326,000 tonnes. The total area of potato crops increased from 12,000 to 19,000 ha, and production from 149,000 to 392,000 tonnes within the ten-year period, with a yield increase of 60%.

In Jammu and Kashmir (J&K), the horticultural sector contributes significantly to the state economy. The agro-climatic conditions are favourable for the production of a range of horticultural crops. The agro-climatic zones range from sub-tropical to intermediate to temperate and thus provide tremendous scope for the expansion of fruit and vegetable production. At present about 20% of the total cultivated area in the state is under horticultural crops. The area under fruit cultivation registered an enormous increase from 12,400 ha in the 1950s to 176,300 ha in 1990-91. Apples alone comprise about 40% of the total production of fruit in the state.

Livestock

The Himalayan region of India supports about 50 million domestic animals (1.6 animals/ha) for various purposes such as transportation and production of milk, meat, fur, wool, hide, and manure. The livestock pressure is higher in the Himalayas than in the plains. Stall feeding and settled grazing (kharak) is normally practised in the low and mid-hills, whereas nomadic or migratory grazing is common in the high hills.

A large proportion of livestock species is raised under mixed cropping systems. The landholdings are small and livestock supplement the family income. Animal dung and bedding material provide manure for the crops. Almost the entire energy requirement of hill agriculture is met from bullock or human power (Rao and Saxena 1994). In the Indian Himalayan region, cattle are the most common animals (47.5%), followed by goats (15.8%), buffaloes (12.3%), and sheep (10.4%) (Rao and Saxena 1994).

In Himachal Pradesh (the western region) livestock contribute about 13% of the gross domestic product. The total milk production increased from 529,190 tonnes to 653,850 tonnes between 1993 and 1998. The state now has one of the highest levels of milk availability per capita–320g per capita per day compared to 178g for all India. Livestock pressure is increasing in the mixed crop farming areas. In the low hills, the average number of livestock per household was reported to be 11, 53% cattle and 36% sheep and goats. In the mid-hills there were eight animals per farm under mixed farming systems, and nine under vegetable- based systems (Mahendra Dev 1994).

Table 4.8 shows the trends over time in the number of animals of different species and their proportion of the total in the ten years up to 1988 in Uttarakhand (central region) and 1992 in Himachal Pradesh. In both states the number of cattle declined slightly while the buffalo population increased significantly. Similarly, the number of sheep declined considerably, and the number of goats increased (Table 4.8).

Table 4.8
Changes in the livestock population and composition in Himachal Pradesh and the U.P. Hills, India

	1982		1992[1]		Change in population [1] (%)	Change in % share in livestock population[1]
	Population	Per cent composition	Population	Per cent composition		
Himachal Pradesh						
Cattle	2173663	44.0	2151616	42.7	-1.01	-1.3
Buffalo	616415	12.5	700917	13.9	13.7	1.4
Sheep	1090322	22.1	1074345	21.3	-1.47	-0.76
Goat	1059862	21.5	1115591	22.1	5.26	0.67
Total	4940262	100	5042469	100		
U.P. HILLS						
Cattle	1909929	47.9	1978331	46.5	3.6	-1.4
Buffalo	767461	19.3	846577	19.9	10.3	0.65
Sheep	407838	10.2	352640	8.3	-13.5	-1.94
Goat	901486	22.6	1075658	25.3	19.3	2.68
Total	3986714	100	4253206	100		

[1]1993 in case of U.P. HILLS

Sources: 1 Livestock Census Report (1982 & 1992), Govt. of Himachal Pradesh, India
2 Livestock Census Report (1982 & 1993), Govt. of Uttar Pradesh, India