

Chapter 5

Agriculture

Although cultivated land is only 15.5 per cent of the reporting area in the NWHRI (the geographical area being much larger), agriculture and its allied activities constitute the occupations of the major component of people living in the region. Statistics regarding distribution of workers show that between 65 and 75 per cent depend on agriculture for sustenance. Between 80 and 90 per cent of the population lives in rural areas. The total net sown area was about 1.98 million ha in 1991, which means that per capita availability of cultivated land was about 0.1 ha. Between 64 and 74 per cent of the land holdings were below one ha, the average being about 0.4 ha. These tiny holdings are often spread over many scattered parcels. A study in the Uttar Pradesh hills showed that usually four to eight scattered parcels constituted a holding. Hardly any attempts at consolidation of holdings have been made. The existing land tenure and titling laws or their implementation are not conducive to putting a stop to fragmentation. Land-use figures combined with satellite-imagery assessments show that actual forest cover is 5.56 million ha, which means that the ratio between forest and cultivated

land is 2.8:1. It is the view of experts that five to seven hectares of forest land are required to support each hectare of mountain agriculture effectively.

Problems of Mountain Agriculture

Mountain agriculture faces multiple problems. It has limitations imposed on it by differing land forms, diverse micro-climates, changing elevations, and generally poor soil types. These conditions can support a great variety of vegetation varying from tropical to alpine. Agriculture in mountain regions does not mean only cereals, pulses, oilseeds, and commercial crops. It includes not only food crops but tree-farming, horticulture, pasture/grassland development, fodder cultivation and floriculture; and it also has a close relationship with animal husbandry and forestry. Use depends on the endowments of each parcel of land in each small watershed. The strategy that is suggested by experts lays stress on integrated, scientific land use and is partial specialisation (niche-advantage approach) aimed at topo-sequencing of crops with appropriate technology for raising production and pro-

ductivity, enhancing economic returns, and achieving sustainability. This should be attempted keeping in mind the needs of local people, requirements of environmental security, and competing demands on land.

Agriculture and allied land-based activities have a close interdependence. Each farming system is an ecosystem that encompasses several subsystems. The ecosystems are diverse, highly varied, and differentiated. Therefore, local adaptations become necessary. This approach encourages both diversification and optimisation. In recent years, the range of diversity has been reduced. This is particularly true of the flat valleys and *Terai* areas in the NWHRI. The Green Revolution has, by and large, bypassed high hills and slopy lands (terraced or unterraced). However, its impacts on broad valleys and foothill flats are conspicuously visible. In these areas, many sharp gains in agricultural production and productivity have been made but, in the process, crop diversity has been reduced by limiting production to a small number of high-yielding varieties with a specified package of practices and high input intensity. In high hill areas, the effect of high-yielding varieties is limited. Biodiverse agriculture is still common. Agriculture in the NWHRI is practised under several constraints.

- Topographical and climatic factors mean that only a small percentage of the geographical area is available for cultivation (6%). Much of this land is slopy or steep and unterraced.
- Land use does not have a meaningful relationship in terms of optimality and sustainability with land capability. For example, slopy lands (over 30%), which are mainly suitable for silvi-pastoral or horticultural uses, are used for cropping. This practice is conducive to soil erosion and consequent degradation.
- The size of land holdings is extremely small and their fragmented nature creates difficulties in land management.
- Changes in land use, particularly on marginal and subsistence private lands, to more sustainable utilisation are difficult to achieve. Often they result in loss of income, and it can take several years before returns from alternative uses mature (e.g., change from cropping to horticulture or tree-farming).
- As land as a resource is inelastic, incessantly increasing demographic pressures put severe strains on its limited base. This amounts to exhaustion of capital rather than the utilisation of interest for subsistence.
- Additions to cropped areas have come from marginal, slopy lands with poor soil cover and moisture-holding capacity.
- Highland farmers are not willing to take risks because of the uncertainty of results, vagaries of weather, lack of research/technology support, and inadequacy of infrastructure.
- There is a lack of appropriate technology for mountain agriculture. Even where good research results have been obtained, their extension and adoption at the field level have not materialised. Area-specific packages of practices are not easily available and their successful 'proving' in actual field conditions is wanting. Inputs, credit, and services are difficult to procure.
- From some areas outmigration of young people has left old people and women to manage farming.
- It has not been possible for niche advantage to lead to economic returns. Market forces do not easily allow this to happen. Special institutional effort and targetting of resources for services, facilities, processing, and marketing support are needed to press the niche advantage and convert it into tangible benefits for producers.
- There is a lack of group action on private lands. In mountain watersheds, individual acts by farmers, graziers, and

animal rearers can result in adverse impacts. Similar negative impacts follow the lack of coordination, in time and space, between work done on government lands and on private lands that are in the same watershed.

- Costs of production are higher.
- There is an inadequacy of research in hill agriculture. For example, enough new varieties have not been evolved to withstand strong acid, low phosphorous, droughty soils, and highly variable temperature conditions so common in hill lands. Rainfed agriculture needs special attention where the gaps between potential and existing levels of productivity are substantial.
- Local knowledge and practices need to be built upon and improved through scientific and efficient applications. This desirable fusion has not materialised.

Agriculture in Jammu and Kashmir

The Jammu and Kashmir economy is largely primary-sector based in terms of employment, if not in terms of its contribution to the state's domestic product—which fell marginally from 47.4 per cent to 45.9 per cent in 1995-96. Nearly two-thirds of the work force depends on the primary sector for employment, out of which 99.75 per cent is engaged in agriculture and allied sectors. Highland population zones are areas with lower levels of work participation. Land-use data for the state show that, of the reporting area of 45,045 sq.km, only 16.2 per cent is net sown, and per capita cultivated land availability is less than 0.1 ha. During the last four decades, the net sown area has increased by about 19 per cent (118,000 ha) while there has been a sharp reduction in current/other fallows. The area of barren and uncultivable land has shot up since 1980-81 from 231,000 ha to 291,000 ha in 1996-97, i.e., by 26 per cent. Area under pasture lands has declined from 132,000 ha to 126,000 ha, while cultivable

waste has gone up. Reported forest area has also shown a decline since 1980-81. Forests and some fallow lands have been partially converted to agriculture and horticulture. Land holdings are small; 74 per cent are below one hectare. If net sown area (731,000 ha) and total number of holdings (1.22 million) are combined, the average holding size is 0.6 ha. Agricultural production and productivity changes in the last four decades are shown in Table 9.

There has been a substantial rise in the gross cropped area under food grains since 1955-56 (27.5%). Total food production has gone up by about 153 per cent, while overall productivity has nearly doubled. However, crop-wise, the gains have been uneven. Rice production was 1,897 kg/ha in 1964-65, rose to 2,211 kg/ha in 1985-86, and fell to 1,742 kg/ha in 1996-97. Maize productivity was 1,511 kg/ha in 1964-65, rose to 1,871 kg/ha in 1993-94, and fell to 1,490 kg/ha in 1996-97. Wheat productivity rose sharply from 645 kg/ha in 1964-65 to a high point of 1,907 kg/ha in 1994-95 and then fell marginally to 1,671 kg/ha in 1996-97 (Jammu and Kashmir Directorate of Economics and Statistics 1996-97). Non-food crop production has declined considerably in the case of oilseeds, sugar cane, and potato in recent years. The per capita availability of food grains rose from 146 kg/year in 1955-56 to 170 kg/year in 1995-96. However, the food deficit has continued, and the import of food grains has risen from 40,000 tonnes in 1955-56 to 487,000 tonnes in 1996-97. Productivity of rice and maize is near national averages, but for wheat is over 40 per cent lower. The consumption of NPK fertilizers was 53 kg/ha in 1995-96 (much less than the national average), but nutrient application was highly skewed, the proportion being 16:5:1 for NPK, respectively. The net irrigated area was 47.2 per cent of the net sown area in 1996-97 and most irrigation (over 90 per cent) came from canals. Irrigation intensity is 141.

Table 9: Area, Production and Productivity of Food Crops in Jammu and Kashmir

Year	Total area sown under food crops ('000ha)	Total production of food grains ('000 T)	Productivity (kg/ha)
1955-56	689	n/a	n/a
1965-66	747	583	780
1974-75	833	1010	1212
1985-86	918	1244	1355
1995-96	956	1474	1542
1996-97	878	1324	1508

Source: Jammu and Kashmir Directorate of Economics and Statistics (1996-97)

Horticulture is an important sector. The area under fruit cultivation has increased from 12,400 ha in the 1950s to about 180,000 ha in the 1990s. Production in 1991-92 was reported at around 700,000 tonnes, mostly apple and walnut. Production of vegetable and flower seed is big business. Overall productivity of fruits was 5.88 T/ha in 1991-92, which was much higher than in Himachal Pradesh and the Uttar Pradesh hills. Value additions to horticultural crops are nominal. Floriculture has started doing well. Saffron and mushroom are specialties that command premium prices and can produce lucrative returns. Sericulture is an important activity that provides income and employment to a considerable number of people.

Jammu and Kashmir has a large animal population that has more than doubled in the last three decades. In 1992 (last animal census held), total livestock numbered 8.7 million of which nearly 30 per cent was cattle, 8.4 per cent buffaloes, 30 per cent sheep, and about 20 per cent goats. Livestock-rearing constitutes an important economic activity in the high hills characterised by transhumance. Increasing animal population has been putting forest floors and rangelands under severe pressure. The grazing intensity is reported to be more than three cow units/ha, which is six times higher than the recommended grazing intensity of

one large ruminant for every two hectares (NRRC 1997). Nearly 40,000 people depend on fisheries for their living.

Agriculture in Jammu and Kashmir is a slow-moving sector. Possibilities for any substantial additions to cultivated land are extremely limited. Therefore, gains in production have to come largely from increases in productivity. Nearly one-fourth of food requirements has to be imported and dependence on supplies from outside extends to edible oils and pulses.

Agriculture in Himachal Pradesh

Himachal Pradesh has three physiographic regions: Siwaliks, the Middle Himalayas, and the great Himalayas. It is, cadastrally, a partially surveyed state, the reporting area being only about 60 per cent of the geographical area. Actual forest cover is 22.5 per cent of the land area. The state has extensive pasture lands that cover nearly 20 per cent. The net sown area was 583,000 ha in 1990-91 (10.4% of the total area) and has not changed much since then. Himachal Pradesh has the highest cropping intensity in the NWHRI at 169 (1990-91 figure). Most of the state's agriculture is rainfed; irrigated areas are about 17.5 per cent of the net area. Irrigation intensity is fairly high at around 170. The difference between the irrigation potential created and that utilised is about 40 per cent. Soils are generally thin and young except in valleys and gently sloped areas. Land holdings are small, average size being 1.2 ha (1990-91 figure). Nearly two-thirds of these holdings (64%) are below one hectare. About 70 per cent of the main workers are in the primary sector, most having occupations related to agriculture and its allied activities. Historically, there has been a steady decline in the proportion of workers in the primary sector, which is indicative of the limitations imposed by the resource base. Income from agriculture and allied sectors accounts for 36.4 per cent of the state's domestic prod-

uct. Agroclimatic conditions are suitable for growing cash crops such as potato, ginger, mushrooms, and off-season vegetables. While, in the past, emphasis was placed on increasing the production of traditional food crops, in recent years, a gradual but steady trend towards diversification is noticeable. Trends of area, production, and productivity in agriculture are reflected in Table 10.

In the last decade, area under food crops has declined by nearly 6.5 per cent but food production has gone up by 13.25 per cent. This is because substantial productivity gains have been achieved (21.3%). Productivity of wheat has gone up by 75 per cent, of rice by 20 per cent, of maize by 11 per cent, and of barley by 11 per cent in the last four decades. However, since 1993-94, productivity for all main food crops has declined.

Land-use changes from 1975-76 to 1990-91 show that reporting area has increased, indicating that more land has been surveyed. There is a nearly 50 per cent increase in the category of barren and uncultivated land, and the area of cultivable wasteland has also risen. The net area sown is almost the same with an increase of 4.4 per cent in a decade and a half, while there has been hardly any increase in gross cropped area. Current fallow is down by nearly 20 per cent. Use of chemical fertilizers has nearly trebled since 1980-81 at 40,000 tonnes in 1992-93, meaning a consumption level of 40 kg/ha. The NPK proportion is skewed at about 6:1:1. A Training and Visit Programme has been implemented for improving extension services. Easy credit flow is wanting and input availability is often difficult for remoter areas. Two universities at Palampur (agriculture) and Solan (forestry and horticulture) provide research support.

Himachal Pradesh has become a major producer of temperate fruit. In 1950-51, area under fruit was 792 ha and production

Table 10: Area, Production and Productivity of Food Crops in Himachal Pradesh

Year	Total area sown under food crops ('000ha)	Total production of food grains ('000 t)	Productivity (kg/ha)
1975-76	844	1129	1340
1980-81	856	1157	1350
1986-87	878	1176	1340
1988-89	881	1137	1290
1996-97	824	1288	1562

Source: Government of Himachal Pradesh, n.d.; Ministry of Agriculture, n.d.

1,200 tonnes; by 1991-92, the area was 170,768 ha and production was 342,303 tonnes. Further gains in both production and productivity have been made since. Estimate of production for 1994-95 was 587,000 tonnes. More than three-quarters of the fruit produced are apples, the other varieties being nuts, citrus, pears, and other pomes. The area under vegetables has risen from 8,000 ha in 1974-75 to 24,000 ha in 1993-94 and production from 90,000 to 385,000 tonnes. Mushroom production has grown (600 tonnes) and, amongst spices, ginger is an important crop (3,200 tonnes). Hops are also grown. Potato is grown in nearly 17,000 ha, production being about 160,000 tonnes.

Post-harvest technology has many gaps. Packing and transport of fruit is problematic. In order to reduce pressure on hill forests, eucalyptus and other types of wood brought from the plains are also now being used in increasing quantities for making packing cases. Corrugated paper-board packaging and transportation in plastic bins are also being adopted. Value additions to horticultural produce are highly inadequate and the potential of off-season vegetable growing and marketing remains to be realised. Efforts are being made to introduce modern methods in orchard management such as drip irrigation, glasshouse technology, and protected cultivation systems. The possibilities of higher production and incomes (and employment) through horticultural

ture are immense.

The high percentage of area under pasture (nearly 20 per cent) is clearly indicative of the importance of pastoral activities. The animal population was 2.7 million in 1961 and, by 1988, had increased to 5.4 million (excluding poultry). In 1992, it had come down to 5.1 million. Grazing pressure is heavy. According to the Department of Forests, Farming, and Conservation, forest floors provide 80–85 per cent of fodder requirements. The rest is obtained as cut and collected grass from farmers' fields, common lands, etc. Stall-feeding is practised only in respect of improved cattle breeds (10–15%). The Forest Department estimates that grazing pressure is about three times the carrying capacity of pastures and forest floors (Gulati 1998). Most animals are indigenous breeds and nondescript with low productivity. Nomadic tribes depend on animal rearing for their livelihood and practise transhumance. About 12,000 families depend on fisheries for sustenance. There is further scope for riverine and lacustrine pisciculture.

Agriculture in the Uttar Pradesh Hills

This subregion of the NWHRI has an area of 53,585 sq.km, all of which is the reporting area. Actual forest cover is about 44 per cent (nearly one-third being open forest). The net sown area is 13.3 per cent of the total area and has recorded a fall of nearly five per cent between 1980-81 and 1993-94. Barren and uncultivated land has registered a rise of about 25 per cent from 23,100 ha in 1975-76 to 29,550 ha in 1990-91. Pasture land is practically stagnant and so is cultivable waste. Current fallow is sharply down by almost 70 per cent while other fallow has nearly doubled. Cropping intensity has increased marginally from 161 in 1975-76 to 164 in 1990-91. Production gains have thus resulted mostly from productivity gains. Seventy-one per cent of land

holdings are below one ha, their average size being 0.37 ha. If all land holdings are taken into account, the average size is 0.94 ha. Fragmentation is common. Net irrigated area has risen to 158,000 ha; irrigation intensity is 167. Net irrigated area is 34.75 per cent of net sown area. Use of chemical fertilizers has doubled from 34 kg/ha in 1980-81 to 70 kg/ha in 1994-95 but there are imbalances. Nearly 97 per cent is utilised in only three of the twelve districts. The NPK ratio was about 6:2:1 in 1981 and had deteriorated to 1:2.5:1 in 1994-95. It is mainly in the *terai* areas that high production and productivity gains have been achieved. For example, in Nainital district in 1993-94, productivity of food grains was 2,767 kg/ha. In 1993-94, yield of rice for the Uttar Pradesh hills as a whole was 2,004 kg/ha, and that of wheat 1,758 kg/ha. Table 11 summarises the area, production, and productivity trends of the main food crops in recent decades.

A typology of the farming systems in the Uttar Pradesh hills that was prepared by the G.B. Pant University in 1989 is outlined in Table 12.

Table 11: Area, Production and Productivity of Food Crops in the Uttar Pradesh Hills

Year	Total area sown under food crops ('000 ha)	Total production of food grains ('000 t)	Productivity (kg/ha)
1980-81	984	1307	1327
1985-86	919	1366	1487
1993-94	895	1497	1685

Source: Statistical Diaries of Uttar Pradesh Hills Government

The areas under rice, finger millet and maize consistently declined between 1980-81 and 1993-94 by 4.6 per cent, 14.5 per cent, and 18 per cent respectively. For wheat, there was an expansion of 63.5 per cent in the same period. Productivity in maize has fallen by 11.8 per cent from 1980-81 to 1993-94. However, in the same period, the

Table 12: Typology of the Farming Systems in the Uttar Pradesh Hills				
Land type and altitude range (m)	Geographical area		Soil type	Principal crops
	Area('000 ha)	Percentage		
Irrigated lower hills (600-1200)	614	12	Alluvial sandy lome	Rice, wheat, onion, potato, chilli, pea, cabbage, radish, cauliflower, citrus, mango
Rainfed lower hills (600-1200)	409	8	Residual sandy loam	Ragi, rice, wheat, citrus, mango
Mid-hills southern aspect (1200-1700)	1841	36	Sandy loam	Rice, ragi, wheat, peach, plum, citrus, potato, tomato
Mid-hills northern aspect (1200-1700)	1227	24	Brown forest soil	Ragi, rice, wheat, tomato, potato, pea, cole crops, peach, plum, apricot, apple
High hills (1700-2500)	614	12	Red to dark black clay loam	Ragi, french bean, pea, cole crops, potato, apple, apricot, pear, walnut
Very high hills (2500-3500)	204	4	Red to dark black clay loam and meadow type	Amaranth, buckwheat, peas, cole crops, potato, apple, almond, apricot
Alpine pastures (3500)	204	4	Heavy textured meadow soil	No crops/trees; only alpine flora

Source: National Agricultural Research Project, G.B. Pant University, 1989

productivity of paddy rose by 25 per cent, of finger millet by 20 per cent, and of wheat by nearly 30 per cent. The per capita availability of food grains is a little over 230 kg/year. However, much wheat and rice is exported from the *terai* region through procurement, commercial sale, or in the form of seeds. The subregion has to depend on an extensive public distribution system to meet its food needs. Agricultural diversification is now taking place through production of basmati/high-grade rice, soyabean, spices, vegetables, fruit, mushrooms, and seeds. Even tea is being reintroduced.

Agricultural extension is insufficient and not well organized. The Training and Visit Programme has not been adopted.

The cooperative structure for credit is weak. In 1991, the per member average loan distributed by primary agricultural cooperative societies was Rs 187. There are many research institutions located in the Uttar Pradesh hills such as the Pantnagar University of Agriculture and Technology, G.B. Pant Institute of Himalayan Environment and Development, National Bureau of Plant Genetic Resources, Central Soil and Water Conservation Research and Training Insti-

tute, Central Potato Research Institute, Forest Research Institute, and many others. The impact of research has been remarkable in the *terai*, but the uplands have not benefitted in any substantial measure.

Horticulture is a growing sector and is of increasing significance to the subregion's agrarian economy. The climatic and altitudinal range and diversity have endowed it with the potential for growing high- and low-chilling temperate fruit, subtropical fruit, and a variety of vegetables (especially off-season ones that can generate high economic returns) in high and low hills as well as valleys. Area under fruit crops was around 2,500 ha in the early 1950s and had risen to 179,200 ha by 1993-94. Production in that year was 470,000 tonnes and productivity was 2.62 T/ha. Area under vegetables is also increasing as Table 13 indicates.

The area cultivated with and production of potatoes have risen; the area from 11,546 ha in 1984-85 to 19,000 ha in 1993-94, and production from 196,000 tonnes to 392,000 tonnes.

Apples are the predominant fruit followed

Table 13: Area, Production and Productivity of Fruits and Vegetables in the Uttar Pradesh Hills in 1993-94

	Area (ha)		Production (tonnes)		Productivity (T/ha)	
	Fruits	Vegetables	Fruits	Vegetables	Fruits	Vegetables
1984-85	141,554	34,141	330,000	1,30,000	2.33	3.8
1989-90	166,231	48,944	397,707	2,38,900	2.39	4.88
1991-92	173,055	57,000	452,000	2,76,000	2.61	4.84
1993-94	179,200	65,000	469,500	3,25,600	2.62	5.01

Source: Government of Uttar Pradesh, n.d.

by citrus, pear, mango, walnut, peach, apricot, and plum. Productivity of fruit, particularly apples, is much lower than in Jammu and Kashmir and Himachal Pradesh. Micro-nutrient deficiencies, poor rootstock, gaps in management, and incidence of diseases are reasons for low productivity. There are hardly any value additions to fruit and vegetables within the subregion. There is a near absence of collection and grading centres, cool houses, processing plants, and marketing support. Progeny orchards need renewal. Research support at the orchard/field level needs to be strengthened.

Niche development has occurred in a few places such as the Garampani area of Nainital district, Chamba in Tehri district, and Mandal in Chamoli district but these are low-scale exceptions. Other issues of priority are varietal improvement, packaging, storage and transportation, value-addition facilities (through industrialisation of horticulture), skill development, easy credit, grower-oriented extension, and strong marketing organization. Apiculture, mushroom-growing, and spices and herbs are other areas of potential growth.

Animal-rearing is inextricably connected with agriculture and land-use systems in the Uttar Pradesh hills. The keeping of livestock is closely related to farm management. There are also pastoralism and transhumance. The population of livestock increased from 3.8 million in 1961 to 4.4 million in 1988. Thereafter, increases have been small. Pasture area is limited and low

yielding. There is grazing pressure on forest floors. Most cattle are nondescript in quality and less than one-tenth are cross-bred. Goats, being browsers, cause a great deal of damage to vegetation. Their number at about a million is nearly three times that of sheep.

Open grazing is practised mostly, and its adverse consequences are visible. Community forests have suffered the most and are extremely degraded. Even reserve forests, where access is somewhat regulated, are subjected to unsustainable grazing pressures. Little stall-feeding is practised. Green fodder deficit is estimated at 40–50 per cent; supplementation of animal nutrition through feeds/concentrates is exceptional. Cattle are kept mainly for manure and draught power but, of late, milk production has begun to increase because dairy and marketing linkages have been provided. Wool productivity is low, and poultry and fishery programmes have yet to pick up pace.

Strategy for Agriculture

A brief look at agriculture in the NWHRI shows that there is scarcity of cultivable land and, except in flats/valleys/gently sloped areas, soil quality is poor and cover is thin. The net sown area of the geographical area is low at around six to seven per cent. If only the reporting area is considered, net sown area is 15 per cent and gross cropped area is 23.1 per cent. The net irrigated area is about one-third of the net sown area. Productivity has been increasing but is still

much lower than national averages, and gains have been made largely in valleys and foothill *terai* areas. The area of forest cover that is required for sustaining mountain agriculture is less than half of what it should be. Human and animal population pressures are acute and increasing. Grazing is 2.5–3 times carrying capacity. In research, technology, inputs, credit, value-addition opportunities, and the evolution of a fair and equal trading system with erogenous markets, the people of the NWHRI are at a clear disadvantage. Socially, most of them are marginalised; politically, their voice does not command numbers and representational strength.

Food self-sufficiency may be an unattainable goal in these subregions, but an integrated agri-silvi-pastoral approach is necessary so that land use approaches land capability in terms of sustainability and niche advantages. Food security has to be ensured through an efficient and fairly-priced public distribution system that is easily and equitably accessible.

Demographic pressure has to be relieved through education (particularly of women) and the upgrading of family welfare and child-care social infrastructure. Off-farm employment opportunities have to be created. Animal numbers have to come down and unproductive cattle have to be replaced by a lesser number of high-quality cross-breeds or suitably improved breeds. In rainfed mountain agriculture, there is distinct productivity slack that can be removed by available technology. Research, extension, and input and credit delivery systems on a decentralized basis need to be in place on the ground.

Fodder and fuel are serious problems. It is possible to resolve these in two ways. Firstly, develop and provide alternative energy sources, e.g., electricity (at affordable prices), liquid petroleum gas, kerosene, solar, wind, biogas, etc. Secondly, improve production

and productivity of biomass (forests, grasslands, farms). This is possible by fully involving hill people in the management of resources. Joint management, community management, empowerment, resource devolution, benefit-sharing, and strengthening of (and trusting) people's institutions seem to be core policy interventions and strategies called for to convert the present situation into a more sustainable, more people-satisfying one that can also be ecologically secure and environmentally friendly. The Indian Constitution has already been amended to facilitate this. Political and administrative will is required to operationalise the amendments effectively.

Other important steps that need to be taken are voluntary consolidation of land holdings, completion of cadastral surveys, and amendments in land laws that can effectively put a stop to fragmentation. Another critical need is to adopt micro-watersheds as local planning area units although implementation would have to be operationalised at the village level. Mobilising NGOs for catalysing decentralized development would be of great advantage. Their functions would be not to replace governmental or *panchayat* agencies but to serve as skilled model-builders, trainers, bridges of communication, motivators and facilitators, and help in monitoring, evaluation, and provision of feedback so that, where necessary, quick corrective action can be taken. A collegial non-hierarchical approach needs to be adopted to bring about dynamic, complementing and constructive interfaces between stakeholders—farmers, growers, pastoralists, research institutions, extension personnel, NGOs, donors, people's institutions, and government departments.

