
RAPPORTEURS' REPORTS

**Hill Agriculture: Problems and Prospects for
Mountain Agriculture**

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INTRODUCTION

The unique ecological entity and topographical diversities are the exclusive characteristics of the hill and mountain (H&M) regions in India. The distinctive socio-economic features, ethnicity, climatic variability and human activities, separate the hill and mountain ecosystem from the rest. The inaccessibility and fragility marginalised the hill economy and the community. These diverse typologies, having difficult terrain, inaccessible habitation, extreme vulnerability to natural calamity, poor infrastructures (socio-economic as well as physical) and distinctive gender dimensions, are the important features of the agri-horti-silvi pastoral economies. This implies that the hill and mountain regions demand a distinctive treatment that is different from the standard followed in the mainland plain areas (North East Council, 2008).

Geo-Political Setting of the H&M Region

The hilly and mountainous areas in India vastly distributed all over the country with a larger area located in the Himalayas, extending upto 2,500 km in length and 250 to 400 km in breadth. Longitudinally, Himalayas are also classified as Shiwaliks flat summits (600-1200m msl altitude), Middle Himalayas (65-75km width, average height 3,000 m), Greater Himalayas (average altitude 5,200 m, 92 peaks over 8,000m) and Trans-Himalayas (average width 60 km, average altitude 4,500 m). In addition to the mighty Himalayas, the areas categorized as Hill and Mountain Zones, are distributed in 23 states, viz., Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. The majority of these areas has slope above 15 per cent, which covers over 35 per cent of the total geographical area of the country.

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The trans-Himalayan region is further classified in three major categories comprising:

- (i) Western Himalayas: Jammu and Kashmir, and Himachal Pradesh;
- (ii) Central Himalayas: eight hill districts Uttaranchal, and
- (iii) Northeast Himalayas: Sikkim, Manipur, Meghalaya, Nagaland, Tripura, Arunachal Pradesh, Mizoram, hilly areas of Assam and Darjeeling district of West Bengal.
- (iv) Trans-Himalayas include Tibet and Central Himalayas as well as Nepal, which is outside the territory of India.

The Planning Commission, further classified the hill areas into two categories: (i) areas which are co-terminus with the boundaries of the State are termed as hill states/union territories. (ii) areas which form part of a State (which are termed as designated hill areas).

The estimated area and population of the hill states and the designated hill areas in India is 6.91 lakh sq km and 62.16 million respectively. The heterogeneity is the built in features of the H&M areas. This is reflected in not only the inter-regional diversity, even the most socio-economic factors in the north eastern hill region behave spatially differently from that of the hills in the north western India. The relative poverty in the North West Hill areas in contrast to the North Eastern hills is low. The farmers, in the North West hills, have shifted from traditional mode of cultivation of low productivity and low value crops to high value crops, which has changed their household income pattern. The region also enjoys relatively better infrastructure and connectivity to large commercial centres. Moreover, on account of male out-migration, the woman participation dominate the rural economy. Yet, the low productivity accompanied by risky agricultural production is common in both the regions at large.

Hill and Mountain Ecosystem

The profile of the hill areas generally is severely affected by large scale deforestation, soil-erosion (a high rate of 46.0 t/ha, top soil and micronutrients washes way annually), dry water bodies, soil acidity, high intensity rainfall, increasing risk, snow and frost, lack of infrastructure in the hostile topography and transportation facility for movement of goods and services. Even the mega biodiversity that has income augmenting potentiality and serene environment situation, is also depleting fast making the sustainability at stake. Thus, effective strategy is essential to maintain balanced growth pathways with limited resource base of the household such as very smaller cultivable area, large forest coverage.

Uncommon Opportunity

Traditional agriculture is the major and dominant activity in the hill economy, which confronts multiple risks and uncertainty. The low yield of food and cash crops, fodder, fuel and other minor forest produce and stagnant growth are the critical pull factors of agrarian economy and in particular the household food security. The scattered land holdings (the landholding could be as small as 200 square meters observed in some part of Tehri Garhwal hills in Uttarakhand), traditional mode of production (eg. Jhum cultivation), low use of modern inputs and lack of market incentives caused the ecosystem highly poverty ridden. The rich variety of flora and fauna existed all along the wide range of altitude as well as east-west variations in the Himalayan mountain system that thrives the ecological settings, failed to convert into productive opportunity. Rather fast depletion of biodiversity is matter of concern.

In order to harvest newer opportunity from the improvised existing system in the niche mountain systems, a proper understanding of the composition of agri-horti-silvipastoral farming systems and livestock based farming system is essential. The hill and mountains house the richest reservoir vector of genetic variation and a large stock of little known crops. The speciality ginger and turmeric of Meghalaya for instance, fruits and variety of vegetables (e.g., pineapple, squash, kidney beans), ornamental plants and the medicinal and aromatic plants (high value crops such as passion fruits, citronella, lemongrass and pachauli etc.) are some of the niche commodities having ample scope to reap the uncommon opportunity. The missing link is the network connecting the market with the producers.

The major challenge is to devise suitable location-specific solutions to restore and accelerate the economic process to ensure sustainable development. The challenge is manifold in the vivid socio-cultural profile of the hill society. This requires multi-pronged strategy to understand the multi-faceted hill and mountain regions. Devolution of appropriate and meaningful policy interventions and strategies for development is the enabling factor in the efforts to understand the complex but lesser known system of hill and mountain areas. The prioritisation of the strategies for development of the hill economy should focus on the factors inhibiting agricultural growth, livelihood and the structural infirmity of the hill economies.

The gravity of the problems of hill and mountain areas may not receive due attention unless the location specificities are understood and translated to action points. The Special Area Programmes such as HADP, WGDP, DDP, DPAP, NEC etc., formulated from time to time by the government to deal with the special problems in distinct geo-physical structure and concomitant socio-economic development in the hill areas, have not been adequately reaching the targeted areas and the people. A sizeable investment made by the government also failed to bear the fruits of desirable extent and to make perceptible changes in the economies. Based on the scattered evidences, it may be inferred that innovative and holistic approach to

development is needed for convergence by synergising the people, institutions, local ecologies and resources use pattern of the hill and mountain specificities.

Issues Identified

In an attempt to understand the ground reality in the changing scenario, a specifically designed theme on “Problems and Prospects of Hill and Mountain agriculture” is identified for in-depth discussion at the annual conference of the Indian Society of Agricultural Economics. The research papers were invited particularly focusing the issues of agriculture development and policy with mountain specificities to pave the pathways for a vibrant and inclusive growth in the bypassed hill areas. The key issues of crucial interest in the spatially differentiated agro ecological zones; the profitability, efficiency, growth, equity and sustainability, are emphasised.

1. Enhancing Efficiency of Hill Agriculture

- (a) Improved and innovative technology to enhance productivity;
- (b) Linking farmers with markets for remunerative prices harvest opportunity through niche commodities in the up markets.
- (c) Farming system approach to agriculture by integrating crops, livestock, fishery, forestry and bee-keeping etc. depending on the location specificities.

2. Sustainable Environment

- (a) Soil and water conservation is extremely useful. System of land use and environment nexus (sustainability), including the issues in amelioration strategies of the environmental constraints.
- (b) Agro-forestry, medicinal and aromatic plants, floriculture, organic farming, etc.

3. Mainstreaming Hill Agriculture Economy

- (a) Integrating the neglected hill economies into the mainstream economy requires the rich natural resources and other opportunities to be translated into prosperity. Role of Innovation in supply chain management;
- (b) Scope for private public partnership in improving the agricultural economy.
- (c) Agro-tourism and brand organic products.
- (d) Male migration and impact of gender participation on hill agriculture.

4. *Role of R&D System in Hill Agriculture*

- (a) Prioritisation of research on appropriate technologies, refinement and development of existing technologies.
- (b) Impact of improved technologies and constrains to adoption.
- (c) Future sources of agriculture growth, with special reference to emerging markets and crop diversification.
- (d) Risk management and insurance in the hill and mountain perspectives.
- (e) Role of village institutions and community in the management of common property resources.
- (f) Future investment needs in hill and mountain agriculture for accelerating economic growth.

The response to a call for research papers on the theme has been very encouraging. The researchers responded and presented research output. Twenty nine research papers were received, which spatially covered most of hill and mountain systems; the distribution of papers are given below:

TABLE 1. DISTRIBUTION OF THE PAPERS ACROSS THE HILL STATES

Sr. No. (1)	Name of the hill state (2)	No. of papers (3)
1.	Uttarakhand	7
2.	North Eastern Region	2
	:Assam (foot hill)	1
	:Meghalaya	3
	: Nagaland	1
	Total NER	7
3.	Himachal Pradesh	6
4.	Jammu and Kashmir	4
5.	Maharashtra (Hills)	2
6.	Uttar Pradesh (plains)	2 (not relevant to the theme)
7.	West Bengal	1
	Total papers	29

The paper writers touched upon variety of issues of hill agriculture. The subject wise classification shows, there are seven papers on understanding hill agriculture, a paper on analysis of off-season vegetables, two papers deal with diversification strategies and its mechanism for income enhancement, yield gap in hill and mountain areas also studied. Among the commodities includes pineapple, strawberry, honey processing of fruits and vegetables, sweet orange, economics of saffron cultivation, maize, rice cultivation. Studies on migratory sheep in Himachal Pradesh, Zabo system of farming in Nagaland, impact of male migration on women labour participation in agriculture, marketing of dairy products in Uttarakhand, etc. covered in various hill production system. As the hill and mountain agriculture faces multiple difficulties in the prevailing ecological situation and climate changes, non farm sector

play crucial role, a study shows the extent of benefits derived from it particularly in improving participation of woman in agriculture in Himachal Pradesh. Issues of land use pattern are important for deriving policy implication for improving land use. Water management is crucial in agriculture in the hill and mountain areas, a meta analysis of 30 different watershed schemes covering entire Himalayan states brought out important parameters for policy purposes. Some of the findings of the studies of hill and mountain agriculture are summarized in the issue based classification:

1. Problems and Opportunities in Hill Agriculture

The North East India, an important H&M ecosystem, remained economically backward and bypassed area. The long legacy of developmental infirmity has been under debate in the socio-political circles from time to time (Deb and Ray, 2006). The region has drawn sufficient policy attention of the mainstream policy circle, but the desired gain is awaited in perpetuity and economic as well as ecological degradation continued. Perhaps, on account of lack of proper understanding of the multiplicity of the problems of the region, policy strategies are not well placed and unable to reach out. Therefore, studies on North East region assume greater importance and relevance (Baruah, 2005). In the paper on unlocking the potential of hill agriculture in North-eastern India, P.S. Birthal studied the sources of agricultural growth in the North-eastern states. The findings of the analysis could provide empirical basis of designing appropriate policies for enhancing growth. Using the Central Statistical Organisation (CSO) survey data of gross value of crops the study reveals few policy perspectives. Rice is an important crop, but the value of output of fruits, vegetables and condiments account for 3.5 times more than the area share. The growth of condiments and spices was 7.3 per cent as against that 2.9 per cent for cereals (Birthal *et al.*, 2006 Joshi, *et al.*, 2007). This over-emphasis on high value crops (70-80 per cent contribution) needs to be inferred carefully as it may camouflage the importance of several critical crops for food security, under the inefficient infrastructure and institution hypothesis. Neglect of food crops (*vis-à-vis* over emphasis on HVC), if so inferred, may create huge drainage on the exchequer under the present scenario. Thus the analysis should account for perennial food deficit nature and the demand structure in conformity, which is more important. While making generalisation and conclusion, inference on prospective identified future innovative prospective crops is needed to account for the ecological reality in the Northeastern region. For instance, in Arunachal Pradesh, the scope of bringing more area under settled agriculture is not easy due to hostile terrain in majority areas. The inclusion of data from Assam, where majority of the areas is in the plains, may create problem of perspectives on hill and mountain agriculture.

The paper by B.K. Bera and A.K. Nandi has compared the performances of hill regions of Darjeeling district of West Bengal and the state itself based, and studied work participation rate (WPR) in agriculture. The WPR declined in West Bengal. The

main reason for declining trend in Darjeeling district was due to closure of many tea gardens and lack of new labour intensive manufacturing industries in the regions. It was revealed that the educated gentry is reluctant to take cultivation as primary occupation, i.e., agriculture was no more a priority sector to new generation work force. Land distribution was skewed and further aggravated over time in Darjeeling district. This resulted in stunted growth of cereals in Darjeeling district. Compared to the dominant crop of rice, an increasing trend was observed in the allocation area to other crops including vegetables, fruits, total oilseeds, tea, ginger, etc., signifying a shift in the cropping pattern. While rice-fallow-maize sequence was followed under rainfed condition, but in partly irrigated areas, farmers commonly planted vegetables, like potato, cauliflower, cabbage, etc. in between rice and maize and ginger, black gram, soyabean etc. Under the circumstance, production and marketing of high value horticultural crops, particularly flowers like gladiolus, orchid, cactus and other seasonal flowers, may be the entry stage for commercialisation. It may be inferred that although the prospects of agricultural development is promising in the hilly areas, the people are vulnerable to extreme poverty because of the fact that the natural resources remained untapped till date. Scarcity of irrigation facility is the major constraint in the development of the region.

S.S. Kalamkar studied the problems and prospects of agricultural development in North Eastern hill region of India and emphasised the need for adequate investment in agriculture in the region to increase the income level of the farmers. The average cropping intensity of the region was 131.7 per cent because of the predominance of rice as the lead crop. Yet its productivity is low as the coverage of irrigation is almost negligible. In those areas where the mountain terrain is an obstacle for normal irrigation practices, water harvesting mechanisms is essential. The existing practice of low input use could be arguably the potential hub of organic farming in the country. The inherent advantages of favourable natural condition such as high rainfall, low temperature, gender power in farm and non-farm sector could be converted to tap the immense opportunities the region has been endowed with and enhance the social capital and cultural milieu of the region.

R. Das and R.N. Barman *et al.*, attempt to identify the ideal agricultural production plan by using deterministic linear programming technique for the foothill agro-ecological situation of Sonitpur district of Assam and developed agricultural production plan. In the existing situation, the cropping intensity varied from 150-163 per cent in small farms to 120-122 per cent in large size group of farms. Under the optimal plan, cropping intensity increased in the range of 150 to 246 per cent in small farms, 131 to 273 per cent in medium farms and in large farms 120 to 208 per cent. Newer crops like vegetables are popular among the farmers. However, inadequate and timely availability of working capital restrain the farmers. Although optimal plans lead to better utilisation of resources, increase in gross cropped area and higher net returns, but its realisation rest only on the relaxing the constraints in resource availability. The optimal plan found a potential increase in the cropping intensity in

the range of 120 per cent (existing) to 273 per cent. Such a phenomenal rise in cropping system needs be inferred carefully and strategise the do-able plan. The study has also shown that the farm income to small farmers is unchanged, while the large farmers gain more than 50 per cent under the optimal plan. In view of the dominance of small farmers, is the optimal plan socially desirable?

M.S. Pathania studied the changes in hill agriculture in Himachal Pradesh. The small and fragmented land holdings, undulating topography and predominance of cultivation under rainfed conditions are the dominant features of farming in Himachal Pradesh. The analysis has however, shown that the presence of 'niche' products or favourable location specificities, has led to some transformation and diversification of agriculture in valleys and mountain areas of the state, albeit confined to a narrow production base, which is due to lack of necessary backward and forward linkages ushering the transformation process. The dynamics of growth and performance of different components reflect the strengths as well as weaknesses of agriculture in Himachal Pradesh. The level of education of the population improved and per capita income increased. Yet, the reliance on the rainfed farming remained unabated. Hence, the dual emphasis on productivity enhancing practices and environmental safeguard is the main thrust. In the meantime, farmers will have to adopt subsidiary income generating vocation like bee keeping, mushroom farming, off-season vegetables etc as alternative windows for augmenting their income.

F.A. Shaheen *et al.*, using a meta analysis framework, derive major learning lessons on sustainable agricultural practices through watershed programs and their impact on Himalayan states. The paper has reviewed the performance of watershed development programme implemented by various governmental agencies. The benefits of watershed programmes for hill areas are quantitatively estimated in five states in Northern India in the Shiwalik mountain range and seven states in north eastern India. Revitalising ecological settings in the hill and mountain areas, which are already been disturbed by indiscriminate human activities, need to be revived through systematic watershed planning. The benefits of watershed schemes are documented. But, more work on standardised methodology could potentially enhance the power of the comparability of the results/findings across various projects. The comprehensively derived parameters and the estimators would be an instrument of exclusive policy strategy for scalability and wider impact. For the sake of comprehension, the robust derivatives of economic surplus, equity, cost reduction, output increase and environmental services needed. Finally a performances comparison of various production system of Shiwalik region with that of North eastern India is desirable, as both the ecosystems have distinct identifications.

2. Pace of Commercialisation of Hill Agriculture

The hilly tract of western Maharashtra has favourable climate for commercial crops. Deepak Shah analysed the cultivation practices of strawberry in the Western

Hilly Tracts of Maharashtra. The region produces 85 per cent of India's total production of strawberry, which is only the high value fruit crop, but payback period of farmer investment is around 100 days of its plantation making it economically viability. Strawberry has high yield potential, yielding unit profit margin as high as Rs. 4.00 lakhs from strawberry orchard. Inefficient financial management, lack of growth are the weaknesses encountered by the farmers. The study underscores the use of plasticultural techniques like micro-irrigation, plastic mulching and tunnel, plastic punnets as packing material for proper marketing, etc., which can potentially revolutionalise the high density strawberry cultivation.

Agriculture sector in the new state of Uttarakhand has been undergoing transformation in favour of diversified farming and non-farm sector. A. Shukla *et al.*, examined the economics of production and disposal of honey in Pitoragarh District of Nainital of Uttarakhand. The apiculture being a profitable enterprise, short-term institutional credit is necessary for investing for handling larger volume of honey, training and supply of necessary tools and equipment in minimum cost are also needed. Net return per kg of honey was estimated to be higher (Rs. 26.18) with production of 902.40 kg on migratory bee farm in comparison to Rs. 8.34 at production of 3973.70 kg per annum on stationary and migratory bee farms respectively. The study emphasised the need for bee keeper's cooperative for the purpose marketing of honey.

Market infrastructure and marketing system is essential for income enhancement and development in West Garo Hills of Meghalaya. L.D. Hatai *et al.* evaluated the problems and prospects of pineapple marketing, which is an important crop. The indices of marketing efficiency calculated for various marketing channels, showed variation of 5.66 in channel-I to 3.14 and 2.76 in case of channel-II and channel-III respectively. The analysis revealed that less is the marketing intermediaries, more is the market margin and efficiency. The study highlighted the prospect of pineapple marketing in Meghalaya. The improved market infrastructures (a) direct and group marketing, (b) establishment of modern marketing and processing units, (c) market integration are needed for enhancing the overall efficiency of the marketing system. Lack of both economic and social infrastructure has been prime inhibiting factor in the rural development of the region. In order to hedge the risk of production and marketing, the market intelligence services, introduction of support price and insurance scheme in West Garo Hills of Meghalaya is advocated.

3. Farming System Approach to Hill Agriculture

The North-eastern India is being promoted as the potential hub or organic farming in the country. The traditional systems of cultivation are time-tested and sustainable, but lack of understanding and human intervention destroyed these systems. A.K. Tripathi *et al.*, studied the relevance of indigenous farming system (Zabo-system) for sustainable agricultural development in hill agriculture in Phek district of Nagaland. The tribal farmers adopt local methods to utilise their land and

water resources in order to meet the local demand and needs, which avoid or minimise the adverse externality arising from vagaries of weather, climate, disease and soil erosion as well. The paper, studying the Zabo system of the Chakaseang tribes, compared with the most popular farming system known as shifting cultivation. It has direct relevance to food security and nutritional security. “Zabo” means “impounding of water”, which is a unique property of conservation of natural resources of local specificities. It protect the forest as deforestation is allowed in the catchment area. The study reveals that due to adoption of the system the area under the Jhum cultivation decreased in the village. The productivity of crops in the system is higher in the range between 15-20 per cent in comparison to shifting cultivation. The farmers achieved self sufficiency (90 per cent) in rice cultivation whereas the farmers practicing shifting cultivation is deficient. It is also economically viable and feasible as the IRR and NPV are 13 per cent and Rs.326 respectively. As the system helps recycling of biomass, which maintain soil fertility, thereby reducing the use of external inputs. The Zabo system may be included in Integrated Watershed Programmes implemented by all State Governments of NEH region. The question arises, despite numerous advantages, what inhibit wide adoption, and is the system comparable to jhum practices in the real sense.

Livestock system plays an important role in the hill economy. Sushila Kaul *et al*, studied the economics of rearing of migratory sheep in providing livelihood and food security in hill economy of Kangra district of Himachal Pradesh. The study revealed that the activity generates employment to various farms. The net income over input costs from sheep varies from Rs. 233 per sheep to Rs. 242 depending on the flock size. The monthly average consumption of meat varied from 0.30-0.37 kg per person of which about 70-80 per cent was home produced, more than half of consumed vegetables were home produced.

S.A. Wani and M.S. Mir studied the land-based economy of cold arid North-West Himalaya of Ladakh. The cold arid region of Western Himalaya mainly comprises the Ladakh area of Jammu and Kashmir State. The two districts namely Leh and Kargil. The land-based economy is practiced mainly in two main sectors: agriculture and livestock. The analysis revealed that soil in the area is sandy, skeletal, celestius, fridged, which is low in nitrogen, moderate in phosphorus and high in potassium content, apart from low zinc and iron but it contains sufficient copper and manganese to support crop production. But the region lies mostly in rain shadow zone. Ground water is saline and not fit for irrigation purposes, thus resulting in poor pasturing development, although livestock is important. The cropping intensity is low at 107 per cent. The economy of Ladakh is primarily livestock-oriented with logistic support of agriculture sector in the respective ratio of 60:40. Agriculture is mainly of subsistence nature. Wheat and barley/gram/millet are important cereals that account for nearly 65 per cent of the net sown area in *kharif* and alfalfa as important fodder crop. The average livestock number per household was 17 in Ladakh with the highest 83 animal per household in breeding tract of pashmina goats. Local cattle, yak and

other small ruminants rearing not only generated income for livelihood under harsh climatic conditions, but also provided nutritional security.

4. *Crop Diversification Prospects*

V.T. Raju, *et al.*, studied the contribution of different crops in the overall growth of crop sector in Meghalaya. The growth analysis and Simpson index of diversification (SID) revealed that cereals and vegetables have registered negative growth during 1995-96 to 2004-05, whereas spices, oilseeds registered positive in area and production, which is a clear indication of crop diversification. This gives SID values around 0.5 during the period. High price volatility and instability is common in vegetables cultivation as compared to cereals may be the reason for reduction in area. To speed up the process of agricultural diversification, government needs to take a series of reform measures to integrate production and markets efficiently. Contract farming, co-operatives and group actions may help small holders in augmenting their farm income despite risk aversion. Although crop and agricultural diversification is an age-old practice in the NEH, a moot question is why it failed to add household income. The need for integrating market and the economy to the mainstream national economy has been the talk of the town for quite sometime, but no durable solution is attained, which imply that tracking the infirmity in the system and appropriate strategies must be crucial.

In the similar line, D.B. Yadav *et al.*, studied crop diversification as an effective tool for agricultural development for hill region of Maharashtra. Konkan region in Maharashtra state lies in the coastal and hilly region, which is famous for commercial crops like alphonso mango, coconut, arecanut, cashewnut and variety of species and condiments. The crop diversification is a powerful strategy for employment generation and sustainable agricultural development. The objective is to study the extent and determinants of diversification in the hill region. In capturing the changes, the study revealed that the share of gross cropped area is just around 30 per cent in Konkan whereas land under non-agricultural use increased more than 526 per cent, which is reflected in the higher value of Herfindhal index. The per capita income of the Konkan region increased by 153.36 per cent during last 10 years which can be attributed to crop diversification towards high value crops in the region. The share of mango and cashew nut in area to total fruit crops increased steadily. The results of regression analysis emphasised the need for provision of assured irrigation facilities in the region.

5. *Agro-Processing and Marketing in Fruits and Vegetables*

The study on marketing of sweet orange (malta) in Kumaon region of Uttarakhand by Divya Pandey *et al.*, revealed that the major component of the marketing to the producer was transportation cost incurred on mules. Producers were

earning 100 per cent margin in channel I and channel II. Producer's share in consumer's rupee was 9.38 per cent in channel II followed by 8.60 per cent in channel I. Channel IV was the most efficient with efficiency of 1.27 and channel VI was the least efficient with efficiency of 1.00. Given the current level of performance, there is need to link the farmers of hilly areas to market for remunerative prices, develop proper road and other infrastructure and co-operative federation for making the marketing mechanism more effective.

In their study on market infrastructure for enhancing agricultural production and prosperity of hill cultivators in Uttarakhand, A.K. Sachan *et al.*, attempted an assessment of prospect of agricultural production among the selected hill farmers in Uttarakhand. There is significant growth of 3 to 4 per cent in production and marketing of fruits and vegetables, but the marketing system for foodgrain commodities was sluggish. The improvement of transportation and communication infrastructure has promoted more collection of marketable commodities even in the far flung areas. However, the pattern of development has not been lopsided and not in the spirit of commercialisation particularly in remote tribal areas. Harboursing the potential niche for fruits and vegetables, still faces transportation problems that needs due consideration.

Saffron is a high profit crop in Jammu and Kashmir. S.A. Saraf and S.A. Rauf studied the economic analysis of saffron cultivation in Jammu and Kashmir. The findings of the study revealed that per hectare cost of saffron cultivation was higher during the initial year of establishment in all the three categories of growers. The human labour formed the major cost component in all the three size-groups. Economic viability of saffron cultivation was worked out and the results revealed the pay back period was the fourth year in all the three size-groups. The net present values were positive; average internal rate of return was higher at 58.18 per cent and benefit-cost ratios were more than unity. All these indicators proved that saffron cultivation was economically viable. Trend analysis indicated that there was a decreasing trend in area, production, productivity and export of saffron in Jammu and Kashmir. The compound growth rates were estimated as 0.60 per cent for area, 10 per cent for production, 9.39 per cent for productivity and 4.90 per cent for export of saffron. The study indicated that saffron crop is highly remunerative and offers ample scope for employment generation.

6. Yield Gap Analysis

Rooba Hasan *et al.*, studied technology adoption, profitability and yield gap in rice cultivation in Bageshwar district of Uttarakhand, and characterised rice cultivation practices at three different altitudes, viz., high, middle and low. Rice accounted for 24.38 per cent, 29.20 per cent and 27.97 per cent of the total cropped area at high, middle and low altitudes, but due to crop diversification, the cropping intensity was found to be more than 200 per cent. The cost and returns of rice

cultivation was worked out using the CACP cost concepts. The net return from rice showed inverse relation to altitude at overall value of Rs. 924 (at high altitude rainfed rice), Rs. 2724, Rs. 2845 and Rs. 2362 per acre at high, middle, low altitudes respectively. Similarly technology adoption index shows identical behaviour. The overall technology adoption index was 47.42 per cent. Yield gap was higher at high altitude (55 per cent) as compared to low altitudes (30 per cent). Significant variation was noticed in the case of yield gap among the different altitudes. 'Level of technology adoption', 'type of seed' and 'visits to Agriculture Development Officer /Scientists per year' were found to be the main determinants of yield gap for rice crop. Major policy implications emerged from the study were (1) need for accelerating adoption is appropriate package of practices of rice cultivation and create irrigation facilities, (2) More interaction between farmers and ADO/Ag. Scientists are required to enhance the productivity of rice crop. (3) Efficient input delivery system in the area will help in minimising the yield gap.

7. Uncommon Opportunities in Hill and Mountain Areas

Off- season vegetable cultivation emerged as a remunerative enterprise for small and marginal farmers of Himachal Pradesh. Brij Bala *et al.*, observed that in Himachal Pradesh as high as 67 per cent population depends on agriculture for its livelihood. The climate is suitable for the cultivation of variety of off-season vegetables. Kullu district has become famous for the production of quality off-season vegetables, where vegetables occupied above 80 per cent area This increased the cropping intensity to 250 per cent even in the small size farms. Per hectare cost A1 was the highest for tomato (Rs. 54,775) followed by cabbage (Rs. 34,206) and the minimum for pea (Rs.28, 633), although the farm size variation exists. The gross returns were the highest (Rs.5,11,956/ha) in tomato followed by cauliflower, cabbage and pea (Rs. 1,38,491). The provision of farmer training from time to time and with the availability of low cost mechanical tools, the labour cost can be reduced and the enterprise can become more remunerative.

Missing Gaps:

- Poverty is a conspicuous problem in the hill areas, which exists both in as an absolute as well as hidden form. Study of vulnerability to poverty did not get due attention of the researchers.
- A number of developmental schemes are operated in the hill and mountain areas for instance HADP, WGDP, DDP, DPAP, NEC etc. Since many of them are implemented by various line departments, there is no unified impact on the economy. Therefore, convergence of developmental initiatives will make greater social benefits.

- Tribal farmers mainly depend on their traditional knowledge and are constrained by inclement and inhospitable terrains. Shifting cultivation or terrace cultivation continued among the hill farmers. Their needs, aspirations and the customary practices of these hill people need to be documented in a comprehensive manner and separate action plan formulated. In the perspective of mainstreaming agricultural sector consider inclusion of tribal farmers, rather than excluding them from the category of farmers. This will enhance the participation the hill farmers in the developmental strategies.
- It is evident that hill farmers own very tiny plot of land, even smaller than that of the marginal farmers in the rest of the country, Thus, studies on small farmers and their livelihood deserve adequate emphasis.
- The vulnerable conditions expose the farmers to more risk due to climate change, erosion of agro-biodiversity, which severely affect their livelihood and the rural economy at large. Thus traditional as well as modern methods of conservation of natural resources such as land, water, flora and fauna assumes greater importance. Certain disaster preparedness strategies and risk coping mechanism must be planned and accordingly information need to be transmitted for disaster mitigation.
- Poor resource endowment (asset ownership) lead to under-investment in agriculture and more severely in the unfavourable areas. Therefore, more studies and specialised credit plan required to be drawn and should reach out adequately.

Policy Perspectives

The hill and mountain areas in India is deprived of many developmental gains and remained bypassed despite a number of initiatives from time to time. This indicates that the policy planning strategies did not cater to the requirement of the region. Appropriate strategies are needed so that the rich and vast natural resources need to be exploited sustainably. This will help accelerate growth and make development more inclusive. Specific strategies suggested:

- (a) Effective provision of production infrastructure in the line of PURA is essential to establish robust connectivity of rural community to market, and reverse the migration to urban areas.
- (b) In order to take advantages of uncommon natural resource base (land, water, low temperature, humidity, rainfall etc.), diversity and other specificities, there is urgent need to create enabling environment in the hilly and mountain areas.
- (c) Poor infrastructure in hill and mountain areas hinders the entry of private investment. Therefore, public investment is indispensable, but the investment portfolio should be planned on the ground of hill and mountain specificities, so that it converts to opportunities and growth of rural development accelerates.

- (d) Possibilities of convergence of numerous developmental programs into an integrated and inclusive hill developmental scheme need more attention.

Ecosystem wise differentiated strategies are essential for linking natural resources and sustainability in hill and mountain areas. Thus, innovative and integrated management strategies in different ecozones or regions are needed in optimal utilisation of natural resources for sustainable production systems and to reap the maximum advantages of the system. Based on the resource characterisation and prevailing production systems in the selected ecosystems, the following management strategies are suggested (*Indian Agriculture in Brief, 2008*).

Western Himalayan Region

- Traditional and modern methods of water and land-use planning for resource use efficiency and need-based accelerate adoption of integrated agri-horti-silvi-livestock system.
- Balance between forestry and agriculture system for ensuring sustainability and livelihood.
- Maintain cereal production for household food security in inaccessible terrains, but promote diversification in favour of high value and low volume crops of fruits, vegetables, flowers, aromatic and medicinal plants and plantation crops for income support.
- Special and exclusive programme on hill area infrastructure, marketing and processing for enhancing marketability of their specialty crops.
- In order to take advantages of favourable ecological settings in the H&M areas, promoting and facilitating off season weather sensitive cash crops, risk free good quality seedlings of vegetables, flowers and even their cultivation in such polyhouses is to be encouraged, and
- Developing and providing simplified pro-farmer credit support and crop insurance cover for stepping up the use of inputs and adoption of modern technology.

Eastern Himalayan Region

- Innovation in soil and water conservation measures on micro and macro-watershed approach,
- Improvise shifting cultivation by imbibing modern methods as alternative,
- In view of the geo-physical situation and vast potential in agriculture including forestry and horticulture, a complete input-output delivery package including improved seeds or saplings of fruit crops, fertilizers and pesticides, coupled with marketing facilities have to be organised, and

- Rather than cropping system, integrated farming systems as in the line of the one developed by the agricultural Research and development establishment in various region including the NEH region should be tested or modified as per suitability of the site and needs of the farmers.

Eastern Plateau Hills

- Intensification of soil and water conservation through watershed programmes and water harvesting, is a common need.
- Animal husbandry, fisheries and silvipastoral programmes which have not made any headway, must be taken up seriously with the participation of local human resources. Entire spectrum of steps, right from breeding, feeding and health care of animals to fodder availability should be streamline and strengthened, and
- A large-scale afforestation programme to rehabilitate the peripheral forests must be taken up for ecological sustainability.

Western Plateau Hills

- In areas where irrigation is available, technology for high value crops should be introduced,
- Revitalise peoples' participation in the development of minor irrigation schemes which is required for increased and sustained productivity of crops; traditional system of water harvesting requires to be revived.

East Coast Hills

- In view of comparative advantages, strengthening of the input supply system by dovetailing it with transfer of technology holds great promise. Integrated horticultural programmes required to be promoted for better economic results. The animal husbandry programmes have also to be strengthened by improving the indigenous breeds through a cross-breeding programme and better supply of feed and fodder.

West Coast Hills

- Rainwater management through conservation of rainwater either in situ or in tanks and micro-reservoirs , development of minor irrigation, crop diversification to replace the low-yielding rice and millets in the region with horticultural crops such as mango, banana and coconut along with their systematised marketing and processing by developing appropriate infrastructure are the major concerns where interventions are required.

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APPENDIX 1.

STATE WISE DESCRIPTION OF AREAS UNDER HILL AND MOUNTAINOUS AGRO-ECO-ZONES

State (1)	Area description and Characterisation (2)
Andhra Pradesh	High altitude and Tribal Zone: Northern borders of the state in the districts of Srikakulam, Vijyanagaram, Vishakhapatnam, East Godavari and Khammam
Arunachal Pradesh	Dibang Valley, Changlang, East Siang, West Siang, West Kameng, Lower Subansiri, Upper Subansiri and Lohit Districts
Assam	Karbi Anglong and North Cachar districts
Bihar	Hilly parts of Gaya and Aurangabad
Chhattisgarh	North Hill Zone of Chhattisgarh, Baster Plateau Zone, Kymore Plateau (Durg, Raipur, Bilaspur, Sarangarh district and Gharghoda tehsil of Raigarh and Kankar tehsil of Baster)
Gujarat	South Gujarat Heavy Rainfall Zone: Hilly areas of Dangs and Valsad districts; North Gujarat Zone 500 to 1,090m m.s.l.
Haryana	Shiwalik Hills, dissected rolling plains in the foot-hills and Southern tract with Aravalli hills
Himachal Pradesh	Sub-Montane and Low Hills Sub-Tropical Zone: Uplands of Chamba, Kangra, Solan, Hamirpur, Sirmaur and Biaspur districts; Mid Hills Sub-Humid Zone: Parts of Chamba, Kangra, Mandi, Solan, Shimla and Sirmaur districts; High Hills temperate Wet Zone: Kullu and parts of Chamba, Kangra, Mandi, Sirmaur, Shimla districts; and High Hills temperate Dry Zone: Kinnaur, Lahual-Spiti and parts of Chamba district
Jharkhand	Western Plateau (Palamu, Lohardaga, Gumla and Ranchi districts), Central and North-eastern Plateau (Hazaribagh, Giridih, Devghar, Godda, Sahibganj Santhal Pargana, Dhanbad districts) and South-eastern Plateau (Paschim Singhbhum and Purba Singhbhum districts)
Karnataka	Hilly Zone: North Kapnada, Chikmangalur, Dharwad, Coorg and Hassan districts
Kerala	High range: The mountainous land (750 to 2,500 m m.s.l.)- Wynad and Ldukki districts and Eastern part of other districts bordering the Western Ghats; and High Land: Hilly tracts (75 to 750 m m.s.l.) on western sides of the Western Ghats covered with forests
Madhya Pradesh	Satpura Hill Zone (Jabalpur, Panna, Satna, Rewa, Seoni and Gopandbana districts and Deosar tehsil of Sidhi district) and Jhabua Hill Zone (Jhabua and Dhar districts)
Maharashtra	Sub-Montane Zone: Spread over Nasik, Pune, Satara, Kohlapur and Sangli districts
Manipur	Senapati, Chandel, Tamenglang, Ukhrul and Churachandpur districts
Meghalaya	Jaintia Hills, East Khashi Hills, East and West Garo Hills
Mizoram	Aizawal, Lunglei and Chhimtuipui

(Contd.,)

APPENDIX 1. (CONCLD.)

State (1)	Area description and Characterisation (2)
Nagaland	Kohima, Phek, Zonheboto, Wokha and Mokokchong, Tuensang and Mon districts
Orissa	Some parts of North-Eastern Ghat Zone (300 to 800 m m.s.l.): Phulabani district; and Eastern Ghat Highland Zone ((150 to 1000m m.s.l.): Koraput, Nawaranpur and Jeypore districts
Punjab	Sub-Montane Undulating Zone: Gurdaspur district; and undulating Plain Zone: Hoshiarpur and Roper and parts of Gurdaspur districts
Rajasthan	Aravalli Hill Zone: Sirohi, Udaipur, Bhilwara and Chittorgarh districts
Sikkim	East Sikkim, North Sikkim, West Sikkim and South Sikkim districts
Tamil Nadu	High Altitude and Hilly Zone: Nilgiris, Shevroys, Elagiri-Javachi, Kollimalai, Pachdi Malai, Annamlais, Palnis and Podhezai Malai
Tripura	Tripura
Uttaranchal	Hill Zone: Uttarkashi, Chamoli, Pauri Garhwal, Tehri Garhwal, Dehradun, Pithoragarh, Almora and Nainital. The Zone comprises of 4 sub-zones: Sub-tropical (250 to 1,200 m m.s.l.), Sub-temperate (1200 to 1700 m m.s.l.), Temperate (1700 to 3500 m m.s.l.), and Alpine Zone (3500 m m.s.l. and above)
Jammu and Kashmir	(a) Low altitude sub-tropical Kathua, footlands of Jastrata, Samba and Jammu (b) Mid to High Altitude Intermediate Zone: Poonch, Rajarui and Doda, Altitude range 1,500-3,333 m m.s.l. (c) Mid to High Altitude Temperate Zone: Ananatnag, Oikwanam Srubgarm Badgam, Baramula and Kupwara. Plain valleys have an altitude of about 1,700 m which rises to 2,160 m and to 2,660m to 3,333m on the upper belts. Altitudes further rises to 4,666 m in snow bound areas (d) Cold Arid Zones: Leh and Kargil districts of Ladakh from 2,660 m to 9,300 or more. Ladakh one of the loftiest inhabited regions of the world is located in the zone
West Bengal	Hill Zone: Darjeeling district except Siliguri Sub-Division. Altitudes varies above 60-90 m in plains up to 4,000m. Classifies in 3 altitudinal ranges (i) Altitudinal range: 1,650-2,150 m m.s.l., (ii)Altitudinal range: 1,250-1650 m m.s.l., and (iii) Foot hills: below 1,250 m

Source: The hand book of agriculture, Chapter 12, Hill agriculture pp.72-74.

Key words: Hill farming, Problems, Prospects, Ladakh. The hill and mountain areas differs the plains in topography, elevation, physiographic feature diversity of habitats for flora and fauna ethnic diversity, land use systems and socio-economic conditions. Hills in general offer a vast scope for cultivators of diverse mix of crops-cereals, pulses, oilseeds, vegetables, flowers and fruits. Animal husbandry is an integral part of farming system. Agriculture Since ancient times, marginal farmers in the Himalayas. have developed many techniques to increase production. Most grow cereals, and nearly 80% of the area is under wheat, maize and rice. Indian agriculture is plagued by several problems; some of them are natural and some others are manmade. 1. Small and fragmented land-holdings: The seemingly abundance of net sown area of 141.2 million hectares and total cropped area of 189.7 million hectares (1999-2000) pales into insignificance when we see that it is divided into economically unviable small and scattered holdings. This is testified by the success story of agricultural progress in Punjab Haryana and western part of Uttar Pradesh where over half of the cropped area is under irrigation! Problems of Agriculture in Nigeria. POOR GROWTH: Despite Nigeria's rich agricultural resource endowment, however, the agricultural sector has been growing at a very low rate. Less than 50% of the country's cultivable agricultural land is under cultivation. Even then, smallholder and traditional farmers who use rudimentary production techniques, with resultant low yields, cultivate most of this land. CONSTRAINTS FOR SMALL-HOLD FARMERS: The smallholder farmers are constrained by many problems including those of poor access to modern inputs and credit, poor infrastructure, inadequate access to ma