Chapter- 8

SUMMARY FINDINGS, INFERENCES AND RECOMMENDATIONS

8.1 Summary Findings

The complex physiographic and eco-fragile environment conditions in the study region have resulted in mountain specificities. These, along with pre-committed land-use policy in the Darjeeling region, have differentiated the land-use and livelihood patterns and occupational structure of the district from those of the state, the district hill blocks from the plain blocks, and the hill tea-growing blocks from the hill agricultural blocks. Thus, the land-use and livelihood patterns of the district and its block clusters carry regional characteristics. The annual population growth rates in Darjeeling district between 1991 and 2001 were well above those of the state, with sharpest growth in the plain region, lower in the principal agricultural hill blocks and lowest in the hill tea-growing blocks. Such rapid population growth in the district and most blocks has put substantial pressure on basic infrastructure and land-resources, leading ultimately to severe crises in rural livelihoods and the environment, particularly in the hill blocks. However, average literacy levels in the district have traditionally been higher compared to the West Bengal and India averages, with relatively higher literacy levels in the hill blocks compared to the plain blocks as well as in the tea-growing blocks compared to the hill agricultural blocks. Historically because of higher urbanisation levels, the number of females per 1000 males (i.e. *FMR*) has been lower in the district than in the state or nation, with higher FMRs in the hill tea-growing blocks than in the agricultural blocks, and lowest in its plain region. Outmigration of males in the workforce because of less work opportunities for male entrants is an important factor influencing the low FMRs in the hill region. The road density and proportion of villages having access to metal road were also relatively higher in the hill tea-growing blocks compared to the hill agricultural blocks.

Because of prior land commitment to tea plantations in the tea-growing blocks and to reserved forests and also due to unsuitable gradients, rocky soil-profiles in hill blocks, the better land-man ratio and per capita cropland of the district compared to those of the state as well as of the hill blocks when compared to the plain blocks and of most hill agricultural blocks when compared to hill tea-growing blocks, are not reflected fruitfully in efficient land-use. The relative area under forest was much higher but under cropland was much lower in the district compared to the state as well as in the hill blocks compared to the plain blocks and in most hill agricultural blocks compared to the hill tea-growing blocks. With limited presence of culturable waste land in the district blocks, agricultural development is stymied by constraints on its expansion along the extensive margin in the district blocks, particularly in the hill tea-growing blocks. This is also limited through the intensive margin in the hill blocks because of their topographical difficulties and adverse agroclimatic conditions. Limited access to irrigation with seasons further constrains on the agricultural development in the hill blocks. Between1991-2001, cultivated land area has increased through clearing of forests and encroaching more marginal, sloping land under cultivation in the district, particularly in the hill blocks, which thus has led to unsustainable land-use. The size-distribution of agricultural holdings was relatively more clustering to below 2 ha. in size in the district compared to the state, in the plain blocks compared to the hill blocks as well as in the hill tea-growing blocks compared to the hill agricultural blocks.

With tea labourers and more white-color work opportunities in the adjacent Siliguri Municipal Corporation, the WPRs in main works was relatively higher in the district compared to the state as well as in the plain blocks compared to the hill blocks and in the urbanised blocks compared to the rural blocks. With many family members engaged in marginal work in cultivation, WPRs for total workers were higher for the hill agricultural blocks than for the hill tea blocks and plains blocks. Similarly, the WPRs for marginal workers were higher in the hill blocks than in most plain blocks, as also for the hill

agricultural blocks. With more employment opportunities for women in tea-plantation, WPRs for women in main works were higher and the gender gap in WPRs in main works was lower in the district than in the state, in the hill blocks than in the plain blocks as well as in the hill tea-growing blocks than in the hill agricultural blocks in relative terms. Between1991-2001, WPRs in aggregate works rose because of intensification of livelihood pressure in rural Darjeeling, especially in the hill agricultural blocks, rather than because of the expansion of livelihood opportunities overall.

The inclusion of tea-plantation land within cropland and tea-plantation workers within other workers in the census report makes the occupational structures of workers critical in the district tea-growing blocks. Nevertheless, a substantial number of rural people in the hills still depend on agriculture for their living. Each hectare of farmland already engaged 1-2 agricultural workers on the average in the hill agricultural blocks. Without major technological break-through, the creation of additional work-opportunities through cropping was limited in the district blocks, especially in the hill blocks. Hence, the district was opted for a major occupational shift from farm works to non-farm works. More than fourth-fifths of the secure non-agricultural work opportunities generated in the district between1991-2001 were confined to the plains blocks, and only a tenth of these were created in the hill agricultural blocks. Hence, currently the rural economy of the Darjeeling Himalayan region has been trapped by unsustainability and livelihood insecurity.

Hamlet level analysis has revealed that the crisis spreads across distinct social and geological locations in the study region. The analysis based on primary data provides more detailed information regarding demographic characteristics, asset-utilisation and livelihood patterns of the hill farmers in the villages and across multiple strata of the households. Between the two non-urbanised hill agricultural blocks─ Kalimpong-1 and Kalimpong-2─ from where the samples were selected, Block-1 is nearer to Kalimpong town. With less population growth and topographical constraints in Block-1, the land-use unsustainability and livelihoods insecurity were relatively lower in this block compared to Block-2. The literacy and cropland were comparatively higher but the land-man ratio and per capita cropland were relatively lower in the villages than in the respective blocks from which the villages were selected. The WPRs in total and marginal works, and the proportion of cultivators to total workers were relatively higher, while gender gap in WPRs in total works and proportion of agricultural labourers to total workers were relatively lower in the villages compared to the respective blocks, mainly because all sample households are farm households.

Land scarcity was more in SC/ST dominated villages, in villages at higher elevations, and also in most villages at a close distance from the markets. The degree of unsustainability and the agricultural livelihood crisis were greater in the SC/ST dominated villages as well as in those with lower level of human resource development. With lower levels of education of the household heads, literacy levels and per capita cropland as well as more limited non-farm work opportunities in most of the remote villages, the WPRs of these villages in main works for both male and female were relatively lower, but proportion of agricultural workers to aggregate workers was relatively higher. With prevalence of exchange labour system in the villages, their opportunity in absorbing workers as main agricultural labourers was limited. The proportion of household industrial workers to total workers was relatively lower in most villages. Hence, the degree of unsustainability and livelihood insecurity was relatively greater in the more remote villages.

Despite having relatively lower land scarcity in villages with lower irrigation access, because of relatively more unsuitable gradients, elevation and rocky-soil-profile in these villages, the extent of cropland was much lower in these villages. With inadequate irrigation access to cropland in the less irrigated villages, their WPRs in main and marginal works were comparatively lower. The degree of agricultural unsustainability and livelihood insecurity was thus relatively greater in the villages with lower irrigation access and in the villages at high elevation. With less forest land, the pressure of fodder and fuel-wood on forest land was high in the villages. The meagerly presence of culturable waste land limits agricultural development through the extensive margin in the villages. Nevertheless, the

physiographic and agroclimatic diversity across the region did provide specific opportunities to farm households in terms of differentiation in production niches. The farmers attempted to harness these niches through agricultural diversification conforming to the sustainability of local resource utilisation for agricultural and economic sustainability and improving their standards of living.

Besides seasonal distribution of rainfall, accessibility to irrigation in the study villages was found to depend on village elevation and slope characteristics of cropland. These together determined the prevailing cropping patterns in each village. Cropping intensity was lower for households with access to perennial *jhoras* compared to the households with seasonal access to *jhoras,* since the former were able to transfer more land to floriculture cultivation than the latter. With increased holding-size, the cropping intensity gradually decreased.

The need of agricultural households for food security led to cereal-dominance in the village cropping patterns. With more cropland commitment to vigna bean in the less irrigated villages, cereal dominance was however lower in these villages, which correspondingly had more cropland under pulses, against substantially lower paddy and vegetable areas despite having greater adaptation to low rainfall and dry cultivation of the farmers in these villages. However, the relative cropland committed to vegetables was higher in these villages. The extent of cropland committed to cereals was higher in the villages at lower elevations, reducing the land under ginger and pulses. Since the perishability of vegetables necessitated more frequent marketing transactions, therefore more households committed land to vegetable cultivation in villages located closer to the market centres.

Cropping patterns in the study villages were also influenced by the climatic adaptability of alternative crops. Less irrigation-sensitive crops like as bitter gourd, pumpkin, squash and coriander were found more prominently in the cropping patterns of the less irrigated villages. The cropping extents under summer and winter potatoes reflected crop adaptation to the local water regime. Another feature of adaptation was the harnessing of microclimatic niches for crops such as green peas, cherry peppers (*dalley* chillies) and cucumber. Less irrigation-intensive crops such as beans and mustard greens *(raya saag)* were grown over an extended period ranging from early winter and the *kharif* season in villages with lower irrigation access, and during the pre-*kharif* season in the villages with better irrigation access. They thus occupied an important position in the cropping patterns in the study villages. Other seasonal irrigation-intensive crops like cabbage and cauliflower acquired greater relative importance in the cropping patterns in the well irrigated villages located closer to the market centres.

Intercropping practices also influenced the cropping patterns in the study villages. These practices resulted from multiple factors, such as the possibility of utilising terrace bunds for paddy-based intercrops, the complementarity of maize cultivation with vigna bean and soybean intercropping, the requirement for intermediary crops during ginger cultivation, as well as overall land scarcity. Land scarcity was not reflected as a relevant cause for the nature of land utilisation in the study villages, except for the smallest holding-sizes.

The low physical yields and profits for cereal dominant cultivation acted as stress-factors. Risk-averse farmers attempted to overcome such stresses by distributing their cropland over a large variety of crops, especially in less irrigated villages. Consequently, because of low cropland commitment despite the large number of crops, crop diversification indices were lower in these villages. Crop entropy indices were higher in the less irrigated villages than in those with better irrigation access. The entropy gradually decreased with growing holding-size.

Cropping with inferior cereals, e.g. millet, was initially substituted by enhanced cropping of superior cereals like maize. Subsequent crop substitution took place through the introduction of higher-valued cashcrops, e.g. cherry peppers, green peas and other green crops like coriander and cabbage, and also floriculture. However, the multiplication in crop numbers was not reflected by the corresponding increase in cropping area. Although the commitment of cropland to maize largely remained unchanged, maize was replaced partially by floriculture in villages with higher access to irrigation and located

closer to markets. The Increase in the commitment of cropland to ginger was higher in the less irrigated villages than in those with better irrigation access. The opposite was true in case of relative land commitment to vegetables. With the diversification indices being more responsive to cropland changes than to crop multiplication, the measured degree of intertemporal crop diversification was low in most villages. In relative terms, the extent of crop diversification was lower at the more distant villages and higher in the villages located close to market centres. Intertemporal crop diversification was highest on small farms and lowest on farms of medium-size. While the extent of diversification gradually decreased for pulses and vegetable crops, diversification had increased over most holding-size categories in case of commercial crops such as ginger.

The effects of these cropping patterns on the livelihoods of the hill farmers as well as the reasons behind changes in cropping patterns are assessed in terms of crop economics. The relatively low crop-yields in hill agriculture acted as primary production constraints in the villages studied. Along with differences in the intensity of input-usage and the hill-farmers' technological capacity for cultivating different crops, crop-yields also varied widely among the villages because of relative differences in their irrigation access as well as in their physiographic and agro-climatic situations. Relative yields of paddy, *vigna* beans, ginger, cherry peppers and most irrigation-sensitive vegetables were lower in the less irrigated villages and higher in villages with better access to irrigation. Most major crop-yields were relatively higher in the small-sized holdings. These yields were also relatively lower for households without adequate access to irrigation for their land.

In money value, the output of cashcrops and green crops was higher than the value of foodgrains output of cereals and pulses in the villages studied. In all the villages, more crop value was generated from vegetable crops and less from foodgrain crops. Most hill farms thus held comparative advantage in vegetable cultivation. The costs of cultivation and profit margins were high in the villages surveyed. In per hectare terms, costs of cultivation and profits were generally much higher for cashcrops and green crops when compared to cereals and pulses. Although most major vegetables were economically viable for the farmers, diversification into cashcrops like ginger and cherry pepper cultivation was more profitable and generated relatively higher yield rates than into vegetables in most villages. With the dominance of cereals in the cropping patterns however, total profits and money value of output on cultivation were generally low in the villages surveyed.

The yield rates and profitability of foodgrain crops were comparatively higher in villages with better irrigation access and lower for vegetable crops. However, the profits accruing from the cultivation of vegetables were more or less depending on the proximity of markets. With the dominance of cereals in the cropping patterns however, total profits on cultivation were generally low in the study villages. For nearly all the crop-categories, the profit margin gradually decreased with growing holding-size and was the lowest in the medium-sized holdings. However, profitability was higher for landowning households and households with adequate irrigated land. Despite the lower comparative yield of vigna beans vis-à-vis other pulses, more land at lower irrigated villages was devoted to the cultivation of vigna beans. Niche adaptation in the extent of land committed to vegetable cultivation and the preservation of some cultivation of drought-resistant inferior crops especially in the villages with lower irrigation access, pointed towards the need for agricultural diversification as a survival and coping strategy. Consequently, the true extent of agricultural diversification in mountain farming is better measured in terms of complexity of crops, climatic niches and land acreages, than as formal crop diversification indices, defined essentially by crop acreages alone. However, the degree of entropy in cropping patterns was associated more significantly with the total value of crop output in most villages. Such crop diversification was more pronounced among the larger farming households compared to the others, as well as among farming households with less access to irrigated land.

The extent of cropland diversification was determined primarily by the need for smoothing household consumption of cereals and pulses, while the income generation depended more on the extent of land commitment to cashcrops and green crops. The market share and contribution to the total crop income

from particular commercial cashcrops like ginger and cherry peppers were higher in villages with lower irrigation access. For vegetable crops in general, the opposite held true. With the dominance of foodgrain crops in the cropping patterns however, the crop income per household was generally low in the study villages. While the yield rates and profitability of nearly all the crop-groups gradually reduced, crop incomes per household rose gradually with increased holding-size. Because of this relation, severe inequality in the distribution of crop income related to farm-size was thus revealed.

The labour absorption in cultivation activities decreased gradually with growing holding-size. In both absolute and relative terms, many more labour man-days were generated by the cultivation of vegetables on lands with moderate to low irrigation, than by the cultivation of foodgrains on irrigated holdings. Nevertheless, less hired labour is absorbed in foodgrains cultivation because of lower physical yield and profitability, and greater reliance is placed on family labour and labour-exchange, than in vegetable cultivation. While labour exchange smoothed the cultivation operation, it restricts the extent of livelihood diversification into non-farm activities in the hamlets, especially in the tribal hamlets where it is more institutionalised. Although the vegetable crops had greater economic potential of diversification, they created more adverse impact on the environment in terms of more intensive use of chemical fertilisers and pesticides and bamboo plants.

The relatively low physical yields and lower crop income and necessity of crop-livestock integration in hill farming worked as push factors, while agroclimatic suitability of the livestock animals and relatively greater access to green fodder in the hilly regions acted as pull factors for rearing varieties of animals such as cattle, goats, pigs and poultry birds in the villages. But the cattle acquired dominancy in the total livestock animals in the villages. The household participation rate in cattle rearing and cattle stock per household were high in the villages. Relatively less proportion of the households reared goats instead of cattle for selling meat in the villages, particularly in the nearer villages. However, with caste barrier in rearing pigs and indigenous chicken birds, the household participation rate in rearing these animals was comparatively lower in the villages. With requirement for special knowledge and more market intensity in rearing exotic chicken birds, despite having their high economic potential, they were reared by a few households for selling meat in the villages located closer to the market centres. Thus, the acute cattle dominancy in total animals in cattle equivalent units [CEUs] primarily resulted in low livestock diversity in the villages.

The economic potential of the livestock components also depended on their population composition based on bred and use. Although the cattle were reared mainly on stall feeding for draught power, milk-yielding and manure generation, the milk-yielding purpose was predominant, and thereby milch cattle were dominant over the total cattle population in the villages. The cross-bred milch cattle yielded much milk than the indigenous ones, while for draught power and management, the latter was more suitable. The pigs were reared for selling both meat animals and piglet, while the latter was practised by a few pig rearing households, despite having more productiveness of pig rearing for selling piglet over pig rearing for selling meat animals. The cross-bred pigs were more productive than the indigenous pigs. The indigenous poultry birds, especially the chicken birds, were reared for meat and egg generation and meeting emergency expenses in the villages, particularly in the more distant villages. The proportions of cross-bred milch cattle to the total milch cattle and cross-bred pigs to the total pigs respectively were relatively higher in the nearer villages. The annual milk and manure production, value addition, profits and income of the cattle per household were high in the villages. The proportion of the households involved in selling milk and the proportion of milk output sold to the total milk yielding were also high in the villages. However, the annual value addition, income generation and profits of both the piggery livestock and the poultry birds per household were relatively low in the villages. Consequently, the total annual value addition, income generation and profits of the total livestock per household were very high in the villages, even higher than crop cultivation activities in most villages. In all such cases, the contribution of the cattle was relatively higher compared to other livestock components in the study

villages. Hence, the livestock animals, especially the milch cattle, played a complementary role to the relatively lower value and income generation from crop cultivation in the villages.

With relatively lower value and income generation from crop cultivation in the less irrigated villages, cattle stock per household and the proportion of milch cattle to the total cattle as well as the total annual value, the income and net return of the cattle and the total livestock per household were comparatively higher in these villages than in the villages with better irrigation access. The opposite was true in case of annual rental income of the drought cattle holding per household as well as of livestock diversity. Despite having relatively greater participation rate and cattle stock per household in the more distant villages, because of lower proportion of cross-bred cattle to the total cattle, and lower proportion of milk sold to consumers directly to the total milk sale, the milk-yield per milch cattle as well as the value and income from per litre milk was comparatively lower in these villages than in the villages located closer to the market centres. Hence, the less access to market in the more remote villages has lessened their economic potential of the livestock. With very less participation of the Brahmin and Chettri households in rearing pigs and indigenous chicken birds, the total value, income generation and net return of these animals per household as well as the mandays generation from livestock were relatively lower in the non-tribal villages than in the tribal villages. .

Along with the increase in fodder availability for large farmer households, the household participation rate in cattle and goats as well as the total livestock in CEUs per household rose gradually with growing holding-size. Hence, the annual income, the total value and the profits of the bovine and total livestock per household rose sharply with increased holding-size. However, in case of piggery livestock, these were the highest for medium farmer households and the lowest for small farmer households. For poultry birds, these were the highest in households with medium-sized holdings and the lowest in households with large-sized holdings. Hence, the inequalities within rural asset and income distribution resulted from farm-size, were mitigated slightly through rearing the livestock that are not dependent upon fodder.

In mixed farming systems, the crop-livestock integration, in forms of dependency of crop cultivation activities upon livestock for manure and draught power, and dependency of the livestock upon crops for fodder and crop-residue, were high in the study villages. However, such integration was relatively lower in less irrigated villages, since their bovine livestock was more dependent upon green fodder. The livestock helped in regaining soil fertility of the cropland, while they produced negative effects on the environment by depleting forests and forest vegetation in the villages, especially in the villages with lower irrigation access. Although the livestock had high economic potential of diversification in most of the study villages, because of less access to market in the more remote villages, such potential was comparatively lower in these villages.

Despite having the low crop-yields in hill agriculture, the agro-climatic and physiographic diversity in the mountain regions offered differential production ‘niches’ to develop other subsidiary agro-enterprises such as fruits, agroforestry, floriculture, apiculture, sericulture and pisciculture. Of these farming operations, fruits and floriculture were dominant in terms of the household participation, value and income generation, and profits. Although multiple varieties of fruits were grown in the study villages, the main commercial fruit grown was orange, reflected in its higher contribution to value, income and profit of the total fruits in most of the villages. With the necessity of suitable agro-climate for orange cultivation, the household participation rate and scale of operation of orange were low in most villages. Conversely, because of the opportunity of cultivation on inferior land and less agro-climatic sensitiveness of banana, the household participation rate in banana cultivation, and the number of banana plants per household, were high in the villages. However, because of the low economic potential in most of the fruits like banana, the annual value, income generation and profits of the total fruits and oranges per household, were low in most of the villages. Relatively more productive avocado and passion fruits were newly initiated by limited households on a smaller scale in selected villages. With lower diurnal duration of sunshine and limited winter cropping in the villages with inferior slope

aspect, the annual value and income generation and profit of the total fruits and oranges per household were comparatively greater in these villages. The orange-intercropping, wholesale and low management cost of mandarin orange primarily resulted in the low yield and value of oranges in the villages, especially in the more distant villages with inferior slope aspect. The plantation of substantial fruit seedlings, especially those of orange and avocado, in the past five years pointed towards future augmentation of the output of fruit in the villages, particularly in the nearer villages.

For fulfilling the needs of fodder, fuelwood and timber as well as for assisting in crop cultivation and smoothing rural life, large species of trees and multiple varieties of bamboo plants were grown on uncultivated, sloping land as well as on field boundaries in the villages. The bamboo plants and agroforestry trees and plants per household, the annual yield and value of bamboo culms, fodder and fuelwood per household were high, but the value of timber and non-timber forest products per household was low in the villages. These were comparatively higher in the villages with more uncultivated, sloping land and high land gradients. Because of low access to road and transport, the annual income generation from bamboo and agroforestry trees and plants per household was low in most of the villages, however this was relatively higher in the nearer villages.

Amliso (broom-grass) and paddy straw were the main items among the miscellaneous crops and collected items. The annual value and income from *amliso* per household were high in most of the villages. These were relatively greater in less irrigated villages than in villages with better irrigation access because of relatively higher uncultivable land in the former villages. The opposite was true in case of paddy straw. Nevertheless, despite being the traditional enterprise in the region, mainly because of limited scientific knowledge and management, only few households practised apiculture with less number of apiaries for honey-yielding in the villages. Consequently, the annual honey yield as well as value and income generation from the subsistence apiculture per household and per grower, were low in the villages. These were comparatively higher in the less irrigated villages.

The sericulture and pisciculture enterprises were developed in the region greatly due to state patronage. With low economic potential in sericulture, it was practised by limited households only in the more distant villages with inferior slope aspect where the opportunity cost of cropland was low. It played a crucial role in sustaining the sericulture of the plains through provision of seed crop, and even in empowering the women, while its growth was stagnant in the region without reeling activity. Because of lack of consciousness and necessity of concrete *jhora* fish pond, pisciculture was practised on a small scale by very few households in most of the villages, but the participation rate in *jhora* fishery was relatively higher in villages with greater *jhora* access. So, the annual fish-yield, value and income generation from the pisciculture per household were low, but these per grower were moderate in the pisciculture-practising villages. With relatively higher pond depth, these were comparatively greater in villages with inferior slope aspect.

More than fifty varieties of floriculture produces were grown at sample farms in the study region. Of these items, only Gladiolus spread more to ordinary farm households in the villages. Thus, over the whole sample, a higher proportion of value and income of floriculture were generated from Gladiolus. With necessity of greater technical knowledge and finance as well as access to market, marketing channels and irrigation, the household participation rate in floriculture and Gladiolus cultivation was low in the villages. However, because of the high economic potential in most floriculture produces, the annual value, income and profit of floriculture and Gladiolus per household were high in most villages, but these varied widely between the villages. Generally, these were relatively greater in well irrigated villages located closer to the market centres. Despite having relatively low yield rates of Gladiolus compared to other floriculture items, Gladiolus yield was many folds greater than the crop-yields in the villages. Hence, the floriculture items, especially Gladiolus, had substantial economic potential of diversification in the villages, especially in the nearer villages with better irrigation access. Nevertheless, because of the commitment of low proportion cropland and labour to non-traditional agro-enterprises in the villages, higher proportion of agricultural value and income was generated from

traditional agro-enterprises, particularly from crops and livestock, in most of the villages. Thus, farm diversification was moderate in the villages. The annual value and income generation of traditional and non-traditional farming operations per household were relatively greater in the nearer villages.

The annual value, income generation and profit in most agro-enterprises and farming per household rose sharply with increased holding-size. Agricultural diversification indices also slightly increased with growing holding-size. Hence, the accumulation motive of diversification was reflected in the diversification patterns of households in larger holding-sizes. However, such farm diversification resulted in acute inequalities in rural assets and income distribution.

Despite having greater economic potential of diversification in floriculture and higher-valued commercial crops like ginger and cherry peppers, they had relatively more adverse effect on soil fertility and the environment in terms of the intensity of use of chemical fertilisers and pesticides. However, other niche-based agro-enterprises had a favourable influence on the environment, and all of them acted against soil erosion. The distribution of cropland by households among the agro-enterprises reflected their consciousness regarding physiographic conditions. For reducing such adverse effects on the environment, they adopted indigenous measures based on indigenous knowledge.

8.2 Inferences

The agriculture in the villages and in the region studied is stymied by multiple physical constraints such as remoteness and inaccessibility, marginality, and eco-fragility. These constraints are caused by complex mountain topography and are expressed in terms of moisture, stress, poor soil conditions and relatively shorter growing season. Added to these are multiple socioeconomic constraints like small landholdings, scarcity of cropland, limited irrigation access to cropland, relatively low crop-yields, poor production and post harvesting management, lack of agricultural entrepreneurship along with limited access to road, marketing and marketing channels. The land and labour market are also imperfect, and thereby exchange labour system prevails in the villages, which is more institutionalised in the villages dominated by the tribal communities. All these together have led to underutilisation of resource-base and generation of limited agricultural surplus which could be used to invest in and to support further agricultural and economic development. The regions, however, have opportunities in terms of micro-climatic niches suited particularly to certain crops, although such niches vary substantially within short vertical and horizontal distances. Hence, in small regions, comparison of the crop-choice of the hill farmers is possible. Harnessing such advantages and promoting investment in higher-valued commercial crops can determine the future path of agricultural development and livelihood improvement in the region. The livelihood options as well as crop and agricultural enterprises choices of the farm households thus reflect some sort of balancing such constraints and opportunities for their survival.

The farm and non-farm livelihood choice of the farm households primarily depends on the extent of crop cultivation activities and availability of non-farm job opportunities in the surrounding economic environment. With limited irrigation access to cropland in the less irrigated villages, cropping extent is lower in these villages. In the villages located closer to market centres, their workers partially shift their occupation from farm works to non-farm works because of relatively more non-farm work opportunities in these villages. On the contrary, in the villages located farther away from market centres, their workforce are compelled to be absorbed in diversified farming activities owing to limited non-farm work-opportunities. Hence, the agricultural sector pulls the workforce towards itself in the more distant villages with lower irrigation access, while the agricultural sector pushes the workforce into non-farm sector in the less irrigated villages located closer to the market centres. Because of stress factors, agricultural livelihood is more diversified in the villages where crop cultivation activities are underdeveloped, and conversely it is less diversified in the villages where crop cultivation is comparatively developed. But livelihood is more diversified in the villages which are located closer to the market centres and at the same time their agriculture is underdeveloped. The rate of transferring of

the workforce from farm to non-farm sector as well as the quality of non-farm works however depends on the education level of the workers.

The cropping system incorporates multiple crops with base crop, because most crops are seasonal and during the year crop-seasons vary. With inadequate access to secured irrigation to the cropland and limited winter rainfall, the crop growing season and thereby the extent of cropping activities are relatively lower in the study region, particularly in maize-based cropping system, which thus reinforce the farm households to involve in other farming activities and ultimately lead to farming diversity in the region. The hill farmers get involved in such farm diversification process for extending agricultural season and generating a year-around stable income and employment.

Since the output of farmers depends on weather, price and yield fluctuations, their agricultural production involves multiple risks. The subsistence farmers plan to cultivate diversified crops with low expected crop-yields but low yield variability for minimising their exposure to risks. With harsh terrain, complex topography, eco-fragile environment as well as underdeveloped market in mountain regions, such risks are relatively higher in the mountain agricultural production environment. Larger landholdings and cropland with secured irrigation access and labour availability lead the entrepreneur farmers, having sufficient capital for purchasing farm inputs and pursuing mechanised process of cultivation, to be specialised in production of relatively higher remunerative crops, which they can sell in the market with the ultimate aim at attaining returns to scale. Such farmers with their technical capacity, devote most of their farm resources to the specialised crops for several years. On the contrary, under multiple agricultural constraints, the risk-averse farmers of relatively smaller holding-size diversify their crops and choices of agricultural activities maintaining complementarities among them through recycling internal farm resources for achieving modest but stable yield as well as maintaining environmental sustainability. Such crop-choice reflects more on survival necessity than attaining productive efficiency. In the study villages, land holding and cropland are small, scattered and mostly economically unviable; the irrigation access to cropland is inadequate and seasonal; the urge for attaining self-sufficiency in crop production is higher because of their inaccessibility. However, the physiographic and agro-climatic diversity in the regions provide multiple microclimatic niches to the farmers in cultivation of diversified crops. Hence, the hill farmers choose diversified crops in their production portfolio for food security and food sovereignty and for survival.

With the dominance of their cropping patterns in cereals that generate low physical yields, the farmers commit their cropland to a large number of crops with commitment of a small area for each crop and thereby each such crop produces small agricultural surplus, which is primarily responsible for the economic distress of the hill farmers. A production of high volume but low value crops is also unprofitable for the hill farmers because of higher transport costs. Hence, the improvement in food security and living standards of the hill farmers solely depends upon their technical capacity in producing higher-valued but low volume commercial crops by harnessing agroclimatic niches that persist in the study region. With the improvement in road connectivity and emergence in technical knowledge and market access, agricultural transition in terms of production of high-value cashcrops takes place in the region studied. While the cultivation of green crops is economically viable for the hill farmers, the cultivation of commercial crops such as ginger, cherry peppers as well as floriculture, especially Gladiolus, generate higher value, income and profits to them. The hill vegetable growers cannot compete with the vegetable growers of the plains because of small scale production as a result of their limited farm resources, particularly cropland, limited irrigation access and chemical fertilisers and pesticides purchased from the markets during the crop seasons when the growers of the plains produce such crops. The hill farmers, however, can produce most of the vegetables during off-seasons without confronting of competition from the farmers of the plains. The cultivation of off-season vegetables is thus an alternative option of the hill farmers for their sustenance and rising income. The farmers practising dry land cultivation are able to enjoy more off-seasons compared to the farmers practising

wet land cultivation. However, the dry land farmers have to make more adaptation to seasonal distribution of rainfalls around the year.

The hill agriculture is more like peasant agriculture, where self-produced and self-controlled internal resource flow dominates the market mobilised resource flow, because hill agriculture is less dependent upon market for factors of production as well as for selling farm products. The farmers follow complex scheme of cropping, integrating with livestock for realising agro-ecological synergies. Recently high growth rates of population create substantial pressure on natural resources, particularly cropland, and thereby they process foodgrains output of cereals and pulses for smoothing household consumption, as well as cultivate varieties of horticulture crops for selling. Such diversification of the farmers is thus a strategic mechanism for re-shaping peasant agriculture towards commercial agriculture for their defending and increasing income. The capitalist mode of production, based on hired labour and marketing the products, as well as reinvestment of agricultural surplus in farming activities for more profits and higher returns to scale are also perceived in the region in case of tea plantation and nursery-based floriculture, while the household level participation in the former is zero and in the latter is very limited.

The crops and other agricultural enterprises, along with variety selection for each enterprise of the hill farmers, varies widely between the villages in variation to their irrigation access to cropland, access to road connectivity and market as well as to technical knowledge and financial capacity of the hill farmers. The perishability of vegetables necessitates more frequent marketing transactions. Because of the high volume of most vegetables, the transportation cost of vegetables is high. Thus, more households were able to commit land to vegetable cultivation in villages located closer to the market centres, particularly in these villages with better irrigation access for the cultivation of irrigation sensitive vegetable crops. The vegetable profitability of the growers also diverges between the villages in their proximity to market centres and *bazars*. The farmers in the villages with lower irrigation access to cropland as well as in villages at higher elevation, principally follow dry land cultivation, and have to adapt more to low rainfall and local water regime. Consequently, less irrigation-sensitive vegetable crops like as bitter gourd, pumpkin, squash and coriander prevail more prominently in the cropping patterns in less irrigated villages. Their farmers also preserve some cultivation of drought-resistant inferior crops. Hence, the crop diversification in such villages points towards more as a survival and coping strategy. However, the adaptation to microclimatic niches for cultivation of ginger and green pea is higher in the less irrigated villages. Consequently, comparatively a larger number of farmers selects these crops for cultivation, and the extent of land commitment to such crops is relatively greater in these villages.

For cultivation of floriculture produce, the farmers need greater levels of education, technological and financial capacity, access to market and marketing channels as well as secured irrigation, particularly for field-based floriculture produce like Gladiolus. The floriculture has no local market unlike foodgrains crops, and thereby, its production involves high degree of marketing risks. Because of unfamiliar production technology, it also incorporates higher production risk. The risk-averse, resource-poor farmers do not select floriculture in their crop choice in general. Consequently, household participation in floriculture is low in the villages. Since most floriculture nurseries are located in the urban periphery, the spillover of technological knowledge on floriculture is confined to the nearer villages, where the farmers also have the opportunity to acquire such knowledge through agricultural training, as in case of high-value vegetable crops like broccoli, from a local agricultural research institution. The spread of such knowledge through *Krishi Prasar Sahayok* [KPS] is also concentrated in the nearer villages. The villages located closer to the market centres also have greater access to transportation, market and marketing channels, particularly in terms of selling floriculture items to local nurseries and urban traders through buy-back conditions, as well as have relatively higher education levels of household heads. Hence, relatively larger number of farmers chooses floriculture in their production portfolio in villages located closer to the market centres than in villages located farther away from the market centres.

Comparatively larger number of farmers with relatively higher education levels choose floriculture, especially Gladiolus, in their crop choice in villages with better irrigation access to cropland, than in villages with lower irrigation access.

Growing of fruit plants generates stable but relatively low annual income to the hill farmers. These plants act as a bulwark against soil degradation because the deep roots of fruit trees prevent soil erosion and also fruit plants can be cultivated without ploughing operation. The principal commercial fruit in the region is mandarin orange, which yields fruit in winter for the region and requires special agroclimatic niches for the yielding of qualitative fruit. The land gradients are relatively higher, but the irrigation access to cropland is comparatively lower at villages with inferior slope aspect. The diurnal duration of sunshine is also relatively lower in these villages. Thus, the extent of cropping, especially winter cropping, as well as crop-yields, along with value and income generation from field crops, are comparatively lower in these villages, where agro-climatic niches for orange cultivation prevail. Hence, relatively larger number of farmers get involve in orange cultivation, and thereby, the extent of cropland commitment to orange and total fruits is relatively higher in these villages. However, in per hectare terms, the value and income generation from the orange land in these villages depend upon their closeness to the market centres.

In the study region, the environment is congenial and the access to green fodder is comparatively easier in the surroundings for rearing varieties of animals, especially cattle. However, crop-yields as well as income and value generation from crop cultivation are low. Because of scattered and uneven cropland, it is not possible to apply mechanised method of ploughing for crop cultivation, rather ploughing operation largely depends on draught power. With remoteness, less access to market and inadequate availability of chemical fertilisers in the locality, the poor farmers mostly apply home-made manure, particularly cow dung, for maintaining soil fertility. Consequently, crop-livestock integration is higher in hill agriculture. The hill farmers thus simultaneously cultivate crops and rear multiple animals, particularly milch cattle. So, the household participation in cattle and total livestock rearing as well as the cattle stock per household is higher in the study region. Higher value and income are generated from livestock than from cropping in most of the villages. The crop-yields as well as the income and value generation are relatively lower, while the access to green fodder in the surroundings and at farmlands is comparatively greater because of presence of more uncultivable land and current fallow land in the less irrigated villages as well as in villages at higher elevation. Hence, the stock of milch cattle per household, proportion of milch cattle to the total cattle population and value and income from cattle and total livestock per household are relatively greater in these villages. However, the total value and income generation from per litre milk of the farming households depends upon their access to market.

The cross-bred milch cattle yield much more milk when compared to the indigenous miltch cattle. However, the installation cost is substantially higher for rearing of the cross-bred milch cattle than for rearing of the indigenous milch cattle. For rearing cross-bred cattle, the households have to depend more on feed purchased from the market and vitamin, and the rearing cross-bred cattle is also associated with the access to veterinary services because these cattle are more sensitive to diseases and local environment conditions. On the contrary, the households can rear indigenous milch cattle based on their farm-made feed and fodder as well as on the indigenous knowledge for treatment of such animals. The access to veterinary services, market-purchased feed and special feed like vitamin as well as the financial capacity of farmers to purchase cross-bred milch cattle and such feed are comparatively lower in the villages located farther away from the market centres. Hence, with the increase in remoteness of the villages, the proportion of cross-bred milch cattle to the total milch cattle gradually decreases. Most farmers in villages located closer to the market centres use seeds purchased from the market for crop cultivation every year, because such seeds can yield much more output once for all. But the practice of purchasing these seeds damages the indigenous seed variety of the farmers in the study villages, and because of the same seed source, crop variety also becomes worse for the hill farmers. Most farmers in villages located at a greater distance from the market centres cultivate crops based on home-made

indigenous seeds for several years. Hence, they play a crucial role in preserving the biological variety of indigenous crop seeds, despite having their relatively lower crop-yields from such seeds.

Because of topographical difficulties in the mountain regions, uncultivated, sloping land prevails, which is more prone to landslides. With rearing of bovine animals and less access to liquefied petroleum gas [LPG] for hill farmers, the fodder and fuelwood needs of the farmers are high in the villages. Hence, for economic utilisation of these lands and to protect these lands against landslides along with for meeting their fodder, fuelwood and timber needs as well as smoothing their rural life, the hill farmers grow multiple varieties of bamboo plants and diverse species of agro-forestry trees mainly on uncultivated, sloping farmland. The extent of uncultivated, sloping land is relatively higher in the villages with high land gradients. Thus, the bamboo plants and agroforestry tress per household are relatively higher in these villages. The access to road and transport is less in the region, and thereby, income generation from agro-forestry trees and bamboos mainly occurs in the villages located closer to the market centres.

With overall land scarcity and absence of reeling activity, the spread of state-patronised, non-traditional silk-worm rearing practice based on mulberry cultivation is limited in the region. In per hectare terms, the income generation of mulberry land through silk-worm rearing is comparatively low. The crop-yields as well as the value and income generation from crop cultivation are relatively lower and thereby the opportunity cost of mulberry land also becomes lower in the less irrigated villages with inferior slope-aspect. The non-farm work-opportunities are more limited in these villages. Thus, because of the low crop-yields, subsistence sericulture is practised by limited households in these villages. For the same reasons, the household participation rate in low yield, subsistence apiculture is also relatively higher in villages with lower irrigation access. Because of lack of consciousness and necessity of concrete *jhora* fish pond, small scale pisciculture is practised by very few households in most of the villages, but the participation rate in *jhora* fishery is relatively higher in villages with greater *jhora* access. So, the annual fish-yield, value and income generation from the pisciculture per household were low in the villages. Hence, agricultural diversification indicates more as a coping and survival strategy, and the livelihoods of the farmers are in a greater distress in the less irrigated villages, particularly in villages with lower irrigation access and with inferior slope aspect villages as well as in the more remote villages with less irrigation access.

Besides economic factors, the characteristics of the farmers play an important role in crop substitution and technology adoption. The younger farmers with their higher levels of education are relatively more risk-takers and are more likely to substitute inferior crops as well as to adopt new agricultural technology, while the older farmers are more conservative to persisting crops and technology. The farmers also prefer selected crops. For instance, the Bhutia (tribal) farmers prefer buckwheat and *ghiu simi* (hyacinth bean, *Dolichos lablab*). The Lepcha (tribal) farmers are more conservative to old crops and agricultural technology, and thereby they do not cultivate Gladiolus, despite the prevailing of agro-climatic niches for Gladiolus in their villages. The higher caste Brahmins and *Chettris* sub-communities do not rear indigenous poultry birds and pigs, but substitute pigs by goats. Hence, ethnicity of the farmers also determines the choice of crop and enterprise and thereby patterns of agricultural diversification in the study region.

Labour is the only active factor for production which interacts with land and other farm resources, particularly capital, to produce agricultural output. Because of scattered, uneven cropland with terracing in mountain regions, substantial proportion of the cropland is ploughed using spade and fork by labour. Building of terrace bunds as well as repair and cleaning of terrace bunds involves higher labour. The application of high volume of manure, especially cow dung, along with back-loading transportation of agricultural output also requires greater labour, in addition to labour requirement for conducting normal process of agriculture as in the plain regions. Hence, hill agriculture is high labour intensive, and the increment in agricultural output in hill agriculture thus primarily depends on application of higher labour, *inter alia*.

One of the special characteristics of labour in the region is exchange labour which indicates imperfection in labour market. The exchange labour is like a social reserve pool of labourforce which the farmers use in their common cropping activities, and thereby it is institutional. The exchange labour prevails more prominently in the region because of absence of seasonal movement of labour, whereas its existence is lower in the plains owing to more seasonal movement of labour. When the hill farmers shift their cropping patterns from foodgrain crops to non-foodgain crops, their self-sufficiency in foodgrains output is broken down. However, self-sufficiency in labour use exists in their production systems with institutionalised exchange labour, i.e., treating labour by a pool of labour. With the dominance of cereals in the cropping patterns and lower yield rates and profit margin in foodgrains comprising cereals and pulses, the hill farmers rely more on family labour and labour-exchange for foodgrains cultivation. Hence, the exchange labour system helps the farmers to manage their labour cost as well as the labourers to get work for an extended period.

Farmers select the most profitable combination of crop-mix or enterprise-mix from among the many crops or enterprises that will maximise their income for the given set of resources. The crops and other land-based enterprises compete at the same time for limited resources, while crops and livestock as well as crops and apiculture are complementary to each other. Farmers substitute one crop by another for raising their income and profits when the additional income of the added crop exceeds the income loss of the substituted crop. They substitute labour for reducing costs of production through economising labour cost. The yield rates and profit margin of cashcrops like ginger and cherry peppers as well as of vegetable crops are higher than of cereals and pulses. These are relatively greater for cashcrops when compared to vegetable crops as well as for floriculture than for cashcrops. Hence, cropping patterns diversification from cereals towards cashcrops or vegetable crops as well as from crops towards floriculture generates higher income to the hill farmers. However, when the farmers choose farming crops with some specialised cashcrop like cherry peppers or floriculture, they have to hire labour through market transaction, since these are not the common cropping activities in the region. Thus, the self-sufficiency in labour use is also broken down which creates stress on them, and the specialised farmers have to adapt with such change in labour institution.

Previously roads, mainly steps, were built in the region through collective labour effort. However, recently more roads are developing in the study region through hired labour. The introduction of cashcrops and commercial floriculture makes the agriculture more monetised which creates social change in the region. The monetised farming exercises greater demand for education and livelihoods in the region. In the current decade, many people are settling down in the Kalimpong urban centre, particularly from the Kalimpong Police Station towards the Siliguri Road. Most of the new settlers came from different rural segments of Kalimpong Subdivision such as Pedong, Algara, Seed Farm, Mongpo, Tista Valley as well as from Tukdah and Peshok of Darjeeling Subdivision and even from Sikkim, mainly to provide more education opportunities for their children. The main occupations of most of them were government service and business. Such new influx in the urban centre resulted in more urbanisation and building-construction. For earning higher non-farm income in the urban centre, the rural labourers are shifting their occupation from farm works to non-farm works. Consequently, the farm sector confronts of labour shortage, and thereby agricultural wage rate raises, which thus results in more fallow land and reduced cropping extent, but price hikes for agricultural products in the local market. The urban expansion also tends to lessen water access to the agricultural households. Added to these are the adverse effects of environmental change on agriculture. One century ago, the Swiss Missionaries had started development initiatives in the region through dairy farming. At present, the development impetus was started in the region by floriculture nurserists. Hence, greater involvement of the farming households in floriculture, particularly small scale nursery-based floriculture, along with higher cropping patterns shift towards high-value commercial crops like cherry peppers and off-season vegetables and small scale cross-bred cattle rearing, is the future hope for improvement in the living standards of the hill farmers in the study region.

8.3 Policy Recommendations

In the globalised and liberalised era, the food security of farmers can be better assessed by increasing purchasing power for foods, rather in terms of production of foodgrains output. In the study region, the farmers can achieve this food security through substantially shifting their cropping patterns from foodgrain crops to cashcrops like ginger, cherry peppers, niche-based green peas and off-season vegetable crops as well as through practising commercial floriculture. The wet land cultivation of paddy crop is not consistent with the physiographic and eco-fragile environment conditions in the region, since it is more prone to soil erosion and landslides. The physical yields of cereals are many folds lower for the hill farmers compared to the farmers of the plains.

Limited irrigation access with insecurity acts as primary constraint to commit greater extent of cropland to green crops and cashcrops in the villages studied, particularly in those villages with lower irrigation access. In the mountain topography, provision of organised irrigation to the farmers is not possible, so the concerned government authority has to take proper measures to provide at least certain extent of irrigation to the farmers through provision of subsidised water pipes to trap more *jhora* water, and also of rainwater harvesting containers. The households also have to undertake appropriate water usage management and rainwater harvesting measures through acquiring proper training.

The relative inaccessibility of mountain areas makes transport and communication difficult and expensive, and the transportation costs of agricultural produces are very high. The farmers face marketing constraints to sell farm products, especially vegetables, particularly in the more remote villages, where marketing information is also limited. Most small scale growers of vegetables are thus compelled to sell their products at distress price at home to local middle men who misappropriate major proportion of consumer surplus. The farmers in villages located at a great distance from the market centres confront difficulties in selling high-volume, low-valued vegetable output like squash. The farmers who bring such produces in the market choose to sell these crops at substantially low wholesale price to vegetable traders in the absence of organised markets and ware-houses of the products. Hence, the concerned authority has to take proper measures in terms of developing greater road-connectivity and communication services in the villages, particularly in the more remote villages, as well as of introducing organised market systems and of constructing ware-houses.

Despite having higher economic potential in the cultivation of cherry peppers and newly introduced broccoli (*Brassica oleracea*) and capsicum (bell peppers, *Capsicum annum* of *Solanaceae* family), few farmers select such crops in their production portolio because of limited technological knowledge of most farmers regarding cultivation of these crops in the study villages. Though ginger is the main commercial crop in villages with lower irrigation access, their commitment of cropland to ginger decreases gradually because of disease attack on the ginger crop. Hence, the local agricultural research institutions have to undertake appropriate research activities for curing the diseases of ginger, as well as proper training programmes with the farmers to acquaint them with such technology and rain harvesting measures. The KPSs also have to visit frequently in the villages, especially the more remote villages, so that the farmers can be aware of these research results.

In per hectare terms, the high costs of cultivation of most of these crops, particularly cherry peppers and ginger, create barrier for the farmers to select such crops in their crop choice. The possibility of crop failure is higher in cultivation of ginger and cherry peppers. The price volatility is also higher for these two crops like cucumber. However, farming-banking linkage is lower in the study villages, particularly in the villages located at a great distance from the market centres. Because of high gestation period in ginger production, some ginger growers thus take advance from traders, who impose buy-back terms to sell ginger to them at relatively low prices. Hence, the concerned government authority has to introduce crop-insurance schemes for these crop growers, especially the growers of cherry peppers and ginger, and the managers of the local nationalised banks have to come forward to give medium term loans to such farmers in advance.

One of the most important reasons for low crop-yields for hill farmers is organic farming practice of most growers and low scale application of chemical fertilisers and pesticides by a few growers. Because of low vegetable-yields, the hill farmers in the study region cannot compete with plain vegetable growers during normal season. With low financial capacity and limited availability of chemical fertilisers, most hill grower thus substantially substitute chemical fertilisers by home-made manure. However, to retain the competition, they have to apply chemical fertilisers. Hence, the concerned authority has to provide subsidised chemical fertilisers to the hill farmers. In per hectare terms, the intensity of applying chemical fertilisers and pesticides is relatively higher for cashcrops and vegetable crops compared to the others. However, higher degrees of application of chemical fertilisers may go against sustainability of the local environment and resources. Hence, the hill farmers have to trade-off between cultivation of crops with high economic potential vis-à-vis crops with relatively low economic potential as well as application of chemical fertilisers vis-à-vis home-made manure in the cultivation of higher-valued crops.

Although the region has the highest potential in commercial floriculture practice, only Gladiolus technology is spread over to ordinary farmers. The technological knowledge on most floriculture produces is unknown to most farmers. Whatever floriculture knowledge has been diffused is confined primarily to the villages located closer to the market centres. The production of most floriculture items, particularly field-based floriculture items like Gladiolus, necessitates secured irrigation access, at least on a small scale. With limited local buyers of floriculture produces, the growers principally depend on their access to marketing networks. For cultivating ordinary field-crops using specialised floriculture or to be solely specialised in floriculture through floriculture nurseries, the farmers also need to possess higher levels of education and mammoth capital because of capitalist mode of floriculture production. Consequently, limited farmers select floriculture items, especially Gladiolus, in their crop choice mainly in the nearer villages having better irrigation access, despite having potential in the cultivation of less irrigation sensitive bulbous floriculture items, like Hemanthus, in the less irrigated villages and higher-valued floriculture items, like Begonia, in the villages at higher elevation. In the study region, buy-back system prevails in floriculture production between the ordinary growers and providers of technology, seed and capital, who are mostly nursery men, traders and Govt. Agents, and these people act as catalysts for the involvement of ordinary farmers in floriculture practice. For improving the living standards of the farmers through floriculture, the local agricultural research institution has to organise training programmes and workshops with farmers to spill over technological knowledge on diverse floriculture produces, especially orchids, since the region is like a green house for the production of orchids. The institution also needs to provide marketing information related to floriculture to the farmers. The concerned government authority and NGOs have to come forward with enthusiastic measures for curing the marketing problems of floriculture and for providing cheap credit to such growers. The local nationalised commercial banks may assist the enthusiastic, young farmers with credit for initiating floriculture. The farmers themselves may form a co-operative team to grow high-value floriculture items, like Anthurium. But, open field-based floriculture items, like Gladiolus, have negative effect on soil nutrition and environment because of high degrees of application of chemical fertilisers and pesticides in the cultivation of most floriculture items, and thereby the farmers have to trade-off between higher earnings through field-based floriculture and degradation of the environment.

The livestock help the hill farmers in realising agro-ecological synergies though recycling internal resource flow, generating year-around income, complementing low crop value and income, and providing emergency expenses. Although the farmers can rear indigenous milch cattle based on internal resource, the economic potential of smallholder dairies is low because of dominance of the indigenous milch cattle over the total milch cattle and due to milk sale at low price to vendors or local dairies in the villages, particularly in the more remote villages. Despite having potential in generating higher income through rearing exotic chicken birds, because of limited knowledge and market access, this potential is limitedly harnessed by few households only in the villages located closer to the market centres. Developing road connectivity and communication system in the villages, especially in the more distant

and remote villages, can partially solve the problem in selling milk of the farming households. Less number of households who have received credits from organised sources, have used their credit in purchasing cattle. So, the concerned government authority has to provide subsidised loans to the farming households in the region for purchasing animals, particularly for purchasing cross-bred cattle and exotic poultry birds. The formation of market co-operative or self-help groups for selling milk and conversion of milk into milk products through proper training, may solve the problem in selling milk at low price in the villages located farther away from the market centres. The concerned government authority also has to organise proper training and enthusiastic measures for the introduction of poultry farms based on exotic poultry birds by the farm households, particularly when this livestock component has the ability to lessen farm-size dependent inequalities in the distribution of rural income and wealth, revealed in land-based income as well as in income from rearing the animals that are dependent on green fodder. Since the tribal farmers mainly rear pigs for improving their economic condition, the government authority has to provide subsidised loans to the farmers for purchasing piglets, especially cross-bred variety.

The livestock, particularly cattle, help maintain soil fertility of cropland by providing manure, while they generate negative influence on the environment by depleting vegetations. The goats create more adverse effect than cattle on ambient forest vegetations, despite having their less contribution to manure. The indigenous milch cattle are less productive than the cross-bred milch cattle in milk-yielding. Hence, for lessening the negative effect on local forests and the ecology, the households have to reduce the stock of these small ruminants and indigenous milch cattle by substituting them with cross-bred cattle. Most cattle rearing households treat cattle diseases through ethno-veterinary services based on indigenous knowledge. Mostly they are unable to cure the diseases of their animals completely, and hence, they face a huge economic loss. In this aspect, the local livestock institutions have to come forward with artificial insemination and related veterinary services and knowledge for the cattle rearing households.

With microclimatic niches for the cultivation of mandarin orange in the study region, a large number of farmers select orange in their crop choice in the villages, particularly in the less irrigated villages with inferior slope aspect, to compensate for their lower value and income generation from *rabi* cropping. However, because of their limited access to communication and market, the orange growers in the more remote villages sell orange in the form of wholesale of the entire orange tree before maturity, at a low price to middle men. They also confront of a series of problems such as improper replacement of old orange trees, low management cost for orange owing to their limited knowledge and economic distress, die-back diseases of orange trees, and orange-intercropping practice because of their land scarcity. Consequently, the orange-yield and income of the orange growers are low in the villages, especially in the less irrigated villages with inferior slope aspect and located farther away from the market centres. On the contrary, a few fruit growers mainly in the nearer villages recently plant avocado and passion fruits, which have higher economic potential. For improving the conditions of the fruit growers, the local horticultural department, together with the agricultural research institution, has to take several steps such as provision of current scientific technical knowledge to them for curing the die-back diseases as well as proper marketing information and training related to management and cultivation of orange trees and preparation of pickle from the passion fruit on a commercial basis. Short-term credit is to be supplied to the relatively large orange growers to keep them away from middle men. The local block development officers have to take initiatives to provide fruit seedlings, particularly those of orange, avocado and passion fruit, without any cost to the existing and new growers for spreading their cultivation, since fruit cultivation is consistent with environmental sustainability. The orange growers also have to incur more management cost per orange tree for increasing their yields.

In spite of having low return of state-patronised sericulture in the study region, very few farmers get involved in this subsistence sericulture because of their livelihood distress in the less irrigated villages located farther away from the market centres. While the spread of sericulture is limited in the region

without reeling activity, it sustains the plain sericulture by providing seed crop and tends to empower women who enjoy most of the income from sericulture. Hence, for incorporating a greater number of households in sericulture, the concerned government has to take initiatives to introduce full-fledged sericulture operation with reeling activity in the region, and the local sericulture departments have to organise more training programmes with enthusiastic women.

Despite having high potential in apiculture in the region, limited households select apiculture in their livelihood choice and generate low honey-yield and income from subsistence apiculture, mainly because of their lack of consciousness and proper training on the related aspects, theirpoor financial condition for constructing apiaries, lack of scientific knowledge on honey extraction from hives and ignorance regarding honey by-products. The local apiculture department has to organise proper training on the related aspects of apiculture and provide subsidised apiaries to the persisting apiculturists and new farmers for spreading apiculture in the region, since apiculture is complementary to crop and fruit cultivation activities, and the expansion of apiculture is not dependent on land holding-size.

In spite of having higher value and income generating potential in state subsidised pisciculture in the region, very limited households select this operation in their livelihood choice because of fear of landslide through water leakage from pond, thus necessitating the building of concrete *jhora* fish pond, to access qualitative fingerlings as well as training on pisciculture. For increasing the yield of *jhora* fishery and spreading pisciculture among the farmers, the concerned government authority has to provide good quality fingerlings to the pisciculturists, subsidised loan to the enthusiastic households having access to perennial *jhoras* to build up concrete fish pond as well as to organise training programmes on related aspects.

For maintaining forestry-livestock-crop linkage, smoothening rural life, meeting the needs of leaf fodder, fuelwood and timber, as well as for using and protecting uncultivable sloping land, the farming households on an average grow varieties of bamboo plants and agroforestry trees in larger number. Their annual yield of matured bamboo culms, fuelwood and fodder leaf is high, while the income generation from these occurred mainly in the villages located closer to the market centres because of limited access to road connectivity and marketing of most of the households. The households in the villages located at a greater distance from the market centres attempt to sell bamboo indirectly by preparing household necessities like *dok*o (a kind of box). In this regard, the department of cottage industry has to organise proper training with the bamboo growers, particularly those who reside in the more remote villages, for preparing diverse varieties of household items, including toys from bamboo, and the department also has to make arrangements for the marketing of such products. Nevertheless, with limited access to LPG and more bovine animals, the great fuelwood and leaf-fodder generation creates substantial pressure on the forest land of the farmers, and this pressure is partly shifted to Govt. Forests. Such pressure creates adverse effects on natural resource-base and the environment, and tends to diminish lowland-highland interlinkages. To escape from this problem, the households have to generate larger income through diversified cropping patterns towards higher-valued crops, and the concerned government authority has to improve communication system on a priority basis in the villages, particularly in the more distant villages, and also needs to organinse training programmes with the farmers for preparing wooden instruments like cartoons, dragons, etc., in order to generate higher value with minimum loss of wood.