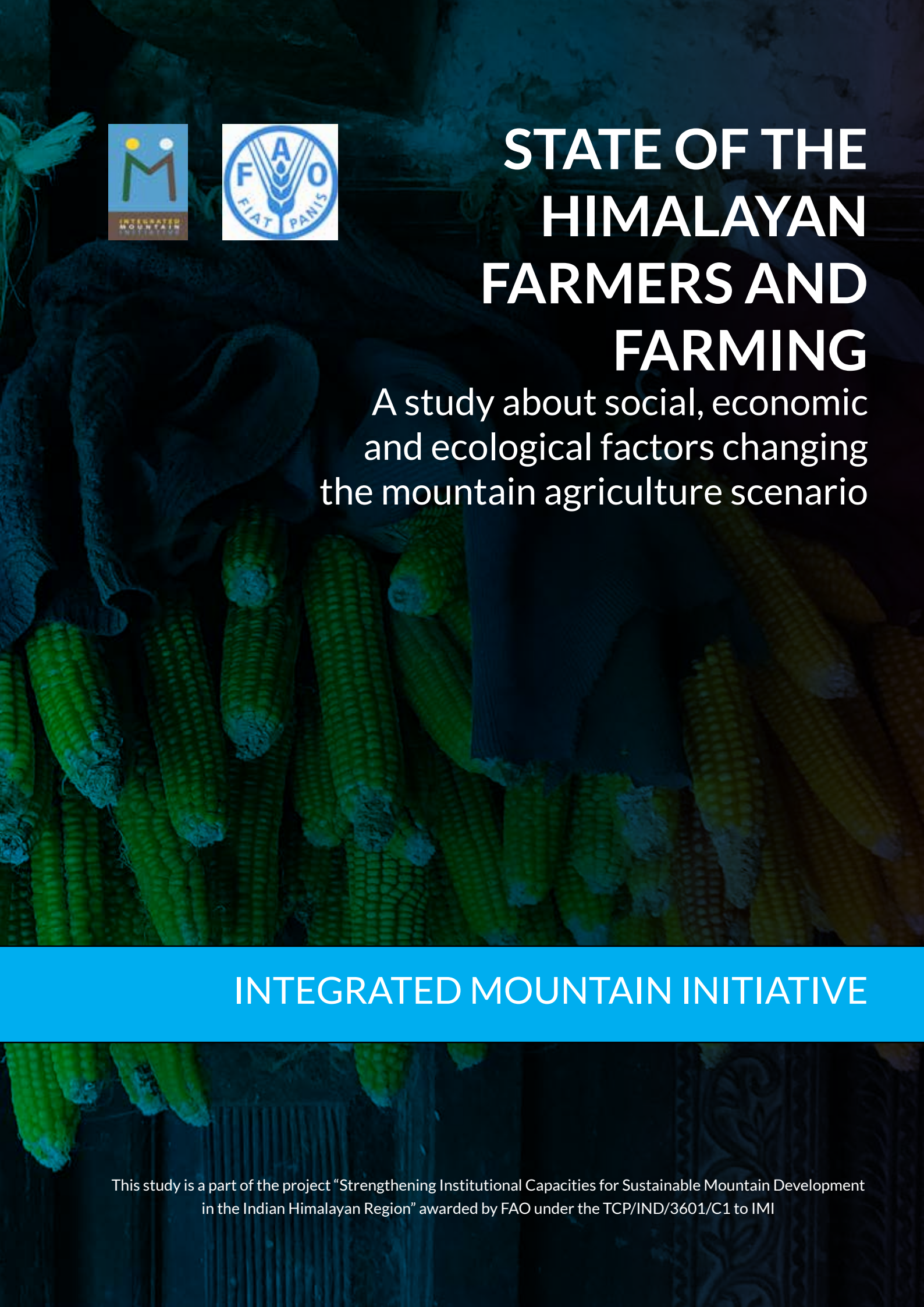

STATE OF THE HIMALAYAN FARMERS AND FARMING

A study about social, economic and ecological factors changing the mountain agriculture scenario

INTEGRATED MOUNTAIN INITIATIVE

This study is a part of the project "Strengthening Institutional Capacities for Sustainable Mountain Development in the Indian Himalayan Region" awarded by FAO under the TCP/IND/3601/C1 to IMI

Foreword

Sushil Ramola

President
Integrated Mountain Initiative

Any agricultural transformation across the states of India Himalayan region must address local changes in the cropping pattern, appropriate understanding and adoption of new technologies, role of agriculture and allied activities in the aspiration of the young generation and issues of sustainability and scale. This project report attempts to cover some of these. It tries to inform on the status of food security and economic wellbeing of farmers as agri-entrepreneurs in the Indian Himalayan Region while holistically covering land resources of Himalayan farmers, change in farming practices, livelihoods, migration, agro-biodiversity, climate change, new age practices, future potential in Himalayan states and experiments with organic farming.

Climate change and other uncertainties have an escalating adverse impact on farming based livelihoods due to global warming and consequent shift in agro-climatic conditions, water security issues and associated disasters, among others. Farming communities cope with these changes based on their perceptions and empirical evidences of changing climatic patterns. This report seeks to understand the challenges, coping mechanisms and necessary steps to transform agriculture practices by bringing in a large number of factors and uncertainties into account which go beyond climate change. While the Himalayan ecosystem has evolved and adapted to natural changes, the human civilization seeks revolutionary developments and has forced changes which will impact its future generations adversely unless the issues are addressed immediately in an integrated and multi-dimensional way, keeping in mind the carrying capacity of the Himalayan ecosystem.

A case study of apple precision farming as a mix of traditional and new technology intensive farming has been documented as an effort by New Age agri-entrepreneurs in the states of Himachal Pradesh, Jammu and Kashmir, and Uttarakhand to build a new future. There is a potential to expand the learning from these efforts to many other mountain states and also adapt for other agri-sectors.

I thank Dr. Shyam Khadka, India Representative, Food and Agriculture Organisation for entrusting this study to Integrated Mountain Initiative (IMI), a civil society institution with the capability of bringing diverse stakeholders from across the mountain states together, to address complex issues of climate change, agriculture, in general, mountain livelihoods, and seeking long term solutions.

I also thank Dr. Tej Partap, Vice Chancellor of Govind Ballabh Pant University, Pant Nagar and a founding Council member of IMI for leading this study. We believe that this work and the results of this report will serve as an important reference document for our stakeholders across mountain states. It will be an important tool as a challenge to transform the lives and livelihoods of our people through better research, policies and practice.

Acknowledgments

The person who thought IMI should engage itself in undertaking such a study was the late Dr RS Tolia. It was his dedication and persistence that convinced FAO the value of funding this IMI project. I am sure IMI and FAO would join me in paying tribute to him, who conceived and wrote this project and asked me to lead it when it was approved by FAO for funding. Unfortunately, due to his untimely demise during the course of this project, he couldn't be here to witness the completion of the project.

I am extremely grateful to FAO who saw value in this work and agreed to fund it. I would also extend my gratitude to the FAO and IMI both for showing patience with me for accepting new timelines for completion of the series of project reports and this final document, since June 2018.

The study demanded a comprehensive field exercise across all the Himalayan states. For accomplishing this gigantic task over one and a half year period, I received support and services of experts, local support teams and the key stakeholders – the farmers in the villages under study. My sincere gratitude to all of them and especially to the state chapters of IMI. The villagers have been eager and impatient to share their experiences and perceptions even beyond the points I had in my field notes to ask them. It greatly enriched the findings.

Two workshops on New Age Farmers and on Upscaling Himalayan Apple Economy were organized in partnership with two different agencies. The National Academy of Agriculture Sciences (NAAS) Delhi hosted New Age Farmers Workshop in November 2017 and Progressive Growers Association of Himachal Pradesh in Shimla hills provided logistical support to organize the apple workshop in Shimla Hills in May 2018. Their gracious support is highly acknowledged.

Among many others whose contribution I am grateful to are two names I need to mention here: Dr C.S. Vaidya and John Paulraj. Dr Vaidya helped in gathering and compiling secondary information, scanning of literature, government reports etc. He was kind to permit liberal use of his own research work at the Agro Economic Research Centre. John Paulraj provided administrative support from IMI office in Delhi. I am also immensely grateful to the staff at FAO in New Delhi, especially Uma Balaji for their unceasing support and patience during the entire period of this project.

I also benefitted a lot from another field study on agriculture and nutrition in the Himalayan region which I did for ICIMOD earlier. The field experiences, raw information and data gathered during that study has also been put to use, wherever I felt it would supplement the findings. For that I am also thankful to ICIMOD.

Dr. Tej Partap

Vice Chancellor
GBPUAT, Pantnagar, Uttarakhand

Sushil Ramola and Fantry Mein Jaswal, two colleagues in IMI, were kind enough to spare time to assist in accomplishing the study. Ramola was instrumental in shaping the design of the two workshops i.e. New Age farmers and upscaling apple economy of the Himalayas, besides his continued involvement at every stage of the study. Fantry Mein Jaswal helped me in undertaking the field study in Arunachal Pradesh. Mr PD Rai offered his valuable suggestions at different stages of the study. I thank them for their valuable inputs.

Last but not the least, I would like to express my gratitude to Dr Shyam Khadka, former FAO Resident Representative, India. He was like one of my team members in thinking through this study. On several occasions, we spent hours discussing about the state of affairs in the Indian Himalayan Region and the necessity to capture their issues in this study. I acknowledge that it is because of his insightful inputs that this report is entirely different than what I had initially thought. His support and encouragement in taking a very different line in structuring this work and adding new activities down the line were originally not planned and were important knowledge inputs to this work. He himself participated in these, giving important intellectual inputs in the workshops i.e. New Age farmers and apple economy.

Personally, leading implementation of this project has been very useful in refreshing my knowledge of Himalayan agriculture systems, which has been my area of study since the 1980s. I thoroughly enjoyed the knowledge gained through the project and also its provision of a far-sighted knowledge and information will serve a great purpose in the future.

Acronyms

MGNREGA	Mahatma Gandhi National Employment Guarantee Act
PDS	Public Distribution System
ICIMOD	International Centre for Integrated Mountain Development
IMI	Integrated Mountain Initiative
IHR	Indian Himalayan Region
FAO	Food and Agriculture Organization

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An Overview

STATE OF THE HIMALAYAN FARMERS AND FARMING

This study on mountain agriculture and its allied sectors is a ground situation report on the state of affairs about farmers' livelihoods, resource, food security and economic wellbeing in the Indian Himalayan Region states. The data and information presented in this report, has been gathered using different means. Primary data has been sourced from farmers during village level focused group discussions. In addition, structured information was also gathered through household surveys in the same village and other villages surrounding it. Each selected village identified for field study represented a major farming culture, farming system and care was taken that these are picked up from across the Himalayan states. Different sources were used for gathering secondary information viz., Economics and Statistics reports, research publications, reports, presentations in workshops organized for this purpose as part of the activities of this project. In fact, two chapters, one on glimpses of future in New Age farmers and the other on upscaling apple economy of the Himalayan region are drawn from reports of the workshops held on these aspects. Above all, as author of this report, I had the opportunity of travelling across the 10 Himalayan states during the project period and gathering plenty of first-hand knowledge on several issues. The findings were organized around ten issues and presented as ten chapters of this report. The summary of findings on each of the selected issues is presented in this overview chapter.

1

LAND RESOURCES OF HIMALAYAN FARMERS

The Indian Himalayan Region Includes:

10 Indian states

Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, Tripura and hill regions of 2 states viz. Assam (Karbi Anglong and Dima Hasao) and West Bengal (Darjeeling and Kalimpong)

Three Major Geographical Entities (Area Size Over 5000 Sq.Kms)

- The Himadri (Greater Himalaya), Himachal (Lesser Himalaya), Siwaliks (Outer Himalaya)
- Home to 4.6 crore (46 million) people
- Living in little over 73,000 villages and nearly 500 towns.

Urban And Rural Population Distribution of 10 Himalayan States:

- Rural Areas – **70%**
- Urban Areas – **30%**
- Variation Among States
- Himachal Pradesh : **90% - Rural**
- Mizoram – 50% - **Rural**
- Uttarakhand – **70%**

Land resources for Himalayan farmers are of two types. One, crop land that is private property or community owned land and remains under tillage or perennial plantations of fruit trees. Two, the other type of land that supports farming based livelihoods is called the support land. Its ownership is not with farmers but they use it for animal husbandry. The dependence on this support land could be absolute or partial, depending on the nature of farming system. Pastoral and agro-pastoral nomadic communities of north west Himalayas in Ladakh, Kashmir and Sikkim in north east Himalaya, have absolute dependence on it. In the north east Himalaya states, there is yet another kind of support land based livelihood system, i.e. land under shifting cultivation. Here the support land i.e. community forest land, is converted into farm land for certain period of time and then abandoned as forest land for some period. Rest periods have been varying from 15-20 years in the past to 2-3 years now. In the rest of the Himalayan region, farmers have been using forests and range lands as their support lands, liberally.

The scenario of crop land in the Himalayan states presents a variable scenario of scarcity to adequacy from west to east. Despite the fact that there is almost constant availability of agricultural land at aggregate level, during the past few decades, its supply for individual farming households has declined in a very significant manner. Major change towards conversion of other land use into agriculture within the Himalayan states is not seen. The average size of holdings for the Himalayan farmers has declined over the years ,and for all classes and put together it has come down to around one hectare. It has reached a stage where the continuation/of traditional food grains based mixed farming on such

small pieces of fragmented farm land, has become non-viable both for food and income security of majority of farmers. However, availability of crop land in north east Himalayan region states is largely better than north west Himalayan states. Nagaland is among the states witnessing the increase in average holding size where it increased by about 25 per cent. In Arunachal Pradesh and Meghalaya, access to crop land size increased by about 6 and 3 per cent, respectively. Even though the issue of shrinking crop lands is wide spread and common, the non-viability of farming due to this is well known, no state has as yet put in place any strategy that would help contain the situation. Some of the Himalayan states may be in danger of becoming "regions of non-viable farming on small land holdings" as crop land holdings of their farmers continue to shrink further.

Conclusion

Himalayan agriculture may not be shrinking in terms of total crop land area in the region, but it definitely is shrinking in terms of land availability to individual farming families. The condition is becoming non-viable for farming by individual farm households due to continuing fragmentation of this already shrinking asset. The scenario is same across the Himalayan states, barring Nagaland and Arunachal Pradesh. The crop land scarcity issue is of urgent nature and requires states to think of strategies that can reverse negative impacts of it on the Himalayan agriculture. There are number of examples of initiatives taken by other countries, such as China, about how to transform small farm household economy into viable farming by the small farmers.

2 HIMALAYAN FARMERS, CHANGING FARMING: A MACRO VIEW

Cereals alone have failed to offer little hope for bringing Himalayan farmers out of food insecurity and poverty. There is no sound reason to assume that it can happen in future, even with the use of new technological options. Therefore, new cropping systems have been and are emerging, with fruit and vegetable cash cropping as lead sectors. Cash crops are generating significantly higher employment and helping in diversifying farm incomes. At present about 175 different types of vegetables are grown across the Himalayan states. This fact is normally undermined because of perception of the need for conserving native agro-biodiversity. The particular suitability of hills and mountains for horticulture have resulted in shifting of cropping patterns from agriculture to fruit crops in the past few decades.

These facts clearly demonstrate that a process of change has been set in motion in the Himalayan states, which appears irreversible, motivating the farmers to divert the cultivated lands for cultivation of commercial crops. Even though there is a wide variation among states in the scale of adoption of diversification, Jammu and Kashmir and Himachal Pradesh are the two leading states so far but serious efforts towards diversification are made in some North Eastern states. In this process, farmers have been able to harness the local niches, provided by the agro-climatic and socio-economic conditions, to a larger extent. The process of shift in cropping pattern to cash crops, therefore, appears to have pushed food grains farming in the Himalaya to lesser degree and future trends indicate dominance of wide varieties of cash cropping, vegetable, fruits, floriculture, medicinal and aromatic plants, across the Himalayan states.

The situation in the north eastern Himalayan region is entirely different with two distinct types of agricultural scenarios – shifting cultivation (Jhum), and settled or plains land agriculture in the valley areas. It has been estimated that 19.91 lakh hectares (83.73%) of the land in the region is under shifting cultivation. However, the area under shifting cultivation had declined from 2.69 to 1.00 per cent of total geographical area and from 2.99 to 1.35 per cent of hill area, during the period 1974 to 2008-09 and the process continues. Certainly by 2017-2018, it will have drastically gone down. The overall decline in area under shifting cultivation across the North East region, coupled with escalating number of farming families practicing it has actually resulted in steep decline in shifting cultivation land holdings of the families. The trend is unfolding in North East, whereby swidden farmers (another name for shifting cultivation or jhum) are also willingly opting for a transition to perennial commercial crops on their swidden land holdings, but their problems relate to providing permanent land rights. Vegetables and fruits, valuable timber trees farming etc. have already made inroads into these shifting cultivation areas and there are possibilities and potentials for farmers to move towards cash crops on larger scale, leading to significant reduction in swidden farming .

The single largest casualty of transformation of agriculture from subsistence to cash economy is the ongoing complete elimination of traditional indigenous crops from the present cropping patterns. Several areas of Himachal Pradesh and Kashmir valley reflect this trend. Similarly, the agro-biodiversity of the Central Himalayan agro ecosystems have also changed steadily. A survey in 150 villages of the Central Himalaya revealed that within two decades the cultivated area under many traditional crops has declined significantly (Maikhuri et al, 2001). In animal husbandry sector, farmers are opting for cross bred cows in fewer numbers, instead of indigenous cows in larger numbers. Replacement of draught animal power, bullocks, from North West Himalayan and Central

Himalayan states had started before but accelerated during the past 15 years and is being replaced by machines. Increasing problem of abandoned cattle on road sides in Uttarakhand and Himachal Pradesh is a direct outcome of this shift in livestock resource use by hill farmers.

The impact of increasing temperatures is currently felt in the form of difficulties about continuing farming certain temperate fruit crops. Apple is one such fruit crop and it is being replaced by other fruit crops such plums, pomegranates and persimmons. Warmer and sometimes drier, sometimes too wet, sometimes untimely too cold, local weather condition, and erratic rainfall patterns, widely experienced over the past one decade, have confused Himalayan farmers and they expect uncertain futures. Climate change is also perceived to have affected the irrigation water availability which is necessary for cash cropping.

For making agriculture profitable on the marginal and small hill farms, intensive agriculture holds the key for them. In some vegetable growing areas of hilly landscapes, the cropping intensity has already passed 200 per cent (Solan district in Himachal Pradesh). Commercialization of Himalayan agriculture has increased the farmers' dependence on external inputs, be it seeds, fertilizers or labour, mechanization included. Labour has emerged as one of the most important inputs, accounting for about half of the total variable cost of cultivation. As a result, seasonal as well as permanent (few years) immigration of migrant labour is there and it is increasingly being used not only by the medium and large farmers, but also by the small farmers. The market orientation of farming has tremendously increased the farmers' interface with market functions. Commercial farmers are now coming out and moving away of the traditional image of subsistence farmers. They rely more on media sources for price and market information. The New Age farmers are also conversant with the application of online marketing specially used for marketing flowers, fruits and vegetables. Cash transaction is changing to the online banking options.

There is, however, wide variations in respect of commercialization of agriculture in different Himalayan states. Small farmers in states like Uttarakhand and North East states are still tied with growing of traditional subsistence food crops. This is considered as one of the causes of migration from the hills of Uttarakhand leading to over 1700 plus ghost villages at the last count in 2018 and abandoned agricultural landscapes across several hill districts of the state.

From the economic well-being view point, commercial farmers of Himachal Pradesh, facilitated by higher income, are now spending much more as compared to other Himalayan states, as demonstrated by the findings of 68th Round-Consumer Expenditure Report of NSS:

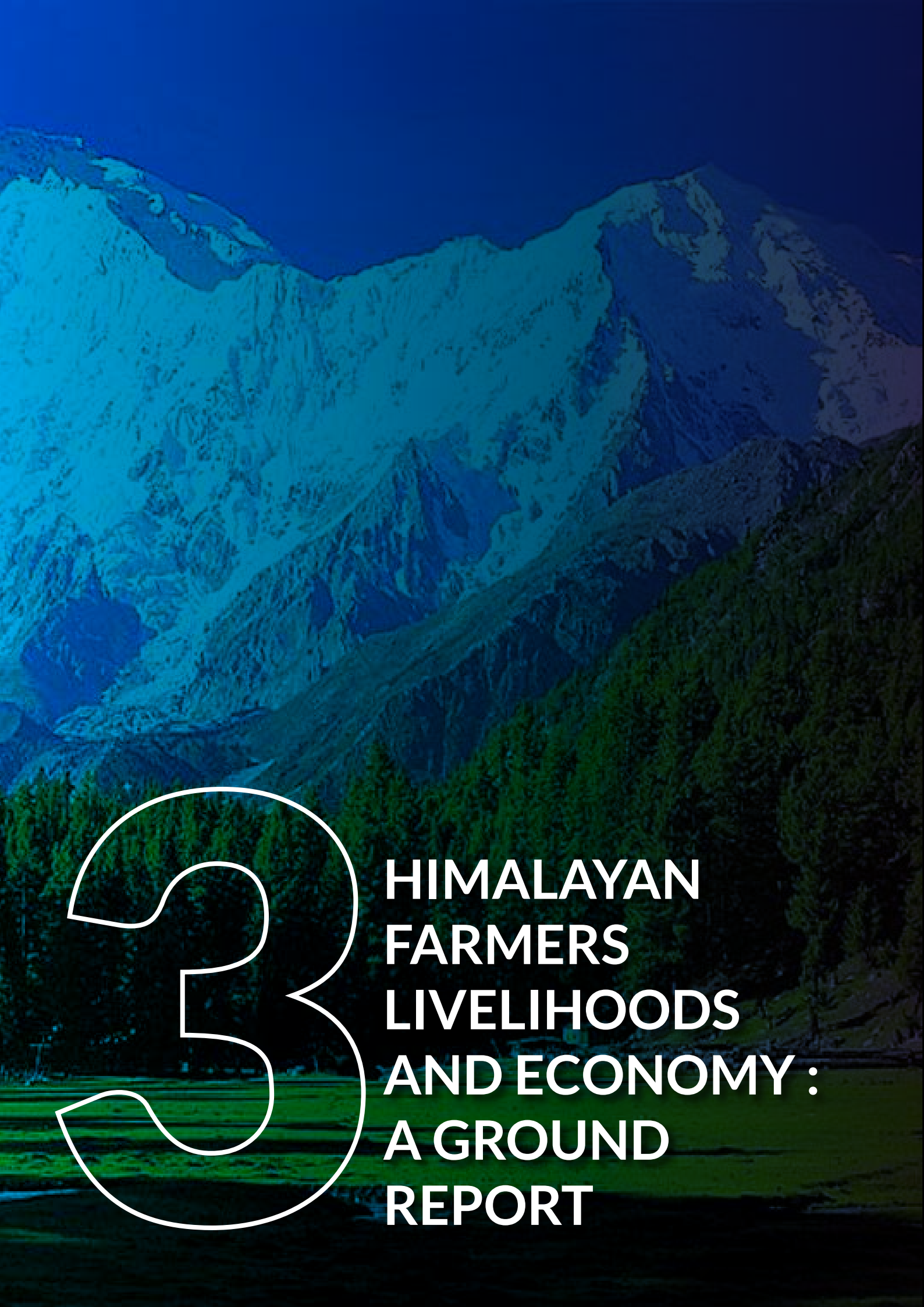
Average Monthly Per Capita Consumer Expenditure (Rural) was reported to be

- Arunachal Pradesh **Rs 1,782**
- Assam **Rs 1,219**
- Himachal Pradesh it was **Rs 2,034**
- The farmers of Jammu &Kashmir were spending **Rs 1,743**
- Manipur **Rs 1,502**
- Meghalaya **Rs 1,475**
- Mizoram **Rs 1,644**
- Nagaland **Rs 2,029**
- Sikkim **Rs 1,565**
- Tripura **Rs 1,334**
- Uttarakhand **Rs 1,726**
- The all India average stood at **Rs 1,430**

This indicates that farmers of the Himalayan states were already better off economically and that among them Himachal farmers excelled in economic well-being.

The fact is that hill farming dominated by commercial crops is on the rise in both area and production wise. But there is a significant drop in local crops area and production. Not only is crop species and genetic diversity of local crops declining on hill farms, but the wild relatives of native food crops, are also on way to extinction. Domesticated varieties are under threat and that is as a result of homogenization caused by demand for uniform varieties. This may have scientific implications for crop breeders who need a pool of crop genes in order to breed new varieties for disease and pest resistance. Traditional approaches of commercialization of hill farming may have improved economic well-being but it has made a dent on traditional resource base and resulted in shrinking native agro-biodiversity. This is due to the missing mountain perspective dimension in our R&D strategies supporting the transformation.

Transformation process has helped in emergence of new breed of farmers who are known as progressive farmers, agribusiness entrepreneurs or we name them as New Age farmers. They are educated and becoming role model for majority of other farmers. The New Age farmers come to limelight through two processes: either they are adopting new mountain niche crops with large market potentials or crops developed by their own ingenuity and are highly beneficial under local conditions.



3 HIMALAYAN FARMERS LIVELIHOODS AND ECONOMY : A GROUND REPORT

Today the most prevalent farming systems of the Himalayan region are;

1. Subsistent rain fed crop livestock mixed farming system
   (a representative tribal village upstream in Kashmir)
2. Apple growers livelihoods and economy
   (a representative village in Kashmir valley)
3. Fruit and vegetable commercial farming systems of small hill farmers
   (a representative village in Kullu valley of Himachal Pradesh)
4. Subsistent crop livestock rainfed mixed farming threatened by wild animal menace, (a representative village in hill district of Almora in Uttarakhand)
5. Swidden slash and burn farming culture of north east Himalaya
   (a representative village in Nagaland, north east Himalayan region)
6. Pastoral & Agro-pastoral systems of the Himalayan Nomads
   (a representative village in the highlands of Ladakh)

The shrinking farm land problem was shared by villagers where farm land holdings were less than a hectare. In Nagaland, however, either there were large land holdings of few farmers or there were land less labourers or the community land users of shifting cultivation. In the apple orchard village of Kashmir and the vegetable and fruit farming village of Himachal Pradesh, people were more concerned. For them changing climate, shrinking land holdings and marketing infrastructure were key concerns.

In the villages with subsistent mixed farming systems, where rainfed farming on sloping farm lands were prevalent, the key concern was wild animal menace and farmers were mostly unable to take home any harvest. For the nomadic highlanders, who depended on vast range land resources, the issue was vast range lands but less people and migration of local families to far away mountain towns. The issue here is that there lesser number of nomads, semi nomads but larger flocks of goat, sheep, yak, as others sell their smaller flocks of livestock to those who are staying put. It is a similar story with Changpas of Ladakh, Bakarwals of Jammu and Kashmir, Gujjars of Jammu, Gaddees of Himachal Pradesh, Van Gujjars of Uttarakhand, Yak herders of Sikkim and Arunachal Pradesh. Warning signals from nomadic lives is that the system is shrinking and faces extinction.

Commercial farming households in Kashmir (apples) and Himachal Pradesh (vegetables and fruits) have far higher annual earnings from farming i.e. three times more than the subsistence hill farmers. Not only do they spend more but also save more after necessary annual expenses. In these cash cropping villages, food, health and education are key expenses of households followed by social affairs. There is wide disparity in the annual incomes of Himalayan farming families. Farmers who had bigger orchards were earning between Rs. 1.5 million to Rs. 2 million (~ US $ 30,000 to 32000). The data indicated that economic opportunities have also widened the range of economic disparity among the villagers viz. from US $ 1000 to US $ 32000 per annum.

Survey findings also indicated that role of non-farm income sources to sustain rural livelihoods is increasing and this source comprises largely low paid unskilled jobs in the form of labour. Among the farmers who were growing food grains, reports said they are surviving on “money-order economy”. In Nagaland, labour families were part of the village life and contributed to farm labour needs of the larger farmers of the village. Farmers of three out of six farming cultures were growing cash crops in varying degrees and in fourth farming culture, livestock was key cash income source of the farmers. Farmers of the other

two subsistent farming systems, were using other smaller means for income generation so as to sustain livelihoods. At the time of the survey in 2017, there were hardly 15% farming families who said they were producing enough food on farm to feed their families. In cash cropping villages, food crops had either been abandoned or the cultivation of food crops was considerably reduced (20-30%).

The cash cropping, supply of subsidized food grains (rice and wheat) under PDS across the Himalaya, even in remote villages, shrinking land holdings leading to focus on few major crops cultivation, access to new HYVs of food crops or cash crops have resulted in farmers who preferred to stop eating local grains and abandon farming of the indigenous crops. The national program of PDS engineered changes in farming cultures i.e. from food crops to cash crops and from farming to non-farming vocations. PDS supplies meet the staple food needs of all families for half a month and MGNREGA does the rest by empowering farmers buy food for another two weeks from the open market. For the Himalayan farmers, these two national programs have essentially helped ensure food security among the masses. For many mountain households, rice and wheat were elite food grains to be eaten occasionally until a decade ago, which now is a thing of the past. Rice and wheat have become part of their regular diet. The regular diet of the past, comprising of maize, pulses, millets, pseudo-cereals and cultivated and seasonal wild vegetables, have been abandoned or are on their way out, for good or bad reasons. Fair number of north east Himalayan farmers' diets however continue to give due place to local food crops and wild foods.

In the subsistent farming conditions of north west Himalayan villages, at the present, only 15% farmers maybe producing enough food for themselves. While in north east Himalaya, above 50% farmers are producing enough food to feed their families. That is not the case with vegetable and fruit growing households of Himachal Pradesh, where these farmers have totally or partially abandoned food crops farming. Food insecurity of long periods and of serious nature was not reported but still villagers reported varying degrees of manageable food insecurity of few days to weeks when there was not adequate food provisioning. The transient food insecurity situation was reported by villagers across the Himalayan states under all kinds of farming conditions, in varying degrees as follows:

- There were 5% food insecure families among high land Pastoralists.
- There were 85 % food insecure families among subsistent farmers.
- There were 15% food insecure families among the fruit orchardists.
- There were 60% food insecure families among those affected by wild animal threatened mixed farming systems.
- There were 5% food insecure families among those doing cash cropping of vegetable and fruit farming.
- There were 58% food insecure families among shifting cultivators of north east Himalaya.

Overall 38% farmer families of Indian Himalayas were found facing transient/ transitory food insecurity.

The high land nomads get to eat enough food grains, sugar, tea etc. Also, their non-vegetarian diets and source of it is fully secure. The only problem they had was that there was little variety in their diet and it was largely monotonous. This also means that, there was food self-sufficiency but variety essential for nutritional balance may be uncertain. The vegetable and fruit growers of Himachal Pradesh were experiencing complete food security, they only quoted the past for such experiences. But among the fruit growers of Kashmir, there were few families facing transient food insecurity, at times, largely because of poor harvest during that year.

One has to understand the dynamics of fruit cash cropping based income led food security. In a good year, when fruit crop is good, enough money comes home, not only there will not be any food insecurity during that year, farmers would in fact show a level of profligacy. During these past few years, fruit growers have been earning less than what they used to earn during the past decade. Thus, among the Kashmir apple growers, there is also a kind of climate driven annual food insecurity and poverty situation, going on for some years, which makes these farmers very concerned about future course of action.

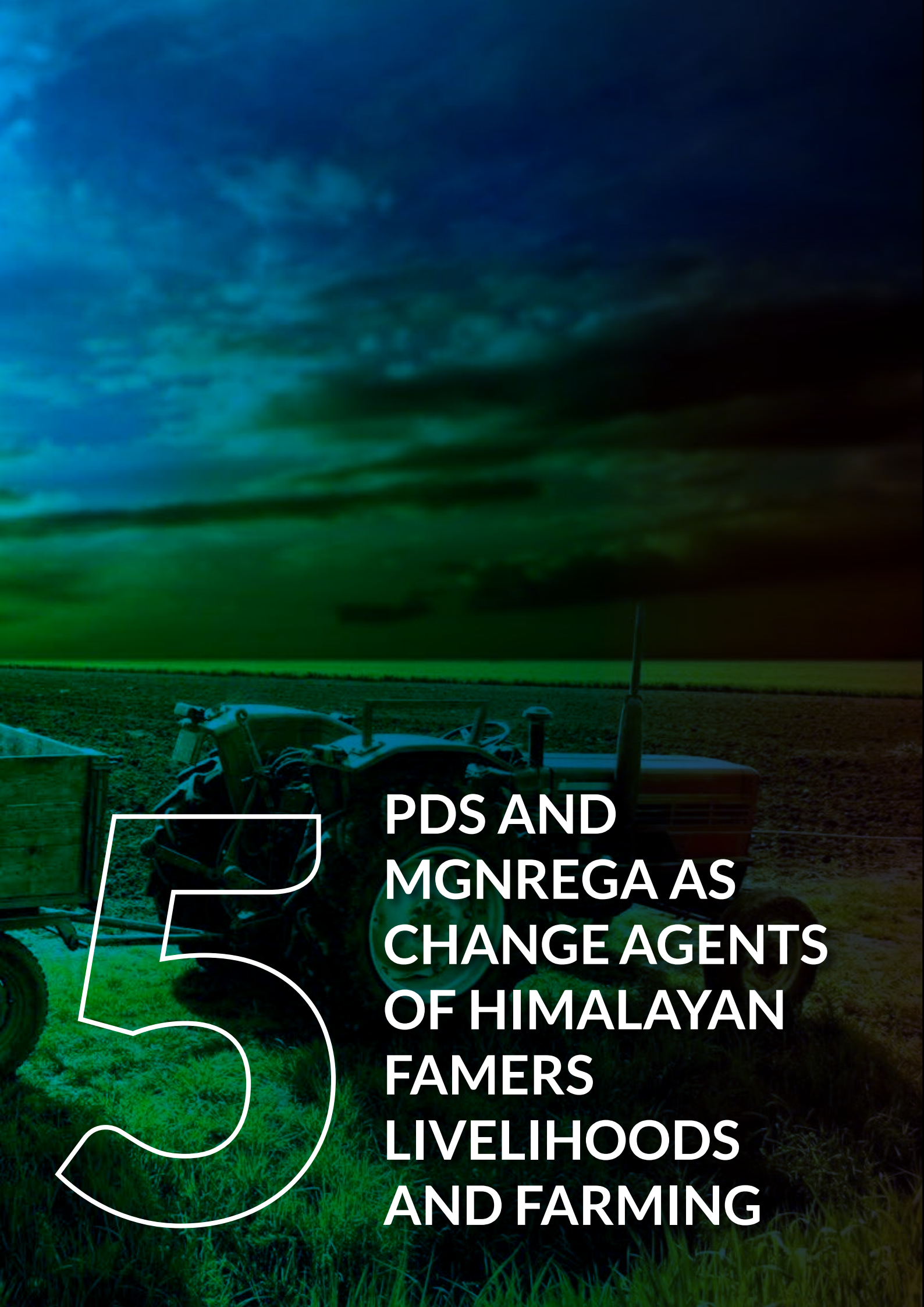
The annual transient food insecurity among mountain households also highlights the fact that the idea of making people food secure on their on farm land is no longer possible in the Himalayan villages.

The wild animals affected farmers speak of yet another persisting crisis. The root causes of food and income insecurity in these villages were that farming failed to meet the food and income needs of people because of wild animal menace. People had either stopped farming except that they keep growing coarse food grains, barnyard millet and finger millet, so that they may at least get some grains or fodder for animals. The last objective also was to engage and show that crop land is occupied to maintain their pride as farmers.

There is a trend of change in the food habits of people in the Himalayan region. Mountain foods (millets, pseudo-cereals, barley, and including maize) have been replaced by mountain communities across Himalaya by rice and wheat. The rice and wheat are staple food items now but not staple food crops. Himalayan states are on their way to become net importers of food – be it food grains, pulses or cooking oil. It has impacted their diet, transforming from the past locally grown food to imported mountain food. The rural food has become urbanized in terms of diet and nutrition. Life style diseases (diabetes, high blood pressure, allergies, cancer) have crept into mountain lives.


4
FARMERS
MIGRATION
FROM
UTTARAKHAND
HILLS

Looking at the issue of migration from hills of Uttarakhand, one finds that while 86% of the state is hilly but 86% of the crop land of the state is in the plains i.e. tarai. The rate of migration increased during past few decades, just before and after formation of the state of Uttarakhand. Conditions have worsened in some hill districts to the extent that over 1700 villages are left unoccupied and many more are joining that category, called locally 'Bhutia gaon' or 'Ghost village'. Many others have just 8-10 people living in few houses. Those people who migrated, not all of them are happy. Same reports indicated that nearly 1000 more villages have less than 100 people per village left in there. Over all, around 3900 villages are presently victims of migration. The analysis of the census of 2001-2011 revealed that more than 2,26,949 farmer families of Uttarakhand have migrated from their native villages. After the migration, main source of their livelihood, elsewhere, was daily wage labourers mainly in factories and shops. For them life has become more vulnerable. Consequent to migrations, today, only less than 20% agricultural land in the hill districts of Uttarakhand is being farmed and rest 80% has become fallow land for varying periods.



5

PDS AND MGNREGA AS CHANGE AGENTS OF HIMALAYAN FAMERS LIVELIHOODS AND FARMING

PDS means Public Distribution System – a scheme of Government of India for giving subsidized food to poor families.

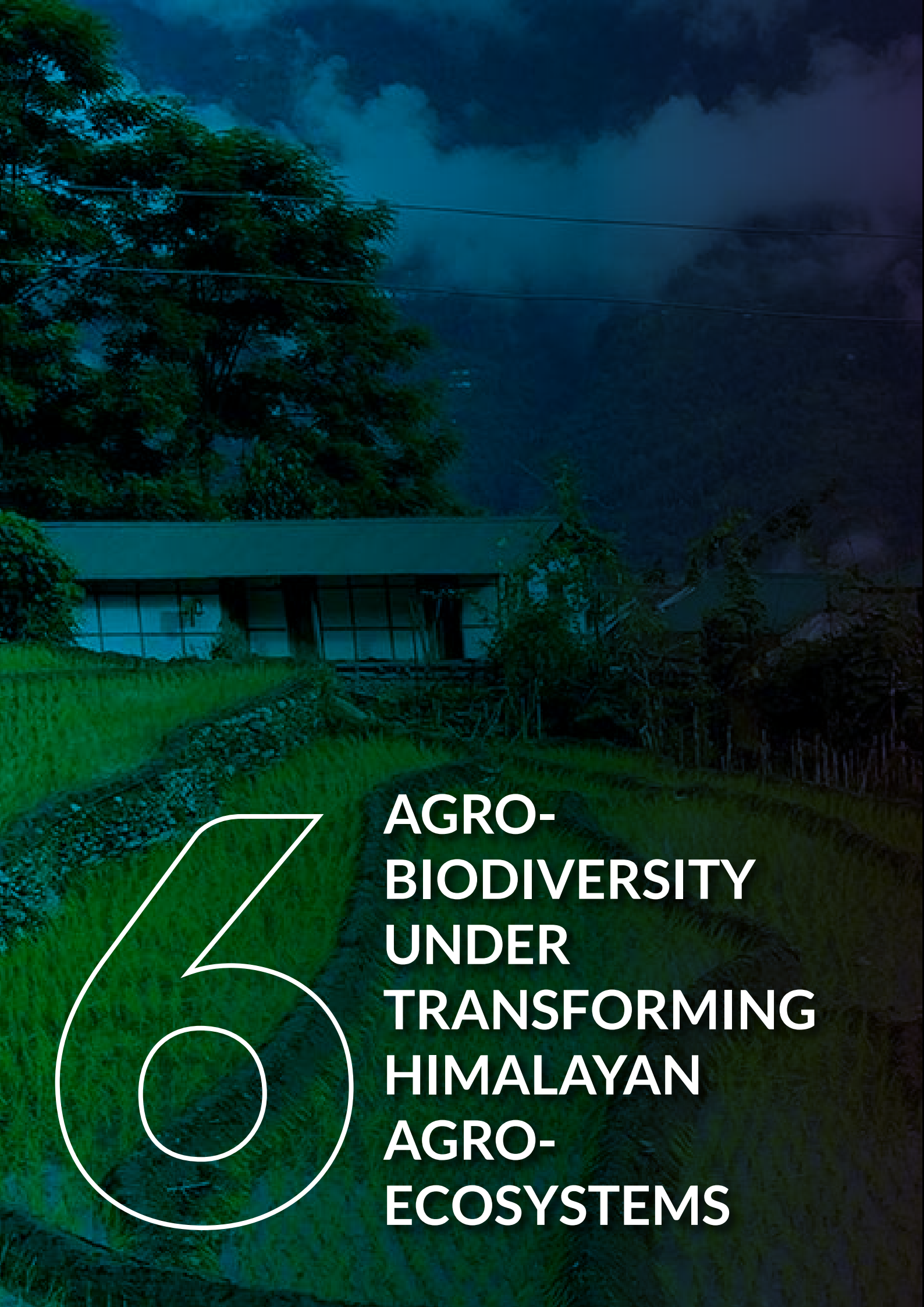
MGNREGA means Mahatma Gandhi National Rural Employment Guarantee Act.

How PDS and MGNREGA has impacted farming in the Indian Himalaya Region? General perception is that it encouraged farmers to leave farming and become dependent on purchased food. Increasing rate of incidences of abandoned crop lands in the Indian Himalayan Region is attributed to these two schemes. This survey of the Himalayan farmers, across all states, revealed a different story. Himalayan farmers considered these two national programmes as great opportunity to come out of food and income insecure subsistent farming. Wherever agriculture was barely subsistent and perpetually breeding food insecurity and poverty, those farmers received food security through these two programmes and now had the risk bearing capacity to shift to cash cropping. Feeling of a food secure family, also encouraged hill farmers to diversify from farming to non-farming options. The picture in mountain states depicts inadequate food production being supplemented by PDS supplies and supplemented income to buy additional food. Where farming families food needs are not met even from subsistent production on their farms in addition to PDS, in such cases money earned from MGNREGA came handy to buy additional food from open market.

Sharma and Vaidya (2009) reported that majority of farmers of Himachal Pradesh were enjoying the status of being food secure, essentially due to PDS and MGNREGA and thus has become a cause factor for trying cash cropping. It also found that the entitlement of grains from PDS was adequate or more than the requirement especially among households in tribal areas and among below poverty level families. The availability of food items at prices which were lower than the cost of production on their own farm land had led to emergence of a situation where farmers were now less keen on growing food crops on their farms.

There is an increased demand for non-agricultural jobs which has been able to fulfil the rising demand of cash income of farmers. The diversion of elite labour force to vocations other than agriculture has not only led to dwindling number of workers available for agriculture; more importantly, the best brains, so crucial for agricultural development, are moving out of this sector. There are two diametrically opposite outcomes of this state of affairs; one is neglect of agriculture due to outmigration of quality work force. Two, in some places this outmigration has contributed to the well-being of agriculture sector, by way of higher farm investment, which came from savings from non-agricultural vocations. This has happened in rural areas surrounding urban centres of the Himalayan states.

Even while the two national programs are serving their purpose well, there is need for a course correction so as to remove deficiencies. The concern that PDS has led to monoculture of diets across the states can be addressed by making provision for inclusion of local traditional mountain crops in the scheme. It will serve double purpose, farmers may start growing them as cash crops as these are more suited to local culture and agriculture and second, grains of these crops may fulfil the cause of promoting nutrition focused agriculture.



6

AGRO-BIODIVERSITY UNDER TRANSFORMING HIMALAYAN AGRO-ECOSYSTEMS

Agricultural biodiversity includes the variety and variability of living organisms (plants, animals, microorganisms) that is involved in food and agriculture. It can be considered at three main levels – the ecological diversity, organismal diversity, and genetic diversity (Heywood, 1999a in Heywood, 2003). This process of few crops based simplification of Himalayan agriculture led to food production models in which farmers are eventually relying on only handful of crop species from vast resource base of food from plants. State of local crop agro-biodiversity, which mainly included the state of diversity of crops in this study, included variations and level of variety of agro-ecosystems, crop, their varieties and land races, kinds of livestock and breeds of domestic animals and the variety of farming cultures.

Traditional Himalayan agricultural systems were and are rich in agricultural biodiversity. All Himalayan agro-ecosystems, represented by different villages in this study, across the Himalayan states were in a dynamic state of functioning, which created the circumstances for their continuing transformation process, both good or bad. What is happening to these traditional farming systems based livelihoods, is very clearly reflected in the village in Uttarakhand. The reasons for the stress of farmers, who are part of this kind of agro-ecosystem in the Himalayan region, is indicated here very well. Forces of nature going out of hand in the face of increasing pressure on these kind of agro-ecosystems to become more productive or face abandonment, is evidently highlighted in the studied villages. The vegetable and fruit farming dominated village in Himachal Pradesh, highlights the kind of future the traditional farming based livelihoods will pass through. Casualty though will be its agro-biodiversity i.e. crops, livestock and the agriculture systems. It also indicated that elements of transformation process are indeed bold and not small changes. The tools of survival of human societies, be it crops, animals or practices, everything is facing change confronted by economic survival of communities.

There is a whole scale abandonment of millets and pseudo cereals from farming as well as food habits. In villages where cash cropping has been adopted, millets and major traditional food grains have been replaced by new crops, causing loss of local crop genetic resources. These changes indicate preference of farmers for economically productive but biologically less diverse agro-ecosystems. Farmers are replacing their old system in which they were growing a range of crops and land races of crops. From aiming at managing farms for ecologically sustainable livelihoods, to focusing on managing farms for economically promising livelihoods, is the biggest turn around we see in agriculture-based livelihoods of the Himalayan states.

In this crop abandonment and replacement process, maize crop has become a major casualty. The maize crop area has been put under vegetable farming by the farmers. When the maize cropping reduced to about 25%, then remaining farmers faced other problems which forced them to abandon maize cropping, consequently leading to 100% loss. Farmers reported that when the maize crop in the villages reduced to 20%, animal attacks on the crop increased. Further, due to declined cultivation of maize, facilities for milling maize grain closed down in the surroundings closed down in the villages. Subsequently, in diet, maize was replaced by rice and wheat, which were available under PDS and in the market. Barley, once a staple crop of the Himalayan farmers, is no longer cultivated by 55% families practicing mixed crop livestock subsistent farming. It is abandoned by 95% families in vegetable and fruit growing villages

and the rest 5% households of these villages are growing it for the purpose of fodder only. For farmers maintaining subsistent mixed farming in villages of Uttarakhand, only 15 % families have abandoned this crop.

For stopping wheat cultivation, farmers had series of reasons; one, from wheat crop, land was shifted to growing vegetables, cauliflower and cabbage. At the same time machines became available to replace bullocks for farming. Here again when wheat cropping area was reduced, wheat thrashers for hire stopped coming to the villages, forcing rest of the 25% farmers to reluctantly join others in abandoning wheat farming. These stories reveal complexities of continuing farming a crop in a village. The will of a single farmer cannot prevail. Once critical mass of farmers abandon a crop, others have to do so per force, because the essential support services necessary for carrying the grain from field to plate break down.

Farmers of Uttarakhand hills have other reasons for abandoning some of these crops – the wild animals are destroying maize and other crops. The wild harvest collection and use in Changthang highlands also indicated the declining trends. It appears there is a wide spread trend towards change in food habits, which may be due to easy availability of other food items in the market or matter of changing tastes or be it a case of crop land shifting under new crops which are more remunerative, cash income wise.

About what new crops are making place for themselves under all categories of agro-ecosystems across the Himalayan states, farmers mentioned well known cash crops, fruits or vegetables, namely, apple, pear, walnut, kiwi, pomegranate, plums, peach, apricot etc. among fruits and tomato, cauliflower, cabbage, beans, potato, capsicum, cucumber and pumpkins etc. Even though scope exist for harnessing the potential of niche crops and vegetables, like wild onion, and tree beans in North East, but that has not happened as yet.

As to reasons for farmers abandoning crops they used to grow, there is not a single reason but variety of reasons, some common but others very local. Change in food habit was mentioned as a reason by 20% farmers, another 10% think that the production of these crops was not good, 5% farmers quoted crop land shortage as a reason for not growing them. It is misleading, though, because farmers had not counted the fact that when they adopted cash crops farming in their fields they brought in new crops leaving old ones out. They did not see this as shortage of crop land but their will to change the cropping pattern for better economic returns. It is also indicated by the next parameter, almost 40% farmers quoting less economic value of their old traditional crops as reason to leave them. Only 5% farmers reported that climate change forced them to change the cropping pattern while the rest think climate change can be used to their advantage. For farmers, more pressing factors than climate and production was the wild animals destroying the crops with increasing frequency – leaving almost nothing to harvest. This is no longer a local issue but Himalaya wide problem, except in North East.

Reasons why farmers were adopting new crops, reason topping the list was higher economic value for cash crop (85%). Climatic conditions favour introduction of new more promising crops and reinforced the earlier point. Third reason being families were forced to adopt new high value crops so as to move from food security to economic security as a livelihood management

strategy. All the three reasons reinforced each other — one can say a combination of these three factors made a strong condition for Himalayan farmers to move towards adopting new cash crops farming. Cases of wild animals destroying crops, forcing changes in cropping pattern are location specific.

Unfortunately, detailed information are inadequate about diversity of crops at the cultivator level and the role being played by these in nutrition. The leafy vegetables, grown and collected from wild sources, are important source of micronutrients and often provide these mountain farming communities with most of their daily requirements of essential vitamins A, B complex, C, E and minerals. Different plants gathered and consumed by the villagers play an important role in human nutrition, supplying necessary daily requirements of vitamins A, B complex, C and minerals. Some local vegetables are even better nutritionally such as colocasia leaves (arabi ka saag), an indigenous food crop whose leaves are consumed as vegetable and they are the highest known source of vitamin A (1000 micro grams per gram of leaves). The so-called Himalayan diets therefore, were blessed with a range of local wild greens, wild fruits and wild roots, besides a variety of wild mushroom. Among mushrooms, morel was and is the most expensive (US $ 200 per kg) mushroom of temperate Himalayan villages which they have it in their wild surroundings and forests.

There is an emerging paradoxical situation – the diversity of crops and animals that forms part of the Himalayan agro-ecosystems and has been part of the dietary systems supplying all kinds of nutritional needs of the Himalayan communities is now lost. Old crops being replaced by fewer new cash crops. So far, there was a wide bio-resource base of crops, wild harvest and animals available to these farming communities of the Himalayan villages, which most likely met the needs of human nutrition. However, study indicated that this may not be the case any longer and future of agro-biodiversity based rich dietary systems of the Himalayan farming communities appears grim. The rapid replacement of both diversity of crops and animals by fewer economically more important species has been observed and amply highlighted by this study. Loss of crop diversity is multidimensional; one, crops were replaced or are being replaced by commercial farming of few crops, fruits and vegetables, replacing traditional diversity of food grain crops, pulses, vegetables, fruits and several other minor crops. Two, the subsistence farming systems are failing to support sustainable livelihoods and under such circumstances, the traditional multi-crop cultivation is being abandoned in favour of other off farm options.

The percentage share of cereals in total agricultural income of mountain farmers is declining in all the Himalayan states, except in Arunachal Pradesh. Traditional food grains and cereals, pulses, local vegetables, among them many having nutrition value are abandoned or have already been abandoned by the farmers. Between 2006-2007 to 2017-2018, the decade has witnessed a major shift in cropping patterns from grains and pulses to vegetables and fruits, further reducing area and production of food grains in the Himalayas to almost half the value of 2006-2007. For agriculture economists, it is definite evidence of structural changes in the value of Himalayan agriculture.

In north east Himalayan states, there is an emerging trend of conservation and promotion of native livestock breeds. In this context there are quite a few success stories. The success story of native Siri cow revival by a group of 18000 small farmers belonging to 240 farmers clubs in Kalimpong district is one such noteworthy achievement of Himalayan farmers initiatives in revival of native livestock breeds. The repercussions of these two scenarios are just opposite; in

Himachal Pradesh, the dependence on grazing land may be declining with higher reliance on purchased fodder, animal feed and concentrates. The orientation towards market may be the important reason for this. The cash income generated from milk products are seen as important source of investment for agricultural sector. But in north east Himalayan states, there is an increasing practice of dependence on grazing lands. This is instrumental in launching initiatives for revival and promotion of local breeds which are adapted to local grazing land resources.

The negative fallout of transforming Himalayan farming on the state of mountain agro-biodiversity is clearly indicated in the ground report on this subject. The challenge is to think about strategies for putting in place mechanisms that serve two purposes. One is transform the purpose of growing traditional local mountain crops from subsistent food crops to cash crops. Two, research and technological innovations are encouraged to enhance their niche value, from only ecological niche value to multiple value – ecological, economic and nutritional. There is also a space for bringing in the social value as a factor for promoting their cultivation. Such steps in combination may lead to revival and conservation of native mountain biodiversity.

7 HIMALAYAN FARMERS RESPONSES TO CLIMATE CHANGE

Himalayan Farmers Responses to Climate Change

A case study on Warming Weather in Apple Valley and Farmers Response to it in 2009 and 2018, has been used in present findings. This study conducted in 2009 and the location scenario revisited in 2018, examines how apple farmers in the western Himalayas of India perceive climatic change. This study by Partap and Partap (2009) dealt with climate change impact on hill agriculture and farmers adaptive strategies. It took apple as an indicator crop to investigate the positive and negative effects of climate change on farm economy.

Findings revealed that in the lower areas of the valley, apple economy failed due to the general rise in temperatures and subsequent changes in the local climate. It was impossible that apple farming continues as the climate did not support it. The failure of apple farming affected the household economy of farmers as their income source was hindered, pushing many of them into loss and causing financial difficulties. It was a major negative impact that climate change brought on the area. However, the climate change supported cultivation of other alternative crops in that area. Farmers shifted to vegetable cultivation along with other fruit crops requiring less chilling. Quite a large proportion of previous apple farmers started benefiting from new crops. For 55% of the farmers, the farming options of the post apple period proved economically even more beneficial. The climate change that pushed them through a painful experience for a short period of time made all this possible.

The study findings revealed that climate change forced these mountain farmers to abandon one set of crops and adopt new ones. The study revealed that in the lower valley areas, the main reason for the apple economy crash was due to poor yield and quality. This was the result of climate change combined with already low market prices for the apple crop which thus, fell even lower. The previously prospering apple farmers in the lower areas went through a painful decline process. However the identification of new farming options such as vegetables and other fruits, coupled with government support resulted in a positive outcome. Climate change opened up new and in general more profiting farming options to the lower valley farmers. Similarly, in the upper valley, the altered climate encouraged the adoption of new crop options i.e. apple farming, which brought prosperity into the household economies and society. The area saw a general ascent in living standards of most farmers.

In this case we saw the upward shifting of the apple belt and those who lost apples discovered vegetables as better new options. Developments by 2018 saw a scenario of technology infusion to neutralize climate change impact.

Around the beginning of the 21st century, based on experiences of the past few decades, there was a general perception that the temperate crops which provided niche based comparative advantage to mountain farmers in the Himalayan region, will move upwards in search of suitable climatic conditions. Apple, the leading crop of the Himalayan region, provided one such good example. Around 2001, mountain farmers had two things in mind, one the apple orchards in the valleys have to be replaced by something else, pomegranates came in the apple valleys because of that. While apples vanished from lower valley areas of Himachal Pradesh and northern more warmer valley area of Kashmir faced poor crop conditions, in Sikkim there was near extinction of apple farming.

Around 2010, research and technology led trials on new low chilling apple varieties were initiated. By 2018, new low chilling, early maturing varieties, with better market appeal/value are already being grown by the farmers. The new technological breakthrough has made it possible to revive apple farming in areas where it was either abandoned or the threat of abandonment was looming large. There is a new thought now, with respect to apple farming/ temperate fruit farming in the Himalayas, that apple belt can now expand both ways. Global warming is making it possible to expand apple farming upwards into higher Himalayan ranges and technological advancements are making it possible to move the apple belt downwards, including those areas from where apple crop had earlier vanished. In the present case study, in the areas from where apples were reported moved up in 2009, they have come back into the same area in 2018, all because of technology.

The story of apples, thus explains that like in the case of apple crop in the Himalayan region, technological advancements can be used for negating the negative impact of global warming on crop zones. However, for that planning R&D interventions in ways that effectively reverse the negative impacts is a necessary condition. That is the reason for apples to be grown again in the same old areas in Himachal Pradesh and in Kashmir but apple farmers of Uttarakhand, Sikkim and Arunachal Pradesh continue to be sufferers of global warming in regard to apple farming.

8

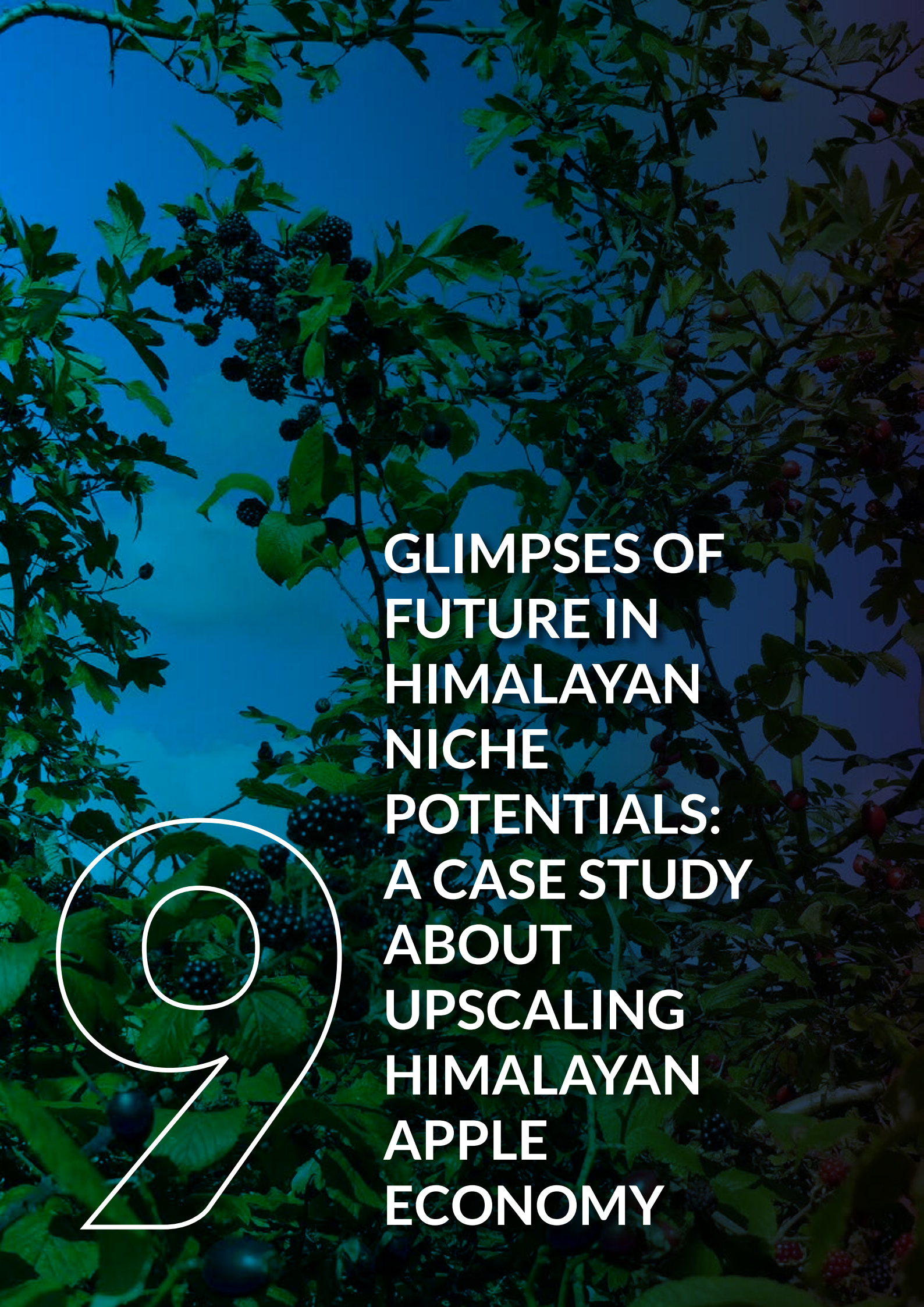
GLIMPSES OF FUTURE - NEW AGE HIMALAYAN FARMERS

There are rare cases of individuals or groups, across the mountain states, who are doing extra ordinary things in farming to show the way how farming can be a promising proposition. The actors – 'New Age farmers', are using extraordinary ways to overcome limitations of small farm size and limited production. They come from all kinds of backgrounds; educated youth from farming families, engineers, professionals, company executives, scientists and many others. Therefore, information was gathered from across the Himalayan region about them. Stories of these farmers helped understand the emerging concept of New Age farmers and learn from their experiences about the challenges and opportunities for mainstreaming the idea.

For the New Age Himalayan farmers, one thing in common was their knowledge and innovation based approach to farming. Their engagement with farming was not for survival alone, nor did they see it as an unprofitable vocation. They take farming as a profession and their aim is to make it as much profitable and economically lucrative agri-business for themselves and for several others who are associated with them. The stories of these individuals offered a glimpse of the new generation of farmers and how there is a shift in farmers behaviour towards selecting niches, production processes, managing supply chains and marketing and aiming at higher economic returns from farming. Besides, innovations in collectivization in farming ,value chain development and marketing are emerging as necessary mechanisms to enhance power of other small farmers.

The stories of these New Age farmers showed that there can be a positive hope and that mountain agriculture has a future. But for that there is a need for different kind of farmers. Presently, knowledge deficit exists. New Age Himalayan farmers thinking can be considered a new approach for reviving farming in the mountain areas. Looking at how farmers envisioned, innovated and executed their New Age farming strategies, New Age farming perspective appears as a fountain head of agri-entrepreneurship. The messages emanating from the stories indicated that it is no longer a single man's job to lead the transition into successfully transforming mountain farmers farming based livelihoods. From single farmers to collective efforts for profit making, the stories offer range of fine examples on how to scale up the non-viable farm economy of small mountain farmers into promising viable farming economies.

In this context, the important point emanating from stories is that the key area we have to learn a lot in order to succeed, is "collectivization". It will be a buzz word of future farming strategies for the mountains. For achieving success it would require cooperative approaches of all kinds to evolve. The experiences of the New Age Himalayan farmers serve as valuable knowledge inputs to chart out new pathways for transforming the farming economies of households, villages, valleys and farming landscapes elsewhere. Essential for mainstreaming New Age Himalayan farmers' movement, is strong back up support of R&D institutions for technological services, in addition to necessary social engineering innovations. As a final word, presently, the choice options of New Age farmers have been decided by the farmers without much input on ecological suitability of a crop or cropping pattern.



9

GLIMPSES OF FUTURE IN HIMALAYAN NICHE POTENTIALS: A CASE STUDY ABOUT UPSCALING HIMALAYAN APPLE ECONOMY

Can apple economy of Indian Himalayan states be up scaled over six times to make it ninety thousand crore rupees (Rs 9 billion) economy of the Himalayan farmers? What would it mean to Himalayan apple farmers with respect to changes in apple farming practices and to governments about putting in place enabling policy environment?

The present apple area and economy divides the Himalayan region into two distinct categories, North west and North East region. North West Himalayan states of Kashmir and Himachal lead the way in apple farming and any upscaling w.r.t. modernizing apple farming, varieties and post-harvest handling has to first happen in these two states. But north east Himalayan states hold the potential of becoming apple economy driven states of the future. They have vast land area which can be put under apple farming, using new low chilling varieties. But for that to happen, weak R&D institutional capacities of the states, need upgrading. Apple farming in India is not yet modernized to realize its full potentials and that the scopes exist for improving productivity, area, production and economic returns.

An analysis of the coming times of apple farmers indicates that Himalayan farmers will need to work out strategies for cutting down cost of cultivation down the supply chain – and that is a must factor for survival of apple agri-business by the New Age farmers. Technology, of late has been helping farmers expand apple farming down wards in lower altitudes having warmer climate and less chilling conditions. Wherever apple farms vanished during past decades, these areas have gotten new opportunity of apple farming through low chilling varieties.

For modernization of apple production the issues that will dominate include HDPs, clonal root stock, new varieties of apples, indigenous Himalayan varieties of apples, innovations in rejuvenating old orchards, better infrastructure for post-harvest handling and better supply chain mechanisms.

Farmers are yet to gain knowledge of new varieties in order to make a decision which ones would suit their agro-climatic and socioeconomic conditions. There have always been one neglected aspect and that is necessity of apple farmers to acquire new knowledge and skills of modern apple farming techniques. It includes new knowledge about varieties, root stocks, kind of plant architecture for higher yields in a particular farm landscape, post-harvest choices, consumer psychology and strategizing better marketing. Aiming at ten times increase in the apple economy means that for such a thing to happen, it will require inquisitive inquiry and thinking on designing long term strategies.

Only climate should not be considered giving mountain farmers the comparative advantage for apple farming. So far in the initial phases of cash cropping thrust it worked well but for the coming times it will be too small a window of opportunity. In thinking about upscaling apple farming, unless other technological and institutional factors are managed, upscaling apple economy on larger scale cannot be expected.

In apple orchards, farmers make money once a year but integrating it with homestay they will make money throughout the year. That is the concept behind apple farming linked agro-tourism and home stays. For apple farming linked tourism, there is a great scope to expand into orchard management operations, apple varieties knowledge, taste of apple plucking and eating apple from trees. Hence, making visitors involved in every kind of operations.

The Himalayan apple farmers were living in the past. Farmers and governments across the Himalayan states have to understand that continuing with old practices of apple farming will not help in continuing apple growing with sustainable economic returns that match 21st century agri-business needs and economic returns. Both need to change and facilitate modernization of farm practices, new varieties, post-harvest handling and marketing to their advantage. Creating a platform of Himalayan apple stakeholders, farmers, R&D agencies and marketing systems is suggested as a strategy which will lead to developing concrete ideas and proposals for collaborative action for up scaling apple economy of the Himalayan farmers and states.

10

GLIMPSES OF FUTURE: EXPERIMENTS WITH ORGANIC FARMING BY THE HIMALAYAN STATES

All Himalayan states have today organic farming promotion programs which offers farmers with several incentive schemes to adopt organic farming. The impact shows that organic farmers in each state with hundreds of hectares of organic farm land. However, today the leading Himalayan states are Sikkim, Uttarakhand, Himachal Pradesh and Mizoram. States such as Meghalaya, Nagaland, Jammu and Kashmir are late starters but with national thrust on organic farming these states are making efforts to bridge the gap. Some organic agri-business entrepreneurs have emerged in some states e.g. Sikkim, Uttarakhand, Himachal Pradesh and even in Nagaland and many more are emerging. Export quantities and pool of products is still rather small.

Sikkim has shown the way that Himalayan states have a strong niche potential for organic agriculture/ horticulture/ livestock production which may lead Himalayan farmers to the future of farming based on agri-business of products with niche and comparative advantage. The "organic" movement in Sikkim gained visibility in the year 2003 when Chief Minister Pawan Chamling announced the decision to adopt organic farming and to convert the entire state into organic. The target was to convert the entire state into an organic one by the year 2015.

The main objectives of the Organic Mission of Sikkim is to achieve the target set by the state government, develop and explore markets of organic commodities produced by the state and lastly, to develop linkage between the organic farmers and their market. The state government acknowledged that farmers need proper training in organic methods of cultivation and access to good quality organic inputs at subsidised rates. For this, different programmes were launched which included the adoption of bio-villages, subsidisation of vermi-compost pit constructions, promotion of the use of bio-fertilisers and programmes to ensure the availability of certified organic manures. More than 100 villages were adopted as bio-villages till 2009, benefitting more than 10,000 farmers.

Sikkim's experience in moving towards the organic has largely been positive and is applauded by environmental and ecological experts in India and globally. In the first place, the state government showed a strong political will and policy consistency, along with well-defined targets and implementation plans. Similar strategy can be adopted by other states.

In Uttarakhand, because of dominance of food grains based rain fed mixed farming in the hills of the state, farmers were more willing to adopt organic farming. Today, there are several government incentive schemes available to encourage farmers adopt organic farming such as Rs 30,000 and Rs 10,000 support to individual farmers for adopting organic farming practices and composting respectively. However, most important of all is the state policy on adding organic farming as one of the activities under MGNREGA. Farmers can register themselves for adopting organic farming on their own farm land and get paid under MGNREGA for 100 days in year. It has prompted wide adoption of organic farming by the farmers of Uttarakhand. The organic food products of Uttarakhand supplied by several private certified organic producers of the state are now available in the urban markets in Dehra Doon and Delhi. The proposed Organic Agriculture Bill of the state, once enacted, would provide legal backing to the government's initiatives aimed at developing the hill region as a full-fledged organic state.

Himachal Pradesh was one of the states where research on organic farming technologies was started in 2003 and the research centre was facilitating organic farming promotion undertaken by the Department of Agriculture. The positive point of state organic initiative was that several food grain farmers adopted organic agriculture. However, because of poor R&D there was no technological back support for plant protection w.r.t. horticulture crops. Particularly apple farmers and vegetable farmers of Himachal, even though keen on adopting organic practices, could not get organic alternatives for plant nutrition and plant protection .

Horticulture department of the state had negative perceptions that organic farming cannot be practiced for horticulture crops. Despite this, there are several ORGANIC VEGETABLE GROWING VILLAGES in Solan and Sirmour districts, who supply organic vegetables to urban markets through BIG BASKET. By 2017, Himachali farmers were growing organic food in 22000 hectares, largely food crops and vegetables. Under a new initiative started in 2018 i.e. Zero Budget Farming/natural farming, government is engaged in a fresh push to encourage farmers go organic in their farming. However, all said and done, the lead economy of Himachal is based on fruits, apples, pomegranates, plums and vegetables and in growing these cash crops farmers make use of chemical fertilizers and pesticides very liberally. Efforts to convert these farmers into organic have failed so far and will remain so until serious research efforts are made to set up R&D systems to provide farmers adequate and effective organic plant protection measures.

The day Himachal Pradesh succeeds in giving farmers alternative to chemical sprays in fruit crops and vegetables, it will become a successful organic state.

11

FARMING BY HIMALAYAN FARMERS FACES THE THREAT OF CHANGES AND MISSING MOUNTAIN THINKING IN RESEARCH AND DEVELOPMENT STRATEGIES

The state of Himalayan agriculture, described in earlier sections, is dominated by highlights of a scenario that reflects different dimensions of a mega change process that is under way. The nature of climatic conditions and availability of resources, notably water, is changing. The economic aspirations of the mountain farmers are changing and so is the case with their social values. Overall essence of the state of mountain agriculture is indicative of a change process that is underway across the Himalayan states. The difference among states is only in its scale, speed, response systems and consequent impact. Some have been quick to understand the need for guided change while others have not responded as well.

The transforming scene of Himalayan agriculture is a mixture of good and bad experiences of mountain people which involved many drivers of change process. For better comprehension, the variety of these drivers are grouped under three broad categories: ecological drivers of change, economic drivers of change and social drivers of change. Social and economic drivers of change are further considered together as socio-economic drivers of change.

Ecological attributes of biodiversity i.e. richness of ecosystems, species and genetic diversity are always closer to subsistent agriculture systems. Potential within Himalayan agro-biodiversity exists for supporting promising economic transformation of mountain agro-ecosystems, that farmers can take forward but a vision and the institutional strategies both have been lacking. Present trends do display hope of a balanced strategy of agro-biodiversity conservation with development.

The process of sustained economic growth is now reaching the unreached mountain societies, so that they are rapidly getting richer in terms of income per person. The region is passing through the age of convergence, which seems instrumental in creating a virtuous cycle of economic growth and this fact cannot be ignored. The income of mountain households of the Himalayan states is both from niche based farm incomes and non-farm sources. The meaning of poverty is also being redefined. It is no longer food insecurity but economic well-being of the families that is taking over the past thinking. Well-being itself is perceived broadly as contentment w.r.t. economic, health and social well-being.

The way mountain people used to live is also changing fundamentally, i.e. from rural roots to urban civilization. It is perceived that the urbanisation process will fundamentally change strategic approaches to address issues of food and income security, poverty and livelihoods in these mountain areas.

Mountain farming families may be experiencing socio-economic stresses within the families. A debate within the family goes on for and against change, a change within farming and of making a living outside farming. As a multiplier effect it is deciding the course of unfolding events on the mountain landscapes and valleys of the Himalayan region. Unaware of impact of the social changes underway within mountain communities, the outcome often is resulting in mismatch of institutional efforts with the mountain farmers' aspirations. It is not therefore contributing to build a well thought strategy of a directed change process.

The state of farm economy and livelihoods of the Himalayan farmers comprising diverse farming communities revealed through findings of this study, present a mixed scenario of despair and hope. Mixed farming cultures traditionally focusing on food grains and livestock based livelihoods appear threatened. The scale of pressure on these traditional subsistent systems differs from area to area and state to state. Dependence on them has definitely reduced and their

continuation today, is dependent on the access to any alternative opportunity, on farm or off farm. Mountain farmer is willing to try alternatives that make a better future for his next generation. “None of the Himalayan farmers are aspiring their next generation to continue with the subsistent farming or farming as a way of life”.

The state of Himalayan farming high lights the facts that the business as usual cannot continue. The fact that Himalayan rural population has increased tremendously (one study estimated the increase is 75 times)have to be accepted. More people in farming with greater aspirations of better life would mean the need for more resources, land and water. However, overall crop land in the Himalayan states is not more than 11% of total land area, some states have even less than this. Availability of crop land per household is at critical levels of less than a hectare and it continues to shrink further with more nuclear families joining the Himalayan farming community. Ironically, all good crop land in the valleys of the Himalayan states, that is the only irrigated land in hills and mountains, is under conversion to non-agriculture purposes, under impact of urbanization process.

After land and water, the third ecological driver of change that is presently increasing its disruptive value to mountain agriculture in all the north west Himalayan states, Jammu region in J&K, Himachal Pradesh and Uttarakhand, is the wild animals increasing domination over the farmers on the standing crops on their farm lands. From partial destruction of the standing crops and partial harvest to no harvest coming home has been reported in this study. Government of the day suggest technological solutions, and social awareness as part of the solutions with no serious efforts. One has to understand that this problem is ECOLOGICAL IN NATURE and right solutions will be ecological only. It is a population imbalance problem between humans and animals and requires strategies that incorporate this understanding in designing strategies that aim at balancing population dynamics between users of agro-ecosystems and natural ecosystems. Giving precedence to technological solutions over ecological alternatives cannot help solve such problems that involve ecosystem dynamics and ecological principles

12

SYNTHESIS OF THE STATE OF AFFAIRS

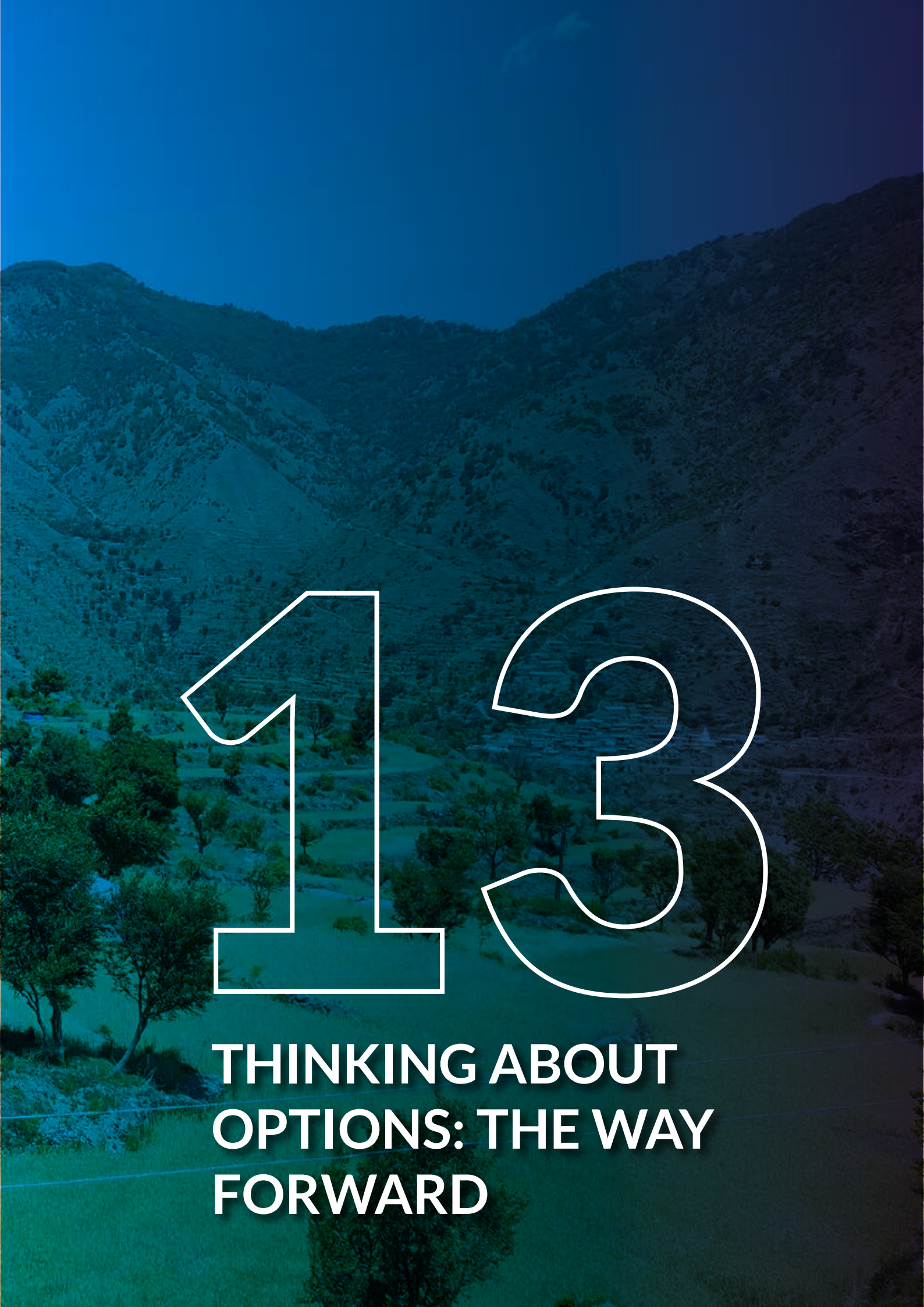
Synthesis of the state of affairs

In a nut shell, comprehending the change of Himalayan farming cultures is rather complex because the drivers of change and their dimensions are varying both in time and space. In local capabilities for managing change, one finds differences in transformation among the Himalayan states. A success story in one state or in one area in a state does not get repeated easily elsewhere. Organic Sikkim is not being repeated elsewhere in same dimensions, transforming mountain economy through fruit farming and vegetable production in Himachal Pradesh may not be happening on similar scale elsewhere, linking conservation of local resources with development in a people's movement with notable success stories of Siri cow and orchids in Kalimpong. Within the Himalayan region states, there are so many local success stories and experiences of failures from which others can learn what to avoid doing. It is highlighted here that there is lack of lateral flow of knowledge, information, and mechanisms for sharing of experiences, among the people and institutions of the Himalayan states. Too little and too slow is the best suited phrase for it. Various scope exists for evolving mechanisms of cooperation among the Himalayan farmers and institutions of these states for lateral partnership.

The new breed of educated mountain farmers is taking over, even if slowly, from the aging older generation with old mindset of food security on farm as first priority. For the old generation, agriculture has been a way of life, however new generation would like to look at it differently. It must either be a promising vocation offering a decent way of life or they will not like to be in farming as a way of life. These social values are force changing the ways mountain farmers evolve farming based livelihoods and economy of the future .

The need has been felt for a significant reorientation in mountain agriculture development thinking. In spite of their many important advantages, traditional farming cultures are breaking down on account of changes in both internal and external factors. Thus, the challenge facing mountain agriculture development strategies is how to combine elements of both traditional and modern knowledge.

Further, even if agriculture is the focal point of discussion it cannot be isolated from the general development framework of the Himalayan states. It will influence mountain agriculture development approaches directly or indirectly.



13

THINKING ABOUT OPTIONS: THE WAY FORWARD

In the past decades, reasons for food insecurity and poverty of mountain farmers were lack of access to better production technologies and markets. In the present, the key reason is and will increasingly be the need for acutely inadequate crop land available to households for managing a living on farming alone. There is also the need for technological inputs to improve grazing and fodder flow from support lands. Migration affected areas of Uttarakhand are facing very aggressive spread of these noxious weeds shrubs into abandoned crop lands. We are facing a precarious situation of losing valuable crop land leading to bushy mountain landscapes dominated by lantana, eupatorium, congress grass and several other plants.

Few experiences of revival of native bio-resources based robust agroecosystems, such as Kalimpong farmers movement for promoting native cattle and plant resources (orchids) for transforming their farming culture to cash economy model, is one good example. The issue is not about lack of potential options based on native resources called native niche potentials. They are very strong in the Himalayan region, our problem has been absence of thought and actions to develop native potentials based transition of the Himalayan farming cultures to cash economy and this problem continues.

There is an urgent need to envision transforming the traditional nomadic sheep and goat herding into a futuristic agri-enterprises of the Indian Himalayan region. There is an unexplored niche for it within the Himalayan agro-pastoral system, where large tracts of support lands exist. Traditional Himalayan wool market may be fading away but the surging demand for safe livestock products, in particular mutton, can become an opportunity for converting the same fading wool based agro-pastoral system into a vibrant safe mutton supply system of the Himalayan brand. So little thought has gone into exploring these potential options offered by niches Himalayan agroecosystems. Developing these would in turn save the dying agro-ecosystems of the Indian Himalayan region. Choices are, either strategies with niche perspective are developed, or these traditional agro-ecosystems fade away into oblivion over the coming decades.

Is outmigration from hills and mountains bad ? Should it be stopped ? Risking criticism, let us take a different view point – a logical fall out of prevailing circumstances leading to a positive perspective of migration. It is logical to consider it part of a change process that is happening within the Himalayan agro-ecosystems. Only if we can improve our understanding of the nuances of this change process within agro-ecosystems, wherein changing human population, numbers and quality plays key role along with climate change and available natural resource endowments i.e. land and water, then we shall be able to look more clearly beyond migration. The unfolding post migration scenarios and the quality of economic, ecological and social milieu available post migration, would depend much on our initiatives for putting in place strategies for post migration - guided change process.

Putting in place strategies about incorporating local food grains in the PDS as an essential component will serve double purpose. One, it may fulfil nutrition needs and two, it may help revive need for growing local crops as cash crops, which was main reason for their continuing decline and extinction. Enhanced need for mountain food grains will open opportunities for their commercial farming, as these food crops are adapted to rainfed farming conditions. It may also lead to revival of rainfed farming with positive perspective.

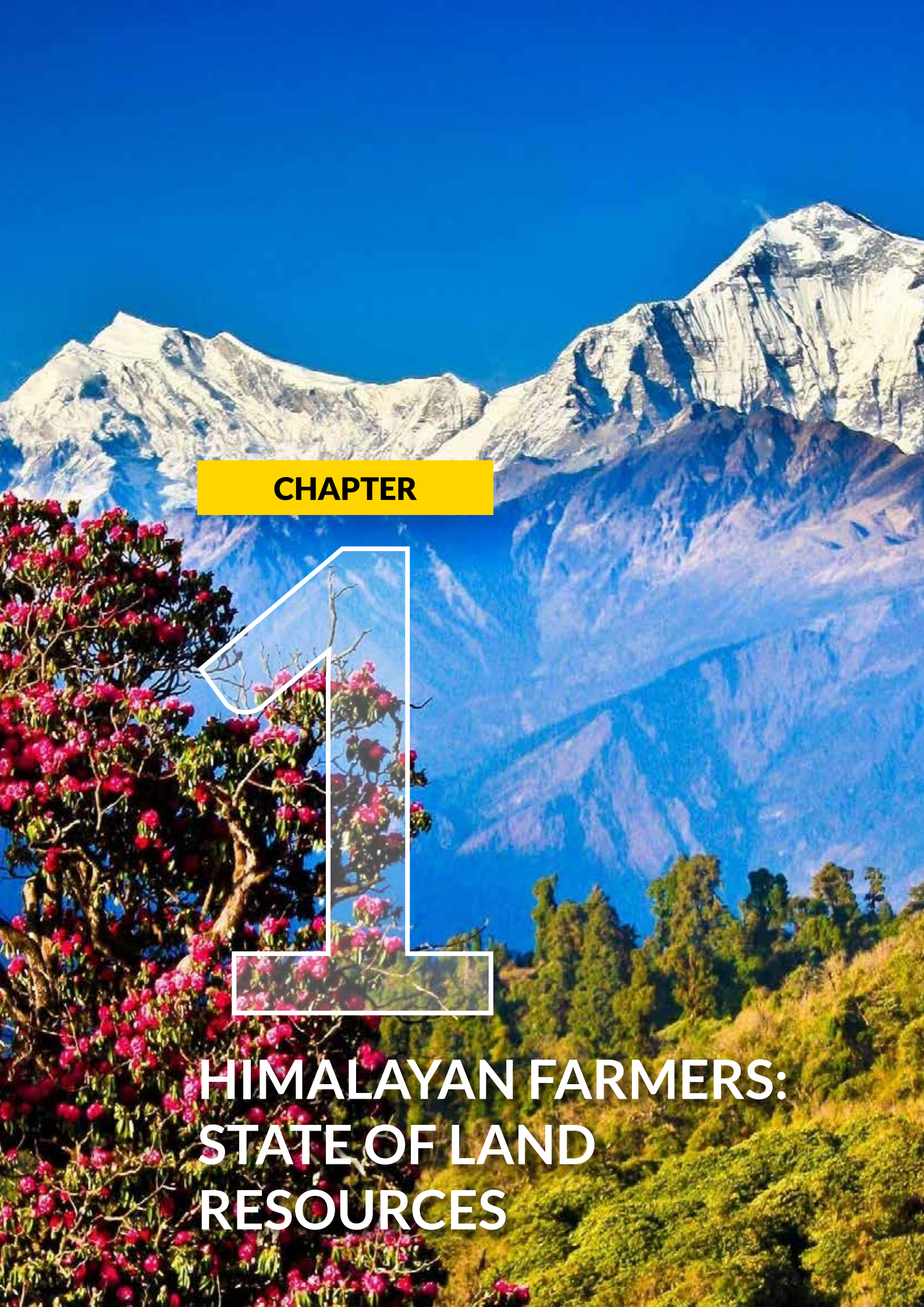
It would be naive to think that declining and abandoned farming of native

Himalayan crops and their genetic resources is a consequence of poor commercial and nutritional value of these crops. As paradoxical it may be that in the past, agriculture research institutions played a key role in bringing new crops and varieties for green revolution. However, today and in near future, market is playing a role in bringing old crops back as future crops/nutrition rich crops. They are part of nutritive safe food section taken over by organic products. Focussed research on these crops may follow. To sum up, as part of the process we may be passing through a phase where we encounter scenario of declining farming of native mountain crop genetic resources in their native areas, as has been found in the present study. But going by the signs of future of food market, which will have thrust on safe food, nutrition and unique food values, it is most likely that most of these crops will make a comeback on the same native lands or elsewhere.

> *"Developing the Himalayan farming niches is the only way forward for evolving promising and sustainable agriculture systems in the Himalayas"*

Indian Himalayan region has space for developing many more examples of apple economy type niche based farming approaches of certain scale. The idea is yet to capture imagination of policy makers and researchers, as to how many specialized agro-ecosystems, cropping patterns and crop products have the space and potentials of growth and success within the Himalayan region, is anybody's guess?

Indian Himalayan states are in the initial stages of their organic farming adoption and there is a long way to walk the talk with credibility. It is a good approach with great potential but even greater challenges to overcome.



CHAPTER

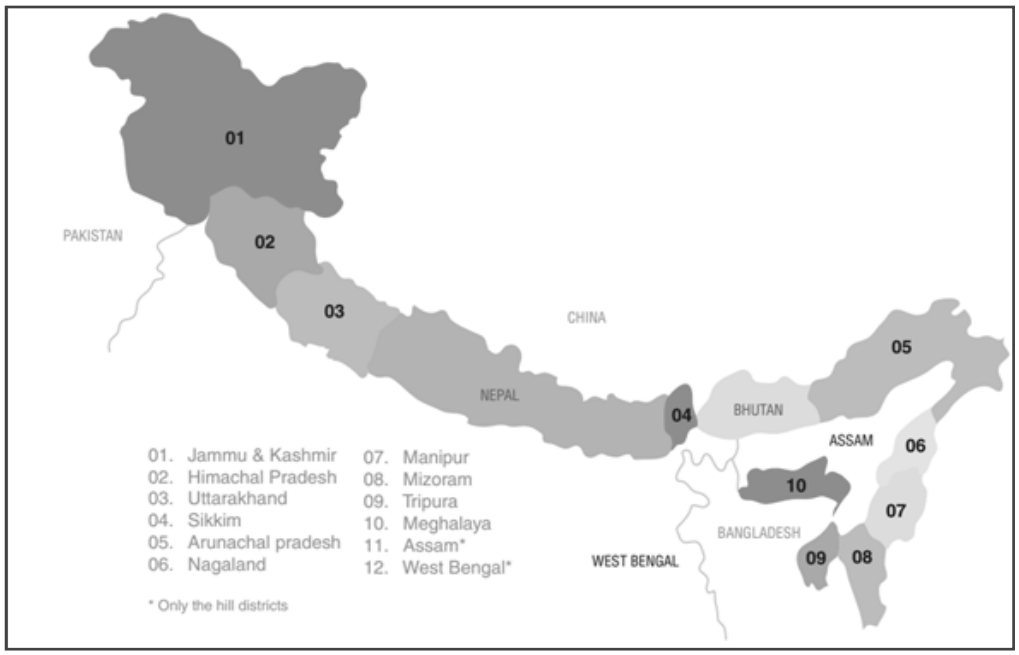
1

HIMALAYAN FARMERS: STATE OF LAND RESOURCES

Indian Himalayan Region

The Indian Himalayan Region (IHR), spanning across 10 Indian states, namely Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, Tripura and hill districts of 2 states viz. Assam (Dima Hasao and Karbi Anglong) and West Bengal (Darjeeling and Kalimpong). The region provides natural water resources to a large part of the Indian subcontinent and contains variety of flora , fauna and agriculture systems.

The IHR, starting from the foothills of south (Siwaliks), extends up to Tibetan plateau on the north (Trans-Himalaya). Three major geographical entities, the Himadri (greater Himalaya), Himachal (lesser Himalaya) and the Siwaliks (outer Himalaya) extends 3500 kms almost uninterrupted throughout its length and are separated by major geological fault lines.



Mighty old rivers like the Indus, Sutlej, Ganga and Yamuna, Kali, Kosi and Brahmaputra have cut through steep gorges to escape into the Great Northern Indian and North-eastern Indian Plains. The northernmost range of mountains are the Karakoram Mountains that continue into Pakistan and China. To the south of the Karakoram Range lies the Zaskar Ranges. Parallel to the Zaskar Ranges lie the Pir Panjal Ranges. These three mountain ranges lie parallel to each other in the north-western part of India, and most of its area lies in the state of Jammu and Kashmir, including its capital Srinagar. Some of the world's highest mountains are found in the region. Many holy rivers like Ganga and Yamuna flow from the Himalayas.

As per the Survey of India records, the Himalayan region is spread over an area little more than 500 thousand sq. kms. This, however, may not be a true picture of the area because there is a large area masked under the elevated terrain. According to a study report (CSKHPK, Palampur 2004) the true area of Himachal Pradesh (using TIN technology) was calculated at 86 thousand sq. kms as against the official figures of 55.6 thousand sq. kms. Going by these figures, official reported area of Himachal Pradesh is just 64% of the actual area. If these figures are extrapolated for whole of the Himalayan region, to have a rough estimate, actual area of Indian Himalaya would be much more. States with more

sloping landscape and mountain terrain, such as Sikkim will certainly benefit from true figures of area much more than, states like Tripura which have more flat land. The actual figures matter considerably in policy making. What if the wild lands i.e. forest area of the Himalayan states is more than what is reported presently? The crop land is based on revenue records so there is little chance of any variations.

Himalayan Demography

Indian Himalayan Region is home to 4.6 crore (46 million) people comprising of a variety of indigenous races, migrants and tribal communities (Table 1.1.) living in seventy three thousand villages and four hundred and ninety six towns. There is as such no major city in the Himalayan region but most state capitals are large towns such as Shimla, Dehradun, Srinagar, Shillong, Gangtok, Aizawl, and Imphal etc. More than 70% population of the ten Himalayan states lives in rural areas but within states there is large variation. For instance, while 90% people in Himachal Pradesh live in villages, in Mizoram, rural and urban population is 50% each.

In Uttarakhand, rural and urban population is at 70:30 ratio. Even while the number of listed towns in 104 districts of the Himalayan region is 496 but with the ongoing urbanization process, several Himalayan villages have grown into many census towns (by definition, where half of the population depends on non-farm activities)

Table1.1.: Indian Himalayan states, area, towns, villages and population

State	Districts	Towns	Villages	Population	Population rural	Population urban	Area sq. km
Arunachal Pradesh	16	27	5589	1387727	10,69765	3,13446	83,743
Nagaland	11	26	1428	19,78502	14,06861	5,73741	16579
Mizoram	8	23	830	10,97206	5,29037	5,61997	21081
Manipur	9	51	2582	27,21756	18,99624	8,22132	22327
Tripura	4	42	875	36,73917	2710051	960981	10486
Meghalaya	7	22	6839	29,66889	23,68971	595036	22,429
Sikkim*	4	9	451	6,10577*	4,55962	1,51726	7,096
Uttarakhand	13	115	16793	1,00,86292	70,25583	30,91969	53483
Himachal	12	57	20690	68,64602	61,67805	6,88704	55673
J&K	22	122	16793	1,25,41302	9134820	3414106	222236
Darjeeling District	1	1	159	18,42034	1123859	718175	3149
Kalimpong District	1	1	51	251642	-	-	1053
Leh District	1	2	60	133487	87816	45671	45110
Kargil District	1	3	67	140802	124464	16338	14086
Zanskar in Kargil	x	-	25 (2327 HH)	13793	13793	0	7000
TOTAL	104	496	73080	46022446	32822573	1319873	519339

*Not available.

Land Resources for Farming

In the context of IHR, land resources for farming are of two types. One, crop land that is private property or community owned and remains under tillage or perennial plantations of fruit trees. It also includes that part of the farm land which farmers keep under permanent fallow to source winter dry fodder for livestock. Two, the other type of land that supports farming based livelihoods is the support land, whose ownership is not with farmers but they use it for animal husbandry.

The dependence on this support land could be absolute or partial, depending on the nature of farming system. Pastoral and agro-pastoral nomadic communities of north-west Himalayas in Ladakh, Kashmir and Sikkim in North east Himalaya, have absolute dependence on the highland range lands – the support lands supporting their livelihoods. Farming culture of shifting cultivation in the north-east Himalayan region is yet another example of support land-based livelihood system, where the support lands are converted into farm lands for certain period and then reverted back to rest and rejuvenate as part of the forests.

Crop land of the Himalaya in valleys and sloping landscapes

The scenario of crop land in the Himalayan states presents a variable scenario of scarcity to adequacy from west to east. In some Himalayan states such as Tripura, crop land has declined from 310 to 277 thousand hectares, over a period of 10 years (2003-04 to 2012-13). In Meghalaya, crop land is declining at -0.04 per cent per annum and in Assam crop land is declining at -0.02 per cent. Only in few Himalayan states crop land area has marginally increased. This increase has been recorded in Manipur where crop land increased from 224 to 316 thousand hectares, with annual compound growth rate (ACGR) of 20.83 per cent. In some other states this increase is below one per cent.

This, however, clarify the reason why crop land area is not showing a declining trend despite the fact that land is increasingly being converted for non-agricultural purposes. There is also no indication of significant decline under land use categories like fallow land, land not available for cultivation and other uncultivated lands. This leads to the conclusion that the augmentation of area under agriculture might have come from the increase in reporting area, leading to present scenario. However, it can be safely assumed that there is not any major change towards conversion of other land use into agriculture within the Himalayan states.

Table-1.2: Land utilization pattern within the Himalayan states ('000 Ha.)

Year	Geographical area	Reporting area	NA for cultiva-tion	Other un-cultivated land	Fallow land	Net area sown	Total cropped area	Crop land
ARUNACHAL PRADESH								
2003-04	8374	5648	64	120	109	201	254	414
2012-13	8374	5661	64	119	107	216	285	424
ACGR	0.00	0.02	0.12	-0.10	-0.15	0.91	1.78	0.22
HIMACHAL PRADESH								
2003-04	5567	4544	1126	1706	73	541	956	804
2012-13	5567	4576	1131	1697	79	543	947	811
ACGR	0.00	0.06	0.04	-0.05	1.07	0.05	-0.08	0.08

Year	Geographical area	Reporting area	NA for cultiva-tion	Other un-cultivated land	Fallow land	Net area sown	Total cropped area	Crop land
JAMMU & KASHMIR								
2003-04	22224	3781	582	339	90	747	1102	1050
2012-13	22224	3781	573	314	126	745	1162	1070
ACGR	0.00	0.00	-0.13	-0.49	18.48	-0.02	0.61	0.18
MANIPUR								
2003-04	2233	1994	27	8	0	217	217	224
2012-13	2233	2086	27	8	0	309	309	316
ACGR	0.00	0.50	0.00	0.00	0.00	22.70	22.70	20.83
MEGHALAYA								
2003-04	2243	2227	215	605	229	227	272	1061
2012-13	2243	2241	239	555	215	285	340	1056
ACGR	0.00	0.06	1.65	-0.54	-0.44	6.99	6.30	-0.04
MIZORAM								
2003-04	2108	2085	134	27	233	98	98	352
2012-13	2108	2094	95	53	244	116	116	408
ACGR	0.00	0.04	-0.95	476.47	0.55	3.66	3.66	2.82
NAGALAND								
2003-04	1658	1583	75	179	160	305	370	645
2012-13	1658	1652	95	164	150	380	489	694
ACGR	0.00	0.47	7.65	-0.55	-0.46	6.24	11.22	0.93
SIKKIM								
2003-04	710	688	6	12	8	78	121	98
2012-13	710	693	11	11	9	77	144	98
ACGR	0.00	0.06	174.19	-0.51	3.53	-0.07	3.71	0.00
TRIPURA								
2003-04	1049	1049	133	26	4	280	283	310
2012-13	1049	1049	141	20	4	256	368	277
ACGR	0.00	0.00	0.63	-0.92	0.87	-0.56	9.61	-0.63
UTTARAKHAND								
2003-04	5348	5668	463	866	114	761	1222	1511
2012-13	5348	5673	449	897	136	706	1124	1547
ACGR	0.00	0.01	-0.24	0.37	4.08	-0.49	-0.53	0.23

Source: Compiled by the project team.

The challenge of shrinking land holdings of the Himalayan farmers

Despite the fact that there is almost constant availability of agricultural land at aggregate level, its supply for individual farming households has declined in a very significant manner, during the past few decades. In the north west Himalayan states, the average holding size of agricultural land has witnessed a continuous declining trend over the decades. Consequently, the small and marginal holdings of less than 2 hectare account for 85 percent of the total operational holdings and 44 percent of the total operated area. The average size of holdings for the Himalayan farmers has declined over the years and for all classes and put together, it has come down to 1.16 hectare in 2010-11 from 2.82 hectare in 1970-71 (Agriculture Census, 2010-11). Between north west Himalayan states and north east Himalayan states, land holding size has reached a stage where traditional food grains based mixed farming has become non-viable both for food and income security of majority of farmers in Jammu and Kashmir, Himachal Pradesh and Uttarakhand. As an example of skewed land holdings, data shown in Table 1.2 indicates a scenario of shrinking crop lands of the farmers of Jammu and Kashmir. Land holdings of farming families in Himachal Pradesh are also within the same range as in Jammu and Kashmir.

However, availability of crop land in north east Himalayan region states is largely better than north west Himalayan states. It has only few states including Tripura where crop land holding are skewed. By Indian standards, two Himalayan states, Arunachal Pradesh and Nagaland, have abundant crop land. As a matter of policy, land records of Arunachal Pradesh indicate that crop land in use is much less than the potential crop land area of the state. Agriculture and horticulture departments maintain their strategic plans for expansion of crop land in the state, under their mandated crops. Indication of abundance of crop land is reflected in the fact that revenue department at district level has provision of granting crop land access at minimal costs to bona fide families of Arunachal Pradesh. From another angle, Arunachal Pradesh appears to be a promising state for providing access to adequate land resources to farmers for setting up their agri-enterprises. In Nagaland, local Nagas have opportunities of access to adequate land resources for developing agro-enterprises. There are local Naga farmers in villages who have private ownership of very large land areas, in rare cases up to 3000 acres.

There are large number of shifting cultivators in the same villages owning no private land holdings. Data presented in Table 1.2 indicates that there are 23% farmers in Nagaland with large land holdings, that may also be indicative of the fact that land is already distributed among people.

However, in case of Arunachal Pradesh, there are only 4% large farmers, as against the large part of potential crop land area not yet being used. This invariably means that crop land scarcity is not an issue and that potential exists for increasing percentage of large farmers or for agri-enterprise farmers type modern farmers with large farm areas.

Table 1.3: Operational Holdings, categories, numbers and size, in North Eastern States, 1990-91 in %.

States	Marginal (Below 1 ha)	Small (1-2 ha)	Semi-medium (2-4 ha)	Medium (4-10 ha)	Large (10 ha and above)	Average size of holding (ha)
Arunachal Pradesh	17.89	18.95	31.58	27.37	4.21	3.62
Himachal Pradesh	35.75	42.25	15.40	5.25	1.35	1.12
Manipur	48.59	34.51	14.79	2.11	0.00	1.24
Meghalaya	36.65	26.09	28.57	8.07	0.62	1.81
Mizoram	46.77	37.10	14.52	1.61	0.00	1.34
Nagaland	9.29	15.00	18.57	33.57	23.57	6.92
Tripura	68.24	21.70	8.81	1.26	0.00	0.97
Jammu Kashmir	52.75	32.25	9.45	3.25	1.25	0.62
Uttarakhand					-	

Source : NEDFi. 2003. NEDFi Data Bank Quarterly 2 (1), Sumi Krishnan Ed. P 144, and State Statistical Data Handbooks of Himachal Pradesh, Jammu and Kashmir, and Uttarakhand

The state wide analysis indicates that out of ten Himalayan states, average land holding size has declined in seven states (Table-1.3). Within a period of about 15 years, the average land holding size in Tripura declined by as high as 45 per cent followed by about 19 per cent decline in Jammu & Kashmir and by about 15 per cent in Himachal Pradesh. Among the states witnessing the increase in average holding size is Nagaland where it increased by about 25 per cent. In Arunachal Pradesh and Meghalaya, access to crop land size increased by about 6 and 3 per cent respectively. The emerging trend is unique in the sense that despite the increase in the area of agricultural land across the Himalayan states, its availability to individual farmers is steadily declining, thus making traditional family farming uneconomical. The situation is more serious for small and marginal Himalayan farmers, who own tiny, fragmented rain-fed crop land holdings.

For many Himalayan farmers of north western states – Jammu & Kashmir, Himachal Pradesh and Uttarakhand, the scale of fragmented land holdings is a more significant concern than the land holding size.

It is clear that not only population is increasing but with an increasing trend of breaking up of joint family systems into nuclear families, the number of farming households is increasing, whereas the land available is fixed. Division of family land holdings continues to reduce the size of land holdings. The direct consequence of declining access to crop land resources is small farms and non-viable farming. As an example, Table 1.4 shows indebtedness of farmers in Jammu & Kashmir, resulting from small land holdings based, non-viable farming economy. Farmers do not have enough crop land to grow enough crops to meet the food and income needs of the families for a sustainable living on farm.

Table 1.4. Indebtedness among farmers (as on 2015-16) mainly due to non-viable farming

S.no.	Districts	Particulars			
		Number of agri. loan accounts (No.)	Total amount Outstanding in agri loan . (Rs thousand)	Total loan amount outstanding (Rs thousand)	Percentage of agri. Loans
1	Anantnag	29770	4899274	16956370	28.89
2	Kulgam	20664	3686394	6146281	59.98
3	Pulwama	24024	5052676	13195330	38.29
4	Shopian	212220	6198732	7759888	79.88
5	Srinagar	5473	1673209	83843988	2.00
6	Ganderbal	12074	1035076	5299857	19.53
7	Budgam	19174	3195359	12000830	26.63
8	Baramulla	46707	10199957	22389303	45.56
9	Bandipora	10166	1555620	4827584	32.22
10	Kupwara	24153	3364630	9279907	36.26
11	Leh	5940	488390	3926883	12.44
12	Kargil	5098	358524	2184164	16.41
13	Jammu	29965	4237233	73240049	5.79
14	Samba	6239	586834	11009135	5.33
15	Udhampur	14838	903083	7719385	11.70
16	Reasi	6850	400495	3795235	10.55
17	Doda	8590	704600	3599591	19.57
18	Kishtwar	5701	610472	2038400	29.95
19	Ramban	9110	630238	2268051	27.79
20	Kathua	18380	1563539	13192813	11.85
21	Rajouri	17023	1141201	5777315	19.75
22	Poonch	6714	409624	3197648	12.81
23	J&K State	538873	52895160	313648007	16.86

Even though the issue of shrinking crop lands is so widespread and common and non-viable farming due to this is so well known, no state government has as yet put in place any strategy that would help contain the situation. Some of the Himalayan states face severe danger of non-viable farming on small land holdings that continue to shrink further, as manifested in the form of abandoned farms, farmers out migration, ghost villages and their afforested crop lands.

The situation analysis of shrinking and fragmented crop land holdings may not look as much alarming, but the fact remains that average holding size is dwindling continuously, pushing farmers out of farming and looking for non-farming livelihood avenues elsewhere. Farmers often complain that, " If the small farmland was a one piece we could do something, but it is a wishful thinking now to think of continuing farming". There is a shift from farming to non-farming vocations by the members of farming households or out migration of farming families. Educated, new generation holds declining profitability of family farms responsible for abandoning farming and migration to urban areas, absentee land lordship, etc. The second factor appears to dominate the process of increasing ghost villages of Uttarakhand mountains.

The conclusion we can draw at the moment is that the Himalayan agriculture may not be shrinking in terms of total crop land area in the state/ region, but it definitely is shrinking in terms of land availability to individual farming family, and becoming non-viable for farming due to fragmentation across the Himalayan states, barring a few North Eastern states. This has serious implications for envisioning a strategy for sustainable livelihoods on family farms in the Himalayas

Table-1.5: Average holding size (No. of holdings in number and area in hectares)

Unit	2010-11		% Change in 2 decades (1991-92 to 2010-11)		Average Land holding (in hectares)		
Himalayan State	Farming households	Crop land in hectares	Farming households	Crop land in hectares	1995-96	2010-11	% Change
Arunachal Pradesh	109298	383872	5.73	11.68	3.33	3.51	5.63
Himachal Pradesh	960765	954651	11.84	-4.50	1.16	0.99	-14.61
Jammu & Kashmir	1449397	895361	13.16	-8.64	0.77	0.62	-19.26
Manipur	145115	167130	1.65	-3.93	1.22	1.15	-5.49
Meghalaya	209561	287258	30.70	35.00	1.33	1.37	3.30
Mizoram	91880	104789	39.38	23.28	1.29	1.14	-11.55
Nagaland	178411	1074228	19.60	49.29	4.82	6.02	24.82
Sikkim	74928	106683	69.35	46.37	1.65	1.42	-13.57
Tripura	578479	284945	187.75	57.24	0.90	0.49	-45.36
Uttarakhand	912650	815684	NA	NA	NA	NA	NA

Source: Agricultural Census 2010-11, Department of Agriculture and Cooperation, GoI, New Delhi.

CHAPTER

2

HIMALAYAN FARMERS AND FARMING: MACRO VIEW

Traditionally, the cereal crops have been integral to mixed mountain farming systems of the Himalayan region. But cereals alone offered little hope for bringing farmers out of poverty. New cropping systems have been and are emerging, with fruit and vegetables finding an important place in the cropping pattern of Himalayan agriculture. The contributing factors for emergence of such cropping pattern are that these crops can be grown quickly (vegetables) and give sustained income for quite a long periods (fruits). Additionally, these have good yields generating higher income as compared with traditional field crops. Vegetable crops are more suited for production on small land holdings as these are highly capital and labour intensive, which become limiting factors for its large scale adoption by a single farmer.

Cash crops are generating significantly higher employment and helping in diversifying farm income. Farmers are developing management and leadership skills for growing these new cash crops, and the new trend is creating service industries that can help the entire community. One of the most important contributions of cash crops, from ecological point of view, is its contribution in diversity. At present about 175 different types of vegetables are grown across the Himalayan states. This fact is normally undermined because of perception of the need for conserving native agro-biodiversity. The particular suitability of hills and mountains for horticulture have resulted in shifting of cropping patterns from agriculture to fruit crops in the past few decades. As an example, in Himachal Pradesh the area under fruits, which was 792 hectares in 1950-51 with total production of 1200 tones increased to 224352 hectares during 2014-15. The total fruit production in 2014-15 was 7.52 lakh tones, which during 2015- 16 further increased to 9.29 lakh tones. In Jammu & Kashmir, particularly in Kashmir valley, similarly there has been tenfold increase in the area that was brought under fruits (one million hectares) during the past one and a half decade. This progress made in diversifying the cropping pattern towards horticultural cash crops is also reflected in its contribution to the state gross domestic product which increased from 3490 crore Indian rupees to 6344 crore Indian rupees during the period 2011-12 to 2015-16, whereas during this period the contribution of agriculture declined from 3244 crore Indian rupees to 3110 crore Indian rupees and that of animal husbandry increased from 1153 crore Indian rupees to 1301 crores Indian rupees. More importantly, the contribution of horticulture in primary sector increased from 29.30 to 38.74 per cent during this period.

These facts clearly demonstrate that a process of change has been set in motion in the Himalayan states, which appears irreversible, motivating the farmers to divert the cultivated lands for cultivation of commercial crops. Even though there is wide variation among states in the scale of diversification, Jammu & Kashmir and Himachal are the leading states so far and some of the north eastern states, namely Arunachal Pradesh, Sikkim and Nagaland are making serious efforts. The rate of diversion of crop land from food grains to cash crops has been going on for the past few decades now and is increasing every year. In this process, farmers have been able to harness the local niches, provided by the agro-climatic and socio-economic conditions, to a larger extent. The process has been so popular that even marginal lands are being put to productive uses; especially for orchard raising. Many economists are apprehensive of using marginal lands as the cost of cultivation goes up with resultant declining profits. But studies of comparative economics of field crops vis-a-vis cash crops

clearly find that cash cropping is significantly more profitable than food crops. The process of shift in cropping pattern to cash crops, therefore, appears to have pushed food grains farming in the Himalayas to lesser degree and future trends indicate dominance of wide varieties of cash cropping, vegetable, fruits, floriculture, medicinal and aromatic plants, across the Himalayan states.

As a consequence of small and fragmented land holdings, low input use and a variety of other factors, unemployment and underemployment are key characteristic features of Himalayan agriculture today. This disadvantage is taken care of to a great extent by labour intensive nature of cash crops cultivation. But its capital intensive nature also puts it to some disadvantage as at times it limits the scope of its large scale adoption, especially by marginal and small farmers. This shortcoming is now understood and instances are thereby taken care of by a strong network of financial institutions in the states. The technological bottlenecks are being looked after, inadequately and/or adequately, by line agencies mandated for agriculture and horticulture development.

North East Himalayan Region

The situation in the North Eastern Himalayan region is entirely different with two distinct types of agricultural scenarios, Shifting cultivation (Jhum) and Settled or plains agriculture in the valley areas. As a large part of the region is hilly, inhabited by clans of different tribal groups, shifting cultivation is a subsistence agriculture system practiced by the tribals. Shifting cultivation is prevalent in hilly red soils and laterite soils of all districts of Arunachal Pradesh, hill region of southern Assam, mountain areas of Tripura, Mizoram, Nagaland and Zo hill regions (Kuki/Zomi) and Naga hill regions of Manipur (Table 2.1). On the other hand, the plain or settled agriculture is a practice in fertile alluvial plains of Assam, plain areas of south eastern Nagaland, Brahmaputra plain in southern Arunachal Pradesh, Barak Valley and some plain areas of Tripura and the central Imphal Valley of Manipur. It has been estimated that 19.91 lakh hectares (83.73%) of the land in the region is under shifting cultivation. The cropping pattern of North East Himalayan region is not similar to rest of the country. About 70% of the area is a hilly, with crop combinations comprising mostly of multiple systems of rice, maize, wheat, and oilseeds which are the main crops in fertile alluvial plains of the whole areas of the Brahmaputra Valley of Assam, southern parts of Tripura, Imphal valley of Manipur and Barak valley. The practice of shifting cultivation, is however declining every decade (Reimeingam 2017)

Table 2.1: Shifting Cultivation in the NER

States	Annual area under shifting cultivation (sq km)	Fallow period (y)	Minimum area under shifting cultivation one time or other (sq km)	No. of families practicing shifting cultivation
Arunachal Pradesh	700	3-10	2,100	54,000
Assam	696	2-10	1,392	58,000
Manipur	900	4-7	3,600	70,000
Meghalaya	530	5-7	2,650	52290
Mizoram	630	3-4	1,890	50,000
Nagaland	190	5-8	1,913	116,046
Tripura	223	5-9	1,115	43,000
All NE	3,869		14,660	443,336

Source: Basic statistics of North East Region, 2006, North East Council.

The outcome is that the area under shifting cultivation declined from 2.69 to 1.00 per cent of total geographical area and from 2.99 to 1.35 per cent of hill area during the period 1974 to 2008-09 and the process continues. It is estimated that by 2017-2018, it will have drastically gone down (Field survey findings, will be discussed later, separately). The overall decline in area under shifting cultivation across the North East region, coupled with escalating number of farming families practicing has actually resulted in steep decline in shifting cultivation land holding of the families' area with each family reducing from 1.20 ha to only 0.28 ha in the year 2006. This trend of declining availability of crop land per family for shifting cultivation appears to be becoming a norm across the North East Himalayan states. As a result, swidden farmers are also willingly opting for a transition to perennial commercial crops on their swidden land holdings.

Traditional six crop combination popular in shifting cultivation are: Rice + Maize, Rice + Maize+ Oil seeds+ Pulses; Rice+ Maize+ potato, Rice+ Maize+ Potato+ Vegetables; Rice+ Maize+ Pulses and Rice+ Potato+ Vegetables (Seintinthan Lh, 2014).

Vegetables and fruits, valuable timber trees farming, etc. have already made inroads into these shifting cultivation areas and there is a possibility of farmers moving towards cash crops on larger scale, leading to a significant reduction in swidden farming in North East Himalaya.

Table 2.2: Horticultural Crops identified for promoting horticulture and vegetable farming in the North East Himalayan States

States	Fruit	Vegetables	Spices	Plantation crops
Arunachal Pradesh	Citrus, apple, walnut, banana, pear, plum, kiwi	Pea, beans, colocassia	Ginger, large cardamom, turmeric, chilli	
Assam	Banana, citrus, pineapple, jackfruit, guava, papaya	Potato, cabbage, sweet potato, brinjal, onion, cauliflower	Chilli, ginger, turmeric, black pepper	Areca nut, cashew nut, coconut
Manipur	Pineapple, citrus, banana, passion fruit, apple	Tomato, cabbage, cauliflower, beans, cucurbits, pumpkins	Chilli, ginger, turmeric	
Meghalaya	Pineapple, citrus, banana	Potato, cabbage, cauliflower, radish, french bean, tomato, capsicum	Ginger, turmeric	Areca nut
Mizoram	Citrus, banana, passion fruit	Chow-chow, cabbage, pumpkin, brinjal, beans	Ginger, turmeric, chilli	Areca nut
Nagaland	Pineapple, apple banana, citrus, passion fruit	Colocasia, chow-chow, tapioca, potato, pea	Garlic, Naga chilli, ginger	
Sikkim	Citrus, kiwi, apple	Cabbage, french bean,YACON chow-chow	Large cardamom, chilli	
Tripura	Citrus, pineapple, banana, jackfruit, mango, litchi	Potato, brinjal, sweet potato, beans, tomato	Chilli, ginger, black pepper	Areca nut, coconut, cashew nut

Source: Yadav et al (2003)

Benefitting from the shift from traditional cropping pattern to the one having significant representation of commercial crops, be it field or plantation crops, is also leading to increasing cropping intensity. Those moving to fruit orchards are not only experimenting with inter-cropping in the orchards with vegetables, but at many places this has become a normal practice. The idea of inter-cropping in the orchards started with taking fodder crops as inter-crops.

The single largest casualty of transformation of agriculture from subsistence to cash economy is the almost complete elimination of traditional indigenous crops from the present cropping patterns in several areas of Himachal Pradesh and Kashmir valley. Such crops were environmentally well adapted and possessed nutritional values of the kind that helped contain malnutrition among local population.

Changing landscape of mountain crops

As a result of rapid changes in land use, during the past few decades, caused by socio-cultural and economic changes and ecological factors, the agro-biodiversity of the Central Himalayan agro-ecosystems has changed drastically (Maikhuri et al, 2001). Maikhuri et al. survey findings of 150 villages in Alaknanda river catchment area in Central Himalaya revealed that over a period of two decades (1970–74 and 1990–94) the cultivated area under many traditional crops has declined significantly. The main reasons listed for this state of affairs are introduction of high yielding varieties of cereals and vegetables.

The trend of change favouring specialization is also visible in animal husbandry sector with more and more farmers opting for cross-bred cows in smaller numbers instead of indigenous cows in larger numbers. There are two factors behind this switch over. First, the milk yields of cross bred is far higher with higher input-output ratio, making it more remunerative. Secondly, these are reared on stall feeding and don't have to be taken out for grazing, taking care of labour scarcity for such operations. This is true for larger sizes farms and/or smaller family size. Public perception is that the culture of cross-bred cows has been a contributing factor for abandoning the aged cows on the roads. The practice is so prevalent that abandoned cattle on road sides have now become a major problem for people and governments in Jammu & Kashmir, Himachal Pradesh and Uttarakhand.

Farm mechanization and continuing scarcity of fodder and grazing areas have been responsible for elimination of bullocks from hill farms. This trend is clearly visible with the number of cross-bred cows increasing from 515964 to 825266 and that of indigenous cows declining from 755439 to 595370 and near total elimination of bullocks from farming operations in many areas of the Himalayan states.

Climate change influences on Himalayan farming

The impact of increasing temperatures is now being felt in the form of difficulties about continuing farming certain temperate fruit crops. Apple is one such fruit crop. Apple trees require a certain minimum chilling period for good flowering and fruiting. Chilling requirement has made it difficult to grow good crops of quality apples in lower elevations. Farmers of these areas, therefore, have already shifted or are opting to shift to other fruit crops such as peach, apricot and plum and now pomegranate and persimmons. The higher temperatures in the apple valleys are also increasing the incidence of diseases, insects and pests. Same consequences are seen as a result of a change in rainfall patterns. Unpredictable rainfall pattern is depriving the orchards of good moisture needs, resulting in poor fruit setting. Timely rainfall is particularly important for rain-fed agriculture at low heights where the soil does not retain moisture.

Warmer and drier local weather and erratic rainfall pattern, widely experienced over the past one decade, is perceived to have affected the irrigation water availability in two ways. Due to global warming, the glaciers are melting at increasing rates and this has disturbed the pattern of water availability in rivers and streams, etc. which are important sources of irrigation. This combined with erratic rainfall having very high run-off and low water absorption by soil,

recharging ground water is becoming insufficient. Depleting ground water resource and low moisture content in soil is affecting mountain agriculture in a significant manner.

Transforming Himalayan Farm Economy

Himalayan agriculture is characterized by small and fragmented holdings. For making agriculture profitable on the marginal and small hill farms, intensive agriculture holds the key for them. Farmers are making more rigorous use of land by way of mixed cropping and intercropping etc. Various studies conducted at Agro Economic Research Centre, H.P. University, Shimla, in the early 2000, clearly highlight this fact. In some vegetable growing areas of hilly districts of Himachal Pradesh, the cropping intensity has already passed 200 per cent (e.g. Solan). Simultaneously, the traditional field crops involving cereals and pulses are being increasingly substituted by commercial crops of vegetables, flowers and medicinal herbs, etc. Commercialization of Himalayan agriculture has increased the farmers' dependence on external inputs, be it seeds, fertilizers, labour and mechanization. Labour has emerged one of the most important inputs, accounting for about half of the total variable cost of cultivation. As a result, seasonal as well as permanent (few years) in-migration of migrant labourers is there and it is increasingly being used not only by the medium and large farmers, but also by the small farmers. The market orientation of farming has tremendously increased the farmers' interface with market functions.

Hence, the farmer has to be conversant with marketing methods in addition to production technologies. Decisions pertaining to choice of market, timing of sale, quantities to be marketed are equally important to what to produce, how much to produce and how to produce. Commercial farmers are now coming out of the traditional image of subsistence farmers. They rely more on media sources for price and market information. The New Age farmers are also conversant with the application of online marketing, specially used for the flowers and vegetables. Cash transaction is also changing to online banking options. In Jammu & Kashmir and Himachal Pradesh, most sale proceeds are transferred online to bank accounts of farmers. Mahog village floriculture farmers (small farmers) of Solan district in Himachal Pradesh also do so for their flower marketing with the sale proceeds being credited directly to the bank accounts. Use of ATMs and internet banking to transfer funds are common among farmers.

Even though the trend of commercialization in the Himalayan states may have begun decades ago but it is yet to spread to all types of the farming systems. The reasons are not difficult to pinpoint. Capital and labour requirements are not easy to meet with, technology involving high yielding varieties and modern cultural and cultivation practices has not yet percolated to all areas and to entire farming communities. Socio-political environment is not conducive in some states or part thereof. These reasons have led to wide variations in respect of commercialization of agriculture in different states. Small farmers in states like Uttarakhand and North East are still tied with growing traditional subsistence food crops. These crops are incapable of generating required amount of cash income. As a result, households have to look for options to supplement the income needs of the family. For that, male members of farming families or even entire families are migrating to low lands or urban areas. This is considered as one of the causes of migration from the hills of Uttarakhand leading to over 1700 plus ghost villages as the last count in 2018.

The scenario is just opposite in the apple and vegetable valleys and mountain landscapes of Himachal Pradesh. There is large scale in-migration of labour, seasonal and permanent, and even if some members in a family migrate because of education and employment, they continue to maintain their homes, farms and keep investing major part of their non-farm incomes on maintaining/improving/diversifying farming. It is resulting in higher capital formation putting them in good stead for adoption of modern farm technology, diversification of farm activities and reducing the risk involved in farm production which is magnified while operating under un-irrigated conditions. Farmers of Himachal Pradesh, facilitated by higher income, are now spending much more as compared to other Himalayan states, as demonstrated by the findings of 68th Round-Consumer Expenditure Report of NSS. Average Monthly Per Capita Consumer Expenditure (Rural) reported Rs 1782 for Arunachal Pradesh, Rs 1219 for Assam but for Himachal Pradesh it was Rs 2034 . The farmers of Jammu & Kashmir were spending Rs 1743 , Manipur Rs 1502, Meghalaya Rs 1475, Mizoram Rs 1644, Nagaland Rs 2029, Sikkim Rs 1565, Tripura Rs 1334 and Uttarakhand Rs 1726. The all India average stood at Rs 1430. It indicates that farmers of the Himalayan states are better off economically and that among them Himachal farmers excel in economic well-being.

From the above scenario, a conclusion can be drawn that economic factors are leading the change in the farm economy of Himalayan states. There are conspicuous changes in cropping pattern and cropping intensity promoting the farmers to higher income brackets and monthly per capita expenditure.

State of diversity within Farming Systems

Farmers with commercial/market-oriented farming systems (based on vegetables or fruits), grow fewer crops (i.e. crop diversity is lower) and devote lesser area to mixed crops compared to the traditional farming system. Mixed crops account for 66% of the total cropped area in traditional type farms while no area is devoted to mixed crops in commercial farms. (Jagdish P. Bhati and Wolfgang-Peter Zingel, 1997)

Many traditional crop varieties are dropped from cultivation, wherever HYV of food crops grown or cash cropping is adopted thus, it prompts growing a limited number of high yielding varieties. The loss of native crops and their land races/varieties, although less widespread than the loss of wild species, presents a more severe situation. Not only is crop species and genetic diversity declining on hill farms, but in areas that are home to the wild relatives of native food crops, are on way to extinction. Domesticated varieties are also under threat as a result of the homogenization caused by demand for uniform varieties. This may have scientific implications for crop breeders who need a pool of crop genes in order to breed new varieties for disease and pest resistance. The fact that hill farming dominated by commercial crops is on the rise, both area and production wise, with a significant drop in local crops area and production. Apple growers, vegetable growers and floriculturists in Himachal Pradesh have almost stopped growing anything else than few target crops for the market.

On the flip side, commercial farming of few new crops is not only resulting in the loss of agro-biodiversity but the diversity in subsidiary occupations adopted by farmers for augmenting their farm incomes by utilizing the time available during the lean crop seasons. This is because the crop production under

commercial farming is eating into most of the farmers' time. Village artisans are finding it very difficult to sell their produce under competition from cheap and commercially produced industrial alternatives. As a result, traditional skills are being lost, incomes are declining and unemployment among such skilled categories is rising.

Emerging Hill Farming Culture

There is farmers' adaptation process involved in developing market savvy farming. It is initiated by innovators or 'early adopters' and these are the farmers who benefit most from market adjustments. Farmers continuously receive signals from consumers in the form of aggregate demand patterns and then they make short and long term adjustments in the cropping patterns as per market signals.

Transformation process has helped in emergence of new breed of farmers known as New Age farmers who are often educated and becoming role model for majority of other farmers who form 'late adopters and laggards' category. The New Age farmers come to limelight through two processes: either by adopting new mountain niche crops with large market potential or crops developed by their own ingenuity and are highly beneficial under local conditions. The examples of farmers are not difficult to find. One such farmer from Kullu district in Himachal Pradesh, for example, received the 'Most Innovative Farmer Award' (Navonmeshi Kisan) in the year 2018 MOA-GOI, for being pioneer farmer in cultivating pomegranate in Kullu valley of Himachal Pradesh. Today, pomegranate has taken over the area vacated by apples in the lower valley areas, due to climate change impact. There are many other such farmers in all the Himalayan states who have relentlessly worked for the development of farming and farmers through their innovations and extension services. Many of such New Age farmers are working in the field of organic farming, not only in Sikkim but in Ladakh, Kashmir, Jammu, Himachal Pradesh, Uttarakhand hill districts, and across other north eastern states.

To sum up scenario of transformation process of hill farming, it is clear that food grains farming as an integral part of mixed hill/ mountain farming systems culture is fast declining. It is giving way either to cash cropping or farmers are simply abandoning farming for non-farm alternatives. Cash cropping of fruits and vegetables by the hill farmers have improved their economy and well-being and risk bearing capacity, but not all Himalayan states are on the same page about this shift to commercial farming. Farmers of some states have moved faster and wider while in others process is weak, slower and limited. Structure of livestock, like hill crops has changed or is changing too. Traditional approaches of commercialization of hill farming have improved economic well-being but it has made a dent on traditional resource base and resulted in shrinking native agro-biodiversity. This is a result of the missing mountain perspective dimension in our R&D strategies supporting the transformation. The hill farming transformation process is based on imported knowledge and materials, undermining the potential value of mountain/ hill niches and their resource base. It is the result of lack of mountain perspective thinking and perspectives in R&D strategies because of weak institutions and expertise.

CHAPTER

3

HIMALAYAN FARMERS LIVELIHOODS AND FARM ECONOMY: A GROUND REPORT

Process of the field study

A Himalayan state-wide field study was carried out to understand the state of affairs of the hill farmers livelihood and farm economy by gathering micro level evidence on food security, income security, and diets of farming families through PRA (Participatory Rural Appraisal), focused group discussions and household surveys. The Himalayan farmers manage their farming based livelihood under different kinds of farming systems and today most prevalent farming systems of the Himalayan region are listed below along with their representative villages selected in different Himalayan states:

1. Subsistent rainfed crop livestock mixed farming system *(a representative tribal village in Kashmir)*
2. Apple growers livelihoods and economy *(a representative village in Kashmir valley)*
3. Fruit and vegetable commercial farming systems of small hill farmers *(a representative village in Kullu valley of Himachal Pradesh)*
4. Subsistent crop livestock rainfed mixed farming threatened by wild animal menace *(a representative village in hill district of Almora in Uttarakhand)*
5. Swidden/slash and burn farming culture of North East Himalaya *(a representative village in Nagaland, North East Himalayan region)*
6. Pastoral & Agro-pastoral systems of the Himalayan Nomads *(a representative village in the highlands of Ladakh)*

1. Subsistent rainfed crop livestock mixed farming system (Sumlar tribal village in Kashmir)

   The village is upstream at 2500m altitude and is surrounded by forests on three sides. Local people have easy access to mountain forests for grazing, fodder, wild produce, fuel wood and timber but it is also prone to wild animals from nearby forest, largely packs of bears. The village is accessible by road, has a school and a dispensary. Normally a nomadic tribe, the settled Gujjar community of the village is in transition from subsistence farming based livelihoods to partial dependence on farming and making efforts for off-farm income through labour services. The village gets a regular mini bus service. The idea of selecting this village was to take a sample case of subsistence communities in transition from pure farming based livelihoods to divided dependence on-farm and off-farm options.

2. Apple growers livelihood and economy (a representative village in Kashmir valley)

   It is a large village in the valley at around 2000m altitude, has flat terraced fields of rice converted into orchards, both old and new. Apparently a prosperous village, it has many good houses of cement and wood, some expensive buildings. The village is accessible by road and has regular public transport access to district headquarters in Bandipora. The village was selected as case study for understanding livelihood and economy of the fruit growers of the Himalayan states.

3. Fruit and vegetable commercial farming systems of small hill farmers (a representative village in Kullu valley of Himachal Pradesh)

   A village on a hilly slope, Preyee in Manikaran valley is 20 kms away from Kullu. It was a subsistent mixed farming area until a decade ago. Few villagers had apples, pears and plum orchards while the rest were growing food grains such as maize, wheat, barley, paddy rice, pulses, oil seeds or any crop necessary to maintain food self-sufficiency. The village notably was self-sufficient in food but had few sources of income. Few families have someone in government service and therefore thrust on education of children is there. A decade later it is a transformed village, covered by cash crops, vegetables and fruits. It is therefore, selected as an example case of transforming rain fed farming in the hills through fruits and vegetables cultivation.

4. Subsistent crop livestock raised mixed farming threatened by wild animal menace (a representative village in hill district of Almora in Uttrakhand)

   A village on sloping dry hills, Jun-kafoon, is about 40 kms from Almora town. In between the two parts of the village, Jun on the top and Kafoon at the bottom are rainfed terraced fields of the village. It had once a vibrant food self-sufficient farming economy. Fields were fully covered with rainfed crops, namely finger millet, barn yard millet, black soy bean other pulses, somewhere maize and few fields of paddy rice at the bottom, vegetables like pea, pea nuts, potatoes, onions, garlic, green leafy vegetables. However, now it gives somewhat deserted look with sparsely cultivated fields with millets, finger millet and barn yard millet, and some pulses. The village has potential for irrigating large part of crop land from a lift irrigation and household water harvesting structures, but there is little interest.

   Many farmers complained about serious problem of wild animals in the villages. Wild animals, namely monkeys, wild boars and bears destroy the crops before they mature and farmers end up harvesting nothing. Frustration and fear of crop destruction before harvest has distracted farmers away from productive farming and in search of alternative livelihood options such as rearing buffaloes for milk, labour work in nearby towns, and search for options to migrate. Some of the village households pool the milk production daily and supply to the town. Finding it difficult, some other households have migrated and still others are staying put and manage livelihoods in whatever way they can. Misery and lethargy are visible in the social environment of the village.

5. Swidden/slash and burn farming culture of North East Himalaya (a representative village in Nagaland, North East Himalayan region)

   The village, Mavalong, is a sample case of life in any shifting cultivation area of North East Himalayan states. Here some land owners, with settled agriculture living in harmony with households practicing shifting cultivation and there are some other land less farmers living only on farm labour. A mix of livelihoods depending on cash cropping, subsistent shifting cultivation and purely farm labour, this village setting is a microcosm of farming conditions of the north eastern region. From a rich household to poor subsistent to food insecure vulnerable land less households, all of them comprise a complex village life, where one is dependent on the other.

6. Pastoral & Agro-pastoral systems of the Himalayan Nomads (the temporary settlements of nomads in the highlands of Changthang, Ladakh)

   Livelihood of nomadic Changpas represent little or no cropping and largely pashmina goat herding based livelihoods in the cold arid highlands of Ladakh. There is no farming of food grains, pulses, oil seeds. Only few members of some of the farming families are engaged in limited farming activities, namely of local pea for fodder, some naked barley and recently introduced protected cultivation of some vegetables. Nomads in the highlands depend on food supplies of PDS system and local shops, far away in village settlements.

Focused group discussions and household surveys in the representative villages

The focused group discussion and household surveys captured information on socio-economic changes that were taking place and the livelihoods, such as state of food security and variety of food and nutrition, income security and scale of vulnerability of food and nutrition conditions and the state of agro-biodiversity in the village. For primary data sourcing, structured questionnaires were designed for both village level focused group discussions and for household surveys.

In each village information was gathered in two ways:

- Focused group discussions: Using a list of questions about the state of affairs of food security, income security, nutrition security and the state of agro-biodiversity. For focused group discussions, villagers were invited to the meetings held within the villages at a common convenient point. In a participatory rural appraisal (PRA) format, after raising a point/issue, discussion was held to arrive at a consensus on quantitative value of an item or the range values. Any differences which cropped up were further analysed to record difference in circumstances. Consensus, majority view point as well as important minority views or observations of villagers were recorded.
- Household surveys: Following focused group discussions, households of the village were selected randomly for home visits to undertake household survey. The information asked was as per the questionnaire and answers were recorded. Both men and women members of the household were requested to stay together for sharing information.

The findings of the surveys are of two types. One, what people revealed during village level focused group discussions about various issues. Two, in a structured survey what each household reported on a variety of issues relating to cropping, income, food security, diet, managing livelihoods, food vulnerability, about crop biodiversity, lost crops, new crops and about their future perspective on farming. The secondary information gathered about nutrition value of the Himalayan food items and about the diversity of crop resources was also compiled to understand the potential value of Himalayan agro-biodiversity for agriculture, nutrition and cash economy.

Findings of the field study

The household survey findings on various aspects of socio-economic conditions of households in the sample villages, are presented from Table 3.1 to 3.4. The observations on the data in these tables and figures are as below:

Subsistent rainfed mixed farming system of villagers of Sumlar

Characteristic features of the sample villages are presented in this Table 3.2. Farming communities of the Indian Himalayas are mostly maintaining a family size of 6-8 persons per family. Poverty and conservative family values have been prevailing in this village of Gujjar community. They have large families with an average of 10 family members. The sample villages were accessible by road. The shrinking farm lands problem was shared by villagers in five villages (except Nagaland) farm land holdings were less than a hectare. In Nagaland, either there were large land holdings of few farmers or there were landless labourers or the community land users for shifting cultivation. It is difficult to explain that even while the land holdings of farmers in Uttarakhand village were the smallest (0.39h) they did not consider it as a priority issue.

In the apple orchardists village of Kashmir and the vegetable and fruit farming village of Himachal Pradesh, people were more concerned about strengthening economic security and for them changing climate, shrinking land holdings and road and marketing infrastructure were key concerns.

In the villages having subsistent mixed farming systems, where rainfed farming on sloping farm lands was prevalent, shrinking farm lands was not as much a concern for farmers, as the loss of hope on farming based livelihoods. In both cases, the key reason was wild animal menace and farmers were mostly not able to take home any harvest, year after year. For the nomadic highlanders, who depend on vast range land resources, the issue was vast range lands but less people and migration of local families to far away mountain town.

Quite a contrast exists on the state of crop land scarcity amongst the Himalayan farmers, explained elsewhere in this report. Shifting cultivators are already experiencing limitation of abundant land for jhum and thereby shortening cycle of shifting cultivation. A shift towards settled agriculture is visible and it seems to have been a consequence of government led efforts for settling as well as process of owning land privately by those locals who can.

Cash cropping has certainly improved the living conditions of people in apple growing areas of Kashmir and vegetable and apple growing areas of Himachal Pradesh. Majority of families in these two sample villages have pucca houses, piped private water supplies and toilets in their houses. Access to such daily conveniences is limited among the tribal farmers in Kashmir, tribal nomads Ladakh and tribal farmers of Nagaland.

Commercial farming households in Kashmir (apples) and Himachal Pradesh (vegetables and fruits) obviously have far higher annual earnings from farming i.e. three times more than the subsistence hill farmers. Not only do they spend more, they also save more after necessary annual expenses. In these cash cropping villages, food, health and education are key expenses of households followed by social affairs related expenses.

Today, any small and marginal Himalayan farmer on an average requires a

minimum of Indian Rupees sixty five thousand (~ US $ 1000) per annum to meet minimum basic needs of his family (food, clothing, education, health care and social events). Himalayan farmers in cash cropping areas do spend much more, an average upper range of family expenses was Indian Rs 640,000 (~ US $ 10,000) per annum. There is wide disparity in the annual incomes of Himalayan farming families. Farmers who had bigger orchards were earning between Rs. 1.5 million to Rs. 2 million (~ US $ 30,000 to 32,000). There are apple orchardists in Kashmir and Himachal Pradesh, but outside of sample villages, whose annual incomes have been reported between Rs 10 million to 30 million every year. Many members of Progressive Growers Association (PGA) of Shimla Hills in Himachal Pradesh have such fabulous earnings. They invest in improving their varieties, plantations, orchard management by importing better planting material from Europe and regularly inviting foreign experts/ scientists to guide them on better management of their orchards. FARM2U, an agro-enterprise similarly aspires to raise returns from Kashmir apples six fold for every farmers associated with them.

The data indicated that economic opportunities have also widened the range of economic disparity among the villagers viz. from US $ 1000 to US $ 32000 per annum. Much of this income comes from cash crops and in case of pastoralists sale of Cashmere wool and animals. Livestock as key source of income for nomads of Ladakh is because of cashmere wool and meat and in the wild animals invaded village in Uttarakhand, farmers daily income comes from milk.

Survey findings also indicated that role of non-farm income sources to sustain rural livelihoods is increasing and this source comprises largely of low paid unskilled jobs, in the form of labour. Among these villages, farmers growing food grains, reported surviving on “money-order economy”. In Nagaland, labour families were part of the village life and contributed to farm labour needs of the larger farmers of the village. Highland nomads, similarly, have opportunity of labour income working with Indian army on the borders. Contribution of local people in better paying jobs is still low.

The outcome of higher income levels of cash cropping households in Kashmir and Himachal villages is that many people from these villages are highly educated, serving as school teachers, engineers, doctors, in hospitality sector and in companies. Villagers also have examples to quote, of those who are serving/or have served in high government jobs or as policy makers. Having their inputs on agri-business enterprises appears new opportunity to them and is yet to take roots with emerging trend of new age farmers among them.

Farmers of three out of six farming cultures were growing cash crops in varying degrees and in the fourth farming culture, livestock was key cash income source of the farmers. Farmers of the other two subsistent farming systems, were using other smaller means for income generation so as to sustain livelihoods.

Table 3.3. If results of this survey are used as assessment of the state of affairs across the Himalayan states, it indicates that presently there are hardly 15% farming families who are producing enough food on farm to feed their families. In cash cropping villages, food crops have either been abandoned or the cultivation of food crops is considerably reduced (20-30%).

Millets are major casualty in this process and already were reported as lost crops by the villagers. So has been the fate of other indigenous crops. Himalayan farmers diets have been transformed by various reasons. Cash cropping, supply of subsidized food grains (rice and wheat) under PDS across the Himalayas, even in remote villages, shrinking land holdings leading to focus on few major crops cultivation, access to new HYVs of food crops or cash crops making farmers stop eating local grains and abandon farming of the indigenous crops.

The villagers in sampled villages were emphatic in pointing that even while national policy of PDS for providing subsidized food to them and it supplemented their food needs but it also engineered changes in farming cultures i.e. from food crops to cash crops ad from farming to non-farming vocations. PDS supplies meet the staple food needs of all families for half a month. In other words, half of the year is assured of cheaper food items, wheat, rice and pulses and for rest of the half year period, their own farm production or buying from market, both options are exercised. For many mountain households, rice and wheat were elite food grains to be eaten occasionally, but now these are part of their regular diet. The regular diet comprising of maize, pulses, millets, pseudo-cereals and cultivated and seasonal wild vegetables have been abandoned for good or bad reasons. Kashmir valley has a long tradition of growing rice for self-consumption and that is why even in cash cropping village 25% farmers are engaged in producing their own rice for food.

Enquiries in focused group discussions highlighted that people are aware of the nutritional value of abandoned/ lost crops and that their diets have become nutritionally different- some accepted that new diets were nutritionally poor but reflected elitist culture. However, they forcefully explained circumstances forcing changes in diets, farming, nutrition and over all rural life in the Himalayas.

In the highlands no one produces food grains, except some barley for bear and peas for fodder (as crops do not ripen in highlands). It is understood that at such high altitudes, most food crops cannot be grown, as climate cannot felicitate adequate growth period for crops. In the subsistent farming conditions of North West Himalayan villages, at the present times only 15% farmers may be producing enough food for themselves. While in North East Himalaya, above 50 % farmers produce enough food to feed their families. That is not the case with vegetable and fruit growing households of Himachal who have totally abandoned food crops farming. They produce no food grains to feed their families but grow vegetables and fruits as cash crops and buy food. Around 30% of them grow some pulses to meet part of their family needs.

Table 3.3 and Fig 3.4. State of food insecurity among the sample households was assessed through spot assessment of food insecurity. Food insecurity of long periods and of serious nature was not reported but still villagers reported varying degrees of manageable food insecurity of few days to weeks when there was not adequate food provisioning.

Alarming situation of food insecurity, like sleeping hungry and not eating during day or night, were not reported. In Nagaland, to manage such situations, forests provide lot of other alternatives to food grains, and therefore one may sleep hungry during night but the day time offers opportunity to feed from forest. However, the transient food insecurity situation was reported by villagers across the Himalayas under all kinds of farming conditions, in varying degrees, as follows:

- There were 5% food insecure families among high land Pastoralists.
- There were 85 % food insecure families among subsistent farmers.
- There were 15% food insecure families among the fruit orchardists.
- There were 60% food insecure families among those affected by wild animal threatened mixed farming system.
- There were 5% food insecure families among those doing cash cropping of vegetable and fruit farming.
- There were 58% food insecure families among shifting cultivators of North East Himalaya.

The household survey explained that food security of this kind, in a particular period of the year, occurs when the winter crop harvest will have exhausted and summer crop is yet to come, and this phenomenon is known as transient/ transitory food insecurity. Also it is time of the year when local labour requirement is less and therefore cash flow is not comfortable. Either reserve funds of the family are taken to buy food or food items are taken on debt from the shop to be paid in next two three months, when work is abundant and income from labour better. Study shows 38% farmer families of Indian Himalayas are facing transient/ transitory food insecurity.

Fig 3.4C. One of the adaptive strategies of the farmers seems to be to cut on favoured energy rich food items which they would otherwise prefer in their diet such as non-vegetarian items, oil and fat, sugar, vegetables. Data indicated that such behaviour pattern is over 40%.

Table 3.3 & Fig 3.4 reported that the highland nomads get enough food grains, sugar, tea etc. Also their non-vegetarian diets and source of it is fully secure. Their only problem is that there is little variety in their diet and it is largely monotonous. That means food self-sufficiency is there but variety essential for nutritional balance may be uncertain. In subsistent farming areas, villagers manage food insecurity by eating less, reducing variety, and at times by skipping meals. There is, however, a contrasting situation among cash cropping households of Himachal and Kashmir. They are well fed and face no food insecurity. Their diets are largely energy dense (rich in fat, meat and sugar).

Fig 3.5 and Table 3.3. present an overview of perceptions and experiences of state of annual food insecurity among the people. The data shows that vegetable and fruit growers of Himachal are experiencing complete food security, they only quote the past for such experiences. But among the fruit growers of Kashmir, there were few families facing transient food insecurity at times, largely because of poor harvest and consequent during that year. Cash crop failures draw such situations in alternate years. One has to understand the dynamics of fruit cash cropping based income led food security. In a good year, when fruit crop is good, enough money comes home; not only there will not be any food insecurity in that year, farmers would in fact show a level of profligacy, overspending on food (continuing non-veg energy dense diets) and spending lavishly on other luxury items.

Contrary to it in a bad crop harvest year, not only that income dries up before the next crop harvest, fruit growers need lot of money for crop husbandry in apples (almost 30-40% of earnings are used as input cost). This puts them under pressure and they face a kind of temporary problem. In recent years (2011-2015), there have been continuous crop failures of apple crop in Kashmir. Harvest was less and of poor quality because of multiple reasons – long spells of rainfall during flowering period leading to reduced apple pollination (people perceiving climate change effect) and less fruit bearing, then a dry spell of warm summer followed by monsoon rainfall spreading diseases (warm humid conditions) – all leading to poor quality and quantity of fruit harvest.

During these past few years, fruit growers have been earning less than what they used to earn during the past decade. Thus, among the Kashmir apple growers, there is also kind of climate driven annual food insecurity and poverty situation going on for some years, making these farmers very concerned about future course of action. They have the tool for economic security led food security, but it is not working. Improving the situation needs both technological and institutional (policy/investment) efforts and until that happens, situation continues to be precarious.

The annual transient food insecurity among mountain households highlights the fact that the idea of making people food secure on their on-farm land is no longer possible in the Himalayan villages.

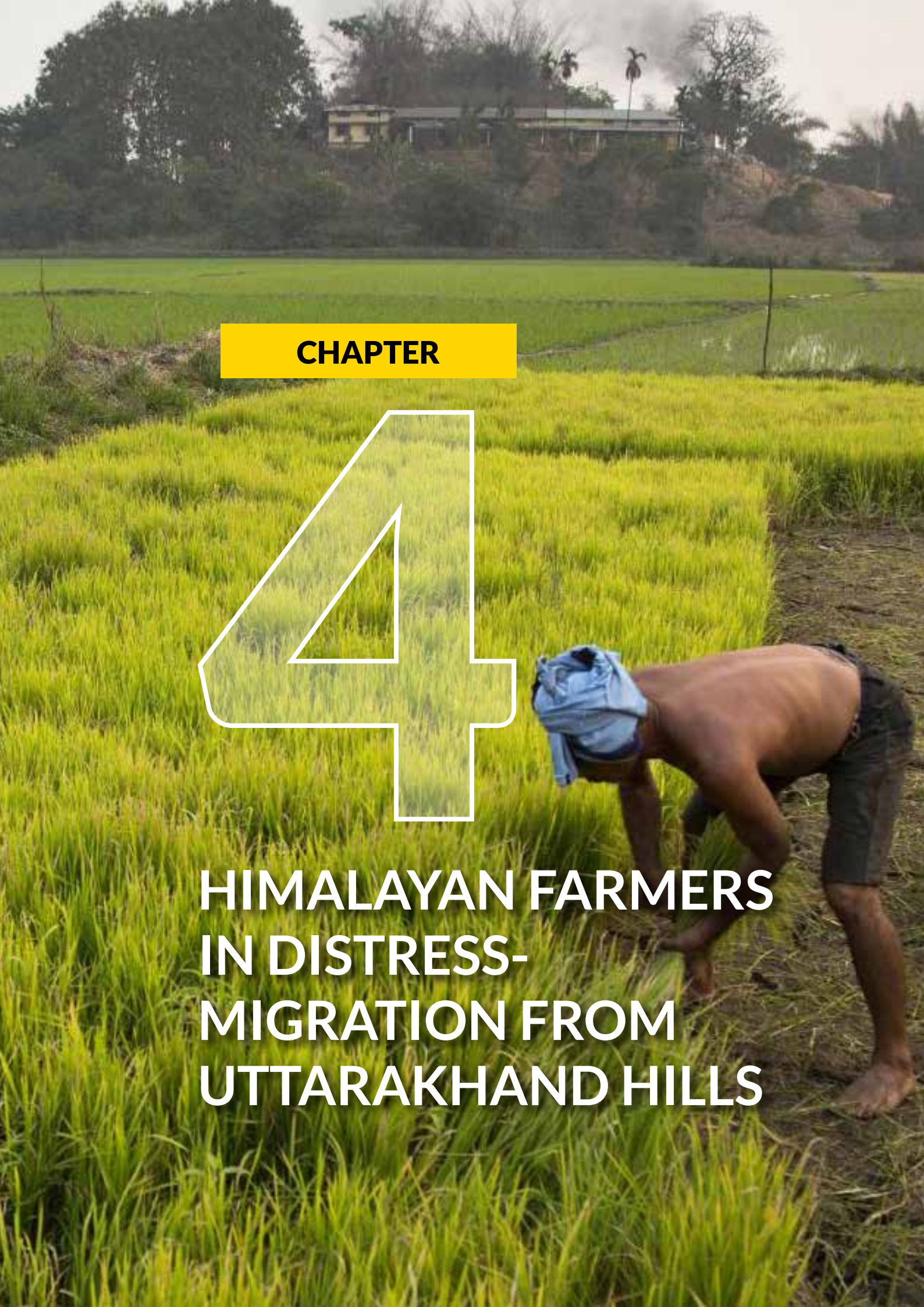
The wild animals affected farmers speak of yet another persisting crisis and that is of nutrition and income insecurity. Almost 50% families have food and nutrition insecurity but a situation of no food at all – is not reported. The root causes of food and income insecurity in this village are that farming has failed to meet the food and income needs of people because of wild animal menace; monkeys during the day and herds of wild boars, porcupines and packs of bears at night. People have either stopped farming except that they keep growing coarse food grains, barnyard millet and finger millet, so that they get some grains, fodder for animals and that fields are maintained.

Whatever harvest they can get after destruction by wild animals only meet part of their food needs. In this village, farming families survive on buffalo milk sales, labour work in town and some trading and few families have some member in service – money order economy. Those who do not have these options have already migrated from the village (30%) and others seem just surviving.

Table 3.3, Fig 3.8 A&B. There is trend of change in the food habits of people in the Himalayas. Data reveals that, one, mountain foods (millets, pseudo-cereals, barley and including maize) have been replaced by mountain communities across Himalayas with rice and wheat. These are now staple food items but not staple food crops. PDS supplies last for half month and open market purchase is done for another two weeks a month. In Kashmir and Nagaland, farmers meet their partial need of rice from their own harvest. Similarly, only few families manage to grow and harvest some wheat for themselves in wild animal affected subsistent farming villages.

It can be said that mountains are becoming net importers of food, be it food grains, pulses, cooking oil. It has impacted diets transforming them from the past locally grown foods, dominated diets, to imported (into mountains) foods, dominated diets. As said earlier, rural food has become urbanized in terms of diet and nutrition. Life style diseases (diabetes, high blood pressure, allergies, cancer) have crept into mountain lives.

Two, since the villagers have stopped eating local foods (as they are no longer growing these crops) the nutrition supplies of various kind, these mountain households used to get from their indigenous food, have been effectively stopped.



CHAPTER

4

HIMALAYAN FARMERS IN DISTRESS-MIGRATION FROM UTTARAKHAND HILLS

"They are migrating , leaving behind me and the fallow land."

State of Uttarakhand in Central Himalaya

The Himalayan state of Uttarakhand is known for its natural environment, the Bhabhar and the Terai. The state is divided into two divisions, Garhwali and Kumaon, with a total of 13 districts. It is bound by Tibet in the north; the Mahakali Zone of the Far-Western Region, Nepal to the east; and the Indian states of Uttar Pradesh to the south and Himachal Pradesh to the west and north-west as well as Haryana on its south-western corner.

The economy of Uttarakhand is predominantly agrarian as 78% of its population is dependent on agriculture for livelihood. Land holdings here are small and fragmented with limited irrigation facilities , especially in hilly areas. Hence, contribution of agriculture is marginal in creating livelihood options. Despite the growth since the formation of the new state of Uttarakhand, issues of regional imbalances and lack of employment opportunities, especially in hill districts, continue to plague the social and economic fabric of the state.

Uttarakhand is primarily a mountainous state, as the plains constitute only about 10% of its total geographical area. Out of thirteen districts, only Haridwar, Udham Singh Nagar and parts of Dehradun and Nainital districts are in the plains. The state is part of the central Himalayas with most of the northern area comprising of high ranges and glaciers and the lower reaches covered by dense forests. Uttarakhand has a total area of 53,483 km2, of which 86% is mountainous and 65% is covered by forest demography.

Source : Ratan Aswal (2017). Photo from a village in Pauri district that is impacted by migration. Waiting for those who left or assessing when to leave?

The native people of Uttarakhand are Garhwali and Kumaoni depending on their place of origin in either Garhwal or Kumaon region. According to the 2011 Census of India, Uttarakhand had a population of 10,086,292 comprising of 51,37,773 males and 49,48,519 females, with 69.77% of the population living in rural areas. The state is the 20th most populous state of the country with 83% of the population living on 1.63% of the land. The population density of the state is 189 people per square kilometre having a decadal growth rate of 18.81%. The gender ratio is 963 females per 1000 males. The crude birth rate in the state is 18.6 with the total fertility rate being 2.3. The state has an infant mortality rate of 43, a maternal mortality rate of 188 and a crude death rate of 6.6.

Agriculture

Like most of India, agriculture is one of the most significant sectors of the economy of Uttarakhand. Basmati rice, wheat, soybeans, groundnuts, coarse cereals, pulses, and oil seeds are the most widely grown crops. Fruits like apples, oranges, pears, peaches, litchis, and plums are widely grown and important to the large food processing industry. Agricultural export zones have been set up in the state for litchi, horticulture, herbs, medicinal plants, and basmati rice. In 2010, wheat production was 831 thousand tonnes and rice production 610 thousand tonnes . The main cash crop of the state- sugarcane, had a production of 5058 thousand tonnes. The interesting paradox is that while 86% of the state is hilly, 86% of the cultivated land of the state is in the plains i.e. tarai.

Infrastructure

The difficult terrain has proved to be a major constraint to creation of adequate infrastructural facilities, especially in ensuring connectivity by road. In the hill districts, large numbers of villages do not have access to electricity. Uttarakhand has 28,508 km of roads, of which 1,328 km are national highways and 1,543 km are state highways. As over 86% of Uttarakhand's terrain consists of hills, railway services are very limited in the state and are largely confined to the plains. In 2011, the total length of railway tracks was about 345 km. The important railway station in Kumaon Division of Uttarakhand is at Kathgodam, 35 kilometres away from Nainital and in Garhwal these are in Haridwar and Dehradun.

State of Migration

Migration in the state started in 1930 in small degree at first. However, the rate of migration increased during the following decades, and significantly more before and after formation of the state of Uttarakhand in 2000. Today, the reasons people cite for migration include lack of basic amenities, education, health care, road infrastructure, and employment opportunities. Despite the creation of the state, the migration to urban areas in the downstream within the state, outside the state and even to urban hill towns continues. Conditions have worsened in some hill districts and accelerated further migration leading to abandonment of hundreds of villages. This phenomenon is locally called "Bhutia gaon" or the "ghost villages". Several villages have only 8-10 people living in few houses as observed during field studies. However, the migrant population are discontented and this issue of discontentment came out significantly across the village meetings held during the time of the study. The migrants are eager to return to their homeland but for lack of social infrastructure and declining environment of hope and opportunities.

Scale and realities of migration

- Census 2011 statistics revealed that after the formation of the state, about three-fifths of the population (60%) migrated from their native places in the hills districts. In absolute terms, after the formation of the state in 2000, more than 32 lakh people have migrated.
- Overall 35% population of hill districts have migrated by now.
- Election Commission of India reported that 246 people per day migrate from hilly rural settlements of Uttarakhand to other areas. At this rate the constituencies will need to be reconstituted, as there has been a decrease in

the political representation of hills in assembly as well as in Parliament.

- Migration commission has reported the figure of ghost villages as 1700 as in 2018, from which people have migrated abandoning their homes. The same reports indicated that nearly 1000 other villages have less than 100 people per village. Over all, around 3900 villages have locals migrating away to other regions.
- Between 2001 and 2011, the population of Uttarakhand grew by 19.17 per cent in the period of ten years, with an even more in mountain towns The total population of Pauri in 2001 was 3,66,017 which became 3,60,442 in 2011. Population decreased by 5,575 in 10 years.
- The population of Almora was 3,36,719 in 2001and 3, 31,425 in 2011. In this way the population decreased by 5,294.
- The analysis of the census of 2001-2011 revealed that more than 2,26,949 farming families of Uttarakhand have migrated from their native villages. These migrant population goes through a shift in their livelihood from agriculture to daily wage labour as mainly seen in in factories, and shops. This shift in livelihood leads to more vulnerability despite migration. .
- From the eleven hill districts of Uttarakhand the account of migration is as follows: 36,401 families have migrated from Almora, 35,654 from Pauri, 33,689 from Tehri, 22,936 from Pithoragarh, 20,625 from Dehradun, 18,536 from Chamoli, 15,075 from Nainital, 11,710 from Uttarkashi, 11,710 from Champawat 11,281, 10,970 from Rudraprayag, and 10,073 farmer families from Bageshwar.
- Today, less than 20% agricultural land in the hill districts of Uttarakhand is under agriculture and the rest 80% has become fallow land for varying periods. Land policy of Uttarakhand has provision of declaring fallow land of 7 years or more as forest land and if that provision is invoked, farm land in Uttarakhand hills is on the way to becoming legally forest land, in due course. Thus shrinking crop land area and agriculture area (farming area) in hills will be a major negative outcome of migration from the hills, limiting options for positive corrective strategies.
- The field studies by GBPIHED and other institutions have listed following causes of migration put forth by the local residents, namely as; lack of quality education, lack of health services, lack of employment, shrinking and fragmented land holdings, lack of access to irrigation and drinking water. In the perception of migrating farmers and of those left behind by circumstances, the rainfed farming appears to have no future, and therefore, alternatives need to be put in place sooner than later.
- Migration Commission reported that 151/1000 men migrate for employment, 539/1000 women migrate because of jobs, marriage, and due to migration of entire family and households.
- In Uttarakhand, the sex ratio has decreased to 886/1000. The number of girl child in Pithoragarh has decreased even more to 842/1000 .

Facts associated with migration

- There is an annual expenditure of 16,881 rupees for a child's education, which is 2 to 3 times more than that for the plains.
- In the state, 17% schools are being run by single teacher. 59% of the teachers are on contract and are under educated.
- The posts of more than 17 thousand teachers in the state remain vacant, mostly in the hills.
- In the hills, 42% of class five students and 24% of class seven students are not able read the textbook of class two.
- In the hills, 70% of class five and 46% of class seven students are not able read a simple line of English.
- In the hills, 65% of class fifth and 43% of class eighth students could not participate in mathematics.

Table 4.1.

Teachers Count in Districts		
	2009-10	2010-11
Almora	5614	5444
Bageshwar	2171	2069
Chamoli	4297	4656
Champawat	2591	2444
Dehradun	6397	6404
Garhwal	6660	6722
Haridwar	8177	8354
Nainital	6887	7255
Pithoragarh	5521	5936
Rudraprayag	2609	2741
Tehri Garhwal	7047	7245
Udham Singh Nagar	8740	9468
Uttarkashi	4042	3802
	70753	**72540**

Source : Aswal Ratan (2017) Workshop presentation

Fig 4.1 Teachers count in Districts

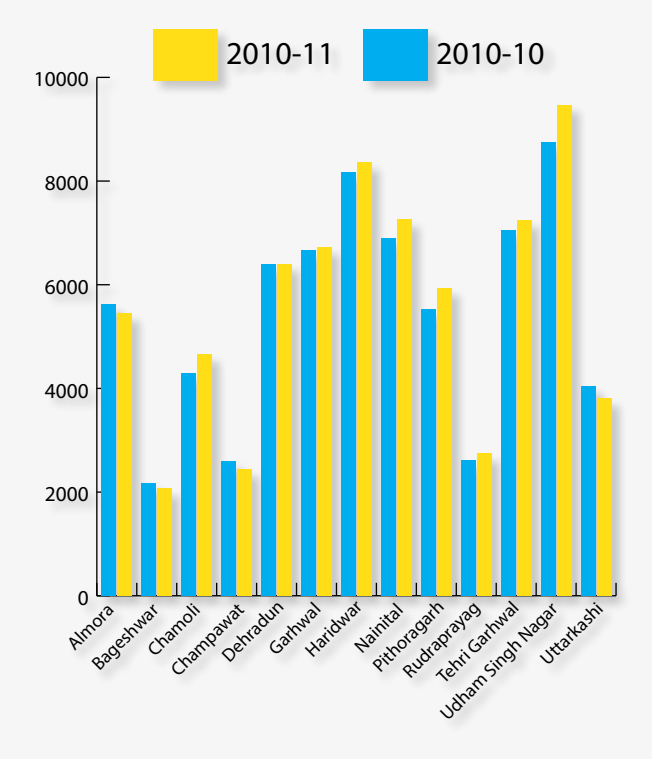


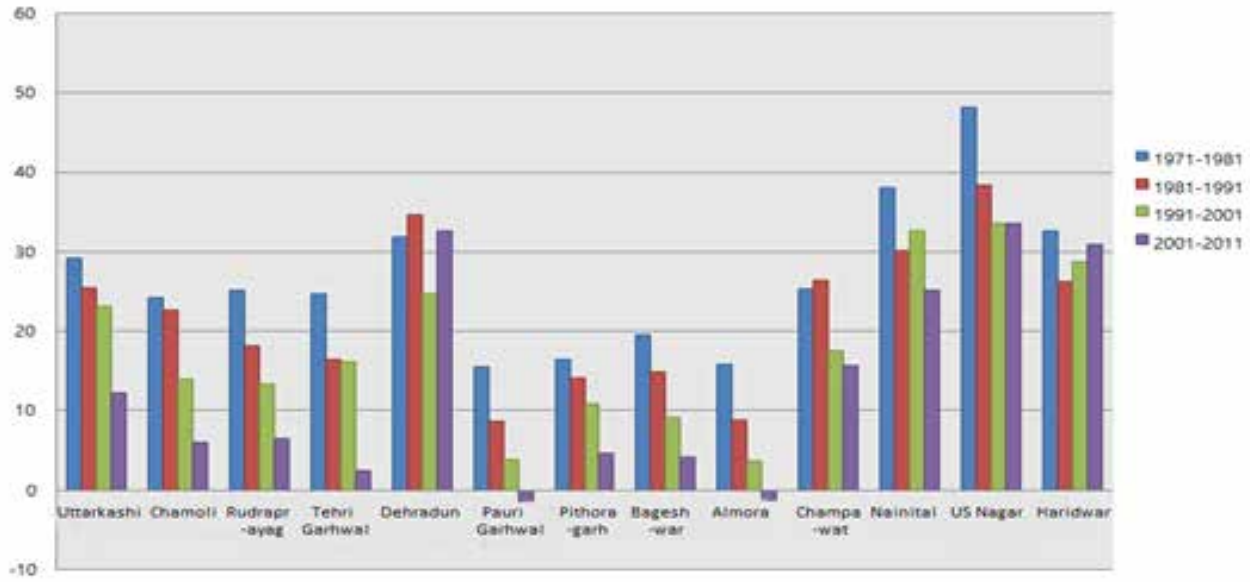
Table 4.2 Uttarakhand, District-wise growth rate in a decade

Uttarakhand: Districtvice Growth Rate in a Decade				
District	1971-1981	1981-1991	1991-2001	1991-2001
Uttarkashi	29.2	25.5	23.1	12.21
Chamoli	24.2	22.6	13.9	6.07
Rudraprayag	25.1	18.1	13.4	6.52
Tehri Garhwal	24.7	16.5	16.2	2.37
Dehradun	31.9	34.7	24.7	32.65
Pauri Garhwal	15.5	8.6	3.9	**-1.37**
Pithoragarh	16.4	14.1	10.9	4.61
Bagehswar	19.6	14.9	9.2	4.19
Almora	15.8	8.9	3.7	**-1.26**
Champawat	25.3	26.4	17.6	15.68
Nainital	38.1	30.2	32.7	25.13
Udham Singh Nagar	48.1	38.3	33.6	33.56
Haridwar	32.7	26.3	28.7	30.9

Hill Districts	
Almora	-1.37%
Pauri	-1.26%
Chamoli	6.07%
Rudraprayag	6.52%
Tehri	2.37%
Pithoragarh	4.61%
Bagehswar	4.19%
Uttarkashi	3.27%

Plain Districts	
Udham Singh Nagar	33.56%
Haridwar	30.9%
Dehradun	32.65%
Nainital	25.13%
Champawat	15.68%
Uttarkashi	3.27%

Fig. 4.2. Population Growth rate in the Decade



Source : Aswal Ratan (2017) workshop presentation

Table 4.3. and Fig 4.3. Number of Closed Houses

District	No of Closed Houses
Dehradun	46490
Pauri Garhwal	38764
Almora	38570
Tehri Garhwal	37760
Pithoragarh	35915
Nainital	23940
Uttarkashi	12850
Champawat	12730
Rudraprayag	11610
Bagehswar	11560

Source : Aswal Ratan (2017) workshop presentation

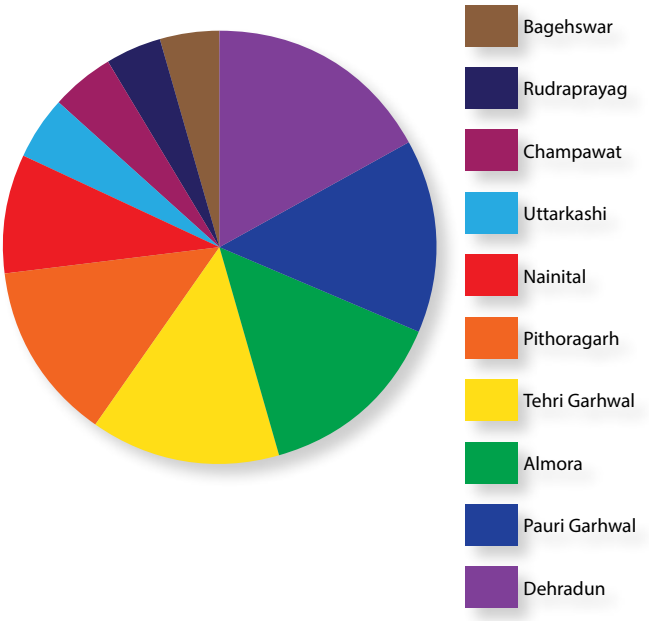
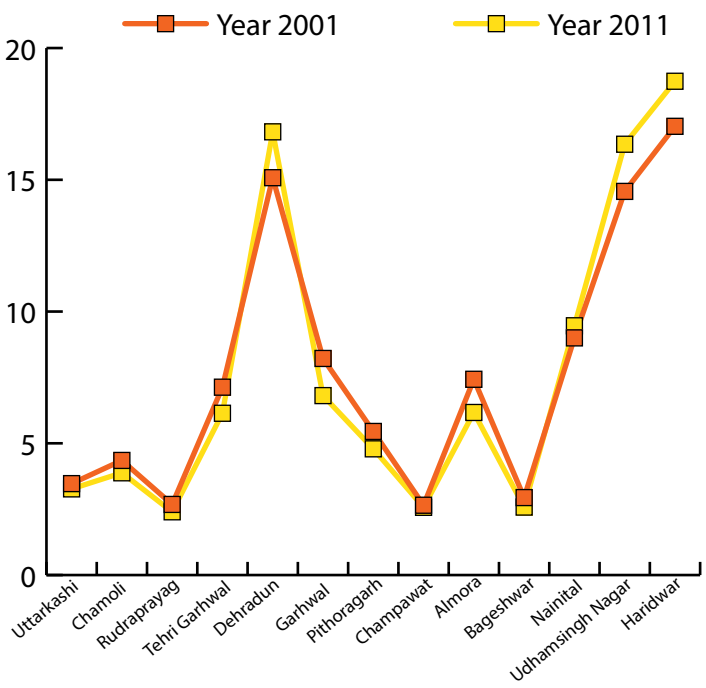


Table 4.4. and Fig 4.4. District Wise distribution of population in 2001-2011(%)

District wise distribution of Population in 2001-2011(in Percentage)		
	2001	2011
Uttarkashi	3.47	3.27
Chamoli	4.35	3.88
Rudraprayag	2.68	2.4
Tehri Garhwal	7.13	6.14
Dehradun	15.08	16.82
Garhwal	8.22	6.81
Pithoragarh	5.45	4.79
Champawat	2.65	2.57
Almora	7.43	6.17
Bageshwar	2.94	2.58
Nainital	9.00	9.46
Udhamsingh Nagar	14.56	16.35
Haridwar	17.03	18.74

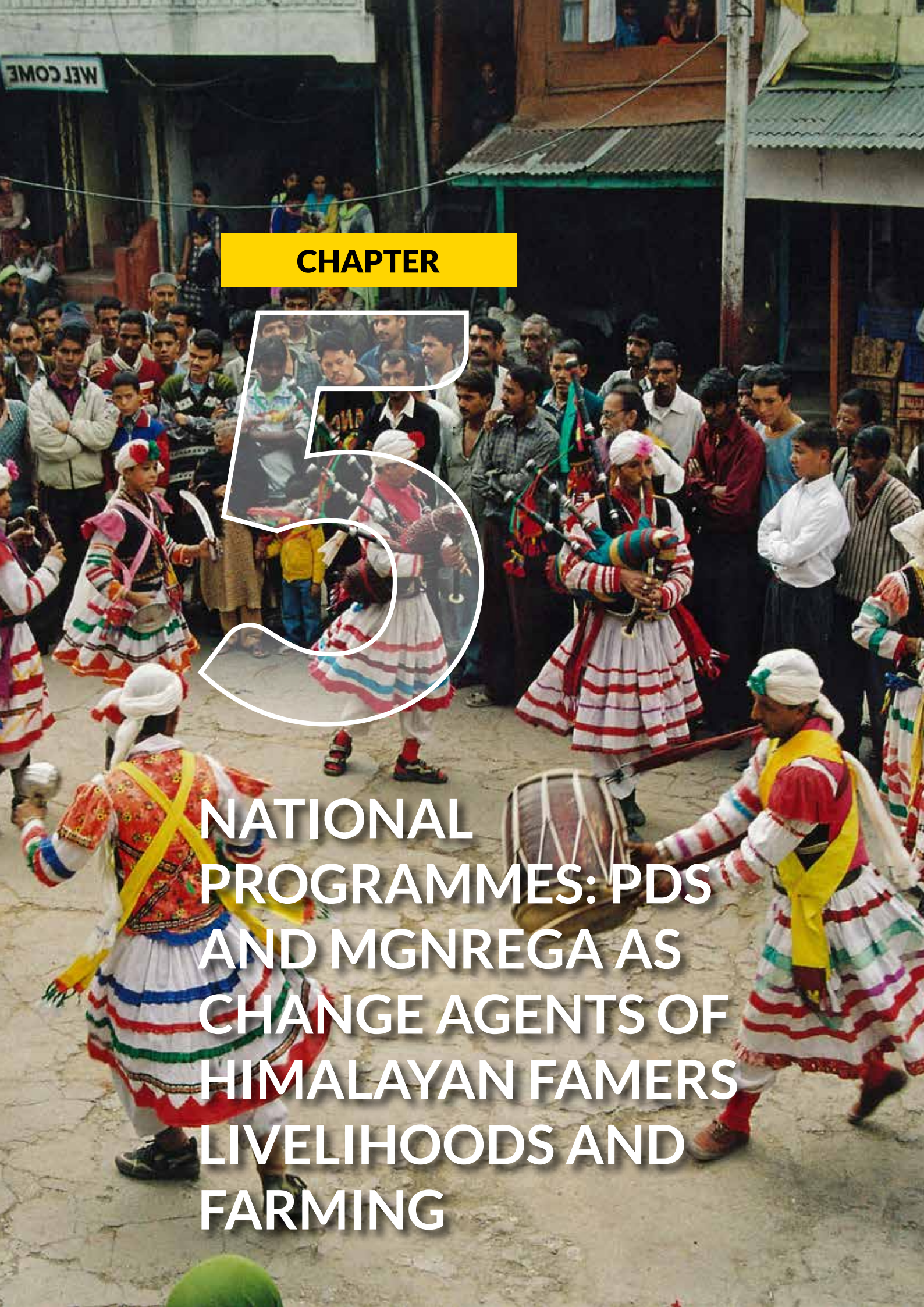


Aswal Ratan (2017) workshop presentation

Compilation of different thoughts within Uttarakhand about containing migration

- New land settlements and new land reforms are necessary to adapt to the changing patterns in the state.
- Migration is growing due to lack of priority given to the agriculture sector. Agriculture must be prioritized. Proper market linkages should be facilitated for farmers and their mountain produce with Minimum Support Price and guarantee of purchase.
- Protection of crops from wild animals and stray animals.
- Commercial use of trees should be measured.
- Reinstatement of public rights in forest panchayats.
- Discussion on expansion of national parks and sanctuaries should be promoted.
- Need to link agriculture activities with MGNREGA in the mountain areas.
- Promotion of animal husbandry & milk production, horticulture and value addition.

Source : Ratan Aswal (2017). Somewhere in a village in Pauri Garhwal from where 90% households had migrated



CHAPTER

5

NATIONAL PROGRAMMES: PDS AND MGNREGA AS CHANGE AGENTS OF HIMALAYAN FAMERS LIVELIHOODS AND FARMING

[PDS stands for Public Distribution System- a scheme of Government of India for giving subsidized food to poor families. MGNREGA stands for Mahatma Gandhi National Rural Employment Guarantee Act.]

India has a large program of public food distribution (PDS) through fair price shops. It is also being implemented effectively in the eleven Himalayan states of India, with additional benefits to tribal populations inhabiting the Himalayan states. It accounts for a significant part of the Government's budgetary subsidies. The PDS in its present form – a producer price-support-cum-consumer subsidy programme – might have evolved in the wake of food grain shortages of the 1960s but PDS gained importance in 1990s when it was extended to all states and areas (Radhakrishna & Reddy, 2004). Today, it is perceived to be the main safety net to protect the poor from potential short-run price-induced adverse effects of economic reforms and has been working well in combination with yet another national program named Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). With 180 days of assured employment to at least one member of household and subsidized food every month that suffices for about 15 days, and complimented by Mid-day meal in the schools and Integrated Child Development Scheme (ICDS) operational in several Himalayan states, rural poor, today, have a wider and more assured safety net with respect to managing their food and nutrition insecurity .

How PDS and MGNREGA has impacted farming in the Himalayas? There are differing views on it. General perception is that it encouraged farmers to leave farming and become dependent on external purchased food. Increasing rate of incidences of abandoned crop lands in the Himalayas is attributed to these two schemes. In the present study, dialogue with Himalayan farmers, however, revealed a different story. Himalayan farmers considered these two national programs as great opportunity to come out of their unpredictable food and income subsistent farming. The security of a feeling of a food secure household is what has encouraged hill farmers to diversify from farming to non-farming options.

However, academic experts' perception is that PDS has been instrumental in nationalizing the dietary systems of such a diverse country. Wherein people and communities from diverse dietary systems have dominantly adopted rice and wheat as staple food across the country. They perceive it as a cause contributing to the slow destruction of agro-biodiversity and food culture of people, hence highlighting how dietary systems can be controlled by policy interventions, leading to unintended impacts on the communities and livelihood of in ways not thought about.

Bhattacharya (2016) reported that even though past decade saw significant improvements in the PDS, there seems to be insufficient improvement in nutritional outcomes. The past decade also saw rapid expansion of India's biggest intervention to fight child malnutrition, the ICDS, which supplied nutritional supplements to pregnant mothers and new born child, including consultation at door steps to the mothers. A 2011 evaluation report of ICDS by the planning commission of India highlighted two factors that do seem to affect under nutrition, are open defecation and the status of women. In the absence of sanitation facilities children faced hostile environment and frequently fell prey to common infectious diseases which reduced their ability to absorb nutrients and grow well. Most governments of the Himalayan states have been implementing these national schemes and in some Himalayan states where they have been implemented at the ground- positive impact is visible on the food and

nutrition security.

Debating on the food and nutrition challenges of the new millennium, Ramachandran (2013) argued that mere self-sufficiency in food grains cannot result in steep reduction in malnutrition rates or micronutrient deficiencies in the country because population needs adequate quantities of balanced diet to remain well-nourished and healthy. Deliberating about value of food items in the plates of Indians, his paper cited an example of pulses to highlight the point. He stressed on pulses as the major source of protein in Indian diets. Reduction in pulses consumption will have adverse effects on nutrition of Indians. Therefore, the impact of changing the local food habits/ dietary which have been responsible for evolving local food systems would in turn affect the nutrition of the people. Ramachandran (2013) emphasized the fact that alteration in income, lifestyles and consumption expenditure pattern have occurred across all communities including the poor. Consumption expenditure on food has decreased and expenditure on other items, such as transport, education, health care has increased and that food The people now list education and health as key priorities.

Interestingly, the local Himalayan farmers' experiences and perceptions of the PDS and MGNREGA schemes vary to academic studies in terms of the importance it plays in helping their daily livelihoods.

The picture in mountain states depicts inadequate food production being supplemented by PDS supplies and supplemented income to buy additional food. A study conducted by Agro-economic Research Centre, Shimla, found out that the farm production fell short of consumption requirements and this deficit varied between of 37 to 62 per cent in four blocks of districts Chamba and Shimla. This deficit was bridged solely by dependence on Public Distribution System (PDS for 15 days). There are exceptions where farming families' food needs are not met even from subsistent production on their farms plus PDS. In such cases money earned from MGNREGA comes handy to buy additional food from open market.

Consumption pattern

As per estimates, though the availability of cereals in India as whole has increased from 334 grams per capita per day during 1951 to 433 gms during 2013, since then it came down to 421 gms during 2015 (provisional figure). The availability of pulses declined continuously from 60.7 gms per capita per day during 1951 to 43.8 gms during 2015 (P). The overall availability of food grains has similar pattern to that of cereals and has seen a decline from 492 gms to 465 gms per day per capita during the period of 2013-15. Similar trend is present in other food item groups. This trend is also observable in per capita consumption of cereals and pulses; the consumption of former declined from 13.40 Kgs/month to 11.22 Kgs/month during the period 1993-94 to 2011-12. During this period the consumption of pulses remained almost constant with marginal increase from 0.76 to 0.78 Kgs/month. This may be due to changes in tastes and preferences and increase in disposable income. The expenditure on food items has been continuously declining and has come down from 63.2 per cent of total expenditure during 1993-94 to 48.6 per cent during 2011-12.

The findings of a study by Sharma and Vaidya (2009) reported that majority of farmers of Himachal Pradesh were enjoying the status of being food secure, essentially due to PDS and MGNREGA and this can been a factor in them trying

for cash cropping. It also found that the entitlement of grains from PDS was more than the requirement, especially among households in tribal areas and among below poverty level families. The availability of food items at prices which were lower than the actual cost of production, had led to emergence of a situation wherein farmers are now less keen on growing food crops on their farms. This is more evident in with small and marginal farmers. Farmers also complained of crop damage by stray and wild animals which has further increased the workload and burden as this would require extra efforts and resources to protect their crops.

The preference of young generation in the farming families today, is paid jobs and services instead of agriculture. This has commonly led to shift in livelihood in case of the new generation from farming. Even though this is only an emerging trend, it is increasing rapidly. It appears there will be continued neglect of subsistent rainfed agriculture with farmers moving out of the subsistent farming, until the time they can find economically promising and secure farming possibilities.

The North Eastern states are also experiencing similar situation with aggregate requirement deficit of 2.51 per cent over domestic production during the year 2014 (Roy et al 2015). This deficit was highest in Mizoram (-60.09%) followed by Meghalaya (-49.21%), Sikkim (-8.73%) and Assam (-6.32%). This is further substantiated by research findings (Singh et al 2007) that food grain availability in north eastern states declined from 164 Kgs per year to 153 Kgs during the period 1975 to 1995 whereas in India this increased from 194 to 213 Kgs per year during this period. The state level analysis indicates that out of seven states, it declined in four states (Assam 151 to 149 Kgs, Manipur 252 to 177 Kgs, Meghalaya 119 to 80 Kgs and Tripura 214 to 152 Kgs). Three states where there has been improvement were Arunachal Pradesh from 173 to 240 Kgs, Mizoram from 115 to 164 Kgs and Nagaland from 146 to 163 Kgs. Status of food availability improved during this period, and witnessed decline in subsequent period. The status of food availability in Mizoram, which appears to be at bottom in this was found to be greatly influenced by availability of fair price shops, and high agricultural working population and high literacy rate, among others (Prasad and Vangchhia, 2017).

MGNREGA and other Social Drivers impacting hill farmers food and income security

In recent years, higher investments in education and its penetration to the interiors of rural areas has been effective in increasing participation and access of rural population in education. This has resulted in increasing demand for non-agricultural jobs. Additionally, government intervention in the field of skill development in the form of National Skills Development Policy, Modular Employable Schemes, up-gradation of existing institutions, Skill Development Centres etc has increased the number of vocationally trained people. The net result is an increased demand for non-agricultural jobs which has been able to fulfil the rising demand of cash income of farmers. The diversion of elite labour force to vocations other than agriculture has not only led dwindling number of workers available for agriculture; more importantly, the best brains, so crucial for agricultural development are moving out of this sector.

Thus, there is decline in quantity and quality of labour force in agriculture. On one hand the farmers are able (to some extent and that too not in all households) to fulfil their cash income demand which is fuelled by increasing

use of purchased inputs in agriculture and changing market based consumption pattern. The cash demand has been increasing tremendously due to exposure of young farmers facilitated by internet and social media. There are two diametrically opposite outcomes of this state of affairs; one is neglect of agriculture due to out-migration of quality work force. But at some places this out-migration has also contributed to well-being of agriculture sector by way of higher farm investment which came from savings from non-agricultural vocations. This has happened in rural areas surrounding urban centres of the Himalayan states.

The above trend has led to a sort of vicious circle where declining importance of agriculture to farming households so as to make both ends meet has led to its further neglect. The institutions of MGNREGA and PDS have gained tremendous importance among farming families of Himalayan states; the former for generating cash income and the latter, for getting food for family consumption.

MGNREGA envisages providing 100 days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work. Women members of the hill farming families, who carried major burden of hill faring operations, are now increasingly involved in MGNREGA. It serves two purposes for them, one provides a fall-back employment source and two, an alternative to farm labour work. It is because of MGNREGA that farm labour wages have increased substantially in the hilly areas. In peak season of cash cropping when there is labour demand but with the emerging scarcity of labourers, the per day wage rates goes up to Rs 500 per day with food. This is because when MGNREGA provides up to Rs 176 per day for soft labour work, it increases the wage for private work to about Rs. 250-500, depending on the work load. MGNREGA at its inception was implemented to act as growth engine for development of an agricultural economy, which it has achieved in areas of efficient implementation .

There is a land mark study on the impact of MGNREGA, conducted by Agro Economic Research Centre Shimla (Vaidya and Singh, 2011). It reported that the income from work under MGNREGA constituted about 11 percent of total income of Rs.87,868 of beneficiary hill farming households. The consumption expenditure among beneficiary hill farming households was Rs.7206 and Rs.9746 per capita per annum among non-beneficiaries. On an average, 1.12 persons in Himachal Pradesh were employed under MGNREGA activities out of which 0.45 were women from each household. Each household put in about 92 man days for MGNREGA work. The women's participation was 45 days per household of hill farmers. This indicated infusion of significant amount of cash in rural economy; some portion of which continued to improve the consumption pattern, such as building household reserves and further investment in farm improvement.

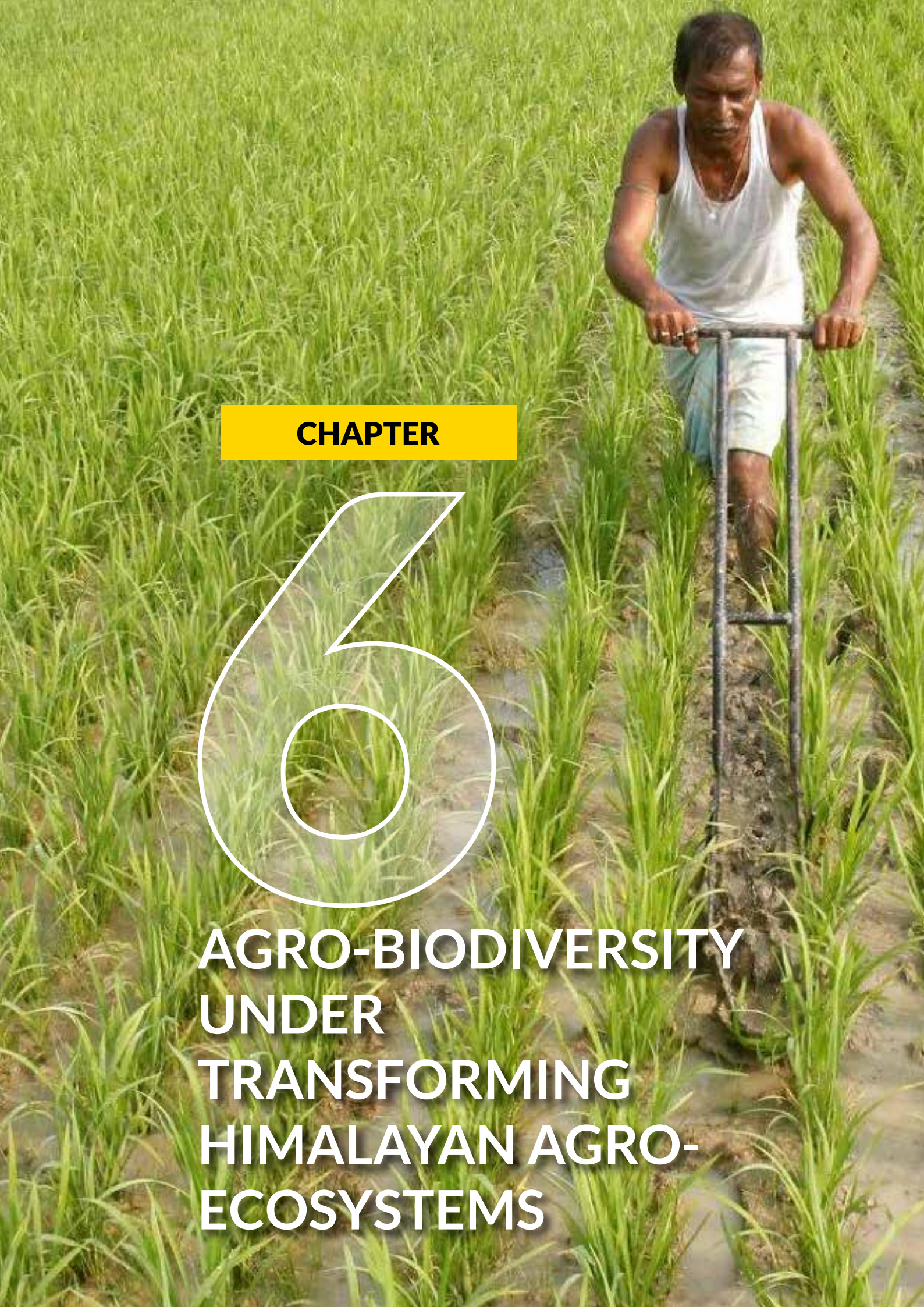
An assessment of Performance of MGNREGA among the Himalayan states can be derived from Table 5.1. which provides a comprehensive picture of all the Himalayan states. In majority of the states, total number of households finding work under MGNREGA has increased over the period 2013-14 to 2017-18 along with significant escalation in wage rates in all the states. However, the number of families completing 100 days of work, as is mandatory, has shown decline in most of the states. It may be due to non-availability of funds as well as the efforts to accommodate as many households as possible within the allocated resources. Overall, there has been a significant infusion of cash in the rural economy. This has led to capital formation in many cases, it has also

led to neglect of subsistent hill farming operations, in many other cases, especially by the small and marginal farmers. Income in the fragmented rainfed farm lands has been declining due to various factors such as menace of wild animals particularly monkeys during day time and wild boars during nights, problem of stray cattle damaging crop day and night and so on. MGNREGA hence provided an attractive alternative to the farmers in rural communities This resulted in a decline in farming activities. This pattern is visible among small hill farmers, where subsistent agriculture is fast losing its traditional place and is being looked down upon in comparison to other income sources and cash cropping. Employment opportunities in state government departments have also grown (Himachal Pradesh, having 1.12 lakh employees in 1990 increased to 1.85 lakhs by 2013, an increase from 2.1% of total population to 2.7%). Similar trends may be seen in other Himalayan states. This clearly indicates that job avenues in the state governments of Himalayan states have increased at a faster pace than the population. Pressure continues to build up for more jobs, so much so that higher employment opportunities within Himalayan state governments have, to some extent, pulled manpower from agriculture sector.

Table 5.1

State	2013-14			2017-18		
	Families completing 100 days of work (No.)	Households got work (in Lakh)	Wage rate (Rs.)	Number of families completing 100 days of work (No.)	Number of households worked (No. in lakhs)	Wage rate (Rs./day)
Arunachal Pradesh	0	1.4	134.83	1	1.34	176.93
Assam	15505	12.62	151.87	9709	16.37	182.97
Manipur	2	4.55	153.01	0	4.74	203.98
Meghalaya	55896	3.64	145.45	90501	4.2	174.94
Mizoram	0	1.73	148.00	0	1.9	194.02
Nagaland	983	4.08	134.98	0	4.02	176.99
Tripura	285699	5.97	133.28	4269	5.22	168.85
Sikkim	13789	0.62	136.38	2483	0.63	179.00
Uttarakhand	27995	3.97	141.78	18863	4.95	174.99
Jammu-Kashmir	66639	6.57	144.72	29751	6.6	178.91
Himachal Pradesh	55350	5.39	137.46	11684	4.94	176.63

This situation is further compounded by crop damage by wild and stray animals. The situation became so alarming that in Himachal Pradesh a scheme 'Mukhya Mantri Khet Sanrakshan Yojana' to protect crops of farmers from stray and wild animals had to be announced with a budget provision of Rs. 25 crores. The scheme provided for electric fencing of the fields to check the entry of wild and stray animals which had been causing massive damage to crops and loss to the farmers. Under the scheme the farmers are to be given 60 per cent subsidy from the government for fencing which would be energized with solar power or electricity. The farmers in the hill state already suffering from the vagaries of weather were suffering additional damage and loss due to attacks by wild animals like wild boars, monkeys, stray cattle and neel gai. In many areas, the situation is so grim that the farmers have stopped sowing crops. According to one estimate, monkeys and wild animals were causing direct loss of about Rs 500 crore annually to agricultural and horticultural crops in the Himalayan region forcing farmers to abandon 70,000 hectares area of the cultivable field.



CHAPTER

6

AGRO-BIODIVERSITY UNDER TRANSFORMING HIMALAYAN AGRO-ECOSYSTEMS

Structural and functional changes

(Structure of Himalayan agriculture refers to crops and their scale of contribution to farm economy. Function of agriculture refers to the objectives of doing farming and cultivation.)

Agricultural biodiversity includes the variety and variability of living organisms (plants, animals, microorganisms and the agro-ecosystems) that is connected to food and agriculture. It can be considered at three main levels – the ecological diversity, organismal diversity, and genetic diversity (Heywood, 1999a in Heywood, 2003). It includes all species (including crop wild relatives) and crop varieties, animal breeds and races, and microorganism strains, that are used directly or indirectly for food and agriculture, both as human nutrition and as feed (including grazing) for domesticated and semi-domesticated animals, and the range of environments in which agriculture is practiced. It includes not just food as such but diets, food intake and nutritional considerations.

It also covers dietary ingredients such as flavourings, colorants, preservatives, etc. that are used in food preparation, cooking, processing and storage. Agricultural biodiversity also includes habitats and species outside of farming systems that benefit agriculture and enhance agro-ecosystem functions (Heywood, 2003). Hence, it also includes the management of goods and services used by humans.

Thus the various components of agricultural biodiversity are categorized as follows;

1. Agro-ecological diversity which includes agro-ecological zones agro ecosystems monocultures rangelands and pastoral systems (the six villages in the present study represent agro-ecosystems/ agro-ecozones)
2. General species, subspecies varieties, cultivars land races; i.e. crops and crop varieties
3. Gene pools populations, individuals genotypes breeds.
4. Socio-cultural diversity: human interactions at all levels, including dietary and culinary diversity, food preparation and storage

Agricultural biodiversity is by definition the result of the deliberate interaction between humans and natural ecosystems and the species that they contain, often leading to major modifications or transformations. The resultant agro-ecosystems are the product, therefore, of not just the physical elements of the environment and biological resources but also varying cultural and management systems. Himalayan agricultural biodiversity includes a series of social, cultural, ethical and spiritual variables that are determined by Himalayan farming communities (Maikhuri et al 1996).

These factors played a key role in the process of selection and evolution of new cultivation of local crops and in the ways in which they were grown and managed. Agriculture gradually led to a significant reduction in our dietary diversity because of new crops and improved crop varieties which increased yields. Eventually only a tiny number of crop species – the staples – have come to dominate their nutritional and calorific intake. While majority of Himalayan farmers earlier concentrated on high carbohydrate crops like rice, wheat, maize, barley and potatoes, the mix of wild plants and livestock products in the diets provided them more proteins, vitamins, and minerals.

This process of few crops based simplification of Himalayan agriculture led to food production model in which farmers are, eventually, relying on only a handful of crop species from vast resource base of food from plants (Annexure 1). Today, only 20– 30 crops are making up the bulk of food and nutrition needs of the Himalayan households, as reported in the section on findings of the study.

Agro-biodiversity links to food and nutrition

Agricultural biodiversity is the first link in the food chain of mountain people. The great majority of farmers in these mountain villages are traditional farmers who rely in varying degrees on small-scale cultivation of staples and various forms of traditional agriculture, including raised fields, terraces, swidden fallows, agroforestry polycultures (e.g. home gardens of North East India), semi-domesticated species and wild harvesting of fruits, fibres, medicinal and so on, and on the natural and semi-natural ecosystems that border or are adjacent to the cultivated fields.

The crops diversity within a mountain agro-ecosystem is thus a result of the interaction between countless generations of mountain farmers and the plants and animals they domesticated through farming. The connection between this diversity, agricultural biodiversity and human nutrition and health is intrinsic, multifaceted and constantly changing. It is complex, reflecting the many dimensions of nutrition, health and agricultural biodiversity.

There is, therefore, no necessary direct link between the amount or quality of agricultural biodiversity and provision of nutritional and health benefits. However it is incontestable that some elements of agricultural biodiversity such as crop diversity and wild-harvested plants have made and continue to make appreciable contributions to human in three village agro-ecosystems (Ladakh-Changthang, J&K-Sumlar and in Nagaland-Mavlong.

Detailed evidence of their importance in terms of energy intake, micronutrient intake and dietary diversification is scarce and subject of further investigations. Correlating agricultural biodiversity with human nutrition with established facts therefore will not be easy, for a number of reasons, including diversity of farming communities. Likewise, eco-nutrition model (Blasbalg et al. 2011) is one approach that appears sound in theory, but will have difficulties in achieving the goals, because of the multiple influencing factors presently operating across villages of the Himalayan region.

State of local crop agrobiodiversity, which mainly includes the state of diversity of crops, in this study, includes variations and level of variety of agroecosystems, crop, their varieties and land races, kinds of livestock and breeds of domestic animals and the variety of farming cultures. In the present study, village have been chosen as a unit of farming system for the reason that the study not only focuses on agro-ecological variations but also socioeconomic differences. The villages chosen in this study capture production systems, influenced by different agro-ecological and socioeconomic conditions, prevailing in the Himalayan states.

Study Findings

Nomadic and semi-nomadic pastoral systems of higher Himalayan region, represented by nomadic production system of Changthang in Ladakh is an ecologically determined agro-production system, evolved by mountain farmers to make a living under the harsh cold and arid environmental conditions. Its uniqueness is maintained well, for it is able to support livelihoods of local nomadic community.

The two farming systems, one representing subsistence mixed crop livestock farming, is represented by a Gujjar village of Sumlar and the other apple orchards dominated farming culture is represented by the village Quilmuqam in Bandipore Kashmir valley. The two villages are adjacent to each other and agro-climatically both would favour growing similar crops. However, both are tremendously different – socio-economically and for that reason both differ in farming practices. Largely influenced by socio-economic factors, Gujjar community, which settled in the village, were traditionally semi-nomadic and knew buffalo rearing so well that their livelihoods was solely dependent on it. On the other hand, Kashmiri culture favoured rice farming based livelihoods which got transformed into apple cash cropping, harnessing ecological niche for fruit farming. So, despite being similar in environment, the two villages represent two different kinds of livelihood systems of the Himalayan region, differentiated by variations in socio-economy and culture.

Sometimes, contrary to natural ecosystems, agro-ecosystems are created by communities to satisfy their culture influenced socio-economic needs. These two villages are a fine example of evolution of different agro-ecosystems in similar environment. These are influenced by cultural and economic considerations and traditional knowledge of mountain communities. This is the rationale behind differences in farming practices of Himalayan farmers, living even under similar ecological environments in different states, such as mountain landscapes of Himachal Pradesh and Uttarakhand.

The other three representative villages, one each in Himachal Pradesh, Uttarakhand and Nagaland are selected to capture three different kinds of farming cultures that are presently prevalent in the Himalayan region. The Nagaland village is dominated by shifting cultivation. It is an ecologically determined farming culture,that is presently under stress of socio-economic pressures. In Uttarakhand, the Junkafoon village is an example of a traditional agro-ecosystem evolved by a mountain community for subsistence farming based livelihoods on rain fed sloping farm lands.

All Himalayan agro-ecosystems, represented by different villages in this study, across the Himalayan states, are in a dynamic state of functioning, which created the circumstances for their continuing transformation process, both good or bad. What is happening to these traditional farming systems based livelihoods, is very eminently reflected in the village in Uttarakhand. Why farmers, who are part of this kind of agro-ecosystem in the Himalayas, are stressed, is indicated here very well. Forces of nature going out of hand in the face of increasing pressure on these kind of agro-ecosystems to become more productive or face abandonment, is evidently highlighted in the studied villages.

The vegetable and fruit farming dominated village in Himachal Pradesh, highlights the kind of future, the traditional farming based livelihoods will pass through with positive interventions. If in Junkafoon village of Uttarakhand, traditional crop livestock mixed farming faced abandonment, because it has not

been able to support farmers livelihoods, then the vegetable and fruit growing village in Himachal Pradesh indicated that transforming these traditional agro-ecosystems can make them economically sustainable to hill farmers.

The casualty though will be its agro-biodiversity i.e. crops, livestock and the agriculture systems. It also indicated that elements of transformation processes are indeed bold and not trivial. The tools for survival of human societies, be it crops, animals or practices, all of them are facing changes confronted by economic survival of communities. Hence, the farming based livelihoods in the Himalayan villages, selected for the study, are an example of a microcosm of changes which agriculture based livelihoods are facing in the Himalayan region.

In order to understand the state of agro-biodiversity following questions have been explored:

- Having been under pressure to become more productive, are these agro-ecosystems facing replacement of crop and livestock i.e. functional tools, and if so what is determining replacement?
- How much agro-biodiversity loss has already occurred?
- What crops are continuing, possibly why and what new crops are coming in ? From purely ecological consideration will these new crops be ecologically sustainable.

Therefore, reasons for this change process of abandoning crops and bringing in new crops are recorded to understand the nature of pressures.

Data in Table 3.5 highlight the state of abandonment of traditional crops by farmers practicing different farming based livelihoods. Data indicated that there is whole scale abandonment of millets and pseudo cereals from farming as well as food habits. In villages where cash cropping has been adopted, millets and major traditional food grains have been replaced by new crops, causing loss of local crop genetic resources. These changes indicate preference of farmers for economically productive but biologically less diverse agro-ecosystems. Farmers are planting fewer cash crops in their fields to maximize on economic returns. Farmers are replacing their old system in which they were growing a range of crops and land races of crops. From aiming at managing farms for ecologically sustainable livelihoods, to focus on managing farms for economically promising livelihoods, it is the biggest turn around we see in agriculture based livelihoods of the Himalayan states.

Scale of Himalayan Crops abandonment and circumstances

Table 3.5 gives an astonishing picture of abandonment of traditional crops. Barley, once a staple crop of the Himalayan farmers is no longer cultivated by 55% families practicing mixed crop livestock subsistent farming. It is abandoned by 95% families in vegetable and fruit growing villages and the rest 5% households of these villages are growing it for the purpose of fodder only. Farmers maintaining subsistent mixed farming in villages of Uttarakhand, of which 15% families have abandoned this crop. Paddy rice is a continuing crop and therefore there are fewer instances of households abandoning it. Since rice continues to be a staple food, so farmers would abandon it either because of scarcity of irrigation water (as is happening in paddy growing villages of Kashmir) or because the farmers plan to use crop land more productively for cash cropping, as is happening in the villages of Himachal Pradesh.

In this crop abandonment and replacement process maize crop has become a major casualty. The maize crop area has been put under vegetable farming by the farmers. When the maize cropping reduced to about 25 %, then the remaining farmers faced other problems which forced them to abandon maize cropping, consequently leading to 100% loss. Farmers reported that when the maize crop in the villages reduced to 20%, animal attacks on the crop increased. Further, due to declined cultivation of maize, facilities for milling maize grain closed down in the surroundings of the villages and then even in diet, maize was replaced by rice and wheat, which were easily available under PDS and in the market. Many households would have liked to continue growing and eating maize, as expressed by villagers during the focussed group discussions but problems faced by the few farmers who cultivated it was too grave. Thus continuing cultivation and post-harvest processing by only few farmers in the village was not feasible to maintain and, therefore, they stopped the cultivation of the crop and that led to total abandonment of maize farming from many villages.

For reducing wheat cultivation, farmers gave series of reasons. One being that the wheat crop land was shifted to growing vegetables, cauliflower and cabbage. As family labour got diverted to vegetable farming there were subsequent problems of labour shortage for looking after the livestock which in turn led to decrease in the size of livestock as well. At the same time, machines became available to replace bullocks for farming. Here again when wheat cropping area was reduced, wheat thrashers for hire stopped coming to the villages, forcing rest of the 25% farmers to reluctantly join others in abandoning wheat farming. These stories reveal complexities of farming a single crop in a village, and that once critical mass of farmers abandon a crop others have to do so perforce, when the essential support services necessary for carrying the grain from field to plate breaks down.

The crop livestock rainfed mixed farming practicing farmers of Uttarakhand hills, have other reasons for abandoning some of these crops such as the wild animals destroying maize and other crops is their problem (Table 3.8). Millets, amaranth, chenopods, buckwheat and other some crops were abandoned for other reasons i.e. improved household economy, changing food habits with no place for these grains in their changing diets. Another factor was that there was lack of awareness about the food and nutritional values of these traditional food crops, these were always considered inferior to rice and wheat based dietary systems (Table 3.5) .

Table 3.6 indicates that even though people in Nagaland continued to maintain the traditional crops, there has been a trend of declining cultivation w.r.t. area and use. The wild harvest collection and use in Changthang highlands also indicated the declining trends. There appears to be a wide spread trend of change, be it food habits due to easy availability of other food items in the market, or matter of changing tastes, or due to a case of crop land shifting under new crops which are more remunerative, in terms of cash income.

Table 3.12 There are crops that are continuing to be cultivated even if in lesser degree. Among these wheat is one which indicates that it does not cover large area and that not all farmers grow it. Maize is growing now as a niche crop, only favoured in some areas. Rice paddy farming is reducing or being abandoned in mountain villages and fewer farmers continue to cultivate it. The emerging problems of irrigation water and promise of growing fruit crop is encouraging even Kashmir farmers, to replace it where rice is a staple food. Since pulses need the most marginal lands, Himalayan villages have some percentage of farmers (up to 20%) who continue to grow pulses on the marginal lands.

In villages like Sumlar in Kashmir and JunKafoon in Uttarakhand, pulses are an essential part of diet as well as an important cash crop. But even in case of pulses, less and less farmers are growing it. Table 3.5 also indicates that farming of some crops has reduced to such levels (5-10%) that it is possible to predict that they are facing eminent abandonment. Contrary to it, there are some niche crops, like colocasia or pine apple in North East Himalayan states, or black soybean. In Kulthi, Uttarakhand local vegetables are widely grown only in small plots or few plants by the farmers, as niche crops for culinary purposes.

Data in Table 3.7. shows what new crops are making place for themselves under all categories of agro-ecosystems across the Himalayan states. There are certainly only a few well known cash crops, fruits or vegetables, namely, apple, pear, walnut, kiwi, pomegranate, plums, peach, apricot, etc. among fruits and tomato, cauliflower, cabbage, beans, potato, capsicum, cucumber and pumpkins etc in vegetables, that Himalayan farmers are growing widely. Even though scopes exist for harnessing the potential of niche crops of vegetables like wild onion and tree beans in many of the North East, but that is yet to be explored. It needs a lot of effort to develop a crop into a commercially viable option and as such Research and Development efforts have been lacking for all native crops.

On the issue of farmers abandoning the crops they used to grow, Table 3.8 lists some reasons as revealed by the farmers. Change in food habit was mentioned as a reason by 20% farmers. Then there were others (10%) who thought that the production of these crops was not good. Only 5% farmers quoted crop land shortage as a reason for not growing them.

It could be misleading, though, because farmers have not counted the fact that when they adopt cash crops farming in their fields they bring in new crops leaving old ones out. They change the cropping pattern for better economic returns. It is also indicated by the next parameter that almost 40% farmers quoted less economic value of their old traditional crops as reason to leave them.

As mostly feared outside farming circles, only 5% farmers reported that climate change forced them to change the cropping pattern, rest think climate change can be used to their advantage. More pressing factor than climate and production potential was the wild animals destroying the crops with increasing frequency – leaving almost nothing to harvest.

From north west Himalayas to central Himalaya, representing states of Kashmir, Himachal Pradesh, Uttarakhand and Sikkim, hill farmers are increasing reporting on their serious concern for wild animals and abandoned cattle led crop destruction, and resultant total failure of harvests to sustain livelihoods. Monkeys dominate the scene along with several other animals .It is a factor in causing changes in livelihood , whereby farmers prefer to leave farming for off farm alternative options.

Table 3.8 lists some reasons why farmers are adopting new crops. The main reason was the higher economic value of cash crop (85%). Other reasons being climatic conditions which favours the introduction of new promising crops. The third reason cited is that families are forced to adopt new high value crops so as to move from food security to economic security as a livelihood management strategy. All the three reasons support each other and hence one can say that a combination of these three factors makes a strong condition for Himalayan farmers to move towards adopting new cash crops. Cases of wild animals crop destruction, forcing changes in cropping pattern are very much location specific.

Himalayan Agro-biodiversity potentials for food and nutrition security

Global food security has been increasingly narrowing down to a handful of species constituting its basic diet of carbohydrates, fats, and proteins. Over 50 percent of the daily global requirement of proteins and calories is met by just three crops – maize, wheat and rice and only 150 crops are commercialized on a significant global scale. On the other hand, more than 7,000 plant species are cultivated or harvested from the wild. Most of them remained relatively "neglected and underutilized", with respect to their ability to contribute to the world's increasing food and nutrition requirements.

Traditional Himalayan agricultural systems are rich in agricultural biodiversity (Maikhuri et al 1996; Partap,1986), in contrast to intensive cash cropping led agriculture shrinking crop diversity in Himachal village. Crop species in these environment are often the product of complex farming systems that have developed in response to the unique physical conditions of given locations such as altitude, slopes, soils, climates and latitude, as well as cultural and social influences. Many of the species grown in the Himalayan agro-ecosystems are local 'underutilized species' and provide nutritional balance to the diet complementing the staple crops that are grown and providing micronutrients and vitamins.

In the context of this study, crop diversity of Himachal Pradesh surveyed and recorded in 1986 (Partap,1986) provided a fair example of diversity of crops in traditional mountain agro-ecosystem of the Himalayan region. The list of 127 crops grown in the state in 1986, does in fact include all the above categories of crops, staple food crops and several underexploited food crops, pulses, oil seed crops, vegetables, fruits, spices etc. Some of these in fact constitute the wild harvest/ wild greens, semi-domesticates and even weedy forms.

Adequate human nutrition involves regular intake of a wide range of nutrients, some of which must be consumed on a frequent basis, even if in small quantity. Growing a range of local crops supplemented by wild-harvested species (such as in Changthang – Ladakh and Nagaland) helps provide such diversity in the diets in these village agro-ecosystems and is complementing the nutrition provided by staples such as maize, rice and millets.

The micronutrient superiority of some lesser-known crops (Partap and Kapoor, 1986) over extensively utilized crops is well known. As an example, the comparative view of nutritional composition of underexploited crops and staple food crops is presented in Table 3.13 and that among cultivators of grain Chenopods in Table 3.5. Thus, intake of one under exploited food crop item rather than another major staple food crop item can make the difference between micronutrient deficiency and micronutrient adequacy. Unfortunately, we lack detailed information about such diversity of crops at the cultivar level and the role being played by these in nutrition.

Underutilized species: those species whose potential to improve mountain livelihoods, as well as food security and sovereignty, is not being fully realized because of their limited competitiveness with commodity crops in mainstream agriculture (Partap and Kapoor 1986, Table 3.13). While their potential may not be fully realized at national level, they are of significant importance locally in the mountains, being highly adapted to marginal mountain farm lands, complex and

difficult mountain environments and contributing significantly to diversification and resilience of mountain agro-ecosystems.

Wild species still represent a minor resource of food today and form an important part of the diet of the mountain people in some of the villages, namely, Nagaland, Sumlar in J&K and Muth in Changthang, providing not only variety but also essential vitamins and micronutrients in the form of fruits, vegetables, herbs and spices, beverages and intoxicants .These range from leafy greens like the wild fern and water cress in Sumlar - J&K, bamboo shoots in Mavlong-Nagaland and wild onion and other herbs in Muth-Changthang.

The use of wild plants, thus, forms part of their indigenous knowledge and practices that play an important part in decision-making in local agriculture, food production, human and animal health and management of natural resources. For example, growing vegetables in kitchen gardens is often supplemented by wild harvesting of local greens, fruits, nuts and fungi. The term 'wild food', therefore, is used by these people to describe all plant resources that are harvested or collected for human consumption from outside agricultural areas.

The leafy vegetables, grown or collected from wild sources, are important source of micronutrients and often provide these mountain farming communities with most of their daily requirements of essential vitamins A, B complex, C, E and minerals. Different plants are gathered and consumed by the villagers, playing an important role in human nutrition, supplying necessary daily requirements of vitamins A, B complex, C and minerals. They may sometimes even be better nutritionally than introduced cultivated vegetables, the notable example recorded in Annexure 8, is of colocasia leaves (arabi ka saag), an indigenous food crop whose leaves are consumed as vegetable and they are the highest known source of vitamin A (1000 micro grams per gram of leaves).

The next nearest well known source of vitamin-A is carrot in which vitamin A content is 657 micrograms per 100 grams of carrot. The Himalayan diets, therefore, are blessed with a range of local wild greens, wild fruits and wild roots, besides a variety of wild mushrooms. Among mushrooms, morel is the most expensive item (>US $ 200 per kg), mushroom of temperate Himalayan villages, two villages of Kashmir and one of Himachal Pradesh, have it in their wild surroundings and forests. The village people take pride in mentioning the high value of their wild produce.

Animal diversity also plays an important role in human nutrition and dietary diversity, mainly in terms of dairy products, eggs and meat. Animal products are excellent sources of high quality protein and fat and are an important source of vitamins and minerals such as zinc, iron and selenium as well as calcium and phosphorus. In these villages, livestock makes significant contributions of calories and of protein, through dairy products, meat, and eggs. The Himalayan region is a place of non-vegetarian diets and the use of milk products takes prominent place in both subsistence livelihoods as well as in commercial farming areas. Diets of people in areas, both in Changthang in Ladakh and Nagaland are predominantly meat and eggs based and significantly non-vegetarian in content.

Challenges to dependence on agro-biodiversity for food and nutrition

There is a paradoxical situation emerging even with the availability of information on animal and crop diversity that forms part of the Himalayan agro-ecosystems, there is an increase in the loss of the same. Old crops are being replaced by new cash crops. Nutritional values of Himalayan foods, amply testify the above statement. Furthermore, another study carried out by Partap(1986) on crop diversity of Himachal Pradesh and the poly culture/ monoculture cropping patterns, under which these crops grew, indicated that 127 crops and plant species grown by people in Himachal Pradesh, is a fine example of the agro-biodiversity based dietary systems of the Indian Himalayan Region.

Hence, there was a wide bio-resource base of crops, wild harvest and animals available to these farming communities of the Himalayan villages, which most likely met the needs of human nutrition. However, study indicates that this may not be the case any longer and future of agrobiodiversity based rich dietary systems of the Himalayan farming communities, appears grim. The rapid replacement of both diversity of crops and animals by fewer economically more important species has been observed and amply highlighted by this study.

Loss of crop diversity is multidimensional; one, crops were replaced or are being replaced by commercial farming of fewer crops, fruits and vegetables, replacing traditional diversity of food grain crops, pulses, vegetables, fruits and several other minor crops (Table 3.13). Two, the subsistence farming systems are failing to support sustainable livelihoods, as in the case of Sumlar village in Kashmir and Junkafoon in Uttarakhand (Table 3.3). Under such circumstances, the crop cultivation is being abandoned in favour of other off farm options.

These areas and farming systems being significant gene pools of indigenous crops and races or local breeds of livestock, have or are thus in the process of losing their value as agro-biodiversity rich areas. With that, these villages/ agro-ecosystems of the Himalayan region, is lost the potential option they had to maintain or build a food and nutrition secure sustainable agriculture in each of these agro-ecosystems. There is ample evidence at the ground showing that local biodiversity and ecosystem services play an essential role in the lives of communities throughout the mountains, by providing a social safety net for food, medicine, fibre, fuel wood etc. This acts as route out of poverty and as a source of income generation for the mountain people.

Limitations of using agro-biodiversity for fulfilling food and nutrition needs

Even while, at least 20 per cent of the world food supply comes from traditional multiple cropping systems, most of them small farm units often less than 2 hectares (Altieri, 2009). The common criticism about advocating a greater use of local agricultural biodiversity in the form of traditional crops (underutilized species and wild-harvested species to address under- or malnutrition), is that it is local and it will have little impact on state or national level. In the case of both underutilized crops and wild-harvested species, it is true that much of the evidence on the nutritional or health benefits of particular species is partial or anecdotal and there is a need for critical scientific assessments.

The chemical, nutritional and toxicological properties of local wild vegetables, the bio-availability of micronutrients present in these, and their modification by various processing techniques still needs to be properly established, before their use as an alternative dietary source can be advocated on larger scale. This poses a major challenge, for most wild-collected species, whether for food, or medicine because of lack of Research and Development.

To conclude this section, study found that there is abundant evidence showing the substantial contribution of mountain agro-biodiversity (crops, wild plants, livestock) to Himalayan dietary systems through the supply of vitamins and micronutrients. There is also ample evidence highlighting that increased production of fruit, vegetables, eggs, poultry and other animal foods in traditional agricultural systems and in particular kitchen gardens not only increased access to energy, protein and fat but also greatly improved the quality and micronutrient content of local diets.

There is a continuing trend of shrinking agro-biodiversity and crop loss. To counter this trend a new thinking as advocated by Pretty et al.(2010) is needed, which advocates that 'the goal for the agricultural sector should no longer be simply to maximize productivity, but to optimize, across landscape of production, rural development, environmental, social justice and food consumption outcomes'. Healthy mountain agro-ecosystems, supporting more ecological approach to agriculture, have the potential to provide a diverse range of food sources, agricultural systems and the dietary systems of people.

Such approaches are known to look beyond production to sustainability, biodiversity protection and the complex dynamics of the agro-ecosystem (plants, animals, insects, water and soil, diversity of crops and livestock, and the role of indigenous communities).

To remove the limiting factors discussed above, attention needs to be paid to investigating the composition and nutrient contributions of local food resources that have in the past provided many of the nutrients and micronutrients in traditional diets and that are now increasingly deficient in today's diets.

Likewise, more work is needed to assess the nutritional diversity of crop cultivars. Himalayan agricultural biodiversity will be an important resource in assuring the availability of adequate nutrition in response to the challenges of global change, population growth and adapting to changing climatic conditions.

There is an emerging view point that rebuilding nutrition in agriculture by making meaningful use of agro-biodiversity resource base of local agro-ecosystems is desirable and will prove more sustainable, instead of increasingly spreading monocultures of commercial farming. Mainstreaming of such

viewpoints in R&D, will positively impact the cause of advocating use of inherent potentials of mountain agro-biodiversity to the advantage of solving food and nutrition challenges of mountain people.

Himalayan crops and livestock (secondary data analysis)

In a survey of the state of agro-biodiversity in agro-ecosystems of Himachal Pradesh, conducted by Partap during 1980s, (Partap, 1986) reported that there were over 120 crops being grown or domesticated (including semi domesticates maintained on farm lands, home gardens) by the subsistent hill farmers of Himachal Pradesh. It included 13 grain crops, 29 vegetables, 11 types of herbs, spices and condiments, 32 categories of fruits, 15 types of oil seed crops and 9 miscellaneous crops i.e. medicinal plants and flowers. Since then, large amount of agricultural land has been diverted from indigenous crops to horticultural crops by the farmers. Initially this trend dominated the scene in apple growing areas of Himalayan states- namely Kashmir valley and Himachal Pradesh. The process was accelerated further by farmers through yet another diversion of agricultural land from cereals to vegetables, entirely new crops or HYVs of traditional crops such as tomato, brinjal, pea, cabbage etc. Selection of new crops was dictated purely by higher profitability. Vegetable farming on smaller land holdings suited very well because of economically gainful engagement of family labour round the year on their own farms.

Himalayan farmers shifting to cash cropping through vegetables and fruits, has already resulted in replacement of traditional cereals and pulses crops. The growing impact of this change process may result in loss of options for future farmers for harnessing the potential local mountain farming niches. The flip side of commercial farming in the Himalayan region may be that the list of such lost crops and genetic resources, which had economic, health or ecological value to future farmers will be expanding.

But that is not all. It had a spill-over effect on diversity of natural flora and fauna too. Due to negative effect of pesticides and fertilizers in horticulture and vegetable farming, there is an ecological back lash. A Himalayan region wide study by Partap and Partap (2000) titled “warning signals from apple valleys” reported serious decline of fruit pollinators across the apple growing areas of Himalayan region countries. According to Economic Survey, Volume II of 2017-18, GoI, there is, however, a marginal increase in crop diversification as indicated by index which marginally increased from 0.740 in 1994-95 to 0.754 in 2010-11. During this period, in J&K, diversification index declined very marginally from 0.800 to 0.798, pointing towards a very slight decline in crop diversification during the same period of time. This aspect is further investigated and elaborated under field surveys in following sections.

A study conducted in Uttarakhand (Maikhuri et al, 2001) found that during the past decades, ecological and economic drivers of change were instrumental in the loss of agro-biodiversity of Central Himalayan region comprising of Uttarakhand. The study survey findings of Maikhuri et al (2001) in 150 villages in Alaknanda river valley revealed that over a period of two decades (1970–74 and 1990–94) the cultivated area under many traditional crops had declined significantly. The main reasons listed for this state of affairs were introduction of high yielding varieties of cereals and vegetables.

The analysis of all the Himalayan states reveals a mixed trend in respect of value generated by various subsectors of mountain agriculture. The percentage share of cereals in total agricultural income of mountain farmers is declining in all

the Himalayan states, except in Arunachal Pradesh. The contribution of fruits and vegetables to income of farming families continues to increase in the eight Himalayan states. These findings only emphasize why there is increasing trend of farmers towards commercialization of mountain farming. Traditional food grains and cereals, pulses, local vegetables, among them many having nutrition value, are being abandoned or have already been abandoned by the farmers.

The same trend has been continuing during the past 12 year (2006-2018), and even faster, which would have further changed the above scenario of structural changes in Himalayan agriculture. Between 2006-2007 to 2017-2018, the decade has witnessed major shift in cropping patterns from grains and pulses to vegetables and fruits, further reducing area and production of food grains in the Himalayan region to almost half the value of 2006-2007.

For agriculture economists it is definite evidence of structural changes in the value of Himalayan agriculture.

Table-6.1: Structural changes in the value of Himalayan agriculture (%)

State	Cereals		Fruit & Vegetables	
	1990-93	2003-06	1990-93	2003-06
Arunachal Pradesh	20.34	33.11	66.03	33.62
Assam	35.22	30.05	27.16	28.58
Himachal Pradesh	44.86	27.92	42.44	59.68
Jammu & Kashmir	36.90	26.41	48.88	54.04
Manipur	64.38	48.69	23.44	40.81
Meghalaya	34.82	24.09	33.04	54.08
Mizorum	47.23	46.23	15.55	22.71
Nagaland	42.40	32.26	25.12	20.19
Sikkim	35.89	19.89	17.16	34.73
Tripura	53.06	35.49	30.04	48.60
Uttarakhand	NA	30.73	NA	34.17

Source: Jha, Brajesh (2009)

Changes in Livestock composition and structure

In this study, an example from the state of Himachal Pradesh is described here. The 2015-16 livestock data of Himachal Pradesh provides information for 12 types of livestock and poultry reared by rural households and having direct linkages with crop farming. The emerging trend revealed that the indigenous cows are being replaced by cross-bred cows (Table 3.10) for its higher milk yields and ease of its preference for stall feeding. Similarly, there is a declining trend in number of she-buffaloes due to its not being as compatible with mountain environment. There is no appreciable difference in the numbers of sheep and goats; the poultry has substantially increased as a part of the diets as well as part of farming vocation. In consonance with the trend in numbers, the milk production of cross-bred cows has increased from 437.13 to 715.76 thousand tons during the period 2007-08 to 2015-16 and that of indigenous cows declined from 182.30 to 142.57 thousand tons during this period. Though the number of buffaloes declined, milk production increased from 330.66 to 380.50 thousand tons during the same period. Milk yield from both cows and buffaloes increased 2787 to 3708 gms per day and 2704 to 3719 gms per day in the same period.

Livestock trends in Jammu and Kashmir (Integrated Sample Survey, 2011-12) revealed that livestock population of Jammu region had increased by 8.40% by 2009-10 and reached to 78.908 lakhs from 72.79 lakhs. Kashmir region also witnessed an increase of 4.63% and livestock population reached to 74.994 lakh from 71.67 lakh. In Ladakh region, livestock population has been declining at 1.44% and it was 6.60 lakhs in 2012.

Table 6.2: Livestock population in Himachal Pradesh (No.)

Year	Cows		She Buffaloes	Sheep	Goat	Poultry
	Cross-bred	Indigenous				
2003	515964	755439	726089	906027	1115587	764136
2007	651916	733917	703410	901299	1240836	809546
2012	825266	595370	655841	804871	1119491	1104476

Source: Statistical Abstract of Himachal Pradesh, 2015-16, Directorate of Economics and Statistics, Government of Himachal Pradesh.

Table 6.3. Livestock population trends of Jammu and Kashmir state

Particulars		2001-02	2011-12
Population in the state (in thousands)	Total Livestock	9899.00	9200.80
	Cattles	3084.00	2798.33
	Buffaloes	1039	738.99
	Yak	47.00	54.99
	Sheep	3411.00	3389.49
	Goats	2055.00	2017.90
Bovine: livestock ratio		0.43	
Number of livestock per 1000 persons		911.1	
Number of bovines per 1000 persons		393.5	
Number of livestock per 100 ha. of net area sown		1226.61	
Number of bovines per 100 ha. of net area sown		529.83	
Area under fodder crops (Ha)		45.45	
Grazing & pasture land to total geographical area (%)		5.17	
Average daily milk yield	Indigenous cows	2.03	
	Crossbred cows	5.19	
	Buffaloes	3.86	
	Goats	0.54	
Annual milk production ('000 tons)		1360. 16	
Per capita availability of milk (g/day)		370. 06	

Source: Compiled by Dr Shabir Wani, Prof. Head Agriculture Economics, SKUAST Kashmir, for this study

The trend depicted in 19th Livestock Census of Assam conducted in year 2012 indicated a different trend in comparison to Himachal Pradesh wherein the crossbred cows declined from 410.47 to 395.90 thousand during a period of 2007-12 with the number of indigenous cows increasing from 9630.8 to 9911.80 thousand during this period

Table 6.4 Cattle population of North- Eastern States ('0000)

States	Cattle			Buffalo	Sheep	Goats	Pigs	Yaks	Mithun	Total livestock	Total Poultry
	CB	Local	Total								
Arunachal Pradesh	13	445	458	11	19	231	330	9		1257	1743
Assam	440	8000	8440	678	170	2987	1543			13829	21664
Manipur	69	349	418	77	6	33	415		20	971	2941
Meghalaya	23	744	767	18	18	327	419			1551	2821
Mizoram	9	27	36	6	1	17	218		2	280	1125
Nagaland	243	208	451	34	4	175	644		40	1349	2789
Sikkim	80	79	159	2	6	124	38	7		337	322
Tripura	57	702	759	14	3	472	209			1458	3057
NEH region	934	10554	11488	840	227	4366	3816	16	254	21032	36462
	(3.78)	6.58	6.2	0.86	0.37	3.51	28.23	24.62	91.37	4.34	7.46
All India	24686	160495	185181	97922	61469	124358	13519	65	278	485002	489012

Source: Compiled by Dr Ram Singh, CAU Campus, Barapani, for this study in 2017

It was accompanied with a decline in number of buffaloes and increase in number of both crossbred and indigenous sheep. Similar trend has been observed in Tripura during a period between 1992-97, where crossbred cows declined by as high as 32.4 per cent with a simultaneous increase in indigenous cows by 37.4 per cent. Buffalo population declined by 10 per cent and sheep and goats increased by 20 and 49 per cent respectively, during the same period.

In North East Himalayan states, there is an emerging trend of conservation and promotion of native livestock breeds. In this context there are quite a few success stories. The success story of Siri cow revival by a group of 18000 small farmers belonging to 240 farmers clubs in Kalimpong district is one such noteworthy achievement of Himalayan farmers initiatives in revival of native livestock breeds. They have collectively created enabling environment for harnessing economic opportunity out of this conservation effort, that is of marketing Siri cow milk products at premium prices. Idea behind this initiative of farmers (KKS) sangathan was saving the native Siri-cow from extinction.

The repercussions of these two scenarios are just opposite; in Himachal Pradesh, the dependence on grazing land may be declining with higher reliance on purchased fodder, animal feed and concentrates. The orientation towards market may be the important reason for this. The cash income generated from milk products is seen as an important source of investment for agricultural sector. But in the north-eastern Himalayan states, there is increasing practice of dependence on grazing lands and that is instrumental in launching initiatives for revival and promotion of local breeds which are adapted to local grazing land resources

CHAPTER

7

HIMALAYAN FARMERS RESPONSES TO CLIMATE CHANGE

A Case Study on Warming Weather in Apple Valleys and Farmers Response to it in 2009 and 2018

The scenario in 2009

This study was conducted in 2009 and location scenario was revisited in 2018. It examines how apple farmers in the western Himalayas of India perceived climatic change. It is done by comparing the locally idealized traditional weather cycle with climate change as perceived by the farmers of the region. Snowfall and rainfall data from 1962-1996 has been used to measure the accuracy of perceptions. Although climate change is usually described by farmers as the temporal displacement of the weather cycle, the changes themselves are not perceived as altering the idealized weather calendar. Most importantly, perception of climate change is structured by knowledge of crop-climate interaction and by differential apple performance outcomes associated with the changed conditions.

Scientists have painted a general dismal picture regarding the consequences of climate change and its influence on human activities and wellbeing. Although less revealing about effects at local levels, they are able to conclude without as much obscurity the general effects climate change is having on a global level such as melting glaciers, rising sea levels, changing weather patterns etc. which may lead to increased flash floods, drought, storms etc. Climbing average global temperatures are slowly transforming the way our system works – the environmental quality, agriculture and food security are all at stake. There are many impacts the people will most likely experience locally even before the large scale effects are noted globally. For example, Flannery (2005), in his book 'The Weather Makers' reported that less rainfall during the wheat season has driven Australian farmers out of wheat farming and they are now taxi drivers in Perth; waiting to sell their land for peanuts.

Most agricultural crops are sensitive to their growing conditions, especially rainfall and temperature which consequently come under the key factors influenced by climate change. It is easily predictable therefore, how variations in annual weather and changing climate may affect their production and growth. It is fairly easy to imagine completely dire prospects for global agriculture. It could definitely end up that way. But as of yet, we only know that crop yields are being altered- this could mean in either positive or negative ways. The effects on agriculture and its consequences on the society are likely to differ locally depending on the type of climate change that has taken place in that area and the options available to farmers. It may well bring new agricultural systems to areas and replace the old crops and farming systems. It may be specially so for mountain regions. One such evidence of local effects, examined in this piece of research, is the climate induced changes on agriculture and livelihoods, in a mountain valley.

The Study

Climate change impact on Himalayan agriculture and farmers adaptive strategies, A case study of Kullu valley in Himachal Pradesh. This study by Partap and Partap (2009) deals with climate change impact on hill agriculture and adaptive strategies adopted by farmers. It takes apple as an indicator crop to investigate the positive and negative effects of climate change on farm economy.

This was a field study to determine the agricultural and socio-economic impact of climate change on the farmers' apple economy in Kullu valley of Himachal Pradesh. It attempts to piece together evidence and aims to enhance our understanding of climate change impacts as observed by farming communities

at very local levels.

The growing threat of global warming and its effects and prevailing obscurities about the future of agriculture are all addressed in this investigation. It determines the impact of global warming on apple farmers and their farm/household economy. The findings showed that the apple belt was shifting upwards due to climbing regional temperatures, making the lower parts of the apple valley areas unsuitable and the upper valley areas more suitable for the apple crop.

This brought a short period of economic decline in the lower valleys, but with government support, the farmers were able to diversify and regenerate their farm economies by introducing new crop varieties into the area. Presently farmers in the upper valley are prospering with apple cultivation.

Nature and scale of climate change impact on the Himalayan agriculture is difficult to imagine as its impacts vary regionally, and may not necessarily be positive always. In order to mitigate climate change from severely hindering farm economy of the Himalayan region, innovative adaptive strategies type of actions at all levels – individual, institutional and national, have to be taken into account.

The Study objectives and methodology

This study takes the apple as an indicator crop to investigate the positive and negative effects of climate change on farm economy. It explores the impacts it had on the agricultural economy of the hill farmers who were forced to abandon apple farming, and those to whom apple farming came to as a new option. It determines the agricultural and socio-economic impact of climate change on the farmers' apple economy in the two areas of the Kullu Valley in Himachal Pradesh, India. In the past few decades, the valley has faced a strange phenomenon. Farmers in the lower Kullu Valley have had to abandon apple farming due to certain climatic changes that eventually made it unsuitable to grow the apple crop. Simultaneously, farmers in the higher regions of the valley discovered that the conditions have been altering, making the climate hospitable towards the apple crop. This change has consequently led to a continuous upward shift of the apple belt

This investigation attempts to answer the following questions;

1. What impact has global warming had on the Kullu Valley climate?
2. Are the farmers aware of this? If so, how and what impact has it had on them?
3. As a consequence of climate change, has the apple belt actually shifted upwards?
4. What effect has this had on the agricultural economy of the affected areas?

Furthermore, it also aimed to enhance our understanding of the issue whether climate change actually is benefiting an economy by providing new farming opportunities. Due to global warming, has the diversified farming options proved to be more beneficial than the destroyed farming niches?

The study was conducted in five villages in two locations about 100 kilometres apart. Among these, two villages, Hurla and Bajaura (named as location –A) are located in the lower/southern end and three in the northern end of the valley at an average altitude of 1200m. The location-B, comprised of three villages, namely- Burua, Vashisht and Kothi, which are at the northern end of the valley at an average height of 2200m.

The most vital sources of information for this research were the farmers. For this purpose, a structured questionnaire for each location was prepared including questions on all relevant aspects of information necessary for this study. A number of farmers from each location were interviewed including holding general discussion on climate change and its impacts on the agricultural/ household economy in the area. In addition, lead farmers and scientists were selected and further interviewed as they were expected to have greater awareness of the issue being discussed. Part of the data was analysed using simple mathematical methods (percentages and averages) and part of it using statistical analysis. Available weather data such as temperature and rainfall was collected from two weather stations located in the valley for the purpose of this study.

Study Findings revealed apple farming- Boom and Decline at location-A

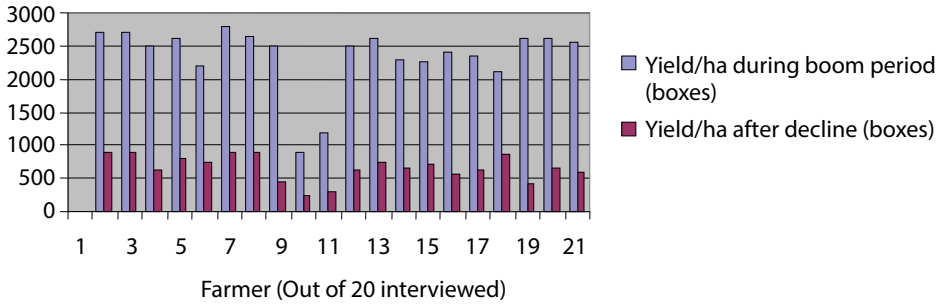
Location A was a valley area dominated by small and marginal farmers. Of the average 2.71 hectares of landholding of each farmer, apple orchards occupied 70 percent of their farmland. It contributed 100% to the household income for 25 percent of the farmers and around 90% for another 50 percent. For the remaining 25 percent of the farmers, other sources held greater value- apple farming contributed an average of 43% to their income. The fact that 75 percent of the families were almost entirely dependent establishes that between the 70s-90s, apple was the leading crop and a majority of the farmers were dependent on its income. Farmers in the lower valley area planted the apple orchards around the early 60's and it dominated the farm economy and livelihoods of this area. However, during the 1980's, farmers observed a continuous decline in the apple economy for a period of 5-10 years, due to which apple farming eventually phased out from the area (Table 7.1)

Table 7.1: Farmers' apple economy during the boom period and the changes

Parameter	Average Value	Range
Farm size (ha)	2.71	0.56-8.00
Orchard size (ha)	1.89	0.16-8.00
Contribution of apples to household income (%) at the boom period just before phase out	For 25% of the farmers apple contributed 100% of household income	-
	For 50% of the farmers, apple contributed 88% of house hold income	75-95
	For 50% of the farmers, apple contributed 43% of house hold income	35-50%
Apples planted (year)	1956-69 (mostly early 60's)	-
Apples removed (year)	1980-95 (mostly in 80's)	-
Phase out period	5-10 years (started declining in early 80's- abrupt to phase out manner)	-

The decline in the quality and productivity of the apple crop was a gradual process. Respondents eventually observed a 2/3 reduction in total apple productivity as compared to the boom period (Figure 7.1). Of the surveyed farmers, 95 percent reported an annual decline in profit of between 10-25 %. The majority (60%) claimed an initial decline in yield, followed by a decline in the quality, and the rest an initial decline in quality

Figure 7.1: A bar graph to show the contrast between the apple yield during the boom and decline period (1box=10Kg)



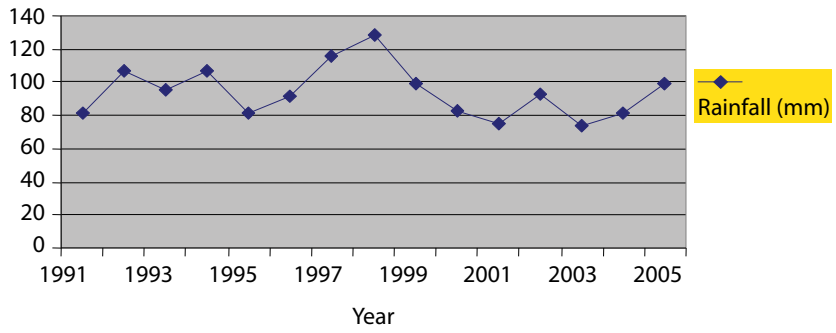
The validity of the results used in the graph above is reinforced by the strong correlation coefficient of 0.7 between the yields at the two different points of time. This value signifies that the results very closely follow the same pattern for all of the twenty farmers.

Climate change and disappearance of the apple crop in the lower valley (Location- A)

For good quality and yield the apple trees require a chilling period of about 90 days in at least 4-5 inches of snow and a moderate amount of rainfall during monsoon season to provide enough water for trees to grow. Without which, the crop results are not satisfying and the colour of the apple is especially affected. All of the farmers observed various climate changes (Fig 7.3).

From all the surveyed farmers responses and what can be deducted from the reducing colour development of the apple crops in the lower area is that temperatures have been steadily climbing. As a result, winter seasons became shorter and slightly warmer, depriving the apples of their chilling requirement. Presently, it does not snow in the surveyed areas during the winters and the summer season has also lengthened. The weather station at location-A, recorded a general increase of around 1°C in average annual temperature and irregular precipitation pattern during the last two decades (Figure 7.2). Furthermore, 35 percent of the farmers reported experiencing increasing drought and dryness during these past years. The key informants, reinforced the fact that precipitation patterns/ rainfall etc. became irregular and erratic, due to which a lot of the apple trees dried up. Sudden hailstorms bruised and damaged the crop, immediately reducing its value in the market.

Figure 7.2: Annual rainfall (mm) in Bajaura, lower valley, Kullu (Source Weather Station of CSK Rainfall (mm) Himachal Predesh)



The size, shape, weight and colour of the apples were impacted. Large apples with a symmetrical shape and full colour fetch a greater value in the market. However, what the farmers in the lower areas harvested were much smaller apples, without the right shape and poor colour with little shine. Therefore, the apple yield received poor or in some cases, no marketing by the end. This was especially seen in varieties such as Red and Royal Delicious which are known for their red colour, as they suffered the most and farmers were unable to profitably market these varieties due to the poor colour development.

Table 7.2: Impact of climate change on apple marketing and income (percentage of farmers' responses)

Parameter	% of responses
Poor or no marketing; low price due to poor fruit quality and low production	100
Rate of profit decline per year during downfall decade	
10-20%	45
20-25%	40
35-40%	15

Infestations and crop care measures

With the change in climate, farmers faced increasing challenges as the altered climate became hospitable to new pests and diseases, causing various problems such as root rot, canker and drying trees (Table 7.3). All of the farmers including the key informants confirmed the attack of the fungal disease called scab that struck in most parts of the valley and caused havoc during the 1980's. It affected the apple crops very harshly, reducing their market value even further. Farmers reported a substantial annual reduction in profits as is highlighted in Table 7.2.

Table 7. 3: Folk indicators of climate change impact on apple farming and orchard management practices (percentage of farmers' responses)

Parameter	% of response
Attack of pests and diseases; Scab	100
Other diseases (scale, root rot, canker, drying trees etc.)	80
Use of pesticides	100
Increase in use of pesticides	100
Use of fertilisers	100
Increase in cost of production and lower profits	100

Additional Comments

Earlier only TSO (tree spray oil- insecticide) was used; since the 80's new pesticides were introduced and use increased

To save their crop from the increasing disease infestations, 100% farmers responded to the situation by applying more fertilisers and pesticides to protect their crop and thus maintain output. This increased the cost of production lowering the profit. The short term primary effects of these substances on these crops were positive, nourishing the crop, maintaining the quality and controlling the responsible pests and diseases. However, not long after, the pests became resistant to the pesticides. These chemicals were, furthermore, killing many of the beneficial insects which included natural pest enemies and hence reducing their number drastically. Most significantly, the honeybees which are responsible for cross pollination, declined amazingly. Reduction in pollination in turn affected fruit set which eventually led to much less yield than the potential amount. Questioned farmers also recognised the degrading impacts pesticides have on human health and soil fertility. Fertilisers, although beneficial for crops in the short run, have many detrimental impacts. The fertilizer use makes the soil turn hard, forming tough clumps and also further affects the beneficial soil fauna such as earthworms that help keep the soil fertile and rich. In the long run, fertilisers degrade the fertility of the soil. Table 5 summarises the effects of excessive pesticide and fertiliser use.

Table 7.4: Effects of excessive use of fertilizers and pesticides on the apple crop (farmer's response)

Positive effects	Fertilizer	Pesticides
	Helped maintain crop yield and quality	Killed Pets
		Controlled Diseases
		Helped maintain crop yield and quality
Negative effects	Long term soil quality and fertility adversely affected	Resistance of pets increased
		Beneficial insects (pollinators and natural pets enemies) killed.
		Negative impact on soil (micro fauna) and health
	Soil become hard	Pollination affected, pest population increased
	Affects beneficial soil micro fauna (Earthworms etc.)	Bad for human health

All of these problems collectively affected the apple crop, contributing to low productivity/quality and low market value. The numerous pesticide and fertiliser sprays used on the crop increases the cost of apple production further. This adds on to the problems of apple farmers with the declining economy. Eventually, as 100% of the farmers stated, high costs and low revenue gave low profit which later on started turning into losses.

Post Apple Farming Period

The phasing out of apples in the lower Kullu Valley area was a result of a chain of reactions triggered by the change in climate. After this, farmers shifted to other crops and diversified their income sources. However, it is reflected from all surveyed farmers that they did not completely abandon farming practices. They continued this activity and diversified to other crop options.

Photo- 1: Tomatoes planted in plum orchard in Lower valley which was previously an apple orchard (Source Bhoomika Partap)

Out of the total, 60 percent of the previous apple orchard owners are now utilizing the land to grow vegetables and other fruits for commercial purposes (Photo- 1). Over 50% of the respondents are also growing wheat and maize for subsistence purposes alongside other crops. Today, 60 percent of the farmers rely on farming for 91% of their household income whereas the rest have other sources which make up 55% of their present income such as government jobs and land dealing. Although the health aspects were not covered in the survey, during discussions, farmers revealed incidences of diseases such as cancer, high blood pressure and kidney failure increased during this period.

The survey also reveals that it took most farmers (65%) 4-5 years to restore their farm economy after the apple farming left them in loss. A greater percentage of respondents said they ended their apple orchards abruptly. They did not slowly shift to other crops while still waiting to see if the apple economy would restore itself as most of them could not afford to do so. The major vegetable crops grown in this area nowadays are cabbages, tomatoes, brinjal, potatoes and chillies, and the major fruit crops are plums, pomegranates etc.

The variety is quite large and 40 percent of the questioned said it was much more beneficial than apples, 45 percent said it was less beneficial while 15 per cent said that it was almost the same (Table 7.5).

Table 7.5: Land use after the phasing out of apples (% of farmers' responses)

Parameter	% of response
Crops replacing apple farming	
Vegetables and wheat/ maize	20
Vegetables, fruits and wheat/ maize	35
Vegetables and fruits	25
Fruit only	20
Contribution of current crops to household income (%)	
Av. 91 (65-100)	60
Av. 45 (35-50)	40
Comparative economic benefit of present crops to apples.	
More beneficial than apples	40
Less beneficial than apples	45
About the same	15
Time taken to restore farm economy after apple decline	
2-3 years	35
4-5 years	65
Change from apple to other crops	
Process oriented	40
Abrupt change (removed orchards immediately	60

Additional Note:

Wheat maize is only grown for self-consumption

Vegetable crops include: Cauliflower, cabbage, tomato, brinjal, potato, chillies

Fruit crops include: Plum, pear, pomegranate, kiwi, persimmon, peach, almonds, walnut and pecan nut

Analysis of Survey Findings

In this area, the apple economy failed due to the general rise in temperatures throughout the valley and subsequent changes in the local climate. It is clear that apple farming cannot be resumed now as the climate does not support it. The failure of apple farming affected the household economy of farmers as their income source was hindered, pushing many of them into loss and causing financial difficulties. Apple cultivation saw a major negative impact of climate change in this area.

However, the climate change supported cultivation of other crops. It is an

undeniable fact that the figures show that quite a large proportion of previous apple farmers are benefiting from their present farming activities. Figures in Table 7.5 emphasise that for 55 percent of the farmers, the farming options of the post apple period are proving to be economically more or equally beneficial than apple. The climate change that pushed them through a painful experience for a short period of time made all this possible. Diagram 1 shows the process of impact of climate change on apple economy in lower valley.

Diagram 1: Flow chart showing the process of change in the apple economy in the lower valley of Kullu, as described by the Key informants

LOCATION B: Northern end of Upper Kullu Valley which saw apple boom period

Similar to Location A, this area predominantly consists of small and marginal farmers. They have planted orchards on 42% of their land and of all the farmers interviewed, apple provides over 80% of the household income for 90 percent of them, with 50% of the total being fully dependent upon the income brought in by apple farming. It highlights how crucial and beneficial this activity is proving for them in supporting their livelihood.

Table 7.6: Farmers' apple orchard holdings and income levels of surveyed households

Parameter	Average Value	Range
Avg. Farm size (ha)	1.46	0.56-3.2
Avg. Orchard size (ha)	0.62	0.08-1.04
Contribution of apples to household income (%)	For 50% of the farmers, apple contributes 100% of family income	-
	For 40% of the farmers, apple contributes 80% of family income	70-90
	For 10% of the farmers, apple contributes 41% of family income	30-50
Changes brought by apple economy in living standards and social development	Increased expenses on education, health, piped drinking water, better housing, electricity, phones, vehicles	-
Apple orchards planted (year)	1963-85 (some in mid 60s but major plantations in 1980s)	-
Difference in household income brought by apple farming	Apples improved family income significantly i.e. Avg 50 times (e.g. from Rs 2000 to 100,000)	-
Crops introduced alongside apples	Nothing, but farmers continued to grow food crops (rice, pulses, mustard, vegetables) for their own use	-
Farmers still expanding apple plantations on new plots		
Yes		80
No		20

All farmers reported that the income generated from apple farming was much more as compared to their previous farming activities (Photograph 3). It enabled them to improve their housing, provide their children with better education and increase their living standards and social status in general. The apple trees were planted by farmers between 1963- 1985 and a majority of the farmers continue to expand their orchards (Table 7.6)

A comparison to the pre-apple farming economy

Before farmers in the upper valley areas shifted to apple farming, 50 percent of farmers said they heavily relied on cultivation of crops such as barley, wheat and millet for self-consumption. The other 50 percent depended on income from livestock rearing and pastoral farming. Overall, their subsistent needs were hardly met and income sources were low. Previously they earned their livelihoods by selling livestock and wool.

Table 7.7: Factors behind shift to apple farming in villages of Upper Kullu Valley and other income generating activities before and after apple farming

Parameter	% of response
Why apples were not planted before	
Unsuitable climate (heavy snowfall, low temperature)	50
Lack of awareness/ uneducated	50
Changes that made apple growing possible	
Increased awareness/ education	40
Suitable climate (appropriate snowfall and temperature)	10
Both climatic suitability and awareness	50
Crops/ activities replaced by apples	
Cultivation of subsistence crops(barley, millet, maize and wheat) reduced	40
Pastoral farming (sheep and goat herders)	40
No response	20
Type of farming before apple orchards changed farm economy	
Subsistent crop-livestock farming	10
Semi- nomadic pastoral farming (sheep & goats)	60
Partly both of the above	30
Present side activities taken by family members to supplement family income	
Tourism services	60
Tourism related shop keeping in season	20
No response	20

Photo-2: Expanding Apple orchards of Kothi village farmers towards Rohtang pass. Source: Bhoomika Partap

Expanding apple orchards in the highland Village of Kothi

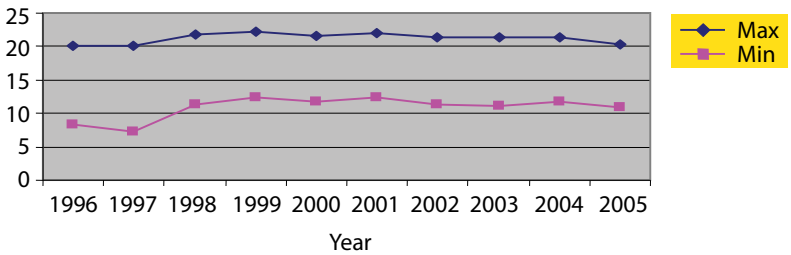
The Kothi area was taken for the study as it was situated at the top most part of the apple belt at 2500m where apple farming has recently begun. Information gathered through using only key informants revealed that apple farming just started in the area about 15 years ago and the activity is still at the initial growth stage (Photo 2). The harsh climate and massive snowfall of 5-6 feet did not support the conditions necessary for the apple growth earlier. In comparison to before, the temperature has risen slightly and the amount of snowfall has decreased slightly with that. At present, yield is low and not enough for full blown commercial purpose but the apples are of top quality.

Most of the farmers said they were uneducated about such activities, but when awareness of alternative income generating activities spread, foreseeing a greater economic benefit in apple farming, they shifted towards apple planting. Half of the farmers also mentioned that previously, the climate to plant apples was not suitable. Apple trees before would not survive in the harsh climate with too much snowfall. However, with increasing temperatures throughout the valley, the climate altered and became accommodating to the apple crop. Apart from apple farming, 80% of the farmers are also engaged in the tourism sector to generate and further supplement family income. These range from taxi service to guides etc (Table 7.7)

Climate Change

All of the farmers indicated that the glaciers were retreating. The data below also reveals a general increase in the average annual temperatures. Lower and increasingly irregular rainfall had led to altered weather patterns and changed season lengths (Figures 7.3 & 7.4). Previously, farmers could only plant crops from May to June. From October onwards, heavy snowfall was liable to damage the crops. However, now cropping season extends from as early as March to November. The factor that seems to pose the most threat for the future as 100% farmers pointed out and agreed upon, is reduced snowfall, the essential 'white manure' for apples. In the upper areas climate has altered from being too cold to being hospitable to the apple. Many expressed concern that continued change in climate may eventually make it too warm to grow apples, like in the lower areas.

Figure 7.3: Changes in average temprature in upper valley of Kullu over the last decade. (Source: Temperate Vegetable Research Station, IARI, Katrain)



The graph above does not show any drastic change in temperature. The slight overall rise is just visible. However, this slight rise has had a great impact on overall climatic conditions in the area. In Diagram 2 we see how climate change affected apple economy.

Figure 7.4: Average annual rainfall (mm) recorded at Katrain upper Valley of Kullu (Source: Temperate Vegetable Research Station, IARI Katrain)

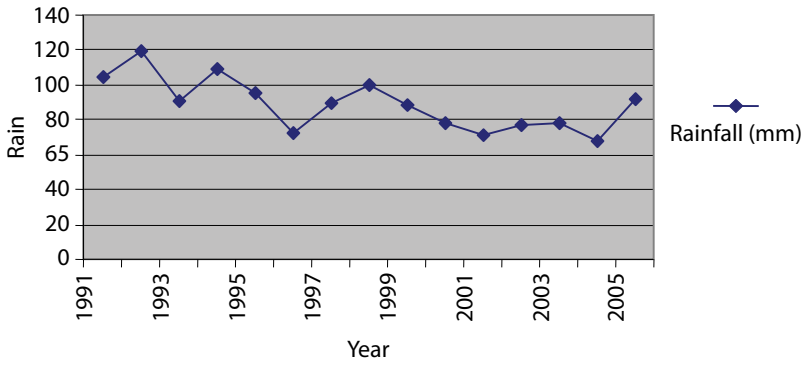
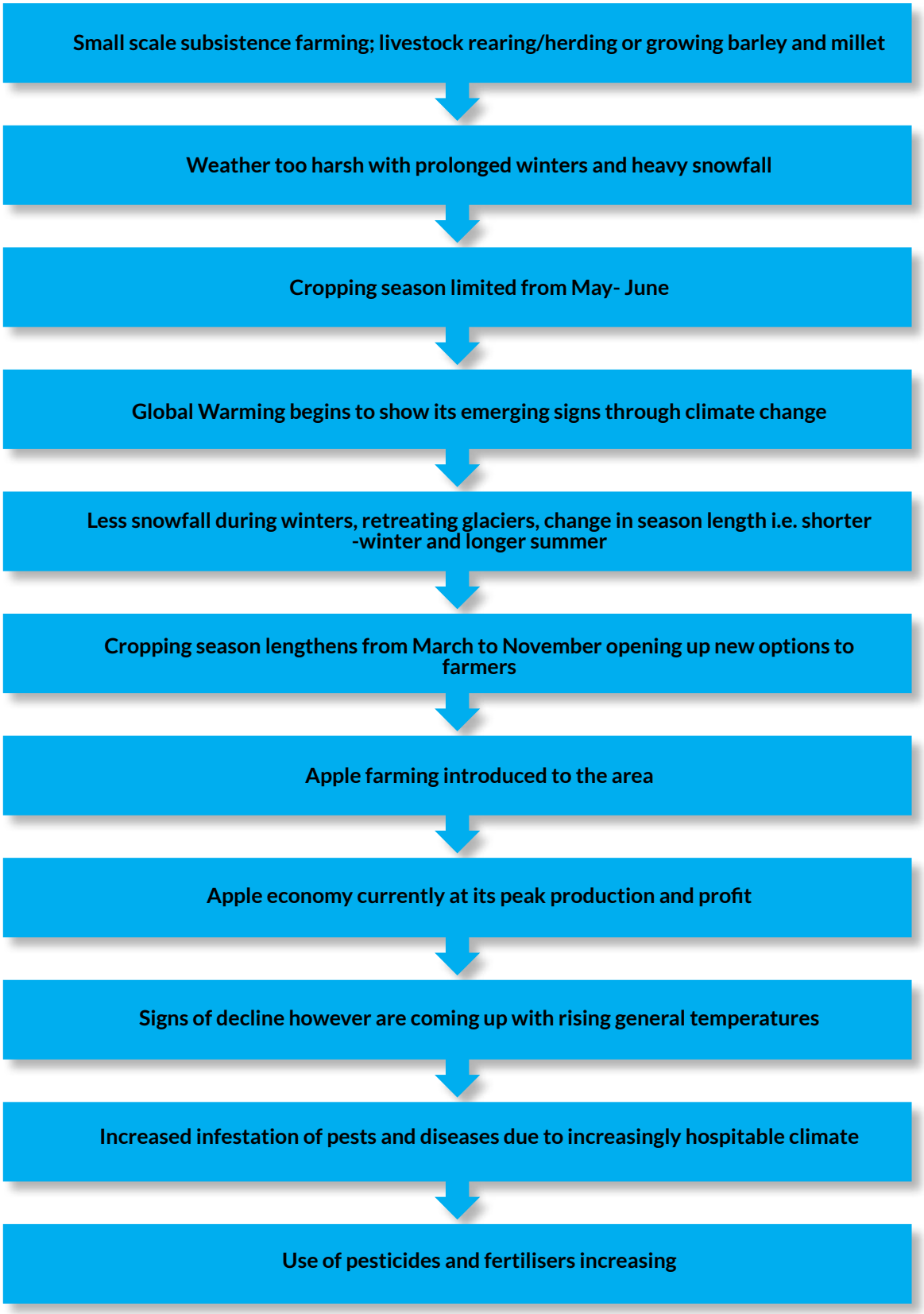


Table 7.8: Folk indicators of climate change and impact on apple farming

Parameter	% of response
Farmers observations of climate change (less snowfall, increased temperature, glacier retreat, change in seasons- long summers, short winters and changed rainfall pattern)	100
Attack of diseases and pests	
Yes	90
No	10
Use of pesticides and fertilisers	100
Increase in cost of production	
Yes	90
No	10
Impact on pollinators	
Population reduced due to pesticides	70
No awareness	30
Quality of apples	
Good	40
Good, but not as good as twenty years ago	60
Is apple farming still profitable	
Yes	20
Yes, but not as profitable as before	80
Replacement of apples being considered	
Yes	0
No (even with rising costs of production)	100

Diagram 2: A flow chart showing the process of change in the agricultural economy of farmers in the Upper Kullu Valley



Conclusion

The study establishes one type of the effects of global warming on cash cropping based Himalayan agriculture/ horticulture which people are experiencing. Climate change forced these mountain farmers to abandon one set of crops and adopt new ones. The unsuitable climatic conditions made it uneconomic and unprofitable for farmers to continue growing apples in the lower valley while it made it possible to grow them in the upper valley. Although some farmers may be unaware of the global warming concept, they are nonetheless conscious of increasing average temperatures in their area over the years and the increasingly unpredictable nature the weather has acquired such as erratic precipitation in both upper and lower valley regions.

Apple has always been one of the primary fruit crops and a major source of income for the Himalayan farmers, particularly in Kashmir, Himachal, Uttarakhand, and Arunachal Pradesh. However, due to climatic change it has been forced to be abandoned in many areas. Failure and near extinction of apple farming in whole of Sikkim state, is a case in point.

The study revealed that in the lower valley areas, the main reason why the apple economy crashed was due to poor yield and quality. This was the result of climate change combined with already low market prices for the apple crop which thus, fell even lower.

The previously prospering apple farmers in the lower areas went through a painful decline process, however the identification of new farming options such as vegetables and other fruits, coupled with government support resulted in a positive outcome. Climate change opened up new and more profiting farming options to the lower valley farmers.

Similarly, in the upper valley, the altered climate encouraged the adoption of new crop options i.e. apple farming, which brought prosperity into the household economies and society. The area saw a general ascent in living standards of most farmers.

The agricultural sector is highly sensitive to climatic conditions of all human activities and easily impacted. In this case we saw the upward shifting of the apple belt and the discovery of better/new options. However, the change may not always be positive.

Here we land on one of the uncertainties of climate change impact on agriculture which leaves us with many unanswered questions. What impact will climate change have on world agriculture? How long these diversified options last before the climate will takes another turn?

There is definitely a visible knowledge gap between present and the future impact of global warming on Himalayan agriculture. More research needs to be carried out to gather pool of micro level evidences for different agriculture systems, crops, geographic areas to enhance our understanding of likely impacts of climate change. However there is no doubt that these changes will bring about major transformations in farm economy in different areas of the Himalayan states.

Overall, this research evaluates the long term and short term effects of global warming on apple farming. The results of this investigation give us an understanding of future of apple farming if the rising effects of climate change are not curbed.

Developments by 2018: Enter Technology to neutralise climate change impact

Around the beginning of the 21st century, based on experiences of the past few decades, there was a general perception that the temperate crops which provided niche based comparative advantage to mountain farmers in the Himalayas, will move upwards in search of suitable climatic conditions. Apple, the leading crop of the Himalayan region, provided one such good example. Around 2001, mountain farmers had two things in mind, one the apple orchards in the valleys have to be replaced by something else; pomegranates came in the apple valleys because of that. While apples vanished from lower valleys areas of Himachal Pradesh, and northern warmer valley area of Kashmir faced poor crop conditions, in Sikkim there was near extinction of apple farming.

By 2010, trials on new low chilling apple varieties were initiated and by 2018, new low chilling early maturing varieties, with better market appeal/ value are already being grown by the farmers. The new technological break though has made it possible to revive apple farming in areas where it was either abandoned or had a looming threat of abandonment. There is a new thought now, with respect to apple farming / temperate fruit farming in the Himalayas, "APPLE BELT CAN NOW EXPAND BOTH WAYS". Global warming is making it possible to expand apple farming upwards into higher Himalayan ranges and technological advancements are making it possible to move the apple belt down wards, including those areas from where apple crop had earlier vanished. In the present case study in the areas where apples were reported moved up in 2009, they have come back into the same area in 2018 all because of technology.

The story of apples, thus explains, that like apples, technological advancements can negate the negative impact of global warming in several other crops. However, for that, planning public interventions in ways that effectively reverse the negative impacts is a necessary condition. That is why apples may have come back or may be coming into the same old areas in Himachal Pradesh and in Kashmir but apple farmers of Uttarakhand, Sikkim and Arunachal continue to be sufferers of global warming w.r.t failure of their apple farming.

Note: This whole chapter is sourced with acknowledgement of authors Partap and Partap (2009)

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CHAPTER

8

GLIMPSES OF FUTURE - NEW AGE HIMALAYAN FARMERS

The stories of New Age Himalayan farmers, gathered from the field under this project, revealed evolving pathways leading to transforming mountain agriculture based livelihoods and the challenges of mainstreaming the idea.

The New Age Himalayan Farmers - who are they?

There are an upcoming of individuals or groups, across the mountain states, who are reinventing in farming by introducing new techniques and learning to show the way how farming can also be adapted and considered beneficial. Hence 'New Age farmers' are using creative and innovative ways to overcome limitations of small farm size and limited production. They come diverse backgrounds; educated youth from farming families, engineers, professionals, company executives, scientists and many others. Therefore, information was gathered from across the Himalayan region about them. Stories of these farmers helped understand the emerging concept of New Age farmers and helped in deriving learnings from New Age Himalayan farmers' experiences on the challenges and opportunities for mainstreaming the idea.

New Age Himalayan Farmers Speak about their perceptions and experiences

The one thing in common for the new age Himalayan farmers is their knowledge and innovation based approach to farming. Their engagement with farming was not for survival alone, nor did they see it as an unprofitable vocation. They are taking farming as a profession and their aim is to make it as much profitable, and economically lucrative agri-business for themselves and for several others who get associated with them. The stories of these individuals, offer a glimpse of the new generation of farmers and how there is a shift in farmers behaviour towards selecting niches, production processes, managing supply chains and marketing and aiming at higher economic returns from farming. Not only that, innovations in collectivization in farming, value chain development and marketing, is emerging as a necessary mechanism to enhance power of other small farmers.

The old apple orchards of Kashmir have been raised from seedlings and give maximum yield of 7-10 t/h to the farmers. Quality fruit is about 35%. The traditional post-harvest chain is too long and non-value added, resulting in wastage of 25% of fruit and loss costs 32% of expected returns. FARM2U, a dream project of a Kashmiri agribusiness entrepreneur, is a blue print of paradigm shift in the way apple farming will be done in Kashmir. Intervention areas of FARM2U have been carefully selected from among the key constraints that apple farmers of Kashmir are facing; such as problem of old orchards, low yields, planting material, poor grading practices, cold storage and branded marketing. FARM2U expects to increase productivity of apples upto 35-40 t/h, bring down wastage to 25-13%. FARM2U estimates that with efforts like theirs, by 2031, Kashmir will help India produce an average of 6.7 million MT apples, up from 1 million MT. This is more than six times the present production of apples annually, hence, upscaling apple economy from Rs. 5 thousand crores to 45

thousand crores (with additional gains from improved quality)

Sikkim Shoten network, an agri-business co. set up by two Dhakal brothers, few years ago, aims to help raise farm income of hill farmers of Sikkim who have been cultivating maize, millets, pulses and paddy. Shoten network started with two crops: i) Yacon, an Andean tuber crop, and ii) Shitake mushroom. The business model planned seeks to maintain crop material, supply crop material and provide guidance on growing with buy back guarantee. It also focuses on investing in processing and marketing. The network strategy is designed to counter the constraint of farm size of mountain farmers. Shoten network is doing a successful agri-business through building backward linkage with farmers for growing the crop and managing forward value chain by themselves. Yacon being a new food crop to the Himalayas, the challenge for Shoten group is about popularizing it as nutritious food. They are processing and marketing its products as breakfast food. Hotels and restaurants in Sikkim have been made partners in popularizing the products of yacon tuber. Shoten's grouse; however is lack of access to technological support services. Even while there is lot of political good will in favour of the Shoten network, but lack of R&D institutional facilities in the state makes it expensive

> *"I thought no one was talking about transforming mountain agriculture in Sikkim, the way it should have been, so two of us brothers decided to take the initiative"*
>
> **Abhinandan Dhakal,**
> Shoten Network

> *"I am asking for no subsidies, but only if trade and transport bottle necks (policies and regulations) are taken care, and technological backstopping facilitated, we young entrepreneurs can work wonders."*
>
> **ChowAmat NamChom**
> Arunachal Spices, Namsai Arunachal

Arunachal Spices Co. of Chow Amat Namchom from Arunachal Pradesh, aims to build a king chilli flavoured Arunachal Spices brand- "Amat". With initial hiccups, his Arunachal Spices Co. is now growing its domestic and export portfolio. His current concerns for further growth include developing marketing linkages, setting up a manufacturing company, developing products, and assistance in B to B meetings.

Organic Kiwi wine Co. "NAARA-AABA" of Rita Tage, the daughter of Apatani tribal farmer of Arunachal. She returned to the village after agriculture engineering degree and planned for organic Kiwi wine "**NAARA-AABA**. Her village was full of Kiwi orchards and fruit was available in abundance and it came at a very low price. Farmers were not able to sell their whole produce. She worked on the plan and her efforts bore fruit when finally on October 26, 2017, she launched her ORGANIC KIWI WINE "NAARA-AABA". She calls her NAARA-ABA organic kiwi wine, a farmers pride and consumers delight". Her concerns include lack of skilled service providers, assistance in export promotion and cold chain. Additional issues of concerns are lack of technological assistance for managing kiwi orchards well, including managing pollination for enhancing fruit quality and production.

Himalayan Research Group (HRG) led by Dr Lal Singh, Himachal Pradesh, uses scientific knowledge and skills, to build a unique model of a business cum social enterprise, that he runs with his colleague scientist. He used his research and technology background for mushroom cultivation along with the local households of Junee valley and trained them in mushroom farming, and helped them set up their own mushroom farming facilities. HRG managed and provided both supply of mushroom spawn and compost to the farmers, with no charges. Input costs are deducted later from the earnings made. In these 20 years, HRG's mushroom agribusiness, essential oils and medicinal plants farming has changed lives of many households. The combination of non-conventional options for local farmers would not be possible without technical and marketing help of HRG.

Ram Lal Chauhan, an apple and pear farmer has made high economic returns (by mountain farmers' standards). He invented the art of producing high quality fruits by rejuvenating his old orchard. Among the fruit famers of Himachal, he is known for his very high average annual returns (Rs.10 million to 15 million) from his two hectares of orchard. He has been importing planting material from USA and Europe, which he picks up regularly visiting orchards and nurseries in USA and Europe. His Ram brand fetches a premium price in the market Ram Lal is one good example of new age farming who also works as a supplier of bud wood bank of new varieties, as well as a consultant on how to rejuvenate old orchards with new varieties of apple and pears for better quality, production and marketing.

Sudhir Chadha has an established floriculture agri-business and imported fruit plantation, He has set up training facility for floriculture where he invites, aspiring youth and horticulture students from universities for hands on training. The agri-business of Sudhir Chadha, located in the foot hills of Uttarakhand near Nainital is a registered floriculture and fruit planting material training cum supply firm. He also provides consultancy services to farmers for establishing modern high density apple orchards.

In Kalimpong, Bishnu Chhetri leads 18000 small farmers grouped in 240 clubs, who have come together for collective good. They have collectively created enabling environment for harnessing opportunities to save themselves from

non-viable farming and threatened livelihoods. The first initiative of this sangathan was saving the native siri-cow from extinction. The second initiative was collective action for reviving the orchid farming through collection, conservation and cultivation of indigenous species of orchids. Farmers collected over 130 species of wild orchids and Sangathan planned and managed there commercial farming, value addition, supply chain management and marketing. Many other projects run by the Sangthan aim at reversing the trend of non-viable hill farming into profitable agribusiness propositions.

Zaikima's Mizo Youth Initiative (MYI), a producers company, brings small farmers together to enhance their collective capacity to do something they would not be able to do alone for transforming their traditional hill farming-Jhum cultivation. He provides leadership for collective action by the shifting cultivators of Mizoram. It has created an enabling environment for enhanced opportunities for improving their subsistent livelihoods through commercial farming ventures such as Anthurium, organic vegetables production and livestock rearing.

Naga Foundation of Sethrichem in Nagaland plays the role of an NGO as well as Farmer Producer Organization. It aims at transforming lives of shifting cultivators in Nagaland by replacing Jhum farming to permanent agriculture systems using horticulture , agro forestry and tree farming as options. It is leading an enterprise on farm home stays and innovations in weekly markets for better benefits.

The Signals stories of the new age farmers, are giving

The stories of these new age farmers showed that there is a way for a positive hope. The stories of these farmers indicate that mountain agriculture has a future but for that adopting new farming strategies and perspectives are needed. Presently, knowledge deficit exists Mountain agriculture will benefit largely from such knowledge pool and hence we need to follow a differentiated approach. New Age Himalayan Farmers thinking can be considered a new approach for reviving farming in the mountain areas. Looking at how farmers envisioned innovated and executed their new age farming strategies, new age farming perspective appears as a fountain head of agri-entrepreneurship. The messages emanating from the stories indicate that it is no longer a single man's job to lead the transition into successfully transforming mountain farmers farming based livelihoods. From single farmers to collective efforts for profit making, the stories offer range of fine examples on how to scale up the non-viable farm economy of small mountain farmers into promising viable farming economies. In this context the important point emanating from stories is that the key area we have to learn a lot, in order to succeed, is "collectivization". It will be a buzz word of future farming strategies for the mountains. For achieving success mountain agriculture is no longer a single person business, it requires cooperative approaches of all kinds to evolve several models

> *"We must recognize that time has come to recognize the professional skills of these new age Himalayan farmers. Thereis need to consider them for a new role, even as Farmer Professors in farm Universities"*

One of the major changes in mountain farming systems is about transition from subsistence systems to commercial systems, promoting fewer commodities and fewer production systems, which is in total contrast to diversity of traditional farming systems with huge diversity/wealth of commodities. The consequences are; i) the value chain is long, by and large, ii) implications of environmental impact are high, iii) there are weak organizations w.r.t. agriculture, social technology, organizational technology/innovations. From the niches view point, the new age apple farmers stories can be impressive because this niche crop leads the fruit economy of the Himalayan region

An environment where perspective thinking, policies, and appropriate technologies for mountain agriculture are so weak, will increased focus on markets for increasing income of farmers always help bring meaningful change towards new age farming? Institutional interventions, whenever they happen, focus on the need for science based initiatives which should help in increasing famer's income, linking them with markets. It is a subject matter for further debate and for that to continue organizing platforms like this one is essential.

Threatened farming cultures, be it yak and pashmina based pastoralism in Ladakh and Sikkim or food grain based mixed farming in Uttarakhand hills, are indicative of mountain farming communities who are shifting livelihoods away from farming.. Fall out of degeneration and extinctions of farming cultures / agro-ecosystems will have a bearing on larger mountain society and mountain ecosystem.

Implications of Evolution of New Age Farmers

Mountain agriculture should be a knowledge initiative, in which revival of mountain agriculture through entrepreneurship or as "New Age farming", be focused on searching niches for (a) Fruits/Apple/Floriculture, (b) Agri-tourism & (c) to create value addition with success stories, like AMUL. The way forward is to approach agriculture as industry / agribusiness, rather than harping agriculture as culture alone or a traditional way of life. There has to be a shift in thinking, leading to a new paradigm of farm policies, and creating an enabling environment for new approaches to succeed.

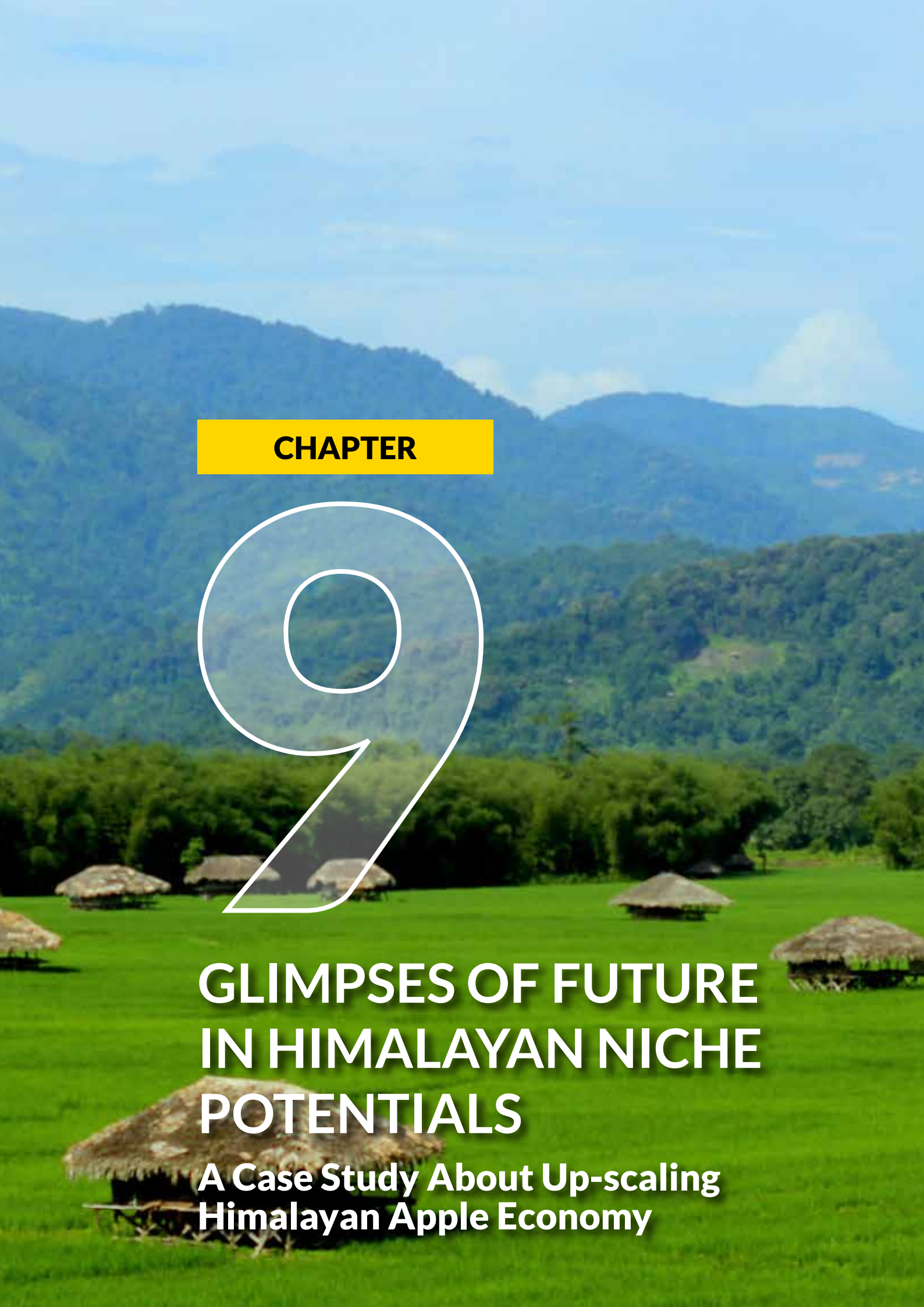
There is immense potential for new age farming but in order to mainstream it, we need to keep adopting new technological and institutional options. The local contexts should also be taken into account so that adequate options are available to the requirements of every mountain farming community. while discussing green economy and new age Himalayan farming, public policies and interventions need to ensure two things; i) green notes coming out of new age

farming. That means promoting use of such technologies and practices which confirm to green economy perspective; ii) ensuring secure and strong market linkages for the farmers. The age old subsidy culture in farming has to give way to incentives approach rewarding those who dare experiment and succeed.

There might be better options for many specialized mountain agro-ecosystems, that remain unexplored. Farmers are doing what they can do and it is imperative for public interventions to put in place mechanisms for such facilitating R&D support services for new age farmers Counting bottle necks to promoting new age farmers concept, planning and strategy making both are weak areas of the Indian Himalayan states and that they simply have poor institutional capacities for it. Therefore, the challenge is for linking capacities horizontally, everywhere, in universities, in governments and their line agencies.

We must recognize that our institutions and people charged with agriculture development in the Himalayan states face a paradoxical situation. We must take into account where the new thinking is coming from; which are new age farmers. As a result, the support systems in place should be able to provide right kind of support needed by the hill farming communities. There can be a number of line departments of governments of the Himalayan states, but there is no single window for serving the farming community. Under these circumstances, to create an enabling environment for the kind of platform needed to promote the idea of new age mountain farming and farmers, flattening of hierarchies in our institutions will be important step forward.

The experiences of the new age Himalayan farmers serve as valuable knowledge inputs to chart out new pathways for transforming the farming economies of households, villages, valleys and farming landscapes elsewhere. A strong back up support of R&D institutions for technological services, in addition to necessary social engineering innovations is essential for mainstreaming new age Himalayan farmers movement.



CHAPTER

9

GLIMPSES OF FUTURE IN HIMALAYAN NICHE POTENTIALS

A Case Study About Up-scaling Himalayan Apple Economy

Apple is number one fruit crop of the Himalayan Region and 4th widely produced fruit in India after banana, orange and grapes .Presently, in the years of good crop yield, the production and productivity of apples across the Himalayan states is an economy of approx. Rs 15,000 crores. India's apple production rarely reaches 2 million MT. In contrast, China produces 43 million MT of apples with average productivity levels of 18 MT/h). Globally apple productivity average is 15.5 MT/hectare. Countries exporting apples to India, namely, USA, Australia, New Zealand, Europe and China all have modernized apple farming as agri-enterprises focused on domestic and export markets. All leading apple growing countries, today, depend on the use of new technological advancements in varieties, root stock, plant husbandry, and post-harvest management and state of art marketing means.

Can apple economy of Indian Himalayan states be up scaled over six times to make it Rupees ninety thousand crore economy of the Himalayan farmers?

What would it mean to Himalayan apple farmers with respect to changes in apple farming practices and to governments about putting in place enabling policy environment?

Analysis that emerged from discussions

Calling all stakeholders on the same platform offered an opportunity to understand the current state of affairs of apple farming in the Himalayan region and gave an idea about what interventions would be required if the apple economy was to be expanded tenfold for maintaining it as a lead sector of the Himalayan farming in future.

> *"There are apple trees but no apples in Sikkim. No agency to find out what went wrong with us."*
>
> **Nedup Bhutia**
> Apple farmer, Sikkim

The present apple area and economy divides the Himalayan region into two distinct categories; one, where apple economy is one of the lead sectors i.e. North West Himalayan states of Jammu and Kashmir and Himachal and two, where apple farming is either stagnating such as in Uttarakhand and Sikkim or is yet to emerge as a promising option of farm economy i.e. North East Himalayan states of Arunachal Pradesh, Nagaland and Mizoram.

Over 3.3 million people of about 300,000 families, both on farm and off farm, are dependent on apple farming in Kashmir. Apple and rice are the two main crops of Kashmiri people and in recent years a trend is evolving where apple orchards are replacing paddy in the paddy fields. It is reflected in the 107% increase in area of apple orchards and 175% increase in production of fruits within two decades. The key issues of apple farmers are aging orchards, pollination, fruit quality and productivity. Shift to clonal root stock, high density plantations and new varieties is in the initial stages, and so far centred around

less than 2% farmers

> *"Kashmir valley is changing from paddy fields to apple farming . For apple farming, Kashmiris' are living on gold mine they only have to use it."*
>
> **Ashraf Thokar**
> Apple orchardist, Kashmir valley

Apple orchards in Himachal Pradesh are largely on rain fed sloping farm lands. Apple economy of Himachal Pradesh is pegged at around Rs 3500 crore. Apple is the most important fruit crop of Himachal Pradesh as it constitutes about 49% of the total fruit production. A good crop year means around 4.4 crore boxes (4.46 crore boxes in 2010) and a bad crop yields nearly 50% of that. Normally production remains in between these two extremes.

> *"We are dictated by foreign root stock and varieties and their choice is our compulsion. It is so sad that no national R&D policy and programs exist"*
>
> **Sanna Masood**
> FARM2U, Kashmir

In Himachal Pradesh, climate change is taking apple farming up wards and increasing access to low chilling varieties and other technological support is taking it down wards not only to areas from where apple had vanished but also to new areas. Apple farmers of Shimla Hills have either innovated ways to rejuvenate old orchards with new varieties, improving both quality and productivity to global standards or they are working to replace old orchards with new high density plantations of new apple varieties, gala, red chief, germane etc, on clonal root stock. Some innovative farmers experiences indicate that it is possible to maintain regular crop, productivity and production if above factors are managed properly.

Some of the innovative pioneer apple farmers of Himachal and Kashmir are getting premium price for their quality produce which is usually higher than the imported apples. This has certainly increased their economic return from apple crop, manifold. It testifies the fact that Himalayan farmers may already be knowing how to manage apple crop for high quality, productivity and marketing and that, up scaling economic return more than six times is possible. The

challenge, however, lies on making it a mass movement.

> *"Apple / fruit sector is under threat today. We are where Italy was 60 years ago. If we do not meet the growing demand for quality apples someone else is ready to grow and export to us, cheaper and better and it will get imported. In 2018, India imported 200,000 MTs even while the demand was for 400,000MTs. Some apple growing countries are even trying Indian consumer market focused apple cultivation, i.e. red and sweet"*
>
> **JC Sharma**
> IAS, Horticulture Secretary, GoHP.

If it is so, question arises on how the potential of up-scaling can be adequately explored. The outcome of discussions among stakeholders pointed to the facts that small holders are continuing with the traditional ways of orchard management, postharvest handling and marketing. The will to change hinges on availability of knowledge, skills, technology, planting material and quality inputs. Studies have revealed that poor quality inputs, especially pesticides, unskilled workers managing orchards like bad pruning of trees, no assured irrigation to fruit laden trees during crop season continue to dominate apple farming in Kashmir and Himachal.

Pioneer farmers and dominating scenario present a paradoxical situation of both gloom and hope, thus keeping both options open to the farmers and governments of the Himalayan states

> *"Consider it a warning signal from trading community. At the ports, imported good quality apples are reaching @ RS 50 per kg and traders care for consumers interest. So, take this message, Himalayan apple growers have only 10-15 years for improving quality and production. It has to be cheaper also; or else you will be eliminated by cheaper and better apple imports"*
>
> **Rohit Maken, Fruit Importer / exporter, Aartiya**
> Delhi market

Apple orchards of Uttarakhand are facing problems of old orchards, outdated varieties, diseases, poor productivity and above all lack of institutional support services. However, otherwise agro-climatically, more apple area could be added. Sikkim shows the collapse of apple farming due to lack of institutional R&D support services. However, in Nagaland and Mizoram, opportunities for starting apple farming are increasing with availability of low chilling varieties. Reports from both states indicate a nascent stage of apple farming with barely few years old orchards.

> *"NE Himalayan states and apple farmers are n initial stage of apple farming. We have no access to research, technology and new planting material. So expanding apple farming in NE will be dependent on efforts to remove these bottlenecks"*
>
> **Dr Moa**
> Deputy Director Horticulture, Govt. of Nagaland

One of the off farm factors that is defining the dawn of new regime of apple economy is the widening consumer base in India with deeper pockets, preferring quality over price and expressing choice of variety. However the new consumer is unmindful of where the produce comes from, imported or national. Therefore, this has given boost to emerging global trade in apples, a scenario of evolving stronger globalized apple economy, and a challenge for Indian apple farmers to overcome. If trade restrictions were removed, imported apples will become cheaper, meaning that the cost of production of quality apples in foreign countries is less than in India. This will be a challenge for Indian farmers, if they have to remain competitive and key players in the domestic market. For apple growers of the Himalayan region, India is a huge market which holds the capacity to consume its production and maintain the need. This need is to improve quality of production and postharvest handling- cold supply chain management for year round availability.

Conclusion

North West Himalayan states of Kashmir and Himachal Pradesh lead the way in apple farming and any upscaling w.r.t. modernizing apple farming, varieties and postharvest handling has to first happen in these two states.

The North Eastern Himalayan states hold the potential of becoming apple economy driven states of the future. They have vast land area which can be put under apple farming, using new low chilling varieties. Apple farming in India is not yet modernized to realize its full potentials and that the scopes exist for improving productivity, area, production and economic returns.

An analysis of the future of apple farmers indicates that Himalayan farmers will need to work out strategies for cutting down cost of cultivation down the

supply chain – and that is an important factor for survival of apple agribusiness by the new age farmers.

Technology, of late, has been helping farmers expand apple farming down wards in lower altitudes having warmer climate and less chilling conditions. Where ever apple farms vanished during the past decades, these areas have gotten new opportunity of apple farming through low chilling HD varieties. The process has begun.

Good planting material – appropriate root stock/seedling stock as well as bud wood of new varieties – all are essential concerns for expansion of the Himalayan apple belt. For cultivation of apples in the lower belts, new skills and technology will need to be acquired by the farmers so as to grow apples successfully in the lower belts.

For modernization of apple production the issues that will dominate efforts include HDPs, clonal root stock, new varieties of apples, indigenous Himalayan varieties of apples, innovations in rejuvenating old orchards, better infrastructure for post-harvest handling and better supply chain mechanisms.

There is also a small basket of indigenous varieties of apples with the Himalayan farmers which hold the potential of specialized niches and produce, for tomorrow, namely, Ambri of Kashmir, Kirkichoo of Kargil and Tha Kush of Leh Ladakh.

Farmers are yet to gain knowledge of new varieties in order for them to make a decision on what suits their respective agro-climatic and socioeconomic conditions. There has always been one neglected aspect and that is the necessity of apple farmers to acquire new knowledge and skills of modern apple farming techniques. It includes new knowledge about varieties, root stocks, kind of plant architecture for higher yields in a particular farm landscape, post-harvest choices, consumer psychology and strategizing better marketing. Aiming at ten times increase in the apple economy means that for such a thing to happen, it will require deep thinking on designing long term strategies.

Climate alone should not be considered for apple cultivation. So far in the initial phases of cash cropping thrust, it worked well but in the coming years, it will be too small a window of opportunity. Unless other technological and institutional factors are managed ,up scaling apple economy on larger scale cant not be fruitful.

In apple orchards, farmers make money once a year but integrating it with home stays they will make more money throughout the year. That is the concept behind apple farming linked agro tourism and home stays. For apple farming linked tourism there are scopes to expand into orchard management operations, apple varieties knowledge, taste of apple plucking and eating apples from trees and hence involving making visitors involved every kind of activity.

The Himalayan apple farmers have so far been living in the past. Farmers and governments across the Himalayan states have to understand that continuing with old practices of apple farming will no longer help continue apple growing with sustainable economic returns that match 21st century agri-business needs and economic returns. Both need to change and facilitate modernization of farm practices, new varieties, post-harvest handing and marketing to their advantage.

The key apple economy stakeholders – Himalayan farmers and governments – need to start with global aspirations w.r.t. apple economy. These include equality and productivity. If we were to adopt these goals for apple farming today, this has potential to lead us to making brand Himalaya in this sector.

India's first apple mission should be about saving nine thousand crores of rupees that go into importing apples, (a slogan for improving apple production) Market of that scale and the economics, in a way, is readily available for Indian Himalayan apple farmers and Himalayan states. The need for new pathways and strategic planning for further expanding apple economy six times should follow this mission

> *"Vocational training of apple orchardists needed to improve their knowledge and skills about varieties, tree architecture and fruit quality"*
>
> **Mr M. Malik**
> President Shopian Apple Growers Association, Kashmir

A Himalayan Mission Towards Creating Orchards Without Boundaries

This implies creating a landscape of large areas of apple orchards, belonging to different farmers but holistically looking at it as one big orchard in every apple valley of the apple growing Himalayan states. It is expected to lead to collective action by the farmers for both on farm and off farm operations.

This also acts as strategy for building capacities to ensure compliance of food safety standards. It is safe to think that Indian population by this time will be willing to pay more for safe quality food. Hence, vast areas of orchard landscapes providing safe fruits would mean that technological advancements will make it possible to do away with use of harmful chemicals in the orchards. That means, in addition to being sources of fruits, apple orchards can also be sources of clean air, clean water, and clean environment on mountain landscapes and valleys.

Creating a platform of Himalayan apple stakeholders, farmers, R&D agencies and marketing systems is suggested as a strategy that leads to developing concrete ideas and proposals for collaborative action for up scaling apple economy of the Himalayan farmers and states.

CHAPTER

10

GLIMPSES OF THE FUTURE: EXPERIMENTS WITH ORGANIC FARMING BY THE HIMALAYAN STATES

”In a mountainous region in eastern India, Sikkim is now a 100% organic state, with no chemical pesticides or fertilizers and no GMOs. Thus, Sikkim has shown the way that Himalayan states have a strong niche potential for organic agriculture/ horticulture/ livestock production, which may lead Himalayan farmers into the future farming based on agri-business of products with niche and comparative advantage”.

All the Himalayan states have today organic farming promotion programs, offering farmers with several incentive schemes to adopt organic farming. The impact is that there are organic farmers in each state with hundreds of hectares of organic farm land. However, today the leading Himalayan states are Sikkim, Uttarakhand, Himachal Pradesh and Mizoram. States such as Meghalaya, Nagaland, Jammu and Kashmir are late starters but with national thrust on organic farming these states are making efforts to bridge the gap.

The organic agriculture movement started in India around 2001, since then there has been a considered view among the agriculture experts and policy makers that farmers of the Himalayan states have a comparative advantage in adopting organic agriculture. It was based on the premise that subsistent farmers practicing mixed farming were by tradition practicing organic agriculture practices.

Most of the produce of the Himalayan farmers was natural organic (uncertified). It was only those farmers who had moved to cash cropping of fruits such as apples and vegetables for market they were making use of fertilizers and pesticides and therefore needed other kind of efforts to convert to organic.

With efforts of the government of India to fund a nation-wide program for promoting organic farming since 2003 through national schemes on promotion of organic farming, many Himalayan states were early starters to promote

(Source: www.FoodRevolution.org)

organic farming.

Sikkim – the 100% organic state of India

Among the Himalayan states, Sikkim was pioneer state and remains so with its distinction of being the 100% ORGANIC STATE OF INDIA by 2017. The "organic" movement in Sikkim gained visibility in the year 2003 when the Chief Minister, Pawan Chamling, announced the decision to adopt organic farming and to convert the entire state into an organic. The reasons to do so were as follows:

Sikkim's economy is largely dependent on agriculture and tourism, and eco-tourism is a niche area of tourism. Thus, by promoting organic farming, the state government wanted to fulfil the dual objective of supporting agriculture and tourism through the concept of an "organic village." To move forward with this objective, in 2004, the government came up with a working policy to implement programmes for organic farming and in August 2010, it launched the "Sikkim Organic Mission" to implement the action plan and policies related to organic farming in the state.

The target was to convert the entire state into an organic one by the year 2015. The main objectives of the Organic Mission were to frame an organic farming policy for the state, prepare a roadmap of organic farming and implement the programmes of organic farming with a systematic approach for achieving the target set by the state government, develop and explore markets of organic commodities produced by the state and lastly, to develop linkage between the organic farmers and their market.

Sikkim Organic Mission reports indicate that out of a total area of 7.29 lakh hectares in the state, farming covers only about 10.2 percent, and the remaining area includes forest, pastures, barren, and uncultivated land. Sikkim has a diverse range of crops including maize, rice, buckwheat, pulses, soybean, mustard, orange, pears, ginger, cardamom, turmeric, cherry pepper, peas, bean, tomato and potato.

It accounts for the largest share of India's production of cardamom while hardly any chemical inputs have been used in the cultivation of this crop. The state government wanted to covert the 10.2 percent of the cultivable land to fully organic, without making any changes in the crops that were grown.

Implementing organic policies

In its organic policy document, the state government noted that organic farming would reduce the cost of production by 25-30 percent and organic products will fetch a premium price in both the domestic and export markets. While organic farming practices can lead to higher incomes and profits for the farmers, the state government acknowledged that farmers need proper training in organic methods of cultivation and access to good quality organic inputs at subsidized rates.

For this, different programmes were launched which included the adoption of bio-villages, subsidisation of vermi-compost pit constructions, promotion of the use of bio-fertilisers and programmes to ensure the availability of certified organic manures. More than 100 villages were adopted as bio-villages till 2009, benefitting more than 10,000 farmers.

The state government farms in Nazitam and Mellidara were converted to "Organic Centres of Excellence" for conducting organic farming demonstrations and trials. Since third-party certification is mandatory for exports to key markets such as the United States and the European Union, an autonomous organisation, Sikkim State Organic Certification Agency (SSOCA), was set up in the year 2015 under the state government to help farmers get third-party certification at lower costs and as per the standards and norms of different export markets.

Support from the central government

More recently, the state government initiatives have also been supported by several central government schemes under the National Mission for Sustainable Agriculture (NMSA), such as the Paramparagat Krishi Vikas Yojana (PKVY) scheme. This is a centre and state government partnership scheme in which organic clusters are provided financial assistance of INR 50,000 per hectare during the conversion (from conventional farming land to organic farming land) period of three years.

Under another scheme of the central government, the Mission Organic Value Chain Development for North Eastern Region (MOVCDNER), assistance is provided for cluster development, input production, supply of seeds and planting materials, setting up of functional infrastructure, establishment of integrated processing units, refrigerated transportation, cold storage chamber, branding, labelling, packaging, hiring of space and assistance in third-party organic certification for the development of the organic value chain in north-eastern states including Sikkim.

While Sikkim has been praised for its forward-looking policy on organic practices, its experience in developing organic farming has not been free of criticism. Further, Sikkim receives a lot of conventional food products from neighbouring states such as West Bengal, which are sold along with the organic products and thus, there can be an incidence of product contamination. Last year, the media extensively covered how orange farmers have been adversely affected by pests such as fruit flies, leading to a loss of income and market share. Lack of pest control techniques and proper netting can lead to pest infestation leading to huge losses of produce, as was suffered by the orange farmers in Sikkim.

A model to follow

In spite of these issues, Sikkim's experience in moving towards the organic has largely been positive and is applauded by environmental and ecological experts in India and globally. In the first place, the state government showed a strong political will and policy consistency, along with well-defined targets and implementation plans. Similar strategy can be adopted by other states.

Mizoram made partial efforts to follow Sikkim but it remained a half-hearted achievement.

Uttarakhand Organic

Unlike the neighbouring Himalayan states of Himachal Pradesh and Jammu and Kashmir where agro-chemical use became widespread following policies promoting them since 1970s, it was confined to only a few farmers in Uttarakhand hill region as policies did not encourage modern inputs. The

north-eastern Himalaya, like Uttarakhand, had also escaped agro-chemicals but shifting cultivation with 3-4 years fallow periods, predominant in that region, is neither an economically lucrative nor environmentally sound land use.

In Uttarakhand, because of dominance of food grains based rain fed mixed farming in the hills of the state, farmers were more willing to adopt organic farming. By 2010-2011, Uttarakhand had 105,486 hectares of certified organic farmland which by now has increased two folds. Government made an early move to create institutional mechanisms to facilitate promotion of organic farming, so Uttarakhand Organic Commodities Board was established. Along with it, the state also set up its own organic certification agency. Further, Uttarakhand being the native region of basmati rice, demanded for its unique fragrance of large size-non-sticky grains and farmers made early efforts to produce organic basmati rice for export since 2000 and they succeeded too. As the desired qualities of the export variety were achieved under organic conditions, "organic labelling" was just a formal value addition. On its part government of India supported through APEDA, the organic basmati production and export and Terai region of Uttarakhand became the main producer.

Today there are several government incentive schemes available to encourage farmers adopt organic farming, such as Rs 30,000 and Rs 10,000 support to individual farmers for adopting organic farming practices and composting respectively. However most important of all is the state policy on adding organic farming as one of the activities under MGNREGA. Farmers can register themselves for adopting organic farming on their own farm land and get paid under MGNREGA for 100 days in year. It has prompted wide adoption of organic farming by the farmers of Uttarakhand.

The organic food products of Uttarakhand, supplied by several private certified organic producers of the state are now available in the urban markets in Dehra Doon and Delhi.

Renewed efforts of Uttarakhand Organic Program , 2018

The Uttarakhand government has launched a new program to develop nearly 10,000 organic clusters in the mountain region. The state is likely to receive a central government project worth Rs 1500 crore to develop 10,000 organic clusters in the state. The proposed Organic Agriculture Bill of the state, once enacted, would provide legal backing to the government's initiatives aimed at developing the hill region as a full-fledged organic state. "It would be mandatory for private parties, who would be roped in to provide plants and seeds to farmers, to register themselves under the proposed law. The new regulation would ban the use of chemical fertilizers or pesticides in areas selected for organic farming. Besides, the proposed law would have strict provisions for penalising those who would be caught using chemical fertilizers or insecticides while growing organic crop of any kind. Under the new law, it would be mandatory for farmers to get their products certified by the designated agencies. The provisions would also be applicable to the agencies that "provide

plants and seeds etc. to farmers or those (agencies) that undertake value addition of organic farm produce." (Hindustan Times, January 25, 2018)

All such legal measures are aimed at establishing distinct UK organic brand. This will help achieve the objective to establish the mountain state as an exporter of organic produce internationally.

Himachal Organic

Himachal was one of the states where research on organic farming technologies was started in 2003 and the research center was facilitating organic farming promotion undertaken by the department of agriculture. The positive point of state organic initiative was that several food grain farmers adopted organic agriculture. However, because of poor R&D there was no technological support for plant protection w.r.t. horticulture crops. Particularly apple farmers and vegetable farmers of Himachal, even while keen on adopting organic practices they could not get organic alternatives for plant nutrition and plant protection. Horticulture department of the state had negative perception that organic farming cannot be practiced for horticulture crops. Despite this, there are several ORGANIC VEGETABLE GROWING VILLAGES in Solan and Sirmour districts, who supply organic vegetables to urban markets through BIG BASKET. By 2017, Himachal farmers were growing organic food in 22000 hectares, largely food crops and vegetables. Under a new initiative started in 2018 i.e. Zero Budget Farming/natural farming, the government is engaged in a fresh push to encourage farmers go organic in their farming. However, all said and done, the lead economy of Himachal is based on fruits, apples, pomegranates, plums and vegetables and in growing these, cash crops farmers make use of chemical fertilizers and pesticides very liberally. Efforts to convert these farmers into organic have failed so far and will remain so until serious research efforts are made to set up R&D systems to provide farmers adequate and effective ORGANIC PLANT PROTECTION MEASURES. The day Himachal succeeds in giving farmers alternative to chemical sprays in fruit crops and vegetables, it will become the most successful organic state.

CHAPTER

11

CONCLUDING SYNTHESIS

"State of the Himalayan Farmers Farming is Under Threat from Three Drivers of Change and Missing Mountain Thinking in R&D Approaches"

Three Drivers of Change

The state of Himalayan agriculture, described in earlier sections, is dominated by highlights of a scenario that reflects different dimensions of a mega change process that is under way. The nature of climatic conditions and availability of resources, notably water, is changing. The economic aspirations of the mountain farmers are changing and so is the case with their social values. Several sections of the report present empirical evidence of the impact of this changing process on mountain resources, production flows as well as resource management strategies. Overall essence of the state of mountain agriculture is indicative of a change process that is underway across the Himalayan states, and the difference among states is only in its scale, speed, response systems and consequent impact. Some have been quick to understand the need for guided change while others have not responded so well.

A summary of the three drivers of change impacting the Himalayan farming and farmers is summed up below.

Dimensions of change process

The transforming scene of Himalayan agriculture is a mixture of good and bad experiences of mountain people that involved many drivers of change process. For the convenience of understanding, the variety of these drivers are grouped under three broad categories: ecological drivers of change, economic drivers of change and social drivers of change. Social and economic drivers of change are further considered together as socioeconomic drivers of change.

Ecological drivers of change

Ecological attributes of biodiversity i.e. richness of ecosystems, species and genetic diversity are always closer to subsistent agriculture systems. We must agree that managed ecosystems i.e. agro-ecosystems will always be designed to have agro-biodiversity that is capable of delivering the necessary goods and services to the human beings at a particular time and space. This law of ecosystem dynamics seems to be at play within the Himalayan agriculture systems also. This is not to justify what is happening but rather reminding that lack of appropriate technological interventions and institutional strategies are responsible for the state of affairs we see today, that of declining Himalayan agro-biodiversity and lack of initiatives to integrate its conservation with development process. Potential within Himalayan agro-biodiversity does exist for supporting promising economic transformation of mountain agro-ecosystems, that farmers can take forward but a vision and the institutional strategies both have been lacking. Present trends do not show much hope of a balanced strategy of agro-biodiversity conservation with development. Be it crops, fruits, vegetables, floriculture related agri-business or livestock resources, so far the focus is on quick fix options promoting introduction and replacement approach w.r.t. to agricultural bio-resources. Mountain farmers

have so far explored and taken advantage of climatic niches only and the potential benefits of Himalayan biological resources remain under harvested for the purpose of transforming Himalayan farming systems/ production systems.

Economic Drivers of change

The process of sustained economic growth is now reaching the unreached mountain societies, so that they are rapidly getting richer in terms of income per person. The region is passing through the age of convergence, which seems instrumental in creating a virtuous cycle of economic growth and this fact cannot be ignored. The income of mountain households of the Himalayan states is now coming, both from niche based farm incomes and non-farm sources. The meaning of poverty is also being redefined and it is no longer food insecurity but economic well-being of the families that is taking over as meaning of poverty. Well-being itself is perceived broadly as contentment w.r.t. economic, health and social well-being.

The rise in income and quality of life of the mountain people, inhabiting the Himalayan states may be getting better but the states will need to become capable, technologically and institutionally, for harnessing the niche potential opportunities of villages / landscapes/ states and the whole Himalayan region.

Social drivers of change

As the world population continues to rise, the population of Himalayan region is also rising. Therefore, besides burdening the economy, it is also going to amplify the overall growth of the regional economy in coming decades. For the first time we may have an opportunity to think differently and positively about the population growth, basically because of unprecedented economic opportunities and social infrastructure development. Many of the Indian Himalayan states may have already started experiencing these changes .

The way mountain people used to live is also changing fundamentally, i.e. from rural roots to urban civilization. As example of the other mountain areas, Chinese mountains are already experiencing the process of urbanisation. In the Indian Himalayan states, there are unnoticed changes going on in the form of emerging census towns (villages which have more than 50% population living on non-farm income). That means the process of urbanisation is impacting the Himalayan states also. It is perceived that the urbanisation process will fundamentally change strategic approaches to address issues of food and income security, poverty and livelihoods in these mountain areas.

With the neo-rich middle class among farmers, educated youth in the families, mountain farming families may be experiencing socio-economic stresses within the families. A debate within the family goes on for and against change, a change within farming and of making a living outside farming. As a multiplier effect it is deciding the course of unfolding events on the mountain landscapes and valleys of the Himalayan region. While R&D institutions keep working on technological possibilities and options, unaware of impact of the social changes underway within mountain communities, the outcome often is resulting in mismatch of institutional efforts with the mountain farmers aspirations. It is not therefore contributing to build a well thought strategy of a directed change process.

Farming by some landed households is a profitable business but for some others it is already non-viable. The farm labour work has become gainful employment because of money with farmers and their families preferring not to make hard work in the fields. Labourers are earning more than some of the small farmers. Migration to these areas is happening for this reason, as opposed to the traditional view of only out-migration of mountain communities. Women are experiencing new forms of economic and social empowerment in several of these areas, which indicate how future is shaping in mountains and the need for rewriting old scripts of thinking and action plans.

The state of farm economy and livelihoods of the Himalayan farmers, comprising diverse farming communities, revealed through findings of this study, presents a mixed scenario of despair and hope. Mixed farming cultures traditionally focussing on food grains and livestock based livelihoods appear threatened, today. The scale of pressure on these traditional subsistent systems differs from area to area and state to state. Dependence on them has definitely reduced and their continuation, today, is dependent on the access to any alternative opportunity, on farm or off farm. Himalayan farming communities seem now ready for change from food security based mindset to cash income based economic security, as there is felt need among them to get integrated into the national and global economy.

Centuries of isolation of these mountain farming culture, promoting conservative mindset and approaches, are now in for change. Mountain farmers are willing to try alternatives that make a better future for his next generation. No farmers are aspiring their next generation to continue with the subsistent farming – farming as a way of life. On the positive side, much focus on education has been instrumental in bringing this change, along with globalised conditions of flat world where the flow of information and opportunities is opening tremendous new opportunities. Young sons of farmers from Sikkim searching for Andean crops, importing and growing in Sikkim to change the local farmers economy for better, Himachal farmers owning few hectares of sloping farm lands, flying to USA and Europe on their own to learn how they can transform their traditional apple farming and then investing in skill development and material, are indications of changing capabilities for bringing positive change. We call this emerging trend the New Age farming and would like to put forth the idea that Himalayan farmers are headed towards a new era of sustainable farming led by educated farmers who employ innovative methods, technology and explore opportunities for growth.

On the negative side, state of Himalayan farming highlights the facts that the business as usual cannot continue. We have to accept the fact that Himalayan rural population has increased tremendously (one study estimated the increase is 75 times). More people in farming with greater aspirations of better life would mean the need for more resources, land and water. However, over all crop land in the Himalayan states is not more than 11% of total land area, some states have even less than this. Availability of crop land per household is at critical levels of less than a hectare and it continues to shrink further with more nuclear families joining the Himalayan farming community. Ironically, all good crop land in the valleys of the Himalayan states, that is the only irrigated land in hills and mountains, is under conversion to non-agriculture purposes, all under the impact of ongoing urbanization. So there is two way process at play working towards shrinking crop lands in the Himalayas. In contrast, need of the farmer is expanded access to land and water resources.

Thinking ecologically, it seems carrying capacity of farm land in the Himalayas, in aggregate, is headed for a situation of "House full" already. There is no scope for adding more farming families who can make a dignified living out of farming. Not far away in the future, governments of the Himalayan states will have to take a call on this issue. With respect to availability of adequate farm land to Himalayan farmers, a paradoxical situation exists as of now.

As subsistent farming on rainfed sloping lands, focusing on food grains, has been under pressure to transform into economically productive production systems, increasingly being replaced by cash crops - commercial farming, access to water for irrigation becomes a key factor. The trends indicate that rainfed farms of subsistent Himalayan famers will either be converting into commercial farming of cash crops, requiring varying degrees of irrigation water or they may be abandoned. The process is visible already in several parts of the Himalayan states, with notable example of Uttarakhand hill districts. Water is and will continue to increase its significance as a crucial limiting factor for hill agriculture. Global warming impacted weather changes causing unregulated water flows in the mountain valleys is already forcing farmers change the cropping patterns and farming as well. In Kashmir valley, farmers are replacing rice farming by fruit plantations, and one of the reasons is lesser availability of water for rice farming complimented by PDS supplies of rice. There are already example cases within the Himalayan region, whereby village settlements have been shifted to other locations because of increasing scarcity of water for farming and household use. Villages in Zanskar valley of Ladakh, where regular snow water availability for irrigation reduced to ineffective levels, the villages decided to relocate itself far away in other locations. Since relocation is not an easy option for every needy village or household in these farm land scarce mountain states, examples of rural population simply fading away into the urban pool of migrants or to low lands is now a well-known process. These may be extreme examples but the fact remains that while on going transformation of mountain agriculture has increased the need for irrigation water, but contrary to it, the availability is becoming increasingly scarce. This is second paradoxical situation of resource limitation of the Himalayan farmers, after crop land.

After land and water, the third ecological driver of change that is presently increasing its disruptive value to agriculture in all the north west Himalayan states, Jammu region in J&K, Himachal Pradesh and Uttarakhand, is the wild animals increasing domination over the farmers on the standing crops on their farm lands. From partial destruction of the standing crops and partial harvest to no harvest coming home has been reported in this study in the house hold surveys of the farmers. The wild animal domination on farm lands is so severe in several areas, that in mind of the farmers, crop land scarcity is no longer a key constraint, it is wild animals. Monkeys during day and wild boars, porcupine, packs of bear during nights make it a 24 hour war on standing crops of hill farmers. To add to this situation, the domestic animals i.e. abandonment of cattle, a new phenomenon, has added new dimension to this whole issue. It is a very desperate situation with much serious implications to sustaining farming in the hills but so far it is being addressed with casual approach. Governments of the day suggest technological solutions, and social awareness as part of the solutions with no serious efforts. One has to understand that this problem is ECOLOGICAL IN NATURE and right solutions will be ecological only. It is a population imbalance problem between humans and animals, and requires

strategies that incorporate this understanding in employing strategies that aim at balancing population dynamics between users of agro-ecosystems and natural ecosystems. Giving precedence to technological solutions over ecological alternatives, cannot help solve such problems that involve ecosystem dynamics and ecological principles.

Large part of the report is devoted to describing how social and economic factors have become stronger drivers of change than ecological factors. It reminds that in short term the socio-economic drivers of change are dominating the process of transformation of mountain agriculture so much so that in due course they may be reshaping the mountain agriculture landscape even before ecological factors are taken as priority.

In a nutshell, comprehending the change process of Himalayan farming cultures is rather complex because the drivers of change and their dimensions are varying both in time and space. In mountain context, space has a particular significance as the farming cultures/ agro-ecosystems/agriculture systems (by whatever names you call them) vary from household and village onwards. Mountain conditions, called mountain specificities, play crucial role in the evolution and differentiation of these farming cultures. Implication of these variety of farming cultures is that it is so much difficult to capture uniform impact of changes within a region. Indicators of a change therefore show variations in a region.

While macro-level changes in Himalayan farming sector are indicators of broad trends of change that are underway, the micro level socio-economic indicators are in fact the resource management responses of farmers to changing condition of resource base and production flows. In assessing the state of mountain farming systems, the value of micro level evidences can be equal or more than macro indicators because these micro level indicators provide answers as to why something is happening and what R&D strategies will work or not work in that locale context.

Time factor assumes significance in the change process for the reason that the technological advancements and access to them has been accelerated in present times and that is going to be still faster in future. Therefore ,when a farming issue has arisen because of economic reasons or global warming impact in a particular context of mountain agriculture system, for instance with a particular crop, the pace of technological solutions and accelerated access to people and institutions, appear faster and wider. In other words, access to developed world technological options is becoming more and more easier, awareness among stakeholders is faster and adoption rates a higher and wider among the mountain farmers. Today, what farmers need locally is awareness facilitated by institutions for flow of information, materials and support services and rest of the process follows.

Therefore, it is this last aspect of local capabilities in managing change, one finds differences in transformation among the Himalayan states. A success story in one state, or in one area in a state does not get repeated easily elsewhere. Organic Sikkim is not being repeated elsewhere in same dimensions, transforming mountain economy through fruit farming and vegetable production in Himachal Pradesh may not be happening on similar scale elsewhere, linking conservation of local resources with development in

a people's movement with notable success stories of siri cow and orchids in Kalimpong. Within the Himalayan region states, there are so many local success stories and experiences of failures from which others can learn what to avoid doing.

Therefore, one important aspect that this study highlights is the lack of lateral flow of knowledge, information, and mechanisms for sharing of experiences, among the people and institutions of the Himalayan states. 'Too little and too slow' is the best suited phrase for it. Much scope exists for evolving mechanisms of cooperation among the Himalayan farmers and institutions of these states for lateral partnership. Building lateral partnership and cooperation means between and among the Himalayan states on the pattern of building centre-state partnership for many programs.

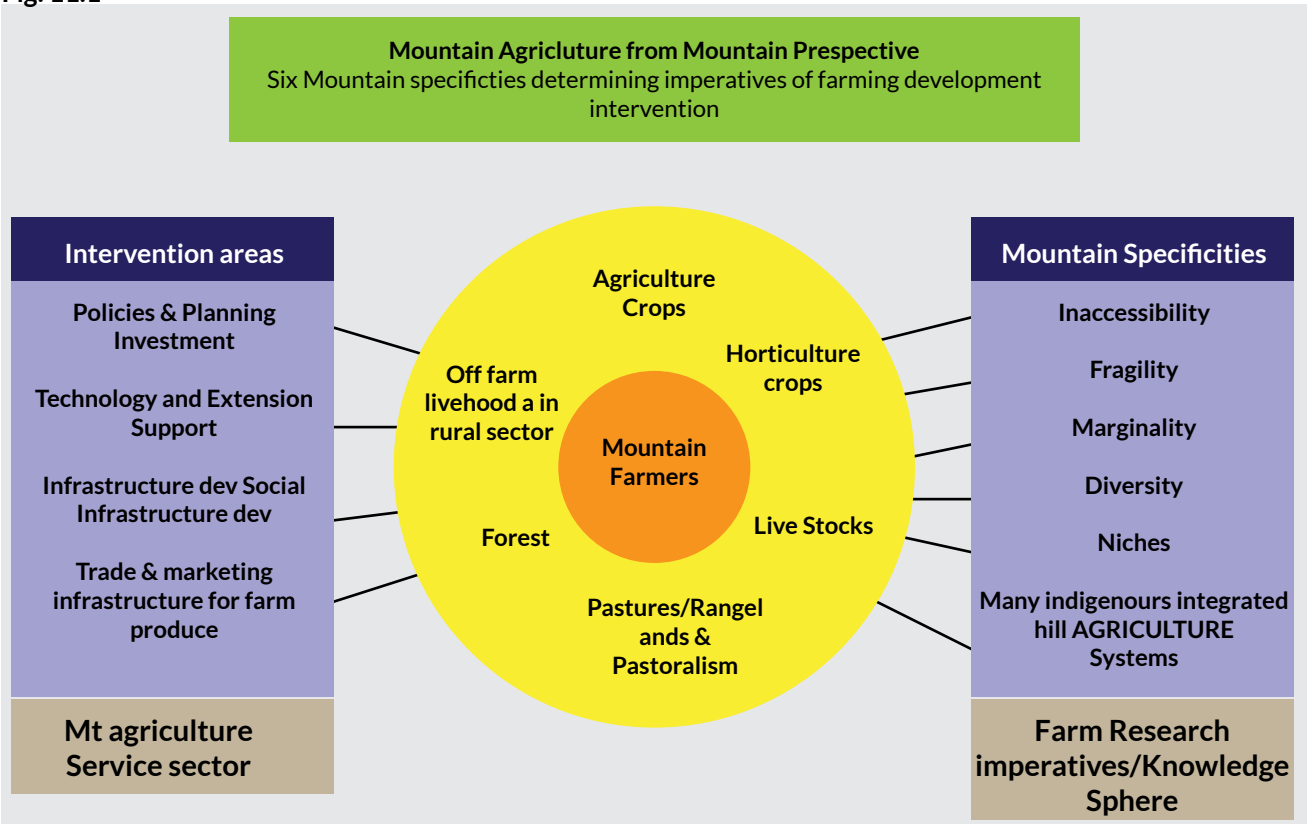
The Himalayan states have a stake in this emerging development scenario in order to evolve right strategies helping successful adaptation to change. Many questions which now have emerged will need new strategic initiative to provide right answers. Few samples of such questions are:

- With rising expectations of an economic well-being and therefore rising expenditures of the mountain farming families, and inability of traditional farming to meet the economic demands of farming families, what will happens next?
- What needs to be done to reduce the impact of driving forces that support abandoning farming, migration and shifting of farmers to non-farming vocations ?
- What strategies can strengthen drivers of change supporting the rise of the New Age farmers in the Himalayan region? How far will creating enabling environment for NEW AGE HIMALAYAN FARMERS make the desired impact, or will it require commensurate social engineering along with it?
- Future of mountain agriculture is seen not in promoting green revolution technologies, for the ecological backlash may become faster and stronger in the fragile and marginal environments under the global climate change regime. In such a situation, how can wider acceptance of green economy pathways be made possible ?
- Economic dimensions of future strategies will have to suggest innovative ways for upscaling niche based specialized economies. We are moving into an arena where shifting from household mountain economy to a group economy, such as an enterprise of a village or villages forming as economic unit for developing area based mega niches for better comparative advantage

The new breed of educated mountain farmers is taking over, even if slowly, from the aging older generation with old mindset of food security on farm as first

priority. For the old generation, agriculture has been a way of life. However, for the new generation agriculture is not a source of food only. It must either be a promising vocation offering a decent way of life or they will not like to be in farming as a way of life. These social values are forcefully changing the ways mountain farmers evolve from farming based livelihoods and economy of the future.

Fig. 11.1



Missing Dimension of Mountain thinking in Himalayan Agriculture R&D strategies

Mountain agriculture, defined broadly from mountain farmers perspective, includes all land based activities, agriculture crops farming, horticulture, livestock, and their support systems i.e. range lands and forests that act as support lands of farming based livelihoods.

By the nature of local environment, therefore farming activities in the hills include several other activities than in plains. The scale of operations and dependence of farmers on these activities is further determined by the sum total impact of mountain conditions called mountain specificities. These are inaccessibility, fragility, marginality, diversity, niche and adaptive mechanisms (Fig. 11.1). Inaccessible high mountain areas therefore qualify for nomadic pastoral activities, because of no possibilities of crop cultivation due to cold climatic conditions and vast range land resources. People make use of livestock to harvest range land grass resources to their advantage as food through livestock. Middle mountains of the Himalayan range were home to subsistent farming but now being converted into fruit farming and vegetable farming. This, however, is dependent on the scale and nature of support R&D services available to farming communities. In lower altitudes and valley areas, the

farming niche is more suitable, ecologically, for food grain farming but it is now under pressure of socio-economic drivers of change.

Mountain niches are a hidden/dormant source of potential niches to develop several kind of farming opportunities, through exploring and developing its valuable unique bio-resources. This has not yet happened, all that R&D has so far focussed is on agro-climatic advantages of hills. It remains a missing dimension of farm research oriented to mountain agriculture. There is however renewed attention to this aspect as R&D efforts search for agri-business opportunities with comparative advantage. Adaptive strategies of farming communities are tools perfected by them to adapt their livelihoods to particular conditions. It is important in the context of mountains, as it has ecological connotations and communities would have experimented with and adopted ecologically suitable strategies. Nomadic lands, rice fields, livestock dominated farming systems, shifting cultivation, medicinal plants gathering from forests for sustaining livelihoods, all these activities are such folk innovations, perfected over time for a agro-ecosystems of a particular locale. During the past several decades, the thrust of R&D strategies was on adopting developed world green revolution technological options. The success rate of these interventions in mountain environments was however not without the danger of ecological backlash. But with increased ecological understanding and compulsions of search for sustainable strategies, significance of adopting mountain thinking in R&D has become an imperative.

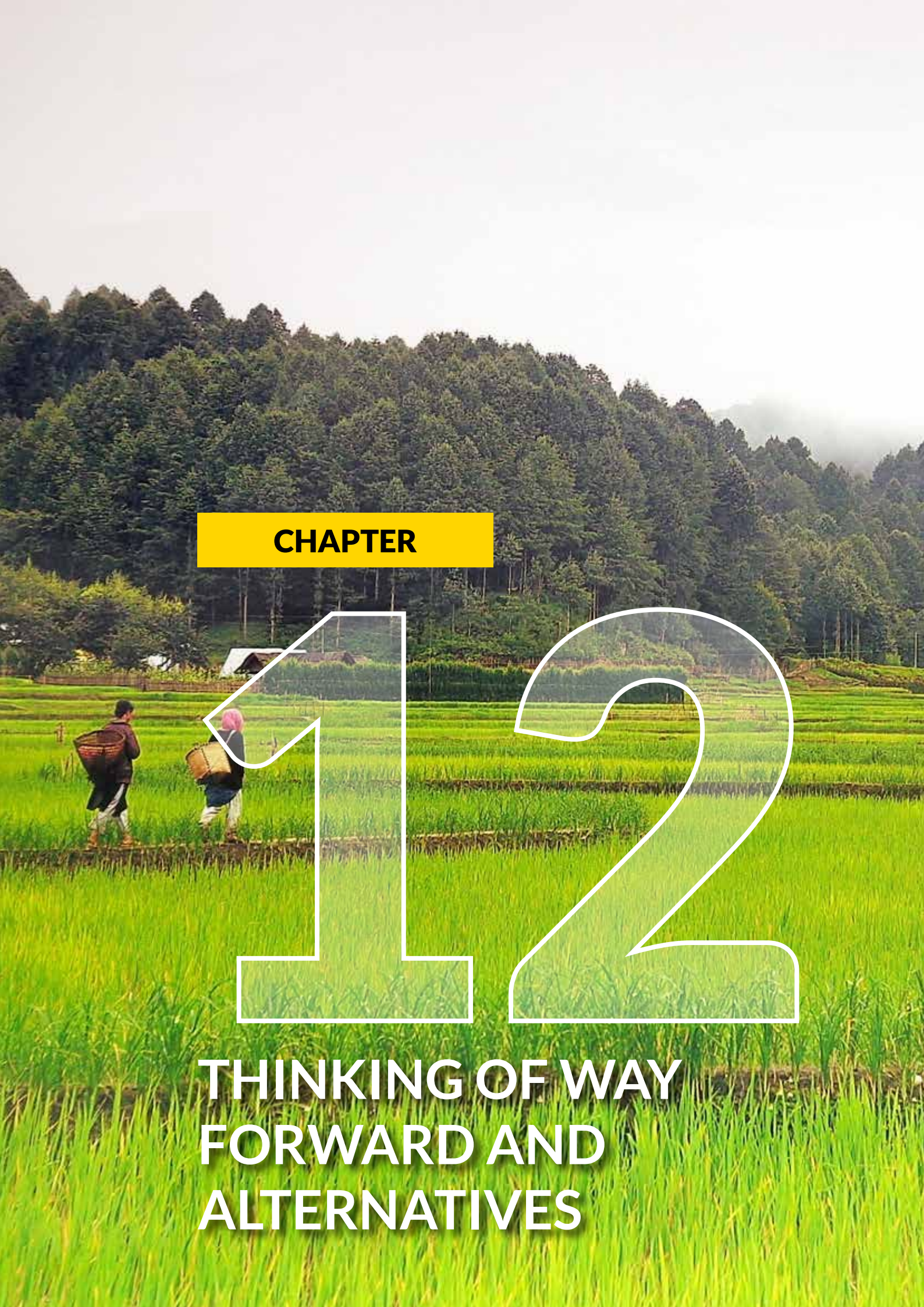
Continuing out-migration from mountain areas has further reinforced a 'plains bias' in development strategies. The implicit arguments have been that immediate costs are lower and opportunities for increased absorption of the labour force are greater in the plains. The predominant thinking has been that most agriculture development programmes in mountain areas are not economically viable due to small farms with marginal production potentials (an absolute outsiders perspective). The sloping land rainfed agriculture, scattered plots of farm land, low capacity of mountain farmers to invest, smaller quantities of varieties of farm produce for markets are included in the long list of limitations mountain agriculture and farmers therein were placed. The predominant thinking, built on these factors, has been that most farming based development programmes in mountain areas are not economically viable, a dangerous, non-mountain perspective thinking, leading to negative outcomes.

More recently, however, the need has been felt for significant reorientation in mountain agriculture development thinking, brought about by the global environmental concerns and environmental problems being encountered by the specific mountain agro-ecosystems. Therefore the emphasis has shifted to economically as well as environmentally sustainable mountain agriculture. Mountain agriculture development strategies are undergoing fundamental change and this is undoubtedly influencing approaches and strategies for their sustainable development of mountain agriculture systems.

Mountain agriculture systems, to a large extent, still employ traditional and subsistence methods that have evolved out of centuries of cultural and

biological practices. Extensive linkages with different resource systems (major ones added as farming components) – forests, pastures as support lands etc. –necessitated the establishment of appropriate institutional mechanisms. In spite of their many important advantages, these systems are breaking down on account of changes in both internal and external factors. Thus, the challenges facing mountain agriculture development strategies is how to combine elements of both traditional and modern knowledge.

Further, even if agriculture is the focal point of discussion it cannot be isolated from the general development strategies and policy programme framework which influence agriculture directly or indirectly. Some states have now shown that demographic growth, considered a burden in the past, is no longer so. With economic growth, a new meaning is being given to the demographic pressure and outmigration from mountain areas. Such success stories serve as useful knowledge and experience that other states would want to know about and learn from.



CHAPTER

12

THINKING OF WAY FORWARD AND ALTERNATIVES

This chapter dwells on possible alternatives to manage the changes facing Himalayan farmers and farming and the likely impacts of farming described in Chapters 1 to 10. Way forward includes viewpoints ranging from wild thinking, lessons learnt from experiences, strategic and policy options as well as possible research and technological opportunities.

Alternatives to increasing state of skewed land resources of Himalayan households

Access to adequate crop land to a farming family is a fundamental need and foundation for economically sustainable farming by households anywhere.

While in the past decades, main reasons for food insecurity and poverty of mountain farmers were lack of access to better production technologies and markets. Today the key reason is and will increasingly be the need for acutely inadequate crop land available to households for managing a living on farming alone.

There have been several efforts in the past, in some of the Himalayan states, to address this problem through consolidation of land holdings but all met with little success. Mountain farmers value locational advantage and disadvantage of crop land parcels of the farmers and that becomes the key hurdle. In a democratic set up like ours, implementing the idea of crop land consolidation can be most difficult proposition.

State Governments of the Himalayan states, aware of the issue, are trying various ways, including promotion of cluster approach farming for commercial crops and farmers producer organization (FPOs). The success of alternatives, however hinges on understanding and implementing a plan considering building complete supply chain mechanisms for these alternatives to succeed. Therefore, success stories of new initiatives are so far very few, indicating the need for further analysis of ongoing efforts to make a course correction.

Learning from Chinese Experiences

In search of solutions to this issue, author has been studying the Chinese strategy to manage this problem. During the years 2012-2014, after making field visits to study various models and holding interaction meetings with Chinese farmers, local officials and provincial authorities, following useful information was gathered

1. Chinese national government acknowledged that shrinking crop land holdings of farmers in the Chinese Himalayan region is a key concern.
2. Multiple steps were taken to address the issue; one, national policy acknowledging that population has exceeded the carrying capacity of the region and therefore migration be permitted and facilitated by creating enabling environment of alternative off farm employment opportunities for migrating farmers around megacities, housing for migrants, schools and above all training schools for acquiring skills to become skilled labour. Further, under a new policy farmers were permitted to keep ownership of land back home and a provision for renting/leasing for long term was created, so that they can return back whenever they wish, or keep families back home, or keep earning from farm rentals.

China has launched a decade long national program (2010-2020) for revitalising the mountain rural economy dependent on small and marginal farms by helping convert these into profitable farming enterprises. A national scheme is in place for encouraging conversion of small household economies into larger village or villages as economic units. Mechanism being put in place are, new types of economic leaders who were better educated and trained for the job paid by and accountable to stakeholders. Putting in place mechanisms for technological support services from institutions to develop niches (comparative advantage) of locations and institutions and they getting paid for services, skill development training schools in villages (specially for women folk who were holding on to farming to maintain their link with home and land. All this leading to conversion of household farming into village level / villages groups level agribusiness-enterprises managed by educated experts from within villages or hired by them. Provincial governments putting in place mechanisms for financing such initiatives with provision for incentives and not subsidies. “Perform and get rewarded” being the key approach. Earnings reflected by bank deposits and loans repaid are used as basis for calculating incentives. The same banks add incentive value annually as reward to the accounts of the stakeholders (it can be 100%, 50% or whatever depending on the declared incentive reward for an activity).

The program is presently rejuvenating farm economy of mountain people in the Chinese Himalayan region of Yunnan and Sichuan (that is where field surveys were conducted). Government officials informed that it is a pilot project of national government for ten years and lessons learnt will determine further steps.

Successful launch of several models within three to five years (which were studied) indicated the appropriateness of the strategy to Indian conditions and looking at the possibilities of replicating the concept in the Himalayan region with suitable modifications.

Need for strategies strengthening forestry - farmer linkages

Traditionally, Himalayan farmers farming based livelihoods depended not only on crop land but on a combination of crop land and support land. Quantity and quality of crop land and support land (i.e. forests and range lands accessible to villagers) determined the type of agro-ecosystem that evolved in that locale. It could be pure pastoralism (where cold dry climate did not permit crop farming), partial nomadism, crop livestock mixed farming or cropping dominated farming in the fertile mountain valleys. Much of Himalayan region had mixed crop livestock farming based livelihoods with very strong forestry-farming linkage. Over the decades, the linkages have become weaker and reasons are many.

However , one of the key ecological reasons has been the biological degradation of accessible grazing lands across the Himalayan region. There is wide spread infestation of these support lands by noxious weeds such as Lantana, Eupatorium, Ageratum and congress grass. These so called waste lands near the village settlements, have been the back bone of farming based livelihoods, thus earning them a name -support lands. Today, these local grazing areas, the support lands, of outer Himalayan region and mid Himalayan range are severely affected by these poisonous weeds and their functional value as support lands has been drastically reduced. For the marginal and small farmers whose livelihoods depended on support land use more than crop land, it has been a big blow for their survival strategies which factored in the role of these lands.

In future, strategies focussing on improving forestry farming linkages as one of the ways to improve mountain livelihoods, will require massive efforts to reduce or eliminate dominance of the noxious weeds on support lands (forests and range lands). There is need for application of technological inputs ,, technologies already tested by farm universities and research institutions located in the Himalayan region, for improving grazing and fodder flows from the support lands. Migration affected areas of Uttarakhand are facing very aggressive spread of these noxious weeds shrubs into abandoned crop lands. We have a precarious situation of losing valuable crop land leading to bushy mountain landscapes dominated by lantana, eupatorium, congress grass and several other plants.

Pathways about managing changes within Himalayan farming

1. Threatened farming cultures

The native farming cultures of the Himalayan region face a grave threat of extinction and being replaced by agro-ecosystems with a different kind of social, economic and ecological functioning. Obviously, functioning of mountain agro-ecosystems have been under pressure to fulfil enhanced demands of cash income needs of mountain farming communities. On a time scale the pressure for changes in traditional farming cultures from subsistent to cash economy has been stronger and faster. Therefore giving space to not so well thought out reactionary responses to change. Result has been emergence of new Himalayan farming cultures with new biological resources, both crops and livestock, replacing in haste native bioresources of farming cultures.

Few experiences of revival of native bio-resources based robust agro-ecosystems, such as Kalimpong farmers movement for promoting native cattle and plant resources (orchids) for transforming their farming culture to cash economy model, is one good example. The issue is not about lack of potential options based on native resources, called native niche potentials, our problem has been absence of thought and actions to develop native potentials based transition of the Himalayan farming cultures to cash economy and this problem continues.

Native farming cultures are strong on nutrition needs linked farming systems and ecological adaptations led farming practices. Unfortunately these potentials have not been fully understood and harvested. From economic view point, bioprospecting research indicates great economic potentials in wait across the Himalayan region, which has the economic power potential of meeting economic needs of future Himalayan mountain farming communities. All it would require is new thrust on imagining the future and investing in developing R&D strategies which open scopes for local resources and practices based new opportunities for the NEW AGE HIMALAYAN FARMERS. Presently we lack that.

2. Livestock – fodder imbalance crisis , fodder crops vs food crops conflict

Mixed farming cultures of the Himalayan farmers also are faced with serious demand supply imbalance between fodder demand and supply. It has been caused by two factors: one much weakened forestry farming linkages, across Himalayas. Symptoms are increasing problem of abandoned cattle locally causing new kind of problems. Two, fodder crops competing with food crops for the crop land that is already scarce. It is less acknowledged fact that subsistent mountain farmers are under pressure to replace native mountain crops with

crops for fodder, in order to make first steps for income generation through few cows based dairy farming. Paradoxically parallel changes have been taking place , on the one hand quality and size of grazing support lands has led to their reduced carrying capacity, on the other demand for quality and quantity for grazing and fodder increased.

It requires new thinking and strategies for striking a balance in demand and supply of fodder needs of the Himalayan farmers. Strategic thinking also is necessary to envision how much of crop lands of the Himalayas can be allowed to be converted into fodder lands and also how to control that, if that is a strategic necessity. For sustainability of the Himalayan agriculture, it is essential to think about strategies for maintaining support land ecosystems and their ecological health, as maintaining their productivity is vital to building sustainability of the Himalayan agro-ecosystems.

Snow water irrigated fodder lands of the high Himalaya, maintained traditionally are helping maintain healthy high mountain agro-pastoral systems. The problem of biologically degraded fodder lands of low hills of the outer Himalaya is waiting for innovative ways for their revival. In doing so we can unleash their potential for fulfilling fodder and grazing needs of the future. Traditional thinking about grazing on support lands was about degradation, but it has to change to allow space for developing such support land niches that contribute in terms of fodder to livestock and manure to maintain farming systems, where ever it is still ecologically desirable and socioeconomically possible. Range lands of Shiwaliks, infested with noxious weeds, hold that niche potential like the high land Himalayan summer pastures.

Envision transforming the traditional nomadic sheep and goat herding into a futuristic agri-enterprises of the Himalayas. There is an unexplored niche for it within the Himalayan agropastoral system, where large tracts of support lands exist. Traditional Himalayan wool market led nomadism may be fading away but the surging demand for safe livestock products, in particularly mutton and cheese and butter can become an opportunity for converting the same fading wool based agro-pastoral system into a vibrant safe supply system of these products of Himalayan brand. It can be as simple an intervention strategy; taking first steps for organic certification of forest lands, pasture lands and grazing lands in use (owner being the forest depts., organic certification application has to be from owners side and on the name of the department), upgrading skills and expertise of livestock departments for promoting and practicing organic ways of disease management, putting in place supply chain systems for certified organic meat supplies from producers to consumers. Innovations will be needed in the area of value chain management from different local areas and for different products – that will be a greater challenge. It is something new and therefore a promising area to try out promoting the NEW AGE FARMERS in this sector.

Demographic census data and livestock census reports of the Himalayan states provide clear clues to the fact that the nomadism is confronting a precarious situation of reducing households within the respective nomadic communities in the Himalayas, namely bakkarwals, Gaddis, van Gujjaras of Uttarakhand, yak herders of Ladakh and Sikkim and Arunachal Pradesh, which were and are part of the high mountain pastoral ecosystem, all communities are passing through similar process of change and declining numbers. It is possible that at this rate of decline in their numbers, these nomadic communities may fade away sooner than later the in future. If nation and the mainstream societ, has to continue benefitting from the wild lands of the Himalayas for unique products and agro-

ecosystems, ways have to thought about to put in place strategies ensuring continued existence of the nomadism but in future forms. As elaborated above, this specialised ecological and economic niche possessing agroecosystem is in danger of being lost forever from the Himalayas, and searching for options to save it should become a necessity. There are examples and ideas about how such approaches can be designed and developed.

As an example of innovation in best practice for nomadic pastoralism, Australia made effort towards organic certification of its large tracts of natural grazing range lands, used for sheep herding. In doing so, it expanded its organic support lands and the livestock grazing these lands became source of organic meat and wool supply globally. Livestock products, specially sheep and goat for organic mutton from the Himalayas, can have several brand names such as Gurezi goat meet, Zanskari sheep mutton etc.

Zanskar Butter sourced from small sized native cows, which graze in natural high land pastures during summers, is valued by locals because it is perceived to have medicinal value as Zanskar cattle would eat lot of medicinal plants of the high land pastures. Because of this it fetches premium price in Leh market. Presently produce in traditional form brings worth Rs 5 crores annually to over 3000 families of the valley. It only needs processing, packaging and branding as Zanskari Organic butter sourced from local highland cows during their summer grazing in highland pastures, like the variety brands of swiss cow cheese. It will have very special niche value but only if there was a New Age farmer to take it up and develop this livestock enterprise.

Similarly there is **yak cheese of the Himalayas**, dried butter milk of the high lands, and Ladakhi Changpaas - **Pashmina wool.** One would always value procuring honey of the valley of flowers. All these are few examples of mountain livestock niche products of the Himalayan region. These products niche are waiting for upscaling and integrating into modern supply chain systems as ORGANIC LIVESTOCK PRODUCE OF THE HIMALAYAS. It can be a new agribusiness-enterprises evolving from traditional niches of mountain agroecosystems.

So little thought has gone into exploring these potential options offered by niches economic opportunities within Himalayan agro-ecosystems. Developing these would in turn save the dying agro-ecosystems of the Himalayas. Choices are either that strategies with niche perspective are developed, or these traditional agro-ecosystems fade away into oblivion over the coming decades.

Switzerland, with its cows all over the mountain pastures, has shown the way that strategic policies can be evolved and systems put in place for a healthy agro-pastoral/pastoral system. Similarly, it can be possible for Himalayan states to think about similar strategies for the Himalayan region. Our present mindsets of forest conservation, first and last, without applying ecological principles of managing mountain landscapes for productive use, is that they are functional agro-ecosystems with people living there. Choices and examples of best practices are there to think differently, if the Himalayan states choose to do so.

Thinking beyond ongoing migration from hills – what could be the next steps

Migration process in Uttarakhand highlights the fact that it is a complex issue of challenged carrying capacity of the Himalayan agro-ecosystem. engineered by new economic aspirations, human well-being and failure of traditional farming systems to meet these aspirations. It is a fact that we can no longer ignore without negative consequences. Even though not so much highlighted, migration of nomads is also going on from Changthang pastoral highlands of Ladakh, and few other remote mountain areas of J&K and Himachal Pradesh. While the North East Himalayan region states are getting urbanised, these are attracting movement of people from rural to urban settings.

1. **Thinking beyond migration with a future perspective**

   All migration stories from the Himalayan region highlight one point – people will keep moving anyway, always in search of better opportunities for making a better living, when their aspirations are not met locally. Migrant makes his own judgement, whether to leave farming for off farm options in a nearby urban area or to a new rural location downstream in the same province, district, or even outside the Himalayan region in to urban centres.

   Available information indicates that there is so far no discussion on possible human carrying capacity of the Himalayan region and the perspectives, institutional and technological ways to enhance it. Time has come for such a debate. Nearly seventy two times increase in human population in the Himalayan region, felt land resources scarcity and desperate human responses to it are before us already and these facts can be undermined only with dire future consequences.

   Is outmigration from hills and mountains bad? Taking a view that migration is a fall out of prevailing circumstances . It would be logical to consider it as part of the change process that is happening within the Himalayan agroecosystems. Only if we can improve our understanding of the nuances of this change process within agroecosystems, wherein changing human population, numbers and quality, plays key role along with climate changes and available natural resource endowments i.e. land and water. It can help understand clearly beyond migration. The unfolding post migration scenarios and the quality of economic, ecological and social milieu available, post migration, would depend much on our initiatives for putting in place strategies for post migration – the steward's guided change process.

   Envisioning a scenario of guided development process post migration from mountain villages, the strategies and policies were put in place for enabling immigration to empty villages of such motivated investment capable new class of farmer/farmers: we have named them New Age farmers in this study. Migration offers us an opportunity of guided change. One such option, for example, is to bring in New Age farmers, fully supported by institutional mechanisms for acquiring available village land for setting up farming enterprises. Backed by initiatives about enabling policy environment, ecologically and economically viable technology options.

   Now envision a scenario of migration from mountain villages – turning them into empty ghost villages where land and biodiversity resources have been put to rest from the view point of human use. It needs to be emphasized that village agroecosystems are modified ecosystems by human adaptation strategies and if not used these will revert back to the ecologically

determined natural ecosystems. The new natural ecosystems may not be the same old replicas but the ones evolving under new climate change impact realities and wild animal populations.

Much of what one can see around is an unhappy situation of shrub lands of obnoxious weeds habitat for monkeys, wild boars and other wild life of nuisance value to remaining local population, compelling them also to leave the villages. Example is a trailer of the unfolding picture what is being witnessed in some areas of Uttarakhand. That is the danger of not having a strategy beyond migration process, resulting in inconvenient emerging scenarios. Therefore, affected states should better think of a strategy for handling post migration conditions.

Research needs for evolving post migration sustainable Himalayan agriculture (ecologically stable, economically desirable and socially just) is another area needing attention. Thrust on research on envisioned niches based new farming cultures or agribusiness enterprises, for these abandoned habitats can one possible option. Otherwise the Himalayan mountains may lose another opportunity of having sustainable farming systems.

PDS and MGNREGA – a revolution half way through

Next steps for making PDS and MGNREGA meaningful contributors to transforming Himalayan agriculture and mountain livelihoods

Unlike general belief based accusations on PDS and MGNREGA about destroying traditional farming and farmers livelihoods, the findings of current study revealed positive impact of PDS and MGNREGA on the Himalayan farmers food and income security. The survey findings also hint at expectations of Himalayan mountain communities about desired improvements. Based on these, it is possible to think of suggesting further improvements in PDS by way of incorporating the idea of nutrition led PDS, such as nutrition linked agriculture. One of the accusation is that PDS has adversely affected consumption of local foods which fulfilled nutrition needs of local people. It has made every one eat wheat and rice across the Himalayan states, where as local diets varied among mountain valleys and landscapes.

Therefore, putting in place strategies about incorporating local food grains in the PDS as an essential component will serve double purpose. One it may fulfil nutrition needs and two it may help revive need for growing local crops as cash crops, which is the main reason for their continuing decline and extinction. Enhanced need for mountain food grains will open opportunities for their commercial farming, as these food crops are adapted to rainfed farming conditions. It may also lead to revival of rainfed farming with positive perspective. Research innovations about maintaining rain fed farming as a modern farming practice is much needed for mountain agriculture and that can happen only if crops adapted to rainfed mountain agriculture have a demand.

Next steps in MGNREGA, if envisioned within the framework of emerging unrest among Indian farmers in the present times, it may give clues of more appropriate strategic options. MGNREGA is not for Himalayan states only and therefore when the issue is debated nationally about making it more worth, it will be appropriate to give space to discussions on mountain farmers specific needs. Agriculture policy strategists are already pondering over the idea of income security options to be devised for the farmers. Among options

on table for debate include increasing days of employment, getting paid for doing farming on one's own farm land. It may encourage farmers refocus on agriculture.

Envisioning pathways for maintaining Himalayan agrobiodiversity

Making native crops, land races and village agriculture systems part of the Himalayan agriculture change process by developing native crops based commercially viable farming niches

It would be naive to think that declining and abandoned farming of native Himalayan crops and their genetic resources is a consequence of poor commercial and nutritional value of these crops. Mountain food grains mainly include crops namely, local maize land races, naked barley, finger millet, fox tail millet, Buckwheat, proso millet, Echinocloa, Amaranth, Himalayan gain chenopods, variety of mountain pulses, vegetables, native fruits and condiment crops such as perilla, coriander, black cumin, saffron, and wild onions etc. While most of the mountain crops and there genetic resources may be in general state of decline but there are also instances of their increasing cultivation elsewhere outside these mountains.

With general improvement in economy, the increasing wealth of middle class Indians is shifting its interest towards nutrition linked food and safe food items. There is increasing interest of the consumer in old native mountain foods. This is leading to bringing these mountain crops into market system with better value than staple crops like rice and wheat. To find out the resurgence of old crops in new food markets guided by organic and other values, one would have to visit ORGANIC AND MILLETS- INTERNATIONAL TRADE FAIR being organised by Govt of Karnataka in Bengaluru since 2017, in association with International Centre for Organic Agriculture (ICCOA)and Agriculture Produce Export Agency (APEDA) of Govt of India, as well as the annual organic trade fair - Biofach India, that is being organised in different mega cities of India since 2008. Both events have numerous stalls show casing food products of several old mountain crops, i.e. all kinds of millets, buckwheat, amaranth, Himalayan grain chenopods under the brand name of Quinoa, an Andean crop and many more. It is expected that the business of nutritive foods, health foods, comprising of mountain crops will continue to expand in future.

Himalayan grain chenopods is a crop belonging to native neglected under exploited crops group. Its decline and resurgence, studied by Partap, explains dynamics of the process of decline > near extinction from native areas and > resurgence of Himalayan agrobiodiversity. Partap and Kapoor first reported (1985a,b) how widely was this crop being cultivated in several parts of Himachal Pradesh, J&K, and Uttarakhand until 1980s. But its farming started declining since 1970s (Partap and Kapoor 1985a,b).

At one stage it was predicted that Himalayan grain chenopods would become extinct, even while it had nutritional superiority over the staple foods (Partap and Kapoor, 1987). Partap (1998) writes in the IPGRI published monograph on Chenopods, " It is less well known that Chenopodium was a common component of farming systems in the hilly and mountainous regions of Asia, particularly the Himalayas, the Hangduan mountains of China and the chain of uplands extending beyond the eastern fringes of the Himalayas as far as Taiwan. Replacement by high yielding varieties of staple crops has led to a decline in their cultivation. The Chenopodium grain has a place in the diet of certain

Himalayan mountain natives and the crop is very well adapted to their mixed-cropping dominated system as it gives optimum yields at relatively low plant densities, which is good for the growth of companion crops. The grains have an appreciable food value, containing all the essential amino acids; the nutritive value of these grains is comparable to that of other staple foods. To cope with the limited growing season on the mountains, the phenological calendars of the cultivars are relatively short (one of them being as short as 13 weeks) which is rare among Chenopodium cultivars. The germination behaviour is excellent: the grains are non-dormant and give 100% germination over wide ranges of physio-chemical conditions. The gene pool of the Himalayan chenopod grain crop is, however, declining for various reasons".

Partap (1987, 1998) further stated that with a shift in focus towards production on agriculturally marginal lands, particularly mountainous regions, Chenopodium will have a role to play in future both as a nutritious food crop and as a cash crop. Chenopodium has a high grain protein content, compared with cereals, is able to survive and compete in intercropping systems and forms mycorrhizal associations which maximise their use of scarce nutrients.

That all native mountain crops would meet the same fate, while this view point was gaining ground until few years ago, there were also new developments elsewhere in the country indicating possible revival of these mountain crops in future.

Since 2014. some agri-business companies started quinoa farming, an Andean mountain crop, in South Indian states, mainly focused on export . Within few years it expanded further and by 2018 quinoa is available in Indian market. As a consequence, it also led to resurgence of cultivation of the Himalayan grain chenopods under the trade name of BLACK QUINOA, particularly in south India. By 2016-17 some New Age farmers of the North East Himalayan states had also started growing chenopods as a commercially promising food crop (August 2017, report of the field visit /study under this project). There has also been clandestine movement of seeds of the Himalayan grain chenopods- trade name black quinoa from India to western countries, particularly USA and UK, and now back to India into Southern states (2014). There are food companies in UK which market black quinoa in UK (this author found packets of the Himalayan grain chenopods in the food stores of Northern Ireland in 2018, marketed as black quinoa). Surprisingly a mountain crop that vanished from its place of origin found place elsewhere and is coming back as a nutrition rich future food crop, under a different brand name. Government of India has during 2018 reclassified millets and pseudo cereals of India as NUTRITION RICH CROPS, a policy initiative with future agriculture thrust in mind. It will go a long way in reviving farming of these native mountain crops.

Available evidence today indicates that there is a promising opportunity for revival of traditional mountain agriculture crops with new value as cash crops of the Himalayan farmers as future foods with better nutrition value and safe food for the urban consumers.

Paradox it may be that in the past agriculture research institutions played a key role in bringing new crops and varieties for green revolution. However, today and in near future market is playing a role in bringing old crops back as future crops / nutrition rich crops/ organically grown crops. They are main part of nutritive safe foods among the organic products. What is still lacking is focussed research on these crops.

To sum up, as part of the process we may be passing through a phase where we are witnessing a scenario of declining farming of native mountain crops and their genetic resources in their native areas, as has been found in the present study. But going by the signs of future of food market, which will have thrust on safe food, nutrition and unique food values, it is a strong possibility that most of these crops will make a comeback on the same native lands or elsewhere. Therefore, the main mountain crops will continue to occupy food and agriculture space in one or the other way, here or there.

Need, is to learn from developing agriculture success stories of these crops elsewhere and look at the possibilities of repeating these in their native lands. If they have value they can make a comeback, the case of Himalayan grain chenopods narrated above, confirms it.

The variety of Himalayan agroecosystems is another unique feature of the region. There has never been a thinking about efforts to preserve and improve health of the existing Himalayan agroecosystems. These are passing through a phase of tremendous human pressure leading to drastic changes both in ecosystem structures and functions. It is a least thought of issue in mountain agriculture research and development strategies. Focus on agroecosystem health is, however, gaining ground elsewhere, since the past few decades.

Need for adaptation strategies to manage climate change impacts on Himalayan agriculture and livelihoods

Contrary to general perception of overall negative impacts of climate change on agriculture, the Himalayan farmers are experiencing contrasting scenarios. While in certain areas, climate change has disrupted productivity and cropping patterns but it also brought new opportunities to farmers in some other agroecosystems. If crops moving higher due to warming weather meant new opportunities to farmers, downward movement of crops due to technological innovations indicates possibilities of maintaining status quo w.r.t. cropping patterns in old areas of crops.

There are however new research challenges and economic costs imposed by climate change. Increasing uncertainty of precipitation timing has forced farmers and institutions to adapt to changes in phenological calendar of crops, shifting sowing periods, reduced or extended growing periods, disrupted flowering timings leading to mismatch between periods of maximum pollinator availability and flowering of crops. Farm universities have to focus on research strategies leading to keeping multiple seed sets of a same crop by the farmers of an area, so as to manage uncertainty of autumn precipitation necessary for sowing. There have been times when sowing had to be shifted from October to February March, which would need chilling neutral varieties of wheat seed, for example. It does happen with summer crops also when early summer sowing gets delayed by few months and available cropping period in middle mountains and high mountains is reduced.

Climate change impact is being experienced in fruit crops farming areas, where it is now common experience of the Himalayan farmers to see failed crops and economic returns in alternate years. For example, dry warm winters in 2017-18 and early snow fall in October 2018, destroyed apple crop of Kashmir and Himachal farmers. New challenges demand new research innovations such as possibility of managed flowering periods of fruit crops and managed pollination as the new research areas.

Main streaming the idea of New Age mountain farmers

On the surface of it the idea and experiences of new age Himalayan farmers appear very nascent and it is so indeed. However, the circumstances that are building up a new scenario of Himalayan agriculture, the class of new age farmers may likely occupy more space than we can envision in present times. The leveraging of constraints through working appropriate institutional strategies, may increase enabling environment for mainstreaming of new age farmers approach.

As New Age farming concept is perceived as agri-business led enterprises models that are based on the social, economic, technological and skill capabilities of younger generation of mostly unconventional farmers. Therefore for this perspective to succeed in innovating sustainable farming cultures of whatever kind and scale, it would need to be facilitated through appropriate technological and institutional (policy) support services. Envisaged ecological back lash of cash cropping by new age farmers, for example, can essentially be averted through promoting organic farming practices. Farmers innovations led success stories of new age farmers indicated that there is much scope for widening the circle of new age farmers in the Himalayan region. There will always be danger of promoting cropping patterns leading to increased use of chemical fertilizers and pesticides, with fears of ecological backlash. But that is when these New Age farmers do not receive technological back support of alternative technological options

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Annexures

1.1. Nutritional significance of finger millet – A Himalayan crop

- Rich source of minerals such as calcium, phosphorus, potassium and iron
- Considered to be one of the best seed for brewing. Indeed, finger millet has much more of this "scarifying" power than does sorghum or maize: only barley, the world's premier beer grain, surpasses it
- Its protein has high biological value with good amounts of tryptophan, cysteine, methionine amino acids.
- People with obesity can reduce half of their weight within short time.
- It is good for anemic persons
- It is most preferable to ladies in their menopause stage (due to high calcium content), anemic and arthritis patients)
- It is a safer food for diabetic patients as its slow digestion keeps low blood sugar levels
- For obesity: One roti of finger millet (unleavened bread) at dinner along with 1 cup of cow's milk do enormous wonders to our health. After 15 days, you will feel your body weightless, extra fat reducing, sugar controlling, very good sleep at nights. This is because it filters unwanted water from our body and makes our bones and nerves tight & fit
- A popular quote in Hills - Mandua raja jab seko tab taja
- The book 'Lost Crops of Africa' mentioned that "Outsiders have long marvelled at how people in Uganda and Southern Sudan could develop such strapping physiques and work as hard as they do on just one meal a day. "Finger millet seems to be the main reason"

Source : Author compiled

Nutritional and Food value Buckwheat (ogla and Phaphra)

- Very rich in protein and amino acid lysine (deficit in what, rice and maize)
- Virtually fat free and seeds contain 1.5-3.7% total lipids
- Rutin, the most important ingredient
  - keep capillaries and arteries strong and flexible thus result in decreased incidence of vascular complications
  - effective preventative measure against high blood pressure or hypertension
  - shown effect in lowering the level of blood sugar
- Contains choline, which facilitates the working of the liver
- Contains considerable amount of vitamins B1 and B2, potassium, magnesium, calcium, phosphate, zinc and iron are abundant

Source : Author compiled

Fig. 3.1. Household Income in six villages of the Indian Himalayas.

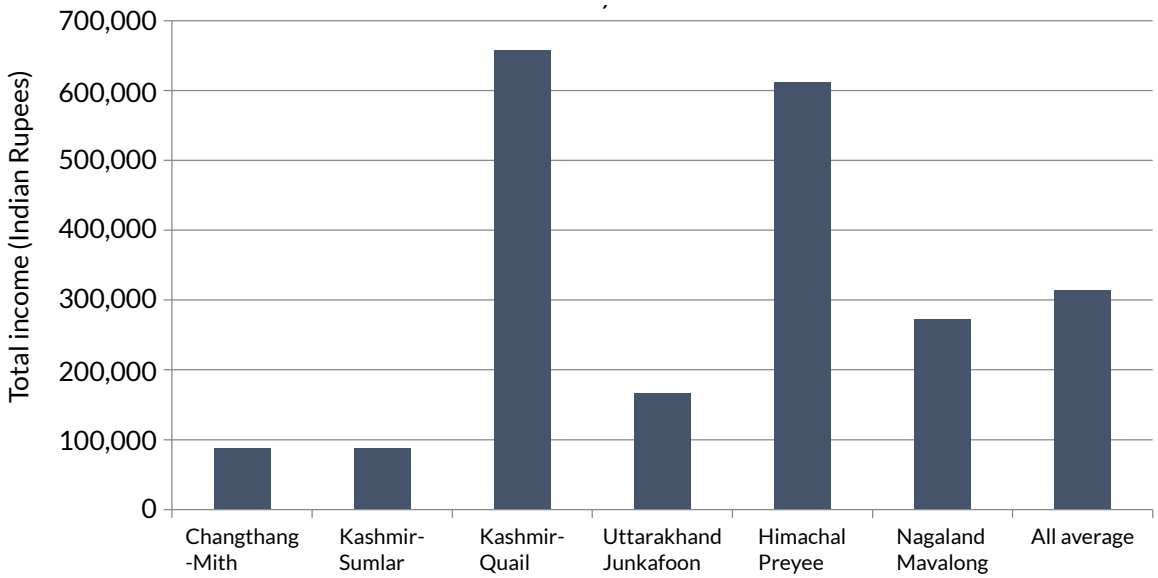
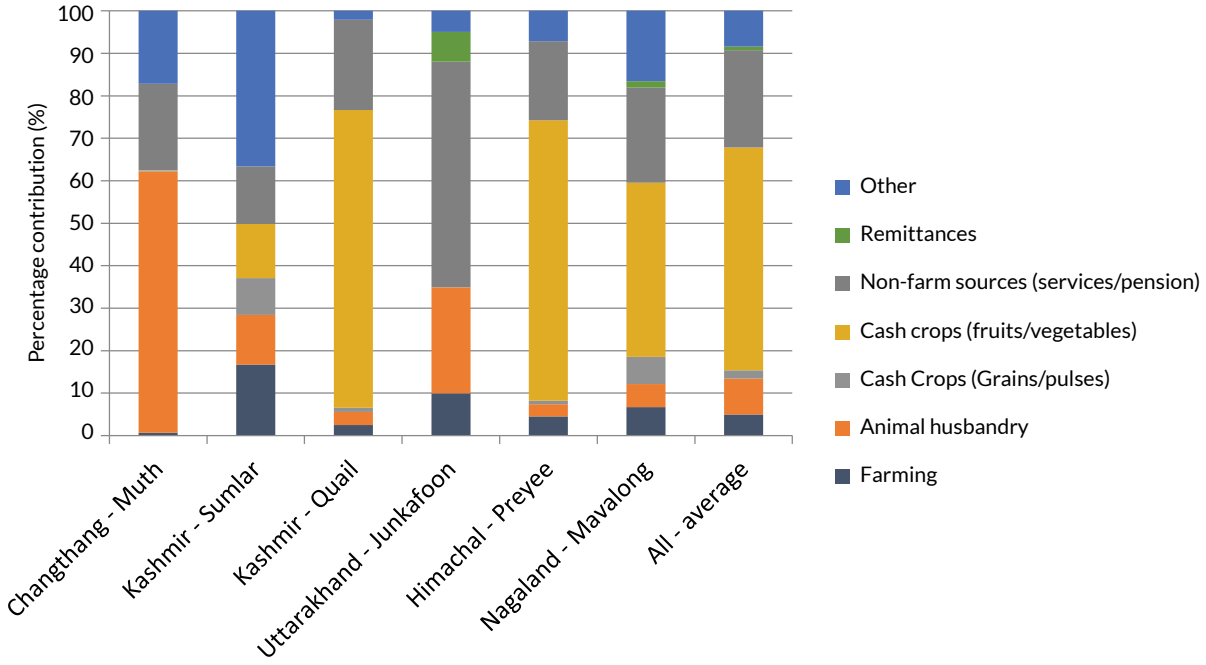
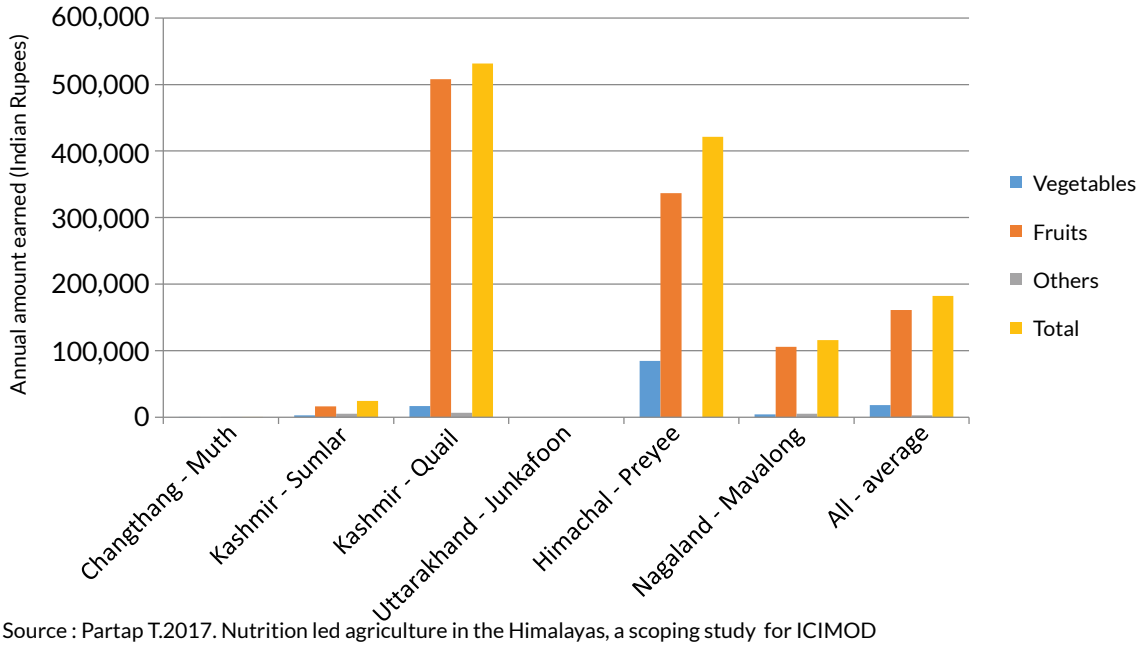


Figure 3.2. Relative contribution of various sources to total income of households (six sample villages of the Indian Himalayas)



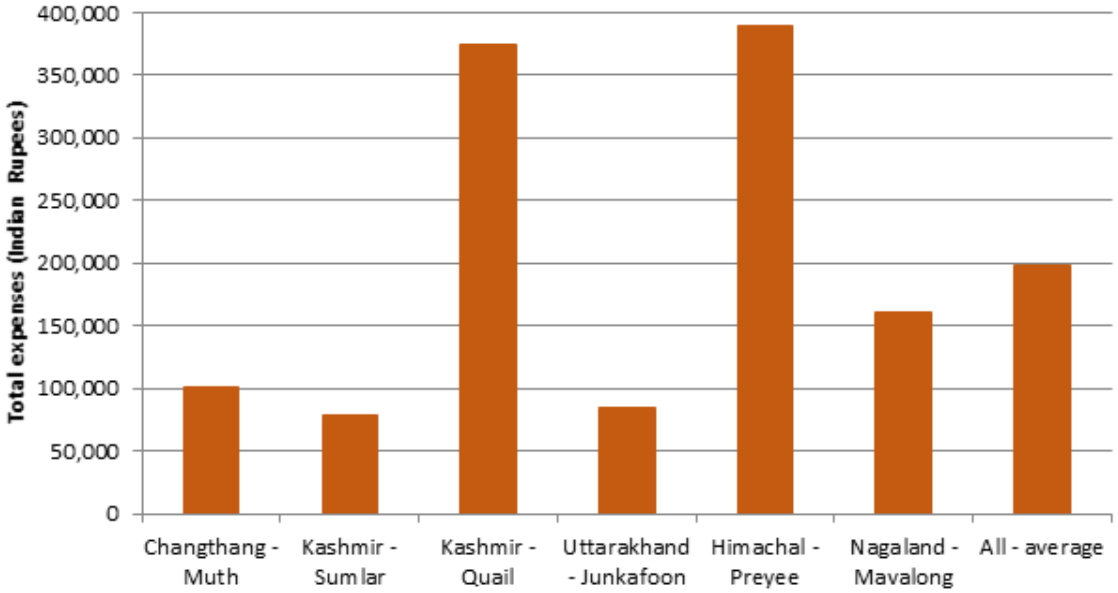
Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

Figure 3.3. Income earned by households from cash cropping in six Himalayan villages.



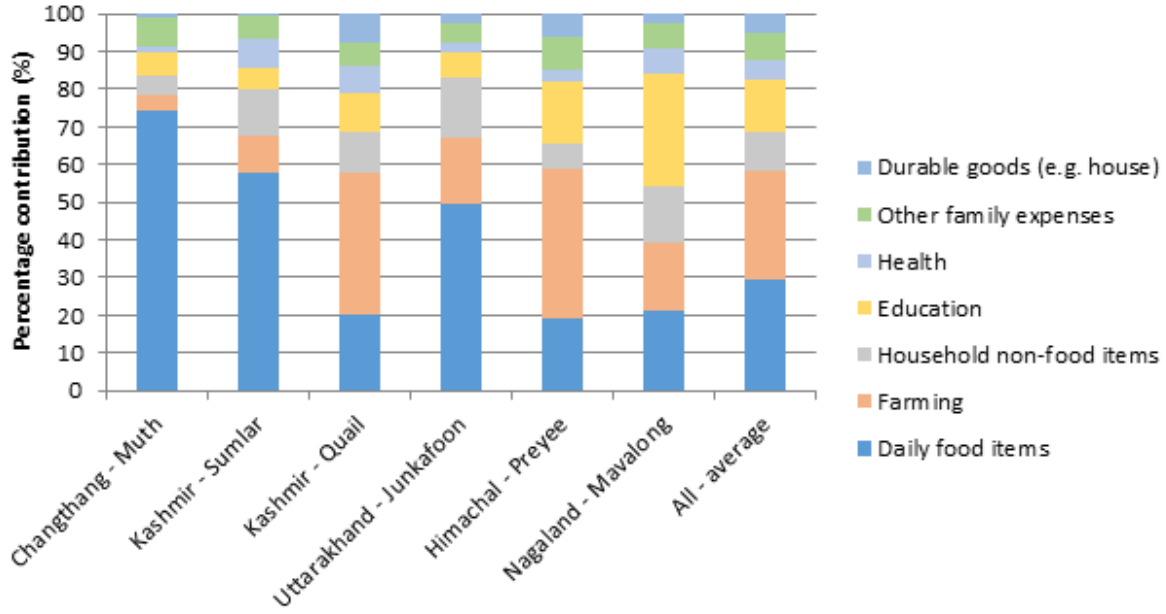
Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD

Figure 3.6. Annual Expenditure of households on managing livelihoods in the six Himalayan villages



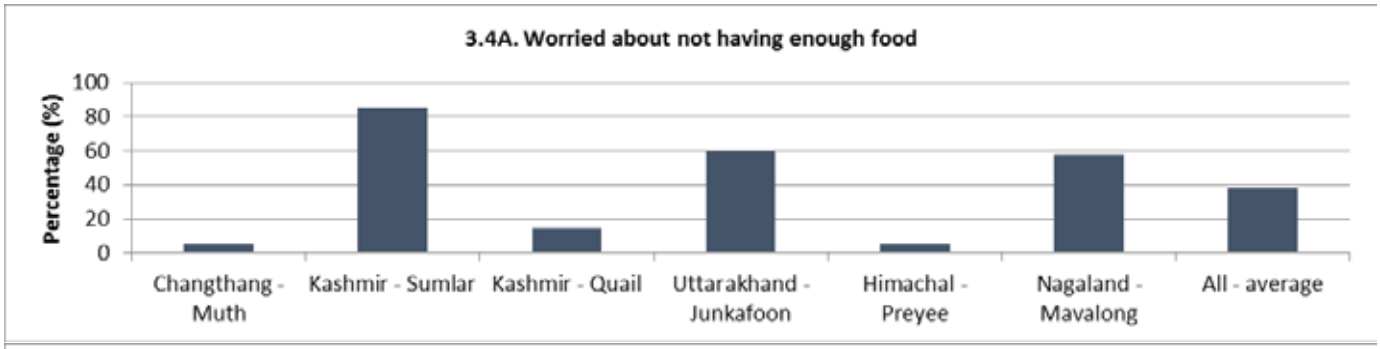
Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

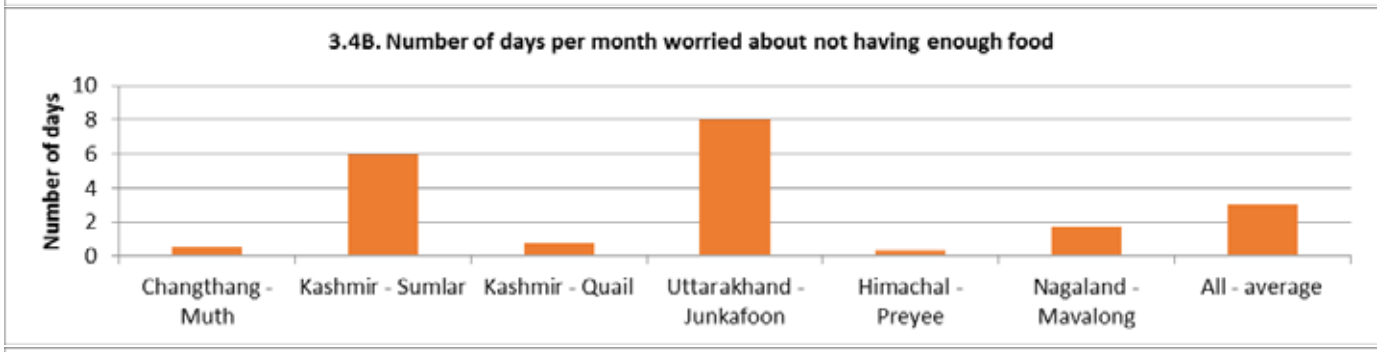
Figure 3.7.Relative contribution of various sources to total annual expenses of households in six Himalayan villages..

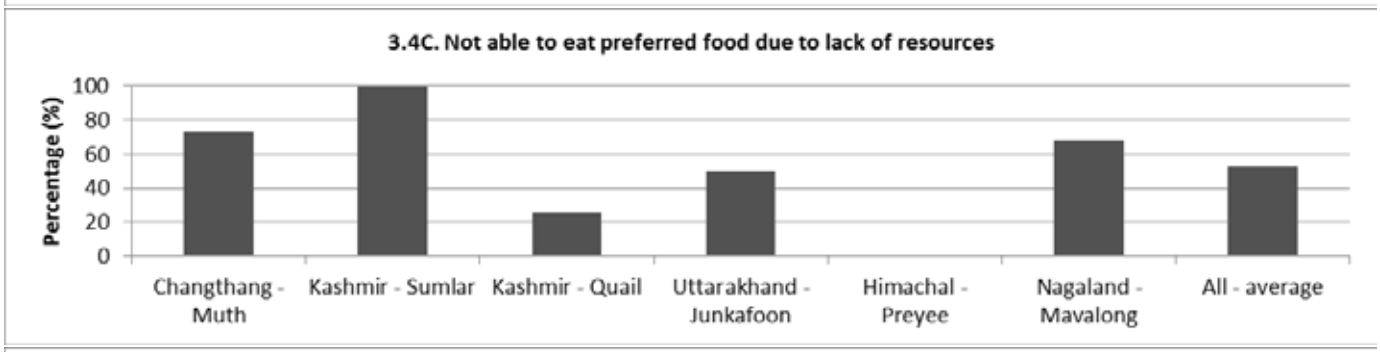


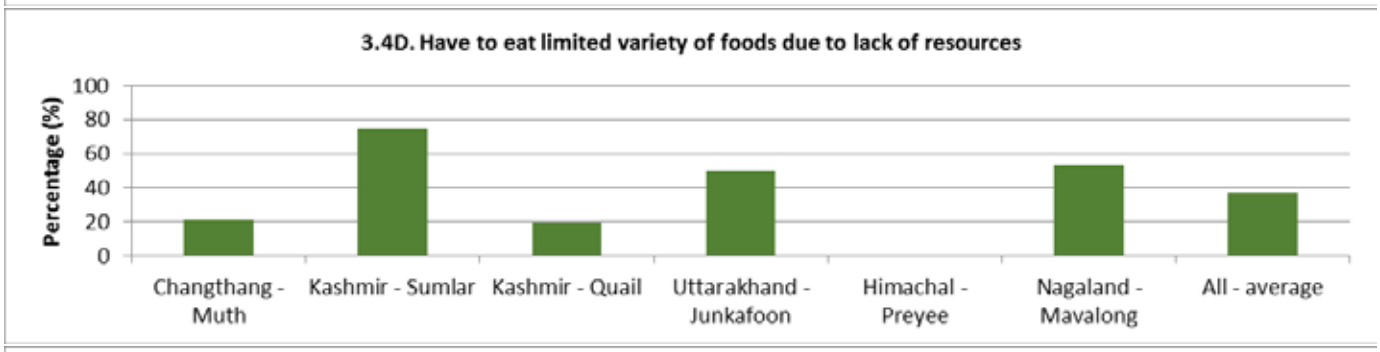
Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD

Figure 3.4. A-E. Food Insecurity Assessment of Households : For the month before study (April 15-May15, 2016)









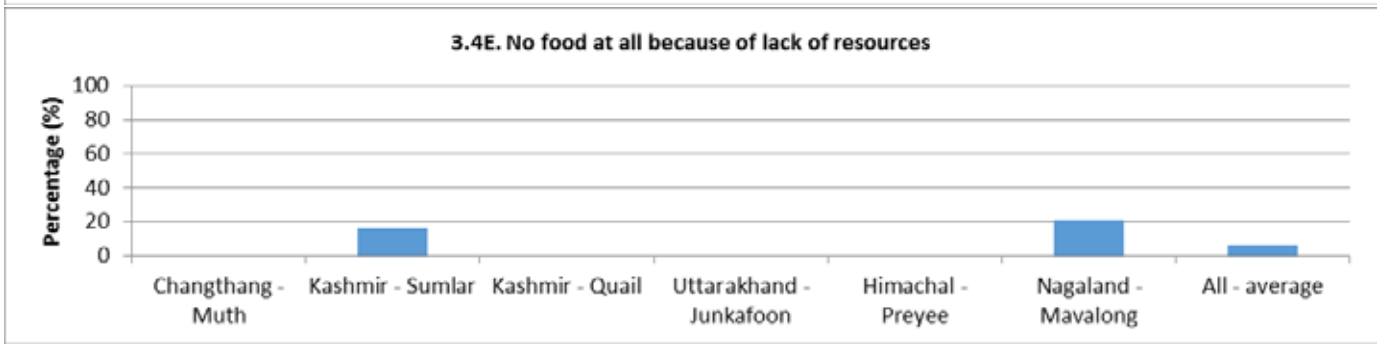


Figure 3.4F-I (continued). Assessing food insecurity among households of six Himalayan villages, during the past four weeks.

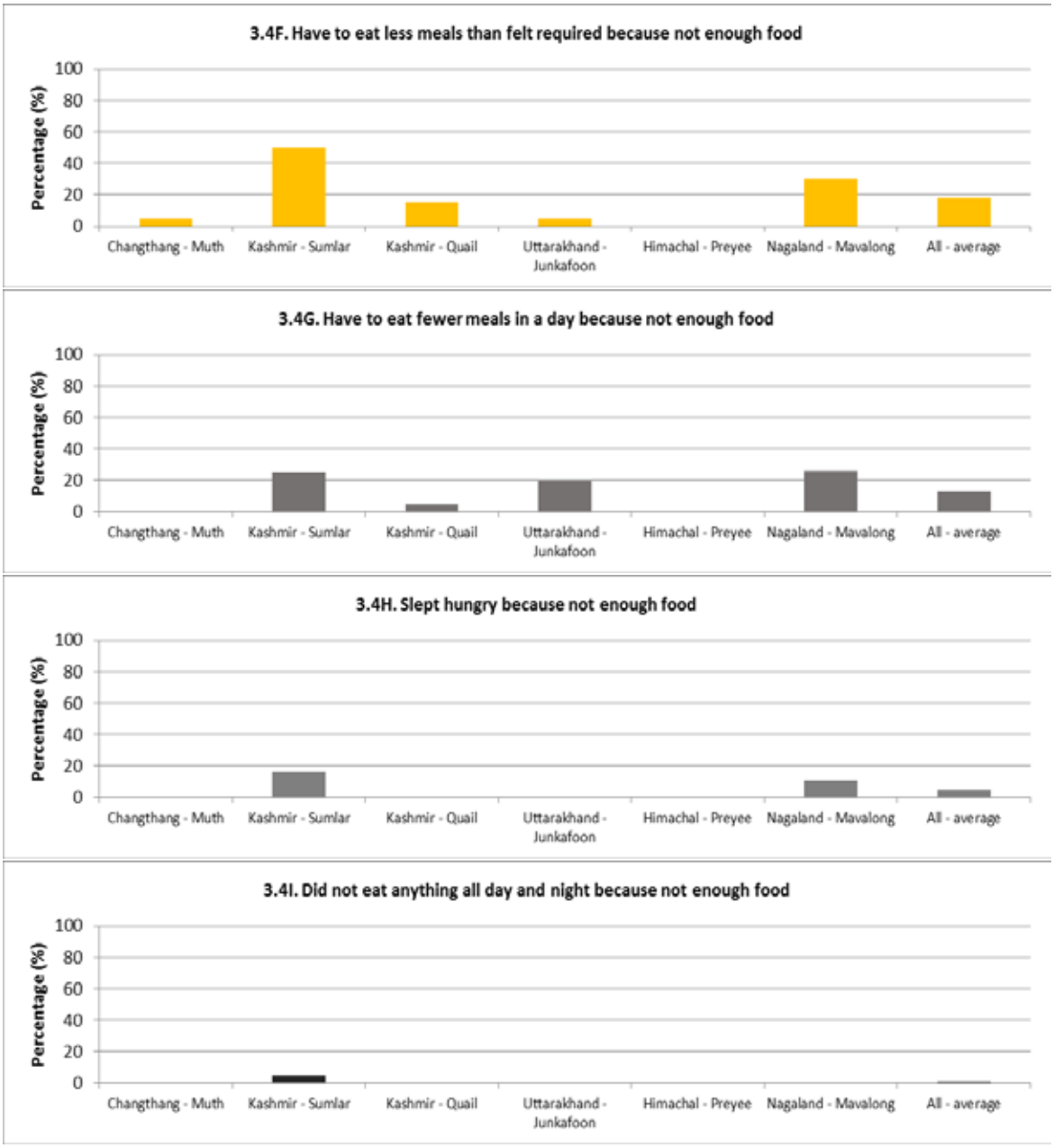


Figure 3.5A-D. Food Insecurity Assessment among Households during the Year.

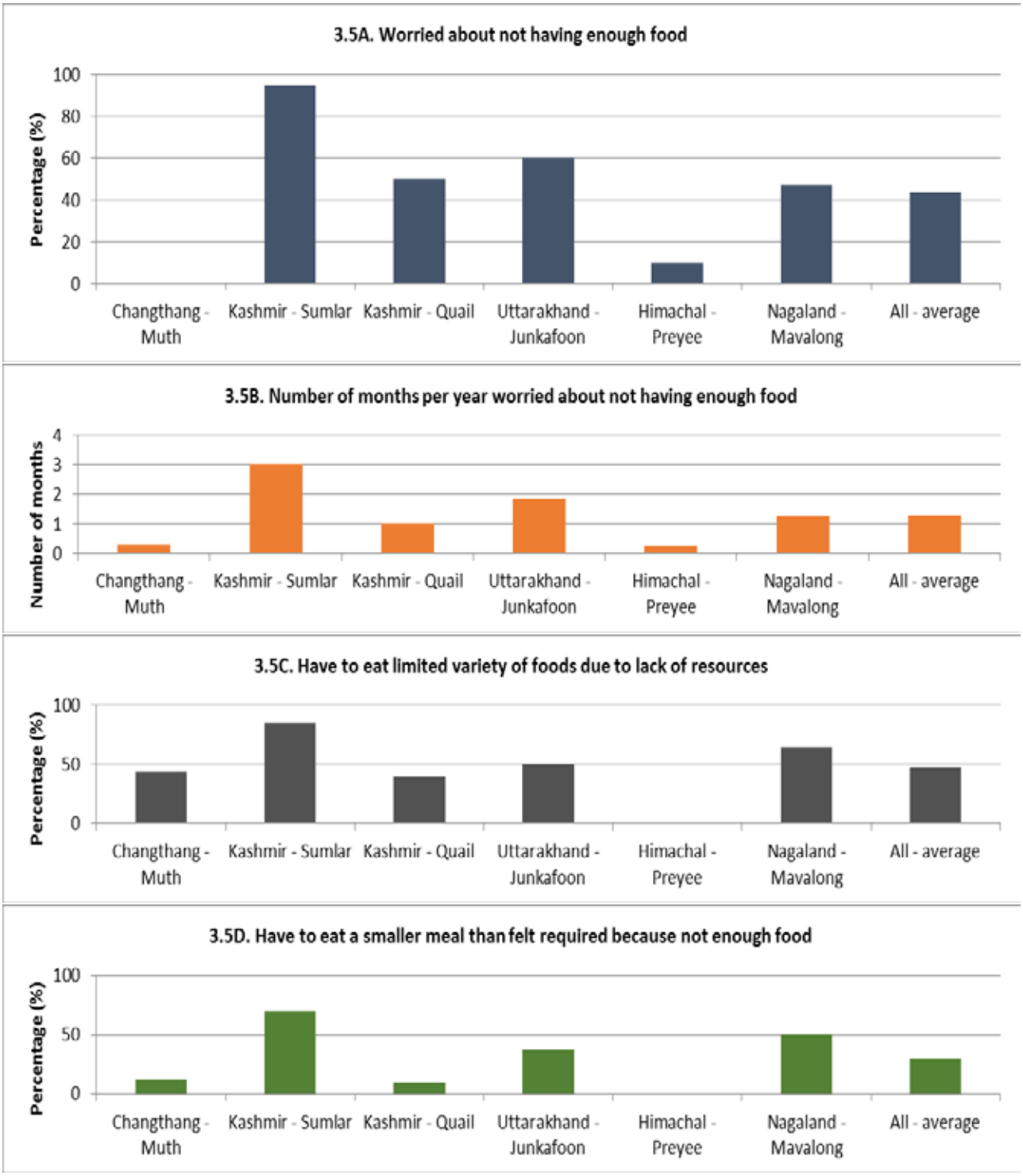
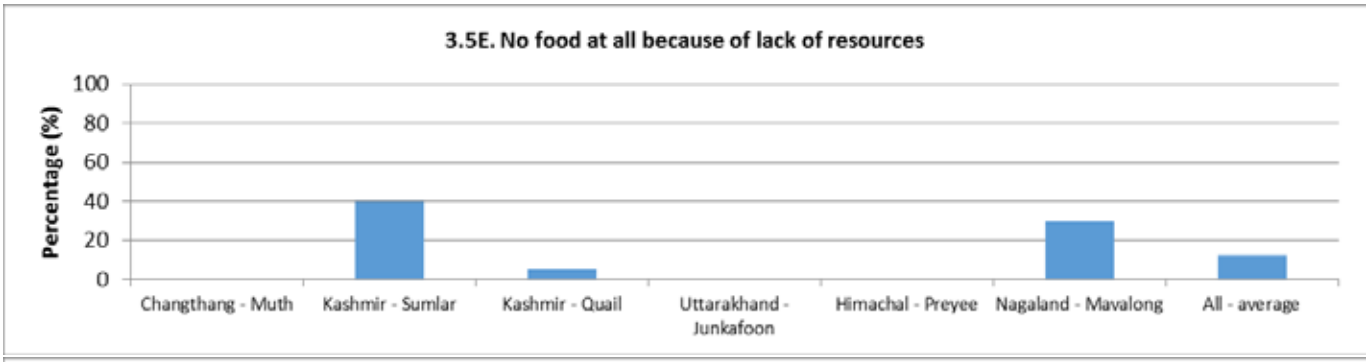
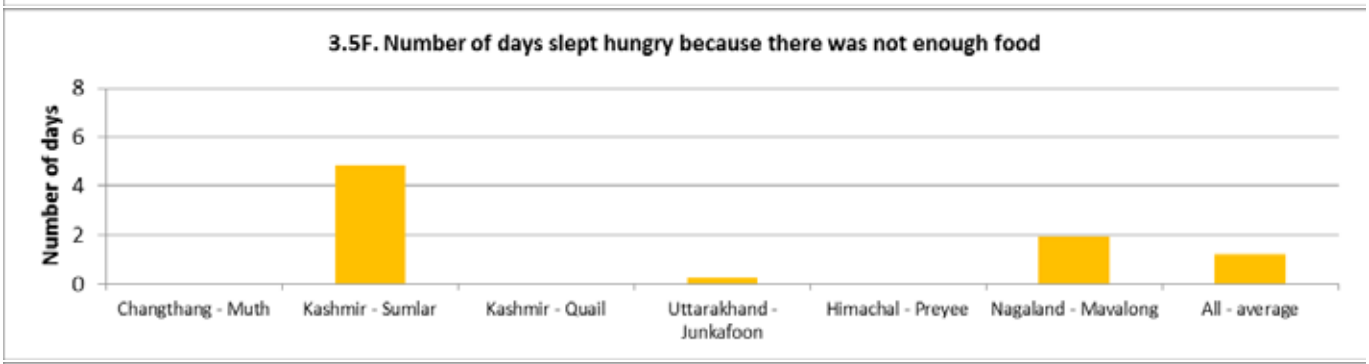
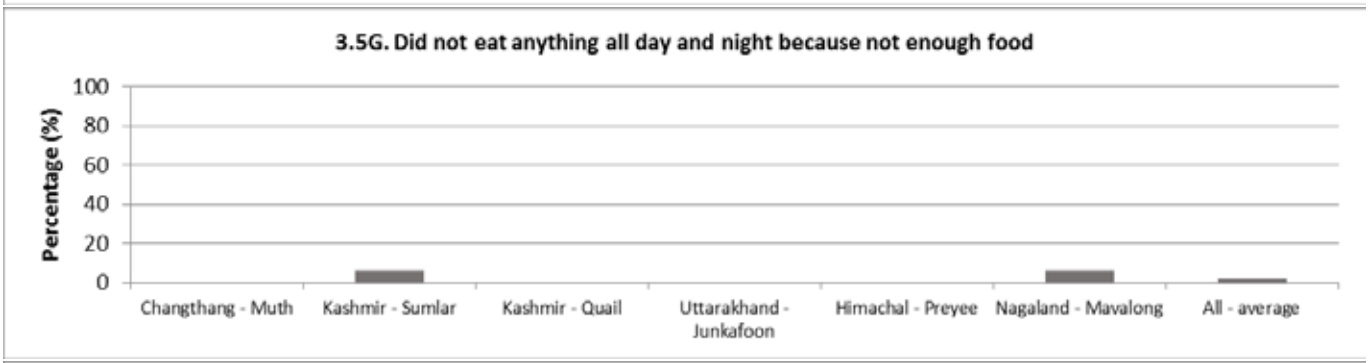


Figure 3.5. E-H. (continued). Assessing Food Insecurity of households in six Himalayan villages during the previous year.







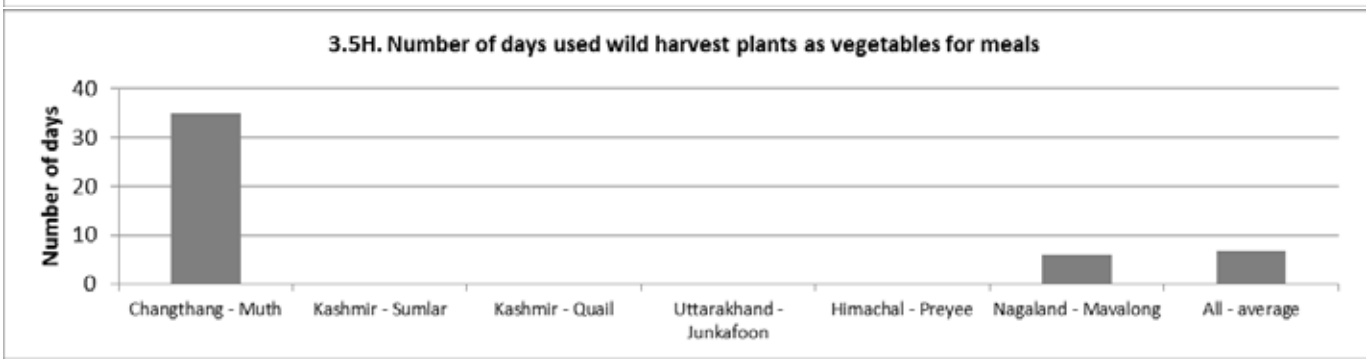


Figure 3.8A. Weekly nutrition pattern of households in six Himalayan villages

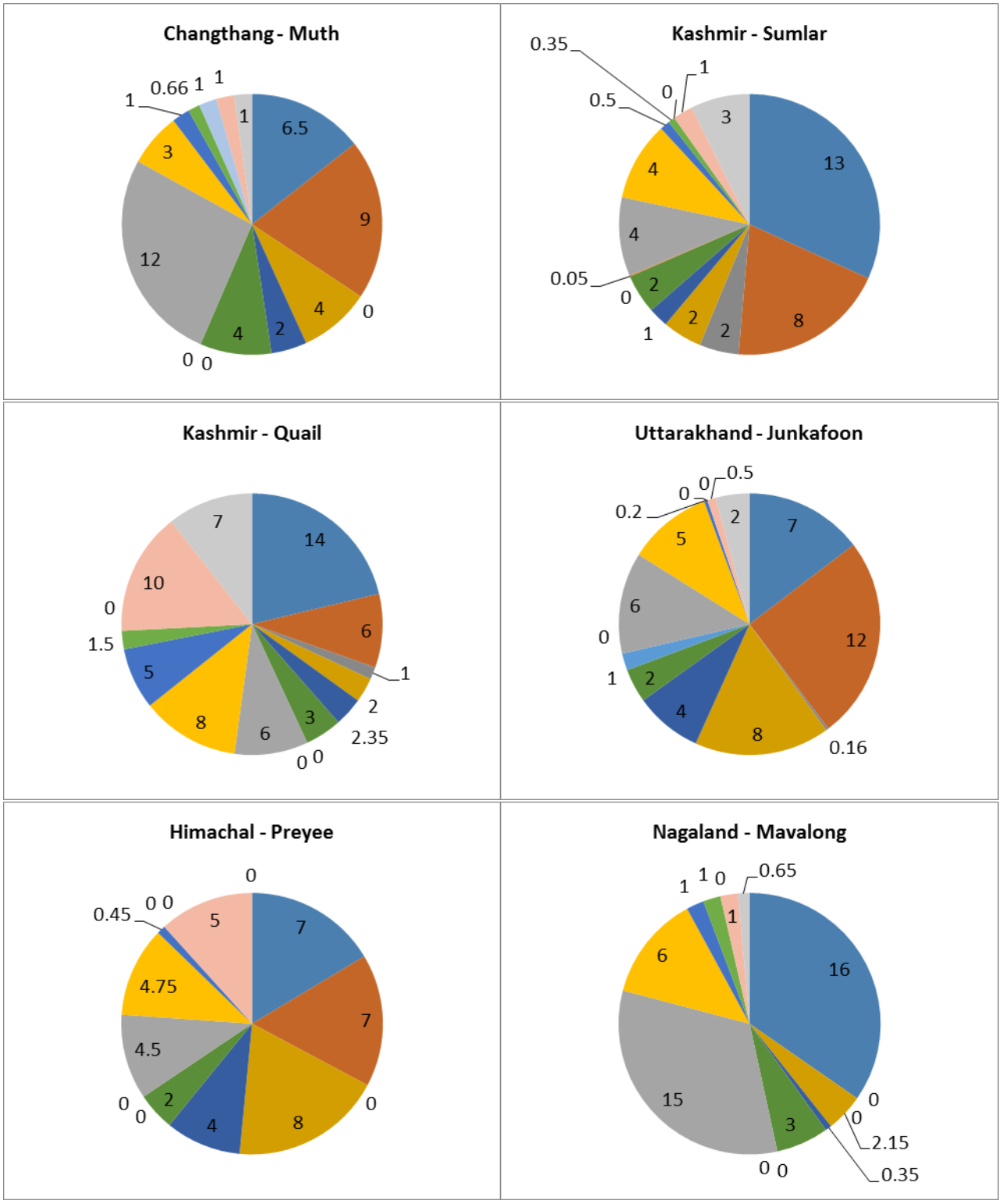


Fig. 3.8B Weekly Diet Chart, all averages

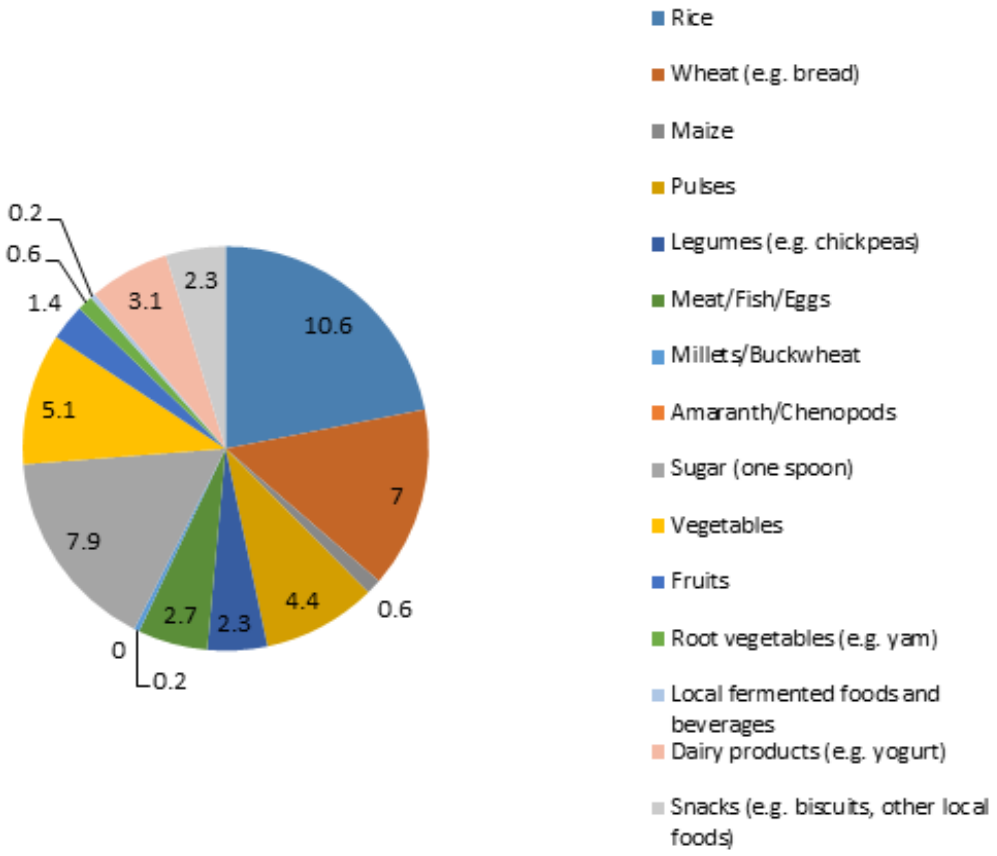


Fig. 3.9. Children getting midday meal in school

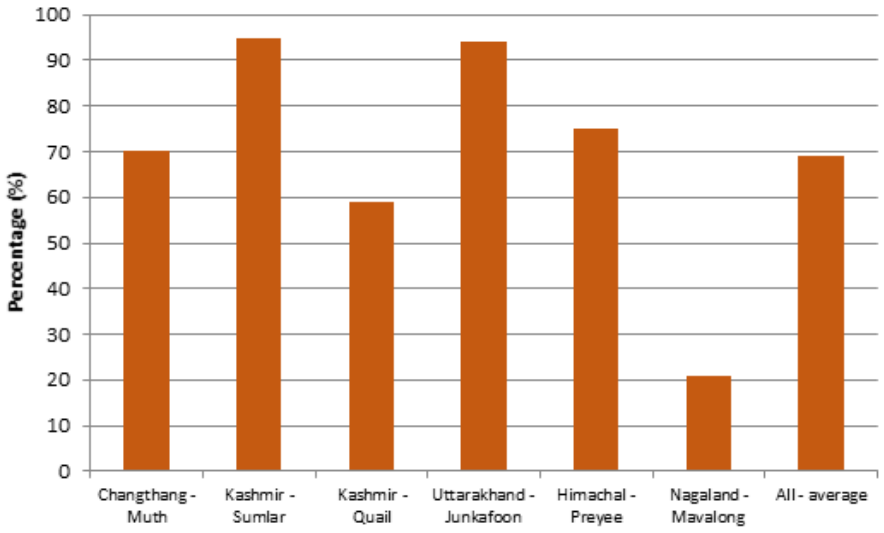
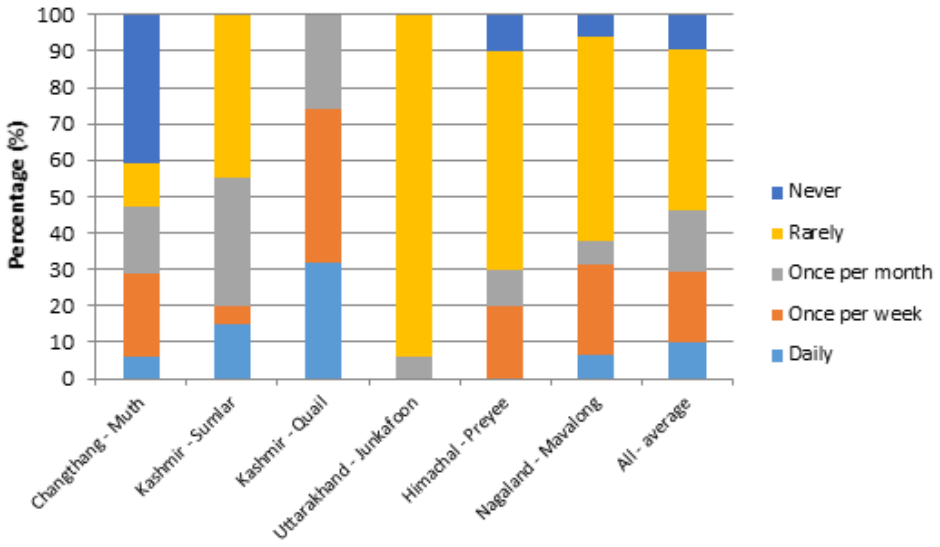


Fig. 3.10. Children eating junk food



Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

Figure 3.11. Reasons for adopting new crops in the Indian Himalayas

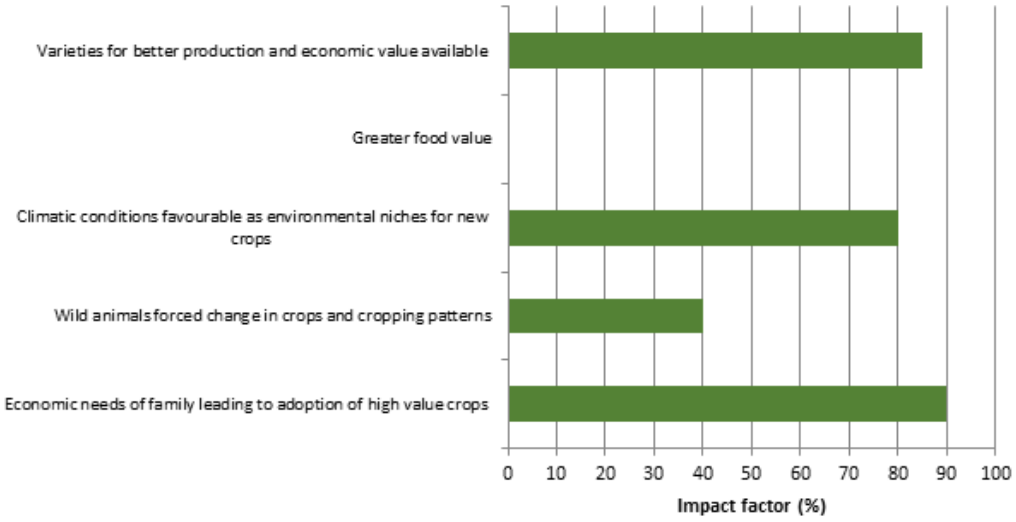
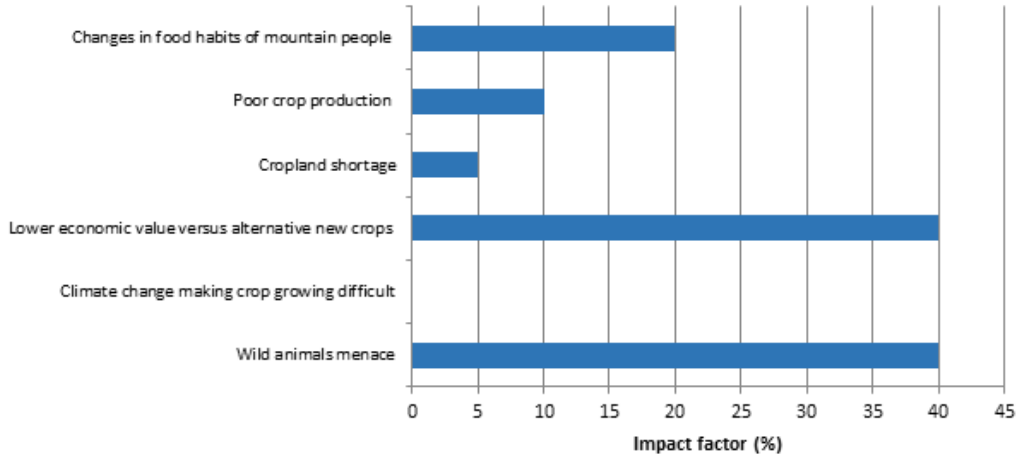


Figure 3.12. Reasons for declining and lost crops of the Indian Himalayas



Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD

Table 3.1

Sl. No	Parameters	Preyee- HP	Junkafun UK	Mavalong Nagaland	Sumlar-JK1	Quail-JK2	Muth.1. Changthang Ladakh2
1	Agro-ecozone	NW. temp. mountains	CH. subtropic mountains	NE wet warm Himalaya	NW. Temp mountain	NW. Temperate mountains	NW. Cold arid trans Himalaa
2	Altitude	1800 m	1600m	1000m	1800m	1700m	4500m
3	Farming system	Vegetables and fruits cash cropping	Food grains and livestock mixed farming	Pineapple cash cropping & shifting cult	Crop livestock mixed farming	Apple orchardists	Agro pastoral nomads owning pashmina goats
4	Terrain of crop land	Sloping and terraced	Sloping and terraced	sloping farm land	Terraced and sloping land	Flat valley and paddy terraces	Vast Range lands and small plots of terraced irrigated crop land near village
5	Households in village	65	175	206	70	700	45
6	State of HH migration	Seasonal immigration of Nepali labour	31 HH migrated elsewhere And migrating	No migration	No migration	No migration	No migration
7	HH not meeting food needs on farm	100	100	100	100	100	100
8	HH (100) not producing sufficient food grains	100 Grains replaced by veg and fruits	100 Because of Wild animals menace	100	90	100	100
9	HH (%) growing pulses	10	60	40	10	0	20
10	HH(%) growing millets	0	75	30	10	0	0
11	HH (%) meet food needs on farm	partial	partial	partial	Partial	partial	Only 10% need met
12	HH(%) using / registered for PDS	100	100	10	100	100	100 (tribals getting more quantity and cheaper)
13	PDS- rice	100	50	2	100	100	100
14	PDS- wheat flour	100	20	0	100	100	100
15	PDS-pulses	100	100	20	100	100	100

16	PDS cooking oil	100	100	20	100	100	100
17	PDS -sugar	100	100	20	100	100	100
18	HH growing vegetables in kitchen garden for consumption	801	50	70	60	75	2
19	Vegetables are cash crops	95	0	5	0	0	0
20	Local Fruits available	yes	yes	yes	yes	yes	No fruits
21	HH using Milk and dairy products	Cow milk for tea, butter milk, sick	Buffaloes milk is a major income source of HH Some use in tea and butter milk	No culture of taking milk/ dairy products Skimmed milk use common	Milk and dairy products Widely used by gujjars	Milk and dairy products Widely used by Kashmiris	HH use Pashmina Goat milk & yak milk taken during short milking season by changpas No cows here
22	Vegetable buying from market	occasional	seasonal	rare	occasional	daily	Not available
23							
	Av. Annual income from farming IRs.	400,000	120,000	70,000	70,000	500,000	180,000
24	Av annual expenses of HH	150,000	85,000	50,000	75,000	150,000	90,000
25	HH (%) meeting expenses fully from farm income	90	5	50	5	25	90
26	HH Expenses on food	30	75	25	70	30	50
27	HH expenses of health	2	1	5	10	10	10
28	HH expenses on education	40	1	50	10	25	20
29	HH expenses on other items	20	5	25	10	25	10
30	Inadequate farm land issue	yes	No	yes	yes	yes	No
31	Awareness of nutrition vitamins, minerals	yes	yes	no	no	Yes	No

32	Awareness about food & nutrition Healthy diet Unbalanced diet Hidden hunger	Aware yes	Aware yes	Less aware no	Less aware no	Ware Yes	Less aware No
33	Local diet In general	Veg Less oily	Veg Less oily	Non veg veg boiled	Veg & oily	Non veg Oily	Non veg Boiled
34	Safe unsafe food	Unsafe on farm veg supplies and fruits	Safe on farm food Unsafe veg	Safe on farm food And veg Wild / cultivated	Safe on farm food Unsafe buys	Unsafe food and veg	Organic non veg diets of people
35	Sugar intake High>5spoons/ day Medium <5spoons/day	High	High	medium	medium	high	Medium
36	Fatty foods	medium	medium	low	high	high	Medium
37	Non vegetarian diet	Once a month	Once a month	2-3 times week	once a week	2-3 times a week	Whole time in winters and alternate days in summers
38	Milk products use	Moderate	Moderate	Rare	Moderate	Moderate	Goat milk moderate

(Values, wherever not indicated are % values)
Note : In sl. no. 38, Moderate use of milk products means, half cup of milk daily in tea, butter milk taken as curry almost daily if available in the village it is commonly shared among households. Occasional use of clarified butter with pulses and vegetables in Preyee, Himachal, and Uttarakhand.
Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD

Table 3.2. State of House holds in study villages representing different Himalayan Farming Systems

	Changthan Muth	Kashmir Sumlar	Kashmir Quail	Utrakhan Junkafon	Himachal Preyee	Nagaland Mavalong	Av value
Type	Pastoralists	Farmers	Orchardists	Livestock mixed farming	Vegetable and fruit growers	Food and cash crop growers	n/a
Average family size (people)	6	10	6	8	7	7	7.3
Rural population (%)	100	100	100	100	100	100	100.0
Distance from market (km)	25.7	5.8	7.4	16.9	14.5	15.5	14.3
Total land holdings (ha)	0.6	0.5	0.8	0.4	0.9	2.6	1.0

Table 3.3. Food Production/ Consumption Pattern in study villages representing Himalayan Farming Systems

	Changthang - Muth	Kashmir - Sumlar	Kashmir - Quail	Uttarakhand - Junkafoon	Himachal - Preyee	Nagaland - Mavalong	All - average
Producing sufficient food for self-consumption (%)	0	15	25	0	0	50	15.0
Producing food grain for self-consumption (e.g. rice; %)	0	70	69	50	20	60	44.8
Producing pulses for self-consumption (%)	0	70	70	25	30	0	32.5
Producing millets for self-consumption (%)	0	20	0	65	0	0	14.2
Family needs met through production of food grains (%)							
Fully	5	0	10	0	0	28	7.2
Partially	95	100	90	100	100	72	92.8
Families listed under PDS1 (%)	100	95	100	100	95	16	84.3
APL2	30	5	60	35	45	33	34.7
BPL3	70	95	40	65	55	77	67.0
Weeks per month covered through items supplied by PDS1							
1	10	0	5	5	0	25	7.5
2	35	70	55	95	95	50	66.7
3	10	30	40	0	5	0	14.2
4 (full month)	45	0	0	0	0	25	11.7
Percentage of families purchasing food items additional to PDS (%)							
Food grains	100	100	75	100	100	60	89.2
Pulses	100	100	75	100	100	55	88.3
Cooking oil	100	100	95	100	100	100	99.2

Families growing vegetables for consumption (%)	50	75	100	70	84	75	75.7
Families buying vegetables from the market (%)							
Whole year	0	15	30	25	20	30	20.0
Seasonal	55	40	35	10	70	25	39.2
Occasionally	40	45	35	65	10	45	40.0
Never	5	0	0	0	0	0	0.8
Families growing fruits for consumption	0	30	65	40	47	55	39.5

1PDS: Public Distribution System, 2APL: Above Poverty Line, 3Below Poverty Line.
Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

Table 3.4. FOOD SECURITY COPING MECHANISMS OF HOUSEHOLDS UNDER DIFFERENT HIMALAYAN FARMING SYSTEMS : REPRESENTED BY STUDY VILLAGES

	Nomads Changthang Ladakh	Gujjartribe Sumlar Kashmir	Orchardists Quailmuqam Kashmir	Wild animals impacted farmers Junkafoon Uttrakhand	Vegetable& fruit farmers Preyee Kullu Himachal	Shifting cultivaros Mavalong Nagaland	Average Value IHR
Eating rice porridge	0	0	0	0	0	0	0
Prioritizing children and elderly for food	0	1	0	0	0	0.6	0.3
Reducing number of daily meals	0	1	0	0.6	0	0.3	0.3
Skipping meat, dairy and fruits	0	2	0.6	1	0	0.4	0.7
Consuming only rice at meal times	0	2	0.2	0.2	0	0.3	0.4
Consuming less preferred staples	0	2	0.3	0.4	0	0.2	0.5
Changing curry ingredients, variety or rice quality	0	1	0.6	0.5	0	0.4	0.4

Begging for food	0	0	0	0	0	0	0
Borrowing food from neighbours or relatives	0	0	0.2	1	0	0.5	0.3
Eating rice seed stocks	0	0.1	0	0	0	0.2	0
Eating immature crops	0	0.3	0	0	0	0	0
Eating wild animals or plants	0	0.2	0	0.4	0	0.5	0.2
Purchasing food on credit	0	1.4	0.4	1	0	0.6	0.6
Reducing health expenditures	0	1	0.2	0.1	0	0.2	0.2
Sending children or elderly away to eat	0	0	0	0	0	0.1	0
Using children to work	0	0.5	0	0	0	0	0.1

Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

Table 3.5: CROPS ABANDONED BY THE INDIAN HIMALAYAN FARMERS: Village survey findings (% Of households abandoning the crops)

No	CROPS	JK-SUMLAR	JK-BANDIPOR	HP-PREYEE	UK-JUNKAFON	NAGALAND-MAVLONG	MUTH CHANGTHANG LADAKH
1	Barley	55	95	95	15	-	-
2	Rice var	5	20	100	25	-	=
3	Mustard	5	20	100		-	-
4	Maize local	15	95	95	55	-	-
5	Pulses	10	55	80	50	-	-
6	Potato	5	-	90	25	-	-
7	Wheat	10	100	95	30	-	-
8	Amaranth	5	100	100	50	-	-
9	Chenopod	100	100	100	-	-	-
10	Foxtail millet	5	-	100	70	-	-
11	Pearl millet	55	-	100	70	-	-
12	Finger millet	55	-	100	20	-	-
13	All millets	55	-	100	50	-	-
14	Pea nut	-	-	-	85	-	-
15	Barnyard millet	-	--	-	75	-	-

16	Pea as cash crop	-	-	-	90	-	-
17	Banana	-	-	-	-	15	-
18	Papaya	-	-	-	-	15	-
19	Guards	-	-	-	-	20	-
20	Winged bean	-	-	-	-	30	-
21	Turmeric	-	-	-	-	25	-
22	Bamboo shoots	-	-	-	-	10	-
23	Wild nettle	-	-	-	-	-	40
24	Wild onion	-	-	-	-	-	20
25	Nainak-local barley	-	-	-	-	-	60
26	Kala Zeera	-	-	-	-	-	60
27	Med plants	-	-	-	-	-	45

Table 3.6: Crops maintained by the Himalayan Farmers

No	crops	Gujjar tribe sumlar	Orchardists of quail Kashmir	Fruit & vegetable Growers Preyee Himachal	Animal impacted rain fed farmers Junkafun	Shifting cultivators Mavalong Nagaland	Nomads of Changthang
1	Wheat	20	5	5	50	-	-
2	Maize	70	10	5	5	10	-
3	Rice paddy	10	45	-	-	10	-
4	Rice upland	-	-	-	5	70	-
5	Mustard	5	5	-	10	-	-
6	Pulses	35	5	20	40	-	-
7	Apple	-	90	90	-	-	-
8	Walnut	10	10	-	-	-	-
9	Pears	-	20	10	-	-	-
10	Barley fodder	-	-	10	10	55	-
11	Oat fodder	5	10	5	-	-	-
12	Finger millet	-	-	-	35	-	-
13	Barnyard millet	-	-	-	45	-	-
14	Sesame	5	-	-	25	15	-
15	Kulthi	-	-	-	5	-	-
16	Soybean	5	-	-	15	15	-
17	Black soybean	-	-	-	15	-	-
18	Onion	-	-	-	5	-	-
19	Potato	5	-	5	5	5	-
20	Pine apple	-	-	-	-	70	-

21	Veg solanaceae	20	10	35	15	35	-
22	Veg cucurbits			5	35	40	-
23	Veg cruciferae			30	30	30	5

Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

Table 3.7: New crops adopted in the Himalayas

No	Crops	JK-1 Sumlar	JK-2 Bandipor	Himachal preyee	UK Junkafun	Nagaland Mavlong	Ladakh Changthang
1	Apple	45	90	85	-	-	-
2	Pear	5	15	20	-	-	-
3	Walnut	10	10	-	-	-	-
4	Cherry	5	10	-	-	-	-
5	Maize as fodder	30	30	30	10	-	-
6	Oat as fodder	10	10	-	-	-	-
7	Paddy rice	30	-	-	-	-	-
8	Poplar for timber	10	-	-	-	-	-
9	wheat	10	-	-	-	-	-
10	Cauliflower	-	-	75	-	-	-
11	Cabbage	-	-	20	-	-	-
12	Tomato	-	-	75	-	-	-
13	Pea	20	-	35	-	-	-
14	Beans	10	-	5	-	-	-
15	Capsicum	-	-	5	-	-	-
16	cucumber	-	-	10	-	-	-
17	squash	-	-	5	-	-	-
18	Tree bean	-	-	-	-	5	-
19	Assam lemon	-	-	-	-	5	-
20	Annamomi HBP. medicine					5*	
21	Banana for inflorescence veg	-	-	-	-	10*	-
22	Wild onion	-	-	-	-	30*	-
23	Kiwi	-	-	*tried	-	5*tried	-
30							

Source : Author

Table 3.8: Reasons for declining and lost Crops of the Himalayas

S.no	Reason	impact factor (%)
1.	Changes in food habit of mountain people	20
2.	Abandoned because of poor production	10
3.	Cropland shortage	5
5.	Economic needs of the family forced adoption of new high value crops So as to move from food security to economic security (prime consideration)	90
4.	Less economic value of the crop as compared to alternative new crops	40
5.	Climate change making it difficult to grow	
6.	Wild animals menace forcing abandonment of farming	40
	Why new crops?	
1.	HY Varieties for better production and economic value available	85
2.	More food value	
3.	Climatic conditions of mountain areas used as environmental niches for growing new crops	80
4.	Wild animals forced change in cropping patterns and crops	40

Table 3.9: High Value Niche Crops and animals of the Indian Himalayas

Crop/ animal	Jk-sumlar	Jk-bandipor	HP-preyee	UK-junkafun	Nagaland-Mavlong	Ladakh-MuthChangthang
Apple/ temperate fruits		orchards	orchards			
Vegetables Off season						
			Cultivated cash crops			
Naga chili					cultivated	
Pine apple sweet					Cultivated cash crop	
Ginger					Cultivated cash crop	

Pashmina goat						Husbanded by Nomadic pastoralists
Cattle/ buffaloe				Rearing		
Chicken	Farming			farming	farming	

Source : Author's survey

Table 3.10 : Changing values of Livestock husbandry-village survey findings

No	Purpose livestock is kept	prevalence
1.	For dairy products	80
2.	For wool	20
3.	For farming operations	25
4.	For sale to generate cash income	30
	THE TREND OF LIVESTOCK BASED FARMING	
A	Households declining livestock	70
B	Households already abandoned livestock husbandry for various local/ family reasons (no longer economically viable or grazing a problem)	30
C	Households increasing a particular livestock holding because of its economic value opportunities (niche based opportunity)	20* Pashmina goat in Changthang
D	Breed Cows, Jersey/ holstein replacing local breeds and other animals as source of dairy in areas of cash cropping systems	35
E	Buffaloes replacing other animals in areas aiming at dairy based livelihood systems	15

F	Sheep stocks declining since replaced as source of wool by Australian wool	70
G	Bullocks being replaced by light machines- power tillers suitable for hilly land	50
H	Where ever farm economy is improving and otherwise, the Poultry rearing is increasing because of increasing demand for poultry products, eggs and meat	20
I	General shrinking of grazing lands putting pressure on fodder scarcity forcing households to reduce / abandon livestock requiring open grazing and more fodder (general cattle, sheep , goats)	60

Source : Author's survey

Table 3.11: CROPS ABANDONED BY THE INDIAN HIMALAYAN FARMERS

(% Of households abandoning the crops)

No	CROPS	JK-SUMLAR	JK-BANDIPOR	HP-PREYEE	UK-JUNKAFON	NAGALAND-MAVLONG	MUTH CHANGTHANG LADAKH
1	Barley	55	95	95	15	-	-
2	Rice var	5	20	100	25	-	=
3	Mustard	5	20	100		-	-
4	Maize local	15	95	95	55	-	-
5	Pulses	10	55	80	50	-	-
6	Potato	5	-	90	25	-	-
7	Wheat	10	100	95	30	-	-
8	Amaranth	5	100	100	50	-	-
9	Chenopod	100	100	100	-	-	-
10	Foxtail millet	5	-	100	70	-	-
11	Pearl millet	55	-	100	70	-	-
12	Finger millet	55	-	100	20	-	-
13	All millets	55	-	100	50	-	-
14	Pea nut	-	-	-	85	-	-
15	Barnyard millet	-	--	-	75	-	-

16	Pea as cash crop	-	-	-	90	-	-
17	Banana	-	-	-	-	15	-
18	Papaya	-	-	-	-	15	-
19	Guards	-	-	-	-	20	-
20	Winged bean	-	-	-	-	30	-
21	Turmeric	-	-	-	-	25	-
22	Bamboo shoots	-	-	-	-	10	-
23	Wild nettle	-	-	-	-	-	40
24	Wild onion	-	-	-	-	-	20
25	Nainak-local barley	-	-	-	-	-	60
26	Kala Zeera	-	-	-	-	-	60
27	Med plants	-	-	-	-	-	45

Source : Partap T.2017. Nutrition led agriculture in the Himalayas, a scoping study for ICIMOD.

Table 3.12: Crop cultivation continuing in one or the other area of Himalayas

No	crops	JK-1 sumlar	JK-2 Bandipor	Himachal preyee	UK-Junkafun	Nagaland Mavalong	Ladakh Changthang Muth
1	Wheat	20	5	5	50	-	-
2	Maize	70	10	5	5	10	-
3	Rice paddy	10	45	-	-	10	-
4	Rice upland	-	-	-	5	70	-
5	Mustard	5	5	-	10	-	-
6	Pulses	35	5	20	40	-	-
7	Apple	-	90	90	-	-	-
8	Walnut	10	10	-	-	-	-
9	Pears	-	20	10	-	-	-
10	Barley fodder	-	-	10	10	55	-
11	Oat fodder	5	10	5	-	-	-
12	Finger millet	-	-	-	35	-	-
13	Barnyard millet	-	-	-	45	-	-
14	Sesame	5	-	-	25	15	-
15	Kulthi	-	-	-	5	-	-
16	Soybean	5	-	-	15	15	-
17	Black soybean	-	-	-	15	-	-
18	Onion	-	-	-	5	-	-
19	Potato	5	-	5	5	5	-
20	Pine apple	-	-	-	-	70	-

No	crops	JK-1 sumlar	JK-2 Bandipor	Himachal preyee	UK-Junkafun	Nagaland Mavalong	Ladakh Changthang Muth
21	Veg solanaceae	20	10	35	15	35	-
22	Veg cucurbits			5	35	40	-
23	Veg cruciferae			30	30	30	5

Table 3.13. Major underexploited crops of the Indian Himalayas

	Crop	Percentage of farmers currently growing
Changthang – Muth	Nettle vegetables	30
	Wild onion	25
	Wild vegetables	45
Kashmir – Sumlar	Barley	30
	Rice	5
Kashmir – Quail	None	n/a
	Finger millet	50
Uttarakhand – Junkafoon	Black soybean	30
Himachal – Preyee	None	n/a
	Naga chilli	35
	Brinjal	35
	Tree bean	15
	Gourds	25
	Pumpkins	70
	Yams	20
Nagaland – Mavalong	Colocasia	20

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