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Smallholder Innovation for Resilience (SIFOR)

Qualitative Baseline Study, Central & Eastern Himalayas India

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Summary

This report summarises the findings of the qualitative baseline study conducted for IIED's SIFOR project in the Central and the Eastern Himalayas. The project aims to strengthen traditional knowledge-based innovation systems, identify innovations developed by smallholder farmers to confront challenges related to climate changes, and understand the factors or conditions that support innovation. The format for the survey was developed as a collaborative effort between all four SIFOR partners and then adapted to each local context, to provide a common scientific framework.

Five traditional farming villages were chosen in each study area in the Central Himalayas and Eastern Himalayas. A preliminary survey was conducted followed by Phase I and Phase II. The objective of the preliminary survey was to understand the local context and agriculture systems and the changes that have occurred over the last 20-30 years. At the beginning of the process, the villages were apprised about the larger context of food and nutrition security, the importance of traditional knowledge and crops and the specific objectives of the project to get their Prior Informed Consent. In Phase I, a questionnaire designed to identify local innovations and understand the factors that support innovation, was adapted to the local context. Focus group discussions and interviews were carried out to identify the smallholder farmers whose agricultural knowledge is respected around the village and who are most likely to be innovators. In Phase II, the questions were explored in more depth with those who were identified as innovators through group discussions, semi-structured and in-depth interviews.

In the Central Himalayas, agriculture is still the main livelihood activity though production has been declining constantly and the decline has been very sharp in the last 5-7 years. This is mainly due to changes in climate — especially rainfall which has become erratic over the years, as agriculture practiced here is mostly rain-fed. Another reason is the damage to crops by wild animals, like wild boars and monkeys, which is increasing due to degradation of forests. Reduced productivity has led to increased dependence on government schemes like the Public Distribution System (PDS) for subsidised rice and wheat. There is a tremendous out-flux of youth from the villages to urban areas in and outside the region in search of employment.

However, those who continue to practice agriculture are developing methods to cope with these challenges and several innovations in their farming technologies and practices were identified. Though traditional knowledge has been the mainstay of these innovations, amalgamation with modern science and techniques acquired from research institutions has also played an important role. Mixed cropping is now intensively practiced and has helped improve productivity by increasing moisture, reducing crop-raidding by animals, enabling the planting of crops to suit changing weather patterns, and making food available throughout the year. People have also modified their composting techniques to increase soil moisture content to counter the deficiency in rainfall; and have developed bio-pesticides which have reduced crop failure due to insects and other diseases. Innovations like increasing production of finger millets and reintroduction of locally extinct crops like *alsi* (flax seed) have helped improve marketability due to a resurgence in their demand, while improving nutrition and enhancing resilience (to reduced rainfall in the case of finger millet, and to increased pests in the case of flax seed).

Government research and extension agencies have also contributed to several innovations through the adaptation of their technologies by pioneering farmers. A new variety of radish which can be used as both a vegetable and a salad and has edible leaves, has been developed by a farmer through 6 years of sustained breeding to stabilise the desired characters, and its seed is in great demand in the region. Informal networking amongst women motivated them to increase the cultivation of finger millet, and helped them to gradually switch from fodder collection to cultivation of fodder trees on farm in response to forest degradation.

In the Eastern Himalayas, rainfall has also declined and become erratic in recent years. Agriculture is more of a community practice as it has evolved from a highly forest dependant lifestyle of hunting and gathering. Innovations here are mostly developed by elders and passed on within families. This information is rarely shared at community level unless they are asked specifically to do so. The young, because of lack of access to markets and technology, move to urban areas instead of investing in improving local agricultural technologies. However, traditional institutions have helped in promoting innovating practices by providing a platform for information exchange and discussion at community

level among the Lepchas and the Limbus. These villages are more remote and have little contact with external research institutions, hence inter-village networking is particularly important to access new knowledge and ideas for innovation.

Various technological innovations, like growing cardamom plants in their fields instead of its original forest habitat when pest and diseases became a problem, developing a new cardamom variety and integrating it in crop rotation with cereals, have helped improve cardamom production. These innovations have also helped by providing biomass for ginger cultivation. Discovered accidentally, the early uprooting of maize plants, enabled farmers to counter the effects of erratic rainfall while maintaining maize yields. The farmers have also developed new cultivars of black rice bean to enhance yields, and brought a new higher yielding variety of squash from Nepal. Other innovations have also been developed to counter the effects of natural disasters like landslides that have destroyed many fields, like growing potatoes instead of paddy, and reclaiming land by growing broomstick grass as a cash crop. Nurseries have also been developed for growing paddy seedlings at a community level in response to reduced rainfall.

Traditional mustard cultivation has been reintroduced because potato is now often damaged by winter dew, and mustard is considered to be a good soil condiment against the increased pests, and produces good quality oil as oilcake and husk for fodder. This was possible because a few elderly people had continued to plant traditional mustard in small quantities. Experiments with millet sowing and harvesting timings have been conducted to prevent the loss of traditional millet varieties. In a market related innovation, produce is collected from various smallholder farmers to create sufficient quantity to enable its sale in Kalimpong. Traditional institutions have also been modified to adapt them to the present situation (eg. labour shortages), like the practice of labour sharing called *huri* and *parma.* This practice is the most important mechanism for sharing of agricultural knowledge amongst farmers in the eastern Himalayas villages, and is also an important practice in the central Himalayas. In both areas, seed exchange is a common practice, including between villages and altitudes, and is important for resilience to climatic changes and food security, providing access to different seeds for adaptation and different foods for nutrition. Seed exchange also helps to sustains crop diversity and traditional knowledge for adaptation to future climatic or socio-economic changes.

Eastern Himalayas study area. Photograph by Ajay Rastogi.

Introduction

The SIFOR project aims to strengthen the traditional knowledge-based innovation systems of smallholder and indigenous farmers to enhance food security in the face of climate change. The four participating countries of Peru, China, Kenya and India are collaborating within a common scientific framework. A comprehensive baseline study has been conducted to provide baseline data for Monitoring and Evaluation, and to address two key research objectives: i) to identify traditional knowledge (TK)-based innovations and practices that enhance productivity, and ii) to understand the conditions and processes which foster vibrant and resilient innovation systems.

This report provides the results of the Qualitative Baseline Study on innovations and innovation conditions in five traditional farming communities in the Central Himalayas, and five tribal communities the Eastern Himalayas, which was conducted between November 2012 and July 2013. Three types of TK-based innovation were explored: technological (e.g. new crops and farming practices), market (eg. new ways to enhance sales), and institutional (eg. new forms of social organisation).

Four social factors or conditions that support innovation were also explored: the *people* who innovate, the *institutions* involved in innovation, the *networking* factors, and the *community* level factors. These four factors are most commonly referred to in the literature and determine the resilience of the innovation system.

Sections 1 and 2 present the innovations identified in the central and eastern Himalayas, and identify the factors that contributed to each innovation where possible, and section 3 explores these innovation factors in more depth for both regions.

In order to understand the context in which people have come up with the innovations, a preliminary survey was conducted on the changes in farming, forestry and livelihoods in the last 30 years. This showed that the communities' production systems have faced significant challenges in recent years largely due to changes in climate (eg. reduced rainfall). However, the farmers are constantly experimenting and innovating to adapt to change and improve their farming systems, and have developed a number of new techniques to enhance productivity.

The qualitative baseline study sought to understand the range of innovation types that exist in the communities so that these could then be captured in a subsequent quantitative baseline study on innovation and innovation conditions. Depending on the nature of innovations, they are primarily classified under three types: Technological, Market and Institutional innovations. In the case of Central Himalaya, no market innovation was found since the agriculture has been largely subsistence oriented with only little surpluses sold locally. The overall findings of the qualitative and quantitative surveys will be published together, along with a study exploring the relationship between cultural values and innovation. These studies will inform the design of action-research processes and tools to strengthen TK-based innovation systems in the target areas.

The subject of innovations required considerable effort in building clarity in the project team as well as capacity of the community mobilisers. Innovations can be simply defined as 'a new way of doing things'. Strictly speaking innovations are developed in the current generation or lifetime, so traditional crop varieties passed down from previous generations are not innovations. By 'traditional' knowledge, do we mean only knowledge handed down from previous generations, or can any local knowledge applied in a traditional social context be considered 'traditional'? And do innovations need to be 'non-obvious' or can they include 'common sense' innovations? While this study has focused largely on innovations developed in the last 30 years, it has taken the broader view of 'traditional' as including local knowledge and of 'innovations' as including common sense innovations.

Methodology

In the Central Himalayas, the research was undertaken in five project villages in the Talla Sari Valley, near Ranikhet, District Almora, Uttarankhand State (Galli, Basyura, Chinauna, Pichna and Gallakot). This is a forest landscape with pine trees at an altitude of 1300-1500 masl. In the Eastern Himalayas, the project villages are three Lepcha and two Limbu communities in a more remote area in Kalimpong sub-division of Darjeeling District, West Bengal State (Tandrabong, Lingseykha, Lingsey, Mudung and Parbingtar). This is mostly temperate and sub-tropical forest, with terrace farming, at an altitude of 1250-1500 masl.

The same methodology was used in both project areas. The work began with transect walks and observations with local community researchers, and interaction with the community for rapport building through informal one to one discussions with men and women, village elders, leaders of self-help groups and local institutions such as *Van Panchayats* in the Central Himalayas and the *Sezom* and *Yak-Thung-Sung Chumfo* institutions of the Limbu and Lepcha respectively, in the East.

In order to understand the context in which people have come up with new, innovative practices and systems to address their changing needs and requirements, a preliminary survey was undertaken to know the situation that existed 20-30 years ago in the area of agriculture, forestry, livelihoods, climate and social capital, and the changes which have occurred in the past few years and their impacts. It was explored the present scenario which is posing serious challenges to people continuing with agriculture as the main source of livelihood. It is often the challenge that gives rise to innovations – hence this provided a way to identify innovations.

A questionnaire was designed to build a basic understanding of the status and trends in agriculture, natural resources and related sectors. Various exercises were carried out to gain an understanding of the situation prevailing currently and 20-30 years ago and the changes that have come about with respect to agriculture, agro-biodiversity, natural resources including water, livelihoods, traditional systems including social capital and government support. Discussions were also held with farmers' organization, women's group, representatives of local self-governance bodies and opinion makers in the villages (e.g. school teachers, civil servants). This helped identify:

1. smallholder families which are still engaged in farming
2. women and men who are highly knowledgeable in the area of agriculture, forestry, livestock
3. farmers who have come up with a new practice, technique, method etc. to address their needs

This preliminary phase culminated in a larger meeting with all five villages in each site where the project objectives, its approach and likely implications in the future were shared. This platform was used to take consent from the community to undertake the research and document traditional knowledge systems and practices.

In Phase I of the study, a questionnaire to identify innovations and explore four innovation factors (people, institutions, networking and community level factors) was prepared by the project partners. This was adapted to the local context using local terminology, broken up into several sub questions to enable understanding by community researchers and translated into the local language. Focus group discussions and interviews were carried out to identify the smallholder farmers whose agricultural knowledge was respected around the village and who were most likely to be innovators.

In Phase II, the questions were further explored through group discussions followed by semi-structured and then in-depth interviews with those who were identified as innovators. The group discussions were carried out with women and men groups separately in Central Himalaya, and included people of different castes and ages (at least 50% participants were elderly). In the Eastern Himalaya, the men and women were present together in the group discussions. Specialists were identified in these discussions as well as during the discussions held in the first phase. In-depth, semi-structured interviews were carried out with people who held specialised knowledge – agriculture, animal husbandry, forests etc, and with the innovators identified. In all, 59 group discussions, 30 semi-structured interviews and 29 in-depth interviews with innovators were carried out.

1. Central Himalayas

Changes in farming, forestry and livelihoods in the last 30 years

Agriculture continues to be the main source of livelihood. People used local, traditional agricultural inputs like seeds, compost etc. until a few years back. The majority of people are still using traditional inputs for most crops but they are forced to use hybrid seeds of wheat especially as they have run out of seeds in most of the households in the village. Changing weather patterns have been instrumental in negatively affecting livelihoods in the area.

Crop production is constantly declining but the decline has been very sharp over the past 5-7 years. According to local people, one of the major reasons behind the lowering of production is the change in weather patterns especially rainfall– the timings, frequency and reduced amount of rain. Agriculture is mostly rainfed. Water availability in natural water springs called *naulas*, has also gone down. Many of the water sources are being tapped for drinking water and this has reduced the downstream flow which was earlier available and used for irrigation. This has had an impact on crop yields. Dependence on water pipelines has also increased.

Another reason for the sharp decline in production is the attack of wild animals as well as stray cattle which has increased manifold. They decimate standing crops- millets, pulses, vegetables - and dig up tubers and corns. This is one of the main reasons for decreasing interest in agriculture and loss of seed diversity. Increased crop raiding by wild animals is due to degradation of forests.

People still depend on forest biomass for fuel, compost etc. Forests are on a path of rapid degradation mainly due to forest fires and erratic/reduced rainfall (leading to dryer conditions more prone to fires). Most people still have local breeds of animals (cows, buffaloes, goats, bulls) but the number of domesticated animals has gone down as fodder is not so easily available. A few families have cross-breeds as well mainly as a result of promotion of artificial insemination by the Government over past few decades.

Dependence on the Public Distribution System (PDS) of subsidised food grains (only rice and wheat) is much higher compared to earlier times, due to reduced production in fields. This has increased their dependence on the market. Now, when the monthly supply of subsidised food grains is not received on time, people have to resort to buying from the market. Often, these purchases are on credit which is paid off when family members working outside the village remit money home.

Migration of individuals and families is on the rise. The search for alternative sources of livelihood and better education opportunities for children, and declining interest in farming as the main livelihood are the primary reasons for this trend. The number of cultural festivals has decreased, and people's participation in festivals and social events is also in decline.

According to most people in the area, facilities and support from government and other external agencies has increased over the years. At the same time, the feeling of community spirit and unity amongst people has gone down. With increased dependence on the market for food items and agricultural inputs, interdependence and co-operation amongst people has been negatively affected. The food grains available in the market are mainly coming from states where intensive agriculture with fertilizers and pesticides is practiced. In addition, packaged processed food items also lack required nutrition. These factors are contributing to poor health of the people.

Traditional knowledge-based innovations in the Central Himalayas

This section presents the findings on the traditional knowledge-based innovations that enhance productivity in the face of climate change identified in the central Himalayas study area. The innovations are largely technological, related to farming systems, crops and practices, but also include a successful institutional innovation that the community came up with (a crop protection committee). Where possible, the factors that supported the development of these particular innovations (people, institutions, networking, and community level factors) are also identified. These factors are further explored in section 3.

Technological innovations

One of the primary challenges of the recent times that have led the farmers to find innovative ways is the insurgence of wild animals. The primary factors for increased incidence of crop raiding by wild animals is general degradation of forests and more specifically loss of food and habitat due to forest fires. Wild animals such as wild boar and monkeys feed on the crops as well as uproot and damage crops. Another factor that has created a cumulative effect is the changing pattern of winter rainfall. These have resulted in more intensive cropping closer to houses in order to be able to guard the crops as well as provide irrigation in times of long spell of no rains in winter. Some of the innovations captured in the course of qualitative survey are mentioned below.

More intensive mixed cropping close to the house and growing turmeric in far away fields to reduce crop damage

Earlier farmers would grow just one or two vegetables in one patch of land but now they grow vegetables, spices, oil seeds, and even one or two grains all on one patch of land. For example *ogal* (buckwheat), pumpkin, radish, french beans and *gadheri* (family of colocasia) are being grown together. Ramesh Singh, a farmer from Chinauna has adopted this technique. Buckwheat is ready first, and after a few days, radishes are ready, followed by french beans. On the margins, he has grown pumpkins where the terrace wall provides support to this creeper. Lastly he gets *gadheri* as a vegetable. This strategy makes food available to the family at different times of the year. It was also adopted to make optimal use of land situated close to their house and address their food security and livelihood needs. Growing several crops together also saves on labour, compost and water used for irrigation. The roots of different crops utilise different zones and some of them (e.g. beans) also fix nitrogen. The decaying leaves and stems also add to soil fertility.

In the far away fields where *gadheri* used to be cultivated earlier, Ramesh Singh now plants turmeric. This replacement was necessary as turmeric is not being decimated by animals like boar and monkeys. It has been adopted widely and cultivation of turmeric has gone up over the past few years. While this has helped in dealing with increasing attack of wild animals in the vicinity, the growing popularity of turmeric in markets has helped establish it as a cash crop.

These innovations can be attributed to ‘people’ and market factors. People have started growing vegetables and other crops close to their houses which are vulnerable to animal attack. This cropping pattern emerged gradually over the past few years, also with a view to use this land (which is always small sized) optimally. At the same time they have started growing few crops away from the houses on large fields which are not being decimated by animals. Some of these crops are being grown in huge quantity like turmeric, ginger etc., and they fetch a good price in the market.

Various modifications in cropping patterns to increase productivity

Cultivating garlic on the margins: This is being done by Shiv Ram of Chinauna village. He grows garlic on the margins of land where he is growing other crops. This is being done as garlic crop is able to consume compost and water which has remained unused after composting and watering the main crops in the field. Moreover, the leaves of the garlic plant being sturdy also allow easy passage through the fields and as the bulb is underground it doesn’t get disturbed. In fact, according to him garlic leaves become stronger with a little disturbance. He came up with this method on his own and experimented for a year or so to observe the results.

Cultivation of haldi *(turmeric) in the margins:* This also by Shiv Ram and he especially grows turmeric along the path of the fields frequented by cows and other domesticated animals. Besides, the underground parts of turmeric are not damaged by trampling of domestic animals, turmeric is also not liked by monkeys and wild boars. This is also an attempt to maximise the utilisation of land and for income generation.

Cultivation of lai *(mustard) on supporting terrace walls:* Farmers have started growing crops especially *lai* on the supporting walls between two terrace fields mainly as a source of leafy vegetable. This crop does not require much looking after as well as composting and irrigation. Moreover, growing on the wall reduces the germination period due to higher temperature on the south facing walls. This technique has been used by many farmers for a few years and now it is hard to find out who invented or introduced it

for the first time. *Lai* is high in iron content, so it also takes care of food and nutrition security and makes use of land and limited water optimally.

Cultivation of potato and coriander together: Bhairav Giri of Siddheshwardevi village grows coriander and potato together. Coriander ripens earlier than potato by almost a month. Since coriander is not liked by animals, it doesn't get damaged and in the process potatoes also gets saved as coriander covers them well enough and keeps the plant out of the view of animals.

Cultivation of wheat and mustard separately: Generally wheat and mustard are mixed cropping crops of the winter season. Ramesh Singh of Chinauna village observed that picking mustard leaves damages the grains of wheat and reduces the production of wheat. He has for last 4 years started growing mustard and wheat separately. He continues to grow wheat only in those fields where he used to grow both together. For mustard, he is using the fields that previously used to lie fallow at this time of year. This practice has increased the production level of both wheat and mustard.

Increased cultivation of finger millet (a traditional crop):
Women in Gallakot have increased the cultivation of finger millet instead of rice and wheat. Several factors are at play here. Finger millets are comparatively less labour intensive, require less water and can accommodate uncertain weather conditions. Being very high in nutritive value, especially calcium, it is in great demand in the market. According to women income generation is also one major motivation behind growing this crop lately.Informal networking and interaction amongst women have motivated them to gradually increase *madua* (finger millet) cultivation for its high resilience to climate change, high nutritional value and increasing potential for marketing.

Revival of an almost extinct crop to reduce pest damage and enhance nutrition:
Alsi (Flax seed) is being grown by Shiv Ram on the margins of the spinach field. Flax seed according to him does not get eaten by birds who otherwise sit on the margins and eat away the seeds of the plants growing in the centre of the field such as spinach and coriander. With *alsi* growing on the margins birds do not get enough space to sit and eat seeds that have been recently sown. *Alsi* was almost locally extinct and now with this innovative idea coupled with increasing popularity and market demand, production potential is high. At the moment he is mainly growing it for home consumption (part of animal feed), for his relatives in the city who have come to know of the nutritive value of the seed and to increase production of other crops by using it as a border crop.

Developing a new variety of Radish:
Dayanand Joshi has developed a new variety of radish by crossing a hybrid with traditional variety. He carried out this experiment for six years several years back. This new variety, called *Dayakesari*, can be used as both a vegetable and salad unlike the original varieties which can be used as *either* a vegetable or salad. Moreover, the green leaves of this variety can be used as a vegetable during the summer season when not many greens are available.

New composting techniques to improve soil fertility and moisture:
Shiv Ram of Chinauna village keeps experimenting and innovating to improve soil fertility. He has developed his own method of composting which has improved the soil fertility over years. He doesn't prepare compost in pits, unlike what is recommended by the Vivekananda Hill Agriculture Research Institute of the Indian Council of Agricultural Research (VPKAS), nor does he leave it out in the open which is the traditional way. He uses pine branches to contain the compost in an enclosure and covers the compost with a layer of dry leaves. While the structure is not leak proof, it still helps in retaining some run off with nutrients and good moisture for microbial activity. Moreover he has purposely kept the location of the compost at a slightly higher platform, so whatever runoff takes place eventually reaches the lower fields and doesn't drain away.

Another farmer, Dayanand Joshi of Gallakot village, has a slightly different way of composting. He mixes cow dung and cow urine in a pit and then covers it with a layer of grass. This layer is covered with a bed of dry leaves. This compost gets ready in 6 months. According to him compost prepared in this manner not only adds fertility to the soil but also helps retain moisture. He has developed this technique on his own to increase productivity, soil quality and water retention.

Shiv Ram has gradually refined a technique to retain moisture in the soil for a longer period of time. He slopes the land upwards towards the terrace wall. He introduced this technique almost 6-7 years ago ever since rainfall patterns became slightly erratic and people started facing water scarcity. He thought of this technique on his own and realized that water run-off is much lower as a result and that crops become sturdy. People have come and observed him doing it and have adopted it in their fields.

These innovations have improved soil fertility water retention and the quantity and quality of the produce. They have also enabled the farmers to use water, the most critical resource, water very efficiently.

Bio-pesticide preparation:
Dayanand Joshi mixes leaves of walnut, *bakain* and *neem* (all three have bitter taste) in water and uses this mixture after a couple of weeks by sprinkling on the plants as a bio-pesticide which has proved very effective especially in vegetable cultivation.

Bio-pesticide preparation. Photograph by Ajay Rastogi.

Switching from fruit tree to vegetable production in response to lower temperatures:
Dayanand Joshi of Gallakot village observed that apple fruiting started to decline since 1975-76 and fruiting in guava, plum, oranges (*narangi*) started to decline in early 1980s. Apple trees have almost stopped bearing fruits in the current times. While apple has been affected by an inadequate number of days of chilling temperatures, guava which could have benefitted with increased temperature has stopped fruiting because of an increased occurrence of frost over the years. However, produce of some fruits such as apricot and pear is still quite stable. Nevertheless, seeing the declining trend in fruit production, Joshi replaced fruit trees with vegetable cultivation few years ago as vegetables are also a good value in the market and used for household consumption. The switch to vegetable production has led to a number of innovations:

- *Modification of the soil to suit vegetable cultivation*: The switch from fruit to vegetable was not feasible because of sandy nature of soil in Dayanand Joshi's farm. So, he brought tons of soil from a river bank 2.5 km away with no road over a 3 year period to change the top soil into a clayey loam,

locally called *do mat mitti*. This example has been well received in the village and another farmer (Shiv Ram) who had too much clayey soil, brought sand from the river bank to balance it and make the switch to vegetables. Joshi claims that he thought of this idea out of his own observations and without any guidance from scientific institutions.

- *Improved cultivation techniques*: His onion seedlings don't lead to formation of seeds and the bulb is much bigger. This is the main reason behind the popularity of his onion seedlings in the entire area which are booked ahead of the season by other farmers. He sows the seeds almost one month later than usual. It takes a bit longer to harvest the bulbs from his crop but the crop is better.
- The quality of his cauliflower is also very good and is quite popular in the local market. Its yield is also better in comparison to that of other farmers. The reason he ascribes is that unlike other farmers who plough the fields, he uses a spade to dig much deeper and mix the soil well by at least one and a half feet.
- The quality and yield of his *gadheri* is also much better than that of other farmers. According to Dayanand Joshi, the main factors that attribute to better quality and yield are frequent weeding which also loosens up the soil; and ensuring proper drainage of water.

Keen observation, introduction of scientific ideas, experimentation and continuous adaptation of all aspects from making the soil suitable to using various cultivation techniques has led to his success in vegetable production. Many of the scientific ideas are his own (as claimed by him), but he has learnt some techniques from research institutions. He has been recognized and invited to lectures in the VPKAS, an organization of the Indian Council of Agricultural Research in the region. Dayanand Joshi has also talked about his techniques, and promoted the cultivation of vegetables through talks on the radio

Planting Fodder trees on farm in response to forest degradation.
Previously, people were highly dependent on forests for biomass needs. They still are, but gradually they have shifted their dependence to fodder trees that they have started growing near hamlets. They now have fodder trees on their agricultural land to take care of their fodder needs as the forests are in a degraded state, situated far away and are mostly pine monoculture plantations which neither provide fodder nor allow good fodder under the tree. Having fodder trees in the vicinity of the house and the village has also reduced their workload –the Gallakot hamlet used to walk for kilometres every day to gather biomass and carry head-loads of fodder from far off areas.This innovation has also partially reduced their dependence on forests.

Informal networking and interaction amongst women has helped the women gradually make changes through cultivation of fodder trees, using their traditional knowledge and experience to choose local species and varieties which are environmentally friendly, to and increase the quality of fodder as well as availability.

The reason for forest degradation lies in institutional factors of control and regulations by the Forest Department. If people had better control of protected and reserve forests around villages, they could have managed them better for sustaining resources and controlling other problems such as damage of crops by wildlife. A key reason for the excessive population of wild boars in the degraded forests is invasion by a weed called lantenna between the villages and forests. These dense bushes provide excellent cover and are used for breeding as the litter is quite safe there with no predators able to penetrate the bushes.

Institutional Innovations

Establishing crop protection committees to confront wildlife crop damage
The village community of Chinauna came up with a novel idea to safeguard their crops. They formed a body called *Fasal Suraksha Samiti* (Crop Protection Committee). The committee decided to collect a contribution from each household and hire a person from the village for keeping a vigil against monkeys and stray cattle during the day. It took a lot of discussion and negotiation to make people agree to make additional investments in agriculture when it had already become a loss making enterprise for several years. Most farmers had not been able to even harvest grains equivalent to the seeds sown.

However, the committee was able to function for the entire cropping season and for the first time in last 5 years there was a good winter crop of wheat in the village. In addition, the community benefitted with greater availability of fodder grasses in their own lands as well as community lands. As a result, the neighbouring villages have started to form such institutions. The first committee formed in Chinauna received an award and recognition from the State Biodiversity Board. Unlike in the Eastern Himalaya, the traditional institutions in the Central Himalaya are mostly redundant now and the new democratic institution of *gram panchayat* (elected body in the village) has taken charge.

2. Eastern Himalayas

Changes in farming, forestry and livelihoods in the last 30 years

Agriculture continues to be the primary source of occupation and livelihood with some noticeable changes in the cropping patterns over last few decades. Firstly, there are some crops that have almost become locally extinct e.g. *kaguni* (a type of millet), *bir makai* (a type of maize) and *gayya dhan* (dryland paddy). Secondly, there are some crops where cultivation is considerably reduced e.g. *phaphar* (buck wheat) and *kodo* (finger millet). Thirdly, the extent and yields of some existing crops has come down e.g. maize and paddy. At the same time, the area for cultivation of pulses and vegetables has grown. This reflects an interesting shift towards market agriculture as pulses and vegetables are cash crops. The traditional mixed farming systems have largely remained with changes mainly in crop mixes.

There is also a continuous process of change in seeds. While seeds for most cereal crops still continue to be from traditional sources, the changes brought about by introduction of new paddy varieties is significant. These varieties have come from other communities including in adjacent Nepal and Bhutan mainly through inter-personal exchange. At the same time, a few rice varieties coming from the agriculture extension system have gained acceptance e.g. Kalimpong 1. For pulses, local seed varieties are mainly used.

As a part of the commercialisation process of agriculture in the region, the main crops being promoted are large cardamom, ginger and orange. All three have had their share of problems. The changing climate (ie. reduced and more erratic rainfall and increased temperatures), has affected orange quite drastically over last 15-20 years. Ginger has been hit by several diseases, largely due to poor soil and seed management practices. Cardamom has also been greatly affected by several insects, pests and diseases mainly due the changing climate. There have been several adaptations and innovations by farmers to safeguard their economic interests. Changes in rainfall patterns and more unpredictable rains have led to adaptations in paddy cultivation, such as the adoption of dry paddy cultivation. Although water sources have declined in some villages , the overall surface water availability in such a high rainfall region has not been affected extensively, despite extended periods of no rain.

Many farmers have kept parts of their holding under forest cover. There are also restrictions through government regulations in changing the land-use from forests to agriculture. However, intensive management of their forests through planting and harvesting species of fodder, timber and other species takes place on a regular basis. The species could be trees, climbers, shrubs and herbs. There is a rich tradition of harvesting wild edibles both from privately owned forests as well as community and government controlled forests. It is interesting to mention that over the last 10 years, there is sustained growth in forests both in terms of cover and density. The reduced manpower available for agriculture at home has led to reduction in the removal of usufructs from far away forests. The tradition of collecting wild edibles is also reduced for similar reasons in addition to changing taste preferences of the younger generation. Some of the commercially important wild edibles such as *nakima* have been brought partly under cultivation in agricultural fields. Pressure on fuelwood resources in the forests has been reduced with greater penetration of gas connections and stoves.

The rapid growth of the road network as well as availability of food through Public Distribution System and greater access to markets has also played a critical role inthese transitions. Agriculture related cultural festivals are still important and are performed to seek blessings from the Creator and the Ancestors; but the communitarian spirit is visibly on the decline. Opportunities for off farm employment are on the rise thanks to increasing infrastructure projects such as roads and engagement in government schemes such as MGNREGA. Improved education levels and road network also enables people to seek employment further away from homes.

Traditional knowledge-based innovations in the Eastern Himalayas

This section presents a number of TK-based innovations that were identified in the Eastern Himalyan study villages. As for the central Himalayas, these are largely technological innovations in farming systems, crops and practices, but they also include a few institutional innovations and one market innovation. The factors that supported the development of these innovations- people, institutions, networking and community level factors - are identified where possible, and are further explored in section 3.

Technological Innovations

New cardamom cropping system and locally adapted variety developed in response to pests and disease:
Cardamom plantation is declining in its original forest habitat. Major reasons for this given by the farmers are outbreaks of pests and diseases due to the rise in temperature and erratic rainfall patterns over the years, and depletion of biomass available for mulching in cardamom plantation areas since it is being collected for use in ginger cultivation. Ginger cultivation has steadily increased over the years due to rising demand.

Growing cardamom in agricultural field and integrating it into crop rotation. Photograph by Nawraj Gurung.

To revive cardamom cultivation and overcome these problems, three simultaneous steps were taken by the farmers. They developed a new cultivar, shifted the cardamom from forest shade to open farmlands and adopted a crop rotation system that requires the uprooting of cardamom bushes every 8 -10 years or so. The new cultivar known as *Bharlang* was brought from Todhay village situated close to Bhutan and gradually through selection, farmers developed a locally adapted variety of the cultivar called *Lhaphrakey*, which requires less soil moisture and shade conditions. The crop rotation based on this new cultivar is that cardamom suckers are planted in the open or on thinly shaded agricultural fields. This newly planted cardamom fields is also used to grow maize and other suitable winter vegetables for two years as intercrops. From the 3rd year onwards cardamom starts fruiting and continues for another 8-10 years of good production. The trend is that after about 6-10 years, the cardamom plantation is likely to become infected with disease. Farmers consciously uproot the cardamom plants after 6-8 years

and start cultivating cereals, legumes and vegetables for two years before bringing back the cardamom again in the same fields.

These set of innovations around resilient cardamom cultivation have several salient features. The farmers could revive cardamom without sacrificing cereals and vegetable production as they could still cultivate these in the initial two years. At the same time, they got more production in cardamom as the gestation period reduced to three years as compared to the normal 4-5 years in its natural forest habitat. Cardamom yields improved due to inter crops such as maize and vegetables where irrigation and manure for the crops were also useful for cardamom.

A dominant factor that enabled the innovations in this case is 'Networking'. This enabled the farmers to access the new cardamom variety from near Bhutan. The farmers from north-east parts of Kalimpong and those from south-west parts of Bhutan attend the same weekly market held at a place called Bindu (in India). In addition, there are family relationships across the border and it is likely that the *Bharlang* variety was brought to Kalimpong by several people around the 1990s when the problem of pest and disease infestation became acute. Seeing the potential of this variety, demand for its planting material suddenly grew. Individual farmers as well as private nurseries started to multiply the planting material. In many places, workers in the nurseries observed that *Bharlang* requires much less water and can grow in open areas with no shade. Some farmers then started experimenting with its cultivation in farm lands. Gradually, the locally adopted crop rotation got standardised and the new locally adapted cultivar was developed.

Early uprooting of maize in response to erratic rainfall:
Farmers normally plant paddy after the maize harvest in July-August. Because of unpredictable and erratic rainfall, farmers find it difficult to follow the normal timing of maize harvesting before planting paddy. To overcome the situation of the rains having arrived and the maize still being immature, farmers of Lingseykha harvested maize early to vacate the land for initiating paddy cultivation. They uprooted the maize plant along with cobs and not to waste time separating the cobs and carrying them home, they bundled them and left them in the field at the side of the terrace until the paddy planting operation was complete. In the process they have realized that, early harvesting by uprooting the maize plant along with the cobs and keeping their roots under wet soil does not affect the maturing process of maize. By accident they have innovated the practice and are able to overcome the prevailing erratic rainfall patterns.

It is difficult to pinpoint who actually is the innovator because it is being practiced for quite some time. However, considering the kind of work, the conditions in which work needs to be performed, the urgency under which it has to be performed (often rain comes at night and they go to the field) and the decision making process of the male-headed households, it is the men who have significant role in this innovation.

Community developing new local cultivar of black rice beans to enhance yield:
Small hamlets like Lungchuk and Dagyang of Lingseykha project village produce a special type of bean called the black rice bean. As reported by Tolley Lepcha (81 yrs.) and others, they have since time immemorial grown rice beans which had seeds of many colours in the same mixture. Over a period farmers have carefully selected the black ones and developed this cultivar which is primarily black. They selected the black ones because they are heavier, i.e. higher yielding and tastier. From the 1980s, the black bean has gained more popularity because it also fetches a better price as compared to other rice beans. The rice bean is one of the staple foods of these villages. Now this crop is the most important food crop and they have been growing it for self-consumption as well as for sale. This bean is a location specific crop and does not suit other villages of the region with different altitudes and climatic conditions.

Replacing an old variety of squash with a higher yielding one from Nepal:
Squash has been an important vegetable crop of the region for a long time. Its production has been declining for several years presumably due to changes in climate. During the late nineties, some farmers of villages such as Sukhia Pokhari and Mirik, brought a new variety of squash from neighbouring Nepal. More investigation is required to find out if it is a modern or traditional variety. This variety gives early fruiting and yields significantly more than the former one. Raiman Rai of

Tandrabong, one of our project villages, also brought this new variety of squash from Sukhia Simana village in Nepal through his daughter who was married there. He never shared the seed with others, but several years later some farmers managed to collect some seeds from his field while working as agricultural labourers. Now this crop has become one of the major cash crops not only in this village but in many adjacent villages of the region. A dominant factor which led to this innovation is the institution of marriage.

Adoption of a new technology for potato production after loss of paddy land due to a landslide: A massive landslide in the region in 1968 destroyed paddy lands and most of the water sources. As a result paddy cultivation was not feasible anymore in many villages. Raiman, who is about 88 years old and from Tandrabong project village, is recognized as a champion of agriculture and was consulted by many villagers. He visited the Government potato seed farm in Darjeeling during 1969-70 where he obtained potato seeds and learnt a new cultivation technology. With this new technology, he could enhance his production tenfold. After this trial, he shared the knowledge with other villagers. Today, potato from Tandrabong village is recognized as having special quality in the Kalimpong market and is grown as a cash crop. Farmers have also synchronized potato cultivation in the annual crop rotation. Iren Lepcha explained that potato and maize cultivation practices are synchronized in such a way that they complement each other. Potato is sown in October to November and earthing is done in February. While doing the earthing up of potato, maize is sown as mixed cropping. This practice integrates the two crops saving on space as well as labour. At the time of harvesting of potato in April, earthing up of maize plants is also done simultaneously.

The dominant factors which led to the innovation for potato cultivation becoming an important food and cash crop are ‘Institutions’ and ‘People’ factors**.** The institution of the Darjeeling potato seed farm because Raiman first got the seed and the initial technology from them and shared it with other farmers after trial and adoption. Farmers then improvised the techniques to take up potato and maize farming in a way that complements both the crops.

Loss of paddy land and improvisation of potato as a cash crop. Photograph by Nawraj Gurung.

Domestication of broomstick grass to reclaim land destroyed by a landslide:
During the landslide in1968, large scale devastation of agricultural fields took place and they became uncultivable. To reclaim the landslide area, the late Duk Tshering Lepcha, Rosan Lepcha Bajey and and a few other farmers from Tandrabong collected broomstick plants from the forest and started planting them in the landslide area in private fields. Similarly, farmers of the Parbingtar project village planted broomstick in agricultural land where they could not cultivate food crops due to the undulating terrain and drying up of water streams following the landslide. Simultaneously, many Government agencies like those dealing with forests, soil conservation, agriculture etc. popularized broomstick plantation in the wasteland and landslide areas. Over time, broomstick has gained tremendous acceptance and popularity amongst farmers due to several factors. There is good market demand for brooms, it is adaptable to any kind of land and soil, has good soil conservation characteristics, is a good source of fodder in the lean season and is used for fencing material as well as fuel. More importantly, it does not require agricultural land and grows well in marginal environments and slopes. At present, broomstick is the most important cash crop of the region after cardamom and ginger. This crop continues to come under non-timber forest product and is taxable under forest rules.

The dominant factors that led to the innovation of bringing broomstick from forest to farmlands and communal land and establishing it as a cash crop are **'**People' factors as it was the work of those pioneering farmers mentioned above. However, at the same time in many other areas the Department of Forests also started to promote the planting of broomstick grass, so its spread can be largely attributed to 'institutional' factors.

Reintroduction of traditional mustard cultivation:
Local mustard cultivars (yellow and red) were traditionally grown by the Limbus and Lepchas of Mudung and Lingsey villages to meet their household requirements of oil and oilcake for cattle feed. Traditional mustard cultivation had declined as potato cultivation became profitable during seventies, when good potato seed was easily accessible on exchange of maize seed with the Sherpas of higher altitude. Since the last 6-7 years, farmers are in the process switching back from potato to traditional mustard cultivation. At present, the majority of the households cultivate mustard and most of them have their own traditional oil extraction equipment.

The main reasons for the reintroduction of traditional mustard cultivation are as follows -

- Potato crop is often damaged by winter dew - this used to happen before but not to the same extent. It is thought to be linked to changes in climate as well as constantly deteriorating quality of seed. Good potato seeds are not available because most of the area earlier used for potato cultivation has been taken under the government protected area system.
- The mustard cropping season fits well in crop rotation like – Maize – Rice – Mustard at lower altitude, and Mustard – Maize/Paddy – Mustard at higher altitude.
- Mustard is also considered to be a good soil condiment against pathogens, and soil pathogens have increased, especially in the case of ginger.
- Good quality oil can be derived from your own harvest, and availability of oilcake and husk for fodder,
- Bee keeping in the villages is expanding due to mustard cultivation; honey is an additional source of nutrition and income, and the presence of a higher density of pollinators enhances the yield.

According to their experience about the traditional mustard crop, rainwater at the time of fruiting is important. Irrigation at this stage to compensate for rainwater shortage causes hardening of the soil and emergence of insects which damages the next crop (maize).

The dominant factor of innovation for reviving mustard cultivation with a traditional cultivar is 'People'. Old people like Retd. Capt. Lal Singh Subba and Bhakta Bahadur Subba and their wives have played major role in conservation of traditional cultivar of mustard seed. They continued to cultivate mustard in small quantity in their field just to avoid extinction of tradition cultivars and to continue the tradition of the family. Slowly other farmers of the village also obtained seed from them and now most of the households have reintroduced mustard cultivation in their fields for reasons cited above.

Sustaining traditional crop species, cultivars and landraces by changing planting times
Lepcha and Limbu community maintain rich agro-biodiversity because of their heavy dependence on agriculture. In the entire mountain region millet is considered a difficult crop to grow and its cultivation is declining faster than in these communities. In the project villages this crop is still grown and conserved for rituals, for making an alcoholic traditional brew and for food. Millet is grown in two different seasons -the early season and late season. Tolley Lepcha, aged 88 years and resident of Lingseykha, has experimented with different times of sowing to adapt to changing climate conditions as explained below.

Cultivars	Laying out Nursery	Transplanting in main field	Harvesting	Problems with harvesting	Reason	Innovations
Early cultivars	April	June-July	October – November	Weeding is tedious, labour consuming and expensive operation	Because of peak rainy season.	Tolley Lepcha changed the planting time of the early as well as late cultivars to plant them in the intermediate period of July or August. By doing this he was able to reduce weeding work and also avoid the dry season during grain formation.
Late cultivars	June	2nd fortnight of August	January	There is often less rainfall these days during late July and August month causing poor soil moisture retention in dry season.	Grain formation period falls during Nov-Dec. (dry season), therefore it needs good retained soil moisture.	

The dominant factor which led to the planting innovation for sustaining the millet agrobiodiversity is ‘Community’ due to the cultural and ritual value attached to the crop in the community.

Market Innovations

Emergence of a vegetable collectorto link farmers to the main market:
Marketing of agricultural produce, especially those of the perishable crops such as vegetables is difficult for farmers, particularly in mountain areas because of various mountain specificities: small land holdings, mixed farming and small quantities produced by individual farmers, fragile topography and difficult road communication. It is not feasible for individual households to carry/transport and sell small quantities of vegetables in the market. However, some innovative enterprising youths of Tandrabong and Parbingtar are taking the initiative to collect individual farmers’ produce to make a quantity that is marketable. They collect vegetables grown in their village and take them to the main market in Kalimpong. This collective action has encouraged small farmers, especially women, to produce vegetables and enhance their income generation capacity.

The trust that the community have and the cooperation they have extended to the enterprising youth are the major innovation factors. Furthermore, his skill in coordinating this community activity for marketing has made it possible to initiate this innovation of establishing a credible supply chain from the village to the market.

Institutional Innovations

Formal or modern institutions or mechanisms play a limited role in the sharing of knowledge and information between people, and the creation of rules and norms for Natural Resource Management in the eastern Himalayas. Instead, there are customary rituals and social activities where exchange of knowledge, information and planting materials take place and community norms for resource management are set. Some these institutions have been adapted in response to climatic and other socio-economic changes.

Collective and coordinated paddy seedling production in response to reduced rainfall:
In the last 10-15 years there has often been less rainfall during winter and a delayed monsoon which has resulted in the drying up of many perennial water streams and resources. Consequently, many farmers find it difficult to raise a paddy nursery during the required time of May-June. To overcome these challenges, farmers of Lingsey village came together and came up with the idea of establishing a common community nursery in the field where water is available. In addition, some farmers raise a nursery by applying mulch to overcome the scarcity of water. They call these seedlings *dhulay bew* or “Dusty seedlings”. The dominant factors leading to the innovation to overcome the impact of erratic rainfall for raising paddy nursery are coordination and mutual trust at village level, which are ‘Community’ level innovation factors.

Traditional practice of managing agricultural manpower adapted to address labour shortages and climatic challenges:
There is a traditional practice in which representatives of many houses collectively work in an individual’s field, and rotate labour turn by turn. This enables the community to regulate the use of natural resources like water and share the work force available in the community. The practice is called *huri* or *parma*. Earlier, instead of accounting the workday in terms of time, it was more about completion of the task. This practice is losing its significance due to scarcity of agriculture labour and impractical norms of not accounting the number of work days put up by an individual. To overcome the gap in economics of the system, the norms of participation in *parma* or *huri* have been adapted. In a new way of doing things, the number of workdays put up by each individual is counted and one can also sell his/her workdays or even sell or swap the turn of *parma* with others according to their convenience. This innovation also has indirect relevance to climate change- by this practice they often address season-bound agricultural activity. This means they can avail labour services for urgent time bound agricultural work needs created by climatic changes, in exchange for non-farm services they provide off season to those who do not require season- bound labour support.

Now, this system of collective work is not limited to seasonal agricultural activities but extended to other activities like construction etc. This is the most important socio-economic activity in which farmers visit each others’ fields in groups for farming and where automatic sharing of knowledge, information and planting materials takes place very effectively. Another significant thing is that the word used for the function of *parma* is. *khelnu*, which means “play” (*parma khelnu*) – i.e. having fun while working in a group. The dominant factors of innovation in adapting the collective work practice in the community are networking and community level factors.

3. Social factors and practices that support innovation

Paul G.H. Engel and Monique L. Salomon in the book, 'Social organization of innovation' (1997) explain that innovation is a social as well as technical process:

"If we accept that innovation is the outcome of social interaction among many stakeholders –who are interdependent, and yet pursue their own strategic objectives – it becomes clear that it is not a straightforward, technical process. Rather, it is a diffuse, social process, involving both individual and collective searches for ideas, information and options for decision making. The social organization of innovation may then be characterized as the way in which actors organize themselves to carry out this search."

This section explores four social factors or conditions that promote and support innovation based on traditional and local knowledge, in both the central and eastern Himalaya study areas: the *people* who innovate, the *institutions* involved in innovation, the *networking* factors, and the *community* level factors. These four factors are most commonly referred to in the literature and determine the resilience of the innovation system.

People factors

The relevance of agriculture for food security in India is directly proportionate to peoples' distance and accessibility to markets since the Government of India is quite committed to providing food at subsidised prices. More remote rural areas are likely to have greater challenges of food security, and hence stronger biodiversity and local knowledge systems - necessity is the mother of invention. Peoples' enthusiasm towards modern technology and crop varieties also depends on market potential.

In the **Central Himalayas**, innovators in the village have devised new methods based on their local knowledge and experience to address their changing needs. As mentioned in earlier, the innovations include developing a new variety of radish, mixed cropping practices, preparing bio-pesticide, compost preparation etc. Though traditional knowledge has been the mainstay of these innovations, amalgamation with modern knowledge, techniques and skills acquired from research institutions has also played a crucial role in developing innovative farming methods..

The two pioneering farmers, Dayanand Joshi and Shiv Ram , seem to have led the effort in innovation as several of those recorded are attributed to them. Many farmers have adopted the innovations developedby them through observation followed by informal discussions. People's ingenuity, experience and needs have led to the development of unique (need and resource specific) cropping patterns making use of the limited land close to their houses. But there have not been any instances of traditional authorities supporting the development or spread of such innovations.

In the **Eastern Himalayas**, most of the resilient farming innovations are based on traditional knowledge. Innovators and champions in the villages are basically elders and they have comparatively better contacts with outside people, institutions and organizations. Innovators are respected by the community for their innovativeness, expertise and experiences. They normally function in isolation and they do not volunteer to disseminate new ideas to the community unless there are specific issues or questions asked. At household level, elders guide and pass knowledge to their children but at community level they do so only if asked for advice.

The Lepcha community possess rich traditional knowledge about forest flora, fauna, food and medicinal values and uses. Elders are valued and respected for their traditional knowledge about agriculture and its relationship with ecology. Culturally and traditionally there is lack of volunteerism in mentoring and teaching others outside the household. Young educated people are interested in changing traditional agriculture and adopting new agricultural technologies and practices but due to a lack of market access, they opt for migrating to towns and cities for better opportunities. Only those young people who do not have options and are uneducated take interest in agriculture and its improvement. The interest of youth in agriculture depends on their education level, proximity to town and the potential for marketing

agricultural produce. Women take equally active interest in agricultural activities especially in vegetable cultivation and seed systems. They also participate in collective agricultural work like *parma*. However, women's participation in meetings, trainings and workshops is not on par with men's. Village authorities take less interest in agriculture and innovations and are more interested in giving their opinion on the religious, ritual and social behaviour aspects of the community.

Institutional factors

Traditional institutions in the **Central Himalaya** have either become redundant or quite week. Prominent reasons could be a long history of administration in the region. Pre-independence this area had officers from the British Empire. The village society actively interacted with outsiders due to the heavy recruitment of soldiers from the area for the British Army. Almora District had the distinction of being included amongst the districts in the country with the highest literacy rate. The only traditional institution that has sustains some importance is that of Van Panchayat which has very little role in innovations.

In the Central Himalalyas, trainings and meetings attended by some of the innovators at Research Institutions like VPKAS (regional research centre of the Indian Council of Agricultural Research), have sometimes helped them learn techniques like line sowing and bio-pesticide preparation, but they have experimented with these techniques to suit their location specific conditions and needs and come up with a better technique and/or product through innovation. These institutions have also sometimes provided forums for innovators to talk about and spread the innovations.

Panchayati Raj institution (local self governance bodies) exist but have not organized any meeting to support the spread or development of innovations. Likewise, though Self Help Groups (SHGs) are in existence and play an important role in micro-saving and credit, they have not played any important role in innovation development or promotion.

In the last 27 years, agricultural policy for the hills of this part of the Eastern Himalaya has been in limbo due to civil agitation during 1986 to 1988 and again reoccurring from 2007. Agriculture Development and research institutions became dysfunctional and could not regain their position under new power sharing arrangements between the government and local political parties. Agriculture Research & Development institutions have either stopped their activities in the hills or transferred them to other agencies like Regional Research Stations of the Agriculture University and Krishi Vignan Kendra (Agriculture Research and Extension Centre). Similarly, Agricultural Development Agencies have been transferred to newly formed local administrative councils (Darjeeling Gorkha Hill Council from 1988 to 2010 and Gorkhaland Territorial Administration from 2011). These agencies mostly function in isolation and have limited access to mainstream institutions and limited reach to farming communities. As a result, the presence of these institutions is hardly seen in the villages.

As in other parts of the country, the Self-Help Group (SHG) movement is extensively established in the hills. Self-Help Groups are social groups or institutions at the grassroots promoted under a national program and implemented by the District Rural Development Cell "DRDC" as the nodal department. The DRDC implements this program through local bodies like NGOs, Panchayati Raj Institutions, Block Development Offices and Banks. All the members in the SHGs have equal rights though there are posts of President, Secretary and Treasurer to undertake the administrative formalities. In principle, there cannot be any caste based discrimination in selection of members. These principles of equity and equality serve as "built-in enablers" for strengthening the social capital of the community. If this social institution is nurtured properly it can play a significant role in the innovation process. However, in the project villages their function is limited to saving and credit activities, although a few are engaged in livelihood activities. Only elected village representatives (Panchayat) and members of the Self-Help Groups participate in meetings and trainings organized occasionally by NGOs and the DRDC.

The Panchayat Raj Institution (PRI) is the Democratic Decentralization form of Local Self-Government Institution in rural India. Many believe that PRI is also a mechanism/tool to mobilize social capital like informal norms, mutual trust and interpersonal networking in the society. However, for the last six to seven years the PRI has also been dysfunctional in these hills and project villages.

The **Lepcha and Limbu** come under the Scheduled Tribe communities of India and have their own community organizations called the *Sezom* and *Yak-Thung-Sung Chumfo* respectively. These organizations have as their objectives the conservation of cultural heritage, rituals, tradition, language etc. The SIFOR project supported the effort of the Lepcha Community Organization Sezom to form the "Mayal Lyang Lepcha Development Board" under the Society Registration Act. The objectives of this society are to conserve traditional crops, biodiversity and natural resources of the mountain, besides other livelihood and cultural aspects. Since the State government is one of the stakeholders of the society, it has potential for influencing relevant state policies, plans and programs of the mountain areas.

There are many traditional institutions in both the communities. Some of them are Parma (for pooling labour), *Naya ko Puja, Udauli* and *Ubauli* rituals and many other specific agriculture related socio-cultural practices. *Naya ko Puja* is an offering to the deity of agriculture which has to be done before their crop can be harvested and is performed at individual households. *Udauli* is done during September-October when temperatures start falling in the mountain and migratory birds are moving to lower altitudes. Agricultural produce is offered to their deity and prayers are said to take away bad luck, illness and so on. This ritual is normally done at community level and near a stream or river. *Ubauli* is a similar ritual performed during February-March at the onset of spring and as they start to see migratory birds returning towards higher altitudes. These occasions provide a platform where the community members exchange ideas, information, technology and also negotiate seed exchange for agriculture. As such these institutions mainly promote the sharing of traditional knowledge and seeds and thus support innovation(s), without specifically providing any financial or organizational mechanism for innovation.

Networking factors

"Farmers and others are seen as actively seeking relationships that will allow them to learn and to make changes in their practices. That is what we call Networking."*(Paul G.T. Engel and M.L. Salomon, 1997)*.

Informal networking and interaction amongst women has helped the women of the **Central Himalayas** gradually make changes through cultivation of fodder trees, using their traditional knowledge and experience to choose local species and varieties which are environmentally friendly, to and increase the quality of fodder as well as availability. This is also led to partially reducing the dependence on forests and their workload in carrying head-loads of fodder from far off areas. In a similar vein, networking and interaction have also motivated them to gradually increase *madua* (finger miller) cultivation for its high resilience to climate change, high nutrition and increasing recognition as a potential product for marketing.

There is no system of formal meeting or mechanism for sharing agricultural knowledge and technologies specifically among both **Lepcha and Limbu** communities. There is no meeting or community house except a Panchayat Ghar at Tandrabong village. There are rarely any agriculture-based trainings or meetings organised in these villages nor have they attended such meetings outside the villages. Self-Help Group representatives occasionally attend livelihood and organizational training programs organized by NGOs under the sponsored program of DRDC. Networking within villages takes place through interpersonal interactions during social occasions like weddings, ceremonies around death, festivals and social visits to each others' houses. Other occasions when people exchange ideas are during the different bio-cultural rituals as mentioned in the section on "Institutional factors".

The most important social activity/platform for sharing and exchange ideas, knowledge and best practices specifically about agriculture is during *parma* or *huri*, a traditional practice in which representatives of many houses collectively work in an individual's field. During *parma* or *huri* elders and champions of the village act as supervisors and mentors to the other participants for carrying out agriculture activities in the field, and people visit each others' fields and share planting materials. In the **Central Himalayas**, the practice of sharing work in each other's farms, or in managing resources such as fodder from the forest, is called 'paltu' and it continues to play an important role especially in seasons of intensive labour.

In the **Eastern Himalayas**, networking outside the village normally happens through kinship because of marriage. Contacts and interaction with development and research agencies is rare and is limited to a few innovative, progressive farmers and panchayat representatives. All the villages are well connected with mobile cell phones services and this technology is popularly used by all. Internet services are yet to be a reality except in some locations in the villages, because people cannot afford it and lack computer skills. Moreover, people are not aware about their practical use for agricultural development. The SIFOR team of Eastern Himalayas has established three computer booths under an E-Learning program using additional funding support arranged from local sources. Efforts will be made to utilize these computer systems for strengthening the networking among the project villages.

Networking for seed exchange is a resilient practice to overcome climatic limitations for seed production. Exchange and sharing is promoted through interpersonal relationships and trust between people. In both the **Eastern and Central Himalayas**, seed sharing among villagers is a well-accepted common practice. There are few specific conditions or rules for exchange or sharing of seed. Exchange of seed between high and low altitude, village to village, between the communities and among the households are common phenomena in the region. Sherpa farmers of high altitude in the Eastern Himalayas exchange their potato seed for maize seed and food grown in lower altitude Limbu villages of Lingsey. Similarly, maize, beans and paddy seeds are exchanged among the households within the villages frequently. It is not necessary for both the parties to give seed for seed - one can compensate seeds with grains of equal value or grains of equal weight (which may not necessarily have the value of the seeds). In the Central Himalayas, it is common for married women to carry seeds back and forth between their new home and parental home when they make visits during festivals and social occasions. Exchange and sharing of seeds enables access to different seed varieties for adaptation and enables people of lower altitudes to continue potato cultivation for food security. This exchange also contributes to the maintenance of agrobiodiversity and traditional knowledge for innovation.

Community factors

There is a common riddle in this region *"Dekah sekhi gari kha arisey marija"*, which literally means *"See, learn and become capable and death to those who are jealous"*. The communities in both the **Central and Eastern Himalayas** believe that a change in the farming system is a continuous process according to the compatibility of crops with changing ecological conditions. It is the culture of the community that they do not volunteer to share new ideas and technologies unless they are asked. Issues or constraints they have in farming system are common for all. When new ideas, practices and technologies are developed, people come to know about them through traditional networking mechanisms and inter-personal interactions. The community respects and supports people with new ideas whether he/she is from within or outside the community or village. The pace of adopting new ideas or practices varies from household to household depending on their own risk taking ability, education and economic condition.

In the **Eastern Himalayas**, more remotely placed communities have limited dependence on external institutions/agencies in addressing the constraints in the farming system. These communities make use of interpersonal relationship and kinship relation with outside villages and communities for continuous adaptation and adoption of new farming practices. The communities also practice collective decision making and coordinate the use of natural resources like stream water for irrigation and management of limited agriculture labour through the community organisations of the Lepchas and the Limbus. Coordinated use of natural resources at community level supports institutional innovation and collective action supports thinking and finding solutions

The Lepcha community of Lungchuk and Dagyang village of Lingseykha are very proud of the local landrace of black rice beans which the community developed through seed selection. It can be grown only in these villages because of the need for specific ecological conditions. This bean has very high market demand because of excellent taste and is recognized as a special product of these villages. Similarly, potato and milk of Tandrabong has its reputation in the Kalimpong market for its superior quality. The Limbu community of Mudung is proud of their village because of its suitability for growing crops of the mountains as well as the plains. Lepchas are proud of their knowledge about wild vegetation and its use as food and medicine. Pride is an important motivational factor which can encourage innovation.

Both the Lepcha and Limbu communities are still very steeped in their cultural traditions, conservation of heritage, traditional knowledge and understanding about nature. They practice rituals like *Naya ko puja, Udauli* and *Ubauli* even though they are not sure about their significance. A very popular agro-social (or bio-cultural) ceremony is *dhan nach*, a community harvest dance for separating the grain from paddy plants. This used be an occasion for the young to choose their life partner. Though it is no longer practical in the real field condition, they maintain the custom by celebrating this practice in different socio-cultural events like weddings, New Year festivals and shows. Cultural values help to ensure that traditional knowledge, crops and farming practices are sustained to provide options for innovation and adaptation in future.

4. Next Steps

As a result of the improved understanding through extensive interactions with the communities in the process of this qualitative baseline survey, some needs for further action have been identified. For example, the farmer who developed the new radish variety in the Central Himalayas and the community which developed the black rice beans variety in the Eastern Himalaya should be promoted for registration under the Protection of Plant Varieties and Farmers' Rights Act (PPVFR) of the Government of India. Similarly, there is a need to initiate registration under the Geographical Indications Act (GI) for unique biocultural products such as black rice beans. In this case, instead of restricting the search just to the project villages, products need to be identified from the larger region in order capitalise on improved market prospects resulting from the declaration of a GI in future. Other planned activities are documentation of traditional recipes elders, competitions for recipe documentation, awareness amongst school children about traditional foods, food festivals and marketing and value addition for traditional foods.

There is also a need for greater understanding of the innovations processes and supporting factors and therefore a quantitative baseline survey has also been undertaken by the SIFOR partners in the four countries, with guidance from IIED. Stronger linkages with scientists are also being established for joint innovation through participatory technology development linking traditional knowledge and science, which is expected to also strengthen TK-based innovation systems. Finally, the possibility of establishing a Biocultural Heritage Area in the eastern Himalayas area is being explored to build on and further strengthen the traditional institutions and collective decision making and revitalise the rural economy and innovation system based on its unique biocultural heritage.

SIFOR (Smallholder Innovation for Resilience) is an action-research project working with indigenous and local communities in India, Peru, China and Kenya, coordinated by the International Institute for Environment and Development (IIED). It aims to revitalise traditional knowledge, crops and innovation systems for food security in the face of climate change.

This report presents the findings of a Qualitative Baseline study conducted in 10 project villages in the Central and Eastern Himalayas. The study explored the farming systems and changes that have occurred in the last 30 years, the innovations developed in response to these changes, and the social factors that support traditional knowledge-based innovation.

Project materials

Food and Agriculture

Keywords:
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