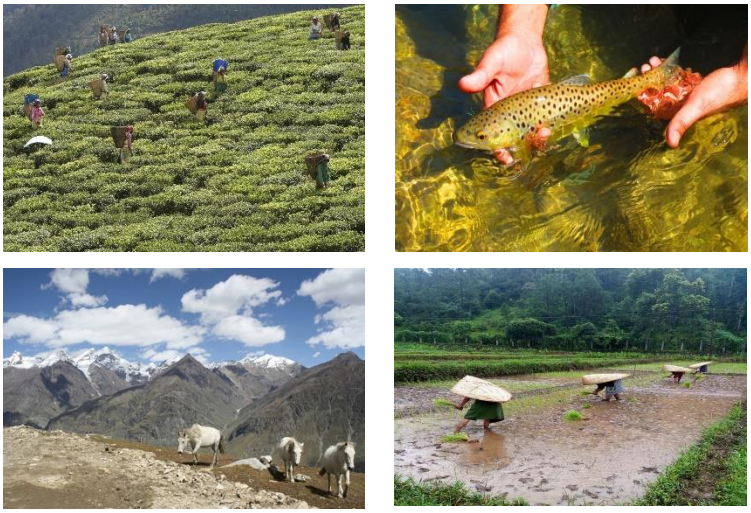
QUARTERLY REPORT

July-September, 2016

TASK FORCE ON HIMALAYAN AGRICULTURE
(TF-6)

National Mission for Sustaining Himalayan Ecosystem
(NMSHE)



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NRM Division
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EXECUTIVE SUMMARY

The report summarizes the quarterly progress of Task Force 6 (TF-6) on Himalayan agriculture under the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) for months July to September, 2016. The TF-6 was commissioned to the Indian Council of Agricultural Research (ICAR) to work in three distinct regions of the Indian Himalayan Region (IHR) viz., cold arid in western Himalayan region, lower and middle Himalayan region and north-eastern Himalayan region. The various objectives of the TF-6 have been categorized under the following heads: Database creation, Monitoring, Modeling and Simulation, Vulnerability Assessment, Adaptation Policy Research, Pilot Studies for Revalidation and Capacity building. The report discusses the progress of the TF-6 along with the activities carried on complying with the work plan for the year 2016-2017 of the three regions.

Cold Arid Himalaya

The baseline survey on yak and their rearers has been completed in five blocks of Leh. Fishery resources of the Indus River have been mapped and fish species have been identified. For vulnerability assessment purpose 10 villages have been surveyed. Demonstrations on improved practices of wheat production and accession trials for Barley and *Chenopodium quinoa* have been conducted to assess the suitability in cold arid conditions. Two training programs on mushroom cultivation for enhancing farm income have been conducted.

Lower and Middle Himalaya

Attempts are being made to develop the HAKN web portal and the secondary data from different sources on various aspects have been compiled and collated. Secondary data of wheat and rice productivity for all the districts of Himachal Pradesh have been collected. Soil samples have been collected and analyzed to assess the soil health of the pilot sites. Pilot studies like fish polyculture, *jalkund* construction, introduction of horticultural varieties *etc.* have been taken up at the pilot sites. Farmers are being sensitized about the climate change impacts and demonstrations have been conducted on improved crop varieties and farm practices.

North-East Himalaya

Biodiversity study is being initiated at one of the pilot site for identification of plant species. Soil properties of different land use systems prevalent in the region have been analyzed. Improved rice varieties are introduced in the pilot sites for modelling and simulation purposes. Farmers are being encouraged to take up pulse and vegetable crops and are provided with inputs such as improved and high yield variety seeds. Intercropping and IFS models have also been planned and trainings are being conducted to enhance farm income. Training and awareness programs are being conducted to sensitize and strengthen the farmers.

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INTRODUCTION

The Indian Himalayan Region (IHR) covers vast areas, with about 17 per cent of the region being under permanent snow cover and glaciers, and about 30-40 per cent under seasonal snow cover, forming a unique water reservoir. This feeds important perennial rivers that provide water for drinking, irrigation, and hydropower. Every year, about 1,200,000 million cubic-meter of water flows from Himalayan Rivers. The IHR is home to nearly 4 per cent of the country's population, and provides directly or indirectly for their livelihoods. The average land holdings are very small and less than a hectare per family; most agriculture is of the subsistence type and depends on suitable climate for good yields. Animal husbandry is another source of income. Owing to the very small landholdings, families rely heavily on natural fodder resources including the forest areas to feed their livestock. Economically vulnerable groups including the scheduled tribes and castes have high dependence on the forest resources including collection of fodder, medicinal plants, and firewood. These ecosystem services are highly climate sensitive and the regional economy is thus more vulnerable.

OBJECTIVES

The Mission targets to improve the status of agriculture in the Indian Himalayan Region which is diverse in terms of its topography, agro-climatic zones, development trajectories, etc. with the following objectives:

- Development of database on soil (fertility and erosivity), water, genetic resources (arable crops, horticulture, agroforestry, livestock particularly double humped camel and yak, and cold-water fisheries) and farmers' practices
- Validation of the extant technologies and refinement of agronomic practices and cropping systems to overcome the negative influence of climate variability and climate changes
- Identification and promotion/scaling up of suitable conservation practices for water, vegetation, soil and carbon sequestration model to attract and flow green bonus towards farming community
- Capacity building of farmers for adaptation and mitigation climate resilient agriculture practices for a low carbon future including popularization and adoption of suitable farm equipment to reduce cost of cultivation and drudgery of hill farm women
- To improvise value addition techniques for available raw material to enrich the diet
- To assess the potential of agroforestry and other integrated farming systems besides conservation agriculture as biological approaches to mitigate global warming

STUDY AREA

Region	Pilot Site
Cold Arid Himalaya	Chushot (Gongma) Village and Stakmo Village, Leh District, Jammu and Kashmir
Lower Middle Himalaya	Jur Kafun Village, Almora District, Uttarakhand
	Kumhali Village, Shimla District, Himachal Pradesh
North East Himalaya	Mawthei Village (Ribhoi District), Meghalaya
	Mongkot Chepu Village (Ukhrul District), Manipur
	Bilkhawthlir Village (North Thingdawl District), Mizoram
	Longleng district, Nagaland
	Lipu-Namchi, Arunachal Pradesh
	Timpyem village (East District) and Lachen village (North District), Sikkim
	Gobinda Takur Para, Tripura

INSTITUTIONAL FRAMEWORK

Cold Arid Himalayan Region

Lead Institute: Central Arid Zone Research Institute (CAZRI), RRS, Leh (Jammu and Kashmir)

- Directorate of Coldwater Fisheries Research (DCFR), Bhimtal (Uttarkhand)
- Central Agroforestry Research Institute (CAFRI), Jhansi (Uttar Pradesh)
- ICAR-National Research Centre On Yak, Dirang, (Arunachal Pradesh)
- ICAR-National Research Centre on Camel, Bikaner (Rajasthan)
- Central Institute of Temperate Horticulture (CITH) Srinagar, (Jammu and Kashmir)

Lower and Middle Himalayan Region

Lead Institute: Indian Institute of Soil and Water Conservation (IISWC), Dehradun (Uttrakhand)

- Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS) – Almora (Uttrakhand)
- Central Agroforestry Research Institute (CAFRI) – Jhansi (Uttar Pradesh)
- Indian Veterinary Research Institute (IVRI) Regional Station – Mukteshwar (Uttrakhand)
- Indian Institute of Soil and Water Conservation(IISWC), Regional Centre – Chandigarh
- Central Institute of Temperate Horticulture (CITH), Regional Station - Mukteshwar (Uttrakhand)
- Directorate of Coldwater Fisheries (DCFR), Bhimtal (Uttrakhand)

North-Eastern Himalayan Region

Lead Institute: ICAR Research Complex for NEH Region, Umiam, (Meghalaya)

- ICAR Research Complex for NEH Region Arunachal Pradesh Centre, Basar
- ICAR Research Complex for NEH Region Manipur Centre, Imphal
- ICAR Research Complex for NEH Region Mizoram Centre, Kolasib
- ICAR Research Complex for NEH Region Tripura Centre, Lembucherra
- ICAR Research Complex for NEH Region Nagaland Centre, Jharnapani
- National Organic Farming Research Institute, Gangtok, Sikkim
- National Research Centre (NRC) on Pig, Guwahati, (Assam)
- National Research Centre (NRC) on Mithun, Medziphema (Nagaland)
- National Research Centre (NRC) on Yak, Dirang (Arunachal Pradesh)

Task Force Secretariat

- Natural Resource Management (NRM) Division, ICAR, New Delhi.

The institutes of the Task force are working in collaborative form with the respective State government in addition to sharing information. The information is also shared with the Climate Cells set up by the State governments.

ACTIVITIES OF TF-6 ACCORDING TO WORK PLAN 2016-2017

Cold Arid Himalaya

Work Plan for 2016-17	Activity so far
Database creation	
Fishery resources will be mapped in terms of lake, reservoir and rivers of the cold desert	• Carried out field survey in Indus river and recorded 23 fish species belonging to 5 families and 13 genera from the river • Prepared maps of fish diversity for three blocks of Leh district *i.e.* Khalsi, Nubra and Leh block, buffer boundary maps of the river and streams, point map for 123 villages in the block and buffer maps of the villages for aquaculture site selection
A baseline survey and collection of data on yak and their rearers in Kargil and Leh districts of Ladakh	Conducted survey in five blocks of Leh district (Tangste, Durbuk, Nubra, Khalsti and Nyoma)
Monitoring system	
Monitoring of invasive alien species in changing climate in cropped and pasture areas and desertification by weedy species	• Weed seed bank studies carried out under different cropping systems of Stakmo village • Screening of herbicides in different varieties of barley crop was carried out
Vulnerability assessment	
Assessment of vulnerable areas	10 villages surveyed for vulnerability assessment. Randomly total 5 farmers from each village were identified
Pilot studies for revalidation	
Demonstration of proven technologies for maintaining sustainable crop production throughout the year at farmer's field	Demonstration of improved packages of practices in wheat at Chushot village
Identification and popularization of climate resilient practices/varieties of the main crops for sustaining Himalayan agriculture	• Conducted Barley accession trial for suitability in cold arid conditions • Conducted trial of new accessions of *Chenopodium quinoa* for suitability in cold arid conditions
Capacity building and forecasting	
Imparting training to target groups/farmers	• Training cum awareness program on mushroom cultivation

Lower Middle Himalaya

Work plan for 2016-17	Activity so far
Database Creation	
Attempts to be made to develop a portal on Himalayan Agriculture Knowledge Network (HAKN)	Development of Portal under process and will be functional shortly
Data collection from secondary sources	Collated and Compiled secondary data for wheat and rice for all the districts of Himachal Pradesh
Monitoring	
Collection of data on crop/plant growth attributes and yield	• Collected and analyzed soil samples from 108 sites at different depths • Completed baseline survey of the village Jur Kafun along with villages Thaat and Jogyadunga • Physico-chemical parameters of water recorded in Dudholi and Todra villages, Uttarakhand
Modeling and simulation	
Collection and analysis of existing weather data	Annual mean temperature and climatic net primary productivity maps prepared for the entire Indian Himalayan region
Vulnerability assessment	
One of the sub-indicators *i.e.* precipitation excess irrigation water demand will be estimated using CROPWAT 8.0 software in districts of Uttarakhand	• Precipitation excess irrigation water demand estimated in two districts of Uttarakhand (Tehri Garhwal and Pauri Garhwal) • Assessed vulnerability indicators of disease status of livestock in Himachal Pradesh
Adaptation policy research	
Collecting baseline information on existing policies and programs for adoption of best management practices with respect to climate change through primary and secondary sources	Listed the relevant existing policies and programs in Himachal Pradesh
Pilot studies for revalidation	
Development of silvipasture system for increased fodder supply	500 seedlings of *Morus alba* planted in village Kumhali for silvipasture system
Experimentation will be started with polyculture of carp including indigenous fish species and integrated fish farming in polytanks	• Selected fish species with a combination of indigenous and exotic carps for culturing in Dudholi and Todra villages. • Exotic silver carp, grass carp, common carp

	and minor carp (*Labeo dyocheilus*) stocked in the prepared ponds in selected villages and growth parameters being monitored monthly
Demonstration of site specific refinement and climate resilient crop varieties	• 1 kg seeds of improved seed variety of Tomato 'Arka-Rakshak F-1' distributed among the farmers of Kumhali village • Introduced IDM/IPM packages (10 light traps introduced) for the management of major diseases and insect/pests in selected pilot site Jur Kafun • Technology demonstration for controlling powdery mildew disease and wooly apple aphids in Sunkiya village • Weed management technology demonstration in vegetable crops (tomato, capsicum *etc.*) in Sunkiya village
Technologies like sloping agriculture land technology, demonstration of silpoulin for checking water seepage, organic farming, Integrated Nutrient Management *etc.* to be demonstrated in farmers' field and their effect on socioeconomics and their climate relevance will be assessed	• Five polythene lined tanks of total capacity 175.5 m^3 constructed • Two tanks of 12.5 m^3 capacity constructed for growing *Azolla*
Horticultural plantation to be taken up in farmers' fields of villages	• Introduced annual flowering plants and flowering trees like Privet, *Ligustrum sp.*
Capacity building and forecasting	
Trainings and demonstrations to be conducted to carry out awareness and sensitization on climate change issues	• Sensitized farmers in every field visit about improved farm practices • Training on 'Vegetable seed production and plant disease management' • One day scientists-farmers interaction meeting for distribution of soil health cards
Capacity building of stakeholders and impact analysis of capacity building program will be carried out	Review workshop of Task Force

North-East Himalaya

Work Plan	Activity so far
Monitoring system	
Biodiversity studies in the monitoring sites in different land use systems	Biodiversity study (identification of plant species) at Mawthei village forest is initiated for trees, shrubs, herbs and climbers
Soil sampling from 0-15 cm, 15-30 cm, 30-60 cm and 60-1 m analysis of changes in soil properties –Bulk density, Soil moisture holding capacity, Organic carbon, Available nitrogen, Available phosphorus, Available potassium, Available micronutrients (Zn, Cu, Fe, Mn), Soil carbon stock, Soil microbial population under ten different land use systems	• Collected soil samples from Mawthei village and analysis of different soil parameters under progress • Soil samples collected and analysis of nutrient content of soil under progress • Analysis of physico-chemical parameters of soil samples collected from different land use systems in Arunachal Pradesh • Collected and analyzed soil samples for physical, chemical and biological properties from 10 different land use systems in Manipur • Collected soil samples from 7 villages of Nagaland and analysis of samples is under progress
Determination of Carbon stock in Different land use in the Monitoring site	• Soil samples collected and analysis of carbon stock under progress in Arunachal Pradesh
Modelling and Simulation	
Seeds of high yielding rice variety to be grown in patches of land for simulation/testing before implementation	• Two rice cultivars (Mendri and Shahsarang variety) grown with three nutrient treatments at Umiam, Meghalaya • Rice cultivars; Thoibi and RCM-9 grown with different nutrient treatments at Manipur • Experiment started in Arunachal Pradesh on low land paddy (one improved rice variety CAUR 1 and a local variety Mipun) under different nutrient treatments • Two rice varieties (popular local variety Phyzum and improved HYV Gomati) grown with three replications and four different fertilizer doses in Cocotilla, Tripura

Pilot studies for revalidation	
Implementation of rain water harvesting and management techniques	• Installed two jalkunds (capacity: 30,000 liters) at farmers' fields in Mawthei village • One jalkund constructed (capacity: 61.86 m^3) at Chandanpokpi village, Manipur and water used for growing crops
Jhum Improvement: Introduction of suitable varieties and cropping system, Sloping agricultural land technology, Introduction of Agroforestry and perennial horticulture, Introduction of N-fixing plants / Green manuring and Water harvesting	• Distributed saplings of multipurpose and fruit trees to the farmers of Mawthei village • Implemented various cropping system at Timpyem village, Sikkim under different land use in farmers' field such as rice-vegetable pea, maize-pahenlo dal-buckwheat, large cardamom-turmeric, large cardamom-ginger, maize-soybean, mandarin- vegetable, *Alnus nepalensis*-turmeric, guava-cowpea • Selected one hillock in Chandanpokpi village, Manipur. Saplings of banana and Lemon; Parkia; and maize, groundnut, ginger, and rice been planted at the base, top and middle of the hill respectively
Varietal introduction and seed production: introduction of stress tolerant HYVs of agri-horticultural crops	• Pigeon pea (UPAS-120) and Blackgram (PU-31) introduced with basal dose of fertilizers (20:20:40 N:P:K) at Chandanpokpi village • Radish seeds (Pusa Chetki variety) and rice seeds (Gomati variety) distributed to farmers of Gobinda Thakur village in Tripura
Soil fertility management: integrated nutrient management and intercropping of legumes with cereals	• Field line demonstrations on intercropping of maize seed Pusa Composite-3 with cow pea, soybean and groundnut in one ha area in Chandanpokpi village, Manipur
Plant health management: field application of IPM/IDM modules in paddy, maize, tomato and cole crops	• Conducted awareness on IPM/IDM module at Chandanpokpi village • Study for incidence and prevalence of various diseases in crops was undertaken at pilot sites of Manipur
Crop diversification for risk management: demonstration on the crop diversification under raised and sunken bed technology and testing HYVs of rice, maize, vegetables, oilseeds, and	• Introduced short duration pre-kharif rice variety (RC Maniphou-12) in Chandanpokpi village, Manipur • 250 g HYV Bhindi Purple long green seeds

pulses	distributed to each of the selected farmer (10 nos.) of Kolasib district, Mizoram • 10 farmers selected and provided with 1 kg rice (Gomati) and 0.5 kg cowpea (YB 7) seeds to adopt rice + cowpea under raised and sunken bed technology
Integrated farming system: Establishment of IFS models for small size holdings with special emphasis on soil and water conservation	• Demonstrated cultivation of improved tomato varieties (MT2 and MT3) in IFS model owned by farmer Angmet Phom developed under NMSHE at Hukphang village • Two IFS models (Agri-Horti-Silvi-Livestock model and Horti-fishery- Livestock-Vermicomposting) initiated in Arunachal Pradesh
Year round vegetable production in low cost poly tunnel/rain shelter	• One polyhouse structure (11 m x 6.2 m) constructed in Hukphang village for flower and vegetable production
Capacity building and forecast	
Organization of need based training programmes like “Awareness and Sensitization on climate change issues”, vermicompost, mushroom cultivation etc.	• Awareness cum training program conducted in Arunachal Pradesh about improvement and livestock (pig and poultry) husbandry practices
Trainings and demonstrations for the farmers	• Four training and 1 demonstration program conducted

WORKSHOPS/ TRAININGS/AWARENESS PROGRAMS UNDER NMSHE TF-6

Sr. No.	Title	Date & Venue	Host Organization/ Institute	Level of Participation/ Stakeholders	No of participants
1.	Awareness-cum-training programme on "Fodder conservation to mitigate hungry gaps in highland animals"	1st-3rd July, 2016 at West Kameng district, Arunachal Pradesh	NRC on Yak, Dirang	Tribal farmers	58
2.	Review Workshop of Task Force on Himalayan Agriculture under NMSHE TF-6	3rd-4th July, 2016 at VPKAS, Almora, Uttarakhand	VPKAS, Almora	Scientists and research staff	19
3.	Training-cum-awareness programme on "Empowerment of Tribal women through rural craft and value addition of locally available resources"	12th-14th July, 2016 at Dirang, Arunachal Pradesh	NRC on Yak, Dirang	Tribal women	30
4.	Awareness program on soil and plant nutrition management for capsicum crop	23rd July, 2016 at Sunkiya Village	CITH, Mukteshwar	Scientists and farmers	11
5.	Technology showcasing cum Farmer-Scientist Interaction	29th July, 2016 at Hukphang village Nagaland	KVK, Longleng and ICAR-RC, Jharnapani, Nagaland	Scientists and Farmers	80
6.	Conduction of One day workshop on 'Scientific Management and Bio Securities in Pig Husbandry	5th August, 2016 at Dimapur, Nagaland	NRC on Pig, Assam	Farmers	45
7.	Awareness and Sensitization on climate change issues	23rd August 2016 at Lipu Namchi village, Arunachal Pradesh	KVK, Longleng and ICAR-RC, Jharnapani, Nagaland	Farmers	30

8.	Animal Health Camp and Awareness Program	26th August, 2016 at Pachim Dairang, Assam	NRC on Pig, Assam	Farmers	100
9.	One day scientists-farmers interaction meeting	29th August, 2016 at Kumhali village	ICAR-IISWC RC, Chandigarh	Scientists and farmers	21
10.	Animal Health check-up camp	29th August, 2016 at Kumhali village	IVRI, Mukteshwar	Scientists and farmers	21
11.	Training-cum-input support system program under integrated farming system for livelihood improvement	1st September, 2016 at Timpyem, East Sikkim	ICAR- NOFRI, Tadong, Sikkim	Farmers	29
12.	Training on 'Vegetable seed production and plant disease management'	5th September, 2016 at Sunkiya village	CITH, Mukteshwar	Farmers and resource personnel	37
13.	Training-cum-awareness program on mushroom cultivation	7th September, 2016 at Ranbirpur, Leh	CAZRI-RRS, Leh	Farmers	20
14.	Pig health camp and Awareness program	16th September, 2016 at Kothauthi, Assam	NRC on Pig, Assam	Farmers	65
15.	Training-cum-awareness program on mushroom cultivation	21st-22nd September, 2016 at ITBP office, Leh	CAZRI-RRS, Leh	Farmers	20

PUBLICATIONS

- Mohd. Raza, Rigzin Dorje, Stanzin Landol, M.S. Raghuvanshi, and J.C. Tewari (2016). Firewood options in Ladakh region. *Voice of Ladakh*: Vol.: 4(23): 5 pp (13 July, 2016)
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- J.C. Tewari, M.S. Raghuvanshi, Kamlesh Pareek, Stanzin Jigmet, Ram Pratap, and J. C. Dagar (2016). Traditional Agroforestry system in Indian Cold Arid Zone: Case study of a village located near Leh, Ladakh. In J.C. Dagar & J.C. Tewari (Eds.), *Agroforestry Research Developments* (181-196), New York, Nova Science Publishers
- M.S. Raghuvanshi, Vikas Gupta, Stanzin Landol, Stanzin Jigmet, and J.C. Tewari (2016) Present Status of Protected Agriculture in Ladakh Region. In: *Protected Agriculture for High Himalayas: Design and Application*. HMAARI, SKUAST-K, Leh, 2-3 September, 2016: 36-43

OBJECTIVE-WISE PROGRESS

Cold Arid Himalaya

Database Creation

- Samples for assessing micro-arthropod community for soil quality from pastoral system were collected. The samples for micro-arthopod and heavy metals are being analysed.
- Fish diversity maps for three blocks of Leh district namely, Khalsi, Nubra and Leh, buffer boundary maps on the river and streams, point map for 123 villages in the block and buffer maps on the villages for aquaculture site selection have been prepared.
- Analysis of plant samples of seabuckthorn shrub collected from Hunder village, Nubra valley, Leh have been completed by NRC-Camel
- Field Survey was carried out in Indus river and 23 fish species (***Annexure I***) belonging to 5 families and 13 genera have been recorded
- Survey was conducted in five blocks of Leh districts namely, Tangste, Durbuk, Nubra, Khalsti and Nyoma. In total, 613 households from 30 villages rear 7,077 yaks on high altitude cold arid pastures under zero input system. The highest number of yaks i.e. 1332 were observed in Sato-Kargyam village maintained by 76 households

Monitoring System

- Weed seed bank studies were carried out under different cropping systems of Stakmo village to address the weed problems in crops
- Screening of herbicides in different varieties of barley crop was carried out. It was found that different formulations of pendimethalin and 2,4-D followed by isoproturon performed well in controlling weeds effectively
- Monitoring indicators for the study of vulnerability assessment of Leh and Nubra valleys were finalized and proforma was also developed.

Vulnerability Assessment

10 villages (Spituk, Stakmo, Phey, Nimoo, Umla, Thiksey, Chushot, Nang, Saboo, and Khardung) were surveyed for vulnerability assessment

Pilot Studies for revalidation

- Improved cold tolerant strains of common carp (scale & mirror) were introduced in the Leh region and they are thriving well in low temperature
- Accession trial of barley was conducted for suitability of accessions in cold arid conditions
- Three accessions of *Chenopodium quinoa* (EC-507741, EC-507747 and KNQWB-07) collected from NBPGR, New Delhi were evaluated for their suitability under cold arid region. It was recorded that EC-507741 (**Figure 1**) performed better in terms of germination percentage i.e. 95% with significant plant growth followed by EC-507747 (80% germination) as compared to KNQWB-07 with 30% germination.

Figure 1: Performance of *Chenopodium quinoa* accession- EC-507741 in field

- Demonstrations were carried out on effect of herbicide on weeds in carrot, cabbage and onion crops (**Figure 2**) at Ranbirpur and Stakmo village, Leh. At Ranbirpur village, application of pendimethalin performed significantly well in controlling weeds in carrot and onion. While in Stakmo village, two different formulations of herbicide pendimethalin and single formulation of oxyfluorfen provided season-long weed control in onion crop

Figure 2: Weed free cabbage-carrot-onion in Ranbirpur, Leh

- Herbicide screening in barley revealed that different formulations of pendimethalin (as pre-emergence) and 2,4-D (as post-emergence) have performed well in controlling weeds. While in case of sulfosulfuron and metsulfuron methyl, crop of barley was seriously affected and could not recover (**Figure 3**)
- At Chushot village, demonstration of improved packages of practices in wheat (**Figure 4**) was carried out and it was found that the improved practices provided better growth for crop including significant return

Figure 3: Herbicide screening in Barley

Figure 4: Field deomnstration on wheat crop at Chushot village

Capacity building and forecasting

- One day training program on mushroom cultivation was organized at Ranbirpur village, Leh on 7th September, 2016
- Two days training was organized on mushroom cultivation for ITBP, Leh on 21st-22nd September, 2016

Lower and Middle Himalaya

Database Creation

- Primary data has been collected from all the institute to be hosted on the HAKN web portal and the portal will be functional shortly
- Secondary data regarding, area, production and productivity of wheat and rice has been collated and compiled for all the districts of Himachal Pradesh (**Figure 5**). The data shows a steep fall in yield in the year 2000-01 and 2005-06. Similarly a minor dip in trend line has also been observed in 2007-08. The reason hypothesized for this is weather aberration and to establish the fact, the data will be correlated with the weather data in future

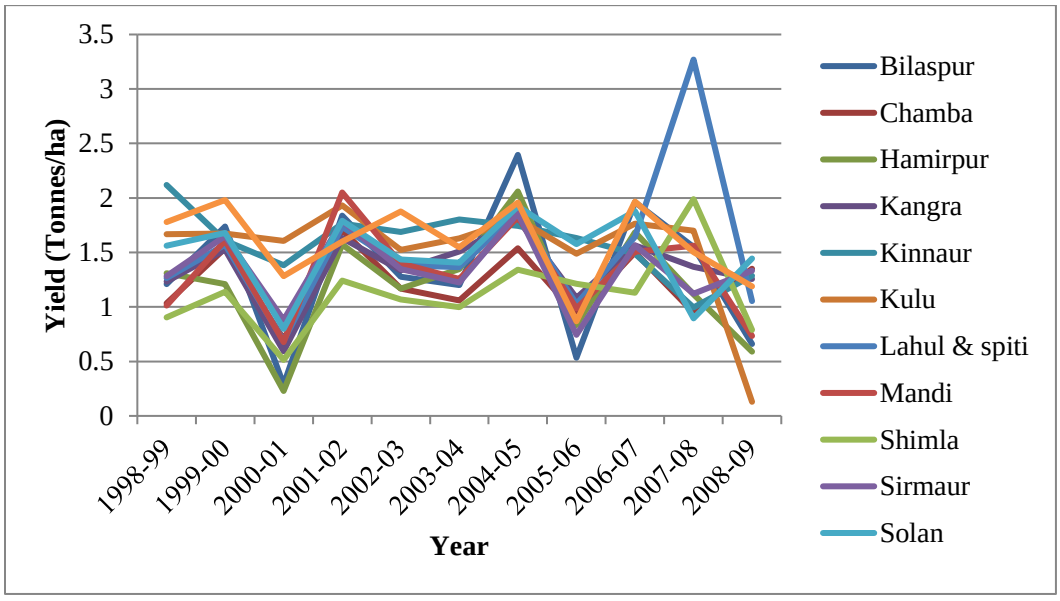


Figure 5: Long term yield trend of Wheat in Himachal Pradesh

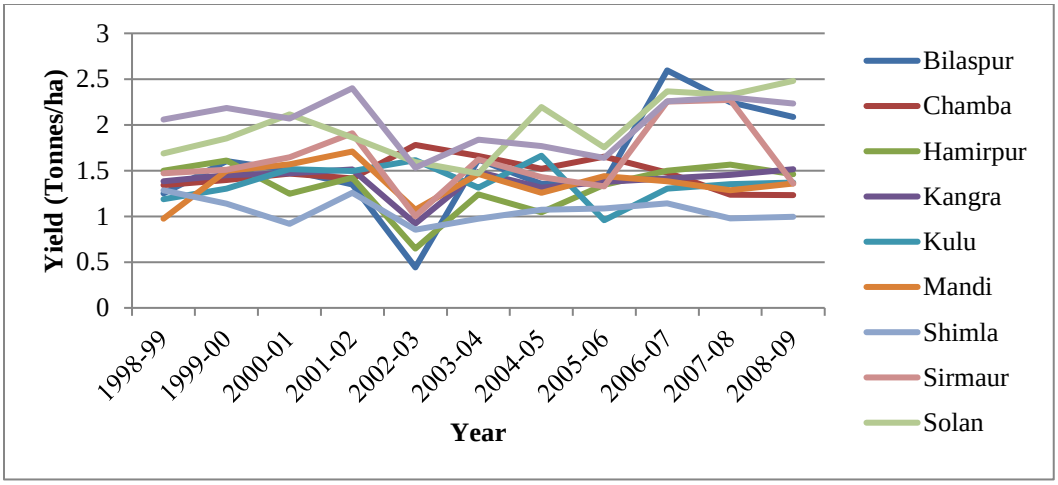


Figure 6: Long term yield trend of Rice in Himachal Pradesh

- The Long term yield trend of rice in Himachal Pradesh shows a steep fall (**Figure 6**) in the year 2002-03 in majority of districts. The reason behind this may be weather aberration during the *Kharif* season. The exact reason will be identified after correlation of yield with weather data

Monitoring System

- Communication with State Animal Husbandry Department, Govt of Uttarakhand was made for collection of data on disease incidence in animals of Uttarakhand
- Base line survey of the study village (Jur Kafun) has been completed. In addition two more nearby villages (Thaat and Jogyadunga) had also been surveyed. Data entry and analysis is in process
- Physico-chemical parameters of water were recorded in Dudholi and Todra villages in Doonagiri area of Almora District of Uttarakhand
- The soil samples were collected from 0 – 15, 15 – 30 and 30 – 45 cm soil depths by using a core sampler (7.5 cm diameter). A total of 108 (Site 1 to 108) composite soil samples of ~1000 g each were collected from 5 to 7 random spots of the field. The GPS coordinates of the sampling sites were recorded (***Annexure II***). Random soil sampling was preferred due to very small size of plots. The required amount (~ 1000 g) of soil sample was taken by quartering method. Root part and other plant residues were removed from the soil and the soil samples were thoroughly mixed, air-dried, and passed through a 2.0 mm sieve. Air-dried soil samples were placed in plastic bag and stored at an ambient laboratory temperature
- The processed soil samples were used to determine different soil parameters such as the soil pH was determined in 1: 2.5 soil: water ratio using the pH meter with glass electrodes and electrical conductivity (dS m^{-1}) was determined by the method of Jackson (1973). The results showed increasing trend for soil reaction from surface soil

layer 0-15 cm to 30- 45 cm soil layers (**Figure 7**). However, a reverse trend for the soil electrical conductivity was found in all three layers of soil (**Figure 8**).

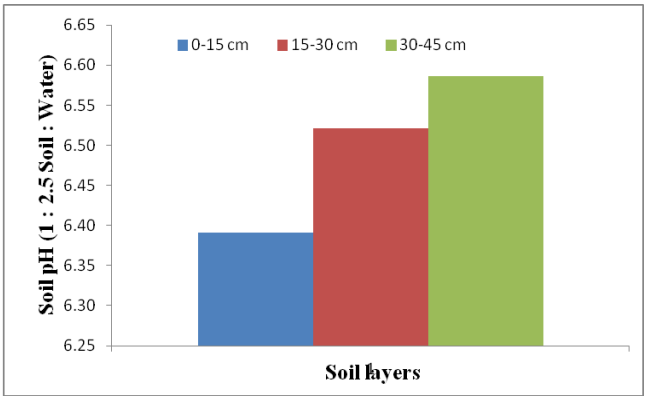


Figure 7: Effects of different depths of soil layers on soil reaction (pH) of the selected ecosystem

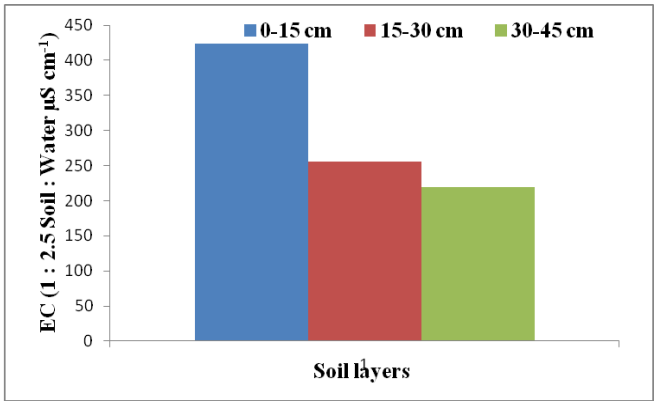


Figure 8: Effect of different depths of soil layers on electrical conductivity (EC) of the selected ecosystem

Modelling and Simulation

The results derived from Modeling and Simulation was used as input in the Vulnerability Assessment. The bioclimatic parameters (Revised maps shown in ***Annexure III***) considered for the study include:

a) Annual mean temperature:
   - change can cause shift in chilling temperature
   - exotic species invasion
   - crops can attain maturity at early stage
   - farmers economy

b) Net Primary productivity (NPP): Maps developed using MIAMI model (***Annexure III***)

Vulnerability Assessment

Vulnerability indicator of disease status of livestock was assessed in HP (***Annexure IV***). These indicators include:

- Viral disease outbreaks
- Animals affected form viral diseases
- Deaths caused due to viral diseases
- Bacterial disease outbreaks
- Animals affected from bacterial diseases
- Deaths caused due to bacterial diseases
- Parasitic disease outbreaks
- Animals affected from parasitic diseases
- Deaths caused due to parasitic diseases

One of the sub-indicators of vulnerability assessment is the precipitation deficit i.e. precipitation excess irrigation water demand which was estimated using CROPWAT 8.0 software in two districts of Uttarakhand (Tehri Garhwal and Pauri Garhwal).

Adaptation Policy Research

The relevant existing schemes/initiatives for agriculture in Himachal Pradesh are:

- Rashtriya Krishi Vikas Yojna (RKVY)
- National Project on Organic Farming
- Work Plan for Accelerated Growth of Agriculture
- Sustainable Agriculture and Rural Transformation Holistic Initiative (SARTHI) Programme- Shivalik Range
- Biogas Development Programs (NBMMP)
- HP Mid Himalayan Watershed Development Project & Bio-Carbon Sub-project
- Promotion of balanced use of fertilizers and organic farming
- Soil testing
- Soil and water conservation
- Wasteland development

Pilot studies for revalidation

- About 500 seedlings of *Morus alba* were planted in Village Kumhali for silvipasture system by CAFRI, Jhansi, with the help of ICRP on agroforestry centers located at Dr. YSPUH&F, Solan
- Fish species were selected with a combination of indigenous and exotic carps for culturing in Dudholi and Todra villages. Exotic silver carp, grass carp, common carp and minor carp (*Labeo dyocheilus*) were stocked in the ponds prepared in the selected villages. Growth parameters are being recorded on monthly basis
- Facilitation for introduction of improved seed variety of tomato 'Arka-Rakshak F-1' from IIHR, Bangalore to farmers of Kumhali by ICAR-IISWC RC Chandigarh. 1 kg seeds worth Rs. 30,000/- were distributed among the farmers
- IDM/IPM package for the management of major diseases and insect/pests demonstrated in selected pilot site (Jur kafun) on 23rd July, 2016. Light traps (VL white grub beetle trap-1) were installed in strategic locations in the village and insect catches are being monitored. A total of 10 light traps were installed covering the area of ~13 ha. Surveillance of insect pests and disease in different crops are being done.
- Technology demonstrated for controlling powdery mildew and wooly apple disease in Sunkiya and Jur Kafun (**Figure 10**) village respectively
- Weed management technology demonstrated in vegetable crops (tomato, capsicum etc.) in Sunkiya village (**Figure 11**)

Figure 9: Disease infected (left) and Protected cultivation (right) of tomato in Sunkiya village

Figure 10: Aphid infected capsicum plants in Jur Kafun

Figure11: Open field of capsicum in Sunkiya village

- *Planned honey bee pollination:* Surveys on floral availability revealed very low and seasonal availability of flowers. Many annual flowering plants were introduced at the site along with flowering trees like Privet, *Ligustrum* sp. (locally called as *Sadabahar*). These trees are fast growing, ever green and produce large number of flowers with copious amount of nectar and pollen especially during the months of May-June, when other plants are not blooming. After establishment of flowering plants and fruit trees (introduced by CITH, Mukteshwar), honey bees will be introduced and honey bee pollination will be planned in targeted crops and trees
- *Water management and crop demonstrations:* The available technologies were demonstrated in farmers' field to assess their climate resilience. The technologies being demonstrated are:
  - ✓ Five polythene lined tanks (**Figure 12**) of total capacity 175.5m^3 which can irrigate around 3410 m^2 area through flood in one filling constructed at Jur Kafun village. The irrigation capacity will increase according to water discharge of source tapped for water harvesting
  - ✓ Two Tanks of 12.5 m^3 capacity constructed for growing *Azolla* (**Figure 13**) at Jur Kafun village
  - ✓ Seeds (89.5 kg) of eight crop varieties was demonstrated in 41 farmers' fields. The data with regard to plant height, yield and farmer response is being collected

Figure 12: Poly Tank at Jur Kafun village

Figure 13: *Azolla* Tank at Jur Kafun village

- *Animal health status:*
  - ✓ Three animal health camps were organized at Hartola, Kumhali and Sunkiya villages covering cattle (90), buffalo (7), goat (43), dog (1) and poultry (360) of 54 families. One sensitization program was jointly organized at Sunkiya village by IVRI with ICAR- CITH, Mukteswar
  - ✓ Mass vaccination of goats against *Peste des Petis Ruminants* (PPR) was conducted at Hartola village. Fifty two animals were vaccinated

Capacity building and forecasting

- Farmers are being sensitized in every field visit about the improved farm practices to minimize the adverse effects of climate change
- Farmers were exposed to technological basket of the research institutes as well as the other agencies through their exposure visit in the institutes
- Review Workshop of Task Force on Himalayan Agriculture under NMSHE TF-6 was organized on 3rd- 4th July, 2016 at VPKAS, Almora
- One day scientists-farmers interaction meeting was organized on 29th August 2016 at Kumhali village, Shimla, H.P. under NMSHE project by ICAR-IISWC, RC Chandigarh. Soil health card of 14 farmers were prepared in collaboration with state agriculture department Shimla and distributed in the event. In the same event, a camp for checking animal health was organized by IVRI, Mukteshwar, Uttarakhand in collaboration with officers from state animal husbandry department, Shimla.
- A training was organized on 'Vegetable seed production and plant disease management' on 5th September, 2016 in Sunkiya village in which 33 farmers and 4 resource personnel participated
- An awareness program was organized on soil, plant nutrition management for capsicum crop in Sunkiya village on 23rd July, 2016

North-East Himalaya

Monitoring system

- Biodiversity study at Mawthei village forest is carried out for trees, shrubs, herbs and climbers. Identification of the plants species is in progress (32 species of herbs, 11 shrubs and 11 species of climbers). Soil samples were collected from 0-15 cm, 15-30 cm, 30-60 cm and 60-1 m and analysis of different soil parameter such as pH, bulk density, soil moisture, soil texture, soil organic carbon, available nitrogen, available phosphorus, available potassium, available micronutrients (Zn, Cu, Fe, Mn), soil microbial biomass carbon, carbon stock and Total Organic Carbon is in progress.
- In Sikkim centre soil samples were collected from different land use system at different depths (15cm, 30cm, 45cm, 60cm, and 1m) from the piloted site. Further analysis of nutrient content (N, P, K, soil texture, *etc*.) of the soil was done at ICAR for NEH Region Barapani, Umiam, Meghalaya laboratory to check the nutrient status of soil for further recommendation of nutrients in future
- Composite soil sampling of different land use in Arunachal Pradesh was done at different depths. The results of analysis are shown in **Table 1** and **Table 2**

Table 1: Soil properties in different land use pattern in Arunachal Pradesh Centre

Land use pattern	pH	EC	OC (%)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Jhum fallow	4	0.8	2.04	238	13	179
Forest	4.2	0.9	2.7	281	21	210
Guava	4.1	1.3	0.55	190	11	157
Khasi mandarin	4.5	1.1	0.85	272	14	126
Wet rice cultivation	4.4	1.2	2.09	270	20	196

Table 2: Spatial variation in soil chemical properties

Soil depth	Soil Organic Carbon	pH	Available Potassium	Available Phosphorus
0-15 cm	2.6	5.3	174.2	6.3
15-30 cm	2.6	5.5	209.4	5.1
30-45cm	1.9	5.3	155.4	3.7
45-60 cm	2.2	5.3	113.4	3.8
60-75 cm	2.3	5.0	87.6	4.9
75-90 cm	2.0	5.1	64.0	4.6

- In Manipur center soil samples were obtained from ten different land use system under three altitudes [low < 800 m (Orange Orchard (3 years old); Banana Orchard (3 years old); Vegetable cropping system (Tomato/Brinjal- Potato/Veg. pea); Rice - Fallow (ICAR Farm); Rice - Tomato (ICAR Farm), mid 800-1600 m (Improved Jhum (3 years); Pine forest (>10 years) and high altitudes > 1600 m (Kiwi orchard (4 years old); Tree bean

plantation (8 years) and Oak plantation (10 years)] from 6 soil depths (0.00-0.15 m, 0.15-0.30 m, 0.30-0.45 m, 0.45 -0.60 m, 0.60-0.75 m and 0.75 -1.00 m) and tested for its various soil physical, chemical and biological properties. The soil sample was collected on 22nd June, 2016. Among the 10 land use system, the highest soil C stock was found in Banana orchard (6502.5 t/ha) followed by Rice-fallow system (5908.2 t/ha) (**Figure 14**). The highest available N was recorded in Pine forest (439 kg/ha) followed by Rice- Fallow system (407 kg/ha). The available P was highest in Banana orchard (58 kg/ha) followed by Pine forest (18 kg/ha) and available K was also highest in Pine forest (487 kg/ha) followed by Kiwi orchard (473 kg/ha) (**Figure 15**)

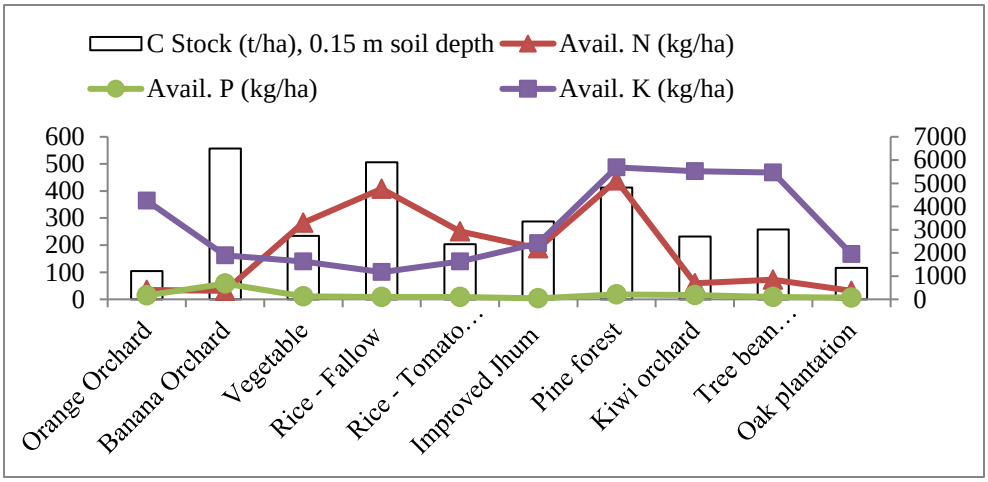


Figure 14: C stock, Available N, P and K under 10 different land use system

Similarly, among the 10 land use system, the maximum Fe was recorded in Rice fallow (140 mg/kg) followed by Rice Tomato (130 mg/kg) system; Mn was higher under Rice-Tomato (14 mg/kg) followed by improved *Jhum* (13 mg/kg); Cu was higher under Treebean (55 mg/kg) and Banana orchard (41 mg/kg); and Zn was higher under Banana orchard (8.66 mg/kg) followed by Oak plantation (6.26 mg/kg) (**Figure 10**).

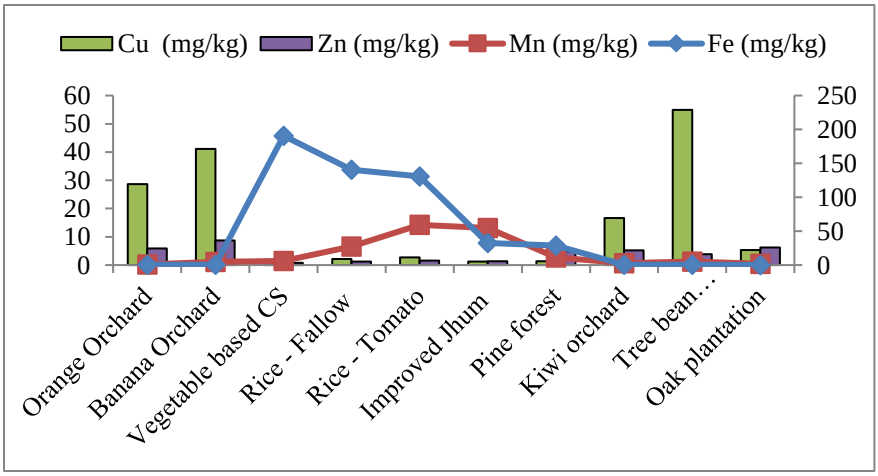


Figure 15: Available micronutrients under various land use system

- In Nagaland centre a total of 189 nos. of soil samples were collected from different land use system at different soil depths (0-20, 20-40 and 40-60cm) from 3 villages of Longleng block, 3 villages of Sakshi block and 1 village of Tamlu block. Soil samples from two (2) more villages of Tamlu block is yet to be collected. Soil analysis results for Pongchin and Mongtikang villages are provided in ***Annexure II*****.** The Land use systems used for soil collection are:
    - ✓ Jhum field (1st year)
    - ✓ Jhum field (2nd year)
    - ✓ Large cardamom based agro forestry system (4 year old)
    - ✓ Orange based farming system (15 year)
    - ✓ Jhum fallow (2 year)
    - ✓ Forest (more than 20 years)
- Soil and water loss: During 1 and half month, the soil loss recorded was 0.24 t/h at 37% slope in Chandel District, while 0.50 t/ha at 32 % slope of ICAR Langol Farm. The Run off was maximum at 37% slope (2.41%) as compared to 32% slope (1.67%) (**Table 3**)

Table 3: Runoff and water loss at Langol and Chandel

Place	Time period	Slope (%)	Texture			Total precipitation (mm)
			Sand (%)	Silt (%)	Clay (%)	
Langol	14th July to 30th August, 2016	37	52.7	15.3	32.0	267.1
Chandel		32	67.3	16.7	16.0	219

- **Seasonal outbreak and prevalence insect attack and diseases in the Monitoring areas and Pilot study area in Manipur centre:**
    - ✓ **Rice:** During the period under study incidence and prevalence of various diseases (**Figure 16**) on the crops grown by farmers was undertaken. In the paddy being cultivated at various altitudes leaf blast and neck blast disease was found to occur. In addition sheath rot, stem borer, Sheath blight, false smut, two horned caterpillar, Rice bug and brown plant hopper infestation was observed. At the pilot study site (Chandanpokpi village of Chandel District) rice fields were found infected by black bug and false smut
    - ✓ **Groundnut:** Infestation of early and late leaf spot and sclerotium rot (**Figure 17**) was recorded on groundnut at Chandanpokpi village of Chandel District
    - ✓ **Citrus:** Citrus plantations were surveyed in Nungba village of Tamenglong district. Citrus plantations were found infected with stink bug, grasshopper and bug (**Figure 18**)

Rice Black Bug

Rice Bug

Two horned Caterpillar

Brown plant

False Smut

Neck Blast

Sheath Blight

Stem Rot

Figure 16: Diseases prevalent in rice crops at pilot site in Manipur

Early leaf spot

Late leaf spot

Sclerotium rot

Figure 17: Diseases prevalent in groundnut at pilot site in Manipur

Stink bug

Grasshopper

Bug

Figure 18: Pest infections in citrus plant at Nungba village, Manipur

Table 4: Details of crop management practices at Umiam, Meghalaya

Sl. No.	Parameters	NPK Recommended dose		FYM + Farmer's practice		Control	
		Cultivar-1 (Mendri)	**Cultivar-2 (Shahsarang)**	**Cultivar-1 (Mendri)**	**Cultivar-2 (Shahsarang)**	**Cultivar-1 (Mendri)**	**Cultivar-2 (Shahsarang)**
1.	Cultivar	Local variety, main kharif	High yielding variety, lowland, late sowing, main crop	Local variety, main kharif	High yielding variety, lowland, late sowing, main crop	Local variety, main kharif	High yielding variety, lowland, late sowing, main crop
2.	Seed rate (kg/ha)	-	-	-	-	-	-
3.	Age of seedling at transplanting	40 days	30days	40 days	30days	40 days	30days
4.	No. of plants on hills	1	2	1	2	1	2
5.	No. of hills per m^2	25	25	25	25	25	25
6.	Date of transplanting	22/7/16	22/7/16	22/7/16	22/7/16	22/7/16	22/7/16
7.	Fertilizers – NPK rate (kg/ha)	80-60-40	80-60-40	18.6 kgs (3 plots)	18.6 kgs (3 plots)	-	-
8.	Fertilizer type	Urea, SSP, MOP	Urea, SSP & MOP	FYM	FYM	-	-
9.	Fertilizer application	Basal:50% N, 100% P & K; Tillering: 25% N; PI: 25%	Basal: 50% N, 100% P & K; Tillering: 25% N; PI: 25%	Basal	Basal	-	-
10.	Rainfall received (seed-seed)	-	-	-	-	-	-
11.	Duration of cultivar (seed-seed)	130-140 days	145-150 days	130-140 days	145-150 days	130-140 days	145-150 days
12.	Weed management	2 manual weeding	2 manual weeding	2 manual weeding	2 manual weeding	2 manual weeding	2 manual weeding
13.	Harvesting	Not yet harvested	Not yet harvested	Not yet harvested	Not yet harvested	Not yet harvested	Not yet harvested

Modelling and Simulation

- In order to generate data on popular rice cultivars for simulation and modeling, two rice cultivars (Mendri and Shahsarang) were introduced (**Figure 19**) at Umiam, Meghalaya. The experiment was taken up in three treatments *i.e*. Absolute control, FYM + farmers practice and NPK recommended dose and line sowing (**Table 4)**. Data on biomass and leaf area index (**Table 5**) of the growth stages of rice (**Figure 20, Figure 21**) has been collected. Data on the other remaining parameters are to be collected after the crops attain their physiological maturity. The collection and processing of database of model input parameters (weather/climate projection scenarios; soil, crops, management including field experimentation and survey *etc*.) is in progress

Figure 19: Transplanting of Mendri and Shahsarang rice variety at ICAR Umiam, Meghalaya

Table 5: Biomass and Leaf Area index (LAI) of Shahsarang and Menri rice variety

Variety	Treatment	Biomass (g/sq. m)		LAI	
		Transplanting	Tillering	Transplanting	Tillering
Shahsarang HYV	**FYM (Plot 1)**	2	95.5	0.034	1.48
	FYM (Plot 3)	2	123	0.034	1.996
	FYM (Plot 5)	2	80.75	0.034	1.34
	NPK (Plot 8)	2	92.25	0.034	1.402
	NPK (Plot 10)	2	87.75	0.034	1.435
	NPK (Plot 12)	2	82.5	0.034	1.211
	Control (Plot 13)	2	96.75	0.034	1.294
	Control (Plot 15)	2	8.25	0.034	1.116
	Control (Plot 17)	2	42	0.034	0.55
Menri Local variety	**FYM (Plot 2)**	3.25	93.25	0.052	1.402
	FYM (Plot 4)	3.25	53.25	0.052	0.905
	FYM (Plot 6)	3.25	69.75	0.052	1.009
	NPK (Plot 7)	3.25	81.5	0.052	1.046
	NPK (Plot 9)	3.25	89.25	0.052	1.363
	NPK (Plot 11)	3.25	105	0.052	1.346
	Control (Plot 14)	3.25	67.75	0.052	0.825
	Control (Plot 16)	3.25	78.75	0.052	1.038
	Control (Plot 18)	3.25	67	0.052	0.718

Figure 20: Tillering (left) and flowering (right) stages of Mendri and Shahsarang rice variety under the two nutrient management practices at ICAR Umiam,

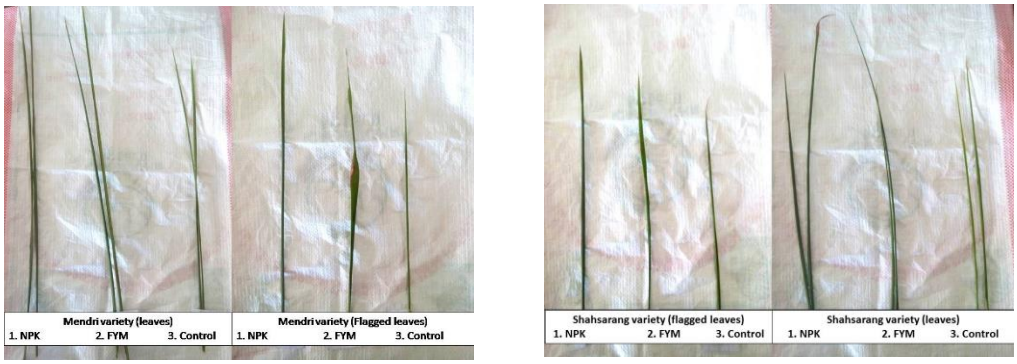


Figure 21: Mendri and Shahsarang leaves (flowering stage) under the different treatment methods

- Two rice varieties (V_1: Thoibi and V_2: RCM-9) were used for modelling and simulation studies in Manipur center with 3 nutrient management practices (N_0 = Absolute control, N_1 = Recommended dose and N_2 = Farmer's practice). The seeds were grown with 3 replications on 18 plots (Size: 4 mX3 m). The different datasets obtained are given below:

Table 6: Initial soil properties before transplanting Thoibi and RCM-9 rice varieties

Depth, cm	Soil texture (%)			B.D (g/cc)	SOC (%)	pH	Avail. K (kg/ha)	Avail. P (kg/ha)
	sand	**silt**	**clay**					
0-15	76.00	13.00	11.00	0.87	7.21	5.62	598.66	23.44
15-30	71.00	15.00	14.00	0.83	6.26	5.66	517.79	22.93
30-45	82.00	10.00	8.00	0.67	5.83	5.49	463.87	20.88
45-60	64.00	15.00	21.00	0.99	3.93	5.41	281.67	17.28
60-90	73.00	11.00	16.00	1.08	3.24	5.57	261.22	16.77
	63.00	19.00	18.00	1.10	2.73	5.41	211.95	16.77

Table 7: Details of crop management practices at Manipur

S. No.	Parameters	Rice Variety	
		Cultivar-1 (Thoibi)	**Cultivar-2 (RCM-9)**
1.	Cultivar	Local variety, main kharif	High yielding variety, lowland, late sowing, main crop and as second crop, fine sticky rice
2.	Seed rate (kg/ha)	60	40
3.	Age of seedling at transplanting	30 days	21 days
4.	No. of plants on hills	3	2
5.	No. of hills per m^2	50	33
6.	Date of transplanting	26/7/16 – 28/7/16	26/7/16 – 28/7/16
7.	Fertilizers – NPK rate (kg/ha)	120-0-0	60-40-30
8.	Fertilizer type	Urea	Urea, SSP & MOP
9.	Fertilizer application	Basal, PI	Basal: 50% N, 100% P & K; Tillering: 25% N; PI: 25%
10.	Rainfall received (seed-seed)	-	-
11.	Duration of cultivar (seed-seed)	140-145 days	135-140 days
12.	Weed management	1 manual weeding	2-3 manual weeding
13.	Harvesting	Not yet harvested	Not yet harvested

- In Arunachal Pradesh center the experiment has been started in *Kharif* season by conducting experiment on lowland paddy under different nutrient treatments (Control, Farmer's practice (Nitrogen @ 40 kg/ha), and recommended dose of fertilizer (80:60:40 kg/ha NPK)) with one improved rice variety (CAU R 1) and a local variety Mipun (Amtum). It has been laid out in RBD with three replications in plot (size: 3mx5m). Transplanting was done on 28th July, 2016 and the crop now is at maximum tillering stage to panicle initiation stage (**Figure 22**). Composite soil samples have been collected from the experimental site at different depths for analyzing different physico-chemical properties of the soil. Analysis of soil samples is under process

Figure 22: View of field at the time of transplanting (left) and current view of experimental plot (right) at Arunachal Pradesh

- An experiment has been set at Cocotilla, ICAR-Tripura centre on 29th July, 2016 with three replications, RBD design (Randomized block design) on two rice varieties (Popular local variety, Phyzum and improved high yielding variety, Gomati), spacing 20x 20 cm with four fertilizer doses- F1 (recommended dose of fertilizer), F2 (farmers practices), F3 (absolute control) and F4 (Integrated nutrient management). The experiment is still running and panicle initiation has been absorbed and about to reach at milking/dough stage (**Figure 23**). Soil samples from the experimental plots have been collected and analysis of samples is under progress

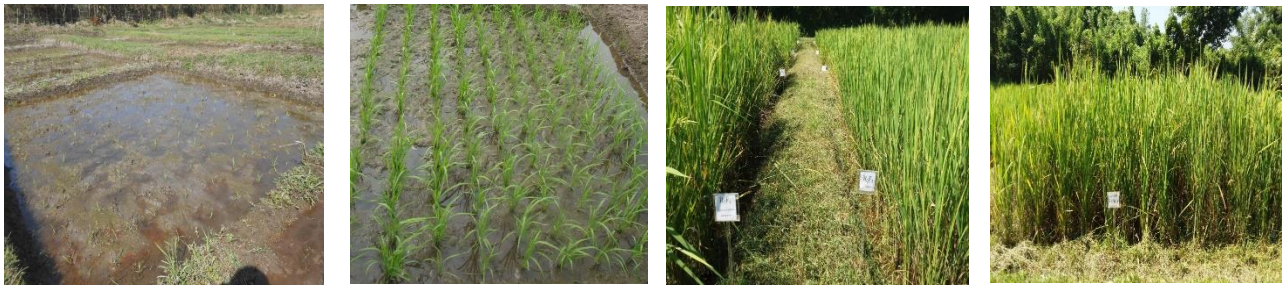


Figure 23: View of the experimental plot at different stages of experiment

Vulnerability assessment

Collection of district wise database for vulnerability analysis completed in Arunachal Pradesh.

Adaptation policy research

Synthesis of available research database information for problem identification in agriculture in Arunachal Pradesh under progress.

Pilot studies for revalidation

- Two *jalkunds* (capacity: 30,000 litres) at Mawthei village (**Figure 24**) at Santa Lynshing and Phlinshon Muktieh farms, 1 *jalkund* (capacity: 61,860 litres) at Chandanpokpi village and 1 *jalkund* at pilot site in Tripura have been established
- Fruit trees and multi-purpose trees were distributed to farmers of Mawthei village. 50 Guava, 30 Sohiong (*Padus napaulensis)*, 50 Sohshang (*Eleagnus latifolia)*, 20 Papaya (*Carica papaya*), 80 *Parkia sps* and 30 *Michaelia sp.,* were distributed to the farmers and demonstration was given for planting the fruit trees and multi- purpose tree saplings (**Figure 25**)
- Introduction of Rajma (**Figure 26**) and Black gram (**Figure 27**) and hands on training were given to the farmers of Mawthei village
- 4 kg radish seeds (variety Pusa Chetki) were distributed to the farmers of pilot village in Tripura
- During the month of July transplanting of paddy was done and line planting was initiated at Mawthei village

Figure 24: Jalkund constructed at the farmers field in Mawthei village

Figure 25: Planting of multipurpose trees at Mawthei village

Figure 26: Rajma field at Mawthei village

Figure 27: Distribution of black gram seeds

- During the month of July transplanting of paddy was done in various farmers' field from the nursery site at Timpyem, East Sikkim. After a month of paddy transplant (August) bunds were cleaned for sowing of soybean seed in order to utilize the bunds to generate extra income. Soybean being a leguminous crop helps to restore soil fertility as well as suppresses the weed growth
- Various cropping system at Timpyem under different land use has been implemented in farmers field such as rice-vegetable pea, maize-pahenlo dal-buckwheat, large cardamom-turmeric, large cardamom-ginger, maize-soybean, mandarin- vegetable, Alnus nepalensis- turmeric, guava-cowpea. This has been monitored at regular interval to check its proper growth and development and also to combat against disease and pest through proper management practices
- Two IFS models namely, Agri-Horti-Silvi-Livestock model (Toko palm- Banana/Khasi mandarin, vegetables, tuber crops-Jhum paddy, maize, pulses-Piggery) and Horti-fishery-Livestock-Vermicomposting (Banana-Fish-Piggery/poultry-vermicomposting) have been initiated at pilot site in Arunachal Pradesh

- Pigeon pea (UPAS -120) was sown on July 20th 2016 by four farmers at Chandanpokpi village and are expected to harvest in the month of Nov. Only basal dose of fertilizers 20: 20: 40 N: P: K, respectively were applied.
- Black gram (PU-31) was also demonstrated and sowing was done on 20th July, 2016 at Chandanpokpi village. Only basal dose of fertilizers 20: 20: 40 N: P: K, respectively were applied. Black gram was harvested on 17th Oct, 2016 and yield varied from 700 -760 kg/ha
- Rice variety R C Maniphou 9 (RCM-9) was sown and transplanted on July 15th 2016 at Chandanpokpi village. Fertilizers were applied as basal dose 50% N, 100% P & K. 25% N was applied at panicle initiation stage. Another 25% N was applied at tillering stage. Harvesting was done on 24th October 2016 and the yield are as follows:
    - ✓ 1st farmer : 4020 kg/ ha of paddy
    - ✓ 2nd farmer : 4040 kg/ha of paddy
    - ✓ 3rd farmer : 4200 kg/ha of paddy
    - ✓ 4th farmer : 4060 kg/ha of paddy
- Rice seeds of RC Maniphou-12 were harvested and the yield is as follows
    - ✓ 1st farmer: 900 kg/sangam (0.25 ha), 3.6t/ha
    - ✓ 2nd farmer: 750 kg/sangam (0.25 ha), 3t/ha
    - ✓ 3rd farmer: 870 kg/sangam (0.25 ha), 3.5t/ha
    - ✓ 4th farmer: 780 kg/sangam (0.25 ha),3.1t/ha
- For SRI, rice variety RC Maniphou 7 has been transplanted in 30 X 30 m^2 area and farmers harvested 865 kg paddy (9.611 t/ha) and 1790 kg of straw yield from 900 m^2 (19.88 t/ha) at Chandanpokpi village. SRI has also been introduced in the GObinda Thakur Para village of Tripura (**Figure 28**)

Figure 28: Intervention of System of Rice Intensification at farmer's field at pilot site in Tripura

- FLD on intercropping of legumes with cereals was held on 6th July 2016 at Chandanpokpi village. Maize seed Pusa Composite-3 along with cowpea seed, soybean and groundnut was demonstrated in one ha area. Fertilizer was applied at the rate 80:60:40 (N:P:K). Basal dose of 50% N and 100% P &K were applied. 50% N was applied when the maize reach Knee height stage. Yield obtained from base crop maize (Pusa Composite-3): Green pod- 3 t/ha (12000 pod approx). Yield obtained for cowpea as intercrop (strip): Could harvest green vegetable cowpea – 4t/ha. Soybean and Groundnut have not been harvested yet
- At Chandel district, one hillock was selected and on the base of the hill Banana and Lemon saplings was planted at a spacing 3m x 3m and on the top hill Parkia saplings were planted at a spacing 8m x 8m. In the middle maize, groundnut, ginger and rice been were planted. Furrow was made and top soil was mixed with NPK, Lime and furadon was also applied at the root zone of the sapling. After 2 months biofertilizer was applied
- Demonstration on composite fish rearing techniques have been initiated at Chandanpokpi village, Manipur. Fish fingerlings were stocked in the month of July, 2016 @7000 fingerlings/ha in the following compositions: Grass carp-100, Rohu-2300, Catla-2300, Common carp-1500, Bangana dero-800 fingerlings. Average initial weight of the fingerlings was 10.0 g. Present weight ranges from 60-80g. Obtained average weight gain @ 0.54g/day
- To promote the pulse production, the cultivation of Green gram, Black gram and Rajma/Kholar (local) were promoted to integrate under the IFS model at Hukphang village
- Hands on training for Black gram variety (KU 301) and Green gram variety (Pratap) under *Jhum* field (rice fallow) with 0.4 ha at Mongtikang village was provided to 7 farmers
- The cultivation of improved tomato varieties (MT 2 and MT 3) has been demonstrated in IFS Model owned by Shri. Angmet Phom at Hukphang village. Around the 0.1 ha of land used for the transplanting of tomato seedlings
- A poly house structure measuring size of 11m x 6.2 m has been constructed at IFS model under Protective cultivation for development of Flowers and Vegetables. The nursery bed preparation and irrigation system is yet to undertake. So far no crops has been sown
- 10 farmers were selected for promoting vegetable cultivation to increase the net cropping intensity and farm income of the Mizo farmers at Saihapui village (Kolasib district, Mizoram). 250 g HYV Bhindi (Purple long green) seeds were distributed to each farmer, cultivated over 500 m^2 area. Cost of cultivation of bhindi was Rs. 1800/- from 500m^2 against Rs. 1250/- from 500 m^2 for each farmer. Yield was about 310 kg/500m^2 against yield of traditional local landraces 80 kg/500m^2. Net income from this crop Rs. 10500/- from 500m^2 each farmer against Rs. 2050/- from 100m^2. Production as well as farm income was enhanced 3 times and 5 times respectively. The variety matured very early (110 days) as compared to local traditional variety (160 days)

- Raised and Sunken Bed technology was adopted to increase the cropping intensity, diversification, productivity and income. In lowland, raised and sunken bed of 1 m width each (1:1 ratio) was developed by cutting and filling method. The surface soil layer from area marked for sunken bed was removed and deposited on the adjacent area identified for raised bed to a height of about 50 cm. The raised beds were leveled in such a way that the 50 % of run-off water from half of the each raised bed will drain off into its intervening sunken beds, to promote inter-plot water harvesting. Raised beds height was maintained as per the requirement of the crops and varies from 40 to 60 cm. In previous year studies, rice + cowpea (**Figure 29**) was observed to be the most suitable combination for raised and sunken bed technology. Therefore, 10 farmers were selected to adopt rice + cowpea in raised and sunken beds respectively. 1 kg rice (Gomati) and 0.5 kg cowpea (YB 7) seeds were distributed to each farmer. Under rice mono cropping, farmer got 2.5 to 3.8 t/ha yield. In rice based cropping sequences in sunken beds, the rice productivity ranged from 3.52 to 4.29 t/ha with mean productivity of 3.77 t/ha. The productivity of cowpea green pods during *kharif* season ranged between 8.30 - 9.06 t/ha on raised beds with mean productivity 8.65 t/ha. The Rice Equivalent Yield (RYE) of Rice + Cowpea during *kharif* season ranged from 31.16 t/ha to 34.40 t/ha with mean

Figure 29: Crop diversification (rice + cowpea) using raised and sunken bed technology

productivity 32.60 t/ha. Cost of cultivation for rice + cowpea of each farmer was Rs. 6000/- for 600m^2 area. Net return of Rice + Cowpea during *kharif* season varied between Rs. 8,375/- to Rs. 10,500/- with mean net return of about Rs. 9,200/-. Production and income enhanced 10 times and 7 times as compared to rice mono-cropping

Capacity building and forecasting

- Training-cum-input support system program under integrated farming system for livelihood improvement was organized at Timpyem, East Sikkim on 1st September, 2016 by NOFRI, Tadong. 29 farmers attended the program. 500 Vanaraja chicks were distributed among the farmers

- An awareness training was conducted on 23rd August, 2016 at project site in Arunachal Pradesh. Various tips and know-hows about the improvement and livestock husbandry practices (pigs and poultry) were discussed between farmers and scientists. Total of 30 farmers attended the programme. In addition, free medicines such as antibiotics, anthelminthic and feed supplement were distributed
- A training programme was conducted on "Production & Cultivation Practices of Large Cardamom & Orange" for the farmers of Mongtikang village Nagaland. Around 27 farmers were attended the programme. At Hukphang village 2000 suckers of large cardamom were planted in four farmers' fields
- A day long programme on "Technology showcasing cum Farmer-Scientist Interaction" was conducted on 29th July, 2016 at Hukphang village Nagaland. Altogether 80 nos of farmers were attended the programme. During the technology showcasing, farm mechanization of tools and implements, models of backyard poultry & low cost piggery unit, farming system model, organic insect & pest management and cultivation practices of large cardamom have been shown. During Farmers'- Scientist interaction, mainly foorkey disease management in large cardamom, bio control of insect & pest in agricultural crop, pulses cultivation, marketing of agricultural produce and animal
- Thirty tribal women of Dirang were given hands on training on craft making and value addition of locally available resources like vegetables, food grains, meat and milk during a three-days, training-cum-awareness programme on "Empowerment of Tribal women through rural craft and value addition of locally available resources" from July 12-14, 2016
- A three days awareness-cum-training programme on "Fodder conservation to mitigate hungry gaps in highland animals" was organized on 1st-3rd July, 2016 for the highland farmers of Chug area of West Kameng. Farmers were educated on the importance of forage conservation for maintaining the livestock during the shortage of feed and fodders in harsh winter. During the programme other topics like housing, breeding, feeding, care and management, reproduction and diseases control of different categories of farm animals were deliberately discussed. Besides, field demonstration on various techniques of forage conservation like urea molasses enrichment of poor quality roughages, ensiling of forages, preparation of complete feed block (CFB) and their utility were described to the farmers. A total of fifty eight tribal farmers were benefitted through this programme. About 4115 numbers of complete feed block (CFBs) were also distributed among the tribal farmers to feed their livestock during feed scarcity period

ANNEXURE I

The following fish species have been identified and recorded from the Indus River:

- *Schizothorax richardsonii* (Gray, 1832)
- *Schizothoraichthys progastes* (McClelland, 1839)
- *Schizothoraichthys labiatus* (McClelland, 1842)
- *Schizothoraichthys esocinus* (Heckel, 1838)
- *Schizopygopsis Stoliczkae* (Steindachner, 1886)
- *Diptychus maculatus* (Steindachner, 1866)
- *Ptychobarbus conirostris* (Steindachner, 1866)
- *Crossocheilus latius diplocheilus* (Heckel, 1838)
- *Botia dayi* (Hora, 1878)
- *Cyprinus carpio communis* (Linnaeus, 1758)
- *Cyprinus carpio specularis* (Lacepede, 1758)
- *Glyptosternum reticulatum* (McClelland, 1842)
- *Glyptothorax kashmirensis* (Hora, 1923)
- *Salmo gairdnerii gairdnerii* (Richardson, 1836)
- *Salmo trutta fario* (Linnaeus, 1758)
- *Nemacheilus botia* (Hamilton Buchanan, 1822)
- *Nemacheilus prashari* (Hora, 1933)
- *Nemacheilus arafi* (Mirza Banarescu, 1981)
- *Nemacheilus fascimaculatus* (Mirza Nalbant, 1981)
- *Triplophysa yasinensis* (Alock, 1898)
- *Triplophysa gracilis* (Day, 1876)
- *Triplophysa tenuicauda* (Steindachner, 1866)
- *Triplophysa microps* (Steindachner, 1866)

ANNEXURE II

Soil sampling sites with global positioning system (GPS), soil reaction (pH) and electrical conductivity (EC) of the selected ecosystem

Sampling site	Sampling site position	Mean sea level (m)	Soil reaction (pH)			Electrical conductivity (EC- µs/cm)		
			0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
1	N $29^0$33'48.3" E $079^0$35' 42.6"	1178	6.29	6.47	6.34	586.0	152.9	169.0
2	N $29^0$33'53.2" E $079^0$36'03.1"	1116	6.66	6.75	6.70	918.0	240.0	277.0
3	N $29^0$33'47.5" E $079^0$35'42.1"	1173	6.36	6.60	6.62	423.0	147.3	103.4
4	N $29^0$33'48.1" E $079^0$35'41.2"	1170	6.43	6.53	6.56	243.0	146.2	121.5
5	N $29^0$33'51.5" E $079^0$35'43.5"	1166	5.81	5.26	5.17	188.5	173.5	178.2
6	N $29^0$33'48.7" E $079^0$35'41.3"	1169	6.73	6.78	6.81	232.0	140.5	69.4
7	N $29^0$33'50.7" E $079^0$35'44.9"	1173	6.48	6.45	6.44	206.0	93.3	76.3
8	N $29^0$33'51.5" E $079^0$35'43.5"	1166	5.67	5.68	5.53	890.3	887.0	642.1
9	N $29^0$33'51.2" E $079^0$35'41.8"	1177	6.80	6.75	6.87	244.0	183.9	94.9
10	N $29^0$33'49.7" E $079^0$35'53.7"	1170	7.06	7.19	6.98	268.0	71.8	95.7
11	N $29^0$33'51.4" E $079^0$35'43.1"	1169	6.40	6.57	6.88	583.0	471.0	223.0
12	N $29^0$33'59.4" E $079^0$35'52.1"	1156	5.70	6.21	6.17	502.0	226.0	347.0
13	N $29^0$33'59.4" E $079^0$35'52.1"	1136	6.30	6.83	6.92	861.0	186.6	208.0
14	N $29^0$33'59.4" E $079^0$35'52.53"	1160	6.16	6.54	6.63	512.0	323.0	358.0

15	N $29^0$33’49.1” E $079^0$35’53.1”	1136	6.36	6.68	6.85	692.0	311.0	249.0
16	N $29^0$33’59.9” E $079^0$35’54.5”	1180	6.12	6.26	6.44	264.0	237.0	170.7
17	N $29^0$33’48.3” E $079^0$35’55.0”	1163	6.88	7.02	7.05	263.0	146.1	59.3
18	N $29^0$33’51.2” E $079^0$35’41.8”	1175	6.86	6.95	7.07	281.0	153.7	80.8
19	N $29^0$33’48.9” E $079^0$35’55.1”	1170	5.20	5.70	5.51	814.5	698.5	400.2
20	N $29^0$33’50.7” E $079^0$35’44.9”	1161	6.10	6.13	6.34	383.0	411.0	392.0
21	N $29^0$33’48.0” E $079^0$35’42.4”	1174	6.55	6.68	6.65	443.0	210.0	108.9
22	N $29^0$33’48.9” E $079^0$35’55.1”	1169	6.23	6.67	6.59	646.0	76.5	193.0
23	N $29^0$33’49.4” E $079^0$35’41.9”	1172	6.78	6.84	6.89	251.0	205.0	121.8
24	N $29^0$33’49.7” E $079^0$35’43.4”	1166	6.82	6.84	6.32	345.0	306.0	866.0
25	N $29^0$33’51.4” E $079^0$36’01.6”	1199	7.20	7.16	6.99	247.0	230.0	445.0
26	N $29^0$33’51.6” E $079^0$36’03.1”	1201	7.15	7.36	7.70	121.4	88.3	137.5
27	N $29^0$33’52.7” E $079^0$36’03.5”	1206	6.13	6.45	7.55	275.0	187.0	411.0
28	N $29^0$33’52.3” E $079^0$36’02.9”	1202	6.77	6.29	6.90	283.0	208.0	230.0
29	N $29^0$33’52.7” E $079^0$36’01.7”	1210	7.05	7.12	7.01	107.3	101.4	223.0
30	N $29^0$33’49.7” E $079^0$35’54.6”	1189	6.36	6.57	6.52	350.0	200.0	195.7
31	N $29^0$33’50.8” E $079^0$35’55.4”	1194	6.85	6.99	7.03	279.0	133.5	78.8
32	N $29^0$33’53.1” E $079^0$36’01.1”	1211	6.50	6.78	6.82	476.0	225.0	171.7
33	N $29^0$33’52.7” E $079^0$36’01.7”	1218	6.66	6.87	6.89	253.0	158.4	157.2

34	N $29^0$33’52.2” E $079^0$36’00.5”	1203	6.83	7.04	6.84	222.0	51.9	62.3
35	N $29^0$33’51.4” E $079^0$36’01.6”	1210	6.99	6.78	6.84	432.0	365.0	285.0
36	N $29^0$33’51.9” E $079^0$36’55.7”	1191	6.25	6.32	6.64	580.0	551.0	348.0
37	N $29^0$33’50.4” E $079^0$36’01.3”	1189	6.61	7.05	7.09	549.0	215.0	176.0
38	N $29^0$33’52.5” E $079^0$36’02.1”	1208	6.76	6.74	6.97	617.0	581.0	324.0
39	N $29^0$33’52.7” E $079^0$36’01.7”	1208	7.30	7.11	6.98	427.0	343.0	410.0
40	N $29^0$33’51.7” E $079^0$35’43.4”	1168	6.46	6.81	6.20	754.0	214.0	252.0
41	N $29^0$33’53.2” E $079^0$36’03.1”	1216	6.42	7.28	7.35	866.0	512.0	480.0
42	N $29^0$33’51.2” E $079^0$35’55.7”	1191	7.13	7.43	7.39	212.0	110.1	109.2
43	N $29^0$33’49.7” E $079^0$35’54.6”	1204	6.30	6.37	6.68	612.0	485.9	379.0
44	N $29^0$34’13.0” E $079^0$35’00.7”	1678	6.60	6.79	6.83	271.0	163.8	165.3
45	N $29^0$34’15.1” E $079^0$34’57.2”	1711	5.24	5.95	6.05	405.0	891.0	457.0
46	N $29^0$34’10.5” E $079^0$34’59.5”	1661	6.16	6.25	6.34	171.7	98.8	88.8
47	N $29^0$34’48.49” E $079^0$34’59.2”	1700	7.12	6.79	6.35	123.9	104.5	325.0
48	N $29^0$34’10.7” E $079^0$35’59.9”	1650	5.94	5.79	5.54	316.0	420.0	996.0
49	N $29^0$34’20.6” E $079^0$34’57.6”	1701	6.14	6.20	6.39	383.0	274.0	91.9
50	N $29^0$33’44.1” E $079^0$35’29.8”	1258	6.02	6.21	6.04	259.0	93.9	101.6
51	N $29^0$33’46.1” E $079^0$35’14.7”	1368	6.57	6.56	6.60	486.0	266.0	136.5
52	N $29^0$33’42.3” E $079^0$35’29.2”	1254	5.94	5.86	6.11	405.0	317.0	105.6

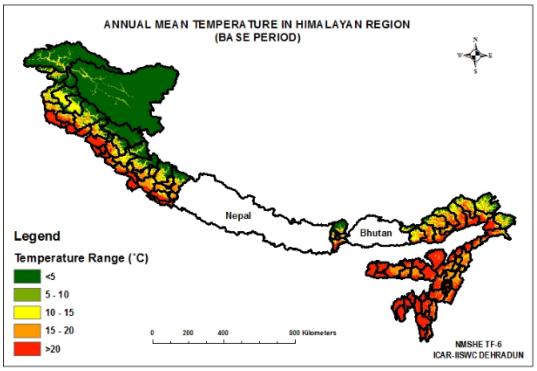
53	N $29^0$33’41.9” E $079^0$35’29.4”	1256	6.58	6.67	7.02	288.0	341.0	366.0
54	N $29^0$33’432” E $079^0$35’29.6”	1252	7.47	6.66	6.78	414.0	145.4	79.4
55	N $29^0$33’45.1” E $079^0$35’28.4”	1256	6.44	6.54	6.71	224.0	107.7	55.3
56	N $29^0$33’44.3” E $079^0$35’27.6”	1275	6.10	6.15	5.92	340.0	123.5	202.0
57	N $29^0$33’45.3” E $079^0$35’42.58”	1277	6.22	5.97	6.26	856.0	463.0	119.1
58	N $29^0$33’51.0” E $079^0$35’14.6”	1384	6.68	6.71	6.85	343.0	185.0	87.0
59	N $29^0$33’48.0” E $079^0$35’19.2”	1341	6.84	6.74	6.81	274.0	209.0	107.3
60	N $29^0$33’44.6” E $079^0$35’19.0”	1342	7.39	7.09	7.27	945.3	601.2	400.3
61	N $29^0$33’55.2” E $079^0$35’32.4”	1269	6.46	6.87	6.98	766.0	343.0	394.0
62	N $29^0$33’55.0” E $079^0$35’32.1”	1283	5.67	6.21	5.89	679.2	419.0	938.0
63	N $29^0$33’52.2” E $079^0$35’30.6”	1281	6.76	6.99	6.96	254.0	68.1	42.6
64	N $29^0$33’52.3” E $079^0$35’31.6”	1260	6.48	6.52	6.66	333.0	269.0	144.8
65	N $29^0$33’53.5” E $079^0$35’31.2”	1278	5.78	6.15	6.14	818.0	357.0	341.0
66	N $29^0$33’54.2” E $079^0$35’32.8”	1276	6.64	6.62	6.83	234.0	126.2	71.3
67	N $29^0$33’51.2” E $079^0$35’31.2”	1272	6.33	6.76	6.83	575.0	206.0	224.0
68	N $29^0$33’52.4” E $079^0$35’31.3”	1275	7.00	7.15	7.13	273.0	191.5	123.6
69	N $29^0$33’54.9” E $079^0$35’31.6”	1286	6.19	6.22	6.67	396.0	310.0	191.6
70	N $29^0$33’53.5” E $079^0$35’32.5”	1271	6.60	6.64	6.53	278.0	207.0	174.2
71	N $29^0$33’53.5” E $079^0$35’29.9”	1297	5.90	6.17	6.26	875.5	610.3	314.8

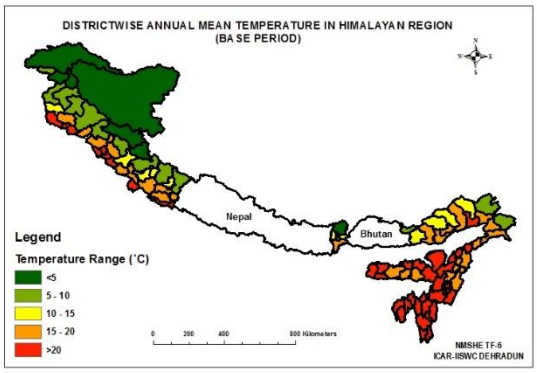
72	N $29^0$33’54.2” E $079^0$35’32.3”	1276	6.84	7.05	6.89	328.0	305.0	246.0
73	N $29^0$33’53.2” E $079^0$35’31.2”	1281	6.17	6.38	6.60	516.0	196.0	28.8
74	N $29^0$33’51.8” E $079^0$35’31.3”	1276	6.79	6.38	6.49	90.4	208.0	116.9
75	N $29^0$33’53.1” E $079^0$35’31.8”	1275	6.20	6.40	6.44	463.0	97.8	158.8
76	N $29^0$33’51.3” E $079^0$35’29.2”	1285	6.57	6.74	7.05	467.0	246.0	164.8
77	N $29^0$33’44.5” E $079^0$35’29.5”	1339	5.70	5.73	5.79	441.0	280.0	248.0
78	N $29^0$33’49.2” E $079^0$35’15.0”	1381	6.08	6.32	6.51	758.5	563.0	321.0
79	N $29^0$33’51.0” E $079^0$35’24.4”	1305	6.57	6.65	6.75	99.0	93.3	26.3
80	N $29^0$33’45.4” E $079^0$35’19.3”	1350	5.54	5.80	6.03	137.0	84.0	74.0
81	N $29^0$33’51.6” E $079^0$35’15.2”	1387	6.12	6.25	6.18	418.0	173.7	198.0
82	N $29^0$33’49.1” E $079^0$35’19.1”	1342	6.37	6.58	6.45	245.0	97.3	113.2
83	N $29^0$33’49.9” E $079^0$35’20.2”	1338	5.91	6.08	6.11	420.0	194.2	143.0
84	N $29^0$33’47.5” E $079^0$35’16.9”	1369	5.86	5.93	5.77	179.2	66.4	122.4
85	N $29^0$33’47.8” E $079^0$35’19.2”	1348	5.43	5.84	6.08	512.0	221.0	122.4
86	N $29^0$33’52.5” E $079^0$35’15.1”	1388	5.85	6.10	6.33	376.0	385.0	224.0
87	N $29^0$33’53.5” E $079^0$35’27.1”	1306	6.48	6.35	6.27	181.2	374.0	499.0
88	N $29^0$33’50.1” E $079^0$35’28.1”	1298	7.15	7.39	7.36	254.0	83.8	69.7
89	N $29^0$33’51.4” E $079^0$35’29.1”	1284	6.74	6.75	6.72	152.2	145.3	143.4
90	N $29^0$33’52.9” E $079^0$35’27.1”	1305	6.02	6.27	5.97	288.0	76.3	247.0

91	N $29^0$33’52.1” E $079^0$35’26.6”	1302	6.57	6.73	6.76	436.0	323.0	360.0
92	N $29^0$33’5.29” E $079^0$35’29.5”	1325	6.22	6.56	6.89	892.0	264.0	96.3
93	N $29^0$33’50.3” E $079^0$35’28.1”	1301	7.05	7.11	7.15	535.0	388.0	222.0
94	N $29^0$33’52.6” E $079^0$35’28.8”	1296	6.48	6.76	6.96	895.0	310.0	140.1
95	N $29^0$33’53.2” E $079^0$35’28.6”	1298	6.92	7.03	7.17	413.0	430.0	184.3
96	N $29^0$33’52.4” E $079^0$35’28.5”	1294	5.79	5.99	6.02	306.0	113.7	122.1
97	N $29^0$33’50.7” E $079^0$35’28.3”	1302	6.00	6.31	6.42	746.0	221.0	136.2
98	N $29^0$33’53.7” E $079^0$35’23.4”	1332	6.13	6.30	6.46	317.0	89.2	64.7
99	N $29^0$33’59.2” E $079^0$35’22.0”	1334	5.95	5.98	6.10	266.0	183.6	94.8
100	N $29^0$33’54.2” E $079^0$35’24.4”	1325	6.36	6.52	6.58	382.0	162.5	945.0
101	N $29^0$33’54.2” E $079^0$35’24.8”	1334	6.64	6.84	6.97	618.0	466.0	118.3
102	N $29^0$33’51.3” E $079^0$35’30.7”	1271	5.97	6.06	6.41	590.0	350.0	125.2
103	N $29^0$33’47.0” E $079^0$35’29.8”	1255	5.71	5.91	6.24	732.0	285.0	109.9
104	N $29^0$33’51.2” E $079^0$35’22.2”	1333	6.09	6.28	6.51	287.0	147.5	67.0
105	N $29^0$33’19.3” E $079^0$35’22.5”	1333	7.06	6.89	6.85	116.3	145.1	124.1
106	N $29^0$33’52.9” E $079^0$35’23.4”	1331	6.56	6.69	6.72	305.0	166.2	85.9
107	N $29^0$33’46.7” E $079^0$35’17.2”	1355	4.86	5.44	5.89	485.0	324.0	59.3
108	N $29^0$33’46.0” E $079^0$35’23.6”	1305	5.77	5.72	5.99	408.0	341.0	94.4

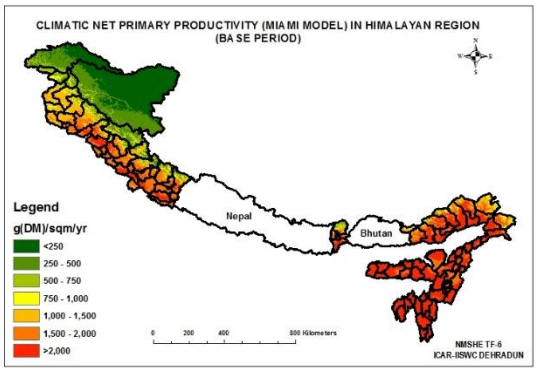
ANNEXURE III

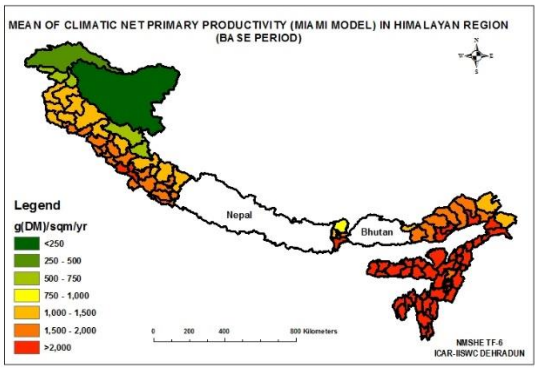
Following maps were created from the modelling and simulation inputs to assess the vulnerability of the Indian Himalayan Region:



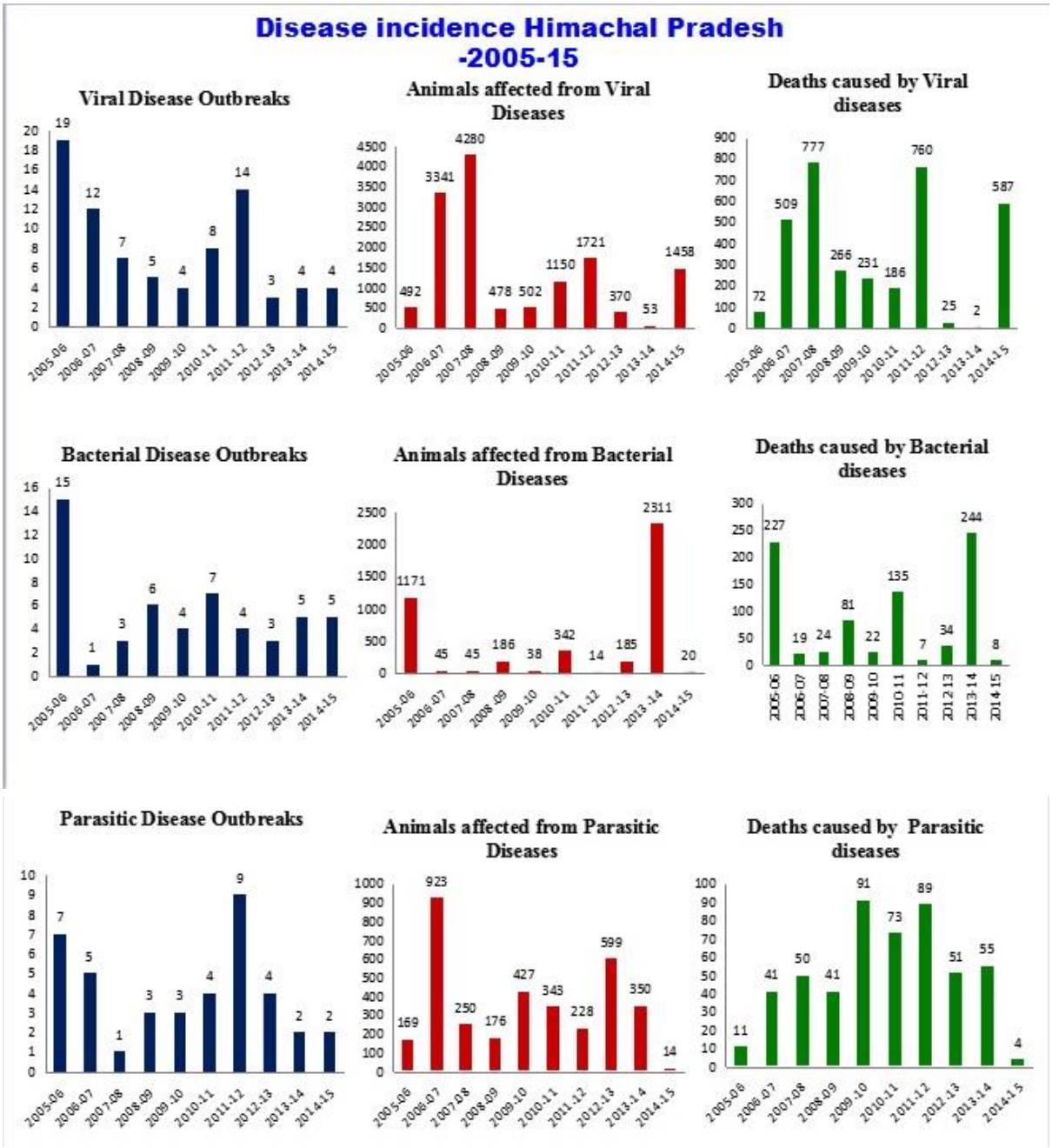


Annual Mean Temperature of Himalayan region (Bioclimatic parameter 1)





Climatic net primary productivity (MIAMI model) of Himalayan region


Disease incidence Himachal Pradesh
-2005-15
Viral Disease Outbreaks
19 12 7 5 4 8 14 3 4 4
Animals affected from Viral Diseases
492 3341 4280 478 502 1150 1721 370 53 1458
Deaths caused by Viral diseases
72 509 777 266 231 186 760 25 2 587
Bacterial Disease Outbreaks
15 1 3 6 4 7 4 3 5 5
Animals affected from Bacterial Diseases
1171 45 45 186 38 342 14 185 2311 20
Deaths caused by Bacterial diseases
227 19 24 81 22 135 7 34 244 8
Parasitic Disease Outbreaks
7 5 1 3 3 4 9 4 2 2
Animals affected from Parasitic Diseases
169 923 250 176 427 343 228 599 350 14
Deaths caused by Parasitic diseases
11 41 50 41 91 73 89 51 55 4
2005-06 2006-07 2007-08 2008-09 2009-10 2010-11 2011-12 2012-13 2013-14 2014-15

Annexure V

Soil Samples analysis report at Pongching and Mongtikang village, Nagaland

S. No.	Land Use	Name of the farmer	GPS reading			Soil Depth	pH	EC	SOC (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)	Avail. S (kg/ha)
			Latitude	Longitude	Altitude (m msl)								
Pongching village													
1	Jhum 1st year	Namtin	26.45	94.76	536	0-20	5.45	0.09	1.76	395.14	73.90	197.12	53.48
2						20-40	5.35	0.05	1.05	382.59	12.31	266.56	91.28
3						40-60	5.28	0.06	0.29	370.05	15.01	250.88	49.56
4	Jhum 1st year	Angkam	26.45	94.76	530	0-20	5.50	0.07	0.88	420.22	12.31	286.72	96.88
5						20-40	5.66	0.05	1.76	351.23	28.87	271.04	105.84
6						40-60	4.95	0.07	0.59	338.69	92.37	280.0	136.64
7	Horticulture based (L. cardamom)	Chonglang	26.45	94.76	493	0-20	5.35	0.08	1.46	363.78	13.46	134.4	98.28
8						20-40	5.00	0.03	0.41	326.14	11.55	116.48	73.08
9						40-60	5.35	0.04	0.88	307.33	6.93	103.04	41.16
10	Horticulture based (L. cardamom)	Longli	26.51	94.73	976	0-20	5.01	0.05	1.2	413.95	98.14	219.52	124.88
11						20-40	5.64	0.03	1.32	338.69	70.43	208.32	105.28
12						40-60	5.25	0.20	1.02	319.87	12.31	188.16	92.68
13	Horticulture based (Orange)	Longkong	26.51	94.73	558	0-20	5.10	0.04	1.9	482.94	10.39	141.12	112.28
14						20-40	5.05	0.04	1.2	420.22	6.93	107.52	87.64
15						40-60	5.08	0.03	0.73	219.52	9.24	58.24	62.44
16	Horticulture based (Orange)	Chonglang	26.51	94.73	493	0-20	5.34	0.11	1.32	432.77	11.15	172.48	75.04
17						20-40	5.20	0.05	1.11	395.14	24.25	212.8	101.64
18						40-60	5.25	0.05	0.73	301.06	68.12	277.76	46.48

19	Natural Fallow	Hungkam	26.46	94.75	526	0-20	5.60	0.60	0.97	526.85	138.56	275.52	110.6
20						20-40	5.35	0.06	0.59	451.58	86.60	246.4	92.96
21						40-60	5.15	0.03	1.46	351.23	17.32	190.4	46.2
22	Natural Fallow	Angpo	26.46	94.75	530	0-20	5.41	0.04	2.55	476.67	127.01	219.52	124.32
23						20-40	5.40	0.04	0.73	370.05	10.39	239.68	64.96
24						40-60	5.16	0.03	0.53	420.22	3.46	62.72	117.32
25	Forest		26.46	94.75	540	0-20	6.60	0.14	1.08	602.11	43.88	103.04	55.44
26						20-40	6.30	0.12	1.35	439.04	2.31	89.6	50.96
27						40-60	6.25	0.1	0.67	344.96	5.77	69.44	85.96
28	Jhum 2nd year	Baushi	26.45	94.73	721	0-20	4.80	0.09	2.2	420.22	8.08	120.96	42.00
29						20-40	4.75	0.08	1.02	388.86	34.64	82.88	125.72
30						40-60	4.65	0.07	1.58	370.05	4.62	174.72	71.96
31	Jhum 2nd year	Panglu	26.45	94.73	647	0-20	4.80	0.06	0.73	407.68	92.37	224	129.36
32						20-40	4.85	0.03	1.46	275.97	34.64	38.08	135.8
33						40-60	5.06	0.04	0.44	269.7	23.09	161.28	89.32
	Mongtikang village												
34	Jhum 1st year	Wanlim	26.51	94.73	840	0-20	4.75	0.18	1.61	457.86	76.21	235.2	104.16
35						20-40	5.1	0.03	0.88	351.23	34.64	201.6	87.64
36						40-60	4.8	0.03	0.5	344.96	46.19	116.48	65.52
37	Jhum 1st year	Namang	26.51	94.73	960	0-20	5.11	0.29	1.61	370.05	33.48	275.52	85.68
38						20-40	4.85	0.07	1.17	326.14	117.77	246.4	59.92
39						40-60	5.16	0.05	1.26	376.32	105.07	203.84	80.36
40	Jhum 2nd year	Moba	26.31	94.73	760	0-20	4.75	0.05	2.37	282.24	5.77	103.04	55.72
41						20-40	4.5	0.06	1.17	238.34	10.39	53.76	86.8
42						40-60	4.53	0.09	2.05	225.79	23.09	64.96	44.8
43	Jhum 2nd year	Lima	26.31	94.64	532	0-20	5.34	0.1	3.98	376.32	10.39	259.84	55.16
44						20-40	4.8	0.06	1.79	338.69	24.25	226.24	58.24
45						40-60	4.65	0.05	1.02	244.61	10.39	210.56	76.72

46	Horticulture based (L. cardamom)	N. Lima	26.31	94.73	569	0-20	5.11	0.05	2.49	395.14	3.46	67.2	112.84
47						20-40	5.1	0.03	1.84	432.77	5.77	60.48	91.84
48						40-60	5.15	0.03	1.46	200.7	23.09	22.4	40.88
49	Horticulture based (Orange)	Manye	26.46	94.73	684	0-20	5.08	0.2	2.43	439.04	69.28	255.36	100.24
50						20-40	5.05	0.07	1.52	407.68	80.82	219.52	70.28
51						40-60	5.11	0.07	1.46	363.78	32.33	280	45.64
52	Horticulture based (Orange)	Chulen	26.46	94.73	674	0-20	4.93	0.05	1.67	482.94	9.24	91.84	96.88
53						20-40	4.9	0.04	1.43	451.58	10.39	33.6	84.28
54						40-60	4.98	0.04	1.02	395.14	32.33	78.4	80.92
55	Natural Fallow	Wongto	26.46	94.73	499	0-20	4.99	0.03	1.23	351.23	48.49	201.6	138.6
56						20-40	4.98	0.03	1.35	332.42	35.79	188.16	120.12
57						40-60	5.25	0.24	0.44	307.33	24.25	163.52	70.56
58	Natural Fallow	Ngakusupong	26.47	94.72	499	0-20	4.94	0.04	0.73	664.83	3.46	159.04	62.44
59						20-40	5.15	0.02	1.05	476.67	2.31	100.8	110.88
60						40-60	4.99	0.03	0.88	213.25	92.37	80.64	108.08
61	Forest		26.47	94.72	560	0-20	5.16	0.05	1.9	470.4	32.33	181.44	68.88
62						20-40	5.1	0.03	0.7	382.59	2.31	163.52	59.92
63						40-60	5.7	0.03	0.59	288.51	24.25	125.44	46.48