



Enabling Adaptation in Himachal Himalayas

Paving the way for
Gender Responsive Adaptation

Local Climate Vulnerability
Capacity Assessment at Village Level



Report by:

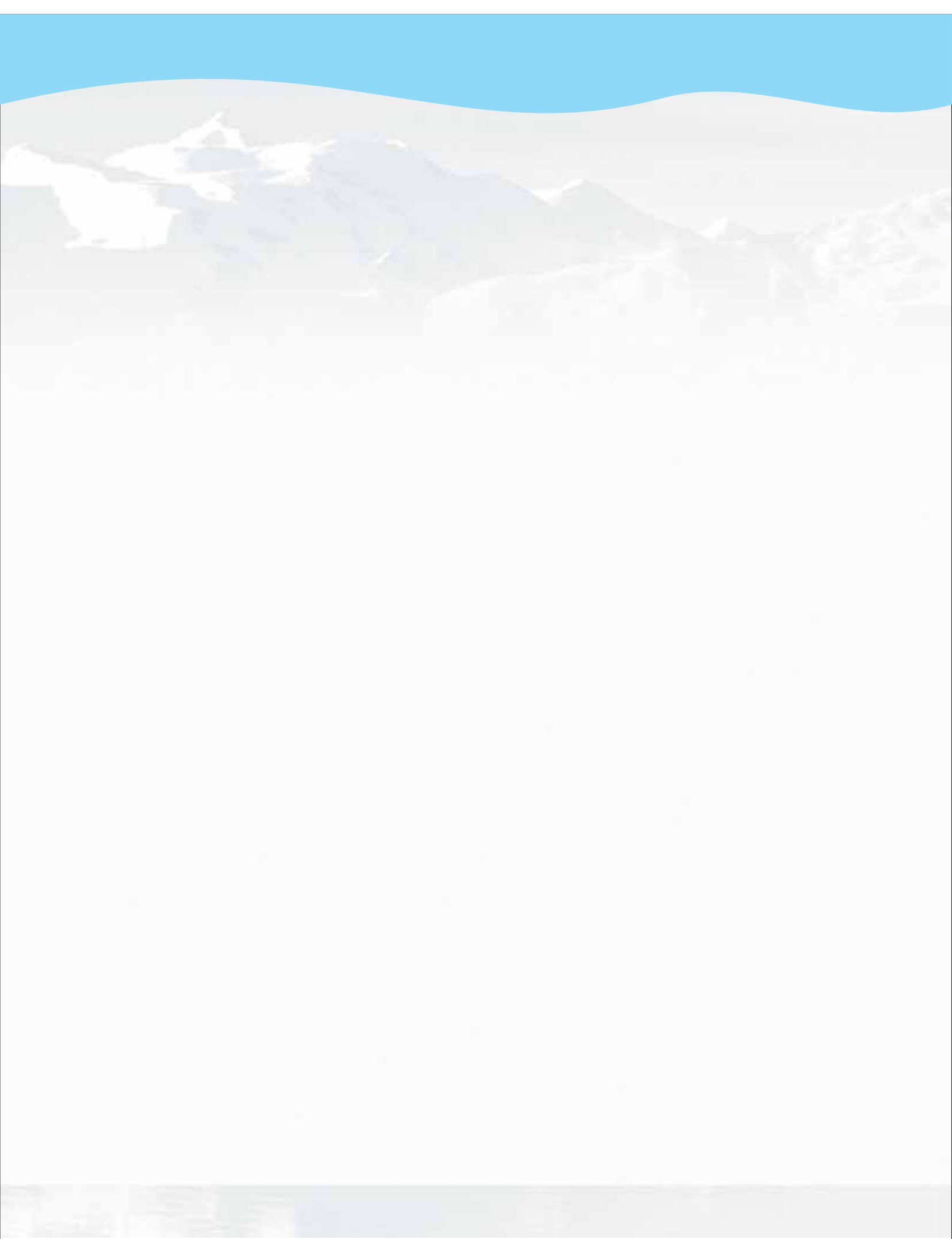
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मुख्य मन्त्री
हिमाचल प्रदेश
शिमला-171002



जय राम ठाकुर

सन्देश

हमारे गांव हमारी सभ्यता के परिचायक हैं। मेरा व्यक्तिगत रूप में मानना है कि अगर हमारी परम्पराएं जीवित रहती हैं तो हम काफी हद तक जलवायु परिवर्तन की स्थिति से लड़ने में सक्षम होंगे। एक ऐसी व्यवस्था की आवश्यकता है जो हमारे किसानों-बागवानों के प्रति पूरी निष्ठा से कार्य करे। जलवायु परिवर्तन से आज हमारी पारम्परिक जीवन शैली बुरी तरह से प्रभावित हुई है। रहन-सहन में बहुत बदलाव आया है। सच कहें तो पश्चिमी जीवन से प्रभावित हम खुद ही अपनी सभ्यता, परम्परा से दूर होते जा रहे हैं।

गांव में गरीब, कमजोर किसानों को कड़ी मेहनत कर अपनी आजीविका सुनिश्चित करनी पड़ती है। सरकार के विभिन्न कार्यक्रम इन किसानों तक आवश्यकता के अनुसार पहुंचें, ये मेरी सरकार की प्राथमिकता है।

मुझे यह जानकर प्रसन्नता हुई कि राज्य पर्यावरण विभाग गांव के स्तर पर महिला किसानों की बात को समझते हुए उन्हें जलवायु परिवर्तन अनुकूलन की ओर प्रेरित कर रहा है। धमून पंचायत की महिला किसानों की जलवायु परिवर्तन से संवेदनशीलता कैसे कम की जाए इस ओर कार्य किया गया जो सराहनीय है। इस पंचायत की महिला किसानों ने जिस तरह से अपनी पारम्परिक खेती को वापिस उगाना शुरू किया है यह अपने आप में एक मिसाल है।

मैं सभी महिला किसानों को इस कार्यक्रम में अपनी भागीदारी निभाने के लिए धन्यवाद देता हूँ और आशा करता हूँ कि ये किसान बाकी स्थानों में भी जा कर अन्य महिला किसानों को जलवायु परिवर्तन अनुकूलन की ओर जागरूक करें।

मैं आशा करता हूँ कि पर्यावरण विभाग द्वारा जारी रिपोर्ट काफी ज्ञानवर्धक साबित होगी। मैं पर्यावरण विभाग के अधिकारियों तथा वैज्ञानिकों को इस प्रयास के लिए बधाई देता हूँ।


(जय राम ठाकुर)

**Additional Chief Secretary-cum-
Principal Secretary to Chief Minister**
Himachal Pradesh - 171002



Manisha Nanda, IAS

MESSAGE

There is already evidence of impacts of climate change on the local economy, with clear signs that the biodiversity, agriculture and water are all getting affected, as are health and livelihoods especially for women resulting in increasing level of stresses. Climate Change is already affecting State's economic output and, therefore State's long term development prospects. The Himalayan region is particularly vulnerable to climate change and variably due to our reliance on sectors like Agriculture, Horticulture that involves food security are sensitive to Climate change such as forestry, and energy production. More than 80% of the disaster in Himalayas are considered to be climate induced/ related. Failed crops as a result of heat and drought, stress, floods in different valleys are felt severely. There is a need to prepare the local community to adapt the climate change and start dealing with it effectively.

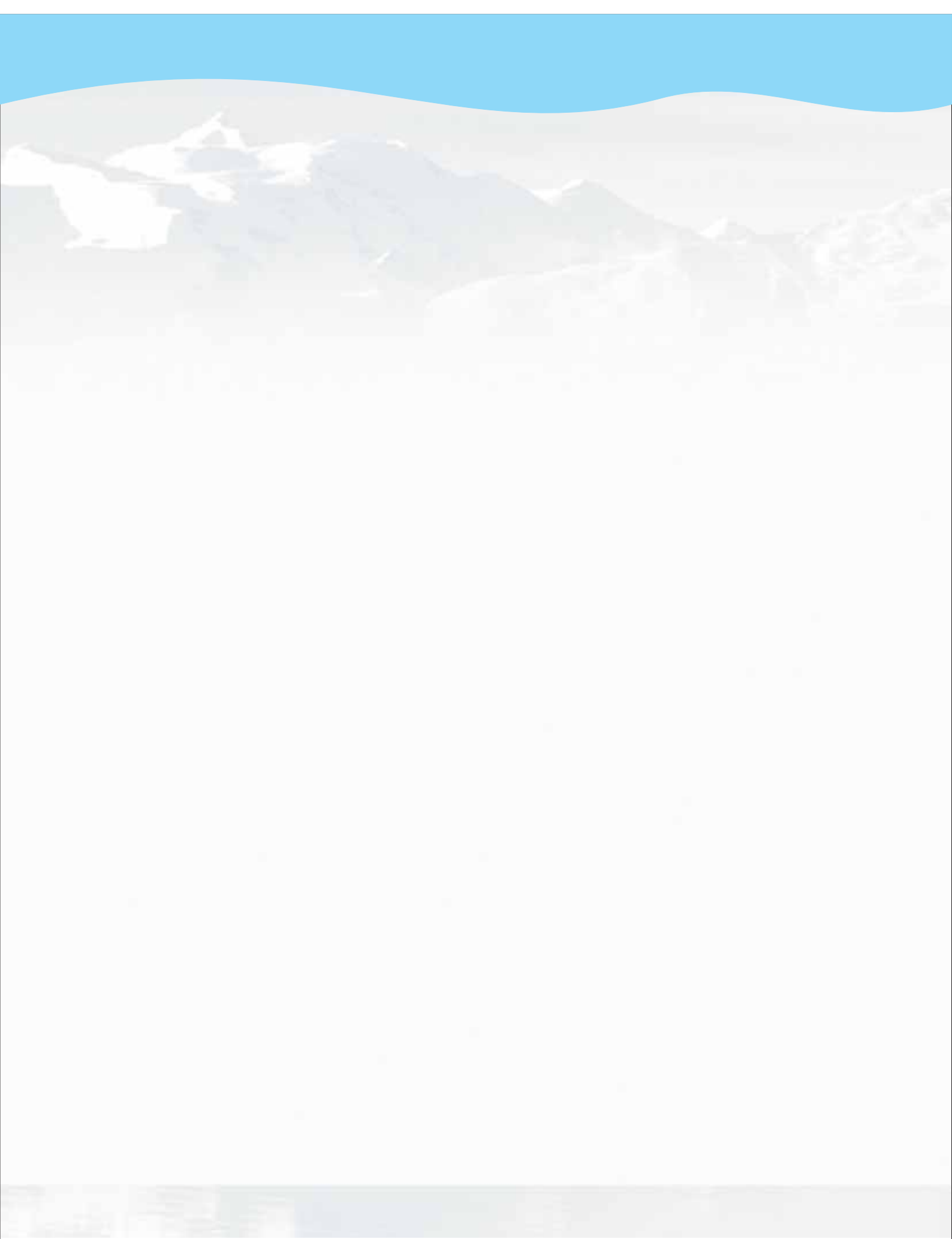
I am happy to know that our 'Team Environment' under National Mission for Sustaining Himalayan Ecosystem (NMSHE) is taking the lead in this direction to work closely with the local community with a focus on most vulnerable section i.e. women farmers in order to built their capacity, train them to tackle the changing climate impacts efficiently.

I am confident that the women farmers will be able to place a sound coordination mechanism for ensuring cooperative and cohesive actions on climate change under active coordination of the Department of Environment, Science & Technology.

'Enabling Adaptation in Himachal Himalayas' is just not a publication but is the path which will enlighten the all stakeholders that how with slight coordination, understanding and the capacity building of farmers there could be a better implementation of schemes to deal with different impacts.

I hope this report will surely ensure the designing of programmes on agri-horti, irrigation sectors keeping in view the risks associated with climate change. I compliment the **'Team Environment'** for completion of this pilot in *Dhamun Panchayat of Mashobra* Block in District Shimla successfully.


(Manisha Nanda)



**Special Secretary-cum-
Director (Env.,S&T)**
Himachal Pradesh - 171002



D.C. Rana, HAS

FOREWORD

The State Action Plans on Climate Change (SAPCC) are intended to support India's environmental policy at the State level by integrating climate change concerns into policies, plans and programmes. They also help to build adaptive capacities at the local level. In current times we are witnessing that the climate change can have a dramatic impact on our natural resources, economic activities, food security, health and physical infrastructure. Himalayan region is one of the most affected regions by climate change. The threat is especially severe in places where people's livelihoods depend on natural resources. In such areas climate adaptation measures take on a special significance for safeguarding rural livelihoods and ensuring sustainable development. The marginalized farmers having very small holding of land are severely vulnerable.

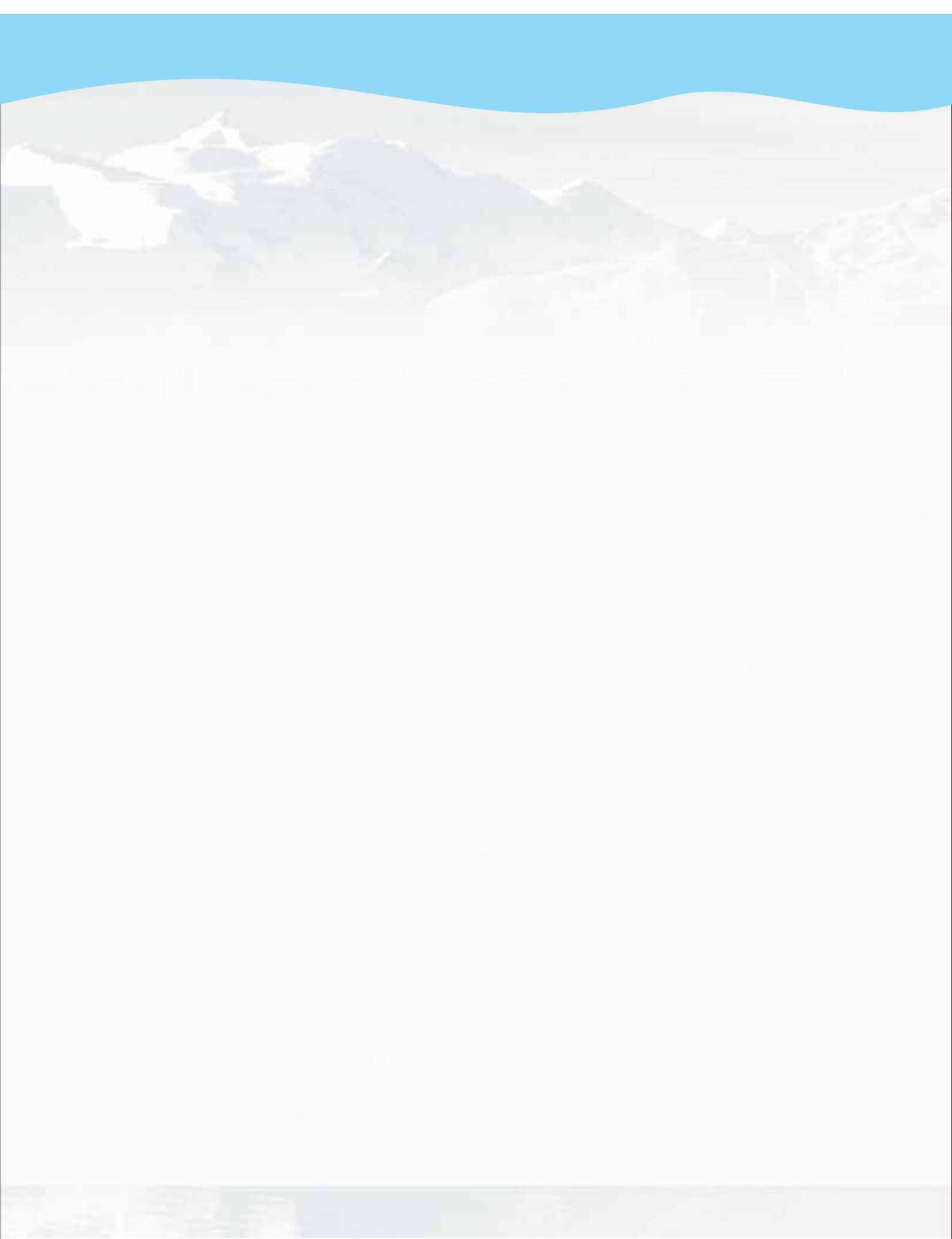
All stakeholder departments, organizations need to act in coordination and to integrate adaptation to climate change in their sector policy decisions and rural development programmes to reduce the risks posed by climate variability and change.

Socio-economic conditions and environmental services are required to be improved at local level, resulting in enhanced adaptive capacities of the communities in question.

It is sometimes very critical to understand the local climatic risks, vulnerabilities and adaptive capacities to develop appropriate coping and adaptation strategies. However, the reliable climate data and information are not available at local level because of limited resources and monitoring and that's the reason our farmers, people suffer. It is very difficult to assess and analyze the climate vulnerabilities and impacts, needs and priorities of the communities at micro level. Keeping in view these facts, the Department of Environment, Science & Technology has initiated a process to directly interact with farmers and work in coordination with community at local level.

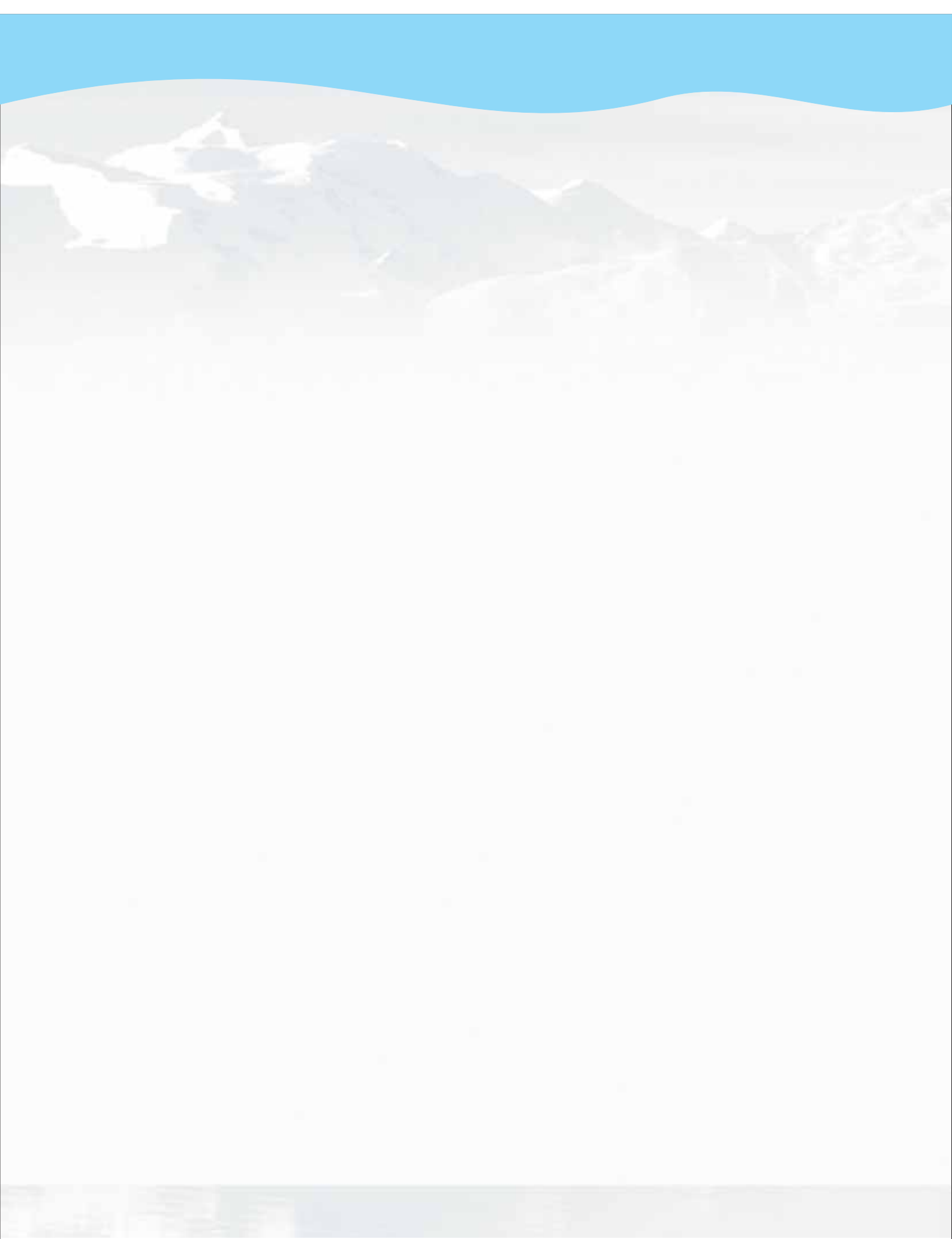
Local community respond better to the challenges of climate change in an environment where adaptive responsibilities are clear, response and evaluation frameworks are consistent across jurisdictions, approaches to mainstreaming climate change adaptation are implemented, and decisions are made on the basis of the best data and information. I am sure the pilot conducted to mainstream climate change agenda in *Dhamun Panchayat* through this process will lead us to develop climate resilient communities in the State.

(D.C. Rana)



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1. Executive Summary

As a part of duties and responsibilities under the Climate Change Knowledge Cell set up under the National Mission for Sustaining Himalayan Ecosystem, a case study has been undertaken by the 'Team Environment' of Department of Environment, Science & Technology, Himachal Pradesh for assessing climate change vulnerability at village level to know the level of vulnerability & how the community is responding to adapt climate change and how local community should effectively deal with changing climate.

This case study aims to, inform policy and programming around climate change and development by assessing the gaps in various interventions applied to address for mitigation and reduction of climate risks. The objectives of this case study as a pilot programme for developing responsive adaptation towards climate resilience at local level are three fold:

1. To understand how different development and climate change factors are interpreted and play out at the local level in relation to the climate resilience;
2. To provide empirical analysis of how various stakeholders, institutions, policies and programmes mediate the climate resilient development to ensure sustainable livelihood.
3. To identify gaps and apply tools to address those gaps;

The findings presented in this report are based on case study data collected and analysed during year 2016 and 2017. Methods of data collection included an initial

stakeholder and institutional analysis conducted at the outset of the study and updated throughout the study period; key informant interviews; and analysis of formal and informal interactions and climate change planning adopted at local level.

Effective climate adaptation requires an enabling environment which helps the local communities, especially poor farmers, in sustainable use of resources, and derive benefits from ecosystems. It has emerged as an example of good governance that provides an opportunity to communities to sustainably use ecosystems on which they depend. Through this study an attempt has been made to document the vulnerability of the village community and their adaptation response to climate change at local level. The adoption of this approach may prove useful in assessing the gaps in implementation of adaptation measures provide productive livelihood opportunities and enhance social integration.

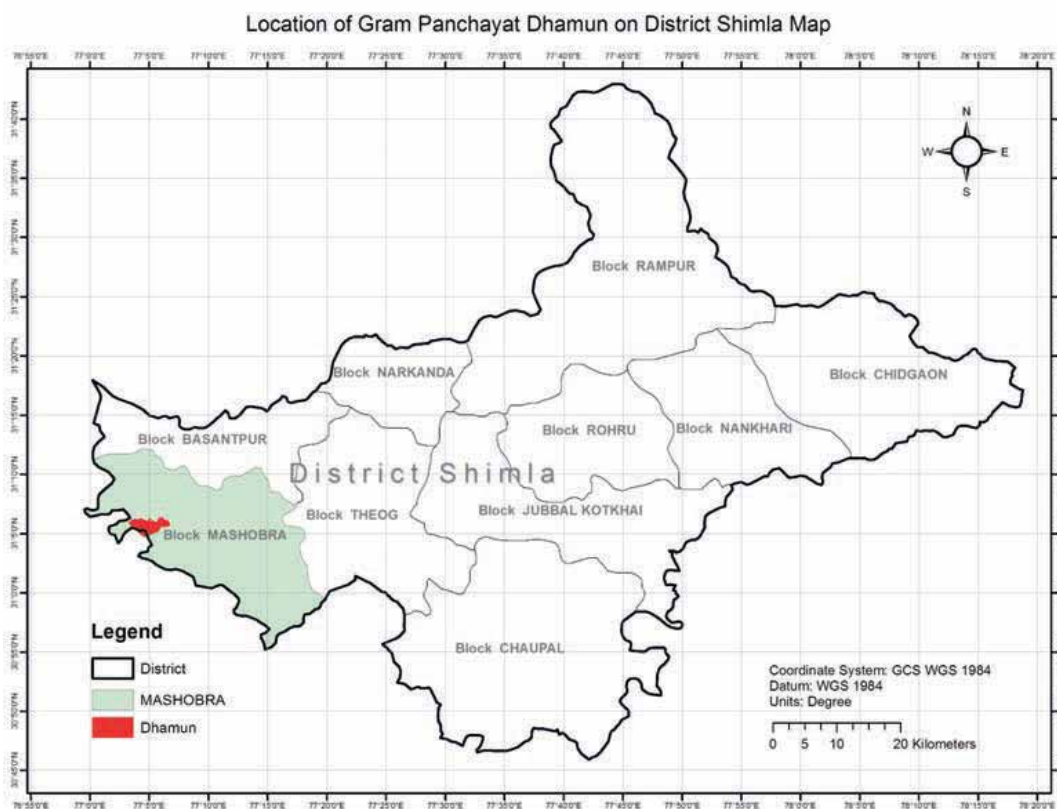
To be more specific the Gender responsive adaptation enables the local community to cope up with the climate vulnerability at the village level, which has implications for livelihoods, food systems and ecological stress more effectively. This process prepares the community to respond to issues of climate change in the context of ongoing socio-economic and environmental transformations effectively. In changing environmental conditions such as variations in temperature, rainfall precipitations the worst conditions are faced by the communities from where the snow line has been shifted.

There are currently large-scale programmes in the State that aim to support farmers over crop diversification, protected farming and financial inclusion that aims to support a national institutional framework and

financing mechanism to manage climate risks finance and to channel resources to local, district and sub-regional levels. The need to coordinate these processes to avoid a proliferation of potential institutional structures is important in view of climate change process.

In order to launch the pilot study an area was preferred where there is much climate change is observed in recent times, application of various adaptive measures

Strategies for adapting to adverse conditions have largely been tactical and short term, rather than planned and well thought actions, in anticipation of changes in climate. The exercise indicates that majority of community of villages of *Dhamun Panchayat* of District Shimla in Himachal Pradesh have suffered due to climatic variations in the past and are adopting adaptive measures in the present times to secure their livelihoods. This *Panchayat* at some time used to receive good snowfall but now it has been shifted and



have been applied. In preliminary survey it was observed that *Dhamun Panchayat* of District Shimla is the one which is worst affected due to shift of snow line, lots of economic transformations in terms of urbanization, livelihood practices and the crop diversification plots, progressive farmers FPOs etc. The first ever fully automated *Hi Tech Green House* in H.P. has also been pilot here in this *Panchayat*. The women farmers were found to be dominant stakeholder in the entire *Panchayat*. During the process there was general consensus from stakeholders- farmers that the programmes are largely complementary but not of much help to uplift the economical positions. These farmers opined that the programmes needed to be longer term and more strategic; the focus on local scale delivery mechanisms and mainstreaming of other climate change programmes is equally important.

even the rainfall is erratic now. The climatic conditions have been completely changed. A systematic planning and policy interventions is required to mainstream adaptation actions to enable community in the protection of important attributes of the local community and those of the mountain agro-ecosystems.

After the gap analysis in implementation process of different interventions applied for sustaining the livelihood practices in changing climatic conditions, few tools to strengthen the adaptive capacity of women farmers were applied during the process of pilot. The women farmers responded in a very efficient manner and the entire process ended up with conclusion that if the interventions are designed, applied with application of participatory approach in a coordinated manner, the climate resilient development can be ensured along

2. Introduction

Climate change represents a classic global problem characterized by infinitely diverse actors, multiple stressors, and multiple scales. As a result, research on vulnerability to this phenomenon must address at least three important challenges: (1) to improve approaches for comparing and aggregating impacts across diverse sectors and populations, (2) to model socioeconomic transformation in assessing the significance of these impacts, and (3) to account for multiple dimensions and coordination efforts.

The physical-environmental impacts of a changing climate, a capacity to recover from extreme events and adapt to climate change over the longer term, and the degree to which system links and other connections assist an institution/ area in its coping and adaptive efforts. At the same time, the existence of competing conceptualizations and terminologies of vulnerability is particularly problematic since they are characterized by intense collaboration between practitioners-researchers from different scientific organizations of thought, including the physical science, risk assessment, sustainable development, economics, and policy analysis. Different definitions not only result in different “diagnoses” of the problem but also in different kinds of “cures”.

The measurement of vulnerability to climate change is a central moment in adaptation activity to mitigate adverse climatic impacts. Both natural and social scientists try to measure and assess such vulnerability, whether from the perspective of regions, socio ecological systems, or individuals.

Initially, the assessment of vulnerability to climate change was approached from an impact's point of view where vulnerability was defined as “...the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. This approach continues to base many of today's assessments and adaptation prioritization efforts. However, the emphasis in these efforts has recently moved from better defining exposure and potential impacts to a better understanding of factors, which affect sensitivity of societies to these impacts and their capacity to adapt. There is an increasing recognition of the importance to consider the social vulnerability equally with the biophysical vulnerability, thus presenting vulnerability on the whole as a function both

of physical characteristics of climate change and of social systems' inherent sensitivity and adaptive capacity. Various researchers have tried to bridge the gap between the social, natural, and physical sciences' contributions to new methodologies that confront this challenge. The attempts to bridge all approaches are especially advanced under the umbrella of sustainability and resilience.

Also, the vulnerability analysis, being a useful integrative and multidimensional conception for evaluating the potential effects of climate change, is a very complex issue unlikely to be directly observed and measured. First of all, due to interactions between socio environmental systems and climate conditions, one cannot describe exhaustively the impacts of climate change. Yet there is also no consensus as to what indicators to measure these impacts and, even within a given conceptual framework for considering vulnerability, other questions arise in the practice of vulnerability assessment.

A system of vulnerability “measurement” is usually developed to allow comparisons between different places, social groups, or sectors whose vulnerabilities are not static but respond to changes in physical, economic, social, political, or institutional conditions over time. Different vulnerability indices and indicators were designed to better understand the drivers of vulnerability or to provide the abovementioned comparison in terms of the climate change risks and capacities to deal with them. The main challenges in selecting representative criteria of vulnerability at any level derive from the fact that effects of climate-induced pressures are mediated by society- community at their own level.

Consequences vary between communities, social groups in a community, individual households, and even between people within a household. A common thread is an attempt to quantify multidimensional issues, using indicators as proxies. These are often combined into a composite index allowing diverse variables to be integrated. Nevertheless, even such integrated indexes are developed to address some specific tasks, and they cannot be considered as a universal measure of vulnerability. In this regard, the task, assigned to the present study, has required some modifications of the general conceptual framework of vulnerability assessment.

The main goal under the present study is to assess vulnerability of villages to climate change on the local level through addressing two specific tasks: (1) to

develop and practically realize a methodology for assessing the climate change vulnerability at the level of lowest planning-tier administrative-territorial units in Himachal Pradesh and (2) to build spatial models of the vulnerability, capacity assessment further lead a way to responsive adaptation.

Himachal Pradesh Knowledge Cell on Climate Change has been set up under the National Mission for Sustaining Himalayan Ecosystem (NMSHE) in the Department of Environment, Science & Technology (DEST) including the following objectives:

- Providing an improved understanding and awareness of the key climate processes and the resultant climate risks and associated consequences.
- Building capacities of communities, ULBs, PRIs, CBCs to deal with climate change Risks and hazards.
- Establishing research networks and encouraging research in the areas of climate change impacts on important socio-economic sectors like agriculture, health, natural ecosystem, bio-diversity etc.

This NMSHE cell is an activity based setup which functions with following approach:

Data Generation, information, Policy directive formulation, Vulnerability Assessments, participatory resource management strategies and development of livelihood options.

Deploying Technologies – for hazard mitigation & disaster management, development of ideal human habitats, and agriculture and forest sector innovations.

Awareness, Capacity Building, developing human resource, emphasis on skill development, enable communities become sufficiently empowered with know-how and mountain specific required skills, necessary for adaptation to climate change.

Active Community Participation for enhancing ecological sustainability – by involving community in investigating causes and consequences of disturbance regimes, promoting conservation of native and endemic elements, and understanding glacier and river system dynamics.

As a part of activity under this Cell this pilot programme was initiated for assessing climate change vulnerability at local level to know how the community is adapting to climate change, what are the interventions analyse gaps and then help local community to effectively deal with changing climate.

The local level Climate Vulnerability and Capacity Assessments are very helpful tools to investigate how climate and socio-economic change is affecting local community's livelihoods, that makes these local communities vulnerable, and how they are coping with and adapting to change. Different initiatives for sustenance of livelihood practices, more particularly focused on production process by various stakeholder organizations mainly experimented over these small units of planning. One can easily go around and assess as how effectively and with what coordination these actions are being under taken.

Gender is a primary factor affecting people's differential vulnerabilities and capacity to survive with and adapt to impacts of climate change. Class, caste, race and ethnicity are additional factors that can increase vulnerability. Within climate change adaptation of community, there is a common assertion that if we could survive better with the present climate risk, possibly we could significantly reduce the impacts of future climate change. Native societies have evolved through complex interactions of climate and environmental systems. There is an intimate relationship between climate fluctuation and consequent human responses such as migration and adaptation. Climatic variability and environmental changes affect men and women differently because they have different roles in their households and society and different rights and access to resources. Although both are vulnerable to climate change, the causes of their vulnerability and experience to it are different, as are their capacities to survive and adapt. There are also views that the adaptation to short term climate vulnerability and extreme events serves as a starting point for reducing vulnerability to longer term climate change. The study of Gender Responsive Adaptation through local Climate Vulnerability and Capacity Assessment enables understanding the differential implications of climate change on the lives and livelihood of men and women.

3. Aims & Objectives

This case study aims to, inform policy and programming around climate change and development by assessing the gaps in various interventions applied to address for mitigation and reduction of climate risks. The objectives of this case study of the pilot programme for responsive adaptation for climate resilience at local level are three fold:

1. To understand how different development and climate change are interpreted and play out at the local level in relation to the climate resilience;
2. To provide empirical analysis of how various stakeholders, institutions, policies and programmes mediate the climate resilient development to ensure sustainable livelihood
3. To identify gaps and apply tools to address those gaps;



High tech Green House

4. Methodology

Usually, the assessment of vulnerability to any phenomenon requires a clear conceptual framework. The most widely used approach to the assessment of climate change vulnerability is based on the above mentioned definition, proposed by the IPCC, and focuses on its three components: *exposure* to climate stressors, climate sensitivity, and *adaptive capacity*. The exposure refers to the degree of climate impacts on certain system *Sensitivity* defines the degree, to which the system is susceptible to direct or indirect climatic impacts. Finally, adaptive capacity describes the capability of a system to adapt to real or expected climatic stresses and to cope with their consequences. Exposure is usually treated as an external dimension of vulnerability, while *sensitivity* and *adaptive capacity* represent its internal dimension. A highly vulnerable system would be very sensitive to modest changes in climate, while its capabilities to cope with significant negative effects are limited. The vulnerability is influenced not just by one factor, both present and future, but by the whole range of social, economic, and environmental factors, which determine the ability of the region to cope with changing external conditions.

To take into consideration a temporal dimension means that an assessment should distinguish between present-day and future vulnerability of a region – area herein *Dhamun Panchayat*. Present-day vulnerability applies to the current variability of regional climate and present

ability of natural and social systems to cope with the current variability of the local's hydrological regime. Assessment of present-day vulnerability contributes to substantial understanding of potential responses to expected impacts; obviously, measures designed to increase today's adaptation potential will reduce future vulnerability. Future vulnerability relates to expected climatic conditions and future capacity to confront their adverse impacts, primarily its likely more severe and frequent extremes.

Provided that vulnerability of local community depends on the combination of multiple factors, its assessment should include a series of aspects and criteria: physiographical, social, economic, environmental, adaptive, and so forth. Evidently also, the completeness of the evaluation depends on the availability and accessibility of corresponding background information. These and some other considerations have served as a basis for the methodological approaches.

There are currently large-scale programmes in the State that aim to support farmers over crop diversification, protected farming and financial inclusion that aims to support a national institutional framework and financing mechanism to manage climate risks finance and to channel resources to local, district and sub-regional levels. The need to coordinate these processes

to avoid a proliferation of potential institutional structures is important in view of climate change process. An evaluation/ assessment of such programmes has also been made.

In the present study an attempt has been made to find out the adaptability of the local people, particularly women, towards climate change and making use of their traditional knowledge while incorporating scientific methods as well.

The present local Climate Vulnerability and Capacity Assessment study was designed to investigate how climate and socio economic change is affecting local community's livelihoods, what makes them yet vulnerable, and how they are coping with and adapting to change. The relevant information and data for study have been collected mainly from secondary source available in publication and reports of various government departments and Panchayati Raj Institutions. However some information pertaining to the local community based Climate Vulnerability and Capacity Assessment has also been collected by conducting primary survey at village level involving local community.

Methods of data collection included an initial stakeholder and institutional analysis conducted at the outset of the study and updated throughout the study period; key informant interviews; and analysis of formal and informal interactions and climate change planning adopted at local level.



Women farmers orientation workshop: Dhamun

A main limitation of the assessment was objective impossibility to consider future social-economic conditions and climate change projections for each village, the former are in principle unpredictable in transition economy due to non availability of documented data base at local level; the later were derived only at a large scale as average values for individual parts of the region. Another limitation consisted in a difficulty to quantify the “weights” assigned to each factor or indicator in the integrated vulnerability assessment; this difficulty was caused by

lack of a science-based analysis, for reliable comparison of chosen indicators.

The details of data collection and compilation are described herewith:

Secondary Data Collection

An extensive review of the available information on urbanization, agriculture and forest resources was carried out by visiting different government departments, local institutions and libraries. Published and unpublished data pertaining to land and forest resources, and their various goods and services were collected, besides reviewing few technical reports.



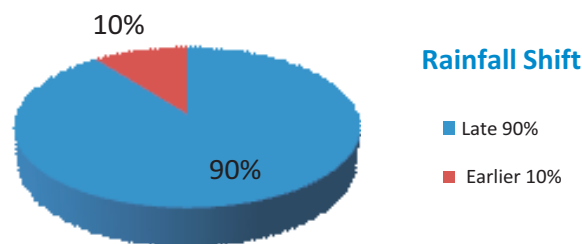
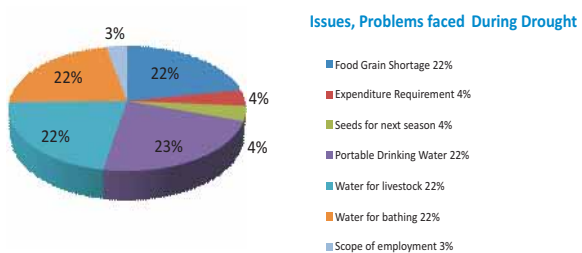
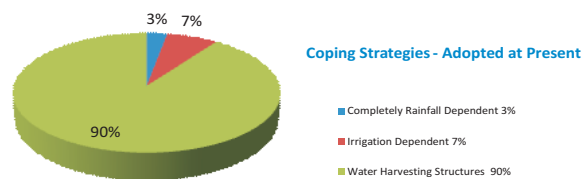
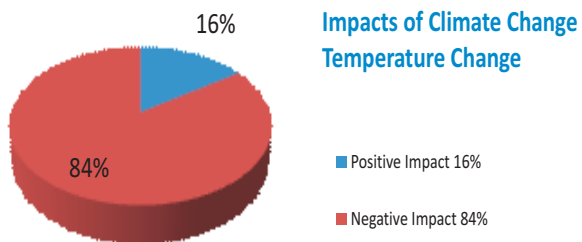
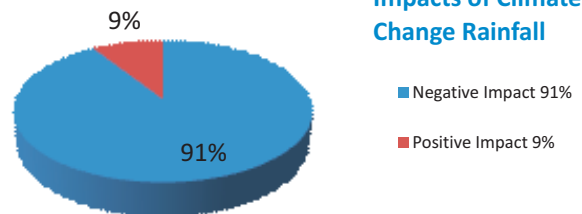
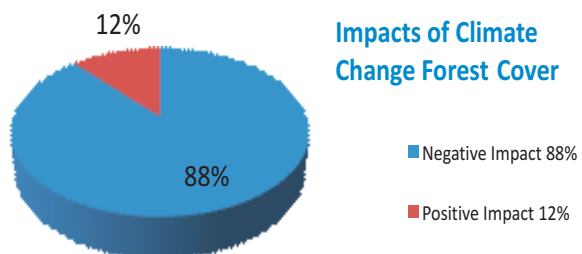
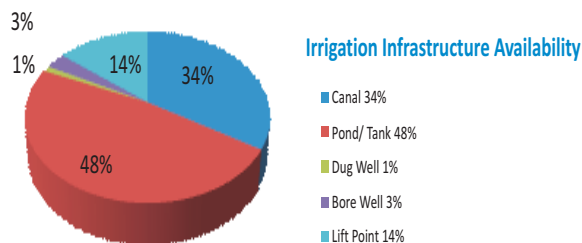
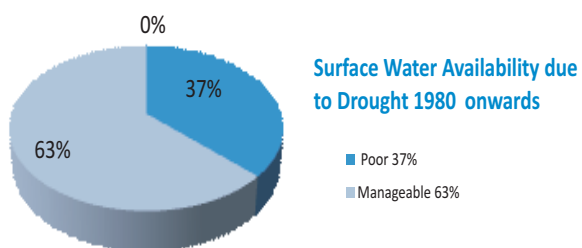
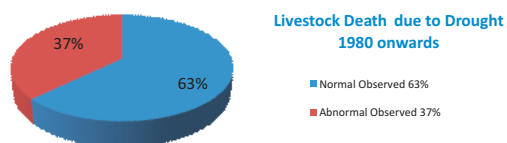
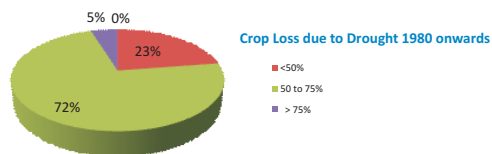
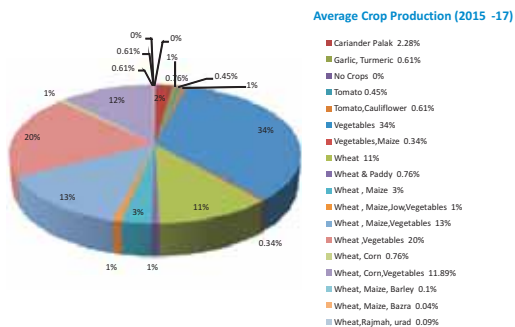
Women farmers: Collection of secondary data: Dhamun

Primary Data Collection

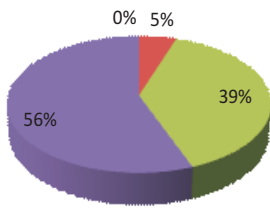
Primary data were collected through semi-structured questionnaire survey and interviewing stakeholders in all the villages of *Dhamun Panchayat*. Interviewees represents a cross section age, gender, and livelihoods in the local community, including fulltime farmers, board members of PRIs, Ward Members, rural community employees, a former Panchayat representatives and school employees. The aim was to interview a cross section of the community that reflected age, gender, types of employment or livelihood and participation in traditional activities. Purposive sampling was necessary for targeting groups such as members of the district council, elders and community leaders, who have been identified in the literature and by community members as important sources of information regarding environmental changes and their effects on people. During present study primary survey was conducted to find out the changes in traditional cultivation and extraction of different type of forest product due to high demand of population pressure and urbanization.

Analysis of Field Survey

Analysis of Field Survey of Women Farmers from Bhagli, Jadoini, Shilly, Klimo, Palwno, Dhamoon, Panyola, Dhadhol, Raudi, Khadal, Dhoehi, Bada-jubbar, Jakri, Jubber Hatti, Khalag, Sadyana, Khairi, Bhawna villages located in Shimla, Himachal Pradesh:

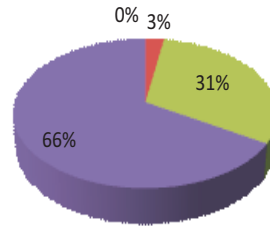


Awareness on drought proofing measures



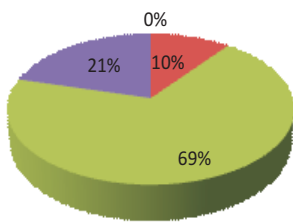
Change in cropping pattern

- Fully aware 5%
- Have heard but not fully 39%
- Not aware 56%



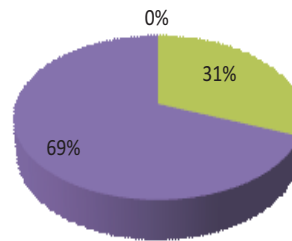
Judicious use of ground water

- Fully aware 3%
- Have heard but not fully 31%
- Not aware 66%



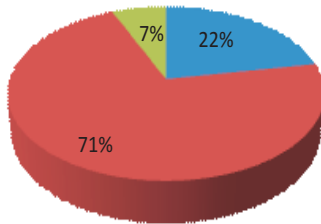
Water Conservation method

- Fully aware 10%
- Have heard but not fully 69%
- Not aware 21%



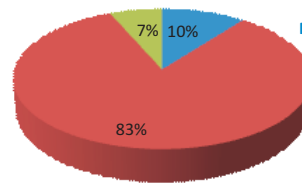
Govt alert warning on drought

- Fully aware 0%
- Have heard but not fully 31%
- Not aware 69%



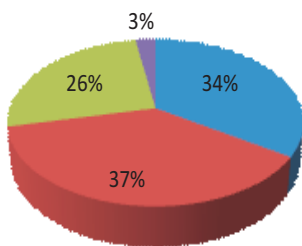
Rain water harvesting

- Fully aware 22%
- Have heard but not fully 71%
- Not aware 7%



MGNREGA/BRGF/Watershed projects

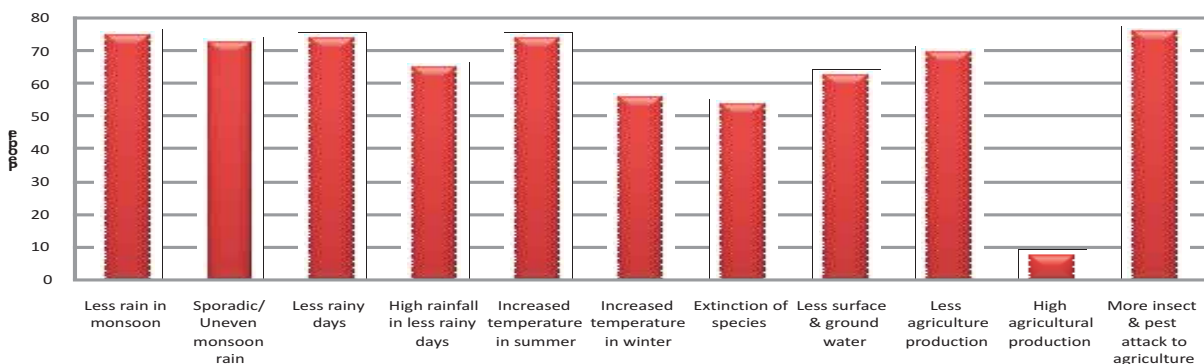
- Fully aware 10%
- Have heard but not fully 83%
- Not aware 7%



Most Affected by Drought

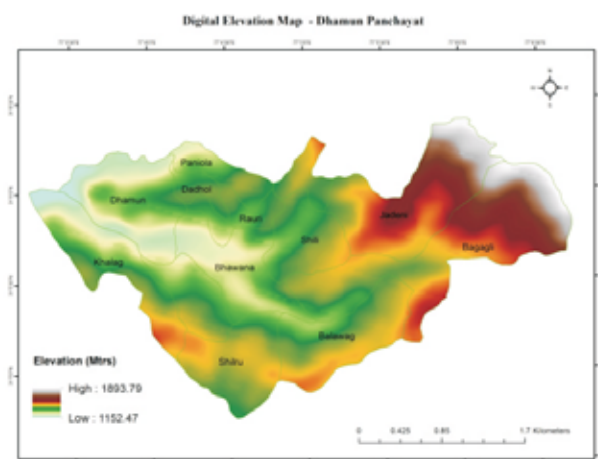
- Children(0 -6 Years) 34%
- Aged(60+) 37%
- Women 26%
- Girls 3%

Climate Change Impact Observed in last 10 years



5. Why Dhamun: Profile of Study Area

In order to launch this type of pilot study an area was preferred where there is much climate change is observed in recent times, application of various adaptive measures have been applied. In preliminary survey it was observed that *Dhamun Panchayat* of District Shimla is the one which is worst affected due to shift of snow line, lots of economic transformations in terms of urbanization, livelihood practices and the crop diversification plots, progressive farmers FPOs etc.



Dhamun Panchayat: Village Profiles

Village Name	Geo-graphical Area (in Ha.)	House-holds	Population	Male	Female
Dhamun	89	27	148	80	68
Dhadhol	14.87	11	58	29	29
Kharun	10.78	4	22	11	11
Khairi	85.78	38	177	93	84
Khalag	71.23	68	294	159	135
Shili	52.54	27	170	83	87
Shilru	45.55	29	150	75	75
Rauri	16.16	8	37	17	20
Panaiola	25.43	15	70	37	33
Kalimoo	17.88	13	62	33	29
Balaog	48.55	9	68	33	35
Bhawana	72.39	39	224	121	103
Jadani	29.67	19	119	62	57
Bagagli	173.17	101	512	274	238
Total	753	408	2111	1107	1004

The villages *Bhagli, Jadoini, Shilly, Klimo, Palwno, Dhamun, Panyola, Dhadhol, Raudi, Khadal, Dhoehi, Bada-jubbar, Jakri, Jubber Hatti, Khalag, Sadyana, Khairi* and *Bhawana* located in Shimla hills of Himachal Pradesh are undergoing tremendous change in recent decades due to varying climate and diversified livelihood activities. The agro-economy has seen a remarkable shift from traditional agriculture to adoption of cash-crops, using protective cultivation techniques. The surrounding forests and grasslands which had been a source of valuable ecosystem services, including natural water resources, to the

villagers are now degraded due to overexploitation and forest fires and be further exacerbated by the impacts of changing climate. People are now less inclined to rear cattle as availability of grass and fodder is increasingly becoming scarce. Forest floors are frequently set on fire by villagers in the misplaced notion of getting good grass cover. Conversely, this practice renders the forests highly vulnerable to soil erosion, compaction, loss of moisture and eventually loss of vegetation, biodiversity; besides the release of green-house gases. All this could play a significant role in increasing the climate vulnerability of a sensitive region like upper Shimla which is considered as a rich biodiversity area. At times these villages used to receive good snowfall with regular rainfall, but changing climate resulted in shifting of snow line resultantly their traditional agri setup got disturbed abruptly and to secure their livelihood they also started shifting from traditional agriculture to adoption of cash-crops using protective cultivation techniques. The surrounding forests and grasslands which had been a source of valuable ecosystem services have also been affected, including water availability which has depleted significantly. The village women are adapting the changing climate and readjusting their practices to minimize the risks with limited capacity.

The first ever fully automated *Hi Tech Green House* in H.P. has also been pilot here in this Panchayat by Agriculture Department. The women farmers are observed to be dominant stakeholder in the entire



Hi Tech Green House

Panchayat. Being the main nearby rural settlement of the capital city of Himachal Pradesh, *Dhamun* plays an important role in Shimla city's economy and supplying day to day fresh products.

The study area covers villages located within four

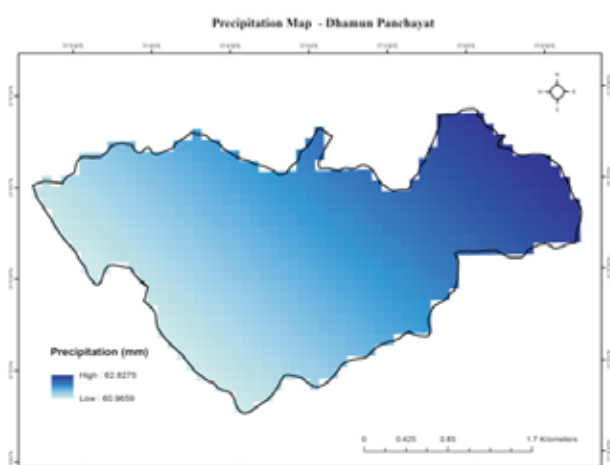
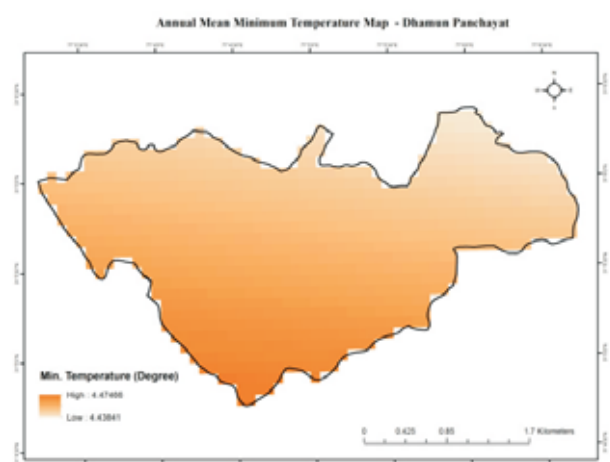
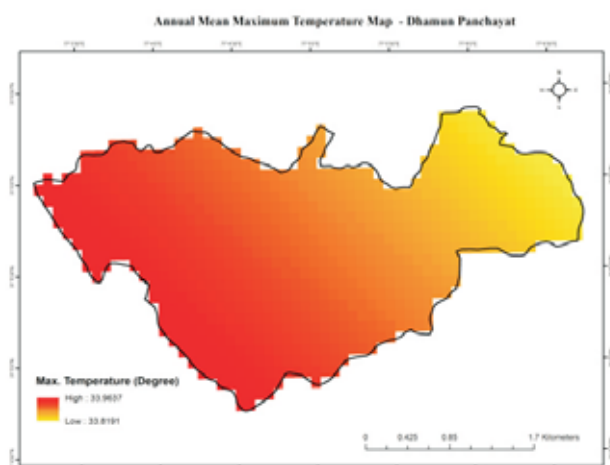
directions viz. west, east, north and south of *Dhamun Panchayat* located in the western part of the Shimla Town. Shimla experience Monsoon type of climate and directly influenced by the south-west monsoon.

The average maximum temperature goes up to 32.7 degrees and means temperature observed low at 3.5 degree C during mid-winter. The average annual rainfall is 2400 mm. Dhamun Panchayat villages are

dominated by the diverse livelihood practices and farmer community is the predominant while other employees are also found in small numbers. The present location of these villages enabled them to maintain many of their trades and characteristics. Significant changes came only after the British Colonization of the area in the first half of the nineteenth century. Traditional customs are maintained and festivals include varied forms of dance and are an important element in the local culture. Sair, Deepawali, Holi etc. are the prominent festivals of the local community. The area is rich in culture and traditions. Drinking and dancing to the accompaniment of traditional music, flutes and drums are integral parts of religious ceremonies and social functions. One of the unique features of the landscapes of Shimla hills is the occurrence of numerous medicinal plants, many of which are protected by the local communities.

Livelihood in Villages

With the shift from traditional cultivation towards cash crops, growing off season vegetables, floriculture has become the main occupation of the people of these villages. The diversification in farming activities in the region have brought in the desired outcomes of economic growth but on the other hand, affected the environment in a variety of ways, which contributes to its degradation. There is no big industry in the region, only few small scale industries are present which are based on local natural resources. Important fruit and cash crops grown here are lemon, guava, potato, ginger, turmeric, tomato, peas, vegetables, etc. Few residents are also dependent on minor mineral mining and small trading. Dependence on forests for sustenance and livelihoods of the local people is significant as supplemental source and also due to other alternative livelihood options being limited.



Crop in a green-house completely destroyed due to frosting as a result of untimely snowfall...

6. Results and Discussions

Climate Change Vulnerability

Vulnerability of a community is generally understood to be a function of stresses experienced by a community and the community's ability to deal with these through adaptive capacities. There is an implicit recognition of multiple sources and scales of change and stress, including climatic and non-climatic forces. While vulnerability is generally defined relative to harm, it is also recognized here that changes or stresses related to climate change have the potential to provide benefits for communities. Through combining local knowledge with scientific data, the process builds people's understanding about climate risks and adaptation strategies. However, little is known about the impacts of climate change on livelihoods of native communities, their perception of these changes, or their capacity to adapt to climatic variability and change is limited. As explained above in order to draw climate change vulnerability exposure level, sensitivity and

adaptive capacity of the farmers and area were analysed for *Dhamun Panchayat* and its villages as follows:

Exposure Assessment

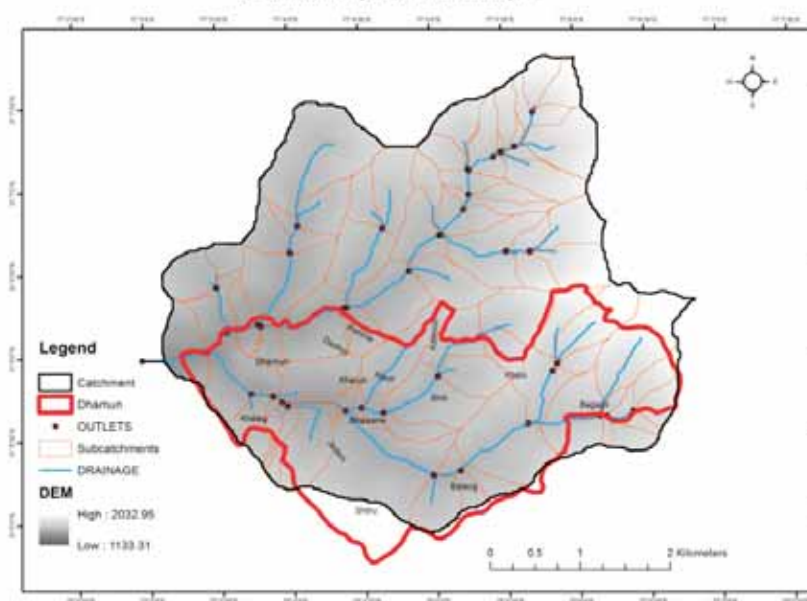
The exposure component of vulnerability evaluated to assess new characteristics of regional climate, described as likely changes in key baseline climatic variables (air temperature and precipitation) and one apply climatic characteristic (the index of air humidity in a warm season). The assessment is based on the analysis of historical observations of temperature and precipitation in the 34-year baseline period (1979–2013).

Since climatic threats are different for each season, there are no reasons to consider an exposure to their stressors in annual climatic variables, and its assessment was done separately for cold (November–March) and warm (April–October) seasons.

Climate Data (1979-2014)													
Month	01	02	03	04	05	06	07	08	09	10	11	12	Avg
Record high °C	19.5	23.5	29	31	35	38	38	34	30	30	25.6	21.5	29.59
Avg. high °C (°F)	10.6	11.6	15.9	21.9	24.9	27.2	25.9	25.4	25	22.5	18.4	13.7	20.25
Avg. low °C (°F)	1.6	0.7	2.3	5.8	8.5	12.4	15.4	14.9	11.2	5.5	1.5	0.1	6.66
Record low °C (°F)	1.6	1	6	1	1	4.4	7.4	7	3	1.5	1.1	1	3.00
Avg. rainfall mm	108.4	133.5	202.3	108	78.9	88	215.1	221.7	100.4	52.3	43	59.5	117.59
Average rainy days	6.6	8.2	9.3	6.2	5.7	7.3	14.7	15	8.5	3.4	2.8	3.5	7.60

Source: Global Climate Data

Catchment Map - Dhamun Panchayat



Waste of Alovera Dhamun

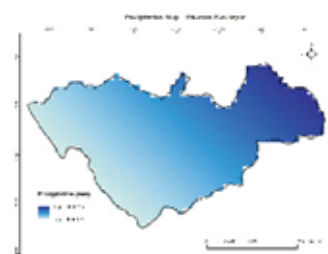
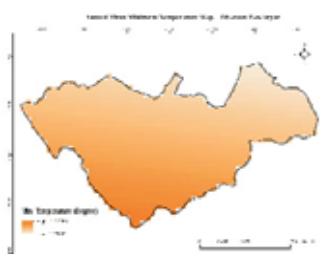
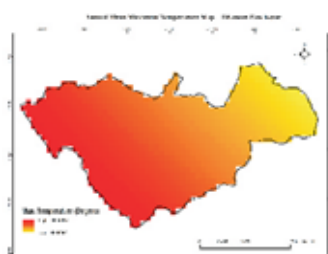
Exposure Indicators

Five indicators of exposure have been computed using meteorological data for a period of 34 years (1979-2013). The maps have been developed for each of these indicators of climatic exposure. The indicator-wise analysis is as under:

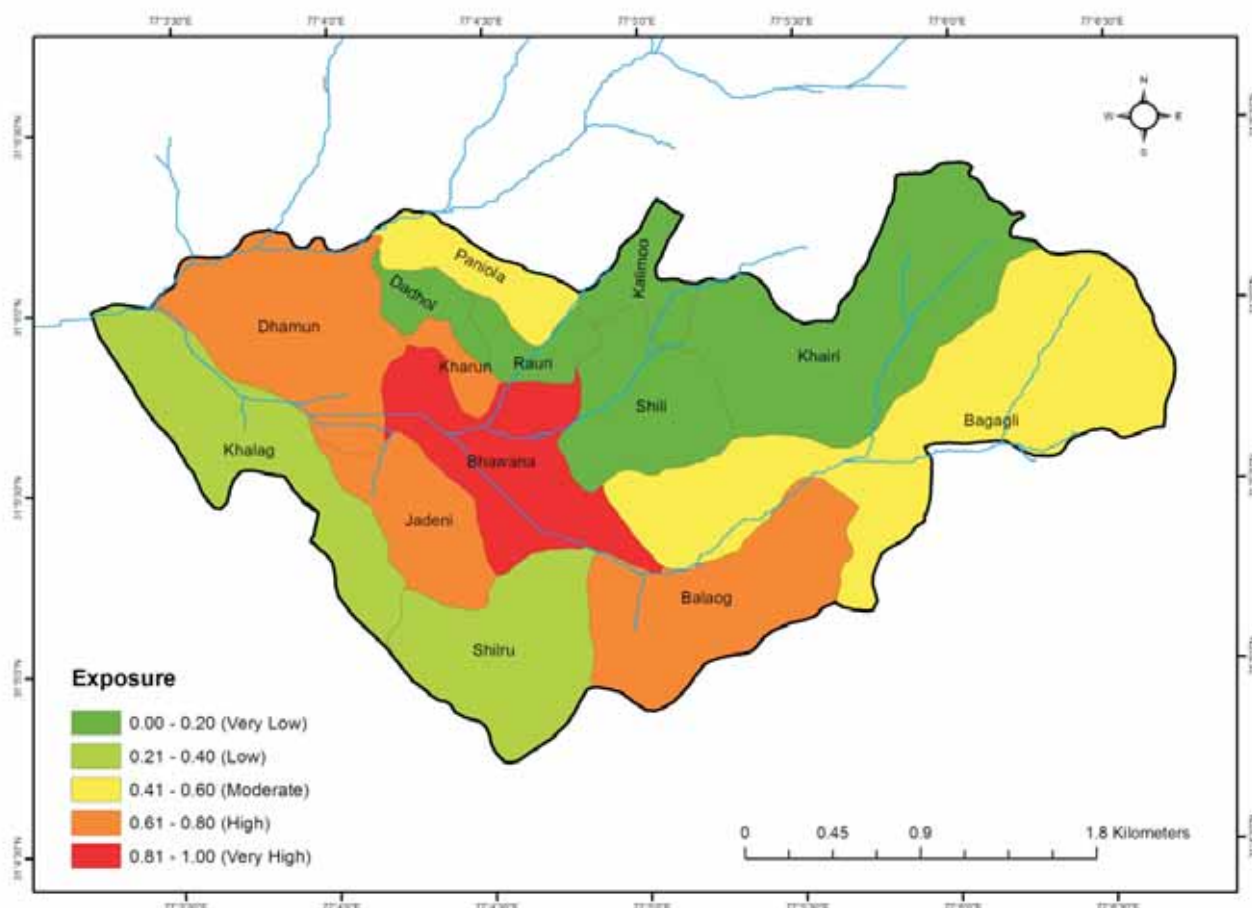
- 01 Average maximum air temperature
- 02 Average minimum air temperature
- 03 Average precipitation
- 04 Water stress days
- 05 Temperature stress days

Based upon these five variables/indicators the composite exposure has been calculated.

Sr No.	Village	Composite Exposure					Composite Exposure
		Exposure Variables					
		01	02	03	04	05	
1	Dhamun	0.79	0.51	0.68	1.00	0.00	0.71
2	Dhadhol	0.58	0.00	0.00	0.99	0.00	0.03
3	Kharun	0.61	0.78	0.59	0.93	0.00	0.68
4	Khairi	0.00	0.05	0.46	1.00	0.00	0.00
5	Khalag	1.00	0.24	0.06	0.74	0.29	0.40
6	Shili	0.42	0.01	0.26	0.24	1.00	0.20
7	Shirru	0.91	0.32	0.42	0.00	0.67	0.40
8	Rauri	0.49	0.13	0.57	0.04	0.41	0.07
9	Panaola	0.47	0.28	0.61	0.50	0.55	0.44
10	Kalimoo	0.27	0.20	0.49	0.88	0.00	0.16
11	Balaog	0.56	0.58	1.00	0.82	0.06	0.73
12	Bhavana	0.67	1.00	0.94	0.97	0.00	1.00
13	Jadeni	0.86	0.25	0.78	0.92	0.00	0.63
14	Bagagli	0.04	0.70	0.87	1.00	0.00	0.53



Composite Exposure Map - Dhamun Panchayat



Sensitivity Assessment

The sensitivity assessment included physiographical and social-economic; in turn, each of these components is described by a set of indicators.

Sensitivity Indicators

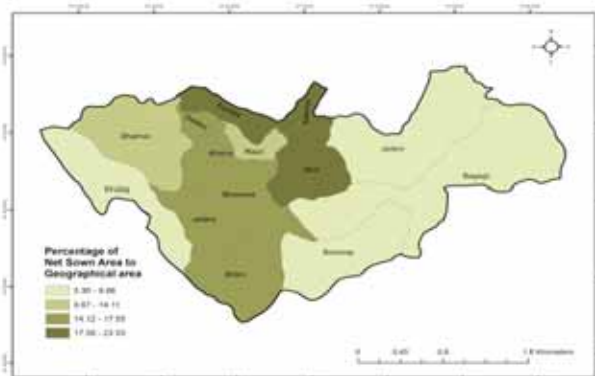
Six indicators of sensitivity exposure have been computed using meteorological data for a period of 34 years (1979-2013). The maps have been developed for each of these indicators of climatic exposure. The indicator-wise analysis is as under:

- 01 Average Hill Slope
- 02 Percentage of Net Sown Area to Geographical area
- 03 Human population density
- 04 Percentage of Un-irrigated Land Area to Geographical area
- 05 Percentage of Barren & Un-cultivable Land Area to Geographical area
- 06 Percentage of Cultivable Waste Land Area to Geographical Area

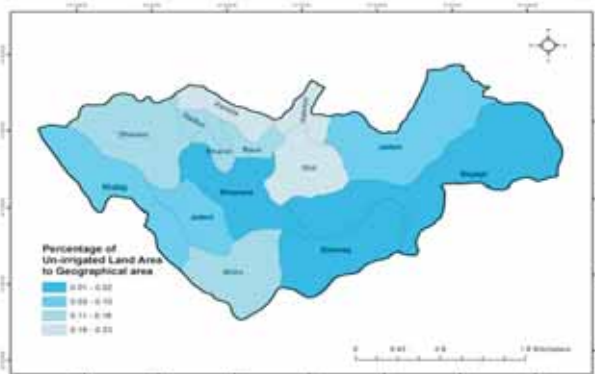
Based upon these six variables/indicators the composite exposure has been calculated.

Sr No.	Village	Composite Sensitivity						Composite Sensitivity
		01	02	03	04	05	06	
1	Dhamun	0.80	0.10	0.46	0.50	0.00	0.15	0.24
2	Dadhol	0.29	0.92	0.69	0.75	0.52	0.77	1.00
3	Kharun	0.74	0.23	0.64	0.68	0.87	0.49	0.89
4	Khairi	1.00	0.24	0.00	0.20	0.73	0.10	0.35
5	Khalag	0.89	1.00	0.25	0.39	0.46	0.15	0.69
6	Shili	0.14	0.67	1.00	1.00	0.48	0.43	0.92
7	Shilru	0.00	0.69	0.59	0.55	0.23	0.27	0.37
8	Rauri	0.00	0.33	0.50	0.56	0.29	1.00	0.50
9	Paniola	0.48	0.50	0.99	0.89	0.60	0.28	0.92
10	Kalimoo	0.18	0.76	0.95	0.96	1.00	0.00	0.96
11	Balawana	0.35	0.00	0.18	0.00	0.52	0.36	0.00
12	Bhawana	0.38	0.62	0.68	0.08	0.46	0.13	0.37
13	Jadeni	0.51	0.96	0.68	0.30	0.37	0.04	0.57
14	Bagagli	0.98	0.57	0.22	0.01	0.49	0.16	0.41

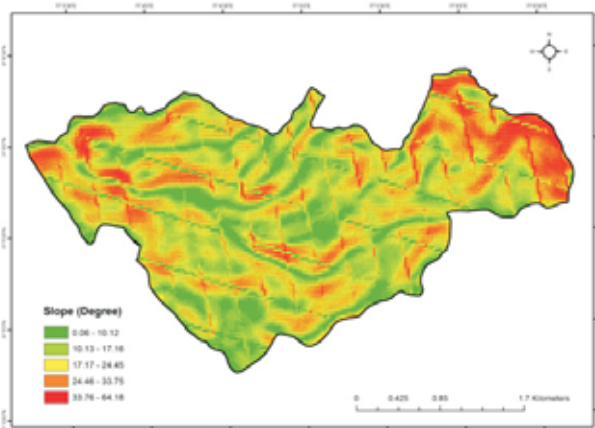
Percentage of Net Sown Area to Geographical area - Dhamun Panchayat



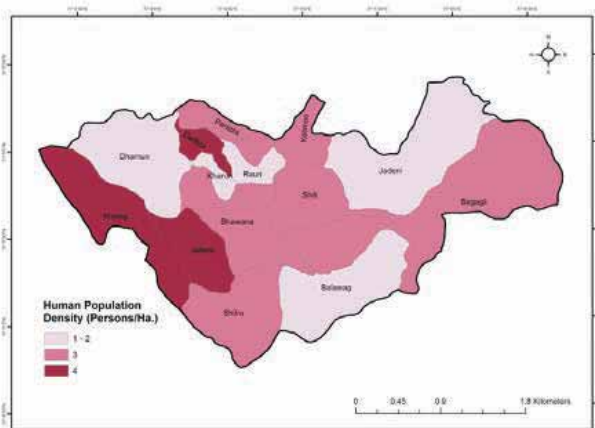
Percentage of Un-irrigated Land Area to Geographical area - Dhamun Panchayat



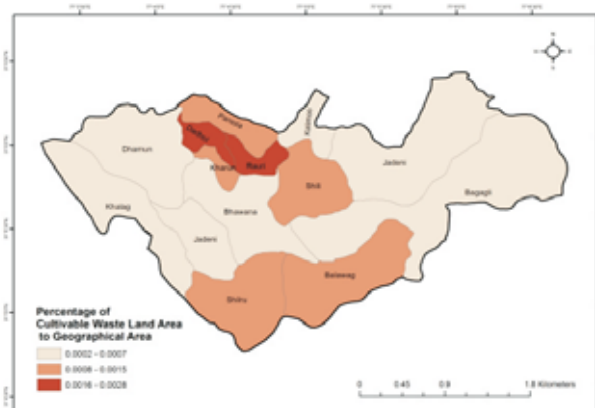
Slope Map - Dhamun Panchayat

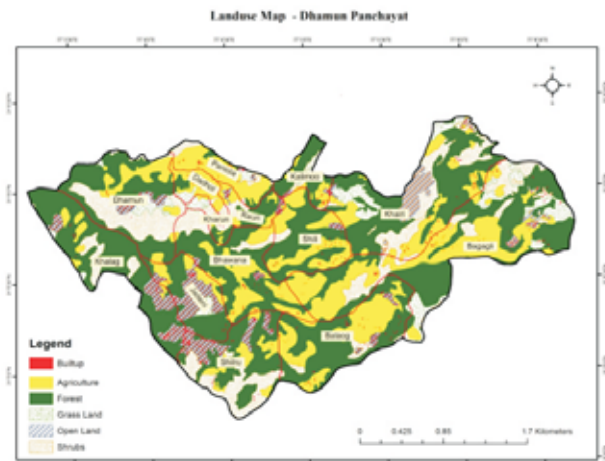
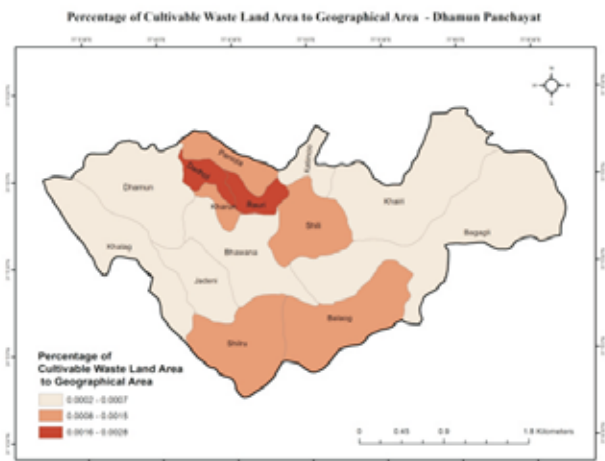


Human Population Density - Dhamun Panchayat

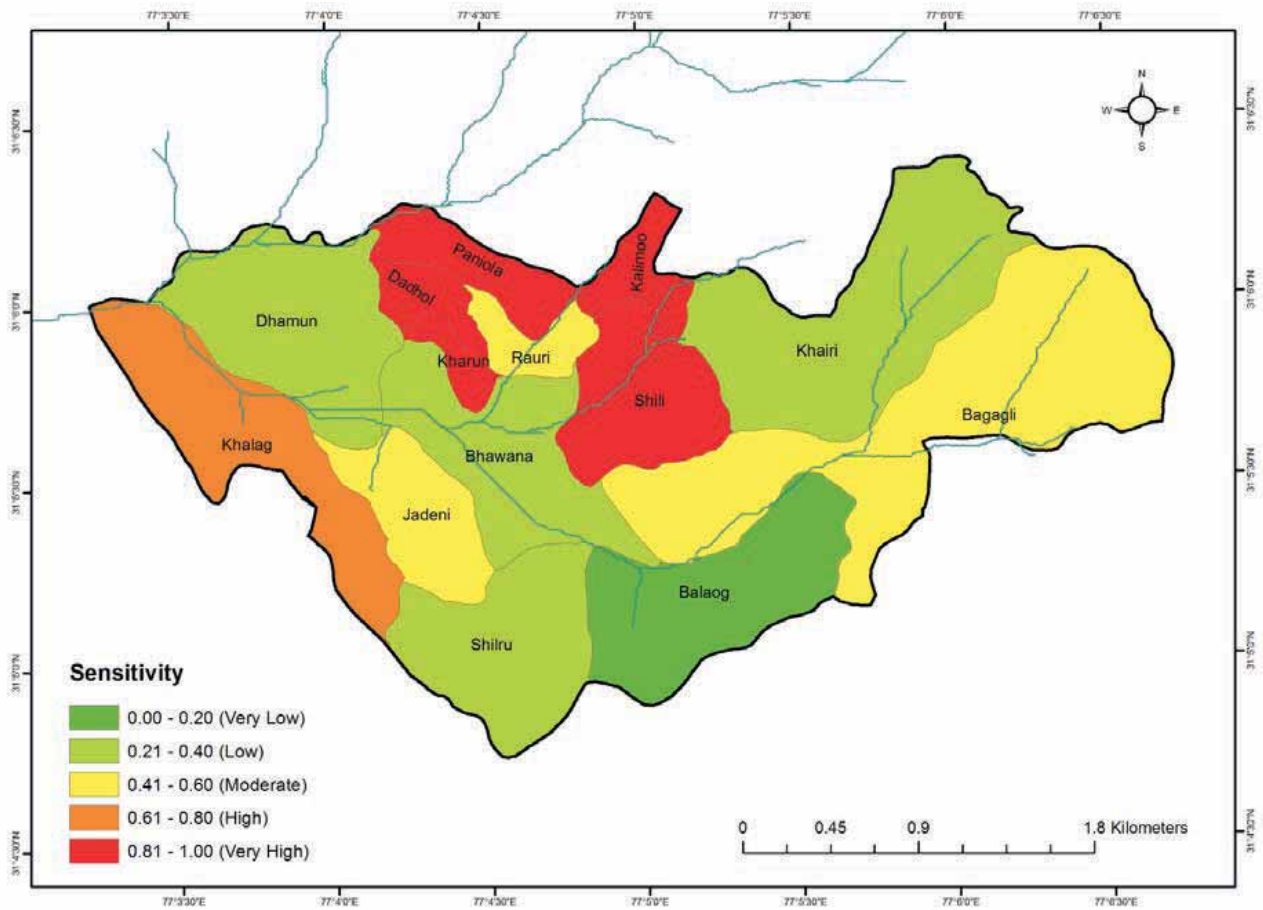


Percentage of Cultivable Waste Land Area to Geographical Area - Dhamun Panchayat





Composite Sensitivity Map - Dhamun Panchayat



The sensitivity assessment included physiographical and social-economic; in turn, each of these components is described by a set of indicators.

Over the period human interventions with natural systems have resulted in large changes in vegetation composition and distribution patterns. Cropping patterns and agriculture practices, changes in land use

and hence in vegetation cover, due to climatic change. Due to massive change of cropping pattern and agriculture practices- native crop diversity is under threat.

Biodiversity is also critical for the maintenance and enhancement of food security. Conserving and maintaining healthy soil, clean water, a variety of

genetic resources, and ecological processes are essential ingredients of a sustainable and productive agricultural system and the subsequent eradication of poverty. Variation in genetic diversity is particularly important in marginal lands, where genetic adaptations to conditions such as water scarcity and poor soil fertility are critical to the maintenance of local agricultural and grazing livelihoods. In the villages vegetable agriculture is the main occupation with 70 percent of the total population being dependent on it for their livelihood. The traditional crops and cultivation of this region is in transitional phase as parts of the cultivable lands in the area are increasingly being replaced by economically viable cash crops concentrated in small farms with multi-species complex agro ecosystem.

In the physiographical component a land use structure, expressed as percentages of its individual indicators in an village area, defines environmental sensitivity, mainly an anthropogenic load on the land. It is observed that territories, where arable lands dominate, are more subjected to climate risks and thus are more sensitive than, for example, lands under perennial plants,

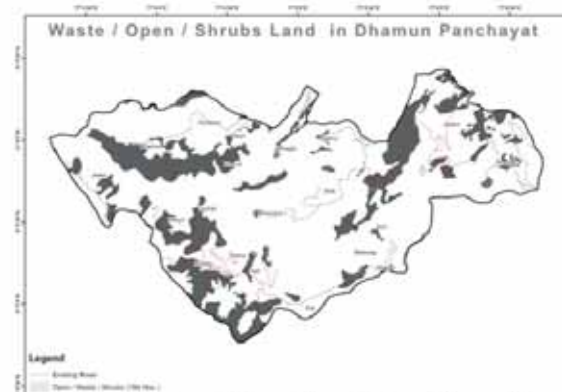
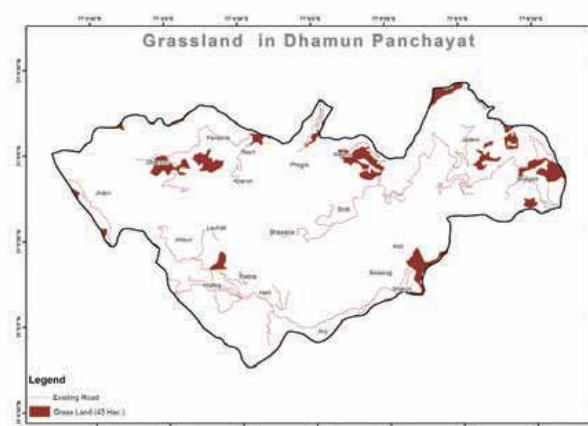
Type	Area (in Hectare)
Agriculture	190
Forest	350
Grass Land	30
Open Land	64
Shrubs	119
Total Area	753

grasslands, open forests, and forests. Also, the larger the built-up area (or the level of urbanization), the higher the physical sensitivity and, respectively, vulnerability of the territory. Soil degradation and geomorphologic processes (ravines, surface erosion, and landslides) determine soil quality and ecological conditions. In these assessments, all indicators in a component are treated as independent, and the ranking by a particular indicator implied equality of the rest. According to such an approach, *Shilli, Kalimoo, Paniola, Dadhol & Kharun* are the most sensitive village from the physiographical point of view, while *Balawag, Dhamun, Bhawana, Shilru and Jadeni* are the least sensitive one.

In the socioeconomic component, four aspects were evaluated, each of which also formed a kind of sub component. The resulting sensitivity is described as follows; (i) In the demographic subcomponent, population density is considered as a representative indicator of populations' general sensitivity to climatic threats. It is supposed that relatively more populated villages are more vulnerable as compared to the less populated. The Sensitivity also increases in parallel

with the increasing share of urban and female populations, which are, according to numerous publications, among the most vulnerable categories. Growth of a demographic load, described as a ratio of incapacitated population to the able-bodied part of a society, indirectly increases its vulnerability. (ii) The agricultural sub component has been preferred as a main evaluation criterion of economic sensitivity due to the role of agriculture- horticulture in Dhamun economy and rural employment. Undoubtedly, regions with, for example, low crop yields or reduced productivity in cattle-farming (e.g., yield of milk), are more sensitive than those where these indicators are higher. (iii) High unemployment and crime rates also contribute to increasing sensitivity to climate change effects.

By their physiographical condition, Dadhol is the most sensitive to external stresses, and Balaog is observed to the least sensitive. Densely populated and highly urbanized villages viz; Dadhol, Paniola, Shilli, Paniola are also highly sensitive in socioeconomic terms. According to the combined physiographical and social-economic factors, Rauri seems to be the most sensitive, and Balaog is the least sensitive to climate change.



The shift in agriculture practices from traditional crops to cash-crop intensive production is driven not only by variations in climate but also due to the socio-ecological evolution in agri-horticulture practices during the period. The ecological diversity of the region has permitted larger number of horticulture crops. This has led to the evolution of a wide spectrum of genetic variability in these crops for various traits. The crop diversity has also been enriched with the introduction, acceptance, and adoption of new cash crops from outside, such as the potato, broccoli, cauliflower, ginger, tomato, peas, capsicum varieties, which are playing a major role in the economy of the region. Many other new crops, such as exotic salad vegetables, leafy greens etc. catering to the metropolitan markets are being adopted in the recent times. For tomato, the local farmers have also developed several in-situ and ex-situ methods for its storage and improved shelf-life to facilitate year round market supply as per the demand and to avoid losses in storage. Similarly, to capture water in the difficult undulating hilly terrain and to facilitate its efficient use, the local people have adopted efficient moisture management techniques like drip irrigation systems etc., availing the provisions under and subsidy from Government schemes. The proliferation of diversification has indirectly made farmers more sensitive.

The rich heritage of different native crop species and genetic diversity of the region, is getting depleted because of several factors such as preference for cash crops, hybrid varieties, cutting, over-exploitation and burning of valuable forests, moisture stress due to climate variability etc. Degradation of forests, erosion causing rapid depletion of the valuable fertile top soil and other nutrients are further adding to the loss of natural resource base in the area. Further, inadequate knowledge among the younger generation about the value of biological diversity is also resulting in the destruction of vegetative cover and removal of valuable flora causing irreparable genetic erosion. Diversification of traditional cropping patterns also leads to severe environment degradation. In addition, increasing human population places more demand on the already constrained resources for meeting the requirements of food, fodder, shelter and transportation; further causing degradation of natural land cover, habitat loss and degradation, biodiversity loss, and ecological instability. Therefore, more efforts are needed to develop awareness, remediation and initiation of appropriate policy initiatives to restrict these processes.

Varieties of Crops Grown in Dhamun Panchayat

Pulses				
Sr. No.	Name of Pulses	Grown in past	Grown presently	Remarks
1	Kolth	Yes	Very less	<i>The farmers are not able to take crops of traditional varieties due to non availability of the seed and the cultivable land being used for other cash crops.</i>
2	Mash	Yes	No	
3	Kaiun	Yes	No	
4	Bahaldri	Yes	Very less	
5	Rongi	Yes	Very less	
6	Rajmah	Yes	Very less	
7	Bhat	Yes	Very less	
8	Soyabean	Yes	Yes	
Vegetables				
1	Peas	No	Yes	<i>The farmers opined that they get good price for the vegetables and therefore have diversified towards cash crops. They also stated that at times there are significant losses due to changing climate and non availability of water.</i>
2	Tomato	No	Yes	
3	Spinach	No	Yes	
4	Broccoli	No	Yes	
5	Cauliflower	No	Yes	
6	Cabbage	No	Yes	
7	Seasonal vegetables	Yes	Yes	
8	Lady finger	No	Yes	
9	Bottle gourd	Yes	Yes	
Other Crops				
1	Til	Yes	Very less	<i>The farmers said that they do not have the seed available for sowing the traditional crops besides the fact that younger generation is not even aware of the high nutritional values of these crops.</i>
2	Bathu	Yes	Very less	
3	Maize	Yes	Very less	
4	Flowers	No	Yes	



Crop diversification adopted by farmers of Dhamun

Assessment of the Adaptive Capacity

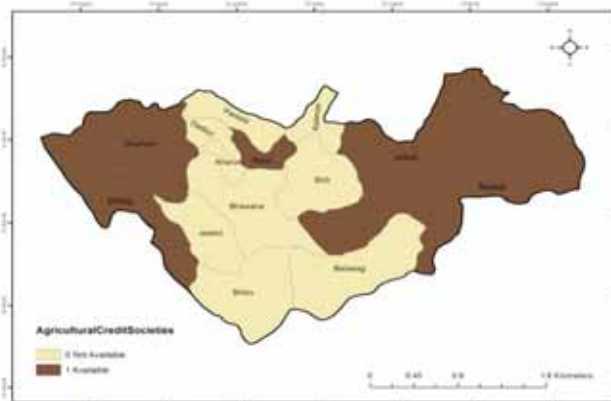
Adaptive capacity is evaluated as the function of a set of general economic and agricultural indicators, as well as taking into consideration the state of medical provision and housing conditions. Obviously, the higher the levels of each of these indicators in a certain village or *panchayat*, the higher its adaptive capacity to climate change; the sum of indicators' ranks determines its adaptive capacity relative to other villages.

The indicators for adaptive capacity are computed using 2011 census data. The maps have been developed for each of these indicators under adaptive capacity. The indicator-wise analysis is as under:

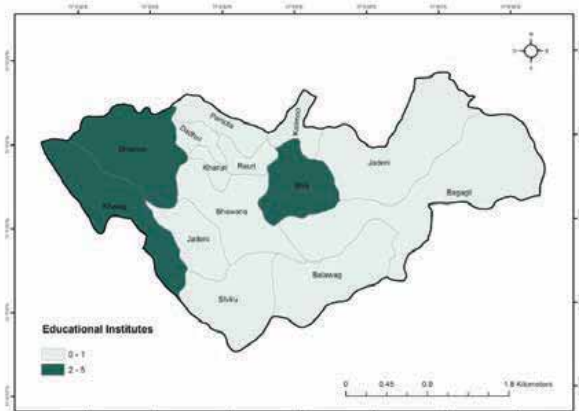
- 01 Educational Institutes
- 02 Road Network
- 03 Agricultural Credit Societies
- 04 Self Help Group
- 05 Hand Pump
- 06 Spring Source
- 07 Tank/Pond/Lake
- 08 Irrigated Area

Sr No.	Village	Composite Adaptive Capacity Adaptive Capacity Variables								Composite Adaptive Capacity
		01	02	03	04	05	06	07	08	
1	Dhamun	0.60	1.00	1.00	1.00	0.00	0.00	1.00	0.09	0.74
2	Dadhool	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Kharun	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.01	0.20
4	Khairi	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.60
5	Khalag	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.01	0.80
6	Shili	0.40	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.28
7	Shirru	0.20	1.00	0.00	0.00	1.00	0.00	0.00	0.09	0.26
8	Rauri	0.00	1.00	1.00	1.00	0.00	1.00	0.00	0.01	0.60
9	Paniola	0.00	1.00	0.00	0.00	1.00	1.00	0.00	0.04	0.41
10	Kalimoo	0.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.40
11	Balawag	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.27	0.25
12	Bhawana	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.77	0.55
13	Jadeni	0.00	1.00	0.00	0.00	1.00	0.00	1.00	0.21	0.44
14	Bagagli	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00

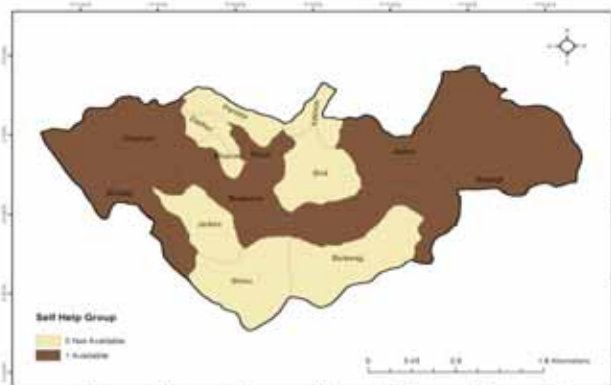
Agricultural Credit Societies - Dhamun Panchayat



Educational Institutes - Dhamun Panchayat



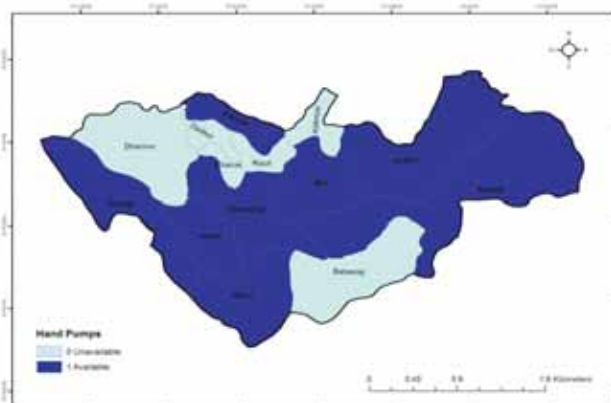
Self Help Group - Dhamun Panchayat

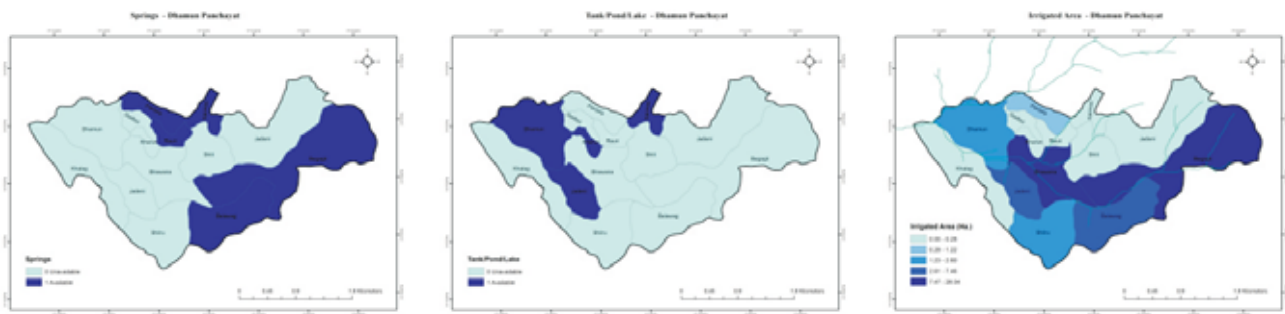


Road Network - Dhamun Panchayat

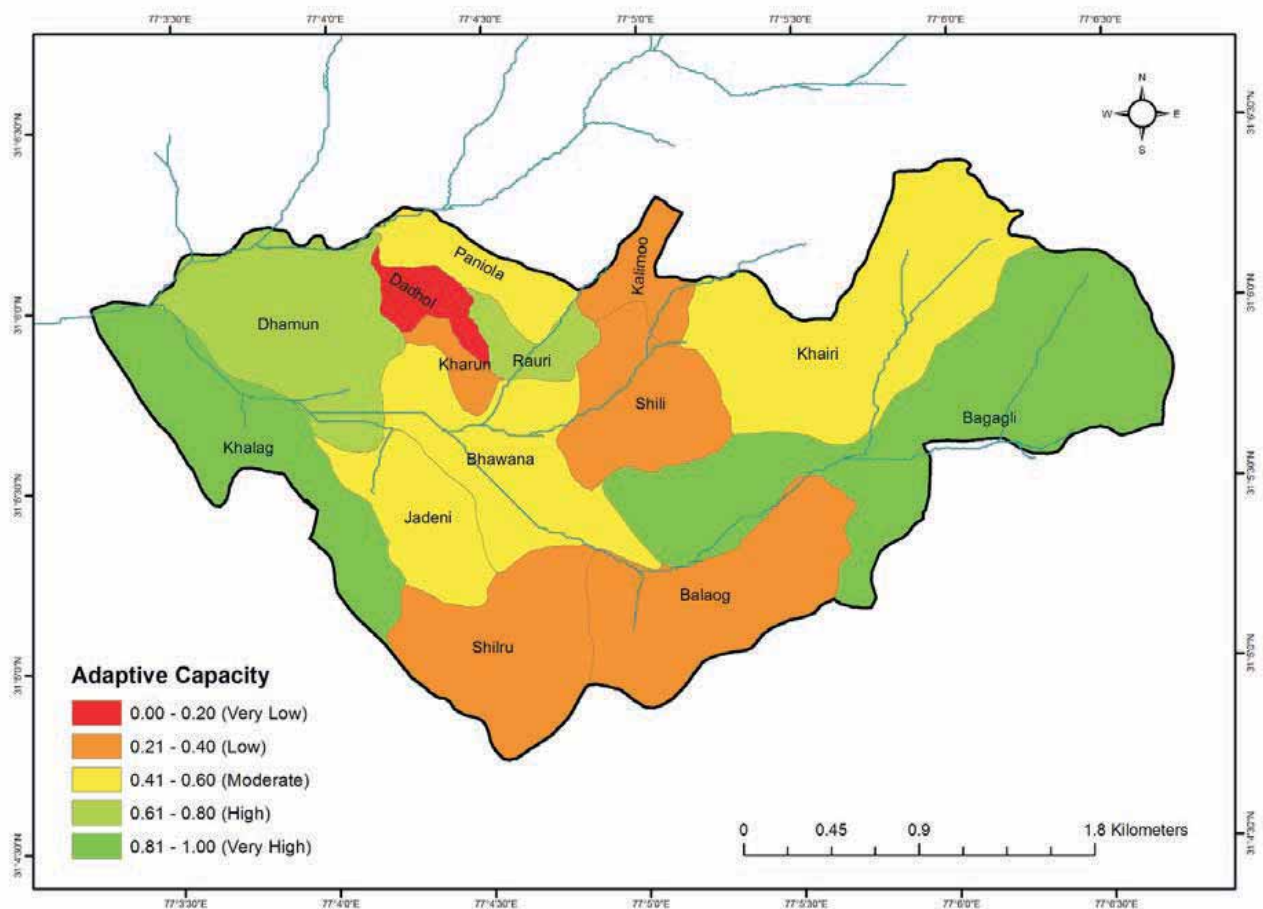


Hand Pumps - Dhamun Panchayat





Composite Adaptive Capacity Map - Dhamun Panchayat



Obviously, the higher the levels of each of these indicators in a certain village or panchayat, the higher its adaptive capacity to climate change; the sum of indicators' ranks determines its adaptive capacity relative to other villages. As it would be expected, the *Bagagli* near to capital city Shimla has the highest adaptive potential to confront climate change challenges, while *Rauri* potential is the smallest.

High adaptive capacity is seen only in the main town and sub urban areas such as *Totu*, Shimla, *Shoghi*, *Ghanahatti* located near to *Dhamun*. A majority of the villages have moderate provision of basic necessities of living. Even in terms of infrastructure development such as educational and health facilities, these villages

rank low in comparison to other villages of Shimla district. These towns are also highly dependent upon natural resources for supplementing their livelihoods, the dependence ranging between 50 to 70 percent. The variations of infrastructure and access to basic facilities show a general trend, that rural areas i.e. panchayats rank quite low when compared to sub-urban areas with the people in urban towns having better access to services and resources. These villages are also highly dependent upon natural resources for their livelihoods that range between 55 to 60 percent. The villages which are far from urban centres to a great extent lack infrastructure development and in case of any changes in the climate pattern, these areas might not be able to cope with the resultant severity due to limited adaptive

capacity. These areas thus need more attention for making them better equipped to adapt to climate change. Road –connectivity is seen to bring along with it a lot of other infrastructure support that enables livelihood strengthening in rural areas. The villages which are connected with roads are also not properly maintained, therefore transportation of agri-hort products is big issue. No cold store etc. is set up to facilitate the handling of agri-horti produce for transit period post harvest.



Crop of cauliflower spoiled due to hail storms



Saplings production in Dhamun panchayat



Farmer irrigating farm lands using bucket



No storage for vegetable crops



Destroyed Traditional Water Mill (Gharat)



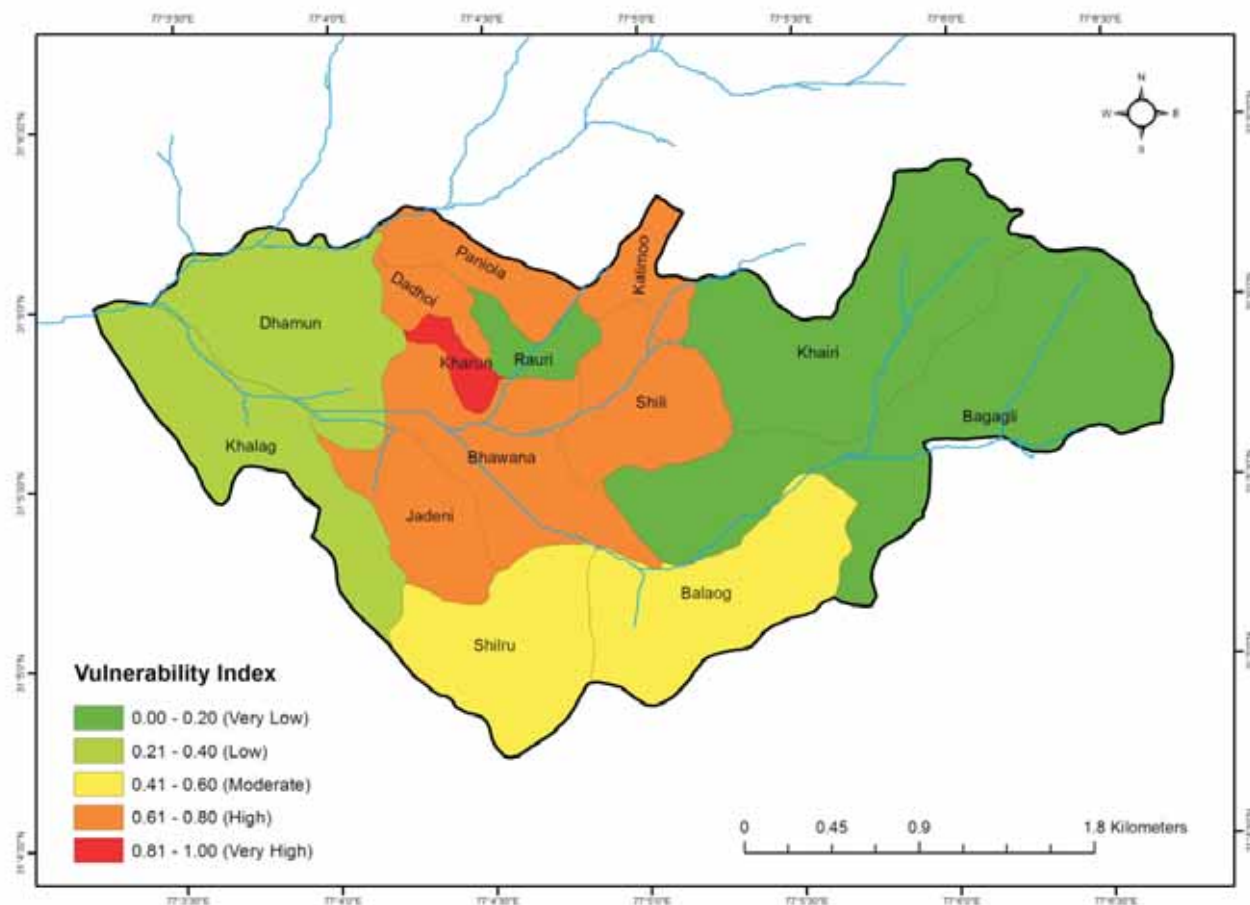
Vulnerability Assessment

Vulnerability to climate change was calculated by summing up the sensitivity and adaptive capacity ranks. Due to the aforementioned lack of a clear knowledge on importance of these two components in the overall assessment of vulnerability, their weights have been taken as conventionally equal. In the process of adding two sides of vulnerability, the sensitivity was ranked in a decreasing order, and the adaptive capacity is sorted increasingly. The resulted villages' ranks of overall vulnerability are shown as follows:

Sr Village No.	Vulnerability Index Exposure Variables			Vulnerability Index
	Composite Exposure	Composite Sensitivity	Composite Adaptive Capacity	
1 Kharun	0.68	0.89	0.20	1.00
2 Dhadhol	0.03	1.00	0.00	0.79
3 Panaiola	0.44	0.92	0.41	0.74
4 Shili	0.20	0.92	0.28	0.67
5 Bhawana	1.00	0.37	0.55	0.66
6 Jadeni	0.63	0.57	0.44	0.62
7 Kalimoo	0.16	0.96	0.40	0.60
8 Shilru	0.40	0.37	0.26	0.47
9 Balaog	0.73	0.00	0.25	0.45
10 Khalag	0.40	0.69	0.80	0.33
11 Dhamun	0.71	0.24	0.74	0.28
12 Rauri	0.07	0.50	0.60	0.14
13 Bagagli	0.53	0.41	1.00	0.12
14 Khairi	0.00	0.35	0.60	0.00

Indigenous communities living in hilly regions of developing countries are predominantly vulnerable to climate change as result of their high dependency on natural resources for their livelihoods, comparatively higher exposure to extreme events and widespread poverty marginalization. It is commonly assumed that communities in developing countries are particularly vulnerable, given their more direct dependence on and exposure to climate related conditions, climate sensitive resources and given limits to their adaptive capacity associated with economic circumstances, institutions, and technology. Already there is evidence of changes related to global warming in hilly areas. Rise in levels of temperature are disproportionately higher rates at higher altitude and changing precipitation patterns and deforestation with hilly areas becoming relative 'hotspot' of climate change.

Vulnerability Index - Dhamun Panchayat



Exploitation of natural resources reflects the vulnerability of people and communities to climatic conditions, and adaptive capacity reflects a community's potential or ability to address, plan or adapt to exposure. Exploitations and adaptive capacity



Peas crop destroyed due to changing climate

are not mutually restricted. Exploitation to repeat climate related conditions, for instance, can develop conditions, and enables response with learning, thus increasing the adaptive capacity of the system. Certain adaptive strategies can also change the nature of the community like location, structure, and organization; such that the community is more or less exposed, or exposed in different way. In this conceptualization, vulnerability at local level is viewed as being conditioned by social, economic, cultural, political and climatic conditions and processes, operating at multiple scales over time and space, which affect community exposure and adaptive capacity.

As it is seen from this table, village *Kharun* has the highest relative vulnerability in comparison with other regions of the *Panchayat*, being among the first village both with high sensitivity and with low adaptive capacity village *Khairi*, *Bagagli* & *Rauri* with the lowest vulnerability; its relatively low sensitivity is combined with a high adaptive capacity.

Many of the community based responses observed in the study area were short term coping strategies. Examples include shifts in the agricultural calendar in response to varying annual precipitation patterns, re-sowing after an early season failure, and use of failed crops as food, borrowing money and selling assets, and even migrating due to lack of drinking water. Many of these coping strategies deplete the household's livelihood asset base and actually render it more vulnerable in case of recurrence of the event. Except few, largely the Adaptation and capacity development strategies are short term and unsustainable. The adaptation practices observed in the *Dhamun* area include the introduction of new crops; maintaining multiple cropping systems; growing more than one crop per year; construction of green houses, drip

irrigation, water harvesting systems; and livelihood diversification. However, in order to increase the resilience of local communities, appropriate longer-term strategies that build on native community's traditional knowledge need to be developed, rather than focusing on short term responses which may actually reinforce vulnerability in the longer term.

The entire process of stakeholder organization is merely production focused rather than building on long term climate change adaptive capacity of these farmers.

Vulnerability Mapping

The maps of vulnerability as well as of its components provide information that can lead to comprehend climate change impacts reduction through drawing of safety and environmentally conscious policies and practices. Numerous vulnerability maps prepared to better understand the drivers of vulnerability and to compare results, regions, communities, and so forth in terms of the risks they face from climate change consequences and their capacity to deal with them. The comparison of vulnerabilities facilitates allocation of limited resources equitably and efficiently among different entities—regions, administrative groups, or different proponents of adaptation; this is especially important for transition economies, to which different villages in *Dhamun Panchayat* are attributed.

The spatial assessment of sensitivity, adaptive capacity, and vulnerability has also been done. Thus, resulted maps highlight areas, which are needed in the first priority adaptation measures. In particular, village *Kharun*, *Jadeni*, *Bhawana*, *Shilli*, *Dadhol*, *Paniola* & *Kalimo* are among the most vulnerable and require special attention in policies dealing with climate change adaptation at local level. Accordingly the target were prioritized for capacity building etc.

7. Participatory Analysis of the Assessment's Results - Explanations

To make the study's findings well known and to test them in the real-life context, there were organized wide consultations with people, communities, and organizations of the *Dhamun Panchayat*. Preliminarily, based on the research outputs the short textual and graphical summaries describing the main identified risks, their probability and urgency, as well as current adaptive capacity were developed and

may be) from a largely non-academic perspective; (iii) provided a platform for brainstorming about specific options for mainstreaming the adaptation.

A methodological conclusion from the consultations is that short and simple summaries of the vulnerability assessment are very effective tools for a real public



Hitech Green House: Village Dhamun

presented through specially organized workshops. During a facilitated discussion, the women farmers, representatives of villages, sectoral experts and agencies, academic, and nongovernmental organizations reviewed the findings from their regional or sectoral perspectives, local community representatives commented the conclusions, and suggested priority adaptation measures to reduce likely climate-related risks. It was also discussed which of the proposed measures can be taken on the tehsil level or locally, and which of them require interdepartmental cooperation or coordination with the stakeholder departments.

On the whole, this exercise has achieved several goals: (i) promoted the communication of the vulnerability assessment findings to a broad and diverse audience in the region; (ii) “confirmed” them (or not, as the case

participation in dealing with such a complex issue as the assessment of climate change vulnerability at a panchayat's level. Women farmers were happy not only on account of on farm exposures or to change their perspectives from the viewpoint of the impacts intensity and probability but eventually were not able to discuss the issues in-depth and much better understand their content, context, and interdependence. Besides economic pressures, the natural stress also plays a vital role.

Adaptation actually taking place at local level and people are already making the changes they can, independently of government. In the rural areas of Himachal Pradesh, particularly in the study villages, people are already adopting diversification in agriculture practices. Gradually traditional cropping has been replaced with cash crops in many parts. But

individual's and community's ability for adaptation action is limited; lack of financial resources and technical know-how, optimal scale of operations are some of the limitations faced by villagers, especially women. Without adequate government support and backing, there are only a few initiatives that small and marginal farmers, can take up on their own.



Small women farmers in Dhamun

The capacity of women farmers about climate change knowledge is not very good so that they are able to cope with timely interventions resulting into struggle for sustaining livelihood practices.

Economic Pressure

Community based climate vulnerability in any form, either man made or natural, often significantly affects the local economic structures through breaking the cash flow systems within the economy, especially the financial systems within the informal sector. Workers in informal sector particularly become economically most vulnerable at the times of disasters. Often in vulnerability affected localities establishing alternative livelihoods and cash flow mechanisms are explored which may not be the right approach. The impact on resource-intensive infrastructure also needs to be considered. Local authorities at present are building infrastructure without taking into account the long term availability of resources to make these relevant to the villagers. For instance, while irrigation schemes and structures are currently being designed conforming to current availability of water in the natural sources, but in the eventuality of shift in temperature and rainfall patterns, there is every possibility of such infrastructure becoming redundant in the long term. This would necessitate building of new type of infrastructure, leading to further need of resources and multiple pressures on the economy of the area.

Local communities in the developing regions are often marginalized from policy interventions and economic opportunities. They generally face high levels of poverty and the ecosystems they dwell in are among the most sensitive. Forest ecosystems and native people are

exposed to multiple drivers of change including globalization, economic policies, and increasing pressure on land and forest resources, resulting from economic growth and changes in population and lifestyle. Climate change is expected to place additional stress on these already challenged ecosystems and livelihoods. In the absence of basic facilities for education, health and most importantly alternative avenues for income generation, it is not hard to comprehend why these people are not so advanced economically. Few village people are land less or having very small land holdings and engaged mostly as agricultural labour. Youth are also engaged for generating livelihoods within the agriculture practices.

Some non-governmental organizations are involved in generating alternative livelihoods for the people by involving them in programs like habitat restoration of degraded forests, by other non-farm income generating activities (IGAs) such as making of jute bags for sale. For instance Mahakali Flower Growers provides employment to a large number of women from each village for more than 100 days per years. Other alternative IGAs implemented by them in different villages are poultry and piggery, development of permanent agriculture land and setting up of flour mills etc.

Climatic and ecological stress

The large scale over-exploitation of forests through logging, grazing and collection of non-timber forest



Crop of aleovra destroyed due to dry weather

product as transformed them into a degraded state, besides rendering them vulnerable to forest fires. Shifting preferences for growing cash crops over traditional agriculture has impacted the local climate besides changing the soil quality and moisture regimes. Destruction of habitat reduces ecological diversity and causes extinction of indigenous species that contribute to the valuable gene-pool reserves, such as native, traditional crops, medicinal and aromatic plants etc. In addition, residue-burning leads to severe environment degradation. Continuously increasing human

population and their growing demands on natural resources and land have further exacerbated the degradation of land, water and bio-resources, resulting into climatic and ecological stress. Climatic and ecological stress can influence the socioeconomic setting in the Shimla landscape in a number of ways. Drivers of degradation, urbanization, forest fires, mining, extraction of timber and crop-diversification are predominated as climatic and ecological stresses. It can influence the economy (e.g. agriculture, livestock, forestry, tourism, etc.) as well as human health. Human activities like sub-surface minor mineral mining and agro-chemical intensive agri-horticulture cause extensive degradation of the traditional agriculture land and forests that support a variety of successional communities ranging from open forest to abandoned fallow fields. Increasing human intervention and excessive exploitation of resources have resulted in great changes and indicates alarming signals of accelerated biodiversity loss. The consequences of biodiversity loss from climate vulnerability are likely to be the worst for the poor and marginalized people who depend almost exclusively on natural resources. Poverty, poor infrastructure (roads, electricity, water supply education and health care services, communication and irrigation) reliance on subsistence farming and forest products for livelihoods, substandard health indicators availability of health infrastructure, and other indicators of development make these villages more vulnerable to climate change



Lemon Grass village Bhawana

The conservation of biodiversity, including restoration and rehabilitation, can be a key adaptation strategy to help vulnerable people cope with climate vulnerability. The maintenance of traditional crop variety is an important tool in adapting to Climate change. In addition to biodiversity playing a role in Adaptation-through local Climate Vulnerability and Capacity Assessment adaptation strategies, Climate change is

threatening biodiversity that is partly catering to livelihoods especially amongst rural populations and local people in these villages.

Role of Forests - Eco system services

It is widely acknowledged that forests help in maintaining a sustainable water supply for the people in



the catchment as well as for those downstream. Forest ecosystems act as a sponge, soaking up and storing water when it is in abundant and releasing it during dry period. Forests are defined as water pools, filtering, retention and storage of water in streams, lakes and aquifers. Filtering is performed by vegetation and soil biota and retention and storage depends on site characteristics. Loss of forests has been blamed for many problems ranging from flooding to aridity and for catastrophic deterioration of water quality. In fact, the hydrological role of forests is complex. Precise impact on water supply varies with location, age and composition of the forest. It has been reported that reduction in native forest cover causes substantial decrease in supply of drinking water.

Due to limited drinking water resources and high dependence on rainfall, as well as reliance on natural resources, the villagers are vulnerable to the impact and ill effects of climate change.

The forest cover in the villages is minimal and the land use pattern suggests that agriculture is mainstay in the villages with little paddy cultivation in the seasonal cycle. Landslides, soil erosion often deluge sloping plots, destroying standing crops and damaging the down slope areas with the debris carried by the flood water. An innovating coping strategy practiced by upland farmers in the villages is the use of wood filters/ frames, across inlet channels to trap the silt and debris brought by the flood water.

Women's role in climate vulnerability and capacity

Climate change impact will be distributed in a different way between men and women as well as among regions, generations, age classes, income groups, and occupations. The poor, the majority of whom are women living in developing countries, will be excessively affected. Yet most of the debate on climate so far has been gender blind. Gender inequality and Climate change had been gender linked. By exacerbating inequality overall, Climate change slows progress towards gender quality and thus impedes efforts to achieve wider goals like poverty reduction and sustainable development. And women are powerful agents of change whose leadership in reducing climate vulnerability and capacity building is



Women farmers in orientation workshop

critical. Local rural women can help or get in the way strategies related to conservation of biodiversity, suitable use of natural resources, control of population pressure, economic growth, and science and technology, among other things.

Community based climate vulnerability disaggregated data are necessary for governments and other public and private organizations to plan adequate services for the overall population which address the different needs for youth, women and men to help bridge the inequality gaps. This also help governments, workers and others to understand how socioeconomic changes affect women and men differently and how they can cope with new realities. In general, gender inequalities affect women's access to education, health care services, and financial resources, and constrain their participation in decision making. This in turn limits their capacity to seize new opportunities and to handle economic stresses. Realisation of this leads to unfounded generalisations; for example the assumption that women-headed households will be poorer - an assumption that can only be tested if gender disaggregated data are available.

This study, therefore, finds the ways and means for knitting the local economy through various interventions with gender specific focus. Considering that women have an important role in local economy, this exercise underlines the need for prioritizing the role of women in any eco-management scheme/ effort, at all stages- planning, design and implementation.

The village survey findings reveal that 10 percent of the households in the villages are in the below poverty level (BPL) category. Further, the villages suffer from serious bottlenecks in respect of transport and communication, education and health facilities. Agricultural activities in the area show poor productivity. Lack of institutional credit has reinforced the presence of money lenders in the villages. Lack of livelihood opportunities has also led to migration of men outside the villages; most of them have migrated to other areas of the State. The development programmes for poor viz., Indira Awas Yojna, MNREGA or low cost sanitation programmes are well accepted by the village people but due to high economic pressure for sustaining day to day existence, youth are forced to forgo higher education to partake in augmentation of livelihoods and add to household income.

In most of the Shimla hills region, women are responsible for supplying water and fuel and play a crucial role in food security besides looking after their children at household level. Since climate vulnerability affects the mountain natural resources and biodiversity that provides water, food and energy, the depletion of natural resources has particularly negative consequences for women. Women will have to work harder to access these resources with the extinction of some plant species and depletion in water levels in water sources; while this will increase their already heavy workload on one hand and on the other they would also emerge as a valuable source of information with regard to the shifts happening due to climate change. Women often appear to be better managers of resources since they are dealing whole day with fuel, fodder and farm activities.

Gender relations are significant 'pre-conditions' of people's ability to anticipate, prepare for survive, manage with, and recover from disaster and women are victims of natural disasters in large numbers. Motherhood partially explains this fact; but the main factor that place women at greater risks are related to social norms and gender roles, such as dress codes, behavioural norms, opportunity for awareness and the mode of decision making. Although women are disproportionately vulnerable, they also play critical role in disaster prevention and response. During the study it was found that women manage and use natural resources, wood, water and fodder on a daily basis. Other important social networks provide them with information about members of the community who may need assistance, or can help in times of crises, for family and community roles make them important 'risk' communicators. In certain PRIs women play important role and they also have leadership roles in informal local networks and organizations.

Like all rural women, women work extremely hard in these villages as well. They work in fields, husk rice, collect firewood, water and some still spin and weave wool. The women cultivate wheat, rice, maize, pulses and variety of vegetables and fruits. They lack infrastructure for transportation of farm harvest though there are planned cultivations but and requires systematic mechanism for this purpose and channelizing the marketing of the farm produce.

The women are also engaging in other eco-activities by

organising themselves into self help and common interest groups cleaning natural water resources etc. The women are not geared to access outside markets as yet. There is tremendous scope for empowering women economically as production is not a problem at all.

Here under this pilot about 350 women farmers from different villages were targeted for capacity building on climate change adaptation. These women farmers were given training, exposure visits in order to learn how to mainstream the climate change adaptation in day to day life.

Some glimpses of gaps in implementation of various adaptive measures

The Poly houses used as Store



Peas Crop in a polyhouse complete covered by weeds



Crop of alovera, spinach and peas failed due to dry weather



Wastage of resources, rain water harvesting tanks built unscientifically, lying unused, similarly saplings supplied to villagers by forest department lying unutilized, dried due to unscientific management



The manure, fertilizers supplied by department kept in open



No irrigation facility



The vermi compost unit built under HTM project not used.



Unscientifically used polyhouses



8. Outcomes

The approach, used in this work for the so-called “quick” assessment of present-day vulnerability to climate change that was based on the historical and up-to-date statistical and hydrological data, has demonstrated undoubted efficiency, when applied at the local level. Nevertheless, underlines an idea that such assessments should be considered just as the first experience, highly dependent on available information and heavily relying on expert evaluation.

Also, it is obvious that the carried out vulnerability assessment has to be extended and deepened along with progress in climate change scenarios development and

..... though the farmers have partially started adapting to new technologies but in want of technical back up or know how even then we are not able to sustain the crops save it from climate change impacts.....
A farmer Sh. Ram Gopal.



i n c r e a s i n g knowledge in the studies of complex interactions of the environment and socioeconomic development. At the same time, it is necessary to further identify and collect detailed information on various indicators

of sensitivity and adaptive capacity at the local level, that requires more time and resources. Such improvements will be the subject of new State level and national researches aimed at more efficient use of information as well as of methods to select and interpret the most representative vulnerability indicators.

During the process there was general consensus from stakeholders- farmers that the various programmes are largely complementary but not of much help to uplift

Rural women also find it difficult to get the quality seed or seedlings to better adapt to changing climate and switch over to better adapt to changing climate and suitable area to climate resilient seed varieties in the villages.

t h e e c o n o m i c a l positions. These farmers opined that the programmes needed to be longer term and more strategic; the focus on local scale delivery mechanisms and mainstreaming of

other climate change programmes is equally important.

A participatory analysis in the vulnerability assessment, with involving the broad range of stakeholders with special attribute to Gender from the Panchayat, has proved to be an effective tool for both verifying and better communicating the assessment results.

The interventions applied are more production centric rather than oriented towards long term benefits and resilience towards climate change.

Long ago may be 40 years past, I use to cultivate Red rice (-a local variety of grain which could be grown in dry soil as it does not require much moisture) Munda and Bagra were the two variety swon in summers. these varieties are not cropped now in view of the changes in cropping patterns that seed is also not available, Government should propagate cultivation of these varieties and must provide seed to farmers. There is hardly any effect of rain or non availability of water-climate change on this variety.....



Smt. Nanki Devi from Shilli village an old woman



Our panchayat is dominated by women farmers. We do best at our level to bring up the marginal farmers. Certainly the financial limitations are there with these farmers, not able to adopt the new technology or programmes. There are progressive farmers within our panchayat who are trying to help small and marginal farmers both economically, technically. We expect and believe that an coordinated effort could make a difference in uplifting the farmers and in making them to combat with impact of climate change.

Sh. Baldev, Pradhan, Gram Panchayat Dhamun

I am really feeling very happy while harvesting red rice crop after so many years from my farms. The intervention of Himachal Pradesh Knowledge Cell on Climate Change are appreciable which encouraged us to restore these crops. We will open a traditional crop seed bank in the panchayat soon. We will learn more about seed banking. State Government must help women farmers in such endeavours. We have gained a lot of knowledge about climate smart agricultural practices from various exposure visits and training/capacity building programmes organized by Department of Environment, Science & Technology, Government of Himachal Pradesh.

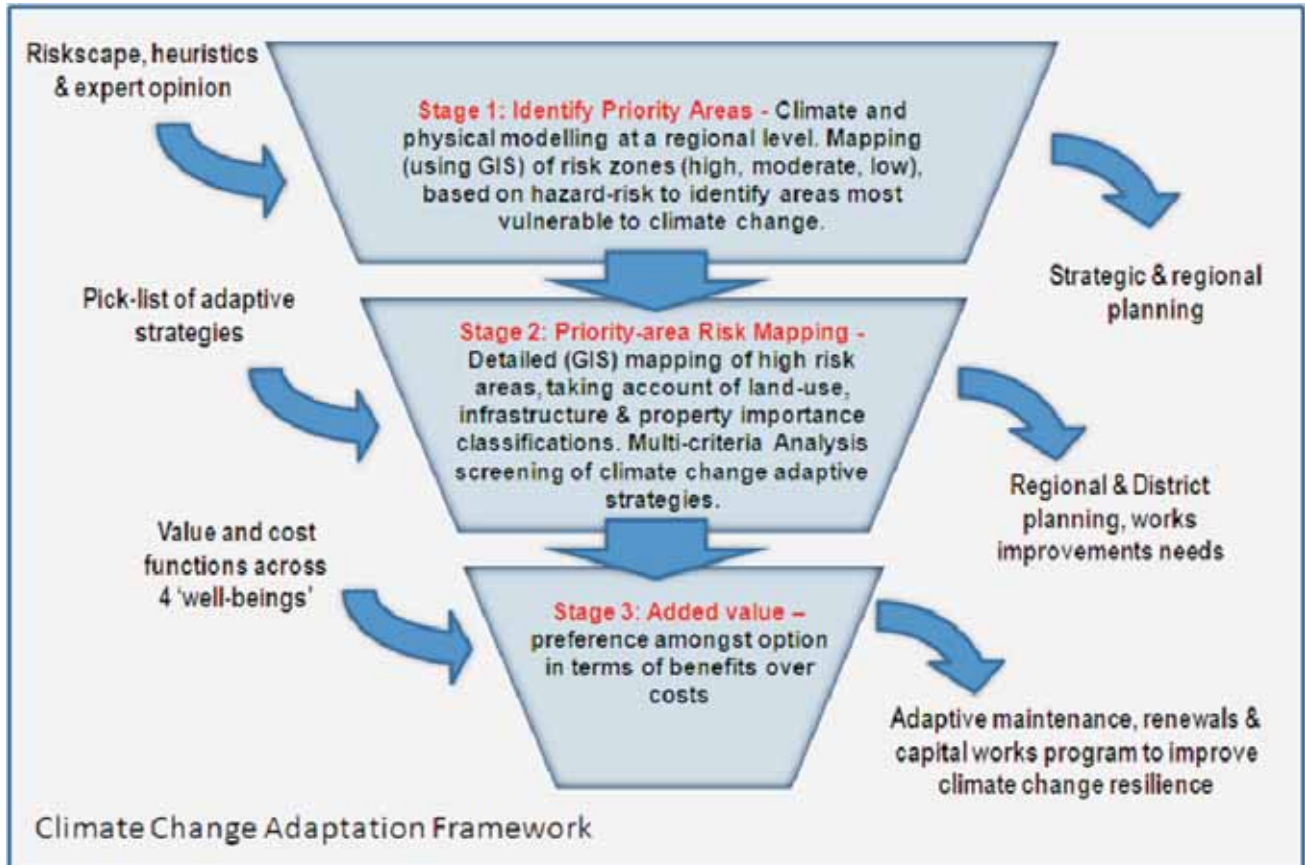


Smt. Kamlesh, Ward Memeber, Shilli Ward

9. Himachal Pradesh Knowledge Cell on Climate Change– Intervention

HP State Climate Change Knowledge Cell understood it well that in every day roles as farmers, foresters, caretakers, household providers, women use and manage natural resources. Women farmer have unique experiences and knowledge with respect to their environment' they offer important

Though the steps are not very big, these have been instrumental in bringing about a significant change in the thinking process of the women farmers in the study villages. The HP KCCC has undertaken following steps while worked with women farmers:



perspectives in governance and management of natural resources. They are adapting to the changing temperatures scenarios and changing rainfall patterns. They have been managing extreme events to the best of their knowledge and capacity and practice. Given their responsibilities to meet needs of food, energy, water, reduction in crop production and degradation of natural resources leads to increased burden on these farmers. A development path that places women at its centre and focus on women empowerment would be more effective in mainstreaming the climate change adaptation solutions for stronger sustainability and livelihood outcomes.

The Knowledge Cell on Climate Change worked closely with women groups on various aspects that have led to achieve climate resilience in the area.

Understanding Climate change with Village Women

The HPKCCC interacted with local women and other stakeholders and held discussions through a participatory process on various issues they are facing in everyday life, including management of various natural resources. This process lets the women express themselves and enables them to share their experiences in a very easy manner and their confidence level was much improved afterwards.

On farm Discussions- understanding climate change issues- solutions

The women farmers groups, representation from all villages were taken for on farm discussions and their problems were discussed. This led to providing workable

local solutions to them. The focus group discussions covered questions such as, what are the day to day issues, how best one can easily tackle these issues, how the rate of efficiency can be enhanced in irrigation practices, how efficiently the water resources can be managed, etc. following aspects were attended during the discussion:



On farm training to farmers at CSIR Chandigarh

Water Harvesting – Precision Irrigation

Agriculture is the mainstay of most of the local women. They struggle to irrigate their farms during summer and winter and are dependent upon perennial natural water resources in the catchment. But short-sighted developmental policies such as construction of rainwater harvesting structures not planned well, though well-intentioned but lacking technical capacity of farmer to deal with these issues, now threaten both



On farm training at CSIR Chandigarh

this unique natural water resources and subsequently the irrigation system and the social consciousness that is spawned by it. The local residents have kuhl (water channels) system in these areas. During the visits the management practices were observed and women farmers were educated on various technical points such as the crucial portion of a kuhl is its head at the intake point of rivulet/ nallah, which is to be tapped. The women farmers were educated that head must be kept free of debris, and so the kuhl is lined with stones to prevent clogging and seepage. The women farmers

were told to initially store water in a circular tank and from which the flow of water can further be regulated by forming a farmer group.

For example, when there is need for irrigation, water is let out of the tank in a trickle. Water from the kuhl is collected through the night and released into the exit channel in the morning. By evening, the tank is practically empty, and the exit is closed. Now this cycle is adopted and repeated daily.

The kuhl system succeeds because local residents mutually cooperate and share. The culture also is



Spring water source management

instrumental in maintaining the carrying capacity of the surrounding cultivable land. However, this system could be carefully nurtured through years, the risk of being getting upset through government intervention is always there, since subsidized incentives to individual farmers under various schemes could lead to a loss of interest in co-operative culture therefore coordination among stakeholder department & farmer interest groups is must.

The women farmers were educated with on farm



Precision - Moisture Management at village Bhawana

demonstration on precision irrigation that how the moisture can be maintained even with less water for better outputs. They were educated on various aspects of precision irrigation.

Precision irrigation is a technical tool to save water and

energy and efficiently manage the water resource in the farms. There are two main parts to a precision irrigation system — the physical infrastructure that delivers the water to the plants and the control and management



Tomato crop at village Shilli

system which operates it. The control and management system itself consists of three sub-units: monitoring, growth management and control. Precision irrigation conserves both water and fertilizer. It also improves crop yield. Precision irrigation is not just to save water, it is also for the more precise application of water. If you water improperly you damage the quality of the crop. Surface irrigation is considered imprecise. When you water an entire field you irrigate a large area where there are no crops, thereby wasting water. Since the fertilizer is delivered via the water you also waste a lot of fertilizer. Surface irrigation also makes it very difficult to ensure all the crops receive a uniform amount of water. For example, plants at the beginning of a field usually receive more water while those at the end receive less.

Drip irrigation, in contrast, is the most precise as it waters plants directly at their roots, so no water is wasted watering areas that do not contain the crop. It also ensures every plant gets an exact and uniform amount of water and fertilizer.

Soil Management

Soil and water are critical natural resources that must be kept in harmony with the environment for agro-ecosystems to be sustainable. Geologic erosion by wind and water has created some of the world's most productive soils, but accelerated erosion, induced by anthropogenic perturbations, has had drastic effects on ecosystem services and resulted in significant dissection and transformation of landscapes. Through this review/ assessment examines integrated soil and water conservation practises, implemented at the catchment scale to balance plant nutrition and increase productivity, while maintaining soil health as well as surface- and ground-water quality. The women farmers were given training at Central Soil & Water

Conservation Research and Training Institute Research Centre, Chandigarh and Uttrakhand and were trained on soil management techniques by the experts of these institutes.

Training and Capacity Building

Training and capacity building of women farmer under this review process was one of the effective instruments



Women farmer applying compost unscientifically

that enabled not only the off farm but also on farm understating w.r.t. climate change impacts. Overall about 350 women farmers were given training at Shimla, about 75 no. at Chandigarh and Uttrakhand on climate change adaptation:



Women farmer under training at CSIR Chandigarh

1. Understand how local climate resilience plans can contribute to the regional economic development, environment conservation and improving the quality of life of residents in the community;
2. Learn about tools to assess local vulnerabilities with respect to climate change, natural disasters and food security;
3. Increase insight for planing effective strategies for climate change adaptation and mitigation;
4. Learn about opportunities for funding local climate initiatives, engagement of the private sector and mobilizing financing from other countries and;

5. Integrate climate resilience plans in the local policy process through designing climate SMART-action plans and applying lessons from examples in the region.

The other thematic areas which were covered under training included continuous self-learning for balancing between forces of nature and actions of mankind, climate change scenario in Himalayan region and associated adversities, climate change awareness



On farm training at CSIR Chandigarh

and perceptions, climate change & culture, climate variability induced distress and social/behaviour



Composting pits scientific management

dilemma, behavioural perspectives to climate change adaptation and psychological barriers, coping with the changing climate through changing life styles and behaviour, Building community resilience and co-management as an adaptation strategy, spiritual strategies to climate change adaptation and cognition techniques.

Banking Traditional Knowledge

The changing lifestyles, developmental aspects have affected the traditional systems to far extent. The

youths are observed to be completely groomed in a different atmosphere. Through this review process the women farmers were given understanding of these interventions with traditional social mechanisms. The young women farmers were brought together with old aged women farmers to nourish, exchange the traditional social mechanisms adopted for seed protection, crop management and for irrigation, the repair and maintenance of kuhls. Traditionally, community labour was used to repair kuhls and each household contributed either in labour or material in kind to keep the kuhls in good condition. But residents of these villages complain that on account of the irrigation department's intervention and non availability of labour in the village resulting from migration for pursuing alternative job opportunities has resulted in the breakdown of the traditional system.

Traditional Crops seeds- Distribution of Seeds

Climate change has contributed to unpredictable or erratic rainfall pattern, drying up of local springs and streams, species migration to higher elevations, shift of



Traditional crop seed storage

sowing and harvesting period of crops, emergence of invasive species and incidence of diseases/pests in crops as well as in fodder species. Building resilience in both human and ecological systems to an optimum level is the best possible way to adapt to climatic



Traditional seed distribution by HPKCCC

variation. This study has identified the primary challenges of women farmers for ensuing adaptive

capacity and water security in the agriculture systems. High levels of impact from climatic change was recorded for paddy, maize, wheat, oil seeds, ginger, drinking water sources and springs and fodder trees.



Crop management

The women farmers were quite aware about the loss of the traditional farming and nutrient value of the traditional crops. They were educated on aspects such as how the social, economic and climate change factors have been eroding the agriculture biodiversity in recent years. They were informed as how the number of traditional crops have been endangered and how important high nutrient and other values these have. A women farmer group has been formed to collect the traditional crops seed and then further distribute it to farmers and get back the seed during harvesting double the quantity for further circulation. About 10-20 bigha area has been brought under cultivation of traditional crops mainly red rice, which is a drought tolerant local species having high nutritional value.

Protected Cropping- Conservation Agriculture

About 40% farmers were found to be using the conservation agri techniques and rest were without such application for one or the other reasons, these farmers group were educated, trained over protected farming and conservation agriculture (CA), which is very popular and effective in many parts of the region. They were educated on the key elements of conservation agriculture are: (i) minimum disturbance to soil; (ii) permanent soil cover; and (iii) the adoption of innovative and economically-viable cropping systems and rotations to decrease soil compaction. CA offers opportunities for arresting and reversing soil degradation and decreasing cultivation costs. Conservation agricultural systems sequester carbon from the atmosphere, promote a healthy environment, improve biodiversity and biological processes. In the region now women farmers have started adopting the protected farming techniques and the concerned line

departments have initiated extensive programmes in the villages on it.

Crop Diversification Contract Farming

The women farmers were also educated on gradual crop diversification to get higher yield and reduced costs of cultivation by applying modern techniques, hybrid seeds (about half of the conventional cultivation). Areas under CA have increased locally, steadily from 2.8 ha to about 17 ha. However, distribution of CA adoption remained scattered, due to lack of knowledge on the impacts of key CA components that affect crop productivity under diverse agro-ecological systems. Bottlenecks impeding CA adoption also include:

1. High initial expenditure of planting equipment.



Contract farming

2. The completely new dimension and dynamics of a conservation farming system, which requires high management skills and a learning process.
3. Risk of crop failure and decreased crop productivity in the initial years.
4. New pest and disease problems.
5. A shift in dynamics of dominant weed species and altered availability of Nitrogen (N), as some N may be locked up within soil aggregates due to better soil organic matter availability. This leads to difficulties in fertilizer management, mainly in the residue-retained plots.

Contour Farming

Contour farming has considerable soil and water conservation potential in the hilly region. The seasonal runoff from the catchments can be decreased from 54% to <40% of rainfall where contour farming is practised and the soil loss reduction. There are reported 20%–50% increase in crop yield of rabi and kharif due to contour cultivation compared with up-and-down slope cultivation. The women farmers were also educated on this aspect to better adapt to climate change risks.

Maintaining Natural Water Resources:

The women farmers were also educated on importance of natural water resources and maintenance of these resources. These farmers were taken to the field visit to understand the dynamics of natural water sources. They were informed and educated about role of upstream forests in maintaining these spring sources. The women farmers were activated to keep these sources clean and maintained and also to work in groups to restore the dried springs in the villages.



Water storage tank for irrigation

Initiatives taken by the HPKCCC- Leading to improvement and sustainable practices among village women.



Traditional Crop – Tangnu (local name), Red Rice, Lamon Grass, restored in village on an area measuring about 3 bigha, Red Rice cultivation restored in villages Shilli, Bhawana and kamnu



10. Conclusion

As a result of this process to review and analyse the activities and mainstream the ongoing actions through integrated climate resilient actions and scientific management practices have led to strengthened the flow of ecosystem services in the cluster of villages of Dhamun Panchayat. The importance of gender-responsive climate adaptation is evident as women have a lot of direct contribution in day-to-day activities based on natural resources. The extensive knowledge that women possess due to their close association with natural resources, further underlines the need for greater involvement of women in finding suitable adaptive responses to climate change challenges.

Through the process of gender focused review, training and capacity building, the villages are on the path of achieving climate resilience, adapting to changing climate while securing their livelihoods as well. The women farmers have been successful in restoring their abandoned farmlands by bringing them under various cash crops, have through community action revived traditional kuhls for irrigation and also initiated the conservation of a few local traditional crops that were almost lost from the area. Some of more specific encouraging results are as follows:

1. Women farmers are adopting watershed approach for self sustainability in the water sector to reduce dependence on natural resources such as water from outside the villages. There is increase adoption of water conservation options practices such rain water harvesting, aquifer recharge through plantation of trees, maintenance/

conservation of forest cover on the slopes of the villages. Training and exposure of women farmers on various aspects of soil & water management, imparted through this programme have yielded desired results.

2. 35 women farmers have reintroduced in farming a few traditional crops and procurement of seeds of these traditional crops.
3. 75 women farmers have been trained and educated on the need of maintaining a wider genetic base of various crops for the future and turn they will act as trainer on climate change adaptation.
4. The women self help groups have been oriented towards undertaking natural resource protection activities and advocacy for adaptation to climate change.
5. Women farmers have also initiated undertaking contract farming as result of which they are able to augment the household income through a secure livelihood.
6. The farmers have started adopting the diversification of crops in phased manner.
7. The village women Self Help Groups have been more organized and better informed trough the institutional technical support provided by HPKCCC.
8. The traditional crop is restored over 10-15 bigha land.
9. The women farmers have started creating traditional crop seed bank.
10. The women farmers groups educated and trained for maintain forests and act to prevent forest fires etc.



Crop of carnation at Dhamun

11. The Way Forward

The present study has been conducted as a pilot case for the application of a participatory approach with a focus on gender, whereby insights can be gained into vulnerability and adaptive capacity through mutual learning and exchange with the affected communities. It also highlights concerns regarding loss of traditional knowledge and threats to indigenous culture as expressed by rural communities- women farmers; their observations on changes in weather conditions and biodiversity loss, their impacts as part of climate vulnerability, with the adaptation responses being consistent with year-to-year adjustments. The stresses documented in rural community bear some similarities and also differences with other such village assessments, like modeling of socio-ecological systems examined climate change risks of different regions under climate change action plan.

The findings of this study lend further support for the need for local communities and governments to play a central and constructive role in adaptation planning. A thorough analysis of ways that these rural communities experience stresses related to infrastructure, livelihoods and well being, under different climate vulnerabilities, coupled with the “gaps” in implementation of the corresponding technological intervention, could provide insights and suitable solutions for further action for improved management and adaptation to climate change. As a community, it is evident that while there are some common experiences, local circumstances indicate that blanket solutions would have limited effectiveness. At the same time, it is apparent that local financial and technical resources alone are not sufficient for Climate change adaptation and contributions from higher levels of governance are necessary. Adaptation planning and policy needs to create a space for and enable involvement of local women in the protection of important ecosystem and community attributes.

It is evident from many scientific reports that the Himalayan region is the most vulnerable to climate change. There are lots of interventions being undertaken by different stakeholder departments viz; Agriculture, Horticulture, water, irrigation, forests but still local communities are vulnerable, as there are gaps in process of implementation of different adaptation or mitigation schemes. Through small steps like, providing technical knowhow, awareness and education may help farmers and reduce the vulnerability and gaps.

In the long term multi-disciplinary focus on vulnerable sectors is required. There is need to invest in: (1) data collection- gap analysis- assessing impacts of schemes (2) detailed, local-based impact assessments, (3) research and development, and (4) extension and technology transfer.

Support to small and vulnerable farm holders should be provided by the State in the form of technical support, training, agricultural insurance systems etc. may be contextualized response for climate change.

Through this initiative the HPKCCC could achieve success in restoration of few traditional crops, motivating the women farmers in the *Panchayat* to start collection, storage and propagation of few traditional crops seeds again and motivate the women farmers to mainstream the adaptation in their day-to-day life. It is hoped that these learning and actions shall ensure the maintenance of the sustainability and regenerative characteristics of the mountain agro-ecosystems as well as the judicious adoption of climate resilient adaptation techniques of modern agriculture for the well being of people.

The entire process was completed with technical interventions and no specific budgetary support or formal assistance was given to the farmers.









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