Training Module

Mitigation and Management of Hydro- Meteorological/Climate Induced hazards

List of Acronyms

CBDP	Community Based Disaster Preparedness
CBDM	Community Based Disaster Management
CC	Climate Change
CD	Civil Defense
CRF	Calamity Relief Fund
CWC	Central Water Commission
DDMA	District Disaster Management Authority
DM	Disaster Management
DMP	Disaster Management Plan
DoPT	Department of Personnel & Training
DoT	Department of Telecommunications
DP	Disaster Preparedness
DSS	Decision Support System
EOC	Emergency Operation Centre
GIS	Geographical Information System
GPS	Geographical Positioning System
HMD	Hydro-Meteorological Disaster
HPC	High Powered Committee
ICS	Incident Command System
IIPA	Indian Institute of Public Administration
IIRS	Indian Institute of Remote Sensing
IMD	India Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
IRBM	Integrated River Basin Management
LCD	Liquid Crystal Display
mha	Million Hectares
MoES	Ministry of Earth Sciences
NCCF	National Calamity Contingency Fund
NDMA	National Disaster Management Authority

NDRF	National Disaster Response Force
NGOs	Non Governmental Organizations
NIDM	National Institute of Disaster Management
NRSA	National Remote Sensing Agency
NSS	National Service Scheme
NYKS	Nehru Yuva Kendra Sangathan
OHP	Over Head Projector
PHED	Public Health Engineering Department
PWD	Public Works Department
RS	Remote Sensing
RWH	Rain Water Harvesting
SAR	Search and Rescue
SDMA	State Disaster Management Authority
SIRD	State Institute of Rural Development
SOPs	Standard Operating Procedures

Contents

Module at a glance…

- **Name:**
- **Developed by:**
- **Technical support:**
- **Total number of modules:**
- **Target Group:**
- **Training programme on the basis of this Module requires:**
  - ✓ ….
  - ✓ …
  - ✓ …
  - ✓ …
  - ✓ …
  - ✓ …
- **No. of total pages**

1.0 INTRODUCTION TO THE MODULE

1.1 CONTEXT

There has been growing awareness and mobilisation over recent years regarding the problem of natural disasters on the part of many of the actors concerned: scientists, policy makers, NGOs, and states. Climate change, a phenomenon now by almost the entire scientific community, is a key factor in the increase in hydro meteorological disasters (HMD). Hydro meteorological disasters are on the rise and threaten the development gains and poverty alleviations efforts in India. At the same time, climate change is modifying the hazards triggering these disasters, leading to more severe impacts. These changes should be factored into development practices and especially disaster risk management in order to reduce the rising human, economic and financial losses from extreme weather events and climate variability. The geo-climatic conditions as well as its close proximity to the Himalayas make Himachal Pradesh among the most vulnerable states to natural hazards in the country. The state is highly susceptible to landslide and avalanche hazards. Disasters strike the state with regular frequency, causing human and economic losses. The state faces a very large number of smaller hydro meteorological disasters which cause serious damage to the infrastructure, community assets and population. Among the disasters which strike the state on a regular basis are floods, landslides, cloud bursts and forest fire, etc. Researchers and policy makers across understood the importance of people dependence on climate-sensitive sectors (agriculture and forests) and natural resources (water, biodiversity, and grass lands) for their subsistence and livelihood. Since disasters are a human phenomenon we can change our ways to reduce our risks. There is need to have a paradigm shift in disaster management especially under changing climate.

Although no region of the country is completely spared by this type of disaster, the Himalayan states like Himachal Pradesh are by far the most vulnerable, due to their lack of appropriate resources. The policymakers, scientists, academicians and NGOs partnership and strengthening of the capabilities of stakeholders are therefore crucial in the struggle to improve disaster risk reduction. Furthermore, training needs, at all levels, remain very considerable and must be looked upon as a primary objective in disaster management strategies.

1.2 TITLE OF THE MODULE

Mitigation and management of Hydro- Meteorological/ Climate induced hazards

1.3 OBJECTIVES

The training programme will primarily focus on enhancement of knowledge and skills of the participants to understand and respond to various core issues in Mitigation and management of Hydro- Meteorological/ Climate induced hazards or strengthen their capabilities, in the field of natural disaster prevention, especially hydro meteorological disasters and/or those related to climate change.

1.4 LEARNING OBJECTIVES

The main objectives are:

- To provide an overview of the relation between climate variability, climate change and weather extreme (disaster): Its past, present and future scenarios /projections; challenges in climate science: knowledge gaps and uncertainties.
- To introduce the possible threats from climate change and its impact on climate-sensitive sectors (agriculture, health and forests) and natural resources (water, biodiversity and grass lands) and related processes in the short and long term.
- To discuss the mitigation and adaptation strategies at various levels.
- Present various case studies relevant in the context so as to discuss lessons learnt and best practices for adaptation and mitigation options in Himachal Pradesh and different part of the country (& around the world).
- Various initiatives by the government, other institutions (NGOs etc) and communities themselves in disaster management especially under changing climate.

1.5 COURSE FEATURES

The training gives professionals an opportunity to improve their knowledge in the field of natural risks directly linked to reality and actual experience. Interdisciplinary is also a very important component of the course, with a dialogue between the exact and human sciences being encouraged for a truly integrated and global approach. The role of **science and technology** in the fight against disaster risks will also be focused on throughout the course.

This topic is in line with the objectives of the India's new National Action Plan on Climate Change.

1.6 COURSE STRUCTURE AND CONTENT

The course will be structured around three closely linked thematic modules: 1. Disaster risk management & concepts of climate change, 2. Climate change and hydro meteorological risks and its impact on different sectors, 3.Mitigation and adaptation: analysis of vulnerabilities and capabilities through case studies.

Module 1: Disaster Risk Management and concepts of hydro meteorological risks and climate change

This module focuses on the notion of risk. Half day will be devoted to an introduction to the concepts of Disaster Risk Management. Different approaches will be presented and analysed, offering participants a critical and complementary vision of the state of the art. Experts will present the institutional framework and national prevention strategies in India. A half-day will be devoted to hhistory & concepts of hydro meteorological risks and Climate Change (Climate change and Extreme Events: Its past, present and future scenarios / projections with special reference to IIMD/PCC). The next half-day will be devoted to early warning and disaster communication.

Lecturers will be from the NIDM, IMD and/or ministries (scientific and academic environments).

Module 2: Climate change and hydro meteorological risks and impact on different sectors

This module proposes (next 1 day) an assessment of current knowledge about early warning and disaster communication. An assessment of natural risks due to anticipated climate change in India with its specificities would be presented, supported by a certain number of field studies/ *research projects/ case studies*. Scientists/ academicians / policy makers will discuss changes in precipitations, impacts on *climate-sensitive sectors* (agriculture, forests) and *natural resources* (water, biodiversity, and grass lands). Reflection will then centre on hydro meteorological disasters (floods, drought, cloud bursts and forest fire, cold wave, landslides and avalanche, etc.) and their prevention.

Module 3: Mitigation and Adaptation: analysis of vulnerabilities and capabilities

A ½ day field outing to the floods, landslides, cloud bursts and forest fire affected site or related institutions etc. will enable participants to visit research and project sites, and have discussions with key local figures.

This module (2 days) will be the link between disaster and development i.e. key Considerations for integrating Climate Risk Management Strategies into Developmental Programs. These will reveal the contributions made by the exact sciences (role of science and new technologies in prevention and preparation), government policies/programmes and human sciences (vulnerability study and strengthening of capabilities thanks to Community Risk Assessment tools). After studying the hazards and environmental factors, attention will be focused on the concept of vulnerability. Social vulnerability is a key component in every disaster risk assessment carried out at local level. Adaptation strategies in different sector will be discussed and focus will be on the case studies and success stories, so that participants can apply/ plan the same on the ground (respective area)

Various methodological tools for assessing and strengthening capabilities will be presented and analysed (community-based DRM in particular). As backup to the theoretical part, seminars will be organised to allow participants to use these methods and assume a proactive role.

1.7 TRAINING METHODOLOGY

The objective is to link theory and practice, involving the use of a wide range of tools:

- Lectures & question answer / presentations/ PPT/ Video
- Case studies /Field studies / Success stories
- Film,
- Interaction through panel discussions,
- Group discussions, Game
- Field trips
- Group exercise /presentation etc.

1.8 OUTCOMES

Thus, upon completion of the course programme, participants should be familiar with natural disaster risk management, especially with regard to hydro-meteorological disasters in changing climate. They will be in a position

to assess risk factors and vulnerabilities. Finally, they will have acquired knowledge concerning various methods, technological options and experiments aimed at enhancing the capabilities of populations at risk.

1.9 LOCATION, DATES AND DURATION

The training programme will commence on Monday and will conclude on Friday i.e. 5 days programme. Resource persons are drawn from the organizing institutions, Indian institutes, International organizations, NGOs and the govt. and private sector.

1.10 TARGET GROUP

The course is primarily intended for Administrators and Disaster Managers, professionals, researchers or managers specializing in natural risks or called upon by their profession to make decisions concerning risk situations. This list is not exhaustive. The Senior and Middle level officers of the State, Depts. of Agriculture, Animal Husbandry, Power, Revenue, Forests, Horticulture, Environment, Panchayati Raj, etc.

1.11 EVALUATION OF THE PROGRAMME

The final session will be devoted to evaluation and valediction. The participants will be supplied with an evaluation Performa, which may be completed and handed over to the programme staff.

1.12 CERTIFICATION

A Certificate will be awarded to each participant on the completion of the programme.

1.13 LANGUAGE OF INSTRUCTION

The medium of instruction will be English. The resource person is free to choose either Hindi or English during the presentation and discussion as per the demand of the participants.

2.0 How to use this module

- This module is meant for use by Course Coordinators and the trainers identified by him / her. Although the module is self-explanatory the trainers are advised to undergo the training organized by national or international training programmes prior to using it for delivering such training programmes.

- Before starting the training programme they must thoroughly familiarize themselves with the module.

- The design brief – an introductory chapter of this module will provide the users the objectives of the module, target group, basic structure and emphasis of the module, methodologies and other concerned information to module.

- The chapter on pre and post training assessments will guide on how to carry out evaluation assessment of the training programme with the sets of subject concerned questionnaires to be used and other necessary details by trainees.

- The technical sessions of the training initiate from then onwards as per the contents of sub-modules i.e. learning units and would be done in an elaborate manner during each session with proper facilitating guidelines. Albeit, the sub-modules such as inauguration, valediction, recapitalization, feedback, etc. do not describe the total duration of a sub-module. It is reflected in the suggested programme schedule. The purpose of doing so is to provide little flexibility to the trainers to arrange or plan the sessions daily as per their convenience or institute's protocol.

- Learning Objective: This describes what the participants will be able to gain in terms of knowledge, skill or attitude by the end of each session. The facilitator / trainer may explain the objectives before commencing each session.

2.1 Trainers Guide

The trainer or facilitator or the programme director may find the following tips useful for conducting the programme smoothly.

- During the inauguration session, the trainees should be asked to put their mobiles/cell phones in silent mode. In case of an urgent call, they should go out to receive the call and join back the session. They should also be asked to take prior permission with valid reasons, if they are to miss a session in between.

- All group activities (if possible & convenient) should be photographed and be shown after the training sessions are over every day.
- A group photograph should be taken on day 3 or 4, which is given to the trainees with the certificate on last day of the programme.
- Participants list with name, designation, address, contact numbers and e-mails should be circulated at least thrice during training before the final printout is brought out for circulating along with certificate and group photograph. One copy is to be circulated, so that all of them can make necessary corrections on that and give the same back to the trainer/ programme director/coordinator.
- All the training materials and equipments should be kept ready before the training.
- The trainees should be informed about the duration of lunch and tea/ coffee break and other group activities clearly every time. They should also be informed about the time when the next day's activity starts.
- The trainees should be informed to share their problems during the training and also on logistic issues so that every possible care should be taken to make their stay comfortable.
- During the programme, the duration of each session specified in various sub-modules may vary from the actual duration of the session, depending upon the number of trainees participating in the programme. As most of the sessions are very much process oriented and trainees centered, the duration would largely depend upon the size of group. So, the total training hours vary between 27-30 hours.
- The trainee shall not be given a certificate if he remains absent for more than one hour during training days. Exceptional cases may be considered favorably at the discretions of the programme director or coordinator.

2.2 Training specific

The program has some common sessions everyday, which are not reflected in the program matrix, but mentioned in program schedule to avoid repetitions. The trainer should keep the following points in mind:

- The trainees shall be informed that the program follows a strict timetable and the minimum training hours would be seven hours per day for the entire duration. So they should book their return tickets accordingly.

- Each session has to be participatory and experiential. The participants may be encouraged to ask questions, seek clarifications, share their personal experience and express their views freely.

- The reading material provides national/ state specific case studies on the Mitigation and management of Hydro- Meteorological/ Climate induced hazards. However, the resource persons should present district and state level data relating to the respective state on various topics and discuss the same. This way the participants will gain more insight into the issues closer to home.

- Case studies depicting the local situation may be prepared in advance for use in the hands on sessions. Course director/coordinator can suggest participants to bring own data sets. This will help them in understanding the data needs, source, updating and applications

- The training days (except first day) shall start with a recapitulation session which should be ideally of 15 minutes in the morning.

- Following the recapitulation, group presentation on the manual review, which should be of 10 minutes for each group (if the number of groups are two or three) needs to be done.

- Group composition shall change for every activity/ exercise through various methods. This would expedite the process of group support network building process.

- Trainer's note will be there in every session, which will guide the trainer to proceed step by step.

- The course has to be sufficiently flexible, in terms of time allotted to each session and content, to accommodate the requirements of the participants.

3.0 COURSE DESIGN

MODULES	Learning Units (LU) & Contents	OBJECTIVES	PEDAGOGY
DAY 1			
1.Disaster Risk Management and concepts of Hydro met risk and climate change	LU-1: Pre and Post Training Assessment	• To compare the entry and exit behavior of the trainees • To evaluate the knowledge and skills gained from the training • To assess perceived competency of trainees on hydro meteorological disasters • To carry out a formal internal evaluation	
	LU-2: Disaster management framework, Disaster management policy, legislation and institutions	• Understanding Disasters • Hazards, risks and vulnerabilities of South Asia • Emerging risks – climate change and urban upsurge • Disaster management framework of India • Policies, strategies and programs	Presentation and discussion
	LU-3: Recent years mega disasters and hydro meteorological risks; lessons learnt and experiences gained	• Increasing the Scale of Disaster in India • Hydro meteorological hazards in Himachal Pradesh: Scales and potential risks • Crisis management: case studies and lessons learnt	Presentation and discussion
	LU-4: Climate change policy and programs in India	• Govt policy & sponsored programs in India • Clean Development Mechanism (CDM) • Chronology of National & international climate change initiatives	Presentation and discussion

	LU-5 : History & Concepts of Climate Change on Risk of Hydro met disasters (Climate change and Extreme Events: Its past, present and future scenarios / projections)	• To introduce History & Concepts of Climate Change • To highlight the issues and importance of climate change in present context • To introduce Climate change and extreme events • About observed change in extreme events • Projected climate change scenarios and extreme events	Presentation and Film
DAY 2			
2. Climate change and hydro meteorological risks and impact on different sectors	LU-1 : Early warning and disaster communication in India	• Data Needs for Preparation of Risk Profile • Use of Science and Technology in Monitoring Hazards (Remote Sensing Technology, GIS based system, Weather Radars) • Early warning system • Different Forecasting (Prediction) Tools • Agencies Involved in Hydro-meteorological Disaster System in India • Role of S&T organizations in EWS	Presentation and discussion
	LU-2 : Impacts on environment and ecosystem (glaciers, forest, biodiversity)	• Impacts on biodiversity, forests, glaciers, etc. • Case studies / project outcome / field studies related to adaptation and mitigation option	Presentation and discussion
	LU-3 : Impacts on population (Heath care, Food Security, water and sanitation, migration and conflict)	• Highlight about climate risks and its impact on food security and Water resource • introduce about Climate related health problems ; current aspects of climate change and human health • Suggest Adaptation options • Issues of migration and conflict due to these impacts • Case studies / field studies	Film, Presentation and discussion

	LU-4:Hydrometeorological risks and impacts	• Review of Climate induced hazards in HP • Potential impacts on different sector • Way forward	Panel Discussion
DAY 3			
3. Mitigation and Adaptation: analysis of vulnerabilities and capabilities	LU-1 : Govt. Policy initiative on adaptation & mitigation at national/state/Community/local level: success stories / gaps in different part of the country	• Mitigation and Adaptation • To highlight the importance of mitigation &adaptation in Changing climate • Current status of Climate related Community based adaptation • Govt. Policies on climate related problems • Practical experience sharing	Panel discussion
	LU-2: Case studies on enhancing adaptive capacity of mountain (Himalayan) communities against hydro-meteorological disasters	• Detailed information on adaptation and mitigation measures in mountain *regions* • To study & understand the control measures for managing hazards • Methodology and tool kit for Adaptation in different sector • Local scale multi-hazard risk management and development action plans preparedness for climate risk • Success stories and Case studies on hydro-meteorological risk mitigation • Alternative livelihood / change in crop and varieties, rehabilitations, drinking water etc. • Success stories and Case studies on hydro-meteorological risk mitigation • To share the practical experience (Lesson learnt / best practices) with officers working in the areas of different hazards • To apply the learning of the classroom in the field.	
DAY 4			

3. Mitigation and Adaptation: analysis of vulnerabilities and capabilities.	LU-3: Recent initiatives on Preventive Measures and Mitigation Plan for different hydro meteorological hazards– gap, need and strategy	• Methodology and tool kits for Preventive Measures and Mitigation plan • Technological solutions • Development of Hazard Vulnerability Risk scenario of the State • Role of science and tech, govt. programme • Hazard Specific Mitigation Plan	Film, Presentation and Discussions
	LU-4: Recent initiatives and Community Based Participatory Climate Risk Management: Case Studies and Success Stories" /Role of UNDP/NGOs /WWF	• Sharing experiences on case studies of climate change and disaster management • Community participation • Vulnerability and preparedness for climate change	Case Studies, Film and presentation
DAY 5			
3. Adaptation: analysis of vulnerabilities and capabilities	LU-5 : Managing Hydro meteorological Hazards through Weather based Agro-Advisory Services (AAS)	• Introducing the format and use of AAS in agriculture and horticulture • Delivery mechanisms of AAS at agro ecosystem and district level • Role of AAS in hydro met adaptation • Role of district level officer for dissipation of information • Success story	Presentation and Discussions
	LU-6: Key considerations for integrating Disaster Risk Management into development programs in India	• Introducing the Key Considerations for integrating Climate Risk Management • Initiative required in different sectors • National Action Plan on Climate change	Panel discussions OR *Presentation (by key person)*
	LU-7: Group Exercise, Presentations & Discussion Discussion on Group Exercise Valedictory and Certificate Distribution		

Module 1

4.0 Description of the Module

Disaster Risk Management and concepts of Hydro met risk and climate change

Himachal Pradesh is vulnerable to 25 out of 33 types of hazards identified by the High Powered Committee (HPC) of Government of India and categorized into 5 sub-groups. Apart from identified hazards by HPC, the state is also confronting the emerging threats of climate change and man and animal conflict. Following events causes due to HMD:

Hydro-meteorological Disasters

1. Floods
2. Hailstorm
3. Cloud Burst
4. Heat Wave and Cold Wave
5. Snow Avalanches
6. Droughts
7. Thunders and Lightning
8. Landslides and Mudflows

Due to heavy rainfall, rainwater penetrates into soil and rock surface; causes landslide and mudflow so Landslide and Mudflows are common in Geological as well as HMD. Hazards both natural and manmade are of immediate concern to the State of Himachal Pradesh as it faces the fury of one or the other disaster every year. The fragile ecology and geology of the State coupled with large variations in Physio-climate conditions render it vulnerable to vagaries of nature in one way or the other. (NIDM, 2013) These disasters events have brought heavy toll to the state as the loss was estimated in several thousand millions of rupees and also killed several hundreds of people besides large number of cattle heads (Sharma, D.D.; 2006). Although widespread floods problems do not exist in the state because of topographical nature, continuing attention is necessary to reduce flood hazards in the state, more particularly the flash flood hazard the incidences of which are increasing causing large-scale damage (Pandey et al., 2015).

This module focuses on the notion of risk. Half day will be devoted to an introduction to the concepts of Disaster Risk Management. Different approaches will be presented and analysed, offering participants a critical and complementary vision of the state of the art. Experts will present the institutional framework and national prevention strategies in India. A half-day will be devoted to hhistory & concepts of hydro meteorological risks and Climate Change (Climate change and Extreme Events: Its past, present and future scenarios / projections with special reference to IIMD/PCC). The next half-day will be devoted to Early warning and disaster communication.

Lecturers will be from the NIDM, IMD and/or ministries (scientific and academic environments).

LU 4.1.1: Pre and Post Training Assessment
LU 4.1.2: Disaster management framework, Disaster management policy, legislation and institutions
LU 4.1.3: Recent year's mega disasters and hydro meteorological risks; lessons learnt and experiences gained
LU 4.1.4: Climate change policy and programs in India
LU 4.1.5: History & Concepts of Climate Change on Risk of Natural disasters (Climate change and Extreme Events: Its past, present and future scenarios / projections

LU 4.1.1: Pre and Post Training Assessment

Context and description of the session

The session consists of some written exercises to determine the knowledge level of the trainees before actual training starts. This will be repeated in the last session of the programme during valediction and a comparison be made between entry and exit behavior of the trainees, to know if the training made a difference.

Learning Objectives

- To compare the entry and exit behavior of the trainees
- To evaluate the knowledge and skills gained from the training
- To assess perceived competency of trainees on hydro meteorological disasters
- To carry out a formal internal evaluation

Methodology

- Questionnaires
- Experience sharing

Duration

- 01 hour

Tool Description

1. **Trainer's expectations from the training programme:** This is an open ended questionnaire with five questions. Circulating small colored cards/papers can also do this exercise and on which trainees may be asked to write down their expectations and later on the facilitator or trainer or course coordinator could display all cards on the training board or on the flip chart as required.
2. **Mitigation and management of Hydro- Meteorological hazards opinion questionnaire:** This is a true/false type of questionnaire with 15 questions covering statements on trainee's 'basic ideas about Hydro-Meteorological disaster, impact & management.
3. **Ten point rating scale on trainee's perceived competency on flood risk mitigation & management:** This scale indicates the perceived competency on ability, knowledge and skills to provide mitigation and management of Hydro- Meteorological hazards aspects. The trainees should be instructed to encircle or tick the options available on both the sides. A higher number on the rating scale means higher perceived competency.
4. **Trainee's knowledge on Mitigation and management of Hydro-Meteorological hazards**: This is a sentence completion test which having 15 multiple-choice questions on different aspects of flood risk mitigation & management. Each statement has 4 or 5 alternative answers.

LU 4.1.2: Disaster management framework, Disaster management policy, legislation and institutions

Description

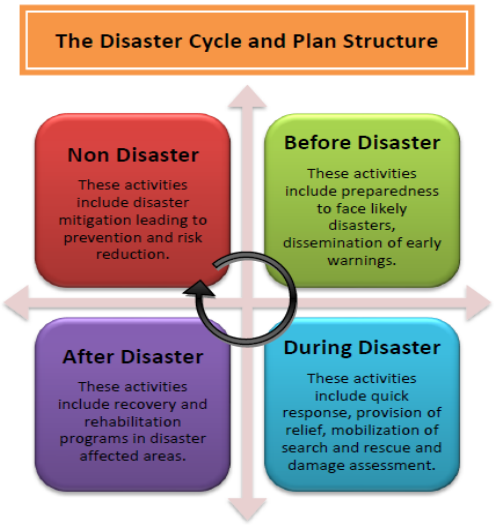
In 2002, a High Powered Committee Report on Disaster Management recommended establishment of a separate institutional structure for addressing disasters and enactment of a suitable law institutionalizing disaster management. Further, the 10th Five Year Plan of India (2002-2007) identified the need for disaster management interventions beyond merely financing relief. The plan stressed on the need for integrating disaster management with development process. The Status Report on Disaster Management (2004) also identified that development, to be sustainable, has to take into account the disaster mitigation needs. These developments necessitated institutionalization of disaster management framework in India and consequently, the Disaster Management Bill was presented in the Parliament in 2004. The Bill was adopted in August 2005. Following the implementation of the Bill, the National Disaster Management Authority was set up in 2005. Disaster management came to be identified as "*continuous and integrated process of planning, organizing, coordinating and implementing measures required for preventing disasters, mitigating the risk, capacity building, increasing the preparedness levels, response actions, disaster assessments, evacuation, rescue and relief and rehabilitation*". The Disaster Management Bill facilitated mainstreaming disaster management in many ways; firstly, by mandating the involvement of various development-related sectors in the disaster management framework, and secondly, by directing them to prepare and execute disaster management plans in their respective sectors of functioning, thirdly, by making provisions for separate resource allocation for managing disasters, in form of the Disaster Mitigation Funds, and fourthly by facilitating training of persons for disaster management through the National Institute for Disaster Management. In this structure, ***National Disaster Management Authority*** is the nodal authority for all disaster management actions in the country. It is the policy making body that frames broad guidelines for the other ministries at the centre and authorities at the state level. The state authorities further lay down the guidelines for ministries and departments at the state level and the districts falling in their respective jurisdictions. Similarly, district authorities direct the civil administration, departments and local authorities such as the municipalities, police department and civil administration. The Executive Committees at each level are responsible for execution of the tasks envisaged by the Authorities (MHA, 2011, Mall &Srivastava 2012).

Paradigm Shift in Disaster Management: Himachal Pradesh State Disaster Management Plan-2012

There has been a paradigm shift from a response and relief-centric approach to a proactive and comprehensive mindset towards DM covering all aspects from prevention, mitigation, preparedness, rehabilitation, reconstruction and recovery. It also provides:

- The creation of a policy, legal and institutional framework, backed by effective statutory and financial support
- Mainstreaming of multi-sector DM concerns into the developmental process.
- Putting in place a continuous and integrated process of planning, coordinating, implementing policies and plans in a holistic, participatory, Inclusive and sustainable manner

This Himachal Pradesh State Disaster Management Plan-2012 (HPSDMP, 2012) has been prepared as per the guidelines provided by the National Disaster Management Authority and based on existing hazard vulnerability and risk perception of the various stakeholders. The roles and functions to be played by the different organs of institutional mechanism have been defined taking into consideration the specificities of the state. Disaster management, by its very nature, requires a multi-disciplinary approach hence a strong coordination mechanism forms the core of successful Disaster Management. This Plan outlines the functions of the principal Agencies like state Disaster Management Authority (SDMA), State Executive Committee (SEC), State Relief Commissioner, and District Disaster Management Authority (DDMA). The Himachal Pradesh State Disaster Management Authority (HP SDMA) and SEC is supported by the line departments. However the functions identified for each line department are mandatory and each line department and DDMA are required to prepare their own disaster management plans in conformity with the State Plan



The role of state Disaster Management Authority (SDMA) / State Executive Committee (SEC) and the State Departments

According to Section 23 of the DM Act 2005, there shall be a DM plan for every state. It outlines the broad coverage of the plan as well as the requirements of consultation in the preparation of the state plans. It also provides for annual review and updating of the state plan, and enjoins upon the state governments to make provisions for financing the activities to be carried out under the state plans. It provides for the departments of the state governments to draw up their own plans in accordance with the state plan.

A typical Disaster Management continuum comprising six elements i.e., Prevention, Mitigation, Preparedness in pre- disaster phase, and Response, Rehabilitation and Reconstruction in post - disaster phase, defines the complete approach toDisaster Management

For efficient execution of the State Disaster Management Plan, the Plan has been organized as per these four stages of the Disaster Cycle.

Learning Objectives

The participants will be able to

- Define the various terminologies used in Disaster Management
- Distinguish between terms e.g. hazard and disaster, vulnerability and risk etc.
- Enumerate various disasters
- Classify based on origin and scale

- Describe various phases of Disaster Management Cycle
- Explain the existing Institutional Mechanism, policy and programs
- Know the salient features of DM Act 2005, Himachal Pradesh State Disaster Management Plan-2012
- Know about National Disaster Management Authority (NDMA), Himachal Pradesh State Disaster Management Authority (HP SDMA), District Disaster Management Authority (DDMA) etc.

Methodology

- Film on Disaster Management
- Power Point Presentation
- Question Discussion & Answer

Duration

- 60 Minutes

Teaching and Performance Aids

- Lecture Note on DM Concepts
- Handout of Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area. A copy of presentation and some reading materials on this topic are attached herewith in the Annexure for the trainer's Handout.

Contents	Methodology	Teaching aids
Definitions, Hazard, Disaster, Risk, Vulnerability, etc., Disaster Management Cycle, Impacts of Disasters, Disasters and Development, Significance of Disaster Management, DM Act 2005, Disaster Management System in India Film on disaster occurred in India and Himachal Pradesh	Lecture cum discussion Through power point presentation	Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Introduce the basic concepts and types of disasters. Make the presentation very interactive. Highlight the main differences between disasters caused by natural and manmade disasters. DM cycle. Discuss the vulnerability map of India and let the trainees study the Himachal Pradesh state vulnerability profile.	20
Focus on main hydrometeorological disasters of India and Himachal Pradesh state its impacts, Emerging risks – climate change and urban upsurge	10
Institutional framework, DM Act 2005 and DM system of India	10
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge. Invite other trainee to supplement whatever their colleague has discussed. The trainer may check out that the learning objectives of the session have been achieved.	10
Open house for question and answer	10

After the interactive presentation, the film on a disaster would be shown to the trainees. Instructions may be given to the trainees to observe the film attentively and note down what they feel important to remember so that it would be easier for them to do the next session. Handouts are attached in the annexure.

LU 4.1.3: Recent years mega disasters and hydro meteorological risks; lessons learnt and experiences gained

Description

Hydro meteorological disasters, many of them related to the climate, and some indirectly related to cause massive losses of life and property. Droughts, flash floods, cyclones, avalanches, landslides brought on by torrential rains, and snowstorms pose the greatest threats. A natural disaster might be caused by earthquakes, flooding, volcanic eruption, landslides, hurricanes etc. In order to be classified as a disaster it will have profound environmental effect and/or human loss and frequently incurs financial loss. Other dangers include frequent summer dust storms, which usually track from north to south; they cause extensive property damage in North India and deposit large amounts of dust from arid regions. Hail is also common in parts of India, causing severe damage to standing crops such as rice and wheat.

Himachal Pradesh is exposed to frequent natural disasters such as earthquake, landslides, cloudburst, avalanches, flash floods etc. with varying intensities. Though, land- slides are considered as one of the most frequents it causes a large scale disruption of natural resources, economic valuables and human lives. Each and every part of the world is more or less susceptible to natural calamities, the Himalayas is more complex due to its dynamic geomorphology/geosystem (Rawat 2013) and seasonal hydro-meteorological conditions experience very frequent natural disasters, especially water induced hazards. Climate change and land-use degradation accelerate water induced hazards such as flash floods, reverie floods, erosion, landslides during the monsoon period, and droughts in non-monsoon periods. The geo-dynamically active Himalayan terrain is being deforested at the rate of 0.36 km2/Year (Rawat and Pant 2007). Several anthropogenic factors namely poorly managed agriculture, forest fires, overgrazing, and substandard construction of roads and buildings may accentuate the process (Bhasin et al. 2002). Increasing population and demand of land for agriculture have resulted in acute pressure on the land in the watershed of the Lesser Himalaya (Rawat et al. 2010, 2012).

Following are the list of recent major hydro meteorological disasters in India with detail report:

1993 Himachal Pradesh Landslide: Jhakari Landslide -road (NH-22) stretch of about 1/2 km was completely damaged and slide debris blocked the river Sutlej. Traffic restored after two months.

2001 Himachal Pradesh Avalanches: Devastated flood caused huge amount of damage.

2002 Indian Heat Wave: India's heat wave in 2002 at south region killed more than 1000 people, Most of the deaths occurred in state of Andhra Pradesh. The heat was so intense that birds fell from the sky, ponds and rivers dried up.

2005 Himachal Pradesh flash flood : Near Parchu lake, Kinnaur, Rampur heavy rainfall leads to 5 bridges damaged, 50 houses submerged.

2005 Himachal Pradesh Glacial Lake Outburst Floods (GLOFs): TheParechu river lake in Tibet burst causing loss of life and heavy destruction of livelihoods and infrastructure, particularly in Kinnaur and the eastern part of Shimla districts in Himachal Pradesh.

2005 Mumbai Catastrophes: The 2005 Maharashtra floods was occurred just one month after the June 2005 Gujarat floods, Mumbai the capital city was most badly affected and witnessed one of its worst catastrophes in the history of India, killing at least 5,000 people.

2010 Eastern Indian Storm: The Eastern Indian storm was a severe storm struck parts of eastern Indian states, spanning for 30–40 minutes. At least 91 people died in Indian states and Over 91,000 dwellings were destroyed and partially damaged.

2013 Maharashtra Drought: Maharashtra state was affected by the region's worst drought in 40 years, worst-hit areas are Jalna, Jalgaon and Dhule are also affected by the famine. Millions of people in Maharashtra are at serious risk of hunger after two years of low rainfall in the region.

2013 Uttarakhand Flash Floods: On June 2013 Uttarakhand received heavy rainfall, massive Landslides due to the large flashfloods, it suffered maximum damage of houses and structures, killing more than 1000 people, sources claimed the death toll could be rise up to 5000. Uttarakhand Flash Floods is the most disastrous floods in the history of India.

2015 Cloudburst in Himachal Pradesh: Shimla, Himachal Pradesh – Four youths went missing after cloudburst triggered a series of flash floods. Chief Minister Virbhadra Singh later visited the site of the tragedy. (May 14) ;Dharampur, Himachal Pradesh – Four persons, including three members of a family, were feared killed after heavy flash floods caused by a cloudburst in the Dharampur area of Mandi district in Himachal Pradesh (August, 2015).

Learning Objectives

The participants will be able to

- Learn about the Increasing Scale of hydrometeor logical Disaster in India and HP
- Recent Disasters in Himachal Pradesh
- Explain the Hydro meteorological hazards in Himachal Pradesh: Scales and potential risks
- Dissuasion about Crisis management: case studies and lessons learnt

Methodology

- Film on recent mega disasters
- Power Point Presentation
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Lecture Note on recent mega disasters
- Case studies related to some mega disasters
- Handout of Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area..

Contents	Methodology	Teaching aids
Trend of hydro meteorological Disaster in India and in the state, Recent Disasters in Himachal Pradesh, Hydro meteorological hazards in Himachal Pradesh: Scales and potential risks, Dissuasion about Crisis management: case studies and lessons learnt Film on major disaster occurred in India/state	Lecture cum discussion Through power point presentation	Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Trend of hydrometeorological Disaster in India and in the state	20
Recent Disasters in Himachal Pradesh, Hydro meteorological hazards in Himachal Pradesh: Scales and potential risks Film on mega disaster	30
Dissuasion about Crisis management: case studies and lessons learnt	15
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	10
Open house for question and answer	15

The trainees will be asked to deliberate their experiences on different events of hydro meteorological disasters happened at personal level or otherwise. They would also be requested to be brief and specific on the concerned events so that all trainees will get a chance to express their thoughts. After it, the first person who raised hand is requested to share his/ her experiences related to hydro meteorological disasters while others would listen carefully so that analysis at the session's end would become rich. The trainer or facilitator will record the important experiences of all persons during this session.

LU 4.1.4: Climate change policy and programs in Himachal Pradesh and India

As public concern about changes in the world's climate mounted in the 1980s, the WMO (World Meteorological Organization) and the UNEP (United Nations Environmental Programme) established the IPCC (Intergovernmental Panel on Climate Change) in 1988 to assess the seriousness of the problem. The First Assessment Report of the IPCC, completed in 1990, highlighted the global threat of climate change. In December 1990, the UN General Assembly decided to launch negotiations on what was to become the UNFCCC (United Nations Framework Convention on Climate Change). The negotiations commenced in February 1991 and were concluded in 15 months. The Convention was adopted in May 1992, and opened for signature in Rio at the UN Conference on Environment and Development. It came into force in March 1994 after being ratified by 50 countries.

By 1995, countries realized that emission reductions provisions in the Convention were inadequate. They launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed countries to emission reduction targets. The Protocol's first commitment period started in 2008 and ended in 2012. The second commitment period began on 1 January 2013 and will end in 2020. There are now 195 Parties to the Convention and 191 Parties to the Kyoto Protocol. India acceded to the Kyoto Protocol on 26 August 2002. On 12 December 2015, 196 Parties to the UN Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, a new legally-binding framework for an internationally coordinated effort to tackle climate change. The Agreement establishes a global warming goal of well below 2°C on pre-industrial average's. India accepted it in the year 2016.

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Environment and Development. It came into force in March 1994 after being ratified by 50 countries.

The Government in India is actively involved with climate change activities since long. India is a Party to the United Nations Framework Convention on Climate Change (UNFCC). The Eight session of the Conference of Parties (COP-8) to the UN convention on Climate Change in 2002, New Delhi ended here with a Delhi Declaration has successfully resolved the technical parameters necessary for the implementation of the Kyoto Protocol (1997). The Delhi declaration gave primacy for the implementation of the Clean Development Mechanism (CDM) in the climate change process. The National Clean Development Mechanism Authority is operational since December 2003 to support implementation of CDM projects. The Bali conference on climate change (December 2009) showed all the countries the way forward to the next phase of the campaign to control the planet's changing climate, the specific objective being to put a multilateral arrangement in place that will succeed the 1997, Kyoto Protocol of the UN convention on Climate Change, which will terminate in 2012. Doha Climate Change Conference (COP-18; 18 Nov.-8 Dec. 2012) adapted the second commitment period of the Kyoto Protocol, something that Parties have been working toward for last seven years (Mall et al., 2016).

To address the future challenges, in June 2007, the Government announced the constitution of a high-level advisory group on climate change and prepared a '**National Action Plan on Climate Change (NAPCC)**' and that was released by the Honorable Prime minister of India on June 30, 2008 outlining existing and future policies and programs addressing climate mitigation and adaptation (http:/pmindia.nic.in/Climate%20Change_16.03.09.pdf); which is in line with the international commitments and Relates to sustainable development, co- -benefits to society at large, focus on adaptation, mitigation, and scientific research (NAPCC, 2008). The plan to be implemented thorough eight missions representing multi-pronged, long-term and integrated strategies for achieving key goals:

1.National Solar Mission
2.National Mission for Enhanced Energy Efficiency
3.National Mission on Sustainable Habitat
4.National Water Mission
5.National Mission for Sustaining the Himalayan Ecosystem
6.National Mission for a Green India
7.National Mission for Sustainable Agriculture
8.National Mission on Strategic Knowledge for Climate Change

INITIATIVES BY ICAR:ICAR has launched in February 2011, a network project called 'National Initiative on Climate Resilient Agriculture (NICRA)' with a view to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The objectives of the scheme are as follows:

- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies.
- To demonstrate site specific technology packages on farmers' fields for adapting to current climate risks.
- To enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its application

The project consists of four components are Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants. The output of the project would be: Selection of crop genotypes and livestock breeds with greater tolerance to climatic stress, Existing best practices for climate resilience, Capacity Building including Infrastructure and trained man power. The scheme will be implemented with the Central Research Institute for Dry land Agriculture (CRIDA), Hyderabad under the supervision of the Natural Resources Management (NRM) Division of ICAR. Currently, the outlay of the project is Rs. 350 crores for the 11th Five Year Plan, out of which Rs. 200 crores is allocated for 2010-11 and Rs. 150 crores for 2011-12 (Planning Commission, 2011).

State Strategy and Action Plan on Climate Change-2012

In **Himachal Pradesh** in order to respond effectively to the challenges of climate change, the State Government has constituted a State Level Governing Council on Climate Change, under the chairmanship of Chief Minister. The Council has broad based representation from key stakeholders departments to monitor the targets, objectives and achievements of the Eight National Missions specified under National Action Plan on Climate Change. The State Governing Council also provides guidance on matters relating to coordinated national action on the State's agenda and review of the implementation of the National Action Plan on Climate Change. The State Level Governing Council chaired by the Chief Minister also provides guidance on the matters relating to national level negotiations including bilateral, multilateral programs for collaboration, research and development in the State of Himachal Pradesh.

Besides, an Executive Council under the chairpersonship of Chief Secretary, Himachal Pradesh has also been setup having involvement of almost all stake holder line Departments with the objective of implementation and monitoring of the directives of the State Governing Council on Climate Change. The Department of Environment, Science & Technology to the Government of Himachal Pradesh acts as a Nodal Agency to coordinate and deal with the climate change issues. The Department of Environment, Science & Technology, the State Council for Science, Technology & Environment, State Centre on Climate Change would continue to evolve strategies and programs, based on new scientific and technical knowledge as they emerge and in response to the evolution of the multilateral climate change regime including arrangements for national and international cooperation.

A Centre on Climate Change has already been established in Himachal Pradesh, which will act as a nerve centre for climate change data base and actions. This Centre is being catered and supported for its GIS applications need by the Aryabhatta Geo-informatics & Space Application Centre (AGiSAC). The Department of Environment, Science & Technology (DEST) will work in close coordination with Local and Regional Authorities, through existing coordination arrangements, to secure implementation of specific aspects of this Strategy and Action Plan at the local level.

Learning Objectives

The participants will be able to

- Discussion about climate change
- Know about Govt. policy & sponsored programs in India
- Policy and programs in different sectors i.e. water, agriculture, health etc.
- State climate change action plan
- Discuss about Chronology of National & international climate change initiatives
- Dissuasion about climate risk management: case studies and lessons learnt

Methodology

- Power Point Presentation
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Lecture Note on Climate change policy
- Reading materials on climate policy and programs
- Handout of Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area..

Contents	Methodology	Teaching aids
Discussion about climate change and climate risk management, Govt. policy & sponsored programs in HP and in India, Policy and program in different sectors i.e. water, agriculture, health etc. Discuss about Chronology of National & international climate change initiatives	Lecture cum discussion Through power point presentation	Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Discussion about climate risk management and clean development mechanism	20
Govt. policy & sponsored programs in HP and in India, Discuss about Chronology of National & international climate change initiatives	30
Dissuasion about Policy and program in different sectors in HP i.e. water, agriculture, health: case studies and lessons learnt	15
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	10
Open house for question and answer	15

LU 4.1.5: History & Concepts of Climate Change on Risk of Hydrometdisasters (Climate change and Extreme Events: Its past, present and future scenarios / projections

What is Weather?

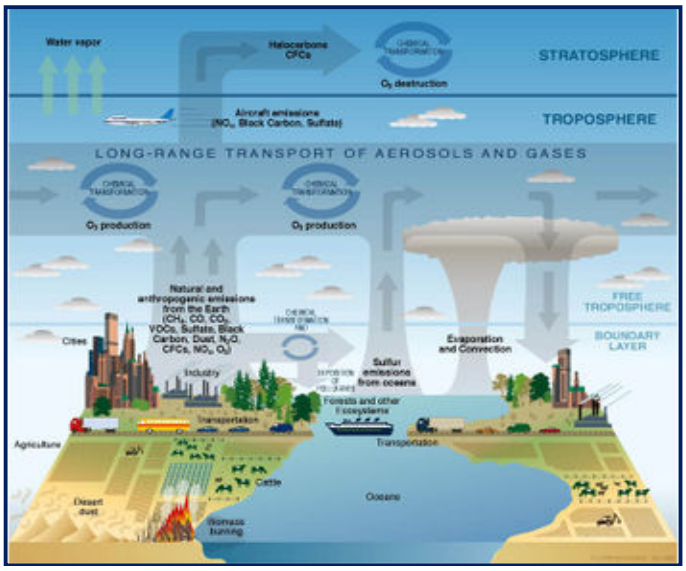
Weather is the set of meteorological conditions – wind, rain, snow, sunshine, temperature, etc. – at a particular time and place.

What do we mean by climate?

There are several definitions of climate:

- The average weather, usually taken over a 30 year time period, for a particular region and time period.
- The average meteorological conditions in a certain area over ascertain period.
- Climate is the measurement of average weather conditions that is maintained or changes over a long period of time usually 10 to 30 years.

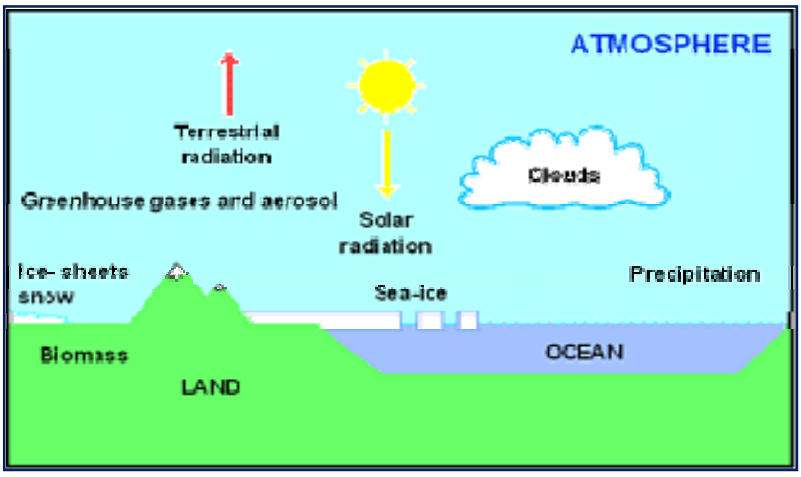
Around fifty thousand years ago earth was covered with thick ice that ended 15,000 years ago then the climate started to become warmer due to which the ice started melting. This was the first step that made earth a living planet.



Do you know what is atmosphere?

Standard atmosphere is a unit of pressure roughly equal to the average atmospheric pressure at sea level on the earth. It is defined as the pressure under 760 mm of mercury.

The combination of gases present in the surrounding of the earth like Nitrogen, Oxygen, Carbon dioxide, Water vapors and tiny amounts of other gases forms the atmosphere. Without these gases, any living being and plants could not survive on earth. They are also protecting us from the harmful rays of the sun.



How do we measure the speed of wind?

We measure the speed of wind with the help of Anemometer. It has three or four rods and at their end there are four-five metal plate shapes which blow around with the speed of breeze or air. The faster the wind blows, the faster the cups spin round. The energy in the moving wind can be used to generate electricity.

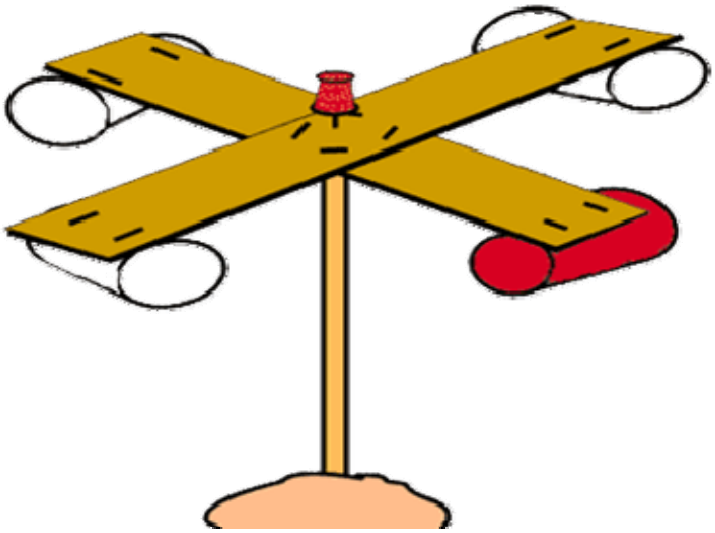
What is EL Nino?

This is usually a sudden warming every few years of Pacific Ocean off the coast of South America. It spreads westwards and affects the weather on many countries. It is not yet fully understood.

Why is air pressure important to weather forecasters and how it is measured?

The change in air pressure bringing different types of weather. On the basis of the changes on Air pressure we predict weather forecasts in advance as which region will have heavy rain, how much will it rain in coming season, how cold would be winters and how hot will be the summer. This can be analyzed by recording air pressure, appearance of and density of clouds etc. Air pressure is measured with a Barometer in units called mill bars.

Aneroid barometers contain hollow capsules with no air inside. As the pressure of the air alters, the capsules changes shape and slowly moves the pointer on the dial to show whether the air pressure rising or falling.



What does the oceans have effect on Earth's climate?

As the ocean absorbs the heat emitted from the sun and then latter spread it around the world in currents. These currents from oceans and in some regions the wind driven rivers in the sea that heat or cool the air above them, creating hotter or cooler weather.

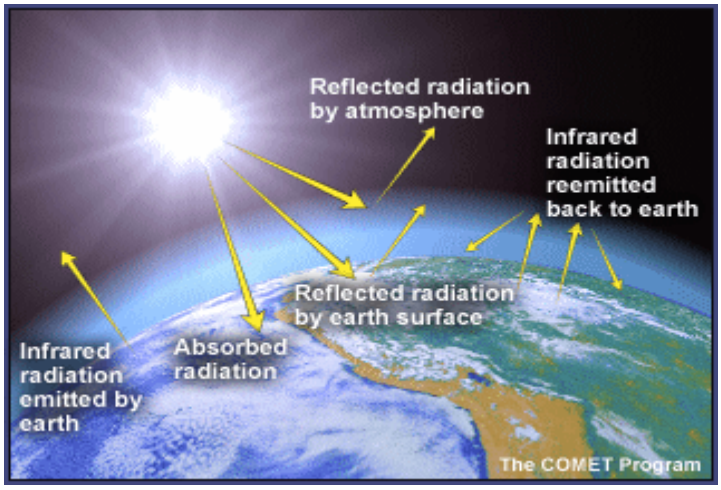
Greenhouse gases in the atmosphere

Existence of the greenhouse effect as such is not disputed. Naturally occurring greenhouse gases have a mean warming effect of about 33 °C (59 °F), without which Earth would be uninhabitable. On Earth, the major greenhouse gases are

water vapor, which causes about 36–70% of the greenhouse effect (not including clouds); carbon dioxide (CO2), which causes 9–26%; methane (CH4), which causes 4–9%; and ozone, which causes 3–7%.[25][26] The issue is how the strength of the greenhouse effect changes when human activity increases the atmospheric concentrations of some greenhouse gases.

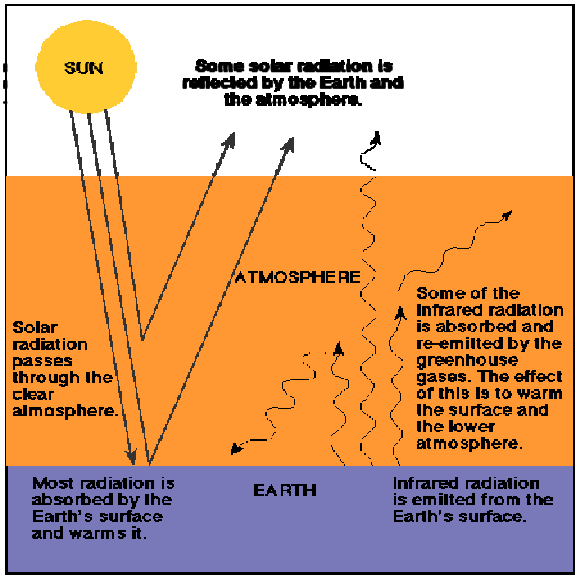
What is the phenomenon called Greenhouse effect?

There are some gases that are emitted by our vehicles, factories etc. mostly Carbon dioxide, forms a layer in atmosphere that traps the heat emitted by earth surface and slowly making the climate warmer. This is called the Greenhouse effect.



Due to Greenhouse effect the temperature of earth will raise and some of the countries will become too hot to live and this extra raise in temperature can also cause glaciers to start melting that result in flooding in low-lying countries this whole phenomenon of raise in temperature due to Greenhouse effect is also known as global warming.

A warmer Earth may lead to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on plants, wildlife, and humans.



What is Global Warming?

Global warming is the increase in the average temperature of the Earth's near-surface air and oceans since the mid-twentieth century and its projected continuation.

What is Climate change?

Climate change is any long-term significant change in the “average weather” that a given region experiences. Average weather may include average temperature, precipitation and wind patterns. It involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years. These changes can be caused by dynamic process on Earth, external forces including variations in sunlight intensity, and more recently by human activities.

This is in line with the official definition by the United Nations Framework Convention on Climate Change (UNFCCC) that climate change is the change that can be attributed “directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”.

The Intergovernmental Panel on Climate Change defines “climate change” as “a change in the state of the climate that can be identified by changes in the mean and / or the variability of its properties, and that persists for an extended period,

typically decades or longer" Each of these two definitions is relevant and important to keep in mind.

What causes climate change?

The Earth's climate has varied considerably in the past, as shown by the geological evidence of ice ages and sea level changes, and by the records of human history over many hundreds of years. The causes of past changes are not always clear but are generally known to be related to changes in ocean currents, solar activity, volcanic eruptions and other natural factors. The difference now is that global temperatures have risen unusually rapidly over the last few decades.

There is strong evidence of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising average global sea levels. The IPCC Fourth Assessment Report concludes that the global warming is unequivocal. Atmosphere and ocean temperatures are higher than they have been at any other time during at least the past five centuries, and probably for more than a millennium.

It is now widely accepted that human activities, in particular fossil fuel use and changing land-uses, are the dominant factor in this growth and are responsible for most of the warming observed over the past 50 years.

What is Facts of Climate change?

- The global CO2 concentration has increased from preindustrial value of about 280 ppm to 400 ppm in 2012 (IPCC 2013).
- The globally averaged combined land and ocean surface temperature data as calculated by a linear trend, show a warming of 0.85 [0.65 to 1.06] °C, over the period 1880 to 2012 (IPCC 2013)
- The global average sea level rise is 1.8 mm per year. The sea level will rise between 18 and 59 cm. The oceans will become more acidic.
- It is very likely that hot extremes, heat waves and heavy precipitation events will continue to become more frequent.
- It is very likely that there will be more precipitation at higher latitudes and it is likely that there will be less precipitation in most subtropical land areas.
- Changes in many extreme weather and climate events have been observed since about 1950. It is very likely that the number of cold days and nights has decreased and the number of warm days and nights has increased on the global scale (IPCC 2013).

- Global surface temperature change for the end of the 21st century is likely to exceed 1.5°C relative to 1850 to 1900 for all RCP scenarios except RCP2.6 and will continue to exhibit inter-annual-to-decadal variability and will not be regionally uniform (IPCC 2013).
- It is likely that tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and heavier precipitation associated with ongoing increases of tropical sea surface temperatures

What is Projected Climate Change?

Climate model projections summarized by the IPCC indicate that average global surface temperature will likely rise a further 1.1 to 6.4 °C (2.0 to 11.5 °F) during the twenty-first century. The range of values results from the use of differing scenarios of future greenhouse gas emissions as well as models with differing climate sensitivity. Although most studies focus on the period up to 2100, warming and sea level rise are expected to continue for more than a thousand years even if greenhouse gas levels are stabilized. The delay in reaching equilibrium is a result of the large heat capacity of the oceans.

Climate Change and Hydro meteorological Disasters

Climate change increases disaster risk in a number of ways. It changes the magnitude and frequency of extreme weather events (meaning that coping and response mechanisms and economic planning for disasters based on past vulnerabilities may no longer suffice). It changes average climatic conditions and climate variability, affecting underlying risk factors, and it generates new threats, which a region may have no experience in dealing with.

The frequency of higher precipitation events has increased, more intense and longer droughts are being observed, widespread changes in extreme temperatures, changes in sea surface temperatures, wind patterns, decreased snow cover are being observed. These factors invariably trigger events of hazard, greater likelihood of landslides, floods, disease and thus more loss of lives.

Climate change will add yet another stress to those of environmental degradation and rapid unplanned urban growth, further reducing communities' abilities to cope with even the existing levels of weather hazards. Poor countries are disproportionately affected, owing to intrinsic vulnerabilities to hazards and comparatively low capacities for risk reduction measures.

What are Uncertainties in Climate Change?

Remaining scientific uncertainties include the amount of warming expected in the future, and how warming and related changes will vary from region to region around the globe. Most national governments have signed and ratified the Kyoto Protocol aimed at reducing greenhouse gas emissions, but there is ongoing political and public debate worldwide regarding what, if any, action should be taken to reduce or reverse future warming or to adapt to its expected consequences.

What is history of climate change?

Here are gathered in chronological sequence the most important events in the history of climate change science. The list of milestones includes major influences external to the science itself.

1800-1870: Level of carbon dioxide gas (CO2) in the atmosphere, as later measured in ancient ice, is about 290 ppm (parts per million). First Industrial Revolution. Coal, railroads, and land clearing speed up greenhouse gas emission, while better agriculture and sanitation speed up population growth.

1859: Tyndall discovers that some gases block infrared radiation. He suggests that changes in the concentration of the gases could bring climate change.

1870-1910: Second Industrial Revolution. Fertilizers and other chemicals, electricity, and public health further accelerate growth.

1945: U.S. Office of Naval Research begins generous funding of many fields of science, some of which happen to be useful for understanding climate change.

1960: Downturn of global temperatures since the early 1940s is reported. Keeling accurately measures CO2 in the Earth's atmosphere and detects an annual rise. The level is 315 ppm.

1967: International Global Atmospheric Research Program established, mainly to gather data for better short-range weather prediction but including climate. Manabe and Wet herald make a convincing calculation that doubling CO2 would raise world temperatures a couple of degrees.

1970: First Earth Day. Environmental movement attains strong influence, spreads concern about global degradation. Creation of **U.S. National Oceanic and Atmospheric Administration**, the world's leading funder of climate research. Aerosols from human activity are shown to be increasing swiftly. Bryson claims they counteract global warming and may bring serious cooling.

1972: Ice cores and other evidence show big climate shifts in the past between relatively stable modes in the span of a thousand years or so.

1977: Scientific opinion tends to converge on global warming as the biggest climate risk in next century.

1978: Attempts to coordinate climate research in U.S. end with an inadequate National Climate Program Act, accompanied by temporary growth in funding.

1979: Second oil "energy crisis." Strengthened environmental movement encourages renewable energy sources, inhibits nuclear energy growth. U.S. National Academy of Sciences report finds it highly credible that doubling CO2 will bring 1.5-4.5 Deg global warming. **World Climate Research Programme** launched to coordinate international research.

1987: Montreal Protocol of the Vienna Convention imposes international restrictions on emission of ozone-destroying gases.

1988:Intergovernmental Panel on Climate Change (IPCC) is established. Level of CO2 in the atmosphere reaches 350 ppm. After 1988 it was difficult to identify historical milestones. Not only do we lack perspective, but the effort was so large that progress on a given topic, even more than before, came through a variety of results spread over several groups and several years.

1989: Fossil-fuel and other industries form Global Climate Coalition in US to lobby politicians and convince the media and public that climate science is too uncertain to justify action.

1990:FirstIPCC report says world has been warming and future warming seems likely. Industry lobbyists and some scientists dispute the tentative conclusions.

1992: Conference in **Rio de Janeiro** produces UN Framework Convention on Climate Change, but US blocks calls for serious action. Study of ancient climates reveals climate sensitivity in same range as predicted independently by computer models.

1995:SecondIPCC report detects "signature" of human-caused greenhouse effect warming declares that serious warming is likely in the coming century. Reports of the breaking up of Antarctic ice sheets and other signs of actual current warming in polar regions begin affecting public opinion.

1997: International conference produces **Kyoto Protocol**, setting targets to reduce greenhouse gas emissions if enough nations sign onto a treaty.

1998: The warmest year on record, globally averaged (1995, 1997, and 2001-2006 were near the same level). Borehole data confirm extraordinary warming trend. Qualms about arbitrariness in computer models diminish as teams model

ice-age climate and dispense with special adjustments to reproduce current climate.

1999: Criticism that satellite measurements show no warming are dismissed by National Academy Panel. Ramanathan detects massive "**brown cloud**" of aerosols from South Asia.

2001:ThirdIPCC report states baldly that global warming, unprecedented since end of last ice age, is "very likely," with possible severe surprises. Effective end of debate among all but a few scientists. Bonn meeting, with participation of most countries but not US, develops mechanisms for working towards Kyoto targets. National Academy panel sees a "paradigm shift" in scientific recognition of the risk of abrupt climate change (decade-scale). Warming observed in ocean basins; match with computer models gives a clear signature of greenhouse effect warming.

2005:Kyoto treaty goes into effect, signed by major industrial nations except US. Japan, Western Europe, regional US entities accelerate work to retard emissions. Level of CO2 in the atmosphere reaches 380 ppm.

2007: 4th IPCC report- The intergovernmental panel reaffirmed that human emissions are very likely to cause serious climate change in a report published in 2007, but they had not been able to narrow the range of possibilities.

2008: India's national Action Plan on climate Change

2012: Himachal Pradesh prepared **"State Strategy and Action on Climate Change"**

2013: Fifth IPCC report

2015: Paris Agreement

2016: Rio Summit

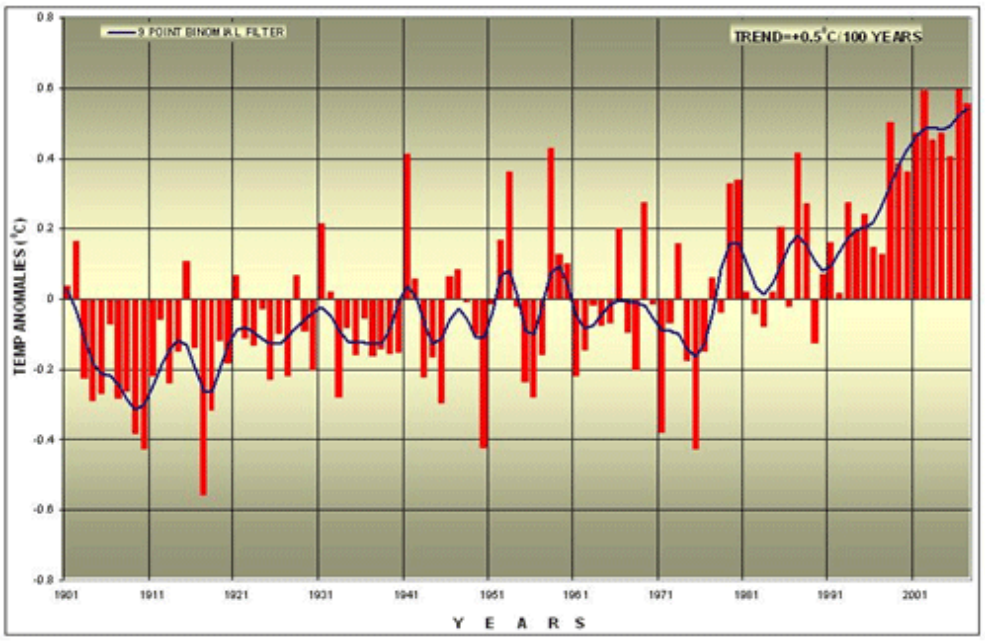
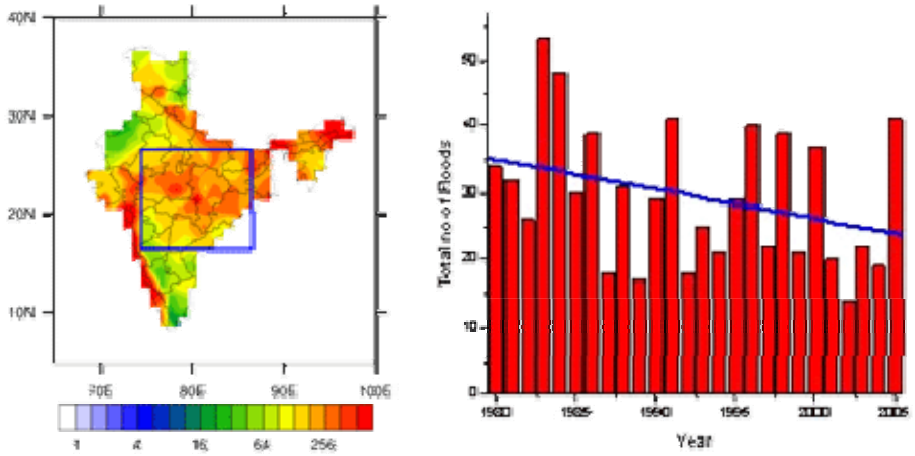
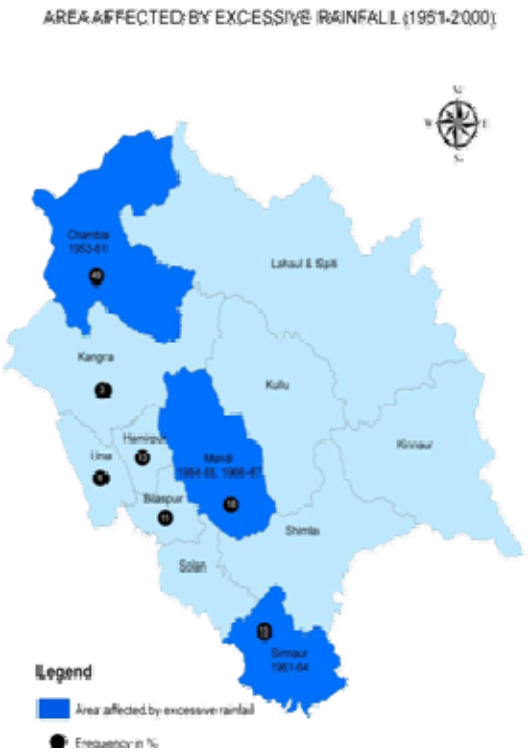


Figure: Temperature trend during 1901-2015 of India





Very recently, disaster managers and policy planners have hardly believed and engaged in climate change debates, but now finding clear evidence for an observed change in surface temperature, rainfall, evaporation and extreme events, climate change getting importance as a significant environmental challenge and disaster. While changes in average climate conditions can have serious consequences by themselves, the main impacts of global climate change will be felt due to changes in climate variability and weather extremes. It is observed during last decade and also projected that extreme weather events i.e. heat waves, cold waves, heavy rainfall, floods, droughts, more intense cyclones and flash floods will increase and for that we must concerned about. For example, extremes in maximum and minimum temperature are expected to increase into the future, but the night temperatures are increasing faster than the day temperatures and that may be very injurious for agricultural crops. Extreme rainfall shows substantial increases over large area, particularly over the west coast and west central India. This unprecedented increase is expected to have severe impact on the hydrological cycle, water resource (drought, flood, drinking water, forest & ecosystems, sea level / coastal area /losses of coastal wetlands and mangroves), food security, health and other related areas.

Learning Objectives

The participants will be able to

- What is climate change, climate variability, causes of climate change and how does climate change affects us
- To know about History & Concepts of Climate Change
- To know about Himachal Pradesh action on Climate Change
- To highlight the issues and importance of climate change in present context
- To introduce Climate change and hydro meteorological events/ extreme events
- About observed change in extreme events
- Projected climate change scenarios and extreme events

Methodology

- Power Point Presentation
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Lecture Note on Climate change concepts, observed and projected climate change
- Reading materials on climate change concepts, observed and projected climate change
- Handout of Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
Discussion about climate change and climate variability, causes and how does climate change affects us, To know about Himachal Pradesh action on Climate Change, To	Lecture cum discussion Through power point presentation	Flip chart/ Sketch board, Handout

highlight the issues and importance of climate change in present context, To introduce Climate change and hydro meteorological events, Discuss about observed change in extreme events, Projected climate change scenarios and extreme events		

Session plan

Teaching Activities	Time
Discussion about climate change and climate variability, causes and how does climate change affects us	20
Himachal Pradesh action on Climate Change, To highlight the issues and importance of climate change in present context	30
Discuss about observed change in extreme events, Projected climate change scenarios and extreme events	15
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	10
Open house for question and answer	15

Climate change and hydrometeorological risks and impact on different sectors

This module proposes (next 1 day) an assessment of current knowledge about early warning and disaster communication. An assessment of natural risks due to anticipated climate change in India with its specificities would be presented, supported by a certain number of field studies/ research projects/ case studies. Scientists/ academicians / policy makers will discuss changes in precipitations, impacts on climate-sensitive sectors (agriculture, forests) and natural resources (water, biodiversity, and grass lands). Reflection will then centre on hydrometeorological risks (floods, drought, cloud bursts and forest fire, cold wave, landslides and avalanche, etc.) and their impacts.

LU 4.2.1: Early Warning and Disaster Communication

Aim of this unit is to introduce the key global and regional level initiatives on space and ground based information for developing early warning system for disaster risk management. Impacts of hydro-meteorological disasters related to heavy monsoon rainfalls, forest fires, extreme and persistent heat or cold waves, avalanches and landslides in mountainous regions are both direct and indirect or short-lived as well as long-lived. Improved use of weather and climate information and forecasts has the potential to reduce risks of such disasters if proper early warning systems are in operation at national and state levels. Many lessons were learnt during the implementation of the international programme on the Decade of Natural Disasters.

Weather/Climate Forecasting/ Early Warning

Forecasting refers to the likely behavior of the atmosphere days in advance, or foretelling the likely status of the atmosphere in relation to various weather parameters like rainfall, temperature, wind etc., the behavior of the atmosphere for only a few days is normally referred to as weather forecasting. Forecasting the likely pattern of climate variables like rainfall and temperature for a longer period (usuallymonths and season) with sufficient lead-time before the start of the season is referred to as climate forecasting. Generally, early warning systems involving weather and climate forecasting are divided into three major types based on available lead-time:

1.	Short range (for a period of 24 to 72 hrs)	Forecasts of cyclones, associated wind speed, andtemperature are provided based on this method. Useful for taking emergency decisions such as securing livelihoods.
2.	Medium range (for a period of 5 to 10 days)	Information about rainfall, wind speed, wind direction, cloud cover and temperature are provided. Useful in making planting/harvesting decisions, storage of water for irrigation, etc.
3.	Long range (for a period of a month up to a season or more)	Also referred to as climate forecasting or seasonal climate forecasting. Useful for disaster preparedness planning in agriculture. They aid in taking better strategic decisions like crop/ cropping system choice, variety selection, and resource allocation.

Meteorology has played a role in safeguarding societies from the wrath of hydro-meteorological disasters. In fact the establishment of India Meteorological Department (IMD) came as a result of a severe cyclone striking Kolkata in 1865 which resulted in heavy losses to trade, commerce and shipping. The developments in IMD during 1875-1950 resulted in upgrading of flood warnings and heavy rainfall warnings as well as warnings against slowly evolving drought situation, landslides, severe local thunderstorms. Avalanche warnings became of special importance since 1975 and a special agency Snow and Avalanche Studies Establishment (SASE) has been established by the Government of India for this purpose. Similarly other countries of South Asia have developed respective disaster early warning system in the mountainous regions.

The progress of early warning system depended on monitoring of atmospheric-ocean environment and research on such events. As weather prediction developed by supplicated dynamical modeling, such forecast began to be used more effectively since 1950s but more specifically since 1980s. There are uncertainties in prediction of high impact weather events which leads to hydromet

disasters. However, there is a hope that a consensus among the models or an ensemble based decision system is superior to empirical methodologies of the past. Recent development in this direction is discussed. Monitoring of atmosphere-ocean environment needs sophisticated modern observational systems. Technological developments in this direction, since 1950s, are traced in the paper and the present status of the atmosphere-ocean observing system and its continuous modernization is emphasized.

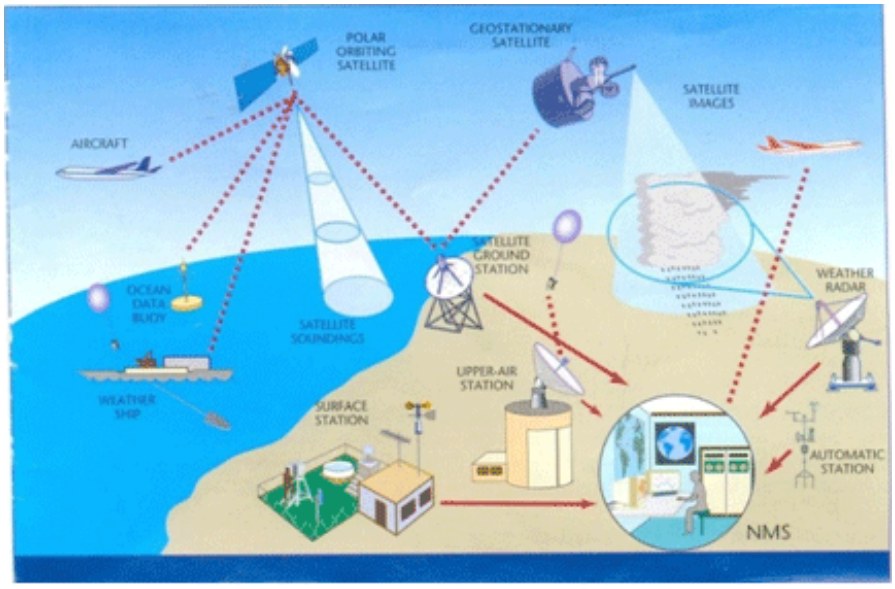


Figure: Atmosphere – Ocean Observing System

Climate prediction of inter-annual to decadal scales is the new frontier. Earth Science System Partnership and coordinated Environmental Observational Programme and Systems are likely to help in the emergence of seamless prediction of earth system and consequently improve Disaster Warnings. The session will focus about the work of special agencies like India's National Disaster Management Authority, the National Institute of Disaster Management and the SARC Disaster Management Centre, New Delhi with the support from National Weather and Oceanographic Services have roles to reduce the risks associated with hydro-meteorological Natural Disasters. The session also stresses upon active participation of print and electronic media and considers it as essential for communicating the early warnings to threatened population. Other steps needed are to determine optimal risk reduction strategies in the face of uncertain weather. Climate thresholds in the context of climate change scenarios add other dimensions and these must be recognized. Research is

needed to reduce the knowledge gap and societies have to be kept informed about the progress. The session ends with the note that the way to continued progress in risk reduction of hydro-meteorological disaster rests with better monitoring, better modeling efforts and better communication of threat perception in a probabilistic manner for which public awareness is to be progressively promoted.

Current Status of Early Warning in India

Following are the Nodal agencies in the Government of India and in the state mandated for early warning of different natural hazards prevailing in the state of Himachal Pradesh:

Hazards	*Organization at National level*	*Organization at State level*
Heat and cold wave	India Meteorological Department	Department of Revenue
Floods	Central Water Commission	Department of IPH
Cloud Burst	India Meteorological Department	Department of IPH
Drought	Department of Agriculture	Department of Agriculture
Snow avalanches	Snow and Avalanche Study Establishment (SASE), Manali (DRDO)	Department of Environment Science & Technology
Fires	Ministry of Home Affairs	Department of Home (Fire), Department of forest
Landslides and Mudflows	Geological Wing of Department of Industries, PWD, BRO and UD	GSI, Ministry of Earth Sciences, Wadia Institute of Geology,

Classifying hydro-Meteorological Disasters, Their Spatio-Temporal Scales and Adverse in Mountainous Region

Weather and climate-related events are variable in space and time domains and their impacts are also different. Therefore, the resultant disasters, associated with them, have to be judged in that framework and the preparedness for facing an event has to be planned appropriately. Media help is needed to enhance

public perceptions about the scale of these events so that public awareness about the potential dangers from such events are aroused to avoid any panic when the event befalls a particular region. In Table 1 we present the spatio-temporal scales and potential risks from hydro-climatic natural disasters over HP.

Table :Spatio-temporal Scales of Hydro-climatic Disasters in HP

Disaster Type	Time and Space Scales	Potential Risks, Degree of Severity and Season of Occurrence
Heavy rainfall	2-3 days (over 6 cm/day, can be 30-90 cm/day)	Very high flooding due to rains, release of dam water and ever dam bursts
Hail storms	< 1 hour 500X500 km	High: in winter and March to May months
Heat and cold waves	3-5 days 1000X1000 km	High: in summer for heat waves and in winter for cold waves
Floods	Few hours for several days. 10X10 km for cloud bursts, flash flood and urban flood and 1000X1000 km for riverine floods	Very high in summer monsoon season
Drought	A few weeks to season 1000X1000km extent to country scale	Moderate in summer monsoon season
Landslides (geomorphological disaster aided by heavy rains)	1-2 days 1000X1000 km	High in heavy monsoon conditions
Avalanches	1-3 days 1000X1000 km	High in winter

Figure: Unmanned weather station and disaster communication

Role of Media in Communicating Early Warnings against Hydro-Climatic Disasters:

An efficient, reliable and skillful the disaster early warning system needs a medium to communicate the warnings, from the originators of the warnings (for example – weather and climate forecasters) to the end users like district administrator, disaster management network and general public. At the beginning of the introduction of the EWS with regard to weather events in the 19th century, IMD has used telegraphic-messages to communicate the warnings to the warnees on their list. As other media, using latest advances in communication science and technology, developed with time in the 20th century IMD adopted them. At present, weather-related warnings are communicated through telephone and internet to central and state authorities who in turn use their own networks to send the warnings down the ladder. IMD also uses network of AIR stations, Door Darshan and other private national and regional TV channels for broadcasting the warnings. Even weather forecasters appear on TV channels and some TV channels approach expert meteorologists for their views and comments on the developing high impact hydro-climatic events. Newspaper also carries the information in English, Hindi and regional languages. In the case of a threatening situation in the face of a tropical cyclone strike, even the

INSATfacility is used in the coastal areas and the general public is constantly kept informed about the developing threat. Thus all methods are adopted to use the reach of different media about development of threatening hydro-climatic events. The changing threat perceptions to regional/local end-users help them to take appropriate measures for risk reduction.

Aryabhatta Geo-informatics & Space Application Center (AGiSAC), Hiimachal Pradesh:

The State Government has taken the initiatives of setting up Aryabhatta Geoinformatics & Space Application Centre (AGiSAC) under the aegis of State Council for Science, Technology & Environment with an objective to facilitate the use of Geo–informatics for developmental planning and decision-making in the State. The objectives for setting up this State Centre is to facilitate decentralized planning, objective decision making, Monitoring & Evaluation of Government Schemes & Programmes, to set up integrated natural resources data management system, to provide services/consultancy based on specific user needs in the field of Remote Sensing and GIS and to promote the use of SATCOM networks for distant interactive training and education in the State. The key functions are

- Developmental Planning/ Decision Support Applications/Yes/No Decision
- Advisories/Alerts
- Surveillance /Regulatory Applications
- Monitoring & Evaluation of Developmental Works/ Schemes

Learning Objectives

Upon completion of this module, participants should be able to:

- Know the different organizations providing early warning.
- Describe the various types of early warning systems and forecast products available in India
- Evaluate currently available climate and flood forecast products
- Elaborate how current forecast products may be used for disaster preparedness in the different sector
- Know about Emergency Operation centers
- Different means of disaster communications to community

Methodology

- Power Point Presentation
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Lecture Note on Weather forecasting, early warning and disaster information
- Reading materials on Weather forecasting, early warning and disaster information
- Handout of Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
Discuss the various types of early warning systems and forecast products available in India and different organizations providing early warning, Evaluate the currently available climate forecast products, Elaborate how current forecast products may be used for disaster preparedness in the different sector, Know about Emergency Operation centers, Different means of disaster communications to community	Lecture cum discussion Through power point presentation	Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Discuss the various types of early warning systems and forecast products available in India and different organizations providing early warning	20
Evaluate the currently available climate forecast products, Elaborate how current forecast products may be used for disaster preparedness in the different sector	30
Discuss about Emergency Operation centers and different means of disaster communications to community	15
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	10
Open house for question and answer	15

LU 4.2.2: Impacts on environnent and ecosystem (glaciers, forest, biodiversity)

The state of Himachal Pradesh lies in western Himalayas, covering an area of 55,673 km2. It is characterized by diverse climate varying from semi-tropic to semi-arctic, and an altitude ranging from 350 m to 6,975 m. Five north Indian rivers flow through the state, namely, the Ravi, Beas, Chenab, Satluj and Yamuna, and there are about 2,554 glaciers covering 4,160 km2area with an ice reserve of 387 km2. It has three main reservoirs, namely, the Govind Sagar (Bhakra dam), the Pong dam and the Pandoh dam with a total reservoir capacity of 14,218 million m3.

The total forest cover in Himachal Pradesh, as per the 2011 State of the Forest Report, is 14,679 km2, which is 26 percent of the total gross area of the state. Between 2009 and 2011, the state has gained 11 km2of forest area. However, the area under dense forest cover has not increased. The medium dense forest cover has reduced by two km2, and the open forest area has increased by 13 km2. Furthermore, state revenue from forest produce has increased from Rs. 14 crores to Rs. 72 crores between 1990-91 and 2010-11 (Himachal Forest Statistics, 2010) due to sustainable forest management practices.

Some of the species such as *Liliumpolyphyclum, Sorbus, Lanata, Swertia, Androsco, Aconitum heterophyllum*that were found in the state in 1902, no longer

exist. Similarly, *PinusLoifolia*that existed at 1,800 m altitude is now found at 2,200 m altitude. About 27 species of wildlife in the state are either endangered or vulnerable. An analysis, carried out by Chaturvedi et al (2010) using IBIS model with climate inputs from PRECIS, a regional climate model, indicates that the forests in the state are likely to undergo changes in about 55 percent of the forest grids that fall within the state boundary ascribed by the Forest Survey of India.

- Himachal Pradesh being a mountain State is rich in floral and faunal biodiversity. The tribal and remote areas of the state have good medicinal and aromatic floral resources which plays a major in their livelihoods.
- With the changing climate, many species are either facing the problem of extinction or declining because of rising temperature affecting health, well being and livelihood of the people who rely on such resources.
- We are committed to preserve this Himalayan reserve as it provides us with biological resources and basic goods like food, fiber, medicine, timber, fuel wood etc.

The glaciers in Himachal Pradesh with seasonal snow cover serve as perennial sources of rivers, and are used as renewable sources of water for irrigation, drinking, energy and industrial use in the state as well as in the states of Punjab, Haryana and Uttar Pradesh. However, evidence suggests rise in temperatures is causing these glaciers to recede. Although the state has five rivers flowing through it, it still faces paucity of water (HPSAPCC, 2013).

Glacier Status in Himachal Pradesh

- An overall reduction in glacier area from 2,077 sq. km. to 1,628 sq. km. from 1962-2001 in Chenab, Parbati & Baspa Basins, H.P.
- An overall deglaciation of 21% of total area in these basins.
- About 10% deglaciation is observed in Spiti Basin during 2001-2007.
- Prominent glaciers as studied by GSI in Himachal Pradesh shows:
    - ChotaSigri 6.81 m/y retreat during 1962-95.
    - Bara Sigri 29.78 m/y during 1906-1957.
    - Trilokinath as 17.86 m/y during 1968-1996.
    - Beas Kund as 18.8 m/y during 1963-2003.
    - Manimahesh as 29.1 during 1968-2005.

According to experts, glaciers in the Himalaya have been reported to be in the retreating phase and in future, this can result in water scarcity for the people living in the mountain region and in downstream area who depend on glaciers and snow as a source of fresh water. Retreating glaciers, depleting snow cover

and Glacial Lake Outburst Floods (GLOFs) are of immediate concern in the mountain environment as GLOFs can have a devastating impact on the hydro power, water sources, people, livestock, forests, farms and infrastructure. Decreases in snow accumulation and glacial retreat might lead to acute water shortages in the future.

Learning Objectives

Upon completion of this module, participants should be able to:

- Learn about Impacts on biodiversity, forests, glaciers, etc. in the state
- Know about the Case studies / project outcome / field studies related to adaptation and mitigation options

Methodology

- Power Point Presentation
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Lecture Note on impact on biodiversity, forests, glaciers, etc. in the state
- Reading materials on Case studies / project outcome / field studies related to adaptation and mitigation options
- Handout of Presentation
- Flip chart
- White Board
- Film on success stories

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
Learn about Impacts on biodiversity, forests, glaciers, etc. in the state,	Lecture cum discussion Through power point	Flip chart/ Sketch board, Handout

Know about the Case studies / project outcome / field studies related to adaptation and mitigation options Film on success stories	presentation	

Session plan

Teaching Activities	Time
Discussabout the Impacts on biodiversity, forests, glaciers, etc. in the state	30
Discuss the success stories of case studies / project outcome / field studies related to adaptation and mitigation options	30
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	15
Open house for question and answer	15

LU 4.2.3: Impacts on population (food security, water and sanitation, migration and conflict)

Increasing global temperature is expected to increase the intensity of hydro Meteorological hazards and to change the amount and pattern of precipitation. Other effects of global warming include changes in agricultural yields, trade routes, glacier retreat, species extinctions and increases in the ranges of disease vectors.

The IPCC Fifth Assessment Report describes the likely effects of climate change, including from increases in hydro Meteorological events. The effects on key sectors, in the absence of countermeasures, may be summarized as follows:

Water	◆ Drought-affected areas will likely become more widely distributed. ◆ Heavier precipitation events are very likely to increase in frequency leading to higher flood risks. ◆ By mid-century, water availability will likely decrease in mid-latitudes, in the dry tropics and in other regions supplied by melt water from mountain ranges.
Food	While some areas will initially benefit from higher agricultural production, for many others at lower latitudes, especially in seasonally dry and tropical regions, the increases in temperature and the frequency of droughts and floods are likely to affect crop production negatively, which could increase the number of people at risk from hunger and increased levels of displacement and migration.
Industry, Settlement and Society	The most vulnerable industries, settlements and societies are generally those located in coastal areas and river flood plains, and those whose economies are closely linked with climate- sensitive resources. This applies particularly to locations already prone to extreme weather events, and especially areas undergoing rapid urbanization. Where extreme weather events become more intense or more frequent, the economic and social costs of those events will increase.
Health	The projected changes in climate are likely to alter the health status of millions of people, including through

increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts. Increased malnutrition, diarrhoeal disease and malaria in some areas will increase vulnerability to extreme public health and development goals will be threatened by longer- term damage to health systems from disasters.

Climate change will affect all countries, but people in the poorest countries and poor people in richer countries are more likely to suffer the most. They tend to live in high- risk areas such as unstable slopes and flood plains, and often cannot afford well-built houses. Many of them depend on climate-sensitive sectors, such as agriculture, and have little or no means to cope with climate change, for example owing to low savings, no insurance and poor access to public services. Climate change is expected to reduce already low incomes and increase illness and death rates in many developing countries.

India's sustainable development will be challenged as climate change compounds the pressures that rapid urbanization, industrialization, and economic development have placed on natural resources. One of the main issues will be the availability of adequate fresh water, which by the 2050s will be a concern for possibly more than one billion people. The continued melting of glaciers in the Himalayan region is projected to increase flooding and rock avalanches and to adversely affect water resources in the next two to three decades.

Learning Objectives

Upon completion of this module, participants should be able to:

- Highlight about climate risks and its impact on food security and Water resource
- Know about Climate related health problems ; current aspects of climate change and human health
- Suggest Adaptation options
- Learn about Issues of migration and conflict due to these impacts in HP
- Get about different Case studies / field studies in HP

Methodology

- Power Point Presentation
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Lecture Note on impacts on agriculture, water, health sectors
- Reading materials on impacts on agriculture, water, health sectors
- Handout of Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
Discuss about climate risks and its impact on food security, health and Water resource in HP. Suggest Adaptation options, Learn about Issues of migration and conflict due to these impacts in HP. Discuss different Case studies / field studies in HP Film on success stories	Lecture cum discussion Through power point presentation	Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Discuss about climate risks and its impact on food security, health and Water resource in HP	30
Discuss the success stories of case studies / project outcome / field studies related to adaptation and mitigation options	30
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	15
Open house for question and answer	15

U 4.2.4: Hydrometeorological risks and impacts

This learning unit through panel discussion identifies the tools and methods needed for assessing hydrometeorological risks and its impacts, focusing on the environment, ecosystem and populations. It introduces some of the key concepts and steps for climate risk assessment in the context of livelihood adaptation to climate change in environment, ecosystem and populations. This covers a range of climate risks with special emphasis on drought, floods, landslides and avalanche etc.

Risk identification and assessment are the two important steps that form the basis for successful implementation of adaptation practices. This involves identification and assessment of current (climate variability) and future (climate change) risks and associated societal vulnerabilities.

Risk is the result of physically defined hazards interacting with exposed systems – taking into consideration the properties of the systems, such as their sensitivity or social vulnerability. Risk also can be considered the combination of an event, its likelihood and its consequences. Risk equals the probability of climate hazard multiplied by a given system's vulnerability.

Hydrometeorological risk identification is the process of defining and describing a climate-related hazard, including its physical characteristics, magnitude and severity, probability and frequency, exposure and consequences.

Risk assessment is a methodology to determine the nature and extent of risk by analyzing potential threats and evaluating existing conditions of vulnerability that could pose a potential threat to property, livelihoods and the environment on which they depend.

Participatory tools and methods for hydrometeorological risk identification and assessment

Participatory tools are ideal for hydrometeorological risk assessment. They can facilitate community participation, exchange of ideas and decisions among the community and other stakeholders. The following list identifies some tools that can be considered for involving communities in hydrometeorological risk identification and assessment.

Hydrometeorological risk maps – identifies areas at risk and vulnerable members of the community. This also includes analysis of available resources

that can be used by community members for hydrometeorological risk management and involves the community in preparing local risk maps.

Economic ranking – identifies typical characteristics of wealth and well-being of groups in the community

Focus group meetings – brings together community residents, farmers' groups and associations, formal and informal village/town cooperatives, landless labourers, fishers, livestock farmers, etc., to discuss specific issues.

Hazard Venn diagram – allows participants to identify and analyze the common hazards that take place locally, their magnitude and likelihood.

Historical transect – provides a graphic presentation of the history of climate risks and development in the community with emphasis on the different sector.

Household composition – provides a breakdown of human capital, looking at the labour force, migration, education and dependency status of various socio-economic groups etc.

Local resource map – pinpoints main land types, livelihood activities on each land type and physical infrastructure such as roads, farming methods, irrigated areas, water points, markets, schools, hospitals, electricity, banks and agricultural extension offices.

Matrix ranking – prioritizes hydrometeorological risks, needs and options.

Problem analysis – analyses perceived livelihood problems, causes of problems, coping mechanisms, livelihood opportunities of women and men, and the impact of hydrometeorological risks on environment and population.

Ranking – analyses problems in order to rate community priorities or the significant problems faced by the community.

Seasonal calendar – tracks seasonal changes, climate-related hazards, community events and other activities related to a specific month

Timeline – narrates the history of hydrometeorological risks and significant events that happened in the community.

Transect – involves the facilitator and community members taking a walk together through the community to get a realistic picture of community vulnerability and the resources that are available or may be available for disaster risk management.

Vulnerability – shows proportion of households affected by hydrometeorological risks and reasons why they are vulnerable.

Vulnerability context – looks at local shocks and stresses, proportion of households that are food insecure in an average year, bad year, good year and why, and the proportion of households/farmers who are income insecure in an average year, bad year, good year and why.

In addition, a certain amount of secondary information is needed for hydrometeorological risk assessment. This includes

- Daily rainfall, temperature and evaporation data to assess the moisture deficit and drought periods (early, mid and late season),
- Land use changes over the years,
- Trends of heavy rainfall, cold and heat waves, extreme temperatures, hail storms and wind storms, avalanche etc.
- Climate change scenarios and anticipated future impacts
- Geographical coverage of the hydrometeorological risk based on the past records
- Frequency of each risk based on past historical records

Learning Objectives

At the end of this learning unit, participants should:

- Understand the participatory tools and processes for assessing climate-related hazards, vulnerabilities and risks in HP,
- Identify key climate risks that have significant impact on communities in general and livelihoods in particular, and
- Identify the vulnerabilities and capacities of the community
- Assess the community perception of risks associated with past and current climate variability in the state
- Get knowledge about different Case studies / field studies in HP

Methodology

- Short presentations, Films etc
- Panal Discussion
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Short Notes on Hydrometeorological risks its impacts, risk map, vulnerabilities and capacities of the community in HP
- Film/Reading materials on Hydrometeorological risks its impacts in HP, Case studies
- Handout of short Presentation
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
To understand the participatory tools and processes for assessing climate-related hazards, vulnerabilities and risks in HP, Identify key climate risks that have significant impact on communities in general and livelihoods in particular, and Identify the	Panel Discussion (3-4 national/regional/local experts)	Flip chart/ Sketch board, Handout, Short film

vulnerabilities and capacities of the community, Assess the community perception of risks associated with past and current climate variability in the state		

Session plan

Teaching Activities	Time
Discuss about participatory tools and processes for assessing climate-related hazards, vulnerabilities and risks in HP	20
Identify key climate risks that have significant impact on communities and their livelihoods	20
Assess the capacities of the community and community perception of risks associated with past and current climate variability in the state	20
Summary & evaluation of the learning in this session. Trainers may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	15
Open house for question and answer	15

Module 3

Mitigation and Adaptation: analysis of vulnerabilities and capabilities

A ½ day field outing to the floods, landslides, cloud bursts and forest fire affected site or related institutions etc. will enable participants to visit research and project sites, and have discussions with key local figures. This module (2 days) will be the link between disaster and development i.e. key Considerations for integrating Climate Risk Management Strategies into Developmental Programs. These will reveal the contributions made by the exact sciences (role of science and new technologies in prevention and preparation), government policies/programmes and human sciences (vulnerability study and strengthening of capabilities thanks to Community Risk Assessment tools). After studying the hazards and environmental factors, attention will be focused on the concept of vulnerability. Social vulnerability is a key component in every disaster risk assessment carried out at local level. Adaptation strategies in different sector will be discussed and focus will be on the case studies and success stories, experiences will shared so that participants can apply/ plan the same on the ground (respective area). Recent initiatives by govt. and communities on climate adaptation in different sectors will be also discussed.

Various methodological tools for assessing and strengthening capabilities will be presented and analyzed (community-based DRM in particular). As backup to the theoretical part, seminars will be organized to allow participants to use these methods and assume a proactive role.

Vulnerability can be reduced either by mitigation and/or adaptation. Mitigation basically involves reducing the causes of damage – in particular the GHG emissions and concentration in the atmosphere - with the aim to reduce the probability of occurrence of adverse conditions for socioeconomic and environmental systems. The adaptation, however, reduces the severity of many impacts when/if adverse conditions prevail.

LU 4.3.1: Govt. Policy initiative on adaptation & mitigation at state/Community/local level: success stories / gaps in different part of the state

Introduction

The Government of Himachal Pradesh is already taking various initiatives to adopt the path of sustainable development and inclusive growth and has initiated various programmes and actions which would be further strengthened and made well equipped to deal with the challenges of hydrometeorological risks especially climate change. The various actions have already been initiated in the State to streamline actions towards expected changes in various sectors viz. Agriculture, Water Resources, Forests, Biodiversity, Ecosystem, Energy (Hydro Power), Health, Tourism, Urban Development, Transport, Industry (Mining), and Disaster Management etc. The State Government has demonstrated its commitment by taking various initiatives for reductions of GHG emissions by way of bringing energy efficiency in the State.

Agriculture – Horticulture: The Department of Agriculture is working with responsibility for the economic up-liftment of farming community of the State through planned agriculture development with a strategy for future sustainable agriculture and production and improvement in productivity and quality through various adaptive measures such as setting up of 21 Seed Multiplication Farms where Foundation Seeds of Kharif and Rabi crops are being produced. Annually about 3,500 to 4,000 qtls.seed of Cereals, Pulses and Vegetables are produced. Besides this, the department has established 11 Soil Testing Labs and 4 Mobile Soil Testing Labs to provide free soil testing facilities to the farmers. Weather Based Crop Insurance Scheme (WBCIS) has been introduced for different crops. The State is also participating in **RashtriyaKrishiBimaYojna (RKBY)** with a purpose to provide comprehensive risk insurance against yield losses from drought, hailstorm, floods and pests disease etc in Wheat, Barley, Maize, Paddy and Potato. **'PanditDeenDayalKisanBagwanSamridhiYojna'** is an all embracing scheme being implemented by Government of Himachal Pradesh for creating self-employment opportunities and diversification of farming for strengthening the economic status of farmers. Under the **'Himachal Pradesh Crop Diversification Project'** activities like promotion of organic farming, vegetable production and transfer of technology are being undertaken. To make Apple cultivation viable in the face of growing economic, environmental and global challenges, the State is implementing Rs. 85 crore**'Apple Re-plantation**

Scheme', where it is envisaged to replace the old and low yielding varieties with value productive varieties in the area of 12,500 acres during the next five years.

Water Resources: Concerns of the community are taken into account for water resources development and management. The State Water Policy has been prepared in the State and is being currently revised. In order to provide permanent drinking water supply and to avoid deployment of tankers/tractors, the Rehabilitation and Source Level Augmentation of various schemes are being implemented in the state. The non-conventional methods for utilization of water, including inter-basin transfers, artificial recharge of groundwater, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, are being practiced to increase the utilizable water resources. The rain water harvesting has been made mandatory in Himachal Pradesh. The Mid-Himalayan Watershed Development Project is operational in the mid and high hill range of 600 to 1800 meters covering 11 sub watershed divisions falling in 10 districts. The project is aimed at reforestation of protect watersheds, improve livelihoods and to generate carbon revenue.

Sustainable & Renewable Energy: The State is the major provider of clean energy hydropower for the country. The State has an identified hydro-power potential of around 23 GW (15% of the total hydro potential in the country) out of which around 8 GW has already been harnessed. This corroborates the national objective of realizing 40% of the total installed capacity through renewable energy in the country. On social sustainability, the Government of Himachal Pradesh has undertaken action to adopt a new revenue sharing scheme that pays annuities to the local communities living in the affected villages during the operational life of hydropower projects. Under this new policy, annual revenue equivalent to 1 percent of power sales from the project will be distributed to households in the project affected area.

Optimizing Renewable Energy in the State: Government is committed for harnessing renewable sources of energy in the State. Wind Solar Hybrid System of 12 KW (10 KW Wind Aero-generators and 2 KW Solar Photovoltaic Panels; investment of Rs. 41.30 lacs) has been installed at Pooh, District Kinnaur during 2008-09 with an objective to facilitate the Military Operations at high altitude near Line of Control (LOC), China. The State Government has introduced CFL for energy conservation through the **'Atal Bijli Bachat Yojna'** by distributing 4 CFL bulbs free of cost to every family in Himachal Pradesh.

Disaster Management: As far as Disaster Management in India is concerned, there is a paradigm shift from the earlier charity approach to a professional way of handling Disaster Management. The Government of Himachal Pradesh has already taken various initiatives for handling disaster at pre disaster level for better management.

- State Disaster Management Authority (SDMA) & State Executive Committee (SEC) to coordinate response in the event of any disaster situation or disaster in the State.
- District Disaster Management Authority (DDMA) to coordinate response at District Level.
- Awareness material developed and circulated throughout the State.
- Training Need Assessment for all stakeholders in DM
- State DM Policy.
- Strengthening of 100 Companies of Home Guards with Search & Rescue (SAR) Equipments.
- Strategy for capacity building for Masons, Barbenders& Carpenters for safe construction practices at Panchayat level.
- Capacity building throughout the State at various platforms for different stakeholders.
- Issuing of guidelines to all departments about:
    - Training officer/officials in DM.
    - Preparation of DM Plans.
    - On-site & off-site Emergency Plans for industrial units.
    - Mock-drills in schools for different hazards.

Learning Objectives

At the end of this learning unit, participants should:

- To get the knowledge about state/national government initiatives in different sectors to enhance coping capacities of the communities,

- Get knowledge about different Case studies / field studies in HP
- Film on good initiatives

Methodology

- Short presentations, Films etc
- Panel Discussion
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Reports of government initiatives
- Film/Reading materials on Case studies
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
To get the knowledge about state/national government/ initiatives in different sectors to enhance coping capacities of the communities, Get knowledge about different Case studies / field studies in HP Film on good initiatives	Panel Discussion (3-4 national/ regional/local experts)	Flip chart/ Sketch board, Handout, Short film

Session plan

Teaching Activities	Time
Discuss about national government initiatives in different sectors to enhance coping capacities of the communities	20
Discuss about state government initiatives in different sectors to enhance coping capacities of the communities	20

Information/discussion about different Case studies / field studies in HP	20
Summary & evaluation of the learning in this session. Trainers may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	15
Open house for question and answer	15

LU 4.3.2: Case studies on enhancing adaptive capacity of mountain (Himalayan) communities against hydro-meteorological disasters

Introduction

The coordinator/ facilitator will brief the trainees about the significance of field visit of a barrage to see the structural and non-structural measures of flood management on site that how do control measures manage flood disaster or India Meteorological Department to see the early warning systems for different hazards or see the mitigation plan for landslides/drought management etc. The coordinator/facilitator will also provide opportunity to trainees for sharing their practical experiences with officials working in the areas of flood control or preventive and mitigation plan for other hazards in the state and they may get an opportunity to apply their learning of the classroom in the field.

Learning objectives

- Detailed information on adaptation and mitigation measures in mountain regions
- To study & understand the control measures for managing hazards
- Methodology and tool kit for Adaptation in different sector
- Local scale multi-hazard risk management and development action plans preparedness for climate risk
- Success stories and Case studies on hydro-meteorological risk mitigation
- Alternative livelihood / change in crop and varieties, rehabilitations, drinking water etc.
- Success stories and Case studies on hydro-meteorological risk mitigation
- To share the practical experience (Lessen learnt / best practices) with officers working in the areas of different hazards
- To apply the learning of the classroom in the field.

Methodology

- On site Interaction and discussion of participants with the officials of Flood control cell of Irrigation Department or drought management unit of Agriculture Department or Watershed development etc.

Duration

- 240 minutes

Teaching/ Performance aids

- Film
- Flip chart, sketch board
- Maps of the field visit
- Models of study site
- Transport facility

Trainer's Note and Session plan

Contents	Methodology	Teaching aids
Mitigation measures of any specific hydrometeorological hazard site (Flood, Drought, Avalanche, Landslides etc.), Early warning system, Action Plan for risk management measures, Measures of concerned department Film on disaster occurred and Mitigation measures in Himachal Pradesh	Lecture cum discussion through power point presentation followed by Question answer	Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Familiarization of trainees classroom knowledge of the site going to visit by sharing with the practical experiences of officials working in the area of mitigation measures along with the tools and techniques.	60 Minutes
Interaction with the officials on the recent mitigation measures and management, forecasting methods, Govt. policy on Early warning system etc.	45 Minutes
Discussion on Action Plan adopted by the department	45 Minutes
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	20 Minutes

Invite other trainee to supplement whatever their colleague has discussed. The trainer may check out that the learning objectives of the session have been achieved.	
Open house for question and answer	10 Minutes
Journey duration of the field site	60 minutes

During the field visit or visit to any organization, the specific works carried out by the concerned Department/organization may be shown to trainees to tell the different types of structural and non-structural measures practically taken up at pre, during and post disaster by the State Governments to reduce the impact on the people's life and their properties.

LU 4.3.3: Recent initiatives on Preventive Measures and Mitigation Plan for different hydrometeorological hazards– gap, need and strategy

Introduction

The flood prone area in the State has been estimated as 2.31 lakh ha. The Government of Himachal Pradesh is making strenuous efforts to protect private properties and culturable land by providing emergent flood protection measures in the shape of embankments, spurs and wire crates etc. Up to March, 2011 the Irrigation & Public Health Department was able to protect an area of 17,602 ha from the fury of floods. A Disaster Management Authority has been setup in the State to combat the emerging threat of natural disasters. The State provides grants-in-aid to victims of weather related disasters. It also supports proactive disaster prevention programmes, including dissemination of information and training on disaster-management personnel. The State Disaster Management Plan is also being finalized wherein the vulnerability assessment of the State would be carried out and various mitigation measures would be suggested. Besides his, District Disaster Management Plans have been prepared by most of the districts and District Disaster Management Authorities have been established. The State Emergency Operation Centre (SEOC) has also been established.

Climate change is likely to increase the risk of natural disasters in Himachal Pradesh. Flash floods and GLOFs, landslides are a feature of State's variable climate. However, climate change is likely to increase the frequency and/or severity of extreme events. The high concentration of people and infrastructure in urban areas, especially along the river and river bed lowlands are likely to result in severe economic losses with changing exposure to extreme events. Remote settlements can be particularly vulnerable to natural disasters due to inadequate health infrastructure, road connectivity.

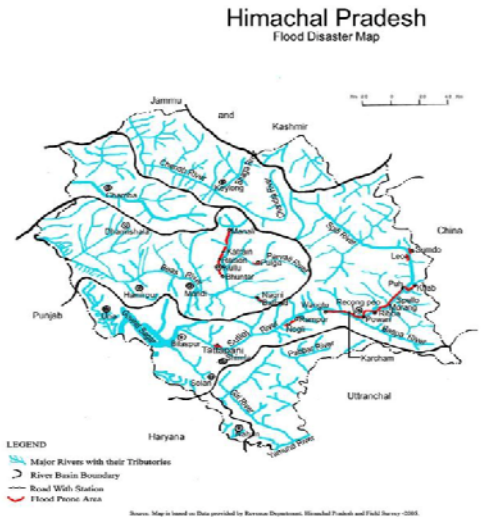
Specific Hazards and Nodal Departments in Himachal Pradesh

Hazards	Supporting Agencies/ Department of early warning system	Nodal Department
Floods/Flash Floods/ Cloud Burst	CWC, IMD	Department of IPH
Drought	IMD, Revenue, RD, Department of Agriculture	Department of Agriculture

Snow avalanches	Snow and Avalanche Study Establishment (SASE), Manali (DRDO)	Department of Environment Science & Technology
Forest Fires	Minstry of Home Affairs, Fire Department	Department of forest
Landslides and Mudflows	IMD, PWD, BRO and UD, GSI, Ministry of Earth Sciences, Wadia Institute of Geology	Department of IPH
Dam / Reservoir Burst	IPH, Environment Science and Technology, CWC and Administration	MPP& Power, HPSEB
Snow Storms	IMD, IPH, Health and Admn, Home, PWD	Revenue
Extreme Cold	IMD, Forest, Electricity, Health, Home	Department of Revenue, District AC
Hailstorms	IMD, home and Insurance, Admn	Agriculture and Horticulture
Wind Storms	IMD, Agriculture and Horticulture, home	Revenue

IMD has established an elaborate network of observatories in the state of Himachal Pradesh. General weather bulletins are issued twice a day based on -3 and 12 UTC observations throughout the year including forecasts for 24 hrs and weather warnings for next 48 hrs. The information is disseminated through electronic media, radio and print media on a regular basis. Weather warnings for extreme weather such as heavy rainfall, heat and cold wave squall and hail are issued as and when situation so develops. Local forecasts for the capital cities and other important cities are provided four times a day with 48 hrs validity. The IMD information is available in website www.imd.gov.in As far as forecasting cloud bursts the most devastating weather event presently there is no technique for anticipating the cloud burst because of its localized nature. A very fine network of radars may help in future.

Flood: Central Water Commission has developed a network of flood forecasting stations and issues Daily Flood Bulletins to all designated Authorities/Agencies of the Central Government and State Governments/ district Administration during the South East Monsoon season for all the major river basins for different categories of floods.



Landslides: Geological Survey of India issues alerts and warnings to all designated authorities and agencies of the Central Government and State Governments/ district Administration for landslides.

Avalanches: Snow and Avalanche Study Establishment (SASE) of the Defense Research and Development Organization (DRDO) Chandigarh is responsible for issuing alerts and warnings to all designated authorities and agencies of the Central Government and State Governments/ district Administration for avalanches.

Hailstorms: Hailstorms create havoc every year to crops and in fruits and vegetable belts damaging about 20-30% of crop every year in the state. In order to minimize the losses suffered by farmers and growers due to hail the Govt. through Department of horticulture has installed anti-hail guns under a project at three locations in fruit growing belt of Shimla district. Using, weather parameters responsible for hail formation, the anti-hail gun device fire acetylene gas into the clouds in order to acquire weather data radar has been installed at Tumdoo at an altitude of 10,000 feet near Khadapathar and three hail guns are installed in Jubbal, Kotkhai and Rohru areas. Proposal to expand the network is under consideration of the Govt.

Setting up of the Emergency Operation centers :

The State level EOC will be located within HP Secretariat. This EOC will strengthen the existing control room and will be the nerve center for Coordination

and management of disasters. For information flow, besides its own toll free number 1070 the SEOC shall be connected to the existing network of emergency 108, Police & Fire. The calls received from victims for help or FIR will be diverted to SEOC and will then be processed as per the SEOC protocol. The SEOC shall have direct connection with NEOC and early warning networks of all nodal agencies at the national and state level. The SEOC as centralized coordination mechanism shall provide direction and control on the following:

- Receive and process alerts and warning from nodal agencies and other sources and communicate the same to all designated authorities.
- Provide data and information to SEC for taking appropriate decisions and to monitor emergency operations
- Provide and facilitate coordination between ESF agencies.
- Provide inventory of resources and requisitioning additional resources during the disaster phases.
- Provide and issue disaster specific information/data to all concerned
- Consolidate analysis and damage loss and needs assessment data.
- Forwarding of consolidated reports to all designated authorities.

State Disaster Response Force (SDRF)

The department of home will constitute four companies for dealing four major disasters such as earthquakes, floods, avalanches and forest fires. These companies will be located in 1st IR Bn., 2nd IR Bn., 3rd IR Bn. and 4th IR Bn. These four companies will be equipped with the following-

- Detection and location
- Extrication and Access
- Fire Fighting
- Medical First Aid

Emergency Health Response

Himachal Govt. has signed an MOU with Hyderabad based GVK-EMRI to provide free ambulance services to the patients in different parts of the state. The state of art fully equipped ambulances is being run under AtalSwasthyaSeva scheme and providing quality health services to the people of the state. The scheme has proved very effective in providing prompt ambulance service and in saving lives. The service is being maintained by local youth para-medics specially trained for delivering effective medical services. The residents of Himachal Pradesh are getting 24X7 emergency services on dialing a single toll free emergency number 108. Assistance can also be obtained at this number

within twenty minute for emergencies such as fire, police apart from medical. The response centre equipped with latest technology and infrastructure is located at Dharampur in Solan district. This facility will be linked with SEOC&DEOC for responding to all calls related to disaster management.

Ensuring Public private partnership

SDMA will enter into agreement with major project developers to support preparedness, relief, recovery, rehabilitation and reconstruction initiatives of the Govt. Major Power projects are located at strategic locations and would help in providing vital data for early warning for hydro meteorological disasters. Availability of necessary infrastructure with them would help in mounting immediate response in the event of any disaster.

Improving Techno legal Regime

Considering the high vulnerability of the State to seismic hazard the plan recognizes the importance of putting in place codes for safe earthquake constructions. The structural mitigation measures being critical to minimizing the impact of earthquake, the SDMA will issue necessary directions to Department Of Towns Country Planning to revise the existing building bye laws and Act by incorporating the necessary amendments. An expert group will be constituted by the Town & Country Department which will meet every six-month to review the various construction codes and laws being practiced in the State of Himachal Pradesh.

Development of Hazard Vulnerability Risk scenario of the State

Knowledge on the magnitude of various hazards and associated risk is adequate for macro level understanding but the existing database on HVRA is not only incomplete but incomprehensive as well for detailed planning at District and Block level. In order to fill this gap the Govt. has commissioned a study through a consultant to prepare an Atlas of Hazard Vulnerability Risk Assessment at Block level. This study is designed to provide generic basic data, undertake analysis, and quantify disaster risk levels and associated causal factors. The study will also propose solutions for reducing the hazard risks. Future plans will be developed by taking into consideration the outcome of this study. The vulnerability and Risk Atlas envisaged to be generated as part of this exercise will contain series of GIS data based maps at State, District & Block level providing insight to hazard exposure, vulnerability and cumulative multi hazard loss geographic region wise.

Implementation of Insurance Schemes

The state Govt. has introduced the insurance scheme since 1999-2000 for major crops such as wheat Barley, Maize, Paddy and Potato. 50% subsidy on premium is being provided to small and medium farmers of the state. The scheme is compulsory for the loaner farmers and optional for the non loaner farmers. The scheme provides comprehensive risks insurance against drought, hail storm floods, pests and disease etc. Ginger crop of Sirmour and Tomato crop of Solan and Sadar block of Bilaspur, Rabi potato crop of Kangra and Una districts have also been covered under Weather Based Crop Insurance Scheme(WBCIS) on pilot basis. Similarly WBCIS is being implemented for 15 blocks in respect of Apple crop and 9 blocks in respect of Mango crop covering dominant fruit growing areas of the state.

Training and Capacity Building of Government Officials

At the state level disaster management will be added as a topic for all induction & foundation courses to be conducted by HIPA and all other training institutes in the state. At the district level, training programmes will be conducted in coordination with NGOs, and government training/research institutions.

Community Level Training and Public Awareness Activities

The community awareness and training activities will basically be carried out in the form of training programmes through NGOs, Private Sector, and Government Training Institutions. Apart from spreading awareness of disasters, the focus will essentially be on community capacity building.

Mobilizing Community Efforts for Mitigation Measures

The community will be encouraged to reduce the impact of the next disaster. Demonstration modal housing units indicating various technology features and options will be built by the Government/NGOs/Community. Priority will be given for buildings like Panchayat, primary health centres, community centre, schools etc.

Land Use Planning and Regulations

The department of Town and Country planning will be the primary agency to encourage new development to occur in locations avoiding or minimizing exposure to hazards or enhance design requirements to improve resiliency in future disasters. This department would also ensure proper enforcement of existing regulations and Acts and revision of existing laws.

Incentives and Resources for Mitigation

It is proposed to create a State Disaster Mitigation Fund to implement the above stated mitigation strategy. The fund will be used to provide incentives to developmental projects where mitigation measures have been adopted. Leveraging of funds from other developmental schemes also needs to be taken into account. The State Disaster Management Authority will be the authority in-charge of the State Disaster Mitigation Fund.

Hazard Specific Mitigation Plan

For detailed hazard specific mitigation plan please see Himachal Pradesh State Disaster Management Plan-2012 (HPSDMP, 2012).

Learning objectives:

Towards the end of this learning unit participants will be able to

- Define preventive measures
- Learn about recent initiatives
- Know about methodology and tool kits for Preventive Measures and Mitigation plan
- Specific recent technological solutions
- Learn the role of science and tech, govt. programme
- Examples of Hazard Specific Mitigation Plan

Methodology

- Lectures and power point presentation
- Film on recent initiatives
- Demo of technological solutions
- Demo of Hazard Specific Mitigation Plan

Duration

- 90 minutes

Teaching/ Performance aids

- Film
- Flip chart, sketch board
- Handout of presentation
- Models of technological solutions

Trainer's Note and Session plan

Contents	Methodology	Teaching aids
Explain Preventive Measures and Mitigation Plan for any specific hydrometeorological hazard (Flood, Drought, Avalanche, Landslides etc.), Action Plan for risk management measures, Explain the new initiatives of concerned department. Explain the new technological solution and role of science and tech, govt. programme Film on Preventive Measures and Mitigation Plan in Himachal Pradesh	Lecture cum discussion through power point presentation followed by Question answer	Power point presentation , Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Explain Preventive Measures and Mitigation Plan for any specific hydrometeorological hazard site (Flood, Drought, Avalanche, Landslides etc.), along with the tools and techniques.	25 Minutes
Discussion on action Plan for risk management measures, Explain the new initiatives of concerned department.	25 Minutes
Explain the new technological solution and role of science and tech, govt. programme	15 Minutes
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge. Invite other trainee to supplement whatever their colleague has discussed. The trainer may check out that the learning objectives of the session have been achieved.	15 Minutes
Open house for question and answer	10 Minutes

LU 4.3.4: Recent initiatives and Community Based Participatory Climate Risk Management: Case Studies and Success Stories" /Role of UNDP/NGOs /WWF etc

Introduction

The Himachal Pradesh State Disaster Management Plan-2012 recognises the fact that in the event of disaster communities are the first responders and hence there is no better alternative to community and local level capacities for disaster response. In order to enhance communities' capacity to take action to help themselves in the absence of necessary outside response for days the plan envisages creating necessary awareness about hazards, risks and response. Areas which would be specifically addressed for community preparedness are-

- Medical first aid
- Search and rescue extrication from damaged buildings
- Road clearance
- Fire fighting

Plan also envisages equipping community at Panchayat level by ensuring the provision of medical supply, communication such as radio, TVs, extrication equipment. Panchayat will be encouraged to establish local early warning systems in higher vulnerable areas and for holding community level disaster response drills. Development of response capacity at Panchayat level for first response would help in avoiding desperate situation. Creation of Sub-division level stock pile for relief and warehouses would be ensured.

The **United Nation Development Programme (UNDP), WWF and Non-governmental Organizations (NGOs)** are the most effective means of achieving an efficient communication link between the disaster management agencies and the affected community. There are different types of NGOs and International Organizations working at the advocacy as well as the grass roots levels in the state. In disaster situations, they could be of help in preparedness, relief and rescue, rehabilitation and reconstruction, and also in monitoring and feedback. Their successful work and plan in other mountainous area can be shared with participants and can be take the motivation from that.

NGOs with Dedicated field Operations and Resource Backup, such as the International Red Cross Society. They have specific areas in which they carry out field operations. They have access to a large resource base, and have the capability to extend material, financial as well as technical support to disaster-affected sites. In emergencies, their role is critical in garnering support and

resources from all over the world and come to the rescue of the affected population almost immediately.

These are also NGOs, which are multi-purpose in nature having varied interests, such as the **Rotary Club and Lion Club**. Such interest groups are very active help to disaster victims in the times of need. They could also play a major role in resource mobilization for relief aid and rehabilitation purpose.

Association of Local Occupation groups are formed on the basis of common occupational backgrounds, and could include groups such as doctors' association, traders' association and Army wives' associations, officers & employees association etc. such groups, just like other interest groups, could play a major role in resource mobilization, and provision of specialized services to the victims in any emergency situation.

Religious bodies such as Radha Swami are one of the most important NGO groups that come to the immediate rescue and relief of the disaster victims. These bodies have a large and dedicated following in their communities. They also have control over the local places of worship, which are usually built on high and safe ground, and can serve as ideal shelters for the disaster victims. Besides, they often have infrastructure and resources to feed mass gathering, which facilitate disaster relief work. District-wise inventory of all such facilities shall be prepared by respective DDMA.

These **Residents' Welfare Associations (RWAs)** are formed by the local residents to look into the interests of those living in their area. These associations are extremely concerned about the welfare of the local community. They could also act as a very useful tool for getting across the massage of community participation at the ground level and mobilization of rescue and relief operations at grass root level.

In India, we have **Red Cross Society** at the national, state and district levels. This is not just an agency, but also a movement for providing relief to the people when they are in dire need of it. Being apolitical organization it is the image of the Red Cross that makes, it one of the most acceptable institutions in the area of providing relief to the people in distress. Effective linkage will be developed with the Red Cross through Himachal Unit located at Shimla.

The **education institutions** such as schools and colleges play an important role in disaster management. Their prime responsibility is to spread awareness on natural disasters, provide preventive action needed to minimize damage due to

disasters as well as ensure immediate relief and rescue. Besides, these institutions have large buildings at local level, which could be used as shelters for the victims in the times of disaster.

The role of the **electronic media** during recent times has emerged as a major component of disaster management. This role has been amply demonstrated in the aftermath of disasters be it the Gujarat earthquake of 2001 or the Muzzafarabad Earthquake of 2005. At the same time, the role of the print media, especially regional press needs to be given due recognition, as this continues to be the only medium accessible to a large section of people in many parts of society, which still remains unreachable by the electronic media. Besides, it is also true that the print media has a major role to play in pre-disaster prevention, mitigation and preparedness activities through generation of appropriate community awareness.

In the state of Himachal, the following industrial associations are very active:

- Parwanoo Industries Association, Parwanoo
- Pharmaceutical Manufacture's Association, Kala-Amb
- BaddiBarotiwala&Nalagarh (BBN) Association

The potential in terms of man and machinery available with the industry can be effectively utilized in protecting the industrial areas as well as in mounting Disaster Management Response and Recovery in the event of any disaster.

Learning Objectives

At the end of this learning unit, participants should:

- To get the knowledge about NGOs/International organizations/UNDP/WWF initiatives in different sectors to enhance coping capacities of the communities,
- Get knowledge about different Case studies / field studies in HP completed/ongoing by NGOs/International organizations/UNDP/WWF
- Sharing the different initiatives in other states
- Film on on good initiatives and success stories

Methodology

- Short presentations, Films etc
- Panel Discussion
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Reports of NGOs/International organizations/UNDP/WWF initiatives
- Film/Reading materials on case studies/success stories
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
To get the knowledge about NGOs/International organizations/UNDP/WWF initiatives in different sectors to enhance coping capacities of the communities, Get knowledge about different Case studies / field studies in HP completed/ongoing by NGOs/International organizations/UNDP/WWF Sharing the different initiatives in other states Film on on good initiatives and success stories	Case studies ,film and presentations	Flip chart/ Sketch board, Handout, Short film

Session plan

Teaching Activities	Time
Discuss about NGOs/International organizations/UNDP/WWF initiatives in different sectors to enhance coping capacities of the communities in HP	20
Discuss about NGOs/International organizations/UNDP/WWF initiatives in different sectors to enhance coping capacities of	20

the communities in other states or at national level	
Information/discussion about different Case studies / field studies in HP	20
Summary & evaluation of the learning in this session. Trainers may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	15
Open house for question and answer	15

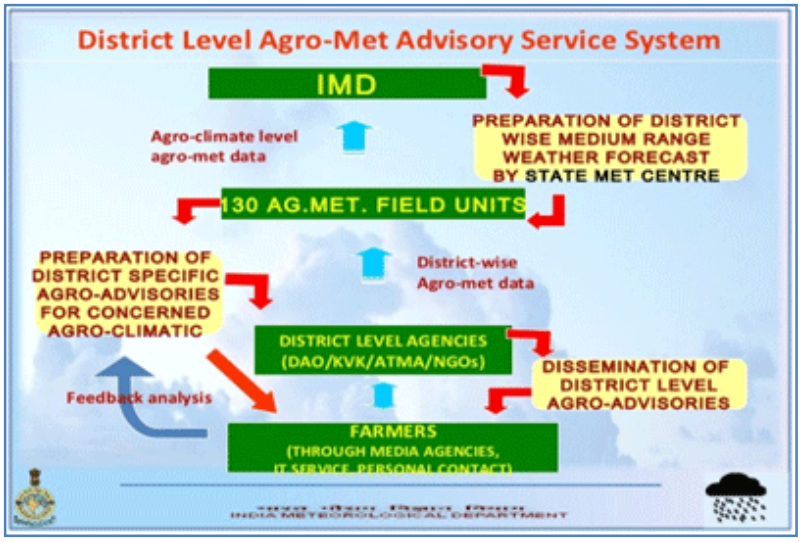
LU 4.3.5: Managing Hydrometeorological hazards through Weather based Agro-Advisory Services (AAS)

Introduction:

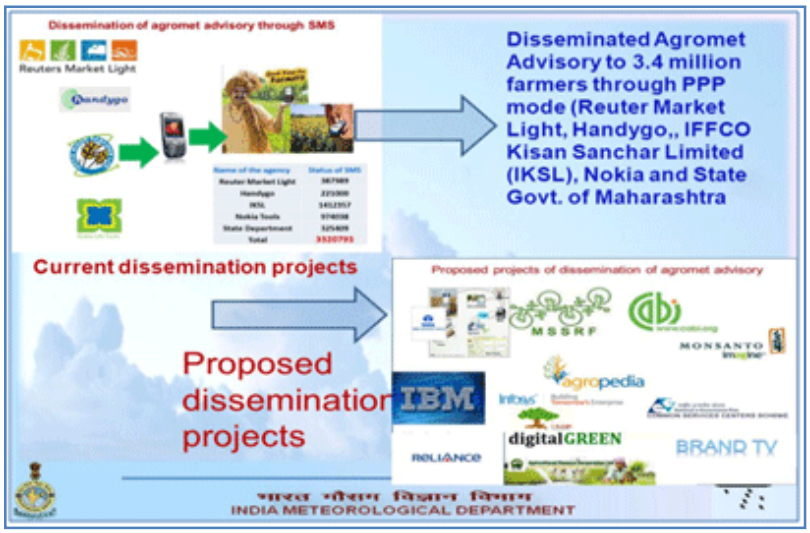
The meteorological services have significant impact on every sphere of life. The demand for accurate prediction of weather and climate at short and long time scales is increasing due to the increased awareness of possible impacts of weather and climate. During recent years, the department has undergone a changeover from being a data provider to service provider. IMD renders assistance and advice on the meteorological aspect of hydrology, water management and multipurpose river valley projects. The hydrometeorological services consist of compilation of rainfall statistics, meteorological analysis of different river catchments for project authorities and providing meteorological support for flood warning and flood control operations to field units of Central Water Commission Hydromet division of IMD caters to the information on various rainfall products through its 'Customized Rainfall Information System' (CRIS) in the form of reports and maps on the CRIS portal.

In order to provide direct services to the farming community of the country, an exclusive division of Agricultural Meteorology was set up in 1932 under the umbrella of IMD at Pune with the objective to minimize the impact of adverse weather on crops and to make use of favorable weather to boost agricultural production. It is also the centre for research programmes in agricultural meteorology and has field units in various parts of the country. Besides, forecasts and advisories for farmers are issued by IMD's forecasting offices located at different state capitals. Services of the division are:

- Gramin Krishi Mausam Seva
- Dissemination of Agromet Advisories
- Feedback and awareness of Agromet service
- Training programmes for Agrometeorological Field Units



District level AAS bulletins are prepared and issued by Agromet Field Units (AMFUs) located in State Agricultural Universities, ICAR institutes, IITs etc. At present these bulletins are issued for 633 districts in the country. Agrometeorological Division maintains a network of agrometeorological observatories, evapotranspiration observatories, evaporation observatories, dewfall recording observatories and soil moisture observatories. The data received from these observatories are scrutinized, archived and supplied to scientists, planners etc. through National Data Centre, Pune.



Learning objectives:

Towards the end of this learning unit participants will be able to

- Learn about the format and use of AAS in agriculture and horticulture
- Know the delivery mechanisms of AAS at agro ecosystem and district level
- Know about role of AAS in hydro met hazards risk mitigation and management
- Know the role of district level officer for dissipation of information
- Learn about success story of AAS at national / state/ district level

Methodology

- Lectures and power point presentation

Duration

- 90 minutes

Teaching/ Performance aids

- Flip chart, sketch board
- Handout of presentation

Trainer's Note and Session plan

Contents	Methodology	Teaching aids
Explain the Format and use of AAS in agriculture and horticulture and delivery mechanisms at agro ecosystem and district level; Explain the role of AAS in hydromet hazards risk mitigation and management and also the role ofdistrict level officer for dissipation of information; Discuss about success story of AAS at national / state/ district level. Show the IMD website showing AAS	Lecture cum discussion through power point presentation followed by Question answer	Power point presentation, Flip chart/ Sketch board, Handout

Session plan

Teaching Activities	Time
Explain the Format and use of AAS in agriculture and horticulture and delivery mechanisms at agro ecosystem and district level	25 Minutes
Explain the role of AAS in hydromet hazards risk mitigation and management and also the role ofdistrict level officer for dissipation of information	25 Minutes
Discuss about success story of AAS at national / state/ district level; Show the IMD website showing AAS	15 Minutes
Summary & evaluation of the learning in this session. Trainer may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge. Invite other trainee to supplement whatever their colleague has discussed. The trainer may check out that the learning objectives of the session have been achieved.	15 Minutes
Open house for question and answer	10 Minutes

LU 4.3.6: Key considerations for integrating Disaster Risk Reduction into development programs

Introduction

Integrating disaster Risk Reduction into the development planning process essentially means looking critically at each activity that is being planned, not only from the perspective of reducing the disaster vulnerability of that activity, but also from the perspective of minimizing that activity's potential contribution to the hazard. Every development plan in the state would require incorporating elements of impact assessment, risk reduction, and adoption the 'do no harm' approach. The measures such as urban planning and zoning, up gradation of building codes their enforcement, adoption of disaster resilient housing designs and flood proofing, response preparedness planning, insurance, establishment of early warning systems generating community awareness, creating technical competence and promoting research among engineers, architects, health experts will be taken on priority.

The current level of urbanization is likely to increase. Urbanization is inevitable and growing at a fast pace, urban settlements are bound to be confronted with problems of greater magnitude in terms of shelter options, cramped living spaces, problems of transportation, access to facilities, services etc and above all the climate change, mainstreaming Disaster Risk Reduction (DRR) issues in Development Plans etc are to be interlinked vertically and horizontally for fail safe infrastructures in Himachal Pradesh.

Himachal Pradesh State Disaster Management Plan -2012 shows the way to address the major challenges through technical, regulatory, organizational and DRR initiatives (Please see Annexure).

DRR refers to the measures used to reduce direct, indirect and intangible disaster losses. The measures may be technical, economic or social. DRR encompasses the two aspects of a disaster reduction strategy: 'mitigation' and 'preparedness'. Mitigation refers to measures aimed at reducing the risk, impact or effects of a disaster or threatening disaster situation, whereas, preparedness refers to the measures undertaken to ensure the readiness and ability of a society to forecast and take precautionary measures in advance of imminent threat, and respond and cope with the effects of a disaster by organizing and delivering timely and effective rescue, relief and other post-disaster assistance. 'Mainstreaming DRR' describes a process to fully incorporate the concerns of disaster preparedness, prevention and mitigation into development and post disaster recovery policy and practice. It means completely institutionalizing

DRRwithin the development and recovery agenda. Accordingly, the following broad objectives of mainstreaming DRR into Development will be encouraged:

- Ongoing schemes and projects of the Ministries and Departments of GoI and State Governments, as well as of all Government agencies and Institutions, including Public Sector Undertakings, will be selectively audited by designated government agencies for ensuring that they have addressed the disaster risk and vulnerability profiles of the local areas where such schemes and activities are being undertaken.

- At conceptualization or funding stage itself, the development schemes will be designed with consideration of any potential hazardous impact associated with it and incorporate measures for mitigation of the same.

- All the development schemes will be pragmatic, incorporating the awareness of local disaster risk and vulnerability, and ensuring that the schemes have addressed these concerns and included specific provisions for mitigating such disaster concerns; and

- DDMAs will ensure that all the disaster relief and recovery programmes and projects that originate from or are funded by any agency satisfy developmental aims and reduce future disaster risks.

Learning Objectives

At the end of this learning unit, participants should:

- To get the knowledge about how to integrate DRR into the development planning,
- Knowledge about Ongoing schemes and projects of the Ministries and Departments of GoI and State Governments, as well as of all Government agencies and Institutions, including Public Sector Undertakings addressing the integration of DRR into development planning
- Knowledge about disaster relief and recovery programmes and projects to reduce future disaster risks

Methodology

- Short presentations, Films etc
- Panel Discussion
- Question Discussion & Answer

Duration

- 90 Minutes

Teaching and Performance Aids

- Reports of NGOs/International organizations/UNDP/WWF initiatives
- Film/Reading materials on case studies/success stories
- Flip chart
- White Board

Trainer's note and Session plan

The trainer will make a power point presentation on the basis of the literature available in the concerned area.

Contents	Methodology	Teaching aids
To get the knowledge about how to integrate DRR into the development planning, Knowledge about Ongoing schemes and projects of the Ministries and Departments of GoI and State Governments, as well as of all Government agencies and Institutions, including Public Sector Undertakings addressing the integration of DRR into development planning Knowledge about disaster relief and recovery programmes and projects to reduce future disaster risks	Panel Discussion (3-4 NGOs/International organizations/ UNDP/ WWF experts)	Flip chart/ Sketch board, Handout, Short film

Session plan

Teaching Activities	Time
Discuss about how to integrate DRR into the development planning	20
Discuss about Ongoing schemes and projects of the Ministries and Departments of GoI and State Governments, as well as of all Government agencies and Institutions, including Public Sector Undertakings addressing the integration of DRR into	20

development planning	
Information/discussion about disaster relief and recovery programmes and projects to reduce future disaster risks in HP	20
Summary & evaluation of the learning in this session. Trainers may ask one of the trainees to summarize whatever the contents of the session has been covered and how they plan to use this knowledge.	15
Open house for question and answer	15

LU 4.3.7: Group Exercise - Presentations & Discussion

Introduction

Group exercise is a very effective method of training. It serves more than one purpose. It reinforces what has already been taught through lectures. It helps assess if the trainees assimilated the concepts explained or the knowledge imparted. It breaks the monotony of classroom lectures. It helps participants apply the knowledge gained during the interaction of the training to near practical situations. Infact, the ultimate test of effectiveness of any training endeavor is its practical utility to the participants. Group exercises have been used with great success in the training programmes organized by the facilitator or course coordinator or trainer of a training institute. Such group exercises have been highly welcomed by the participants. These exercises have very often sprung up novel ideas on different topics related to hydrometeorological risk mitigation and management set by the facilitator or course coordinator or trainer of a training programme. These are used in various training courses conducted in the training institutions at National level followed by State, Regional and District levels. Training institutions also develop other similar exercises and use them in the concerned training course.

Group Exercise Presentation by participants

Facilitator or course coordinator or trainer will provide the topics related to various aspects of hydro meteorological disaster management to the groups of participants who would be equally divided into a number of groups based on their profile and experience on first or second day of the course by the facilitator. Participants of the concerned groups will choose their group leaders to make the presentations on allotted topics on the last day of the course. Before presentations, the groups will prepare their power point presentations after making own study learned during lectures and consulting the literature in the library and reading material. On last day the group leaders will make presentations followed by discussion among the participants and with the experts or facilitators of the course.

Objectives:

- To exchange the practical experiences with other groups on structural and nonstructural measures of hydrometeorological risk mitigation and management
- To illustrate the best practices as well as the lessons learnt
- Future measures and Plans to handle such situations of hydro meteorological events.

Methodology

Group presentation followed by discussion

Guidelines to Facilitator

- Ask one representative (Group leader) from each group to make a presentation of the group's answers to the questions raised.
- Discuss these in the open house.
- Focus on how mitigation and preparedness measures are often ignored in the formulation and implementation of development projects resulting in adversely affecting the lives of people
- Explain the concepts of hydro meteorological mitigation and management and its policies

Annexure

HIMACHAL PRADESH
Hydro-meteorological Hazards

(STATE STRATEGY & ACTION PLAN ON CLIMATE CHANGE)

Issues & Problems

- Deforestation,
- Landslides,
- Land degradation,
- Desertification
- Glacier Lake Outbursts Floods (GLOF)

The commonly observed events and likely ones in the State are as follows:

- ✓ State is likely to face warming, erratic rainfall and rainfall changes, floods.
- ✓ Change in precipitation pattern.
- ✓ There is likely to be a shift in snow line, agriculture /horticulture line; certain areas may open up with some good livelihood openings.
- ✓ Significant impacts on agriculture production, water resources, forests, natural wetlands.
- ✓ Health risks are likely to increase in the State. Instances as malaria, water borne disease, jaundice etc. may break along river bed predominantly.
- ✓ Impacts likely to adversely affect large percentage of population depending on natural resources.

Hydro-meteorological Disasters in Himachal Pradesh

Himachal Pradesh is vulnerable to 25 out of 33 types of hazards identified by the High Powered Committee (HPC) of Government of India and categorized into 5 sub – groups. Apart from identified hazards by HPC, the State is also confronting th emerging threats of climate change and man and animal conflict.
Following events causes due to Hydro-Meteorological Disasters :

1. Floods
2. Hailstorm
3. Cloud Burst
4. Heat Wave and Cold Wave
5. Snow Avalanches
6. Droughts
7. Thunder and Lightning

District wise Hazard threat in Himachal Pradesh

District	Floods	Cloud Burst	Avalanche	Drought	Earthquake	Landslide
Kangra	M	M	M	H	VH	L
Chamba	H	H	M	M	VH	VH
Hamirpur	L	L	-	M	H	L
Mandi	H	H	-	M	VH	H
Kullu	H	VH	H	M	VH	VH
Bilaspur	L	L	-	M	H	M
Una	H	L	-	H	H	L
Sirmour	L	M	-	M	H	L
Solan	L	L	-	M	H	M
Kinnaur	H	VH	VH	M	H	H
Lahaul & Spiti	M	H	VH	M	H	M
Shimla	H	H	M	M	VH	H

(Symbol: L= Low, M= Medium, H= High, VH=Very High)

(Source: NIDM, 2013)

Climate change is any long term significant change in the 'average weather' temperature, precipitation and wind patterns that a given region experiences, which includes processes such as solar radiation, green house gas concentration and the effects of human activity.

Adaptation, in context of climate change is defined as the measures taken to minimize the adverse impacts of climate change, e.g. switching to crops that can withstand higher temperatures is adaptation, relocating the communities from sea shore to some other places to cope with the rising sea level.

Mitigation in context of climate change is defined as measures to reduce the emissions of green house gases that cause climate change in the first place, e.g. by switching to renewable sources of energy such as solar energy or wind energy, or nuclear energy instead of burning fossil fuel in thermal power stations.

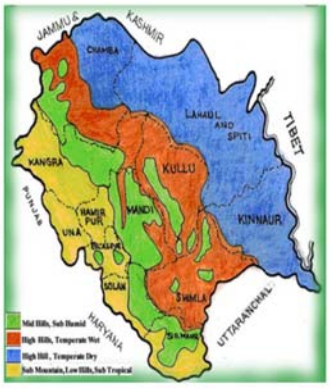
Agro-climatic Zones of Himachal Pradesh

SHIVALIK HILL ZONE : Climate Sub Tropical, consists of foothills and valley sres from 350 to 650 meters above mean sea level. It occupies about 35% of the geographical srea and about 40% of the cultivated srea of the State.

MID HILL ZONE: This zone extends from 651 meters to 1,800 meters above mean sea level. Having mild temperate climate. It occupies about 32% of the total geographical srea and about 37% of the cultivated srea of the State.

HIGH HILL ZONE : It lies from 1,801 to 2,200 meters above sea level with humid temperate climate and alpine pastures. This zone covers about 35% of the geographical srea and about 21% of the cultivated srea of the State

COLD DRY ZONE : It Comprises of Lahaul-Spiti and Kinnaur Districts and Pangi Tehsil of Chamba District lying about 2,200 meters above mean sea level. It occupies about 8% of the geographical and 2% of the total cultivated srea of the State.



CLASSIFICATION BASED ON CLIMATE PATTERN

Climate Pattern Classification		Type	Area/ Districts
Sub Tropical monsoon	Mild and dry winter, Hot summer	Cwa	Bilaspur, Kangra, Mandi, Sirmour,
Sub Tropical Monsoon	Mild and dry winter, Moderate hot summer	Cwb	Shimla, parts of Chamba
Sub Tropical Monsoon	Without dry winter, With hot summer	Cfa	Chamba, Major parts of Kullu and Mandi
Sub Tropical monsoon	Without dry winter with moderate hot summer	Cfb	Minors parts of Kullu
Humid continental	Severe and dry winter, warm summer	Dwb	Kinnaur
Humid continental	Severe winter, moist all seasons, short warm summer	Dfb	Lahul & Spiti

Source: IMD Pune

PAST AND CURRENT CLIMATIC TRENDS IN HP

Temperature

- The annual temperatures are set to rise.
- The rise in temperature with respect to 1970s shows a range between 1.5-2.8 °C.
- Temperatures are also showing a rising trend in all seasons.

Precipitation

- The mean annual rainfall likely to vary between 1250±225.2 and 1550±175.2 mm
- The rate of increase is more in North-western parts of the State i.e. areas of district Kangra, Chamba, Kullu, Una are likely to receive rainfall with increased intensity.
- The High Hill areas like Kinnaur, Lahul & Spiti and some parts of Chamba and Kullu districts may also experience rainfall in place of snowfall with increased temperature.
- There may be staggering decrease in snowfall patterns in mid-hills temperate wet agro climatic zone.
- The number of rainy days may increase in Himachal Pradesh with decrease in average intensity.
- An increase in rainfall in the pre-monsoon and post-monsoon months with increasing incidence of storms in Himachal Pradesh.

Source: STATE STRATEGY & ACTION PLAN ON CLIMATE CHANGE HIMACHAL PRADESH – 2012, Govt. of HP

PAST AND CURRENT CLIMATIC TRENDS IN HP

Extreme Events

- ✓ Change in rainfall patterns with increased variability in some regions (Southeastern parts) may be experiencing less rainfall.
- ✓ Increase in temperature, rainfall, rainfall variations and intensities in the State to accelerated summer flows leading to situations like floods/flash floods in North-western parts of the State.
- ✓ Health risks are also associated indirectly with extreme events in sub montan low hills, and sub humid agro climatic zones of the State.

Source: STATE STRATEGY & ACTION PLAN ON CLIMATE CHANGE HIMACHAL PRADESH – 2012, Govt.

ALTITUDE WISE CLIMATE TREND IN HIMACHAL PRADESH

Altitude (amsl)	Obs. Stn.	Annual Mean Temp.	Annual Mean Rainfall	Data base
1,500-2,400	Theog (Shimla) High Hill Temperate wet	(+) 1.8 °C	(-) 127 mm (+) in Kharif season)	20 years
1,200-1,800	Kullu High Hill Temperate wet	(+) 2.8 °C	(-) 20.1 mm (+) in Kharif season	34 years
700-1,500	Palmpur (Kangra) Mid Hill sub Humid	(+) 1.0 °C	(-) 1,000 mm exceptional decrease (+) in Kharif season	35 years
< 700	Fatehpur (Sirmour) Low Hill sub Humid	(+)	(-) 29.4mm	23 years

PROJECTED CLIMATIC TRENDS IN HP

Climate Variable	Current Trend	Projected Trend	Impact
Temperature	Increase	Increase	Both Direct and Indirect (-ve & +ve)
Rainfall	Increase	Slight Increase	Both Direct and Indirect (-ve & +ve)
Frequency of Rainfall	Decrease	Increase	Direct (-ve & +ve)
Intensity of Rainfall	Low	Decrease	Direct (-ve)

Source: STATE STRATEGY & ACTION PLAN ON CLIMATE CHANGE HIMACHAL PRADESH – 2012, Govt.

Impacts of climate change

Agriculture

- With increasing temperatures, it is anticipated that there may be an all-round decrease in horticultural- agricultural production in the region in long-term, and the line of production may shift to higher altitudes.
- Apple production in the Himachal Pradesh region has decreased between 1982 and 2005 as the increase in maximum temperature has led to a reduction in total chilling hours in the region-a decline of more than 9.1 units per year in last 23 years has taken place.
- Temperature Humidity Index (THI) is projected to rise in many parts of State during March–September with a maximur rise during April–July in 2030s with respect to 1970s will lead to discomfort of the livestock productivity and therefore will have negative impact on livestock productivity.

Impact of climate change on Apple Production

- Temperature in apple growing regions of Himachal Pradesh showed increasing trends whereas precipitation showed decreasing trends in the regions.
- The area under apple cultivation in recent years have fallen (92,820 ha) in 2001-02 and 86,202 ha in 2004-05 in the entire state
- whereas, area in Lahaul & Spitti and Kinnaur district which lie above 2500 msl showed increase every year in recent decade which is 533 hectare in 2004-05 from 334.0 ha in 1995-96 and 7700 ha in 2004-05 from 5516 ha in 1995-96, respectively.
- The farmers perception in apple growing region revealed that per farmer area under apple showed decrease in Kullu and Shimla by 18.2 and 3.3 percent respectively. The area in higher elevation (above 2500 msl) namely Lahual and Spitti valley showed substantial increase by more than 127 percent over the recent decade.

Forests, Natural Eco-systems & Biodiversity

- It has been projected that the forest vegetation type of the four eco-sensitive regions are vulnerable to projected climate change in the short term, that is, in 2030s, even under a moderate climate change scenario.
- The impacts vary from region to region. For Himachal Pradesh, of the 98 IBIS grids covering this region, 56% of the grids are projected to undergo change in 2030s shows a high degree of vulnerability of forests in the State.
- The dense forest line is expected to undergo more changes. The Net Primary Productivity (NPP) is projected to increase in the region by about 57% on an average by 2030s.
- The occurrence of forest fire may increase.

Forests and climate change

1. Deforestation and land use change contribute to CO_2 emissions
   - IPCC; 20% of CO_2 emissions
2. Forests provide a large potential to mitigate climate change
   - IPCC; 15 – 20% of CO_2 emissions
3. Forests will be impacted by climate change and are highly vulnerable to climate impacts
   - Need for adaptation to enable forests to cope with climate change

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Forest sector is critical in addressing climate change

Forest sector is very contentious in global negotiations

Assessment of Impact of climate change on forests

BIOME4: Equilibrium model

- Climate, vegetation, soil and water data

IBIS (Integrated Biosphere Simulator): dynamic global Vegetation Model

- Climate, vegetation, soil and water data

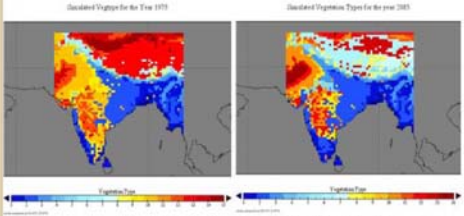
Climate Model: GCM and RCM data from

- Hadley Had RM3 data (50x50 km^2)

Climate Change Scenarios:

- A2, B2 and A1B
- 2030s and 2070s

Impact on Forest and Other Vegetation Types (1975 - 2085) – IBIS Model outputs



1: tropical evergreen forest / woodland, 2: tropical deciduous forest / woodland, 3: temperate evergreen broadleaf forest / woodland, 4: temperate evergreen conifer forest / woodland, 5: temperate deciduous forest / woodland, 6: boreal evergreen forest / woodland, 7: boreal deciduous forest / woodland, 8: mixed forest / woodland, 9: savanna, 10: grassland / steppe, 11: dense shrubland, 12: open shrubland, 13: tundra, 14: desert, 15. polar desert / rock / ice

Water

- The rainfall is projected to increase during June to September.
- Increased occurrence of floods and increased flow in rivers and dams, increased instances of soil erosion and silt load.
- Increase in water stress for rain-fed crops due to warming (1.7°C to 2.2°C)
- Glaciers retreat may affect the discharge dependability of all rivers.

Health

- Morbidity and mortality of the population in the regions under focus are likely to increase with warming temperatures and variable precipitation as they have direct as well as indirect effects.
- Direct effects can manifest as heat stress and indirect effects can be in terms of vector borne diseases, water borne diseases and malnutrition etc.
- In Himachal Pradesh which is nestled in the North-Western Himalayas, projections of malaria transmission windows for 2030s, based on temperature, reveal introduction of new foci and an increase in opening of more transmission months in different districts of the State.

Frequency of Droughts

- There is an increase in the drought like situations for those areas of various regions that have either projected decrease in precipitation or have enhanced level of evapo-transpiration in the 2030s.
- Similarly, the weeks belonging to moderate soil moisture stress, show an increase in severity of drought from baseline to the mid-century scenario, which is self-evident.
- It is very evident from the depiction that the moderate to extreme drought severity has been pronounced for the State, where the increase is more than 20% in many areas despite the overall increase in precipitation.

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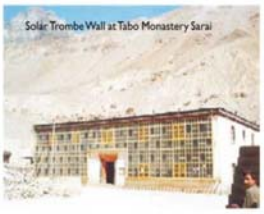
RECENT INITIATIVES

Himachal Pradesh Solar Energy Programme

In the State 'Himurja' is set up to significantly increase the use of solar energy in the total energy mix while recognizing the need to expand the scope of other renewable and non-fossil options such as thermal energy, wind energy and biomass.

Himachal Pradesh is a tropical Himalayan State, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has an enormous potential as future energy source. It also has the advantage of permitting a decentralized distribution of energy, thereby empowering people at the grass root levels.


Solar Trombe Wall at Tabo Monastery Sarai

Himachal Pradesh Energy Efficiency/ Saving Programme

The Energy (Conservation) Act, 2001 provides a legal mandate for the implementation of energy efficiency measures through the institutional mechanism of Bureau of Energy Efficiency (BEE) not only in the Central Government but also in each State. A number of programmes have been initiated and it is anticipated that these would result in saving of 500 MW in overall consumption of the energy in Himachal Pradesh.

In the State Government has initiated various programmes to enhance energy efficiency:

- Launched '*Atal Bijli Bachat Yojna*' in the State by distributing CFL to the people of State at free of cost to promote saving of energy as a shift to energy efficient appliances/equipment's.
- Complete ban on use of coal for space heating etc.
- Developing economic instruments to promote energy efficiency in Himachal Pradesh.
- Committed to harness the entire potential of 22,000 MW of Hydro Power available in State though the demand of the State is far less than the available potential, so as to contribute to the country's clean energy demand for meeting the set goals for reduction in the GHG emissions.
- Encourage the use of solar passive heating systems and promote the use of biogas plants.
- Discourage the energy intensive industries that contribute large to GHG emissions.

Himachal Pradesh Sustainable Development Programme for Urban & Rural Areas

- The State Government is committed to develop in a sustainable manner so as to conserve its beautiful environs through improvements in management of solid waste, waste water, modal shift to public transport, construction of buildings and roads, energy efficiency in buildings etc. The State Government is firm to promote sustainable development, energy efficiency as an integral component of urban and rural planning through various initiatives.

Sustainable Water Management

- The State's Water Policy is being revisited in consultation with the line departments such as Urban & Rural Development, MPP & Power, State Ground Water Authority to ensure basin level management strategies to deal with the variability in rainfall and river flows due to climate change.
- Water quality is impacted by untreated or inadequately treated hotel, industrial effluents and sewage flowing into nallahs and rivers or affecting the surface and ground water. Since it has potential to adversely affect the health of the populace, special attention needs to be paid to these aspects.
- Improvements in existing strategies, innovation of new techniques resting on a strong science and technology base are needed to eliminate the pollution of surface and ground water resources to restore the pristine quality.

Disaster Risk Management in India

Outline

- Understanding Hazards and Disasters
- Risks and vulnerabilities
- Emerging risks – climate change and urban upsurge
- Disaster management framework of India
- Policies, strategies and programmes

Hazards of India

Major natural hazards

- Earthquakes
- Flood
- Cyclones
- Drought

Other natural hazards

- Landslide
- Avalanche
- GLOFs
- Forest fire
- Heat & cold wave

Man made hazards

- Industrial & Chemical
- Rail, road accidents
- Epidemics, pandemics
- Oil spill . Dam bursts
- NBC hazards

Disasters Identified By High Powered Committee (HPC)

1. WATER AND CLIMATE RELATED DISASTERS

Floods
Cyclones
Tornadoes
Hailstorm
Cloud Burst
Heat Wave and Cold Wave
Snow Avalanches
Droughts
Sea Erosion
Thunder and Lightning
Tsunami (Added)

2. GEOLOGICALLY RELATED DISASTERS

Landslides and Mudflows
Earthquakes
Dam Failures/ Dam Bursts
Mine Fires

3. CHEMICAL, INDUSTRIAL AND NUCLEAR

4. ACCIDENT RELATED DISASTERS

Forest Fires
Urban Fires
Mine Flooding
Oil Spill
Major Building Collapse
Serial Bomb Blasts
Festival related disasters
Electrical Disasters and Fires
Air, Road and Rail Accidents
Boat Capsizing
Village Fire

5. BIOLOGICALLY RELATED DISASTERS

Biological Disasters and Epidemics
Pest Attacks
Cattle Epidemics
Food Poisoning

4

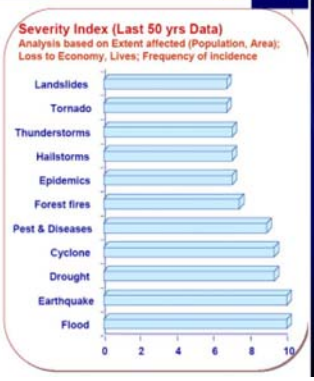
Ministry of Home Affairs , DM Division

Disaster in India - Vulnerability

Source: ISRO

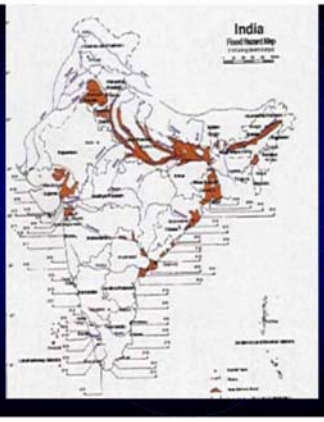
Key Vulnerability:

- 5700 Km Long Coastline - Cyclone-prone
- 40 Mha - Flood-prone
- 68% of Net Sown Area (116 Districts) - Drought-prone
- 55% Total Area - Seismic Zones III - V
- Sub-Himalayan/ Western Ghats - Landslide-prone



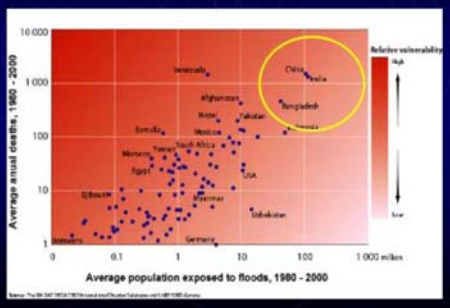
Flood

- **40 million hectres** are prone to flood
- **8 million hectres** affected by flood every year
- **Brahmaputra and Gangetic Basin** are most flood prone areas

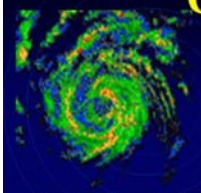


11

Exposure to flood hazards



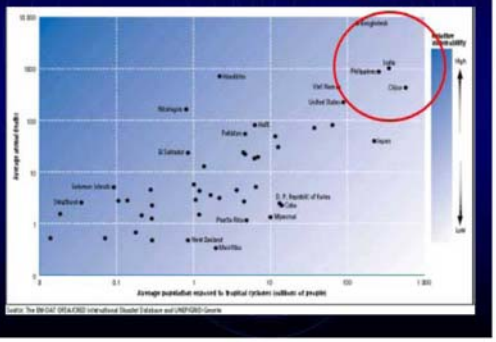
Cyclone



- Long coastline of **8000 kms**
- Pre-monsoon (May-June) and **post-monsoon (Sept-Oct)** cyclones
- Coastal districts of **Orissa, Andhra Pradesh and Gujarat** most prone to cyclone
- Most casualties caused by coastal inundation due to tidal waves, storm surges and torrential rains

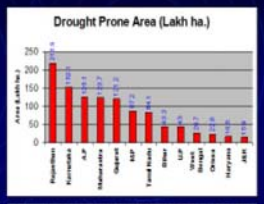
14

Exposure to Cyclones

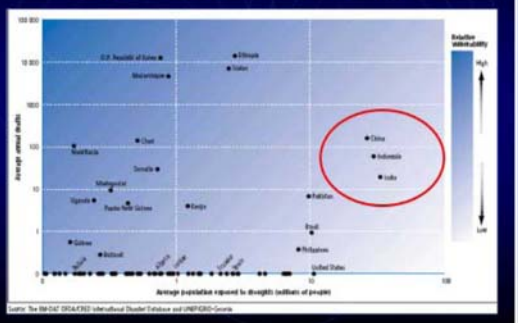


Drought

- **68% of the net** area sown in the country is prone to drought
- Out of this **33% is chronically drought** prone, receiving rainfall less than 750mm per annum
- 35% drought prone that receive rainfall between 750-1125 mm per annum



Exposure to droughts



Hazards - *Potentiality* of a physical event that may cause loss of life or property

Risks - *Probability* of harmful consequences or losses

Vulnerabilities - *Factors or processes* - physical, social, economic, and environmental - which increase susceptibility of an area or a community to impact of hazards

Capacities - *Strengths and resources* available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

Multi- Hazard Areas

Major Hazards	Vulnerable States and Population
E, F, C, D	Andhra Pradesh, Gujarat, Maharashtra and West Bengal (220 million)
E, F, D	Bihar, Haryana, Jammu & Kashmir Karnataka, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and Goa (563 million)
E, F	Uttarakhand Himachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Kerala, Mizoram, Assam, Tripura (103 million)

E-Earthquake, F-Flood, C-Cyclone, D-Drought

Components of Risk Management

Hazard x Vulnerability = Risk

(natural event) (social factors)

Climatology, Geology, Probabilities, Forecasts

Population growth and shifts
Urbanization
Technology
Land use practices
Environment degradation
Water use trends
Government policies
Environmental awareness

Disaster

Environment and Disaster

Environment, Development and Disasters are connected and is rarely disputed. While it is often recognized that ecosystems are affected by disasters, it is forgotten that protecting ecosystem services can both save lives and protect livelihoods.

Five links that connect environment to disaster risk – and ultimately link environmental management to disaster risk reduction.

1. Natural hazards are physical processes that can be directly affected by development processes
2. Healthy ecosystems provide natural defences
3. Degraded ecosystems reduce community resilience
4. Some environmental impacts require immediate attention
5. Environmental degradation is a hazard in itself

Layers of vulnerabilities

- 1.2 billion people - still growing at 1.41% per annum
- 300 million people live below poverty line
- More than 50% malnourished
- 39% people above 15 are illiterates
- Women, children, aged and disabled more vulnerable to disasters
- Unsafe building practices and settlement pattern
- Unplanned urban areas growing at faster rate of 4.5% per annum creating further layer of urban vulnerabilities

Mega disasters

- Latur Earthquake 1993: 9475 dead, 1 million houses damaged, 8 million people affected
- Orissa Super Cyclone 1999: 10086 dead, 2 million houses damaged, 15 million affected
- Gujrat Earthquake 2001: 13805 dead, 1.8 million houses damaged, 12 million people affected
- Indian Ocean Tsunami 2004: 12405 people dead, 3.5 million houses damaged, 18 million people affected

Uttrakhnad Disaster-2013: >5000 people dead (????), >2 million houses damaged, >10 million people affected (????)

Cyclone Phailin- 2013

Average annual loss

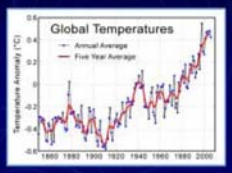
- Loss of human life: 4350
- Crop area affected: 1.42 million hec.
- Houses damaged: 2.36 million
- Expenses on relief: Rs. 5,000 cr
- Expenses on reconstruction: 4,000 cr
- Indirect socio-psychological losses that can not be quantified

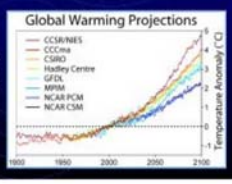
Impact of disasters

- Caused huge loss of life and property - estimated GDP loss range between 2 to 20% and revenue loss between 12 to 66%
- Eroded hard earned gains of development
- Diverted scarce resources to relief and rehabilitation
- Aggravated poverty and caused distress to more vulnerable groups - women, children, aged and disabled
- Degraded fragile eco-system of the region

Emerging risks: Climate change

- There is now agreement among scientists that global surface mean temperature of the earth has increased by 1 degree centigrade during last 100 years
- There are varying projections that temperature would increase between 2.4 to 4.8 degrees in next 100 years





Public policy on disaster

- Till recently India did not have a policy on disaster management
- Attitude towards disaster was marked by fatalism – *'wrath of nature'* or *'anger of God'*
- Government intervention limited to provided post disaster relief and rehabilitation assistance
- Disaster management was the concern of Ministry of Agriculture in Centre and Revenue and Relief Departments in the States
- Civil response system heavy depended on armed and other paramilitary forces

Paradigm shift in disaster management

National Action Plan on Climate Change

On June 30, 2008, Prime Minister Manmohan Singh released India's first National Action Plan on Climate Change (NAPCC) outlining existing and future policies and programs addressing climate mitigation and adaptation.

National Action Plan on Climate Change

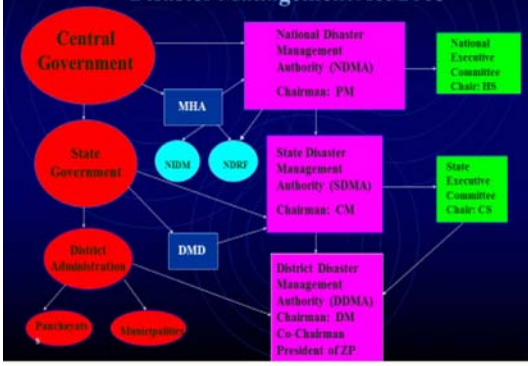
- Comprehensive framework with approval of the PM' 's Council on Climate Change
- Relates to sustainable development, co- -benefits to society at large, focus on adaptation, mitigation, and scientific research

The plan to be implemented thorough eight missions representing multi-pronged, long-term and integrated strategies for achieving key goals:

1. National Solar Mission
2. National Mission for Enhanced Energy Efficiency
3. National Mission on Sustainable Habitat
4. National Water Mission
5. National Mission for Sustaining the Himalayan Ecosystem
6. National Mission for a Green India
7. National Mission for Sustainable Agriculture
8. National Mission on Strategic Knowledge for Climate Change

Legal-institutional framework

Disaster Management Act 2005



National Disaster Response Force

- 8 battalions of National Disaster Response Force raised (8 x 1158) - two each from CRPF, CISF, BSF & ITBP
- Each battalion to consist of 18 Specialist Response Teams besides other supporting staff
- Each SRT to have 45 persons comprising:
  - 4 Search & Rescue Teams,
  - 1 Medical Support Team,
  - 1 Technical Support Team and
  - 1 Dog Squad
- Each battalion to have 1 Diving and 1 Water Rescue Team
- Four of these battalions to specialize on Nuclear Biological and Chemical (NBC) disasters

National Institute of Disaster Management

Core mandate of the NIDM under the Act:

- Provide assistance in national level policy formulation on disaster management.
- Formulate and implement comprehensive human resource development plan on disaster management
- Develop training modules and undertake research and documentation work on disaster management
- Mainstream disaster management in education
- Network with research and training institutions at national and international level

Few recent initiatives for reducing risks of disasters in India

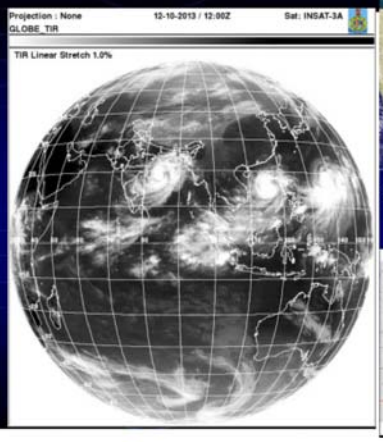
Early Warning System

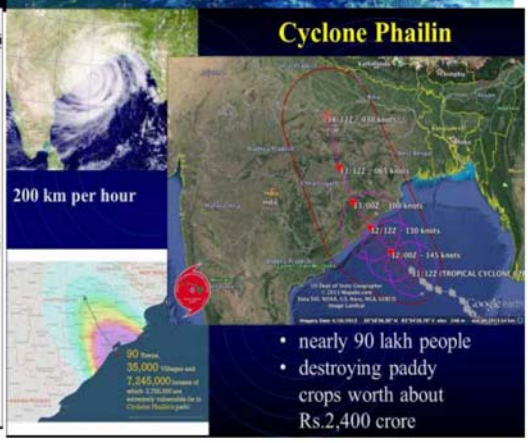
India has developed an elaborate early warning system through a network of satellite, ground and ocean monitoring stations

Agencies involved:

- Department of Science and Technology
- Department of Space
- Ministry of Water Resources
- Department of Ocean Development

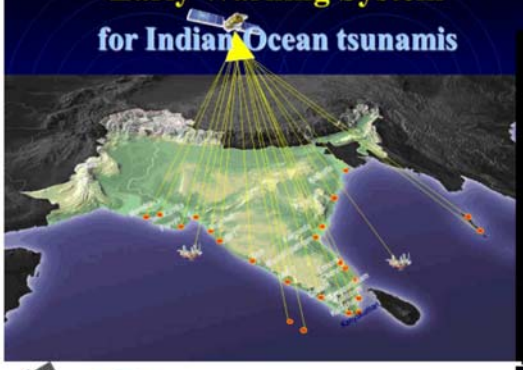
Cyclone Phailin



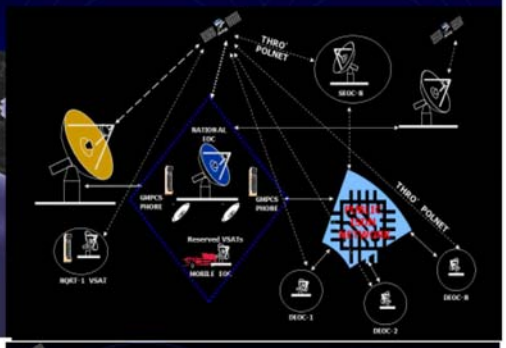


- nearly 90 lakh people
- destroying paddy crops worth about Rs.2,400 crore

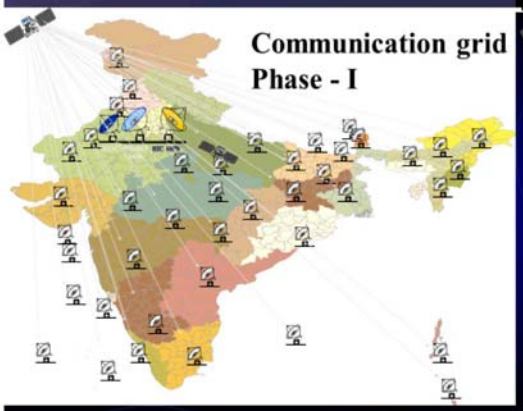
Early Warning System for Indian Ocean tsunamis



NATIONAL EMERGENCY COMMUNICATION PLAN



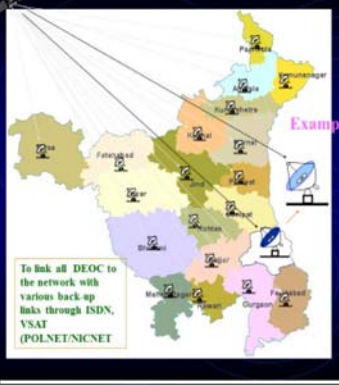
Communication grid Phase - I



Phase - II

District level

Example: Haryana State



Basic links :

DEOC <=> SEOC & NEOC through ISDN

Back-up links:

First back-up

DEOC<=> SEOC & NEOC thro' VSAT (POLNET)

Second back-up

DEOC<=> SEOC & NEOC– VSAT (NICNET)

Other Recent initiatives

- **Emergency Operation Centers** (Established in MHA for data, video and audio up-linking with all State, District and remote areas)
- **Disaster Communication Plan** (Satellite-based)
- **Disaster Management in School Education**
- **Disaster management in Engineering & Architecture**
- **Disaster Management in Medical Education**
- **National Cyclone Risk Mitigation Project** (to cover 13 cyclone prone States/Union Territories [cost US $ 365 million/ Rs 1650 cr)
- **Earthquake Risk Mitigation** (National Project to cover 229 districts located in seismic zone IV & V.)
- **National School Safety Project** (All existing school buildings shall be retrofitted; All new school buildings shall be constructed as per earthquake/ cyclone resistant construction technology)
- **Regional Cooperation** (SAARC Disaster Management Centre set up at the premises of the NIDM; 8 countries)
- **By UGC**

Regional Cooperation

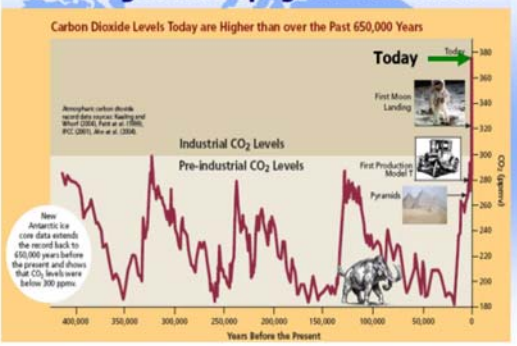
- SAARC Disaster Management Centre set up at the premises of the NIDM
- The Centre to have jurisdiction over eight South Asian countries
- Many new initiatives taken for developing common platform for sharing regional knowledge and experience on disaster management

Climate Change and India's Development Pathway

Outline

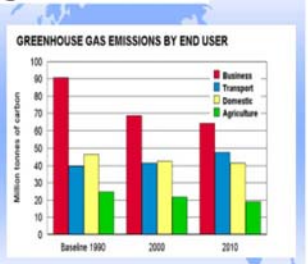
- CC Scenario at Global scale
- CC Scenario in India
- India' s Progress in Human Development
- India' s current programmes and actions on Climate Change
- Summary

Unprecedented increase in CO_2 levels through Anthropogenic Emissions

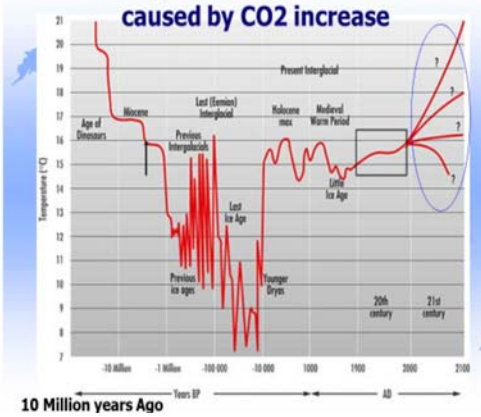


Four main Sources of Anthropogenic emissions

- **Business** (Industry, Energy, etc)
- **Transport**
- **Domestic**
- **Agriculture**



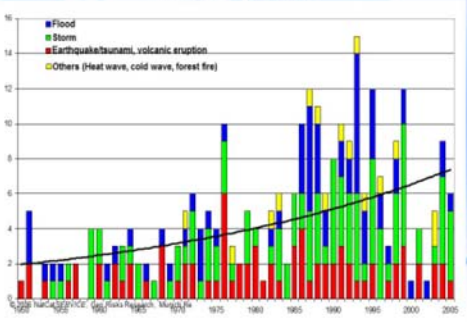
Rising trend in Temperature caused by CO2 increase

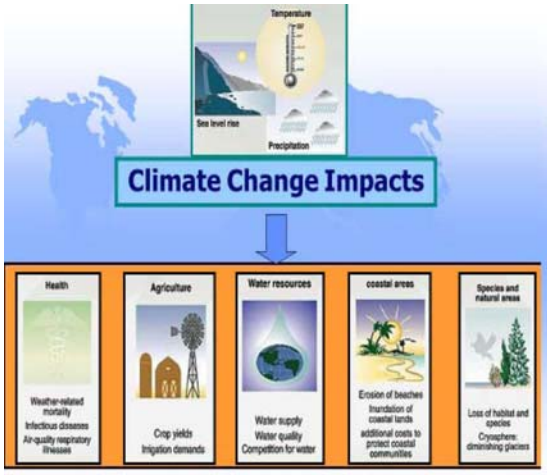


10 Million years Ago

Great Natural Disasters 1950 – 2005

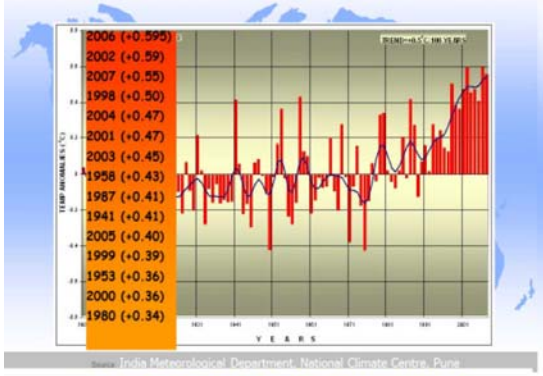
Number of events





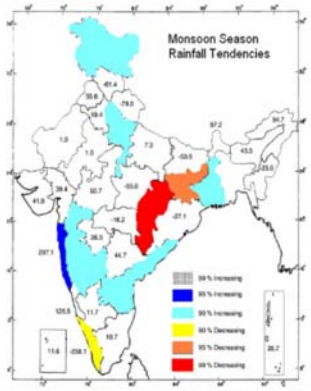
CC Scenario in India

All-India Temperature Time Series



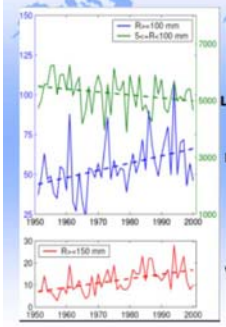
Source: India Meteorological Department, National Climate Centre, Pune

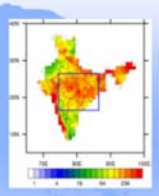
Spatial patterns in Monsoon Rainfall Trends



Source: Guhathakurata & Rajeevan, 2007

Changes in the Frequency of Extreme Rainfall

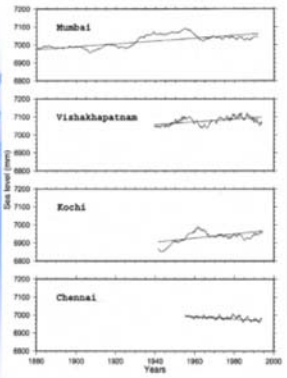




Goswami et al., Science, Dec., 2006

Sea Level Rise- Observations

- Sea-levels increase by ~ 1.3 mm/year



Unnikrishnana et al. Curr. Sci, 90, 366-372, 2006

Figure 2. Estimates of sea level rise for selected stations. Monthly mean tide gauge data from the past sea level records measured by tide gauges are used to estimate the trends.

Summary India's Present and Future CC scenario

- A clear signature of Global Warming in the Indian Surface air Temperatures
- No significant effect of global warming in the All-India Mean Monsoon Rainfall – regional changes are indicated
- However, the high rainfall events appear to have increased in their frequency over some areas.
- Future climate model projections indicate increase in the mean monsoon rainfall and 3-6 ° C change in the surface temperatures by the end of 21st Century over India
- Large uncertainties associated with the estimation of future emissions and climate model biases have to be borne in mind while framing policy decisions

India's Progress in Human Development

Human Development Index

HDI comprises of Factors relating to :

- Long and Healthy life
- Knowledge
- Decent standard of living

India's Progress in Human Development*

Health Issues	1990	2005
Life Expectancy at Birth	50.7	62.9
Infant Mortality rate (per 1000 live birth)	127	56
Under 5 Mortality rate (per 1000 live children)	202	74
Maternal Mortality (per one lakh)	540	450
Population using improved sanitation(%)	14	33
Population under-nourished (%)	25	20

Source: Human Development Report-2008

India's Progress in Human Development*

Education	1990	2005
Adult Literacy	48.2	61.0
Youth Literacy	61.9	76.4
Net Primary Enrolments	-	89
Public Expenditure in Education (% of GDP)	3.7	3.8
Public Expenditure in Education (% of total budget)	12.2	10.7

Source: Human Development Report-2008

India's Progress in Human Development*

Human Poverty Indices	2005
Human Poverty Index	31.3
Population Below Poverty line (%)	34.3 ($1/day) 80.4 ($2/day) 28.6 (National Poverty line)

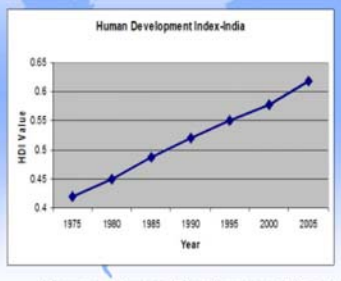
Source: Human Development Report-2008

India's Progress in Human Development*

Communication	1990	2005
Tel. mainlines (per 1000 persons)	6	45
Cellular Phone (per 1000 persons)	0	82
Internet (per 1000 persons)	0	55

Source: Human Development Report-2008

India's Progress in Human Development



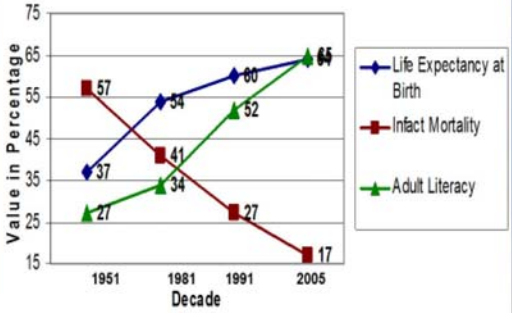
HDI comprises of Factors relating to

1. Long and Healthy life
2. Knowledge
3. Decent standard of living

Source: Human Development Report - 2008

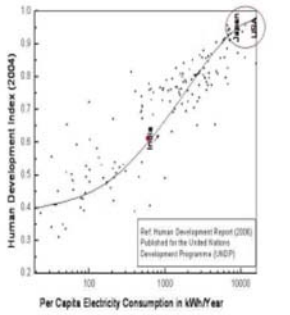
Progress of Human Development in India since 1951

(Values per 1000 persons)



Energy Use and Human Development

The strong positive correlation between energy use and human development is well recognized. It is obvious that India needs to substantially increase its per capita energy consumption to provide a minimally acceptable level of well being to its people



India's sustainable development Pathway

- India has a civilization legacy that places high value on the environment and the maintenance of ecological balance
- The country has traditionally been following the famous Mahatma Gandhi's dictum "The earth has enough resources to meet people's needs, but will never have enough to satisfy people's greed".

Climate Change-Development Paradox

- **Development vs Mitigation**

  [Development and emission are closely linked.... One follows other]

- **Development vs Adaptation**

  [Without development, capacity to adapt is low...for countries to develop capacity to adapt to CC, they need resources which would come from development]

India's Current Programmes and Actions for Climate Change

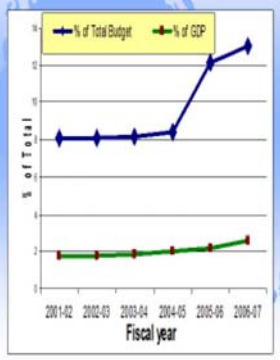
National Programmes for Adaptation

National Programme on adaptation would focus:

- **Agriculture**
- **Forestry**
- **Disaster management**
- **Water sector**
- **Coastal zones**
- **Health sector**

India's Budget for Adaptation

Government of India expenditure on adaptation to climate variability, already exceeds 2.6% of the GDP, with agriculture, water resources, health and sanitation, forests, coastal-zone infrastructure and extreme weather events, being specific areas of concern.

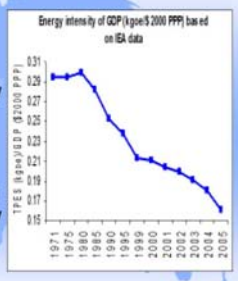


Mitigation: Regulatory Mechanisms

- Electricity Act 2003,
- Tariff Policy 2003,
- Petroleum & Natural Gas Regulatory Board Act, 2006
- Rural Electrification Policy, 2006
- The New and Renewable Energy Policy, 2005
- The National Environment Policy, 2006
- The Notification on Environment Impact Assessment (EIA), 2006

India's Energy Intensity

- **India has a well-developed policy, legislative, regulatory, and programmatic regime for promotion of energy efficiency, renewables, nuclear power, fuel switching, energy pricing reform, and addressing GHG emissions in the energy sector.**
- **As a consequence of these measures, India's energy intensity of the economy has come down sharply since the 1980s and in 2005, compared favourably with the least energy intensive developed countries.**

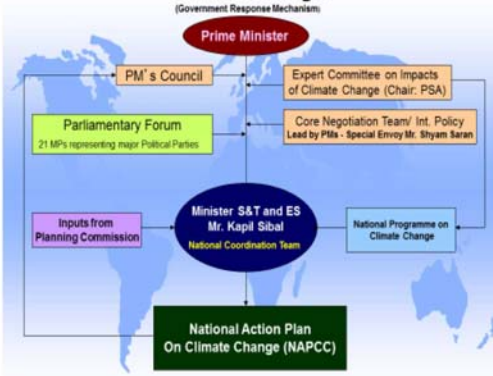


Key Elements of India's Current Policy on Mitigation

- **Promotion of energy efficiency in all sectors**
- **Emphasis on mass transport**
- **Emphasis on renewables sources including biofuels**
- **Accelerated development of nuclear and hydropower for clean energy**
- **Focused R&D on several clean energy related technologies**

Climate Change

(Government Response Mechanism)

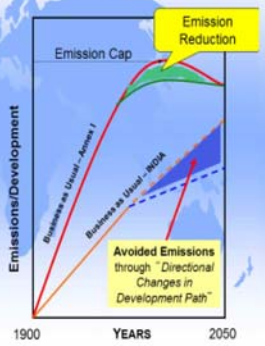


Eight National Missions

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- Mission for Sustaining the Himalayan Ecosystem
- National Mission for Green Forests
- National Water Mission
- Mission for Eco-green Agriculture
- Strategic Knowledge Mission for Climate Change

Strategy

Evolve a development path that is ecologically sustainable



India's approach towards Mitigation

...thank you

History and Concept of Climate Change on Risk of Natural Disasters

Understanding Climate Variability and Climate Change

- **WEATHER** is the **day-to-day** state of the atmosphere and its short-term (from hours to a few weeks) variations such as temperature, humidity, precipitation, cloudiness, visibility or wind.
- **CLIMATE** is statistical information, a synthesis of weather variation focusing on a specific area for a specified interval. Climate is usually based on the weather in one locality averaged for **at least 30 years (WMO)**.

Understanding Climate Variability and Climate Change

- **CLIMATE VARIABILITY** refers to variations in the mean state and other climate statistics (standard deviations, the occurrence of extremes, etc.) on all temporal and spatial scales beyond those of individual weather events. Variability may result from natural internal processes within the climate system (internal variability) or from variations in natural or anthropogenic external forces (external variability).
- **CLIMATE CHANGE** refers to any change in climate over time, whether due to natural variability or anthropogenic forces.

What is Climate?

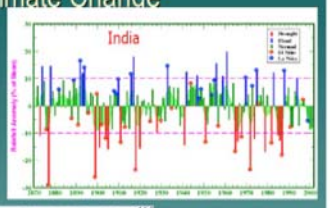
There are several definitions of climate:

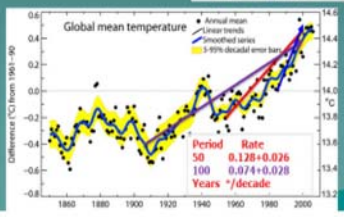
- The average weather, usually taken over a 30 year time period, for a particular region and time period.
- The average meteorological conditions in a certain area over ascertain period.
- Climate is the measurement of average weather conditions that is maintained or changes over a long period of time usually 10 to 30 years.

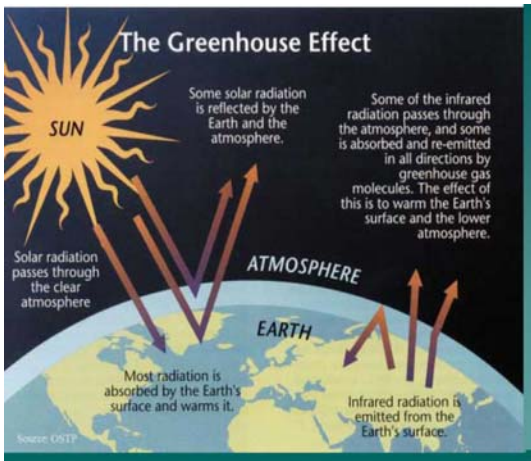
What is Climate change?

- Climate change is any *long-term significant change in the "average weather"* that a given region experiences.
- Average weather may include average temperature, precipitation and wind patterns. It involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years.
- These changes can be caused by dynamic process on Earth, external forces including variations in sunlight intensity, and more recently by human activities.

Understanding Climate Variability and Climate Change



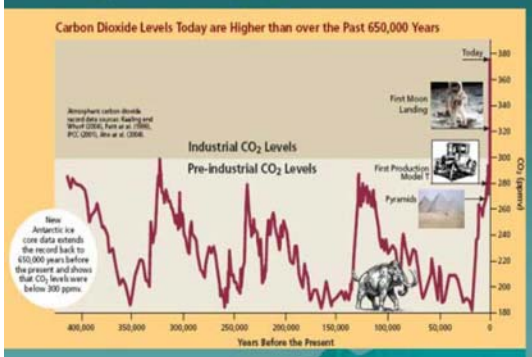




Enhanced greenhouse effect

- CO2, CH4, N2O, O3
- **Greenhouse gases** are a natural part of the atmosphere that, through a natural process called the **greenhouse effect, trap the sun's warmth and maintain the earth's surface temperature at the level necessary to support life (approximately 15°C).**
- **The earth's climate has been alternating between hot and cold periods for at least the past million years.**
- **Records from polar ice cores show oscillating periods of glacial (ice ages) and interglacial (warm) periods. The earth is currently in an interglacial period. However, the observed warming since the 1970s cannot be explained by natural causes alone. During the past 200 years, human activities such as fossil fuel-burning and land clearing have caused an increase in greenhouse gases in the atmosphere - called the enhanced greenhouse effect -trapping more heat and raising the earth's surface temperature.**

Unprecedented increase in CO2 levels through Anthropogenic Emissions



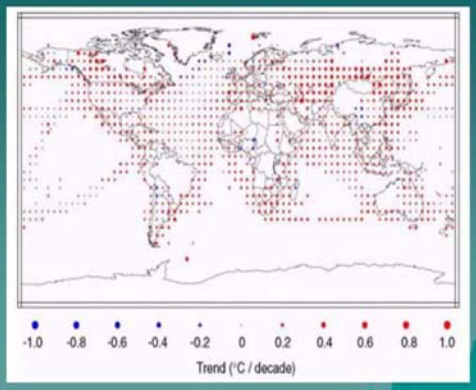
Methane and Nitrous Oxide

- The global atmospheric concentration of **methane** has increased from a pre-industrial value of about 715 ppb to 1732 ppb in the early 1990s, and is **1774 ppb in 2005**.
- The global atmospheric **nitrous oxide** concentration increased from a pre-industrial value of about 270 ppb to **319 ppb in 2005**.

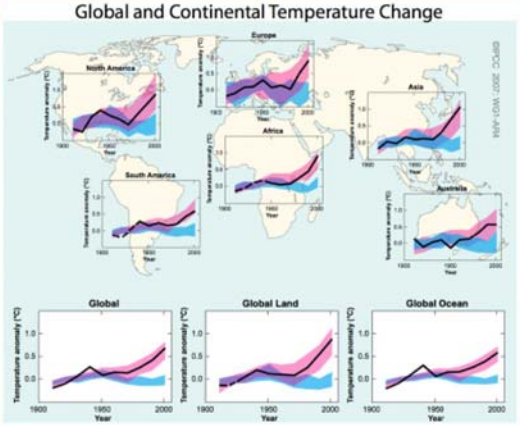
The Land and Oceans have warmed

- Eleven of the last twelve years (1995 -2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850).
- The updated 100-year linear trend (1906–2005) of 0.74°C is therefore larger than the corresponding trend for 1901-2000 given in the TAR of 0.6 °C.
- The linear warming trend over the last 50 years (0.13 °C per decade) is nearly twice that for the last 100 years.
- Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3000 m and that the ocean has been absorbing more than 80% of the heat added to the climate system.

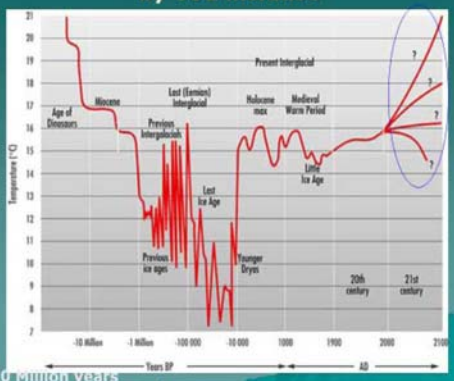
Global temperature trends: 1901 – 2000



Global and Continental Temperature Change



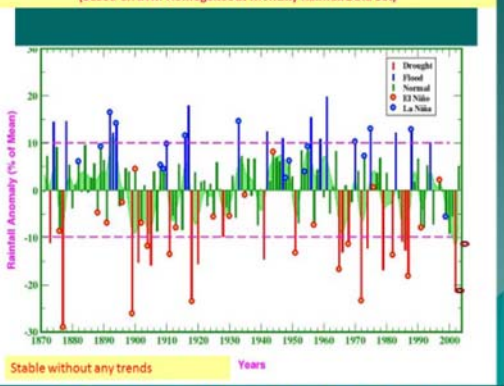
Rising trend in Temperature caused by CO2 increase



10 Million years

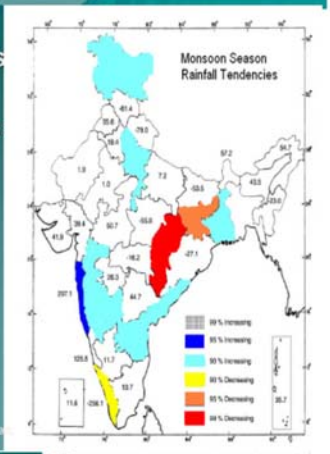
All-India Summer Monsoon Rainfall (1871-2004)

[Based on IITM Homogeneous Monthly Rainfall Data Set]



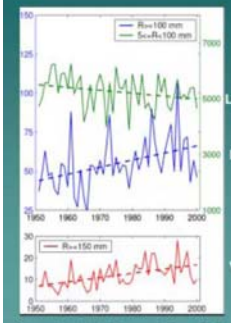
Stable without any trends

Spatial patterns in Monsoon Rainfall Trends



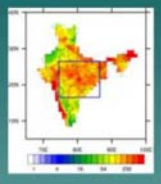
Source: Guhathakurata & Rajeeva 2007

Changes in the Frequency of Extreme Rainfall



Low & Moderate events

Heavy events (>10cm)

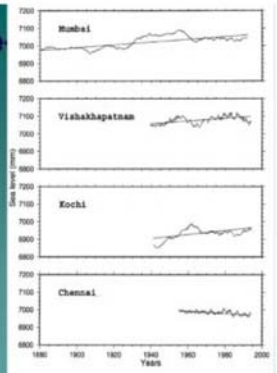


V. Heavy events (>15cm)

Goswami et al., Science, Dec., 2006

Sea Level Rise - Observations

- Sea-levels increase by ~ 1.3 mm/year



Unnikrishnana et al. Curr. Sci, 90, 362-372, 2006

Figure 2. Estimates of sea level rise for selected stations. Monthly mean tide gauge data from the post sea level records measured by tide gauges are used to estimate the trends.

What we know

- The climate is *unequivocally* changing
- The change is due to human activities, beyond reasonable doubt
- All models, under all scenarios, show significant future warming
- Half of the 'uncertainty range' (2-4.5ºC) is 'scientific', and the other half is 'social'

History of Climate Change Science

1800-1870

- Level of carbon dioxide gas (CO_2) in the atmosphere, as later measured in ancient ice, is about 290 ppm (parts per million).
- **First Industrial Revolution**. Coal, railroads, and land clearing speed up greenhouse gas emission, while better agriculture and sanitation speed up population growth.

Contd.

History of Climate Change Science

1859

- **Tyndall discovers that some gases block infrared radiation. He suggests that changes in the concentration of the gases could bring climate change.**

1896

- **Arrhenius publishes first calculation of global warming from human emissions of CO_2.**

Contd.

History of Climate Change Science

1870-1910

- **Second Industrial Revolution**. Fertilizers and other chemicals, electricity, and public health further accelerate growth.

1930s

- **Global warming trend since late 19th century reported.**
- **Milankovitch proposes orbital changes as the cause of ice ages.**

Contd.

History of Climate Change Science

1945

- U.S. Office of Naval Research begins generous funding of many fields of science, some of which happen to be useful for understanding climate change.

1960

- **Downturn of global temperatures since the early 1940s is reported.**
- Keeling accurately measures **CO_2** in the Earth's atmosphere and detects an annual rise. The level is **315 ppm**.

Contd.

History of Climate Change Science

1967

- **International Global Atmospheric Research Program established**, mainly to gather data for better short-range weather prediction but including climate.
- Manabe and Wetherald make a convincing calculation that doubling CO_2 would raise world temperatures a couple of degrees.

1968

- Studies suggest a possibility of collapse of Antarctic ice sheets, which would sea levels catastrophically.

Contd.

History of Climate Change Science

1970

- **First Earth Day**. Environmental movement attains strong influence, spreads concern about global degradation.
- Creation of U.S. National Oceanic and Atmospheric Administration (NOAA), the world's leading funder of climate research.
- **Aerosols** from human activity are shown to be **increasing** swiftly. Bryson claims they counteract global warming and may bring serious **cooling**.

Contd.

History of Climate Change Science

1976

- Studies find that **CFCs** (1975) and also methane and **ozone** (1976) can make a serious contribution to the greenhouse effect

1977

- Scientific opinion tends to converge on **global warming** as the biggest climate risk in ***NEXT century.***

Contd.

History of Climate Change Science

1979

- Second oil "**energy crisis**." Strengthened environmental movement encourages renewable energy sources, inhibits nuclear energy growth.
- U.S. National Academy of Sciences report finds it highly credible that doubling CO2 will bring 1.5-4.5EC global warming.
- ***World Climate Research Programme*** launched to coordinate international research.

Contd.

History of Climate Change Science

1981

- Hansen and others show that sulfate aerosols can significantly cool the climate, raising confidence in models showing future greenhouse warming.
- Some scientists predict greenhouse warming "**signal**" should be visible by about the year 2000.

Contd.

History of Climate Change Science

1987

- Montreal Protocol of theVienna Convention imposes international restrictions on emission of ozone-destroying gases.

Contd.

History of Climate Change Science

1988

- Toronto Conference calls for strict, specific limits on greenhouse gas emissions.
- Ice-core and biology studies confirm living ecosystems make climate feedback by way of **methane**, which could accelerate global warming.
- ***Intergovernmental Panel on Climate Change (IPCC) is established.***
- Level of CO2 in the atmosphere reaches ***350 ppm.***

Contd.

History of Climate Change Science

2003

- Variety of studies increase concern that collapse of ice sheets (West Antarctica, perhaps Greenland) can raise sea levels faster than most had believed.
- Deadly summer heat wave in Europe accelerates divergence between European and US public opinion.

Contd.

History of Climate Change Science

2005

- **Kyoto treaty goes into effect**, signed by major industrial nations except US, Japan, Western Europe, regional US entities accelerate work to retard emissions.
- Hurricane Katrina and other major tropical storms spur debate over impact of global warming on storm intensity.
- Level of CO_2 in the atmosphere reaches **380 ppm.**

Contd.

History of Climate Change Science

2007

- The IPCC reaffirmed that human emissions are very likely to cause serious climate change in a report published in 2007, but they had not been able to narrow the range of possibilities.
- Depending on what steps people took to restrict emissions, by the end of the century we could expect the planet's average temperature to rise anywhere between about 1.4 and 6°C (2.5 - 11°F).
- Although only a small fraction of this warming had happened so far, predicted effects were already becoming visible in some regions — **more deadly heat waves, rising sea level, stronger floods and droughts, the spread of tropical diseases and the decline of sensitive species.**

Contd.

History of Climate Change Science

2008

India's National Action Plan on Climate Change

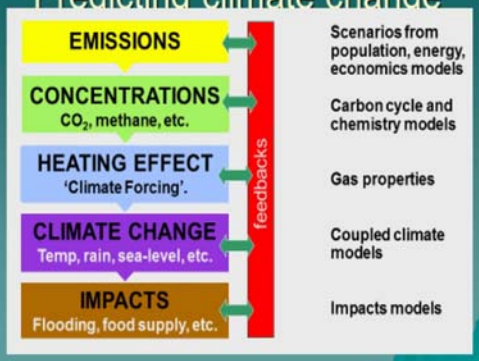
History of Climate Change Science

2009

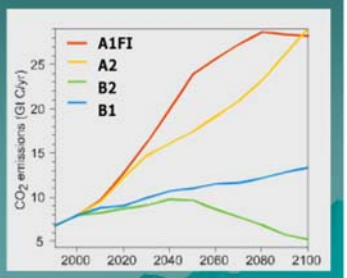
?????

Expected Future Changes Under Increased GHG Conditions

Predicting climate change



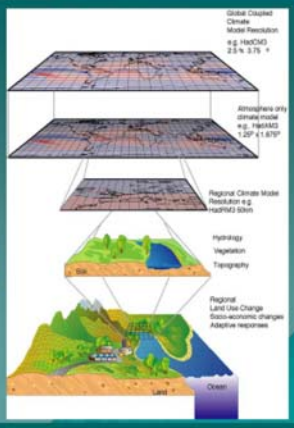
IPCC SRES emission scenarios



GCMs to Regional Adaptive Responses : Modelling Path

Cs = f(Cl, Øs)

Cs - small scale climate
Cl - large scale climate
Øs - physiographic details at small scale



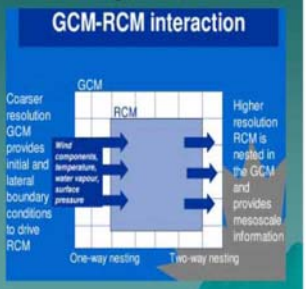
Nesting procedure :

a higher resolution model sub region is nested (or embedded) in a lower resolution global model

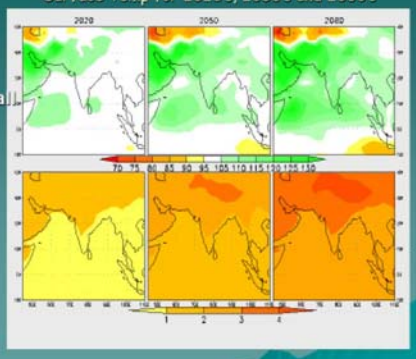
Basic idea

The GCM can provide the correct large scale circulation response to global climate forcings and the limited area model (LAM) can describe the effect of sub-GCM grid forcings that may significantly influence the climate of local

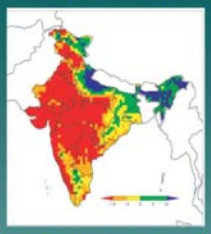
RCM may be nested either in the observations (analyses) or GCM outputs



Expected Future Change in Monsoon Rainfall and Annual Surface Temp for 2020's, 2050's and 2080's



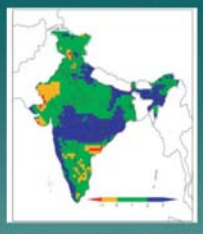
Projections of extremes in rainfall (2041-2060)



Overall decrease in the number of **rainy days** over a major part of the country.

Decrease more marked in the western and central part of the country (by more than 15 days).

foothills of Himalayas (Uttaranchal) and in northeast India the number of rainy days is found to increase by 5–10 days.

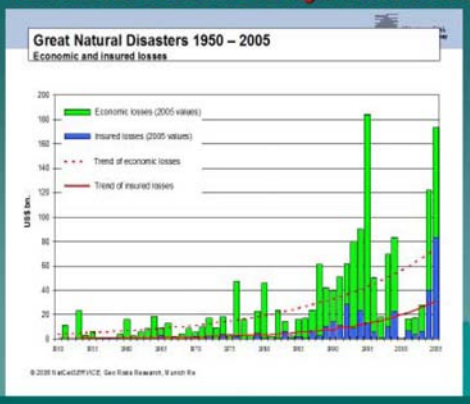


The increase in GHG concentrations may lead to an overall increase in the **rainfall intensity** by 1–4 mm/day

northwest India - the rainfall intensities decrease by 1 mm/day

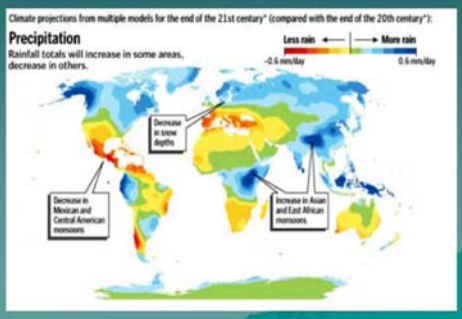
increase in the highest 1-day rainfall over a major part of the Indian region - may be up to 20 cm/day

Weather-related economic damages have increased

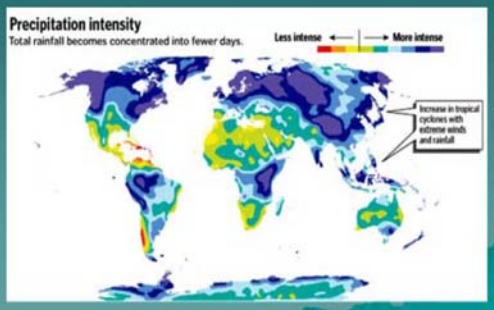


Projected changes by end of this century

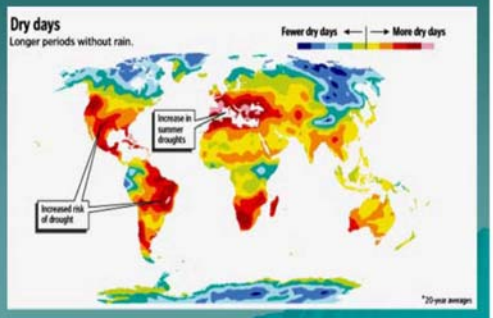
I. Changing rainfall patterns...



.....means more rain in fewer days per year.....



....and will mean too many days without rain.



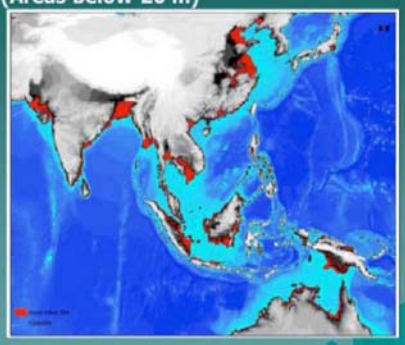
Relative vulnerability of coastal deltas as indicated by estimates of the population potentially displaced by current sea-level trends to 2050 (extreme >1 million; high 1 million to 50,000; medium 50,000 to 5,000). Climate change would exacerbate these impacts.

Countries at Risk

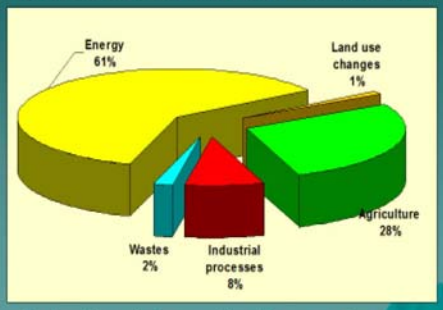
Low -lying atoll States

Example: Maldives

Vulnerability to sea level rise
(Areas below 20 m)



What is the contribution of different sectors in India to climate change?
(Sources of Greenhouse Gas emissions in India)



Fossil fuel used in agriculture considered in energy sector

Source: India's Initial National Communication on Climate Change, 2004

- *"Climate Change is a far greater threat to the world than international terrorism"*

Sir David King, UK Chief Scientific Advisor

- *"I'm no longer skeptical...I no longer have doubts...I think climate change is the major challenge facing the earth"*

Bill Clinton, Former US President

Extreme weather

- Small changes in average conditions can have big influence on extremes such as droughts & Floods. India is vulnerable to extreme weather events.
- Over the decade of the 1990s, both the number and severity of such events increased. One of the anticipated effects of climate change is the possible increase in both frequency and intensity of extreme weather events.
- These changes are already noticeable, and the trend is **expected to continue**.

Examples of extreme weather events

Primary Climatic Events

- **Cold wave**, Fog, Snow storms and Avalanches
- Hailstorm, Thunderstorm and Dust storms
- **Heat wave**
- Tropical Cyclone and Tidal Wave
- Floods, **Heavy rain**
- Droughts (Hydrological, Meteorological and Agricultural etc.)

Secondary Events (May be Climate-Driven)

- Incidence of epidemics or diseases
- Urban and Rural Water shortage
- Crop Plantation Failure or harvest failure
- Malnutrition or under nutrition and hunger
- Landslides, saline water intrusion and mudflows

According to WMO

Type of natural disasters around the world	Damage caused by natural calamities (%)
Floods	32
Tropical Cyclones	30
Droughts	22
Earthquakes	10
Other disasters	6

Climate change uncertainties (IPCC)

There is more confidence in temperature projections than rainfall projections because there is a direct relationship between atmospheric greenhouse gas concentrations and temperatures.

- **Very high confidence**
  - Increased Heat Wave, High temperature in winter and changes in **extreme temperature**, **Diurnal Asymmetry**
  - ***sea level rise** during the latter half of the 20th century*
  - Increased **drought and water scarcity** during dry season
- **High confidence**
  - **Human health** (heat related mortality, change in infections diseases vector)
  - More monsoon rainfall variability
  - *changes in* **wind patterns**, increased intense **tropical Cyclone**
- **Medium to high confidence**
  - Increased risk of **extreme rainfall** events during monsoon season
  - Change in **onset of rainfall and seasonality**
- **Moderate confidence**
  - Change in stream flow
  - Declining surface water resources
  - Increased terminal (end-season) drought during monsoon season

Points for Consideration

1. *Present Climate vs Future Climate Change*
2. *Adaptation measures for climate variability and extremes already exist*
3. *Adaptation to future climate change should first seek to identify gaps in current capacity*
4. *Adaptation should be based on quantitative assessment of potential impacts - scientific data required!*

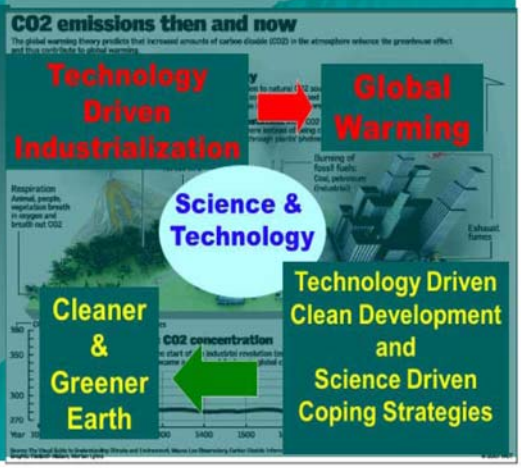
Points for Consideration

5. **Vulnerability assessments required including consideration of land use planning**
6. **The need to increase risk awareness and strive towards risk reduction**
7. **Climate change impacts for disaster management are multi-sectoral and must be addressed from a multi-sector approach**

The crisis: the science of climate change

- Climate change is **real**; it is already dangerous; heading towards catastrophe.
- Climate change is **urgent**; it needs us to act quickly and drastically;
- **But how?** Climate change is linked to economic growth. Can we re-invent growth?

India's approach towards Mitigation



Early Warning and Disaster Communication

Outline

- Understanding Disasters
- Hazards, risks and vulnerabilities of South Asia
- Emerging risks – climate change and urban upsurge
- Disaster management framework of India
- Policies, strategies and programmes

Introduction

Hydro meteorological disasters and role of National Meteorological Services in monitoring adverse weather and early warning system

Public policy on disaster

- Till recently India did not have a policy on disaster management
- Attitude towards disaster was marked by fatalism – *'wrath of nature'* or *'anger of God'*
- Government intervention limited to provided post disaster relief and rehabilitation assistance
- Disaster management was the concern of Ministry of Agriculture in Centre and Revenue and Relief Departments in the States
- Civil response system heavy depended on armed and other paramilitary forces

Disaster risk management strategy

•Early warning to disaster management agency

•Post- disaster weather surveillance for emergency operations

Hydro-meteorological hazards over south Asian region: Scales and potential risks

Hazard	Time Scale	Potential risk
Tropical cyclone	2- 5 days	Very high Strong winds and heavy rainfall
Storm surge inundation	One day to several days	Storm surge of 4-10m height
Strong winds	several days in tropical cyclone and strong monsoon conditions	Very high to moderate (20-80 m/s)
Heavy rainfall	2-3 days (over 6 cm/day) Can be 30-50cm/day	Very high Flooding

Hazard	Time/ spatial Scale	Potential risk
Severe local thunderstorms	6 -12 hrs 50 X 50 Km	High under Tornado
Squall lines	6 -12 hrs 500 X 500 Km	Moderate
Hail storms	< 1 hour 500 X 500 Km	High for crops
Heat waves	3-5 days 1000 X 1000 Km	High
Cold waves	3 - 5 days 1000 X 1000 Km	High
Land slides	1 - 2 days 1000 X 1000 Km	Very high
Floods	Few hours to several days Few km^2 to 1000 X 1000 Km depending on flood type	Very high
Drought	Weeks to season 10000 X 10000 Km	Moderate

Flood Types

Flood Types	Scale	Forecast capability
Flash floods	10 x 10 km, a few hours	Small
Metropolitan city/ Urban floods	20 x 20 km, 6-12 hours	Small
Riverine floods	1000 x 1000 km, 2-7 days	Moderate
Dam burst floods	1000 x 1000 km, Few days	Moderate
Mountain flooding / Valley flooding	1000 x 1000 km, Few days	Moderate

Disaster Risk Profile over South Asia

South Asia is situated in a disaster prone area because of its Geography, Monsoon flood systems, Tropical cyclone strike, Cold waves in some countries and Heat wave in some other countries, Mountain region land slides and avalanches etc.

The natural disaster profile of constituent countries (Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) differ from each other.

To formulate disaster management policies, develop preparedness and mitigation plans and allocate human and financial resources each country needs to prepare its own profile.

Data Needs for Preparation of Risk Profile

- **Prioritization of main hazards affecting the country**
- **Preparation of area-specific detailed vulnerability maps for each disaster type showing low, moderate and high risk zones**
- **Develop guidelines and manuals for each hazard** (say TCs, Floods, Land slides, Storm surges etc.)
- **Capacity building**
- **Demographic profile of specific high vulnerability zones and poverty index**
- **Preparedness at official and citizen level**
- **Availability of resources and trained manpower**

Selection of Major River Basins for Riverine Floods in each Country

- **Need to study**
  - **Historical data on flooding**
  - **Listing of major and minor dams in the region**
  - **Profile of embankments**
- **Needs coordination between irrigation departments, meteorological services, local and regional disaster management services etc.**
- **Discussion on a particular river basin of India -**

Hazard Zonation for Droughts

- **Taluk level**
- **District level**
- **Sub-Division level**
- **Country scale**

- **Historical seasonal rainfall series needs to be prepared and drought defined** (say on the basis of standard deviation of weekly, monthly and seasonal scale)
- **Droughts on neighboring districts**
- **Scientific study of data - urgent need**
- **Prepare plans for specific drought area monitoring and management**

Science and Technology in Monitoring Hazards

❖Atmospheric and ocean observational system on large and mesoscale network and efforts to enhance them in India

❖Exclusive communication system for transfer of observational data such as V-Sat, HF radio, satellite phones, telephone, internet etc.

❖International data communication

❖Creating awareness among official agencies and citizens

Documentation of meteorological knowledge on different hazards

- Tropical cyclone
- Monsoon depressions
- Western disturbances
- Severe local storms
- Hail storms etc.

Early warning system

- Early warning system in place
- Weather/ disaster prediction methodology and uncertainty level attached to each disaster type
- Making local and regional disaster management authorities aware about the level of calamity attached to different warning (Certainly level depends on our scientific understanding, monitoring network and prediction methodology used)
- Communication links for sending early warnings

Use of Remote Sensing Technology

- For Disaster monitoring
- For Data collection
- For Disaster warnings
- For Damage assessment

Disaster management agencies may coordinate with remote sensing agencies to prepare specific plans. Application of space science and technology has changed disaster management profile greatly

Use of Weather Radars in Disaster Monitoring and Prediction

C - Band radar monitoring capability

S - Band Doppler radar monitoring capability

Weather radar data in weather prediction on nowcasting to large scale weather prediction scales

Areal rainfall assessment by radar

Increasing scope and limitations

Use of GIS based system

- Vulnerability
- Communication
- Resource mobilisation and other purposes

Forecasting (Prediction) Tools

- Empirical methods
- Statistical (probability) approach
- Numerical Weather Prediction (Global scale, large scale and regional scale)

- Need for data on each scale and limit of predictability

Agencies Involved in Hydro-meteorological Disaster System in India

- National authority for disaster management
- State level authorities for disaster management
- District level authorities for disaster management
- India Meteorological Department and its regional, state and district level offices
- National Centre for Medium Range Weather Forecasting
- Dept. of space
- Government of India ministries : Home, Science & Technology, Water resources (Floods), Agriculture (Drought)
- State Government
- Research organisations

Linkage among different agencies

Role of S&T Organisations

- Role of organisations dealing with S&T have a great role to help the central and state disaster management authorities.

- They are well aware about potential disasters through their early warning systems.

- Also they pursue R&D about each disaster type and improvement of the disaster monitoring and prediction systems.

Climate Change (Global change) and Natural disasters

Special studies on

- Floods
- Droughts
- Extreme events
- Glacier melts
- Glacier lake outflows etc.

needed system in south Asia (India, Pakistan, Nepal etc.)

Few recent initiatives for reducing risks of disasters in India

Early Warning System

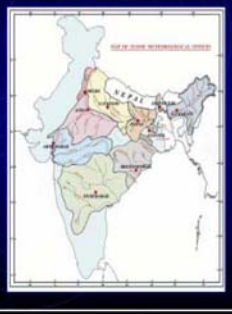
India has developed an elaborate early warning system through a network of satellite, ground and ocean monitoring stations

Agencies involved:

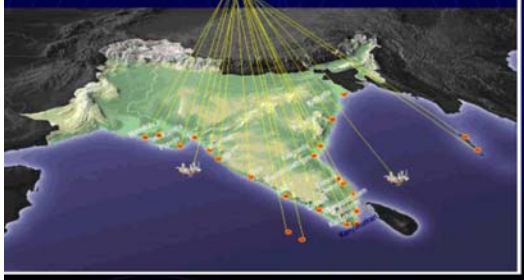
- Department of Science and Technology
- Department of Space
- Ministry of Water Resources
- Department of Ocean Development

Flood forecasting centres

RIVER BASIN	FF CENTRES
GANGA-BRAHMAPUTRA	114
WEST FLOWING RIVER	17
KRISHNA BASIN	08
MAHANANDA BASIN	03
EASTERN RIVERS	09
GODAVARI BASIN	15
Total	160



Early Warning System for Indian Ocean tsunamis



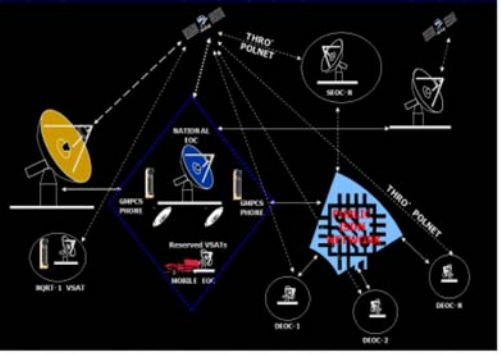
Emergency Operation Centres

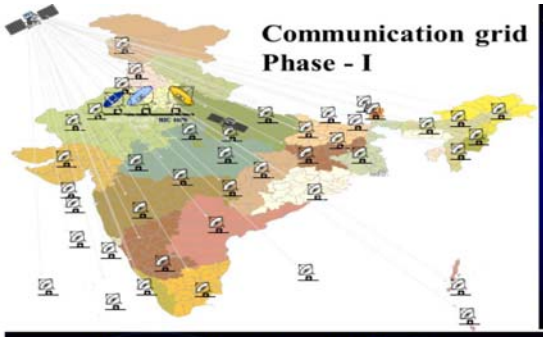
- State-of-the-art **Emergency Operation Centres** established in Ministry of Home Affairs for data, video and audio up-linking with all State, District and remote areas
- EOCs being set up in all State, Union Territory and District headquarters
- **India Disaster Resource Network (IDRN)** - web-enabled, centralised inventory of resources established - **www.idrn.gov.in**
- Over 80,000 records from 565 districts of 35 States/ Union Territories uploaded.

Disaster communication plan

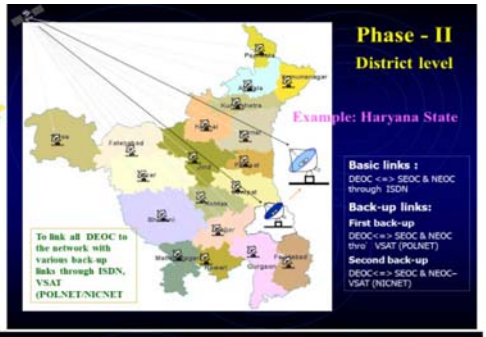
- Satellite-based mobile voice /data /video communication between National, State, district and mobile EOC at remote disaster sites
- Triple redundancy for 100% reliability
- Terrestrial links of POLNET, NICNET and SPACENET used

NATIONAL EMERGENCY COMMUNICATION PLAN





Communication grid Phase - I



Community Based Disaster Risk Management

- India is implementing largest community based Disaster Risk Mitigation program in the world.
- Sponsored by UNDP under a multiple donor supported program it covers nearly 300 million people in 169 multi-hazard districts in 17 States
- Under this program community prepares and implements Village Disaster Management Plan
- VDMP is integrated vertically with District and State Disaster Management Plans and horizontally with sectoral plans.

Disaster management in school education

- Disaster management as a subject in Social Sciences introduced in school curricula for Class VIII, IX, X and X through CBSE
- Many State Governments adopted the same curriculum as developed by CBSE

Disaster management in engineering & architecture

- Curriculum on earthquake resistant technology in undergraduate courses on engineering and architecture finalized in consultation with AICTE and CoA
- Introduced in civil engineering and architectural courses throughout the country 2006-07
- National Programme on capacity building of engineers and architects

Disaster management in medical education

- Curriculum on emergency health management in MBBS and Nursing courses finalized in consultation with MCI
- These are likely to be introduced in MBBS and Nursing courses throughout the country from the academic year 2007-08

Cyclone Risk Mitigation

- **National Cyclone Risk Mitigation Project** to cover 13 cyclone prone States/Union Territories [cost US $ 365 million/ Rs 1650 cr].
- Main elements of the project:
  - Strengthening of cyclone tracking and monitoring
  - Developing cyclone shelters in coastal areas
  - Regenerating mangrove forests as protective shields for coastal settlements
  - Supporting State/Union Territories for taking up high priority cyclone risk mitigation activities.
  - Providing technical assistance for hazard risk management capacity building.

Earthquake Risk Mitigation

- National Project to cover 229 districts located in seismic zone IV & V.
- Main elements of the project:
  - Earthquake hazard assessment and micro zonation in selected metropolitan cities
  - Techno-legal regime for earthquake risk mitigation.
  - Retrofitting of life-line buildings and infrastructure.

National school safety project

- All existing school buildings shall be retrofitted
- All new school buildings shall be constructed as per earthquake/ cyclone resistant construction technology

Regional Cooperation

- SAARC Disaster Management Centre set up at the premises of the NIDM
- The Centre to have jurisdiction over eight South Asian countries
- Many new initiatives taken for developing common platform for sharing regional knowledge and experience on disaster management

Concluding Remarks

Disaster management at each level (Preparedness, Early warning, Damage assessment and control, Risk mitigation etc) requires vital support from science and technology inputs

- be it at monitoring, prediction , damage assessment and mitigation levels

Risk management is an emerging science

Disaster management itself is a multidisciplinary science

National Programmes for Adaptation

National Programme on adaptation would focus:

- **Agriculture**
- **Forestry**
- **Disaster management**
- **Water sector**
- **Coastal zones**
- **Health sector**

7 Major Components of Adaptation

i. Crop improvement & research

i. Drought proofing & flood control

i. Health improvement and prevention of disease

ii. Risk financing

iii. Disaster management

iv. Forest conservation

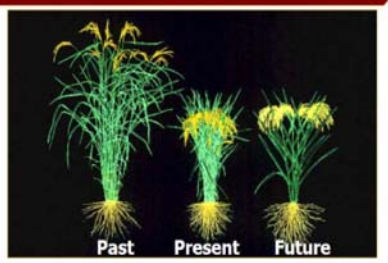
v. Poverty alleviation and livelihood preservation

Agriculture

Agriculture

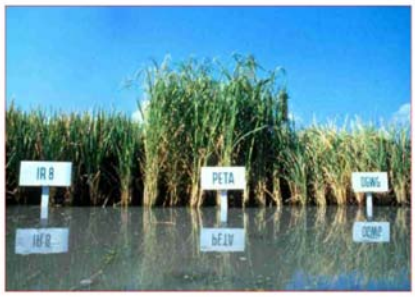
- **The proposed national programme will focus on four crucial areas, namely**
  - **dryland agriculture,**
  - **risk management,**
  - **access to information, and**
  - **use of biotechnology**

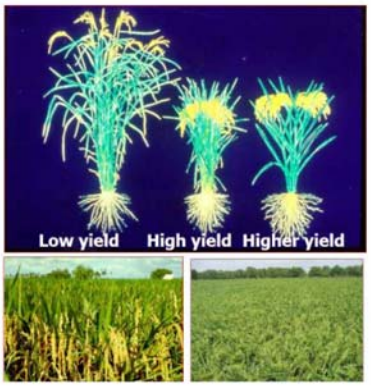
Climate-ready crops
New plant type in rice



Greater absorption of sun light, better root system, drought tolerant, photo-insensitivity, high yield

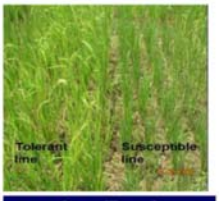
High-yielding, short-stemmed varieties sparked the Green Revolution in rice and wheat





Flood and Drought Tolerant Rice

Waterproof rice provides flood (up to 17 days) relief for farmers



Drought resilient rice out yield traditional varieties

Converting Rice from C3 to C4

C3 + Anatomy Change + Biochem Change + Fine Tuning = C4

Resource Conserving Technologies (RCT)

	Conventional	RCT
1. No-tillage		
2. Laser land leveling		
3. Direct seeding of rice		
4. Leaf colour chart for N		
5. Crop diversification		

No-till wheat is more tolerant to abrupt temperature rise: A case for adaptation

Conventional | No-till

Direct dry-seeded rice is more tolerant to water stress: A case for adaptation

Direct dry-seeded | Puddled transplanted

Crop diversification

Initiatives by the Govt. of India

- Climate change impacts and adaptations to be considered in all planning activities
- Developing research infra-structure for integrated assessment of climate change
- Developing insurance and forecasting system
- Increasing climate literacy among stakeholders of agriculture

Indian National Network

Impacts, Adaptation and Vulnerability of Indian Agriculture to Climatic Change

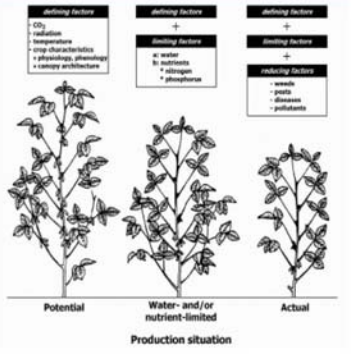
Involves 16 research institutes, >60 scientists

What can be done to ensure food security?

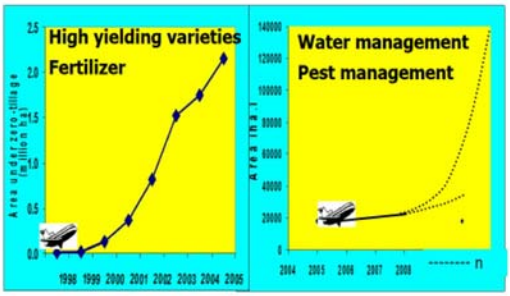
- Increase productivity
- Develop and disseminate technologies
- Improve public distribution system
- Control population growth
- Educate people
- Develop good marketing system

Increase productivity

Bridging the yield gap



Dissemination of Technologies



Educate people

All Partners have to play their role

- Government
- International Institutes
- Civil Society Organizations: NGOs
- Private Sectors
- Farmers

New private sector efforts for technology dissemination

Haryali Kisaan Bazaar, DSCL

TATA Kisan Sansar

ITC Choupal Saagar

All Technologies

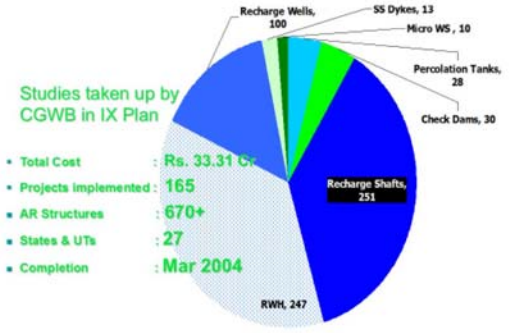
All Stakeholders

Remember the farmers, who feed us

WATER

Rain water Harvesting

Rain Water Harvesting & Artificial Recharge



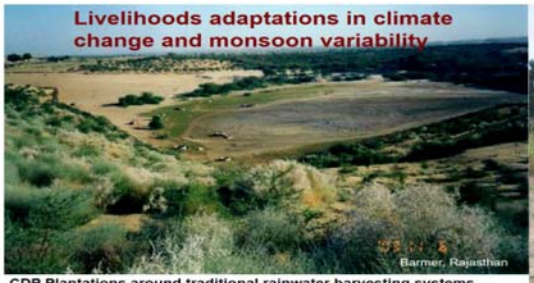
Rain Water Harvesting & Artificial Recharge

- Studies undertaken have created mass awareness
  - Of scientific AR & RWH designs, by example
  - By extension activities and publications
- Built capacity at state and grassroots level
- Proven results in arrest of GW level decline
- Activated States and Beneficiary involvement

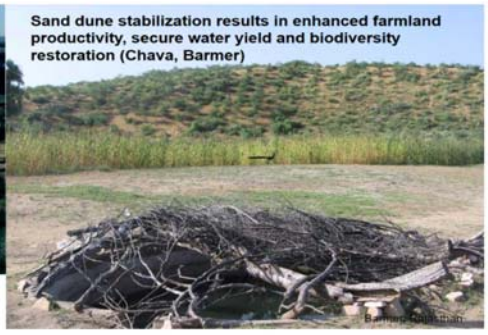
Rain Water Harvesting & Artificial Recharge

Master Plan of AR (2002)

Geographical Area of India	32.87 lakh sq. km
Identified area for artificial Recharge (excluding hilly terrain)	4.5 lakh sq. km
Estimated Surplus Monsoon Run Off for Recharge	36.4 BCM
Cost of 2.25 lakh AR structures in rural areas	Rs.19,874 Cr
Cost of 37 lakhs RTRWH structures in urban areas	Rs. 4586 Cr
Total Cost	~Rs. 24500 Cr



CDP Plantations around traditional rainwater harvesting systems protect against sand-filling, improve livelihoods, act as an adaptation to random recurrence of drought, and conserve desert biodiversity



Sand dune stabilization results in enhanced farmland productivity, secure water yield and biodiversity restoration (Chava, Barmer)

View from space: Biodiversity Conservation and protection to settlement, Chohatan, Barmer

India's current energy policies

- Improving energy efficiency
- Power sector reforms
- Increasing hydro power generation
- Promotion of clean coal technologies
- Energy and infrastructure development
- Coal washing
- Cleaner and lesser carbon intensive fuel for transport
- Promotion of Renewable Energy

GREEN BUILDINGS IN THE CONTEXT OF CLIMATE CHANGE

Green buildings: features

- have minimal impact on their site and surroundings

- and improve the micro-climate through better tree cover, cooler ambient temperatures, shading, etc.

Green buildings: features

- are energy efficient (minimize electricity and fuel consumption) and maximize use of renewable sources of energy (solar, wind, etc.)

- and can save energy by 40-50%

Green buildings: features

Use very less water and promote recycling and reuse of water
Enable solid waste segregation, management and generation of resources from wastes

Save water by up to 40% and promote maximum recycling and reuse of waste

Green buildings

- Have minimal negative impact on people
- Catalyse healthy and productive work environment

National Action Plan for Climate Change

- National Action Plan released on 30th June 2008
- Identifies measures that meet development objectives with climate change co-benefits
- 8 National Missions
- Other Initiatives

Principles of NAPCC

- Inclusive and sustainable development strategy,
- Efficient and cost-effective strategies for Demand side management
- Accelerated deployment of appropriate technologies
- Innovative market, regulatory, and voluntary mechanisms
- Effective linkages with civil society and public-private partnerships

1. National Solar Mission

- Increase the share of solar energy in the total energy mix
- Decentralized distribution of energy
- Creation of more affordable, more convenient solar power systems and storage

2. National Mission on Enhanced Energy Efficiency

3. National Mission on Sustainable Habitat

- Extension of application of Energy Conservation Building Code, incentives for re-tooling existing building stock
- Recycling of materials and urban waste management; technology development for power from waste
- Better urban planning and modal shift to public transport

4. National Water Mission

- Focus on conservation of water, minimizing wastage and ensuring equitable distribution
- Recycling of waste water to meet needs of urban areas
- Adoption of new and appropriate technologies such as low temperature desalination for coastal cities
- Basin level management strategies in consultation with states
- Optimize efficiency of existing irrigation systems

5. National Mission for Sustaining the Himalayan Ecosystem

- Sustaining and safeguarding the Himalayan glacier and mountain eco-system
- Understand whether and the extent to which the Himalayan glaciers are in recession
- Observational and monitoring network for the Himalayan environment: to assess fresh water resources and health of ecosystem
- Protection and enhancement of forest lands

6. National Mission for a Green India

- Afforestation of 6 million hectares
- Coverage of degraded forest land
- Enhancement of ecosystem services including carbon sinks
- Involvement of communities in Forest protection & afforestation

7. National Mission for Sustainable Agriculture

- Develop new varieties of crops capable of withstanding extreme weather: thermal resistant crops, alternative cropping patterns
- Orientation of agricultural research systems to monitor and evaluate climate change and recommend changes
- Convergence and integration of traditional knowledge and practice systems, information technologies and biotechnology
- Focus on improving productivity of rainfed agriculture

8. National Mission on Strategic Knowledge for Climate Change

- Funding of high quality and focused research into climate change
- Study impact on health, demography, migration patterns and livelihoods
- Establish network of dedicated climate change related units in academic and scientific institutions
- Set up Climate change research fund
- Private sector initiatives through venture capital funds
- Research to support policy and implementation through identified centres

Other Initiatives

- Capacity Building Measures
  - **Disaster Management Response to Extreme Climate Events (page 42, par 4.3)**
  - **Disaster Mgt requires greater attention**
    - Infrastructure design,
    - communication networks,
    - protection of coastal areas,
    - health care services
  - Institutions at State/Community level

Managing Climate Change through Weather based Agro-Advisories Services

Rise in Extreme Weather Events

- Global temperature has increased 0.15 to 0.3 degree/decade for 1990 to 2005. Next 2 decades, warming of 0.2 deg./decade projected.
- Indian scenario not different.
- Frequency of intense rainfall events has increased over past 53 years. Extreme rainfall events also increased over the west coast of India (Analysis of 100 years of data; 1901-2000).

Multi-decadal changes in Break Days During Monsoon

PERIOD	NUMBER OF BREAK DAYS DURING					
	JULY			AUGUST		
	01-10	11-20	21-31	1-10	11-20	21-31
1888-1917	46	49	53	43	84	26
1918-1947	14	36	21	55	54	25
1948-1977	22	44	64	21	33	41
1978-2003	23	32	39	6	14	37

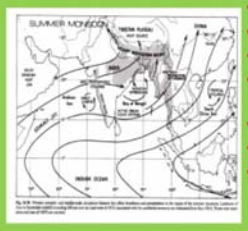
Data of past 50 years show that number of Break days are more in July as compared to August

Factors Governing Response of Farming System

- Crops have to cope with increased variability of weather, extreme events, and changing climate patterns throughout the growing season.
- Agriculture may learn to adapt to climate change but climate variability needs to be combated.
- The frequency of occurrence of extreme climate conditions dictates the response of agriculture to climate variability/change.

Components of Variability in Weather & Climate

- Heat/Cold Wave
- More variable R/F
- Increased Extremes Weather Events
- Erratic Onset, advance and retrieval of Monsoon
- Shift in Active/break cycles
- Intensity and frequency of Monsoon lows/depressions



Role of Weather Information in Farm Management

- Cultivars Selection
- Choosing windows for Sowing/harvesting operations
- Irrigation scheduling – optimal water use
- Mitigation from adverse weather events such as frost, low temperature, heavy rainfall – at critical crop stages
- Nutrient Management : Fertilizer application
- Plant Protection : Pesticide/fungicide spraying schedules
- Feed, Health and Shelter Management for Livestock [Optimal temperature for dairy/ hatchery etc]

AAS: India Meteorological Department

- Milestones 1932, 1945, 1976
- 23 State Agromet Service Centre in collaboration with SDA
- Agro-advisory preparation - Monday & Thursday
- Composite Agro-advisory preparation- Tuesday & Friday
- Dissemination- AIR, Doordarshan, Print media, Website

AAS : National Centre for Medium Range Forecasting

- 107 AAS units with SAUs & ICAR institutes
- 4-days forecast + weekly outlook preparation- Tuesday & Friday
- Agromet Advisory Board & Agro-advisory - Tuesday & Friday
- Composite bulletin preparation
- Crop Weather Models
- Dissemination- AIR, Doordarshan, Print media, Web
- Feedback – Farmers, Forecast Verification, Economic Impact Assessment & Annual Review Meetings
- AAS awareness & user interaction programs

Agro Met R&D back up: ICAR

- 25 Centers of AICRP on Agro Meteorology
- Located at SAUs with AAS of NCMRWF
- R&D in Agromet
- Agromet data bank & Website

Gaps in Earlier AAS System

- Though IMD/NCMRWF services were useful but farmers' needs could not be fully met due to following gaps:
  - Non-availability of automated met. observations
  - Non-availability of Locale specific weather forecast
  - Non-availability of Extended Range Weather Forecast
  - Non-availability of real-time crop information
  - Lack of objectivity in Advisories
  - Inadequate outreach/extension mechanism
  - Poor communication and dissemination

CHALLENGES

- Weather Forecast : Skill, Quantitative, Locale Specificity, Seamless
- Agriculture : Assessment of conditions of
  - Crop
  - Livestock
  - Soil
  - Pest & Diseases
- Weather Sensitivity of Crops & Management Practices
- Decision Support Tools for Translating Weather Forecast into Advisories
- Advisory Dissemination, Outreach & Feedback
- Synergistic Collaboration among Participating agencies

Reorganization Plan for IAAS

Is Aimed to Improve in:

- Weather Forecast & Advisory Content
- Use of Modern Technology in AAS
- Advisory Dissemination Mechanism
- Feedback Mechanism
- linkages with Administrative Authorities
- Monitoring System
- Mechanism for Continuous Up-gradation
- Mutual Collaboration by Related Agencies

Launching of Integrated Agromet Advisory Services

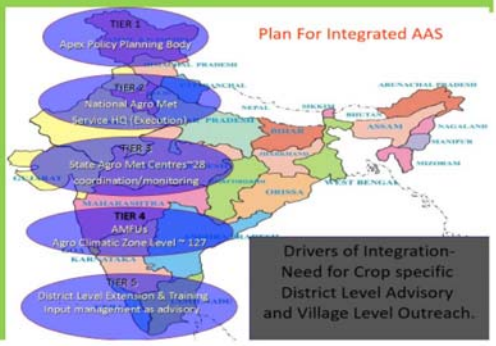
- AAS of IMD and NCMRWF has been converged and the services are being provided under single window system.
- All the AMFUs of NCMRWF has been transferred to IMD since 01-04-2007.

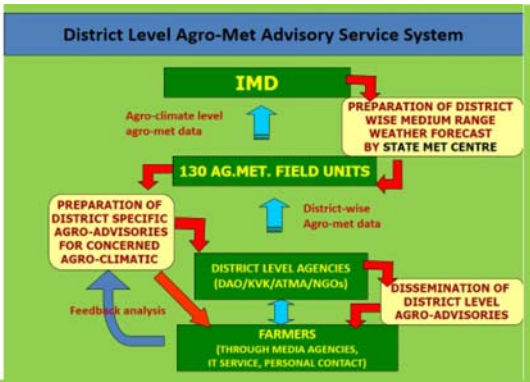
PHILOSOPHY OF INTEGRATED AAS

- AAS has to be essentially a multi-institutional program.
- As the basic core is weather and climate, IMD has to play pivotal role. Integrate AAS at IMD in a collaborative manner.
- Around meteorological nucleus, one needs to synthesize the orbits of agro-meteorological data base along with decision support system to translate weather forecast into advisory—SAUs, ICAR Institutions & others
- The final orbit comprises of Information dissemination agencies. These include; KVK, DAO, ATMA, NGOs etc
- Mass media dissemination agencies such as Radio, television, print media etc. And Village level knowledge dissemination agencies (DIT) needs to play an active role.

Collaborating Agencies

- Ministry Of Earth Sciences
  - India Meteorological Department
  - National Centre For Medium Range Weather Forecasting
  - Indian Institute of Tropical Meteorology
- Indian Council For Agricultural Research
- Department Of Agriculture & Cooperation
- State Departments Of Agriculture
- State Agricultural Universities And Other Universities
- Ministry of Information Technology
- Ministry of Science & Technology
- Ministry of Information & Broadcasting (AIR & TV)
- Print Media
- Department Of Space
- Min. of Rural Development
- MSSR Foundation & Other NGOs & PP

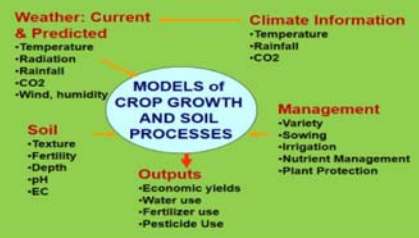




Integrated Agro-advisory Services - District level Forecasts (5 days) of:

- Rainfall
- Max and Min temperature
- Total cloud cover (day average)
- Surface Relative humidity (morning and evening)
- Surface Wind

Advisory Preparation : General Approach



Three tier Agro-met Advisory System

- AMFUs issue district level advisories.
- State Level Composite AAS Bulletins are prepared by State Meteorological Centre.
- National Agromet Advisory Bulletins are prepared by National Agromet Advisory Service Centre, IMD, Pune .

District Agromet Advisory Bulletin

- More than 300 districts are covered
- Bulletin is targeted for the farmers.
- This contains advisories for all the weather sensitive agricultural operations form sowing to harvest.
- It includes advisories for horticultural crops and livestock also.

State level Composite Bulletin

- This bulletin is prepared for the State level CWWG meeting.
- This is also meant for other users like Fertiliser industry, Pesticide industry, Irrigation Department, Seed Corporation, Transport and other organisations which provide inputs in agriculture.

National Agromet Advisory Bulletin

- The bulletin is primarily prepared for the Ministry of Agriculture for taking important decision in Crop Weather Watch Group (CWWG) meeting.
- Besides the same is also communicated to all the related Ministries (State & Central), Organisations, NGOs for their use.

Dissemination of Agromet Advisory

1. **Mass Mode of Dissemination**
   - All India radio
   - Television
   - Print Media

2. **Outreach at Village level**
   - Ministry of IT Internet based Village Connectivity
   - Web Pages: IMD, SAUs, ICAR Web Pages

3. **Human face for advisory dissemination**
   - KVK (ICAR): Training + interaction
   - DAO (SDA): Coordinate Farm inputs with Line Function Dept. in rhythm of weather forecast
   - NGOs & other intermediary groups
   - Awareness Programme

The National, State, & District bulletins are put on web sites of IMS, SAUs, ICAR etc. More than three hundred district level AAS bulletins are being displayed in the website of the Agrimet Division.

Krishi Vigyan Kendras/ATMA

- As Krishi Vigyan Kendras (KVKs)/ATMA centres have been established at district level, these centres are proposed to be utilized as strong extension agency.
- Meetings held with officials of Ministry of Agriculture, and ICAR to set up linkages of the service with ATMA/KVKs.
- Follow up actions of the meetings are being taken to steer the service through ATMA/KVKs.

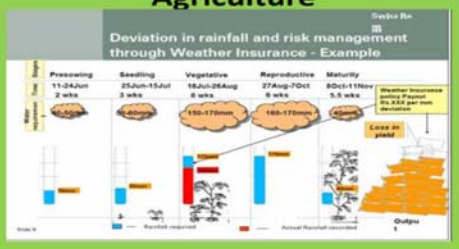
Feedback Issues & Mechanism

- Quality of Forecast
- Quality & relevance of Advisories
- Farmer should contact Whom & How?
- Problem solving through interactive mode
- Answering questions of common interest through bulletins
- Accessibility to information via ICT
- Accessibility to Experts & video Conferencing

TRAINING NEEDS OF END-USERS

- FARM LEVEL DEMONSTRATION
- TRAINING WORK-SHOP
- KISAN GOSHTHI (EXPERIENCE SHARING)
- TEACHING WEATHER SENSITIVITY OF CROP/ANIMAL PRODUCTION
- TIME AND METHOD OF PESTICIDES FOR PLANT PROTECTION
- TEACHING METHODS OF CROP PROTECTION FROM ADVERSE WEATHER
- FARMERS TRAINING AND AWERNESS PROGRAMMES.

Weather Risk Insurance for Agriculture



Way Forward

- Improved prediction needed for Extreme weather events & shifting climatic regimes
- To generate advisories on cultivar selection in view of variable thermal/precipitation regimes
- Advice on selection of sowing window
- Develop appropriate management practices to cope with extreme weather events.
- Develop forewarning system for P&D spread and duration.
- Develop advisories on forest fire danger

Forecast Tool

- NWP (DMO)
- MOS
- Multi-model Ensemble

Crop Weather Models for AAS

- Calibrate, validate and operationalise crop simulation models appropriate to each crop in different districts.
- Considering the number of Districts and the number of crops grown in each of them, a few hundred crop growth models would have to be developed, tested and operationalised.
- This is a highly inter-disciplinary task and experts in modeling, weather prediction, agronomy, plant pathology, entomology and other agricultural disciplines would have be drawn into the mission to make it successful.
- Final aim is to develop Expert Systems for farm level decision making.

Remote Sensing for AAS

- Enhance the quality and usefulness of the AAS utilizing the Remote Sensing(RS) data.
- Crop Yield Forecast at District level using Crop Simulation Model
- Collaborative Efforts (with SAC, ICAR, & DoAC) to generate crop and soil information at smaller scales for use in AAS.

Key Considerations for Integrating Climate Risk Management Strategies into Developmental Programs

Climate Change

In the past century the global climate warmed by about 0.7° C because of human activities

Accompanying changes in rainfall patterns, extreme weather events, and sea levels.

Another 1.4° C– 5.8° C temperature rise is projected in the next hundred years with increasing frequency and intensity of extreme weather events

The impacts of higher temperatures, more variable precipitation, more extreme weather events, and sea level rise are already being felt and will continue to intensify.

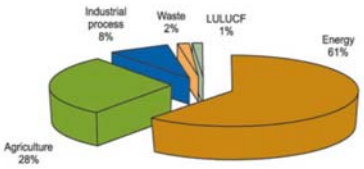
Most of the changes projected for the coming decades can no longer be avoided.

GHG Emissions from Sources and Removals by Sinks - India 1994

GHG source and sink categories (Gg per year)	CO_2 emissions	CO_2 removals	CH_4	N_2O	CO_2 eq. emissions*
Total (Net) National Emission	817023	23533	18083	178	1228540
1. All Energy	679470		2896	11.4	**743820**
2. Industrial Processes	99878		2	9	102710
3. Agriculture			14175	151	344485
4. Land use, Land-use change and Forestry	37675	23533	6.5	0.04	14292
5. Other sources as appropriate and to the extent possible					0
5a. Waste			1003	7	23233
5b. Emissions from Bunker fuels	3373				3373

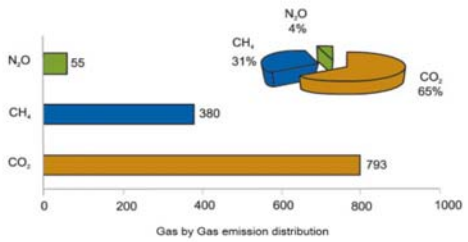
*Converted by using GWP indexed multipliers of 21 and 310 for converting CH_4 and N_2O respectively.

Sectoral Distribution of GHG emissions – India 1994



Emissions in terms of CO_2 equivalent

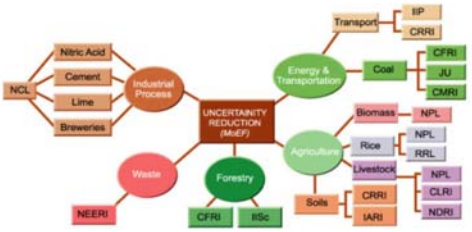
Relative GHG Emissions - India 1994



Inventory Estimation - Institutional Arrangement

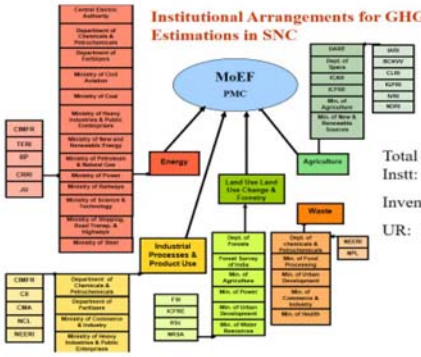
19 Research Teams

Uncertainty Reduction – Institutional Arrangement



17 Research Teams

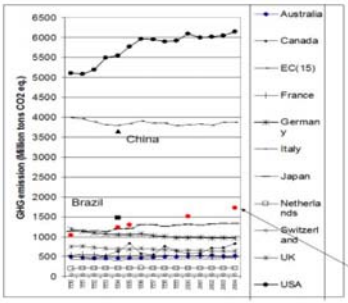
Institutional Arrangements for GHG Inventory Estimations in SNC



Total Research Instt: 21

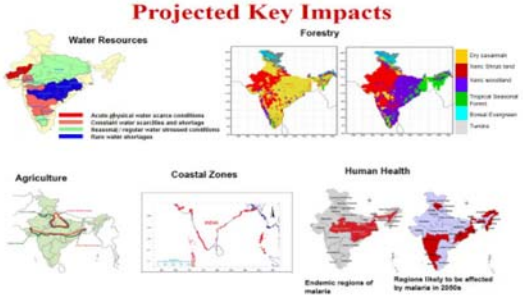
Inventory: 11

UR: 18



A Comparison of Trends of GHG emissions with some key countries

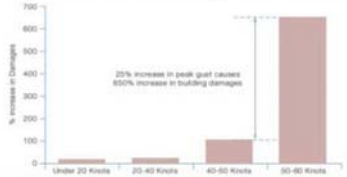
Projected Key Impacts



Vulnerability and Adaptation - INC

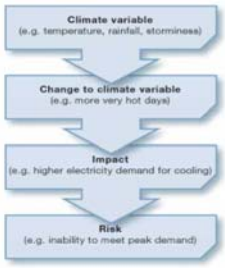
36 Institutions

Increase in adversity and Damages



Hazard	Cause of Change in Hazard	Resulting Change in Damage/Loss
Windstorm	Doubling of windspeed 2.2°C mean temperature increase	Four-fold increase in damages Increase of 5-10% in hurricane wind speeds
Floods	25% increase in 30 minute precipitation	Flooding return period reduced from 100 years to 17 years

Links Between Climate Change & Risk



Risks Associated with Changes to Climate Variables

Change to climate variable	Examples of impacts
Higher mean temperatures	→ Increased evaporation and decreased water balance. → Increased severity of droughts (see below). → Reduced alpine winter snow cover. → Reduced range of alpine ecosystems and species. → Increased stress to coral reefs.
Higher maximum temperatures, more hot days and more heat waves	→ Increased incidence of death and serious illness, particularly in older age groups. → Increased heat stress in livestock and wildlife. → Increased risk of damage to some crops. → Increased forest fire danger (frequency and intensity). → Increased electric cooling demand and reduced energy supply reliability.
Higher minimum temperatures, fewer cold days and frost days	→ Decreased cold-related human morbidity and mortality. → Decreased risk of damage to some crops and increased risk to others. → Extended range and activity of some pest and disease vectors. → Reduced heating energy demand.
Decrease in precipitation	→ Decreased average runoff, streamflow. → Decreased water quality. → Decreased water resources. → Decrease in hydro-power potential. → Impacts on rivers and wetland ecosystems.

Risks Associated with Changes to Climate Variables

Change to climate variable	Examples of impacts
Increased severity of drought	→ Decreased crop yields and rangeland productivity. → Increased damage to foundations caused by ground shrinkage. → Increased forest fire danger.
Decreased relative humidity	→ Increased forest fire danger. → Increased comfort of living conditions at high temperatures.
More intense rain	→ Increased flood, landslide and mudslide damage. → Increased flood runoff. → Increased soil erosion. → Increased pressure on disaster relief systems.
Increased intensity of cyclones and storms	→ Increased risk to human lives and health. → Increased storm surge leading to coastal flooding, coastal erosion and damage to coastal infrastructure. → Increased damage to coastal ecosystems.
Increased mean sea level	→ Salt water intrusion into ground water and coastal wetlands. → Increased coastal flooding (particularly when combined with storm surge).

Key Development Sectors Directly Affected by Climate Change & at Risk

- Water supply and sanitation
- Energy
- Transport
- Industry, mining, and construction
- Trade and tourism
- Agriculture, forestry, and fisheries
- Human health
- Environmental protection
- Disaster management

Key Developmental goals at Risk

- Poverty eradication (MDG1)
- Child mortality (MDG2),
- Combating HIV/AIDS, malaria, and other diseases (MDG6)
- Environmental sustainability (MDG7).
- Energy for all
- Food Security

Climate Risks Facing Development Investments

- Direct threats to investments (e.g., effect of extreme weather events on infrastructure)
- Underperformance of investments, e.g., irrigation investments that fail to perform when rainfall Decreases
- Maladaptation, as when economic development triggers settlement in vulnerable areas or adversely affects the resilience of natural resources
- In addition, there is the risk of foregoing opportunities that may arise from climate change and could be captured if factored into plans and projects.

Levels of Risk Management

- National
- State
- District
- Community

The Risk Management Framework

Establish the context

- defining the program or the project to be assessed and the scope of the assessment;
- clarifying explicitly the objectives of the program/project;
- identifying the stakeholders and their objectives and concerns;
- establishing success criteria against which risks to the program objectives can be evaluated;
- Identify the key elements of the project/program as a means of structuring the process; and
- determining relevant climate change scenarios for the assessment.

Identify the Risks

- describe and list the climate change impacts on each of the key elements of the program.

Analyse the risks

- Review the policies and institutional mechanism already in place to deal with each specific risk
- Assess the consequences of each risk against the program objectives and success criteria, taking into account the extent and effectiveness of existing arrangements;
- Form a judgment about the likelihood of each identified risk leading to the consequences identified; and
- Determining the level of risk to the program, for each of the climate change scenarios used in the analysis.

Evaluate the risks

- Reaffirm the judgements and estimates;
- Rank the risks in terms of their severity;
- Screen out minor risks that can be set aside and which would otherwise distract the attention of management; and
- Identifying those risks for which more detailed analysis is recommended.

Monitoring and Review

- Keep the analysis and evaluation up to date, including updating climate change scenarios or incorporating new information about climate change impacts;
- Review progress on actions flowing from the process, including implementing treatment actions to reduce risks or undertaking further and more detailed analyses; and
- Ensure that the process itself is implemented in a timely and cost-effective fashion with documents produced, meetings held, plans reviewed and so on.

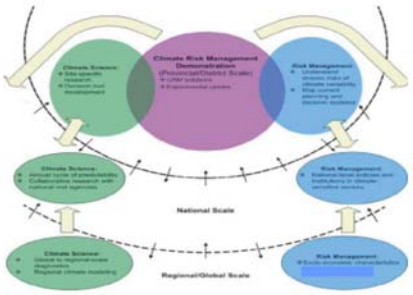
Examples of Climate Change Risk Treatments

Treatment type	Description and examples
Spread risk	**Insurance and diversification strategies:** → Use of financial products that off-lay the risk → Geographical diversification
Structural and technological	**Prevent effects through engineering solutions and changed practices:** → Increase reservoir capacity → Implement energy demand management measures → Scale up coastal protection measures → Change design of storm-water systems → Build more resilient housing → Install more efficient irrigation systems → Create wildlife corridors
Regulatory and institutional	**Prevent or mitigate effects through revised regulations and planning:** → Adopt integrated planning approaches → Amend local planning schemes to give greater weight to flood risk → Revise guidance notes for urban planners → Amend building design standards → Increase resources for coastal planning → Factor climate change into criteria for designation of species or ecosystems requiring increased protection → Improved contingency and disaster planning → Lengthen strategic planning horizons (from say 5-10 years to 20-30 years)

Examples of Climate Change Risk Treatments

Avoidance	**Avoid or exploit changes in risk:** → Grow new crops → Migration of people way from high risk areas → Change location of new housing developments → Improve forecasting systems to give advance warning of extreme climate events
Research	**Research to improve understanding of relationship between climate change and risk:** → Improve knowledge of relationship between past and present variations in climate and performance of economic, social and environmental systems → Improve modelling of regionally-based climate change impacts → Improve knowledge of the probability of frequency and magnitude of changes to extreme climate events and other climate variables under climate change → Improve understanding of the relationship between changes to frequency and magnitude of extreme events and critical thresholds for individual risks
Education, behavioural	**Educate and inform stakeholders about the risks of climate change:** → Increase public awareness about the potential impacts of climate change and about climate change adaptation measures → Educate and inform management and personnel about climate change risks and adaptation measures

Climate Risk Management Solutions : An Integrated Approach to Climate Risk Management



Agriculture Risks - India

The agricultural sector faces several risks:

extreme climatic events

pests and diseases,

unforeseen changes in demand and supply

Measures to manage risks

- Identification of 'vulnerability hotspots'
- Crop diversification, income diversification,
- Risk-pooling mechanisms like insurance. The most feasible insurance mechanism in the case of dryland agriculture is weather insurance
- Development of efficient crop futures markets and stable support price regimesfor agricultural produce
- Expansion and effective implementation of the National Rural Employment Guarantee Programme (NREG),
- Decentralized water conservation, watershed management, and social forestry projects

Priority areas for research are as follows.

Development of GIS and remote-sensing methodologies

- detailed soil resource mapping
- land use planning at the level of a watershed or a river basin
- Mapping vulnerable eco-regions
- Mapping of pest and disease hotspots,
- Development and validation of weather derivative models (by insurance providers)

Dissemination of Information

- Development and validation of crop simulation and operational models to simulate impacts of droughts, changes in water availability, pest incidence, and higher temperatures and greater concentrations of atmospheric CO_2, besides decision-support systems based on these simulation models,
- Monitoring of water resources, soil erosion
- Developments of regional language websites and integrating them into a national-level agro-advisory system
- Off-season crops, aromatic and medicinal plants, greenhouse crops, pasture development, agro-forestry, livestock, agro-processing, etc.
- Collation of block-level data on agro-climatic variables, land-use, and socio-economic features and preparation of state-level agro-climatic atlases

Basic Requirements for successful implementation of risk management strategies

Thank You

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