# STATE ACTION PLAN ON CLIMATE CHANGE

## UTTAR PRADESH

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF UTTAR PRADESH

# Uttar Pradesh State Action Plan on Climate Change




DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF UTTARPRADESH
2014

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## ABBREVIATIONS

| | |
|---|---|
| AT&C | Aggregate Technical and Commercial Loss |
| BEE | Bureau of Energy Efficiency |
| Deg | Degree |
| Giz | German Technical Cooperation |
| GOI | Government of India |
| ICAR | Indian Council for Agricultural Research |
| It/ites | Information technology and information technology enabled services |
| Lpcd | Liter per capita per day |
| MORD | Ministry of Rural Development |
| NDMA | National Disaster Mitigation Agency |
| NIDM | National Institute of Disaster Mitigation |
| RKVY | Rashtriya Krishi Vikas Yojna |
| Sq.km | Square Kilometer |

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We also thank all the core-group members of different missions whose deliberations find place in this report. Considering the fact that, we had access to secondary information, efforts have been made to make the report as much error free; as sometimes the original models and datasets are with the concerned agencies and we had no access, so the interpretations have been made based on available information.

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CTRAN Consulting.

# EXECUTIVE SUMMARY

National Action Plan on Climate Change (NAPCC) is guided by the principles of sustainable development (SD) and aligns the environmental and economic objectives. It outlines a national strategy that aims to enable the country adapt to climate change and enhances the ecological sustainability of India's development path. However, this national strategy and actions can only be fructified if these are pursued by the states according to their own vulnerability and low carbon development consciousness. There are eight "National Missions" which form the core of the National action plan. Broadly the State level action plans are envisioned to be an extension of the NAPCC at various levels of governance, aligned with the eight National Missions.

## UP and Climate Change Vulnerability

UP, India's fifth largest state and its most populous, is diverse in geography and culture. The population is largely rural and its occupation is agrarian. The climate sensitivity of agriculture is very high in the state and high level poverty, rapid urbanization coupled with flood, heat waves and cold waves makes it one of the most vulnerable areas in India. As per the projection, annual rainfall is predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%). Inter annual variability is higher towards 2080's. There is also predicted increase in maximum temperature 1.8 deg C to 2.1 deg C during that period. Combined vulnerability index that is largely linked to natural resource driven sectors shows all the districts in the Bundelkhand and Vindya regions are highly vulnerable to climate change, as is Kaushambi from the central plains and two districts of the north-eastern plains. The less or moderately vulnerable districts were observed mainly in the western plains, Midwestern plains, Bhabhar and Tarai zones, and the south-western semi-arid regions. Mixed pattern is seen in the central, eastern, and north-eastern plains.

## Emission in UP

As per 2005 inventory, Uttar Pradesh is the highest emitting state of India emits and contributes nearly 14% of national greenhouse gases (GHG). Fossil fuel consumption, power generation and agricultural activities are the major factors responsible for this. Sonbhadra, Rae Bareli and Gautam Buddha Nagar are the three highest emitting districts during 2005, contributing to 27%, 5% and 4% GHG emissions of the state respectively.

## Process of SAPCC formulation in Uttar Pradesh

The state has formulated action plan for seven missions (1) Sustainable agriculture mission (2) Solar Mission (3) Energy Efficiency Mission (4) Green UP Forestry Mission (5) Jal Mission (6) Strategic Knowledge Mission (7) Sustainable Habitat Mission. Some components of Sustainable Himalayan Mission has been currently covered under Strategic Knowledge Mission and later a detailed mission document is to be prepared in consultation with other states in the Himalayan region to have a cohesive and integrated plan that extends beyond the state. Each mission has a core group with diverse expertise. The state environment department is the nodal department for formulation. The high level committee is chaired by Chief Secretary which oversees the process. The process has been intense taken more than a year. Several studies and papers have been commissioned and workshops and seminars have been organized with academic institutions, experts, departmental consultation and interface with civil society. GiZ has provided technical support and CTRAN consulting had been engaged for the compilation of inputs received.

The state has covered 93 priorities under seven missions in this exercise. The details of each mission has been summarized below.

## Sustainable Agriculture Mission

The contribution of Uttar Pradesh in the national food grain basket (about 19%) is well recognized, but, stabilization in food grains productivity during the recent past decade has become the major cause of concern. Further, climate change will have an adverse impact on food security. Disadvantaged regions and socially and economically backward people will be affected more as food cost will increase due to its less availability. Available trends indicate that agricultural productivity will decline up to 25% in irrigated areas which could be as much as 50% in rainfed areas. Dominance of small and marginal farmers (about 92%) with small land holdings will make Uttar Pradesh more Vulnerable to climate change. Inconsistent and erratic monsoon and water scarcity has substantially affected the crop yields, cropped area and livestock in Bundelkhand region during the last 4-5 years.

Therefore, considering the increasing population and limited availability of natural resources, agricultural productivity needs to continuously increase to meet the growing demand of food despite the adverse impacts of changing climate. It is therefore, imperative to have the proper perspective plan and implement them judiciously to cope-up with the changed climate.

### KEY PRIORITIES: AGRICULTURE MISSION

Establishment of climate change and agriculture cell/ Coordination & Monitoring

Identification of Vulnerable areas and assessing Vulnerability

Establishment of Climate Field Schools (CFS) (One in each block)

Promotion of Carbon Sequestration Agricultural Practices (PILOT)

Use of organic manures (One village per block per year)

Soil Management Practices (Farm machineries in adopted villages)

Farming system approach for diversifying incomes and livelihoods (10 farmers from each identified village)

Diversification of cropping systems and promotion of a biotic stress tolerant crop varieties in identified villages

Popularization of aerobic rice cultivation methods in identified rice villages

Popularisation of Agro-forestry in identified villages

Climate responsive research programmes

## Solar Mission

**KEY PRIORITIES: SOLAR MISSION**

Promotion of solar water heating systems

Promotion and implementation of standalone systems like solar street lighting systems

Deployment of solar pumps in irrigation

Addition of 500 MW of grid interactive solar power in five years to bridge the conventional energy demand-supply gap.

Promote pilot scale (2 MW) grid-interactive pilot scale roof top solar power plants

Uttar Pradesh houses the largest number of energy poor in India and climate change would enhance stresses on them. Developmental needs such as health for all, housing for all, education for all, potable water for all, and meeting other Millennium developmental goals and national and state planning targets would require more energy to be consumed and thus produced. Climate change would also enhance the space cooling and heating requirements, industrial energy demand, as well change the energy supply mix. Considering the fact that the state is the largest emitter of $CO_2$, Uttar Pradesh needs to assess these implications enhancing clean energy generation like solar and spearhead the mitigation effort.

## Energy Efficiency Mission

There are huge scope of energy efficiency improvement in the state of Uttar Pradesh in agriculture, municipalities and small industries sector. Similarly for the SME cluster; seven energy intensive clusters have been identified in Uttar Pradesh, namely; Cold Storages, Carpet, Pottery, Brass, Foundry and Glass Clusters for energy savings assessment is estimate at 9206 tonnes of oil equivalent. The major avenues for energy savings in rural domestic sector include: Replacement of GLS bulbs with CFLs Adoption of BEE star labeled domestic appliances like ceiling fans, refrigerators, AC units, tube lights, etc. Overall there is a possibility of achieving energy saving of 30-40% in the state. If the capital investment programmes for AT&C loss reduction included this can even increase further. In this mission only policy actions have been proposed without state investment as a large part of it is

**KEY PRIORITIES: ENERGY EFFICIENCY**

Energy Audits should be strictly enforced for all government buildings

Sensors/Timers in the Street Lights should be made mandatory

Reduction of Transmission & Distribution Losses in Power Sector

The use of Solar Water Heaters, Solar Water pumps & Solar Street Outer Building Lights should be made mandatory for buildings above the load of 500KVA

Energy conservation Building Code (ECBC) may be made mandatory for New Government office Buildings and all new commercial buildings

Government Taxes & Duties may be lowered on energy efficient technologies like LED, Solar etc.

Rain Water Harvesting mandatory for all buildings

Demonstration projects on off grid electricity supply to villages

Plantations around and on the roof tops of government buildings should be made compulsory

Use of BEE rated products in irrigation, public buildings

likely to be from the designated consumers, private sector and individual consciousness and compliance.

### Green UP (Forestry) Mission

Forests in Uttar Pradesh are among the most important natural resources, which have played a fundamental role in supporting the livelihood of the people, mainly the poor rural masses. Historically, the forests provided the basic resources for survival and economic development. However, in recent years, factors such as rapid increase in human and cattle population, incidence of poverty and industrial growth have resulted in a situation where in the demand trends are far outstripping the forest's natural ability to sustain the frequently conflicting needs.

**KEY PRIORITIES: GREEN UP MISSION**

- Plantation (Afforestation and Reforestation) by Forest Department
- Road side/canal side plantation
- Enhance agro Forestry
- Density Improvement programme
- Enhancement of Private Plantation by Land Owners
- Works in protected area network and wetlands
- Outreach and demo/pilot activities

. The dynamic vegetation model outputs show that during the short-term period of 2030s, out of the 752 forested grids in Uttar Pradesh, 53 (7.04%) will be impacted by climate change. Similarly a higher percentage (35.64%) of the forested grids is projected to be impacted by 2080s. A change in forest types is projected in the southern part of Chandauli, Chitrakoot and Mirzapur, north-western part of Khetri, Sonbhadra and parts of Pilibhit, Agra and Lalitpur districts. Thus the forests in some of the districts of Uttar Pradesh are projected to be adversely impacted by climate change by 2030s. To enhance both adaptation and mitigation effort several direct investment programmes and research priorities have been identified and some programmes have been conceived under convergence with other departments such as agriculture, irrigation and urban development.

### Jal Mission

The economy of Uttar Pradesh, with a geographical area of 24.093 million hectares, is agriculture dominated with about approximately 80% of total geographical area as agriculture land. The agriculture sector contributes about 40% of the State GDP and 75% of employment. An estimated 35% of the State population is living below poverty line. About 70% of agriculture is dependent on irrigation. The net and gross sown area in the State is 16.68 and 25.52 million hectares respectively. The net and gross irrigated areas from all sources are 13.12 and 18.94 million hectares respectively with about 11.7 million of crops land currently irrigated by surface water systems at an average cropping intensity of about 100%.

The following summarize the critical situation of water resources in the state and how climate change will act as an additional stressor:

Many semi-arid and arid areas are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources. Changes in climate variables like temperature increases can affect the hydrologic cycle by directly increasing evaporation of available surface water and vegetation transpiration. Changes in climate variables can influence precipitation amounts, timings and intensity rates, and indirectly impact the flux and storage of water in surface and sub-surface reservoirs i.e. lakes, soil moisture, and groundwater. Climate change can impact surface water resources directly through changes in the major long-term climate variables such as air temperature, precipitation, and evapo-transpiration. Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%). Inter annual variability is higher towards 2080's. Greater variability in rainfall could result in frequent and prolonged periods of high or low groundwater levels, and saline intrusion in aquifers. Considering the impact of the climate change impact, the state has proposed several adaptation actions and some mitigation actions in the sector.

**KEY PRIORITIES: JAL MISSION**

- Reducing Gap between Irrigation Potential Created and Utilized through Restoration of Old Project
- Increasing Water Use Efficiency (through lining of canal), water metering, etc.
- Increasing Water Use Efficiency (on-farm water management)
- Completion of New and Ongoing Projects
- Survey and Investigation
- Research and development
- Training and Capacity Building
- Management of urban storm water and STP
- Integrated water resource management in over exploited areas including basin management plan
- Rainwater harvesting
- Assessment of impact of climate change on water resources of Uttar Pradesh

### Strategic Knowledge Mission

The state mission on strategic knowledge on climate change intends to create a dynamic knowledge system that would help take actions to reduce vulnerabilities as well as take advantage of the mitigation opportunities. Strategic Knowledge on Climate change is therefore, the system of knowledge that is required by various stakeholders to respond to climate change. State Mission on Strategic Knowledge for Climate Change will promote a better understanding of climate science, impacts and challenges through research

**KEY PRIORITIES: STRATEGIC KNOWLEDGE MISSION**

- Knowledge Creation, Knowledge Management, Knowledge dissemination and capacity building, M&E activities
- Primary data generation with surveys, studies, research, modelling (about 15 identified studies and budget for responding to needs of other departments)
- Funding from Climate change research fund to Dedicated Research Centers at Universities/Colleges
- Publicity through TV/AIR/Hoardings & Buses
- Integrate Climate Change agenda with National Green Corps activities and District Plan activities
- Training programmes for administrators, policy makers, development departments, students and other stake holders regarding Climate Change
- Setting of Climate Change Authority and M&E coordination

and development. It calls for the establishment of a new Climate Science Research Fund under Climate Change authority for improved climate modeling, and increased national and international collaboration and cooperation. It will also foster private sector initiatives aimed at developing adaptation and mitigation technologies through venture capital funds.

### Sustainable Habitat Mission

This mission has three components (a) Sustainable Habitat (b) Sustainable Transport (c) Health issues relating to climate change. There are 630 urban local bodies in Uttar Pradesh (16% of all India). 22% of the state's population reside in urban areas. 13 of the 630 urban local bodies of the state are Municipal Corporations. By 2016, almost 30 percent of the state population would be residing in urban areas. The key attributes of a sustainable city evolves from a proper land use plan, improved basic civic facilities, clean drinking water supply, decongested and well planned roads / streets that address the growth of city as well as reduces congestion, drainage, sanitation, waste disposal, sewerage system, street lighting, parks, clean environment, etc. In addition to decrease private transport mas rapid transit systems are being planned. The seasonable city planning also include Environmental Protection (air and water quality management) monitoring health of rivers / lakes, pollution control etc. are being carried out. The key adaptation and mitigation actions planned under this mission are listed here.

**KEY PRIORITIES: SUSTAINABLE HABITAT MISSION**

- Urban water supply and sewerage scheme including solid waste management taking in to account the climate change related vulnerability
- Sustainable city roads and buildings with proper low carbon habitation plan: housing for all, transit corridors, parking (Awas bandhu)
- Modification of municipal laws for encouraging PPP projects in water supply, sanitation and affordable climate proof housing and implementation of energy conservation building codes
- Water Metering to improve efficiency
- Creation of Urban Infrastructure Fund
- Management of Storm Water
- Four-laning of roads to connect district headquarters and avoid traffic congestion and improved city mobility plan
- Bus rapid transit systems
- Energy efficient street lighting plan
- Conversion of all Community Health Centre (CHC) into First Referral Unit (FRU) in climate vulnerable areas
- Vector borne disease control and early warning systems
- Developing standard operating procedures for extreme weather conditions (heat wave, cold wave)

### Cross-cutting issues

Mainstreaming climate change agenda in the policy and planning at the state level is still in a formative stage. Mainstreaming requires not only cross-cutting policy approach but also both horizontal and vertical integration and systemic scrutiny to avoid duplication of effort. A proposed state climate change authority will coordinate with sectoral departments to improve climate change governance. The sectoral departments also can have specialized cells to integrate these concerns and cadres staff to be trained on these issues. Industry, private sector, academic and professional research partnership

also are being planned. The gender issues, roping in PRIs and ULBs as well building climate change awareness and low carbon lifestyle right from the primary school curriculum will prove beneficial.

## Budget for the implementation of Climate Change in UP

The budget for the implementation of SAPCC in UP for 2014-18 is estimated to be Rs 46,946 crores in 93 actions that include both adaptation and mitigation. This budget includes both business-as-usual and additional activity.

| Mission | Adaptation | Mitigation | Both | Total | No of Priorities |
|---|---|---|---|---|---|
| Sustainable Agriculture Mission | ₹ 74.75 | ₹ 21.50 | ₹ 6.50 | ₹ 102.75 | 11 |
| Solar Mission | ₹ - | ₹ 449.75 | ₹ - | ₹ 449.75 | 5 |
| Energy Efficiency Mission | ₹ - | ₹ - | ₹ - | ₹ - | 11 |
| Green UP Mission | ₹ 4,469.85 | ₹ - | ₹ 4,010.65 | ₹ 8,480.50 | 7 |
| Strategic Knowledge Mission | ₹ 136.00 | ₹ - | ₹ - | ₹ 136.00 | 16 |
| Jal Mission | ₹ 24,175.77 | ₹ 224.90 | ₹ - | ₹ 24,400.67 | 27 |
| Sustainable Habitat Mission | ₹ 1,524.53 | ₹ 11,851.37 | ₹ - | ₹ 13,375.90 | 16 |
| **TOTAL** | **₹ 30,380.89** | **₹ 12,547.52** | **₹ 4,017.15** | **₹ 46,945.56** | **93** |

However, this budget is indicative. The document is also dynamic and sectoral mission and nodal departments are expected to update it periodically. The funds for the implementation of these activities not necessarily would only be from the state or federal budget. Several mission level funds, special international funds like clean technology funds, funds for smart city, private sector, adaptation fund, clean development mechanism and new market mechanism based funds can be used judiciously.

# 1 OVERVIEW

## 1.1 BACKGROUND

India's National Action Plan on Climate Change (NAPCC) released in 2008 outlines its strategy to meet the challenge of Climate Change. NAPCC is guided by the principles of sustainable development (SD) and aligns the environmental and economic objectives. .It outlines a national strategy that aims to enable the country adapt to climate change and enhances the ecological sustainability of India's development path. It stresses that maintaining a high growth rate is essential for increasing living standards of the vast majority of people of India and reducing their vulnerability of the impacts of climate change. There are eight "National Missions" which form the core of the National action plan. They focus on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation.

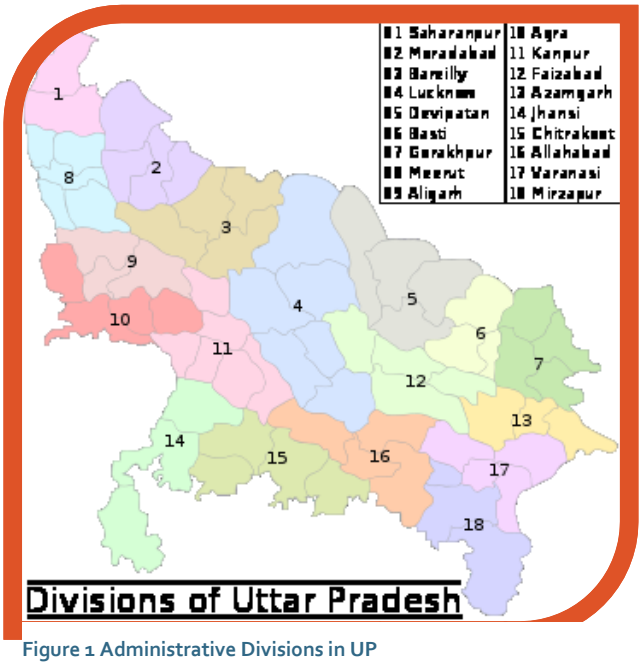



Figure 1 Administrative Divisions in UP

http://en.wikipedia.org/wiki/List_of_districts_of_Uttar_Prades

As a second step, after the National Action Plan on Climate Change (NAPCC) was announced, all States have been asked to prepare a State level action plan to deal with the challenges of climate change. Broadly the State level action plans are envisioned to be an extension of the NAPCC at various levels of governance, aligned with the 8 National Missions. Building on such a need, a National Consultation Workshop was held on 19th August 2010 in New Delhi for discussing the common framework/approach for preparing State level action plans on climate change. During the workshop, it was suggested that States can take their lead from the Mission documents while formulating mitigation/adaptation strategies under the State level strategy and Action plan (SAPCC). It was recommended that all state governments finalize their SAPCC by 31st March 2011. Delhi and Orissa became the first two states in the country to complete and launch their State Action Plans. Although all State governments are implementing climate-friendly strategies (broadly aligned with the missions) as a part of their development programmes, some states have taken specific leads in the matter. State action Plan of UP is thus aligned with NAPCC.

UP, India's fifth largest state and its most populous, is diverse in geography and culture. Its area of 2,94,411 sq. km lies between latitude 24 deg to 31 deg and longitude 77 deg to 84 deg East. It is half the area of France, three times that of Portugal, four times that of Ireland, seven times that of Switzerland, ten times that of Belgium, and a little bigger than England. Uttar Pradesh is the most heavily populated state in India. Its population (166 million) exceeds the population of Japan and is many times the population of Norway, Ireland, Switzerland, New Zealand, Spain, and even the UK. Administratively the state had 83 districts, 901 development blocks and 112,804 inhabited villages. The state is divided into four economic regions: western, central, eastern, and Bundelkhand. The state has nine agro-climatic zones. It is the leading state in terms of agriculture production in the country. The state has a strong agriculture base with the most fertile land masses and a well-connected river network and enables it to play a significant role in the country's food and nutrition security programme. Developing a state action plan on climate change taking in to account the diversity it represents is a daunting task.

## 1.2 OBJECTIVE

Objective of the State Action Plan on climate change is to align state priorities along the national action plan on climate change as well as to identify state specific vulnerability and key priorities related to adaptation and mitigation.

## 1.3 APPROACH

The key approach followed for the preparations of this action plan has been identified in the steps outlined below.

| | |
|---|---|
| 1 | Workshop on SAPCC Common framework and nodal department initiates action planning process |
| 2 | Departmental consultation process |
| 3 | GiZ 1st phase support for approach paper and scenario development involving INRM consortia |
| 4 | Departmental deliberation and identification of key priorities through stakeholder consultation |
| 5 | Draft submission and comments from the Ministry of Environment and Forest (MoEF) |
| 6 | GiZ 2nd phase support through CTRAN for the gap analysis compilation and finalization |

**Figure 2 Steps in the development of SAPCC, UP**

## 1.4 STRUCTURE OF THE REPORT

The Draft Final Report consists of twelve chapters and an Executive Summary. The Chapter 1 is an introduction to the SAPCC with the background information. Chapter 2 describes the identified state missions and linkages with NAPCC. The Chapter 3 describes climate change scenarios and vulnerability of the state. The Chapter 4 describes state greenhouse gas emission sector-wise and district-wise. The Chapter 5-11 cover sector wise impacts, details of ongoing projects addressing possible mitigation, local coping strategy and adaptation options. These chapters are (5) Sustainable Agriculture Mission (6) Solar Mission (7) Energy Efficiency Mission) (8) Green UP Forestry Mission (9) Jal Mission (10) Strategic Knowledge Mission (11) Sustainable Habitat Mission (including Health and Transport submissions). Finally, Chapter 12 deals with cross-cutting issues and way forward.

# 2 NATIONAL ACTION PLAN ON CLIMATE CHANGE AND LINKAGES IN UP SAPCC

## 2.1 INTRODUCTION

National Action Plan on Climate Change emphasizes on aligning the measures to promote national development objectives with co-benefits for addressing climate change effectively. It also advocates strategies that promote, firstly, the adaptation to Climate Change and secondly, further enhancement of the ecological sustainability of India's development measures.

## 2.2 DOMESTIC ACTIONS

India's National Action Plan on Climate Change emphasizes on promoting inclusive and sustainable development strategy sensitive towards climate change so as to protect the poor and vulnerable section of the society. Eight National Missions form the core of the National Action Plan represent multipronged, long term and integrated strategies for achieving key goals in the context of climate change. The focus is to promote understanding of Climate Change, framing adaptation and mitigation strategy and promoting energy efficiency and natural resource conservation. While many of these programmes are already a part of the current actions, the Action Plan seeks to enhance them in scope and effectiveness and implement them in an accelerated manner through time bound plans.

## 2.3 NATIONAL MISSION

National Action Plan on Climate Change (NAPCC) outlines existing and future policies and programs addressing climate related mitigation and adaptation measures. The plan identifies eight core 'National Missions' running through 2017.

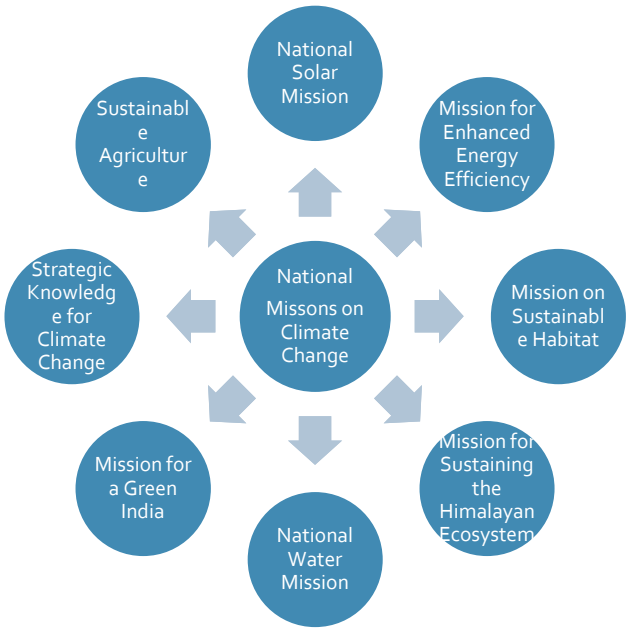



Figure 3 National Missions on Climate Change

The idea of a sub-national action plan emerged to address the local issues and has high ownership. This would generate better awareness rising from experiences on climate related issues to corrective actions, better preparedness and also to set strategic priorities at the Sub-National level. These priorities would enable the leaders in the states to plan for the resources and also to monitor the savings in terms of long run cost associated with climate change.

### 2.3.1 NATIONAL SOLAR MISSION

The NAPCC aims to popularize the use of solar energy for power generation and other purposes over other fossil-based energy options. The plan includes:

- Specific goals for increasing use of solar thermal technologies in urban areas, industry, and commercial establishments;
- A goal of increasing production of photo-voltaic power to 1000 MW/year; and
- A goal of deploying at least 1000 MW of solar thermal power generation.

Other objectives include the establishment of a solar research centre, increased international collaboration on technology development, strengthening domestic manufacturing capacity, and increased government funding and international support.

### 2.3.2 NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY

Current initiatives are expected to yield savings of 10,000 MW by 2012. Buildings adhering to the Energy Conservation Act 2001 which plan recommends:

- Mandating specific energy conservation options decreases consumption in large energy-consuming industries, with a system for companies to trade energy-savings certificates;
- Energy incentives, including reduced taxes on energy-efficient appliances; and
- Financing for public-private partnerships to reduce energy consumption through demand-side management programs in the municipal, buildings and agricultural sectors.

### 2.3.3 NATIONAL MISSION ON SUSTAINABLE HABITAT

The National Mission on Sustainable habitat comprises of three components, viz.

- Promoting energy efficiency in the residential and commercial sectors
- Management of municipal solid waste and
- Promotion of urban public transport

To promote energy efficiency as a core component of urban planning, the plan calls for:

- Extending the existing Energy Conservation Building Code (ECBC);
- For addressing component 2 on management of municipal solid waste, a greater emphasis on urban waste management and recycling, including power production from waste is envisaged;
- For addressing promotion of urban public transport the following are promoted:
    - Strengthening the enforcement of automotive fuel economy standards and using pricing measures to encourage the purchase of fuel efficient vehicles; and
    - Incentives for the use of public transportation.

### 2.3.4 NATIONAL WATER MISSION

Some of the major areas of intervention identified in the Water Mission are to increase efficiency of water use, to explore options to augment water supply in critical areas and to ensure more effective management of water resources. With water scarcity projected to increase as a result of climate change, the Mission sets a goal of a 20% improvement in water use efficiency through pricing and other measures.

### 2.3.5 NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM

The Himalayan Ecosystem is vital to the ecological security of the Indian landmass, through growing forest cover, feeding perennial rivers which are sources of drinking water, irrigation and hydropower, conserving biodiversity, providing a rich base for high value agriculture, and spectacular landscapes for sustainable tourism. Climate change may adversely impact the Himalayan ecosystem through increased temperature, altered precipitation pattern, glacial melting and episodes of drought. The plan aims to conserve biodiversity, forest cover and other ecological values in the Himalayan region, where glaciers which are major sources of India's water supply are projected to recede as a result of global warming.

### 2.3.6 NATIONAL MISSION FOR A "GREEN INDIA"

The Mission aims at addressing climate change by enhancing carbon sinks in sustainably managed forests and other ecosystems, enhancing the resilience and ability of vulnerable species/ecosystems to adapt to the changing climate, and enabling the adaptation of forest dependent local communities in the face of climatic variability. Goals include afforestation on 6 million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory.

### 2.3.7 NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE

The National Sustainable Agriculture Mission aims to focus on four areas crucial to agriculture for adapting to climate change, viz., dry land agriculture, risk management coupled with weather insurance, access to information and use of Biotechnology. The Mission aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms and agricultural practices.

### 2.3.8 NATIONAL MISSION ON STRATEGIC KNOWLEDGE FOR CLIMATE CHANGE

To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It also encourages private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

## 2.4 MAPPING NATIONAL MISSION IN THE STATE

The identified mission in the state has been linked to the national missions in the following manner.

The following section maps the State missions according to the National Action Plan. Therefore it would have the following kind of linkages as detailed out in the table below

Table 1 Linkage of State Missions with National Missions

| National Mission | State Mission | Key Issues to be Addressed |
|---|---|---|
| **Solar mission** | **Solar Mission** | • Reduction of carbon foot print – Bringing about grid parity for solar PV and solar thermal technology including concentrator<br>• Address energy security through MW size solar plant<br>• Promoting stand-alone solar systems (pumps, roof top solar, etc.) in power starved areas to improve energy security<br>• Promotion of Renewable energy technology other than Solar |
| **Enhanced Energy Efficiency Mission** | **Energy Efficiency Mission** | • Investment grade energy audit<br>• Energy efficiency in industrial (MSME sector) facilities, commercial, agricultural and residential sector ,<br>• Addressing the issue of lowering T&D losses<br>• Using financial mechanism and fiscal instrument to promote energy efficiency in public lighting in (ESCO)<br>• Policy support for ECBC, label and rating programmes |
| **Sustainable Habitat Mission** | **Sustainable Habitat mission** | • Climate resilient urban planning<br>• Solid waste Management<br>• Efficient public transport mechanism |
| | **Sub Mission: Health** | • Improving health infrastructure<br>• Early warning system of health related stress<br>Reduce surface water contamination and prevention of water borne diseases |
| | **Sub Mission: Transport** | • Sustainable city mobility plans<br>• Inland water transport |
| **Water Mission** | **Jal Mission** | • Water management and water use efficiency and related capacity building, awareness generation<br>• Basin management<br>• Management and regulation of ground water<br>• Conservation of wetland<br>• Watershed development |

| National Mission | State Mission | Key Issues to be Addressed |
|---|---|---|
| **Mission on Himalayan Ecosystem** | **Mission on Sustainable Himalayan Ecosystem** | • Academic research, glacial flow, delta management, local variability<br>• State will consult other linked states to formulate and some components will be addressed now under strategic mission. No separate mission document has been prepared. |
| **Green India Mission** | **Green UP Mission** | • Forestry, Bio-diversity conservation<br>• Enhancement of forest areas<br>• Livelihood promotions and decreased dependency on forest |
| **Sustainable Agriculture Mission** | **Mission on Sustainable Agriculture** | • Soil-water management practices<br>• Stress tolerant crop varieties and improvement in dry land agriculture practices<br>• Methane management from rice cultivation<br>• Diversification through promotion of Horticulture , Floriculture and agro-forestry<br>• Farmer field schools for climate smart agriculture<br>• Climate proofing of the animal husbandry sector |
| **Strategic Knowledge for Climate Change** | **Strategic knowledge Mission** | • Enhanced research on Climate Change Issues<br>• Capacity building and awareness generation<br>• Partnership with academic, research and professional organisation on thematic issues<br>• Develop knowledge repository, best practices for mainstreaming climate change issues in planning |

The Directorate of Environment, U.P. has been nominated as the nodal agency with the Director, Environment as the State Nodal Officer for climate change related matters. The Directorate has a coordinating role to interface with respective departments/agencies to put together climate change related priorities and works with them in climate related activities monitoring and fund flows. It also interfaces with the Ministry of Environment and Forest, Government of India on issues relating to climate change, with external funding agencies and technical support institutions.

# 3 CLIMATE CHANGE SCENARIOS AND VULNERABILITY ANALYSIS

## 3.1 UP AN OVERVIEW

**Physiography:** Uttar Pradesh is situated between 23° 52'N to 31° 28' N latitude and 77° 51' E and 84° 38'E longitude. The state has a geographical area of 243290 Km². The state has three geographical regions. The larger Gangetic Plain in the north which includes Yamuna - Ganga Doab, Ghagra and Avadh Plains, the Terrai region, the Vindhya range and the plateau in Rohilkhand region.

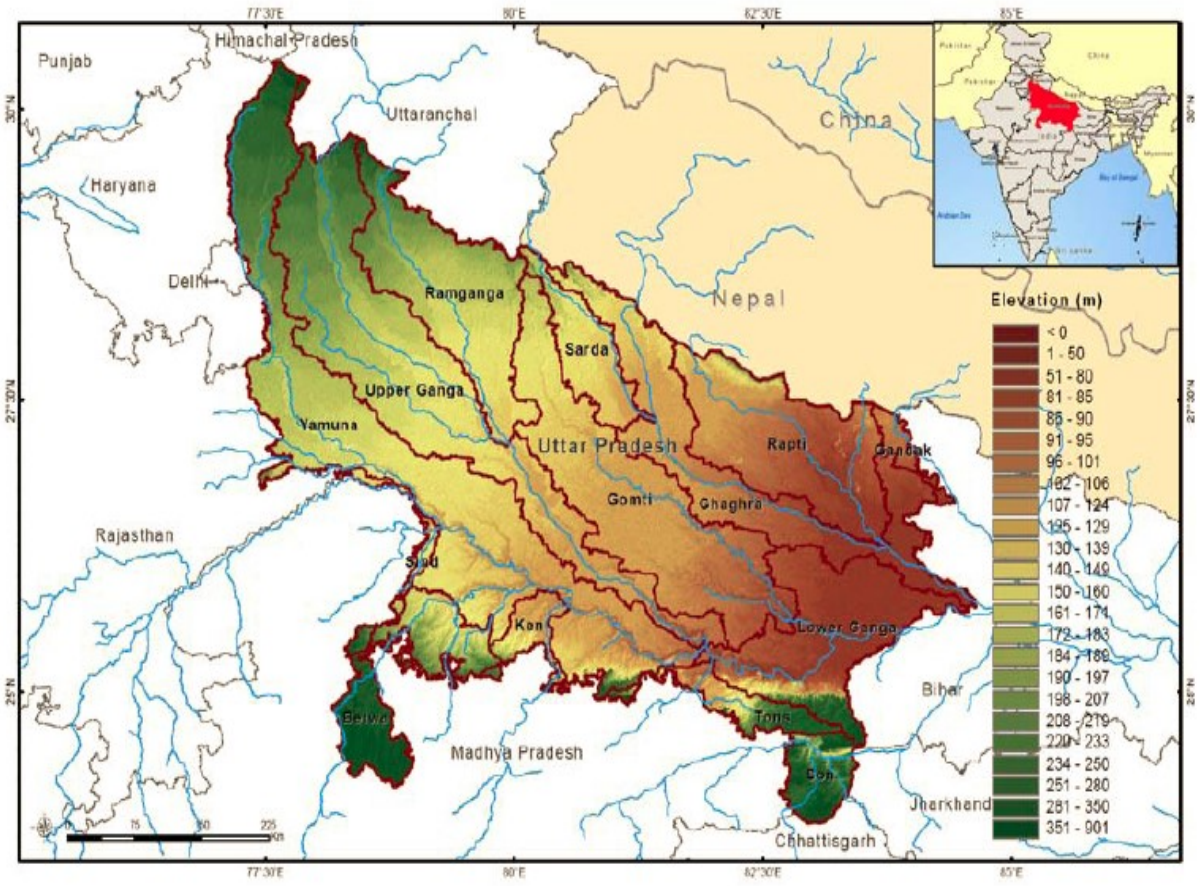



Figure 4 Physiography of UP with elevations

**Demography:** As per details from Census 2011, Uttar Pradesh has population of 19.98 Crores, an increase from figure of 16.62 Crore in 2001 census. Total population of Uttar Pradesh as per 2011 census is 199,812,341 of which male and female are 104,480,510 and 95,331,831 respectively. According to the Uttar Pradesh Census 2011, the density of population in Uttar Pradesh is about 800 people per square kilometer which is way above the national average of about 380 and a major cause of concern. The literacy rate in the state has gone up in recent years and yet continues to linger at about 70% which is below the national average of 74%. The sex ratio is almost at par with the national

average and stands at about 900. The largest city in the state of Uttar Pradesh is Lucknow while Kanpur is the capital city of the Uttar Pradesh. The languages spoken in the Uttar Pradesh state includes Hindi and Urdu.

**Economy:** The State is divided into four economic regions, namely, Western U.P., Central U.P., Eastern U.P., and Bundelkhand. The first three regions fall in the fertile Gangetic plains, while Bundelkhand lies in the dry vindhyan plateau. Economy of Uttar Pradesh is dominated by the agricultural sector with heavy dependence on Monsoon. This sector employs about two thirds of the work force and contributes about one third of the State income there is a high percentage of marginal and small land holdings with high population pressure. The manufacturing sector is very small and consists of a large base of small scale industries. This sector employs about 7.7% of the work force and contributes 20 per cent of State income. The economy of the State is characterized by a sharp variations at the regional and district levels. The state has a low HDI value of 0.380, which is below the all-India value of 0.467 (UNDP).

**Infrastructure development:** Infrastructure in the state has improved till recently, though considering its physiography, there is a huge scope of improvement.

**Transport**: Roads length per ten thousand populations in the State is 99.00 km (national level of 136.9 km). In terms of road length the State occupies 15th position among the major 19 States. The state's highways account for about 9.6% of the total National Highway network in India. The railway network in Uttar Pradesh is the largest in the country spanning over 8,890 km. Intra-state rail network is well-developed, connecting the towns and the district headquarters of the state.

**Irrigation:** Ground water resources accounts for about 78% of irrigated area and surface water resources for about 22%.

**Power**: The installed power capacity of Uttar Pradesh is 9,983.7 MW consisting of 4,621.2 MW of state share, 862.6 MW of private share and 4,499.9 MW of central share. The installed power capacity in has increased from 8,181.7 MW in 2005-06 to 9,983.7 MW during 2009-2010. Demand for power is driven by, both, the agricultural and industrial sectors. The per capita consumption of electricity in Uttar Pradesh was lowest, at 340 kWh as compared to the all-India number of 672 kWh. The State occupies 15th position among the 18 major States in the country in terms of per capita power consumption. 69.43% of villages in the State are electrified as compared to the national average of 75.93%.

**Telecommunication:** The state has good telecom infrastructure with vast postal circle, divided into six regions namely Allahabad, Agra, Bareilly, Gorakhpur, Kanpur and Lucknow. The state has about 17,662 post offices and has 3,273 telephone exchanges.

**Urban infrastructure:** Uttar Pradesh has about 22% urban population and its cities are growing in size. Some of the key areas of development are water supply, solid-waste management, sewerage and drainage/storm water drains. Under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), 33 projects have been sanctioned for various cities.

**Urban Housing:** Urban development schemes in the State are being implemented within the framework of Master Plans of different cities by the Housing and Urban Planning Department, Urban Development Department and Urban Employment and Poverty Alleviation Department.

**Water supply:** Average per capita supply of water in the cities is 167 lpcd, higher than the desired supply of 150 lpcd. All the cities are fully covered by piped water supply system.

**Solid-waste management system:** Solid-waste collection efficiency is 70 per cent, on an average, for all the cities, with Kanpur having 100 per cent efficiency and medical waste is disposed scientifically in most of the cities.

**Industrial infrastructure:** The state has a robust industrial infrastructure, including 15 industrial areas, 12 specialized parks, three growth centres and four industrial infrastructure development centres (IIDC). The state had 17 notified special economic zones (SEZ), as of July 2010. Proposals for 40 IT/ITeS parks, two biotech zones and a knowledge park are under consideration.

**Social infrastructure**: (a) Education sector: The state has 27 universities; five deemed universities, 34 medical colleges, 34 engineering colleges and 676 degree colleges. (b) Health infrastructure: The state has a three-tier public healthcare infrastructure, comprising primary health centres, health units, community health centres and sub-centres. On an average, about 6,400 persons are served by a sub-center in Uttar Pradesh, as against the prescribed norm of 5,000. The state ranks eleventh among Indian states in terms of population per public health centre (PHC). The per capita expenditure on health in the state is about Rs. 300 as compared to the national average of Rs. 500.

## 3.2 VULNERABILITY ANALYSIS

Vulnerabilities arising out of climate change are multidimensional and interlinked. They vary from location to location, across sectors and cross sectoral parameters. For the vulnerability profiling of UP, the following framework has been used.

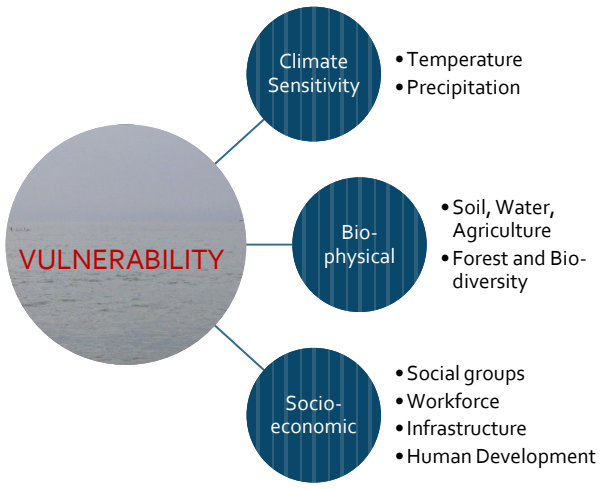



Figure 5 Vulnerability Analysis Framework

### 3.2.1 PRECIPITATION TREND

Variability in the precipitation and its long trends have a strong relationship in several sectors agriculture, forestry, fishery, water resources, etc.

IMD data for the state has been given in the table below:

Table 2 Precipitation Trend

| Season | Statistics | Value | Contribution in Annual Rainfall ( %) |
|---|---|---|---|
| **Annual** | Average (mm) | 946.07 | |
| | Inter-annual variation (CV[6]) | 0.30 | |
| | Range - Average (mm) | 501.2 - 1444.25 | |
| | Range- Inter-annual variation | 0.49 - 0.19 | |
| **Winter (JF)** | Average (mm) | 33.66 | 3.6 |
| | Inter-annual variation (CV) | 0.94 | |
| | Range - Average (mm) | 14.85 - 116.17 | |
| | Range- Inter-annual variation | 0.58 - 1.75 | |
| **Pre Monsoon (MAM)** | Average (mm) | 66.77 | 7.1 |
| | Inter-annual variation (CV) | 0.92 | |
| | Range - Average (mm) | 8.41 - 875.52 | |
| | Range- Inter-annual variation | 0.27 - 1.81 | |
| **Monsoon (JJAS)** | Average (mm) | 798.83 | 84.4 |
| | Inter-annual variation (CV) | 0.36 | |
| | Range - Average (mm) | 42.67 - 1260.26 | |
| | Range- Inter-annual variation | 0.2 - 1.25 | |
| **Post Monsoon (OND)** | Average (mm) | 46.81 | 4.9 |
| | Inter-annual variation (CV) | 1.11 | |
| | Range - Average (mm) | 18.32 - 85.61 | |
| | Range- Inter-annual variation | 0.78 - 1.76 | |
| ***Source: IMD Gridded rainfall data (1971-2005)*** | | | |

The mean south-west monsoon (June, July, August & September) rainfall (799 mm) contributes 84.4% of annual rainfall (946 mm). Mean monthly rainfall during July (268 mm) is highest and contributes about 28.3% of annual rainfall. The mean rainfall during August is slightly lower and contributes about 26.5% of annual rainfall. June and September rainfall contribute 11.2% and 18.4% of annual rainfall, respectively. Contribution of pre-monsoon (March, April & May) rainfall and post-monsoon (October, November & December) rainfall in annual rainfall is 7.1% and 4.9% respectively. Coefficient of variation is higher during the months of November, December, January and February.

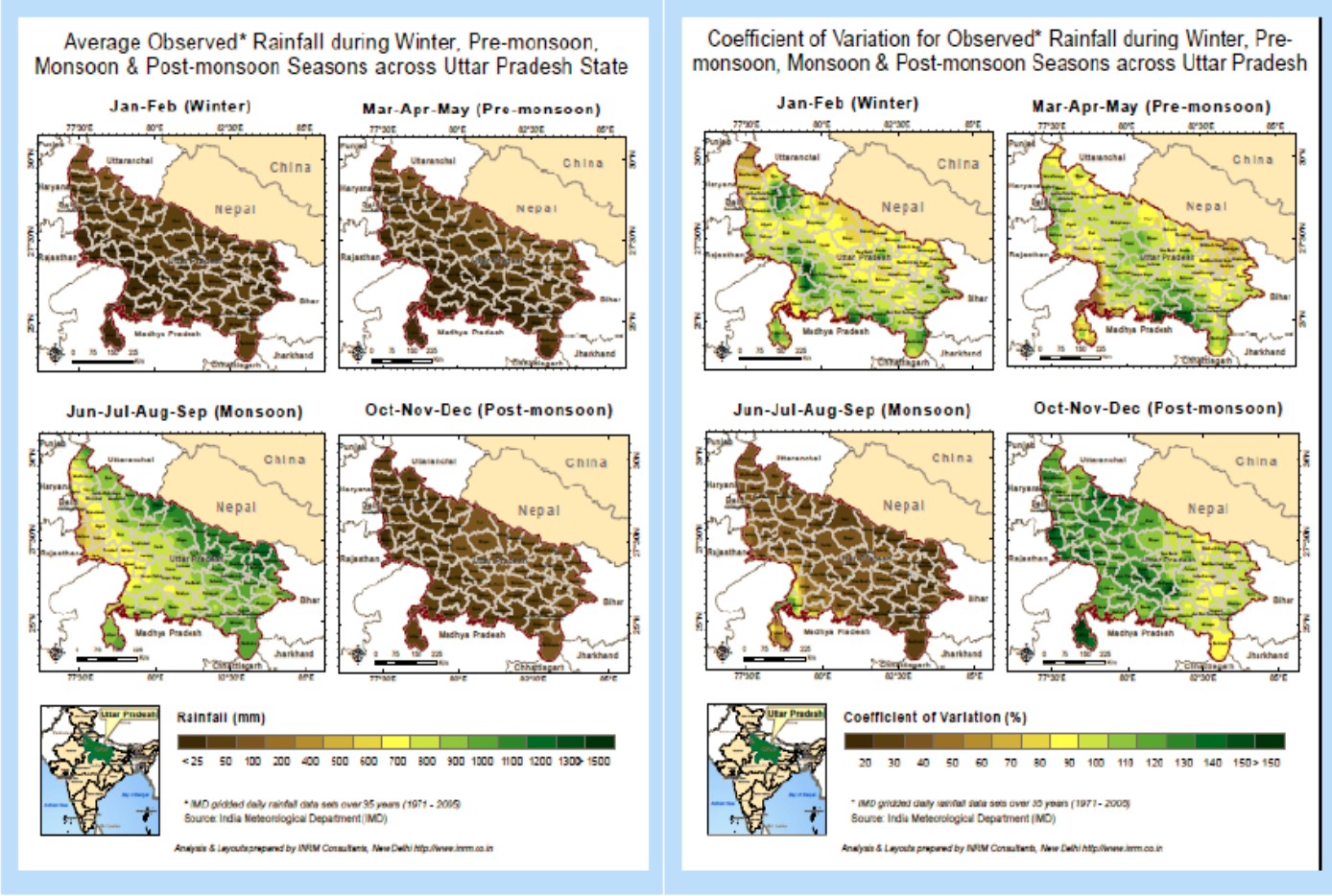
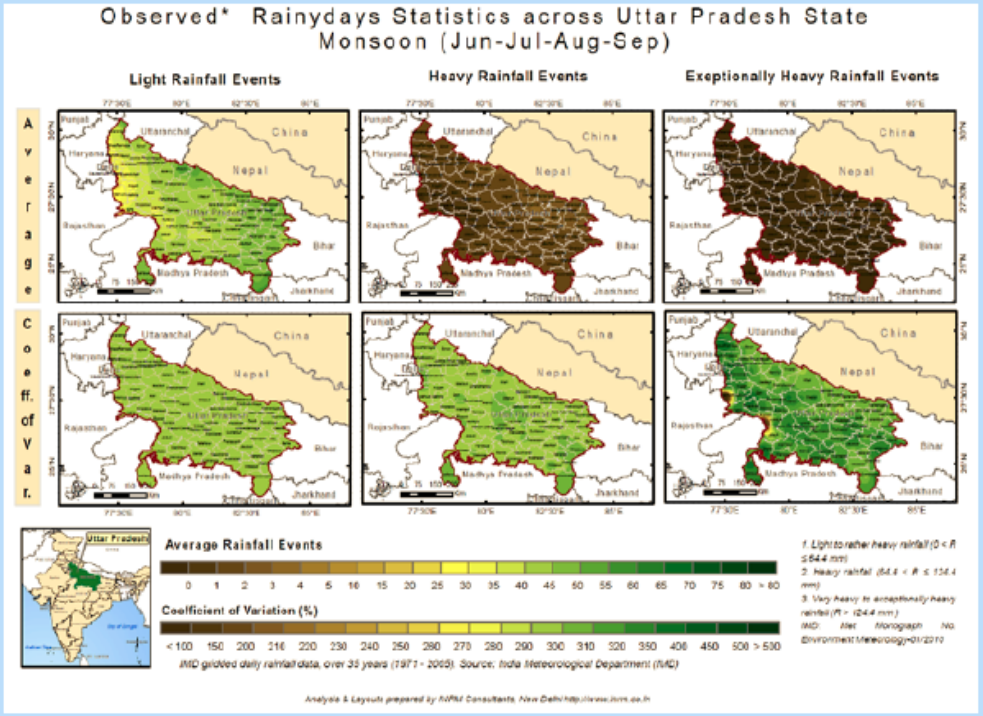


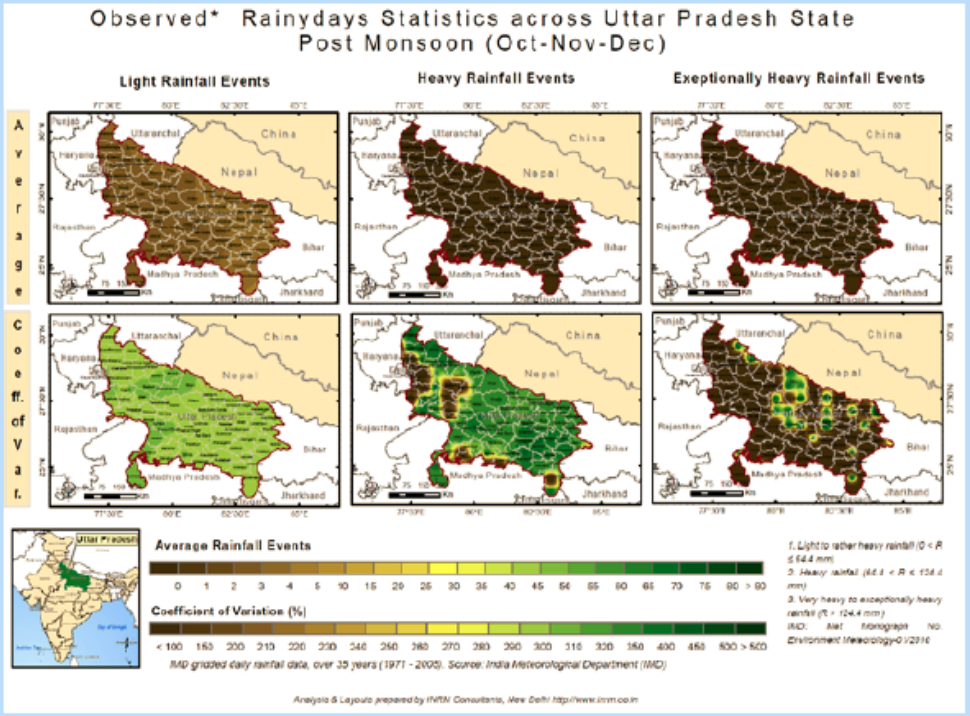

Figure 6 Variability of Monsoon in the state

Rain has been regrouped into three broad categories (Pattanaik and Rajeevan, 2010 ) for calculating extreme rainfall. i) light to rather heavy rainfall (0 < R ≤ 64.4 mm), ii) heavy rainfall (64.4 < R ≤ 124.4 mm) and iii) very heavy to exceptionally heavy rainfall (R > 124.4 mm ). Rainfall > 124.4 mm is referred as extreme rainfall events. Figure 7 shows these events during monsoon and post monsoon period.

The analysis of inter-annual precipitation in the state has been given in the figure below:




Average number of rainy days in the state during the south west monsoon is about 45 days and varies from 30 days to 60 days. Days when there is high rainfall events range from 1 to 4 days and similarly the extreme rainfall days are less and is about 1 to 2 days




Average number of rainy days in the state during the post monsoon (winter) is about 3 days and varies from 2 days to 4 days. Days when there is high and extreme rainfall events are very few and is about 1 to 2 days

Figure 7 Inter-annual variation in precipitation

### 3.2.2 TEMPERATURE TRENDS

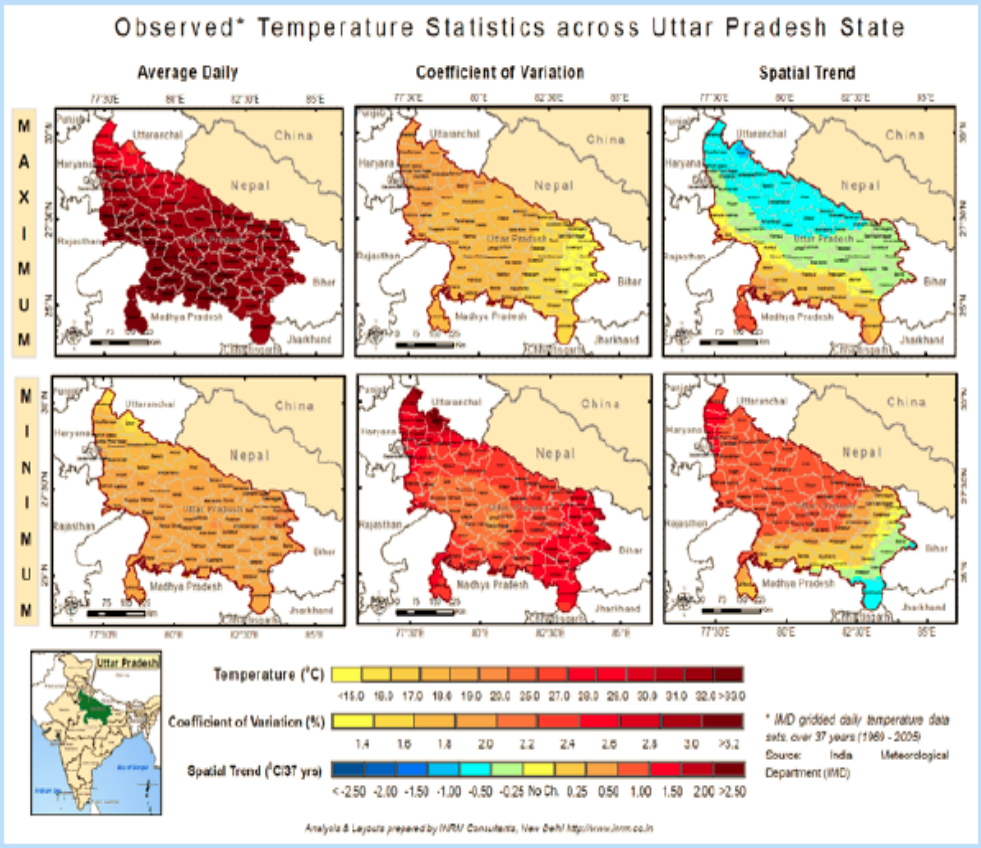
Rise and fall in temperature have direct impact on flora, fauna, health, water, etc. Uttar Pradesh shows a large spatial as well as temporal variability. Table below gives the summary of the temperature trends and statistics.

Table 3 Temperature variability

| Season | Statistics | Maximum Temperature (°C) | Minimum (°C) |
|---|---|---|---|
| **Annual** | Average | **31.4** | **18.4** |
| | Range - (OC) | **26.7-32.6** | **14.9 -19** |
| | Trend | -0.11 | 0.57 |
| **Winter (JF)** | Average | 23.5 | 8.9 |
| | Range -Average (OC) | 23.9-29.5 | 6.3-9.9 |
| | Trend | -0.91 | 0.98 |
| **Pre Monsoon (MAM)** | Average | 36.1 | 20.2 |
| | Range - Average (OC) | 30-38.1 | 15.8-21.2 |
| | Trend | 0 | 0.56 |
| **Monsoon (JJAS)** | Average | 34.2 | 25.2 |
| | Range -Average (OC) | 30.2-35.8 | 21.4-26 |
| | Trend | 0.31 | 0.23 |
| **Post Monsoon (OND)** | Average | 28.3 | 13.7 |
| | Range - Average (OC) | 18.7-25.9 | 10.9-15.1 |
| | Trend | -0.23 | 0.77 |

***Source: IMD Gridded temperature data (1969-2005)***

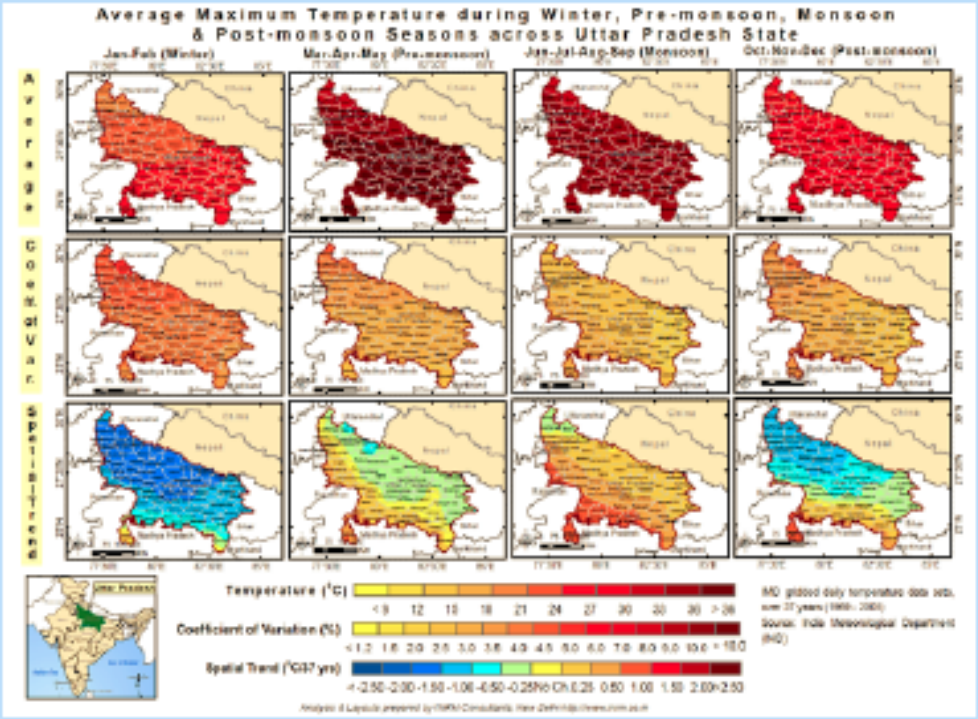
The figure below shows the temperature statistics for annual and seasonal average maximum and minimum temperature across the state.




**Annual Statistics:**

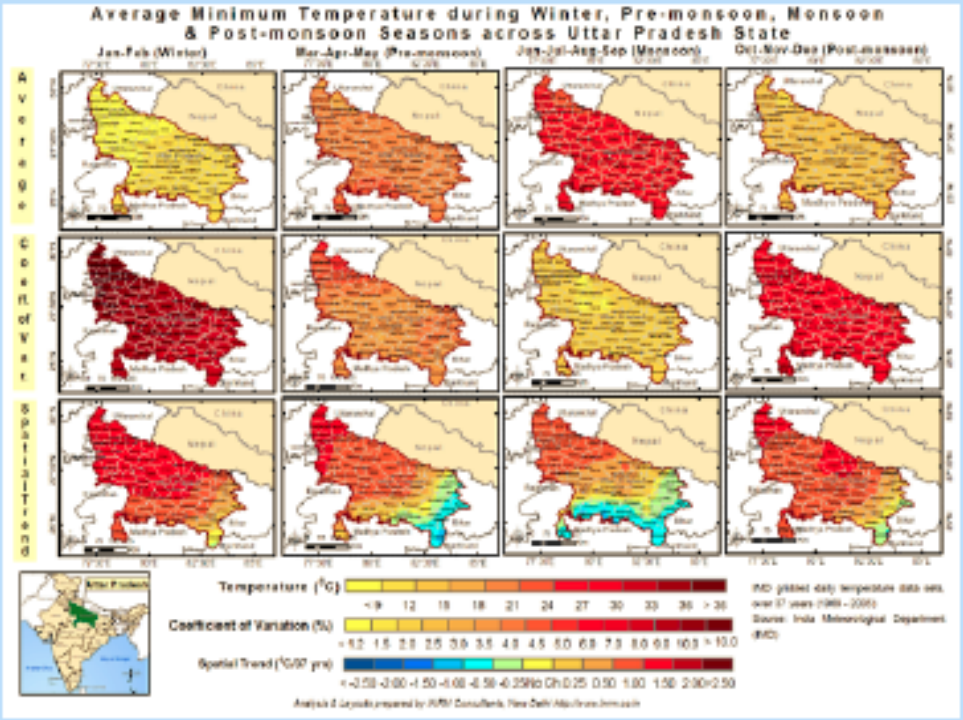
Spatial pattern of trends in the mean maximum annual temperature shows marginal negative (decreasing) trend over most parts of the north east UP and mean minimum annual temperature shows significant positive (increasing) trends over most parts of the north east and central part of UP.

Figure 8a Observed Temperature Statistics – Average, inter annual variation and trend: Annual




**Seasonal Statistics:**

Average Maximum temperature is higher is ore monsoon season and ranges between 30 to 40$^0$C. Season wise, maximum rise in mean maximum temperature is observed during the monsoon season (0.3$^0$C). Rise in maximum temperature is appreciably higher during monsoon months.

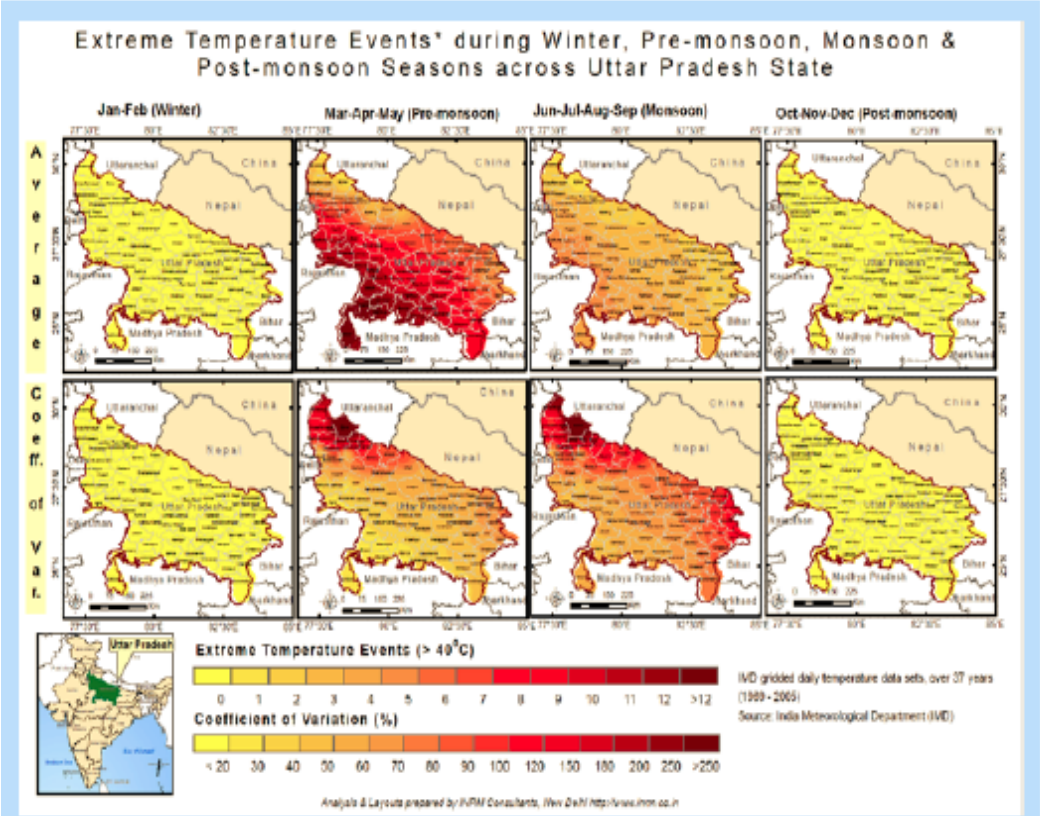



Rise in minimum temperature is appreciably higher than that of maximum temperature over northern plains.

The rise is nearly 1$^0$C in the northern plains during winter followed by post monsoon season (0.8$^0$C) and pre nonsoon season (0.6$^0$C).

Interannual variation is higher druing winter and post monsoon seasons

Figure 8b Observed Temperature Statistics – Average, inter annual variation and trend: Seasonal




Seasonal extreme hot days are highest during pre monsoon period in south western part and the northern part shows a large inter annual variation.

Figure 8c Observed Temperature Statistics – Average, inter annual variation and trend: Extreme events

Based on the above observed data climate change scenarios have been constructed for the state as a whole.

### 3.2.3 CLIMATE CHANGE SCENARIO: PROJECTIONS

The projected climate change in 2030 (average of 2021-2050) and in 2080 (average of 2071-2098) over Uttar Pradesh using IPCC SRES A1B scenario have been studied. The following paragraphs give the analysis of the same.

The IPCC scenarios provide a mechanism to assess the potential impacts on climate change. The IPCC Special Report on Emission Scenarios (IPCC SRES November 2000) has been published for Global emission scenarios. These scenarios provided input into the Third and Fourth Assessment Reports and were the basis for evaluating climatic and environmental consequences of different levels of future greenhouse gas emissions and for assessing alternative mitigation and adaptation strategies.

Climate models are mathematic models used to simulate the behaviour of climate system. The latter, known as Global Circulation Models (GCM), incorporate oceanic and atmospheric physics and dynamics and represent the general circulation of the planetary atmosphere or ocean. The GCMs are usually run at very course grid (about 3° X3°) resolution. These GCMs are strengthened with the

incorporation of local factors and downscaled, in general with a grid resolution of about 0.5°X0.5° or less. The downscaling can be of dynamic or statistical type. These models are referred to as Regional Climate.

**Regional Climate Change Scenarios (RCM - A1B):** A regional climate model is a comprehensive physical high resolution (~50km or less) climate model. A RCM contains representations of the key processes within the climate system e.g. cloud, radiation, rainfall, soil hydrology. Providing Regional Climates for Impact Studies (PRECIS) is an atmospheric and land surface model of limited area and high resolution which is locatable over any part of the globe. PRECIS is the Hadley Centre portable regional climate model developed to run on a PC with a grid resolution of 0.44° x 0.44°. High-resolution limited area model is driven at its lateral and sea-surface boundaries by output from global coupled atmosphere-ocean (HadCM3) and global atmospheric (HadAM3) general circulation models. PRECIS captures important regional information on summer monsoon rainfall missing in its parent GCM simulations.

Indian RCM PRECIS has been configured for a domain extending from about 1.5°N to 38°N and 56°E to 103°E. For the analysis the weather conditions of the present and future have been provided by the IITM Pune as the output of a regional climate model (RCM-PRECIS) at daily interval at a resolution of about 50 km. Simulated climate outputs from PRECIS regional climate model for present (1961-1990, BL) near term (2021-2050, MC) and long term (2071-2098, EC) for A1B IPCC SRES socio-economic scenario (characterized by a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and rapid introduction of new and more efficient technologies, with the development balanced across energy sources) has been used. Q14 QUMP (Quantifying Uncertainty in Model Predictions) ensemble has been used for the simulation. Figure 9 shows the annual rainfall statistics.

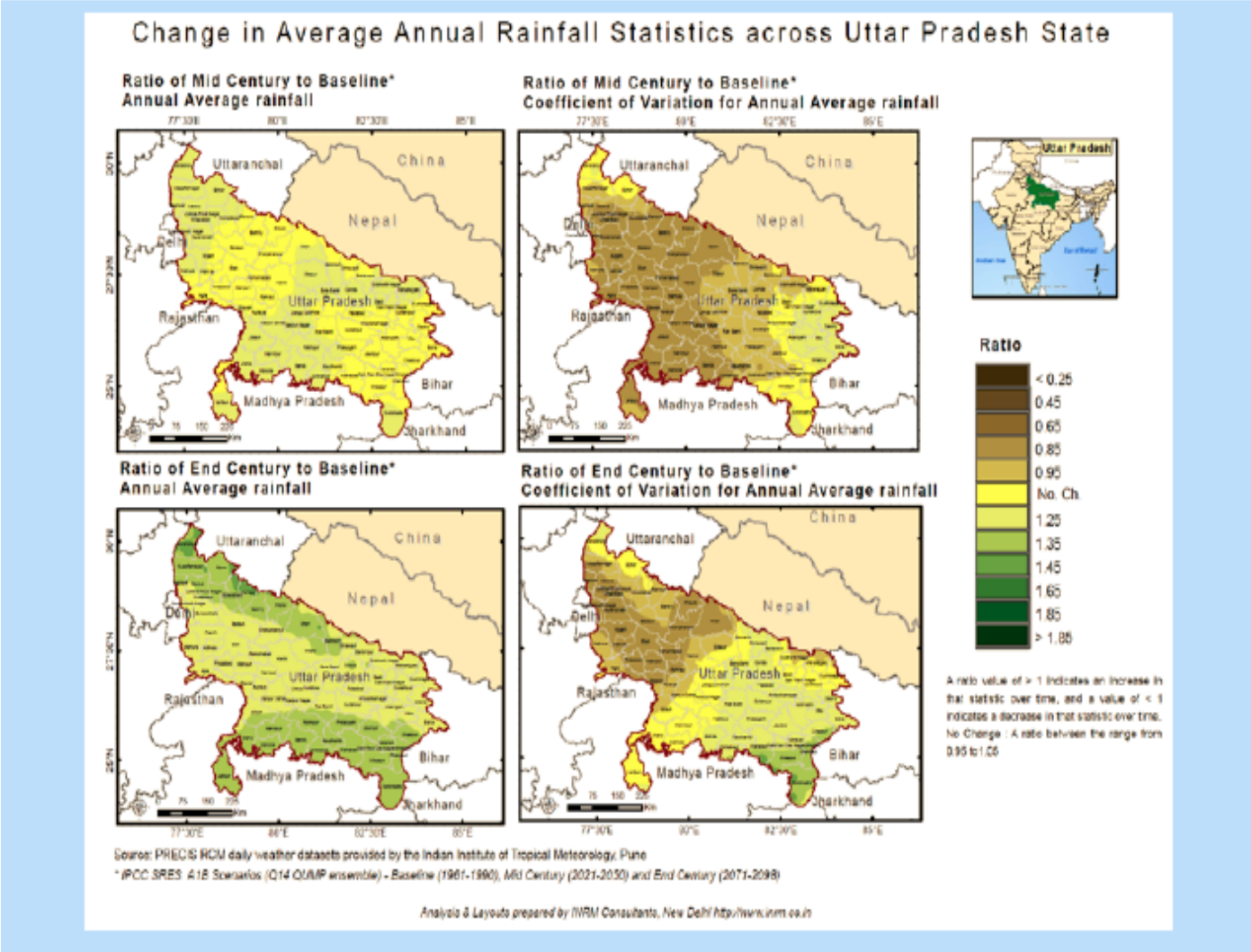
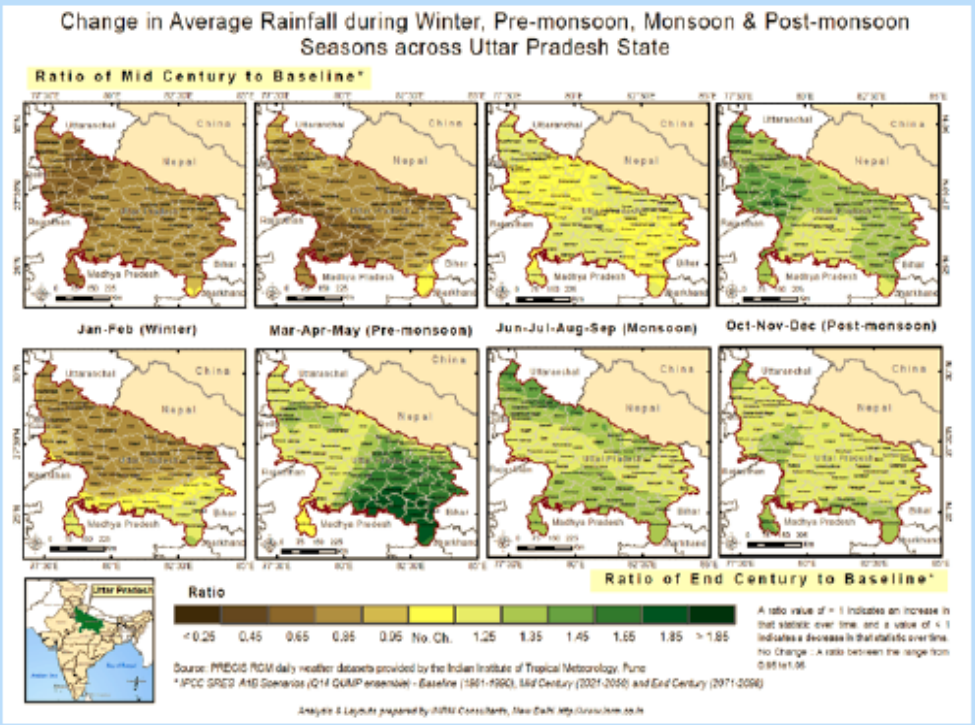



Figure 9 Climate Change scenario rainfall Statistics – Annual Average and inter annual variation

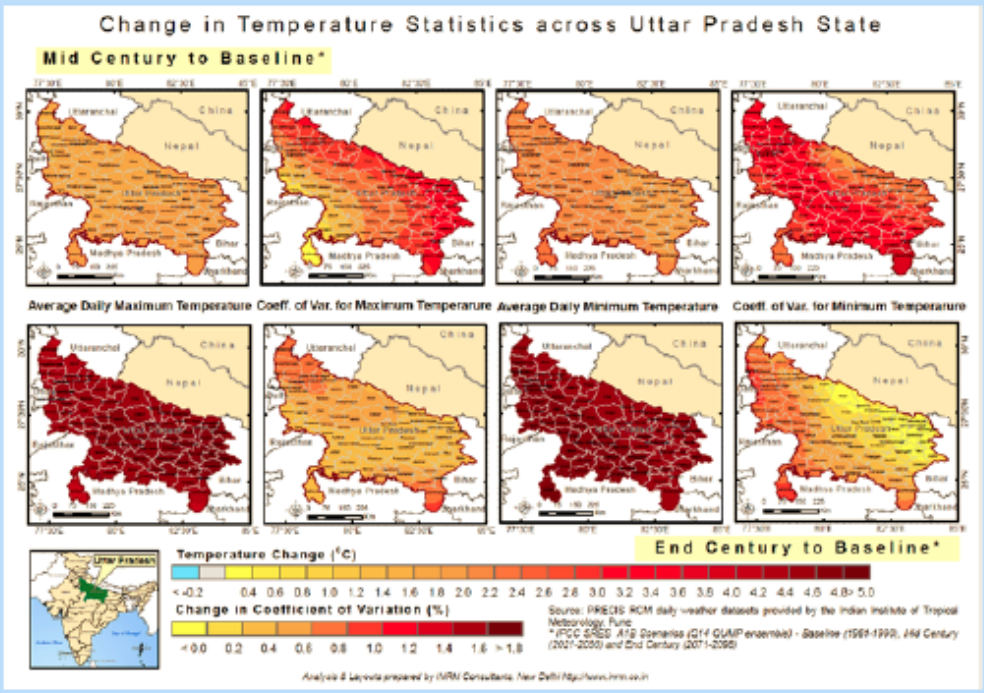
Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%). Inter annual variability is higher towards 2080's. Spatial variability can also be seen from the figure. Change in seasonal rainfall for 2050's and 2080's as compared to the baseline is shown in Figure 10.




**Seasonal Statistics:**

Season wise, decrease in rainfall is predicted during winter and pre monsoon and increase in post monsoon period for both 2050's and 2080's as compared tobaseline. Monsoon rainfall shows no significant change towards 2050's and show increase to the tune of 25% 35% towards 2080's. Inter annual variation in the seasonal rainfall is lower in 2050's than 2080's as compared to the baseline

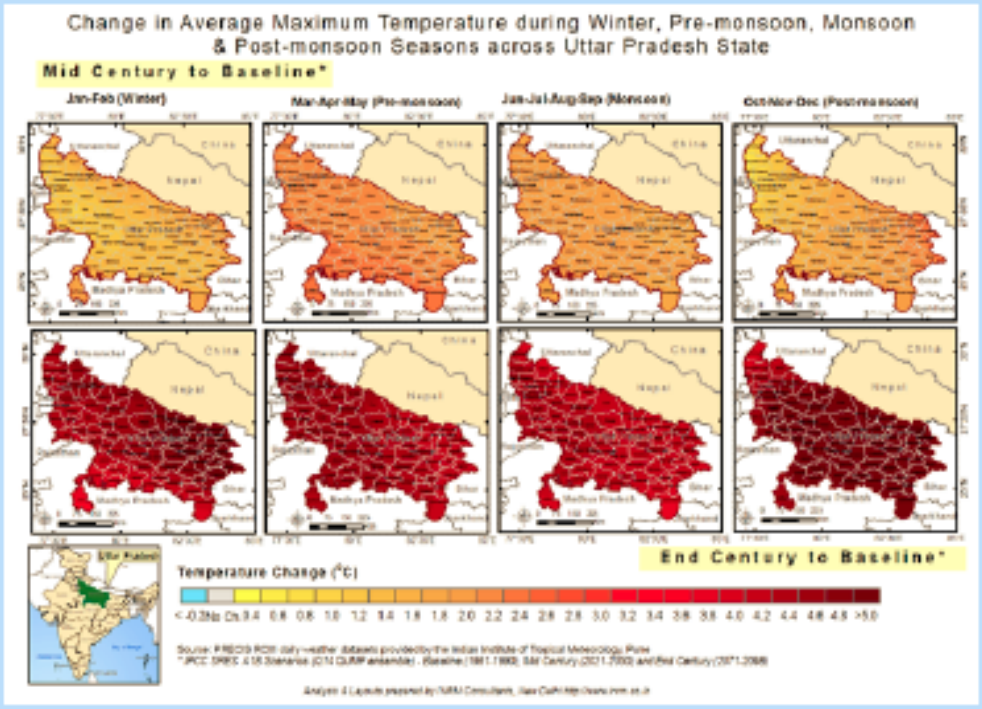
Figure 10 Climate Change scenario rainfall Statistics – Seasonal and inter annual variation in rainfall



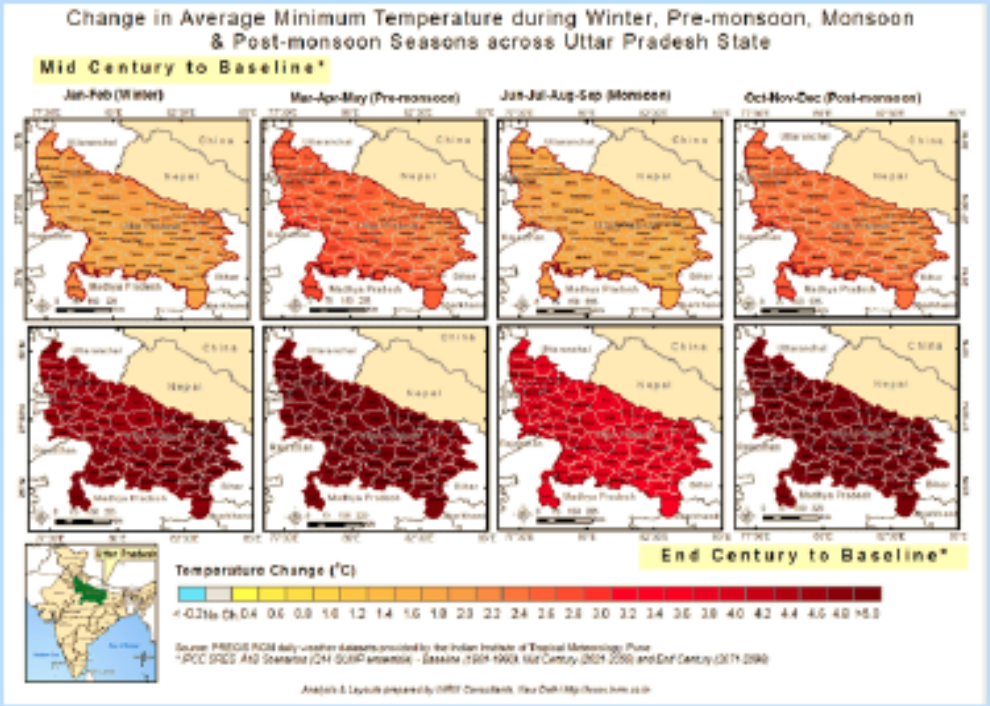

**Annual Statistics:**

The increase is shown both towards 2050's and 2080's as compared to the baseline in maximum as well as minimum temperature. The increase is around 2°C towards 2050's and about 4.5°C towards 2080's.

Figure 11 Climate Change scenario Temperature Statistics – Average and inter annual variation




Maximum temperature is predicted to increase by 2.1°C during pre monsoon followed by monsoon (1.8°C) towards 2050's. Predicted increase in maximum temperature during post monsoon (5.3°C) followed by winter (4.5°C) towards 2080's. Inter annual variability in maximum temperature is predicted to increase towards 2050's and the variability is higher during the winter season. 2080's show comparitively less inter annual variailty and predicted to be similar to the inter annual variability of the baseline.




Season wise, maximum rise is in mimimum temperature for both the scenarios. The increase in minimum temperature is observed during pre monsoon season (2.5°C) followed by and post monsoon season (2.3°C). Predicted increase in minimum temperature during post monsoon (5.3°C) followed by post monsoon (5.0°C) towards 2080's. Inter annual variability in minimum show less inter annual variailty and predicted to be similar to the inter annual variability of the baseline.

**Figure 12 Climate Change scenario Temperature Statistics – Seasonal average and inter annual variation**

Figure 11 and 12 depicts the annual maximum and minimum temperature statistics for the mid-century and end century period. Most of these are covered under the exposure component of vulnerability.

## 3.2.4 BIO-PHYSICAL VULNERABILITY

### 3.2.4.1 LAND USE AND AGRO-ECOLOGY

There are 9 Agro-climatic zones in Uttar Pradesh reflecting the climatic diversity due the large size of the state. Figure below shows the agro climatic zones of the state.

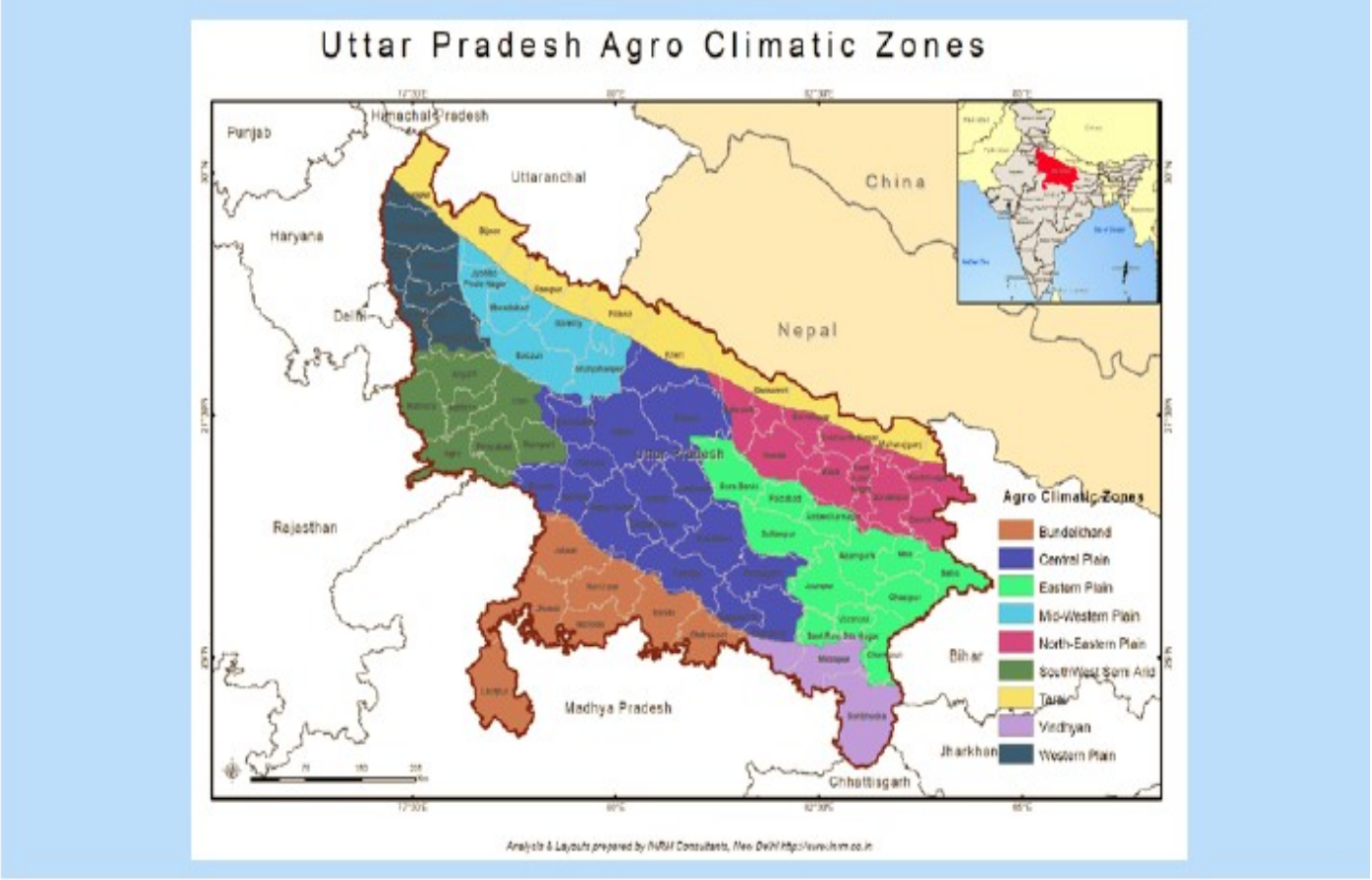



Figure 13 Agro-climatic zones in Uttar Pradesh

### 3.2.4.2 FOREST

According to the India State of Forest Report 2013, the forest cover in the state is 14,349 sq. km which is 8.8 percent of the state's geographical area. In terms of forest canopy density classes, the state has 1546 sq. km area under very dense forest, 3487 sq. km area under moderately dense forest and 4252 sq. km area under open forest. The state has one national park and 23 wildlife sanctuaries covering 5,712 sq. km which constitutes 2.37 percent of the state's geographical area. The oldest wildlife sanctuary of the country, the Chandraprabha wildlife sanctuary is located in Uttar Pradesh. Comparison matrix as shown in SFR 2013 shows there is an increase in forest cover due to plantation and conservation activities. The spatial variation is shown in the map below.

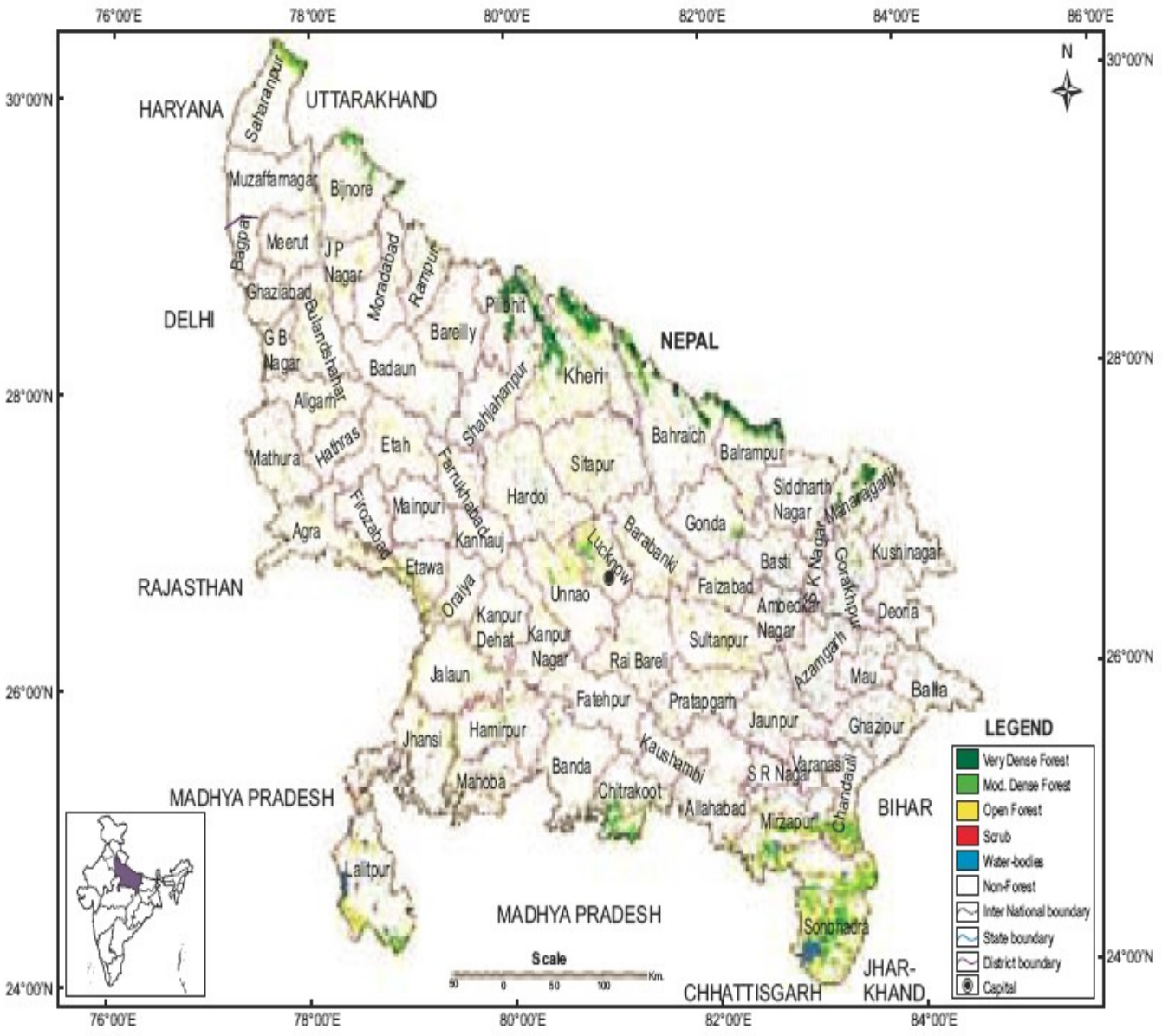



**Figure 14 Forest cover map of Uttar Pradesh**

Most of the bio-physical factors relating water, land degradation, etc. are covered under the sensitivity component of the analysis.

### 3.2.5 SOCIO-ECONOMIC FACTORS

The nature of social grouping, issues relating to urbanization, female work participation rate, human development profile, % of people below poverty line, extent of non-farm activity, livestock development, etc. determines higher or lower adaptive capacity of the state.

As per UNDP[1] the performance of the state in terms of basic household amenities such as improved drinking water facilities (at 87.5 percent) is marginally below the national average (91.2 percent). However, in terms of the percentage of households with no sanitation facilities, the state's average (at 42.5 percent) is slightly better than the all-India average (49.2 percent). This, however, is not the case with respect to access to electricity. Only 31.9 percent of the households have electricity connection, while almost 67.4 percent used kerosene for lighting. In addition to this, more than 85 percent of the households still use biological wastes such as firewood, crop residue and cow dung cake as fuel for cooking. In view of all the above mentioned factors, the state has a very low HDI value of 0.380, much below the all-India value of 0.467 and one of the worst in the country. In fact, social development and economic growth in the state is hampered on multiple counts including inability to create gainful employment for its population.

According to the Planning Commission, Uttar Pradesh also has one of the lowest per capita power consumption of about 316 units. In addition to the low level of electricity consumption, UP is also characterized by very low level of accessibility, with only 32 percent of households having electricity facility as compared to the all-India average of 56 percent (Census, 2001). In addition to this, the power supply growth in the state has remained sluggish over the last 10 years. The overall shortage of power has remained within the range of 10-14 percent and shortages in peak periods ranging at even higher levels.

A combined vulnerability index has been computed by Institute of Economic Growth (Tripathi, 2014) shows the following spatial distribution of vulnerability in the state considering some of the dimensions discussed in this chapter.

The exposure related vulnerability has been given in the figure below indicating variables that include the frequency of extreme climate events drought, flood, and warm year in the past 40 years (1970–2010) and variability in climatic variables rainfall and temperature.

[1] http://www.in.undp.org/content/india/en/home/operations/about_undp/undp-in-Uttar-Pradesh/about-UP/

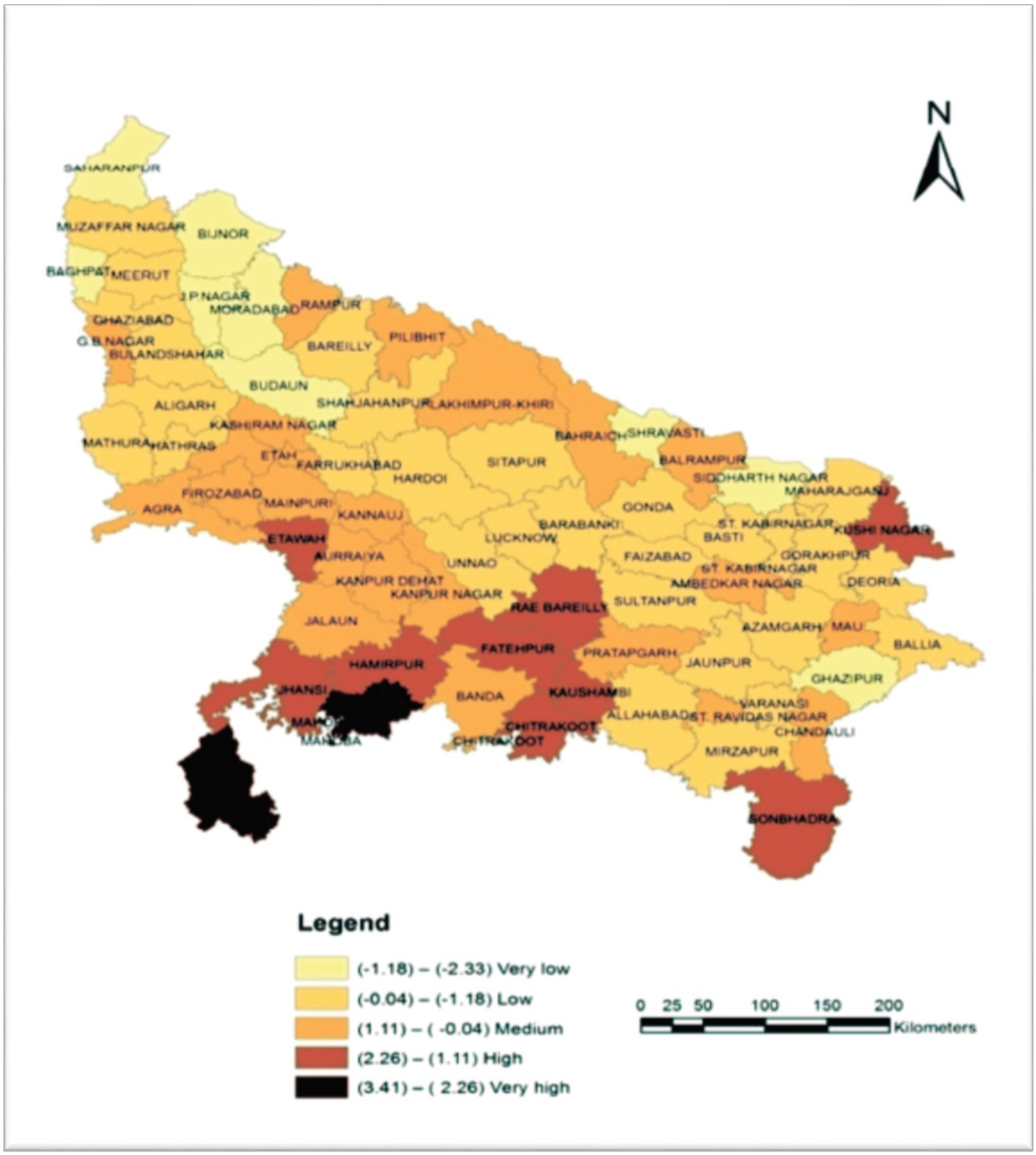



Figure 15 Exposure related vulnerability

The sensitivity related climate variability has been given below:

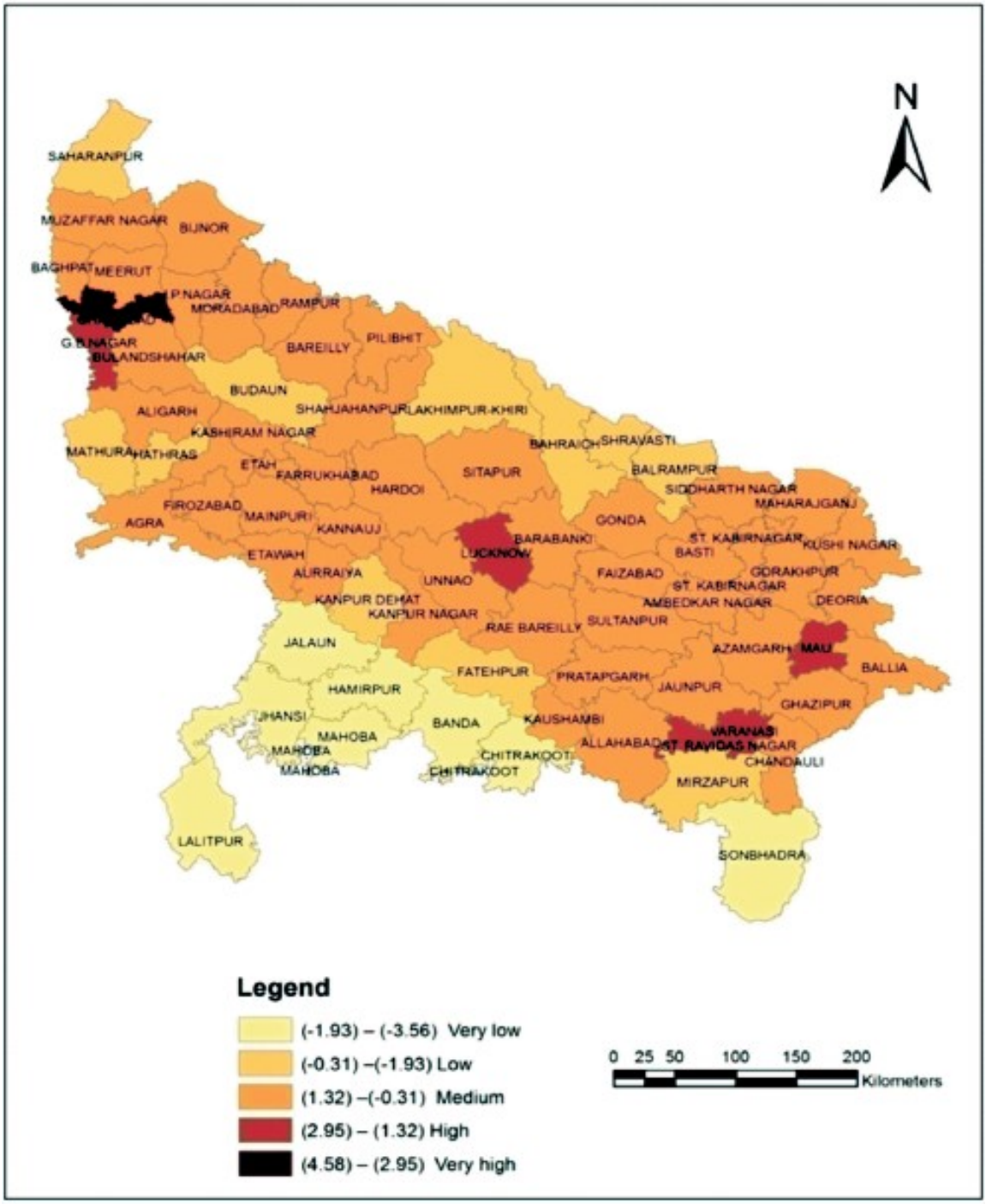



Figure 16 Vulnerability due to climate sensitivity

Factors in this component include percentage of irrigated cropped area, small and marginal land holdings, crop diversification, population density, and dependency on agriculture sector, etc.

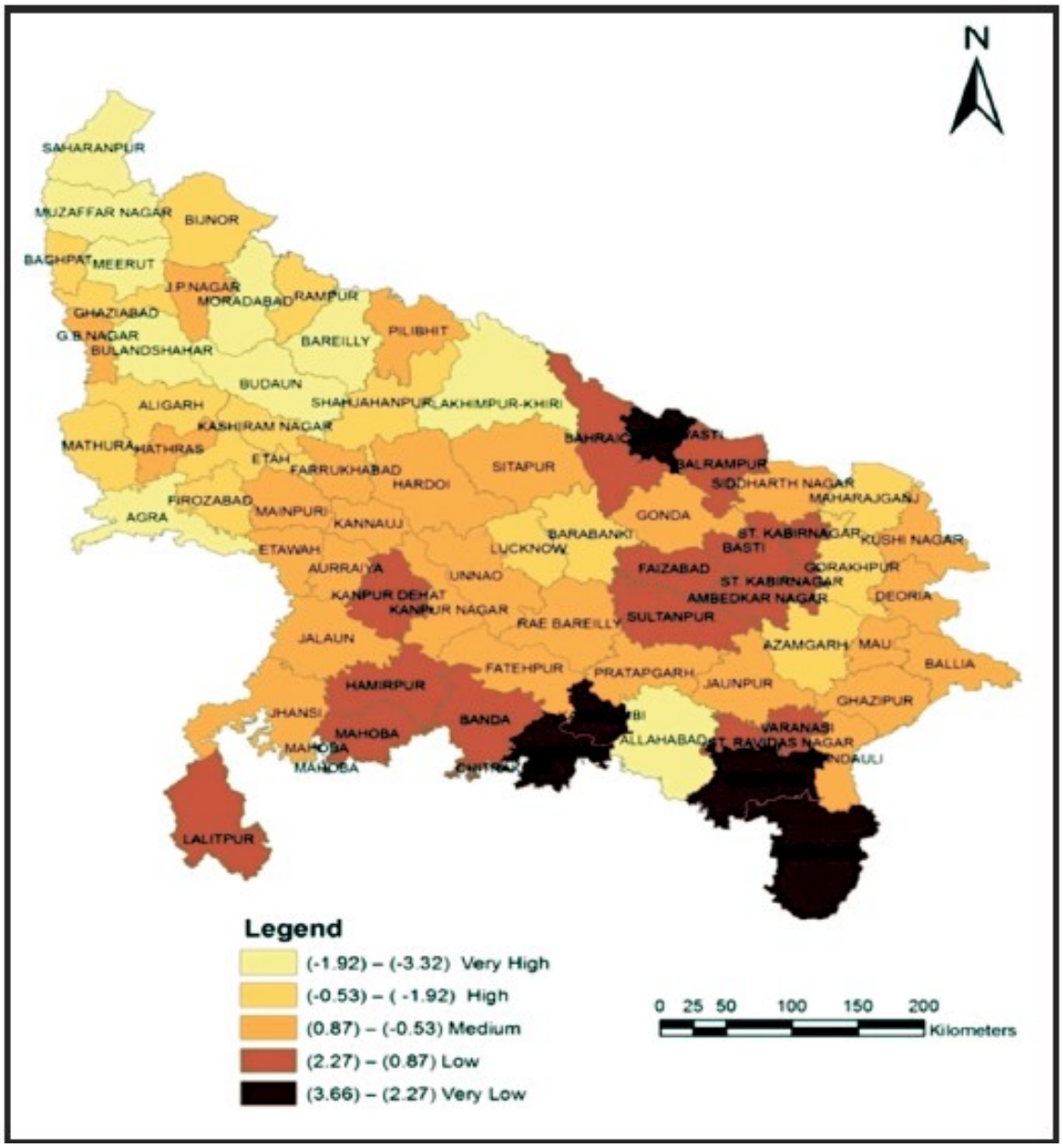



Figure 17 Adaptive Capacity

A combined vulnerability index that is largely linked to natural resource driven sectors has been presented below:

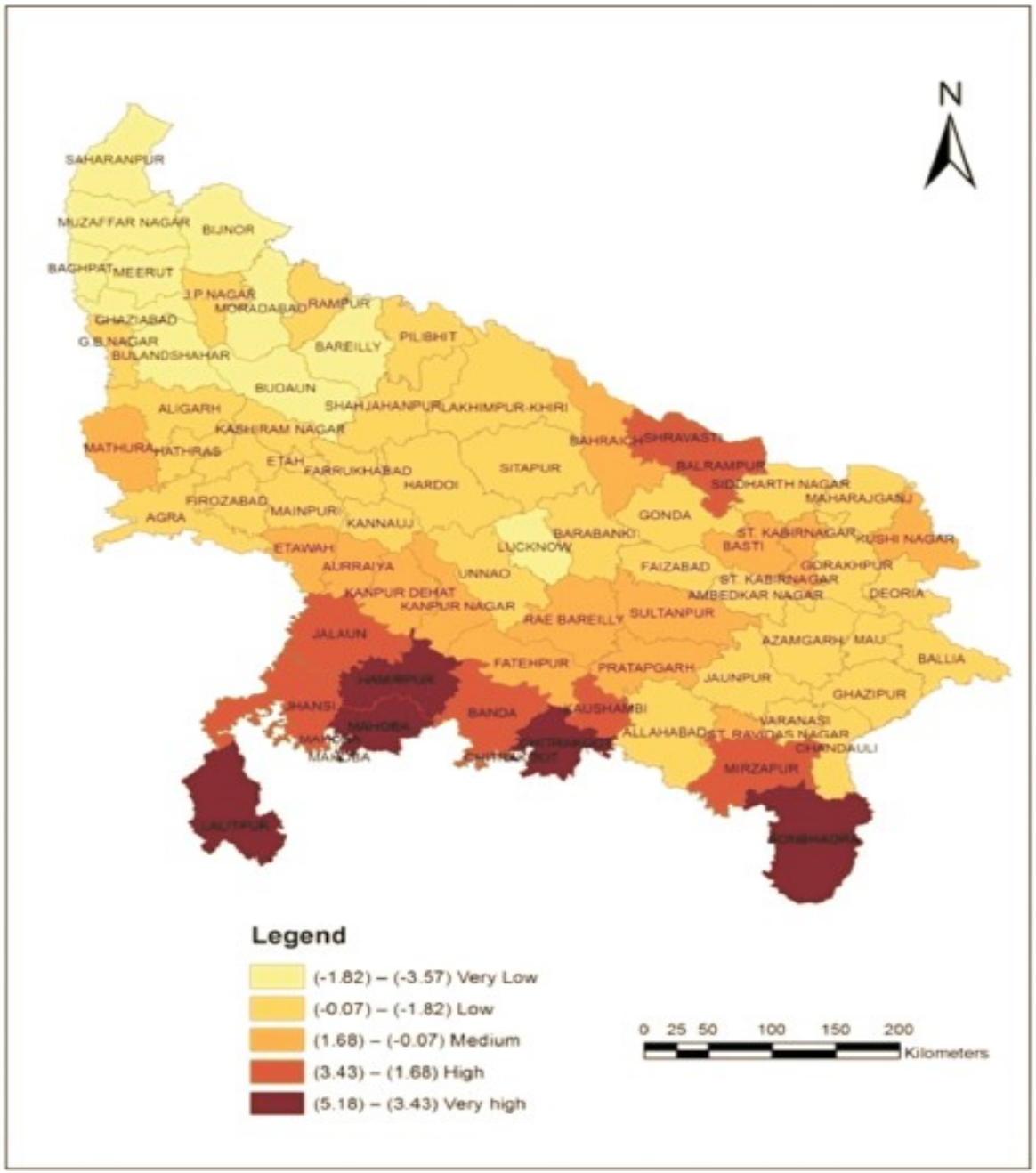



Figure 18 Climate Vulnerability Index (Combined) for UP

Based on the above analysis, it seems all the districts in the Bundelkhand and Vindya regions are highly vulnerable to climate change, as is Kaushambi from the central plains and two districts of the north-eastern plains. The less or moderately vulnerable districts were observed mainly in the western plains, Midwestern plains, Bhabhar and Tarai zones, and the south-western semi-arid regions. Mixed pattern is seen in the central, eastern, and north-eastern plains. However, many districts in the above regions are moderately vulnerable to climate change and variability. The analysis suggests that low adaptive capacity and high exposure to climate change and variability are mainly responsible for the high vulnerability to climate change.

# 4 UP STATE GHG EMISSION

A greenhouse gas (GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. GHGs of anthropogenic origin in the atmosphere such as carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) contribute directly in increasing the warming of the earth's surface. GHG inventory is estimated for all the IPCC sectors except LULUCF (Land use land use change and forestry), since no state level estimates are available and LULUCF sector was insignificant to India's national GHG inventory.

## 4.1 ASSESSMENT OF EXISTING GHG EMISSIONS GASES

Current GHG emission and relative increase in GHG emission at district level and for different sectors is covered in the following paragraphs. Uttar Pradesh is the highest emitting state of India emits and contributes nearly 14% of national greenhouse gases (GHG). Fossil fuel consumption, power generation and agricultural activities are the major factors responsible for this.

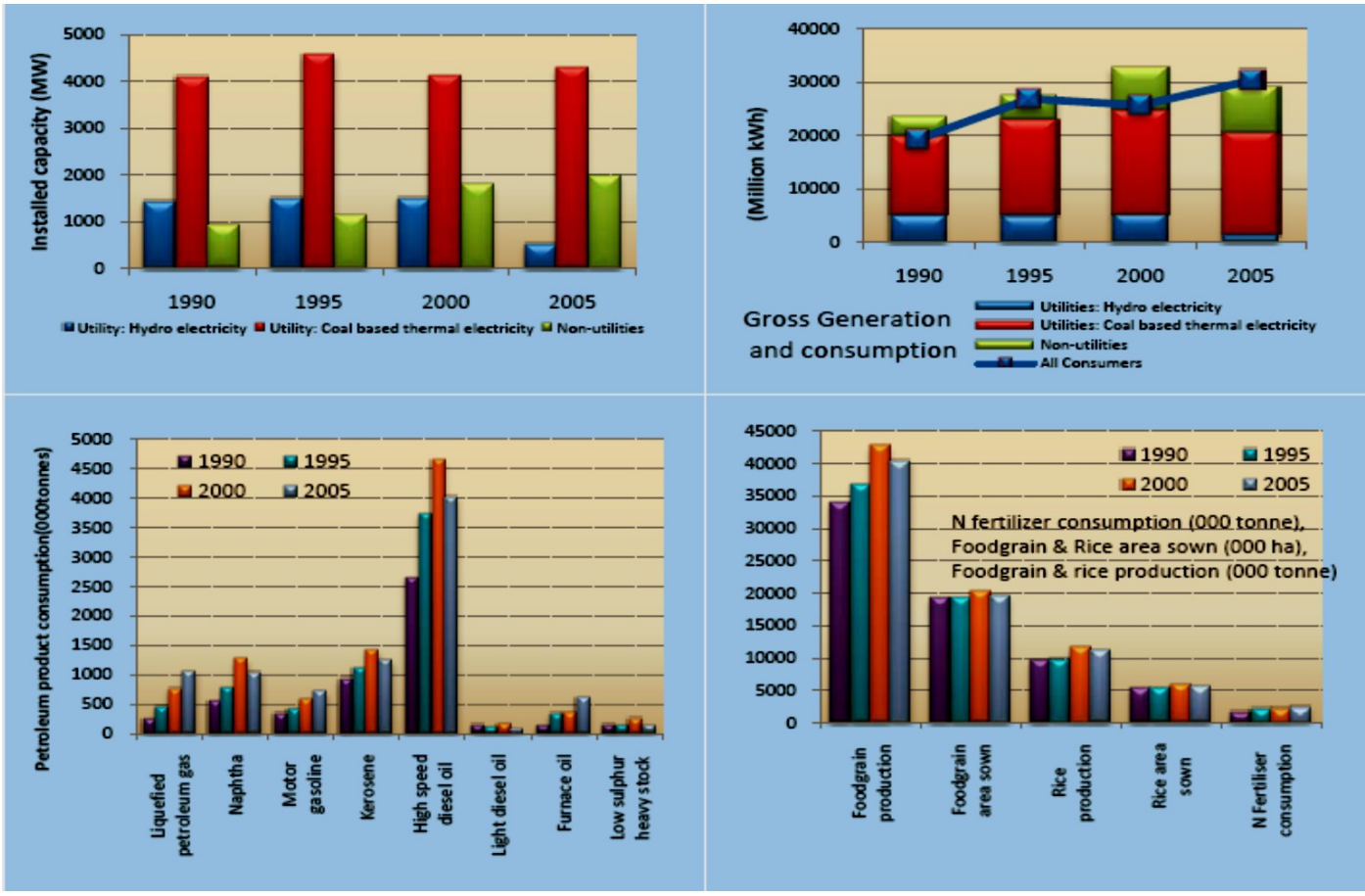



Figure 19 Major driving forces of GHG emission in UP

Uttar Pradesh represents about 21% of national fossil fuel consumption and 7% of national electricity consumption. Power generation in the state covers about 45% of the state $CO_2$ emissions which is

15% of national power related $CO_2$ emissions. Coal based thermal power generation in the UP utility has increased 2% per annum since 1990 (Figure 19). Total power consumption has also increased (3% per annum).

Petroleum products consumption has almost doubled during 1990 to 2005 (Figure 19). Trends in the major driving forces of non-$CO_2$ emissions namely nitrogenous fertilizer application and rice production in Uttar Pradesh are also depicted in Figure 13. Fertilizer consumption has grown at a rate of 2.5% per annum against only 1.2% and 0.9% growth rate of food grain and rice production respectively.

GDP and population, the main driving force of GHG emissions, have increased at 7.1% and 1.2% CAGR respectively. While fossil fuel consumption, electricity consumption and GHG emissions have increased at 3.9%, 3.0% and 4.1% CAGR respectively. A strong relation can be noticed between growth patterns of fossil fuel consumption and GHG emissions. Per capita emissions of Uttar Pradesh are 1.7 ton, and have increased by almost 50% since 1990. This value is similar to the national average of 1.8 ton $CO_2e$ per person. The state has continuously improved efficiency of its economy and has reduced GHG intensity of its GDP by 35% during the same period (Figure 20).

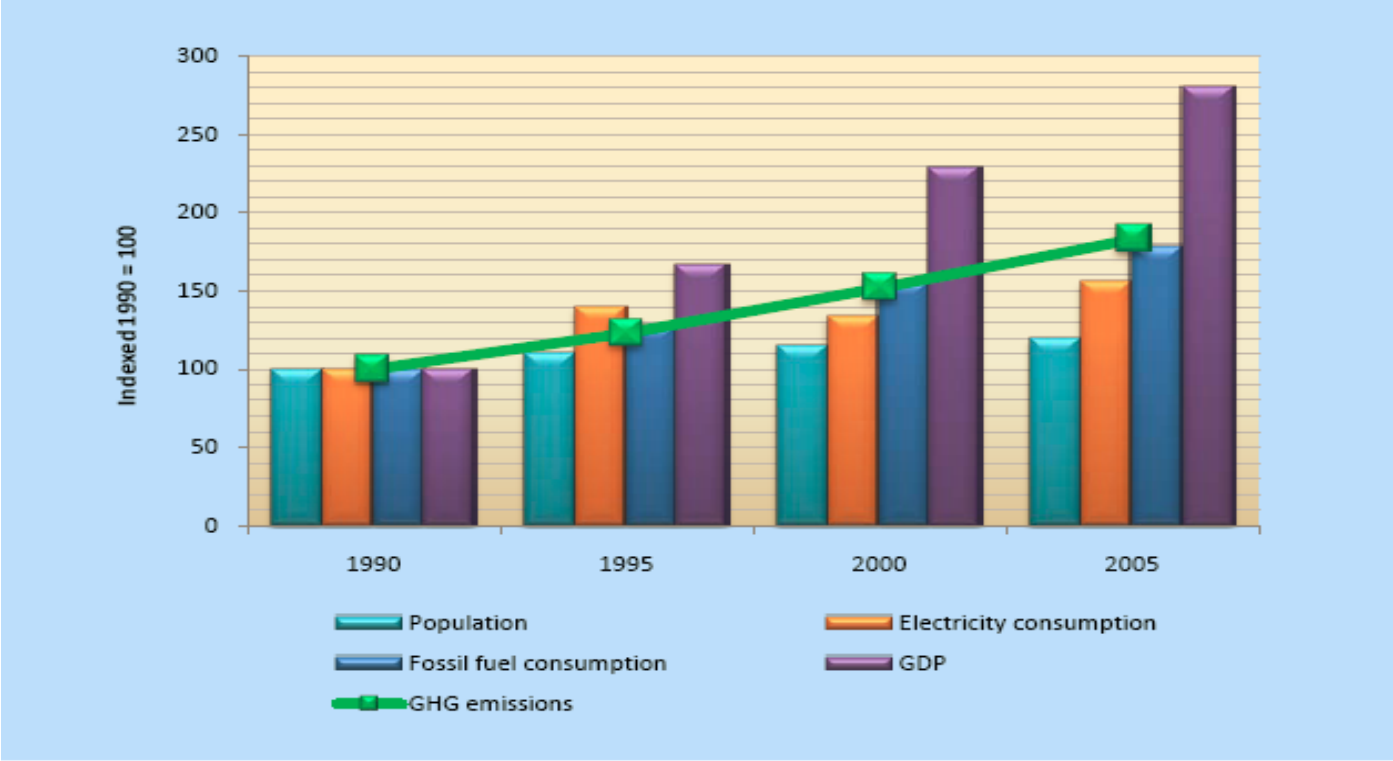



Figure 20 Relative increase in GHG emissions and other indicators of Uttar Pradesh

$CO_2$ emissions have increased at 5.6% CAGR (Compound Annual Growth Rate) since 1990, as compared to 1.5% and 3.0% CAGR of $CH_4$ and $N_2O$ emissions respectively. In 2005 GHG emissions equated to approximately 289 million tons of carbon dioxide equivalents, or 289 Tg (teragrams)

$CO_2e$ has been estimated for Uttar Pradesh.$CO_2$ contributes about 66% of the state's GHG emissions followed by $CH_4$ (26%) and $N_2O$ (8%). Figure 15 shows emissions of $CO_2$, $CH_4$ and $N_2O$ of Uttar Pradesh during 1990 to 2005.

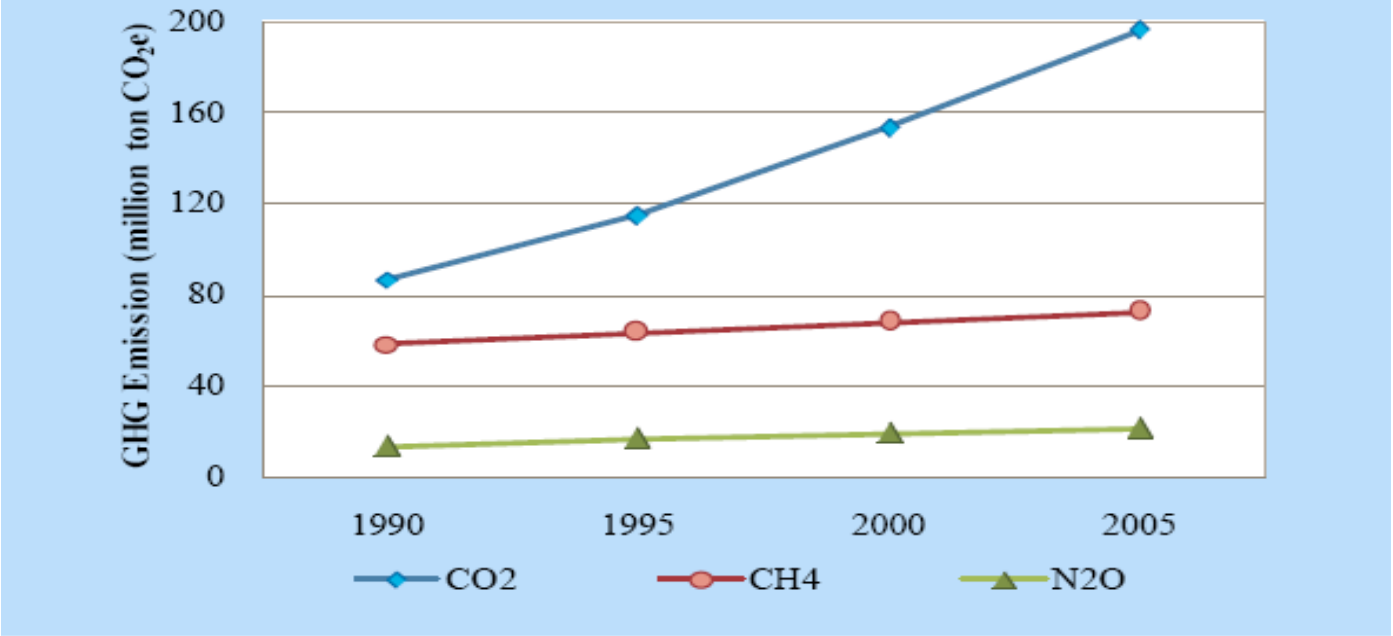



Figure 21Trend of GHG emissions (excluding LULUCF) in Uttar Pradesh during 1990-2005

The district level GHG emissions have been presented in the figure 22 below. Sonbhadra, Rae Bareli and Gautam Buddha Nagar are the three highest emitting districts during 2005, contributing to 27%, 5% and 4% GHG emissions of the state respectively. Four coal based thermal power plants and India's largest aluminum producing plant are the major $CO_2$ emission sources of Sonbhadra district. The district accounts for about 7% of national thermal power generation and 39% of national aluminum production. Thermal power generation plays major role behind higher ranks of other two districts also. In case of $CH_4$ emissions, districts of Barbanki, Mathura and Mirzapur are the highest emitting districts. Enteric fermentation accounts for almost three forth of the district $CH_4$ emissions in Barbanki and Mirzapur. Oil and gas refining acts as major emission source of Mathura. Mathura refinery has about 6% share in total domestic oil and gas production in India. Kheri, Moradabad and Muzaffarnagar are the highest $N_2O$ emitting districts of Uttar Pradesh having more than two third of the emissions from synthetic fertilizer application.

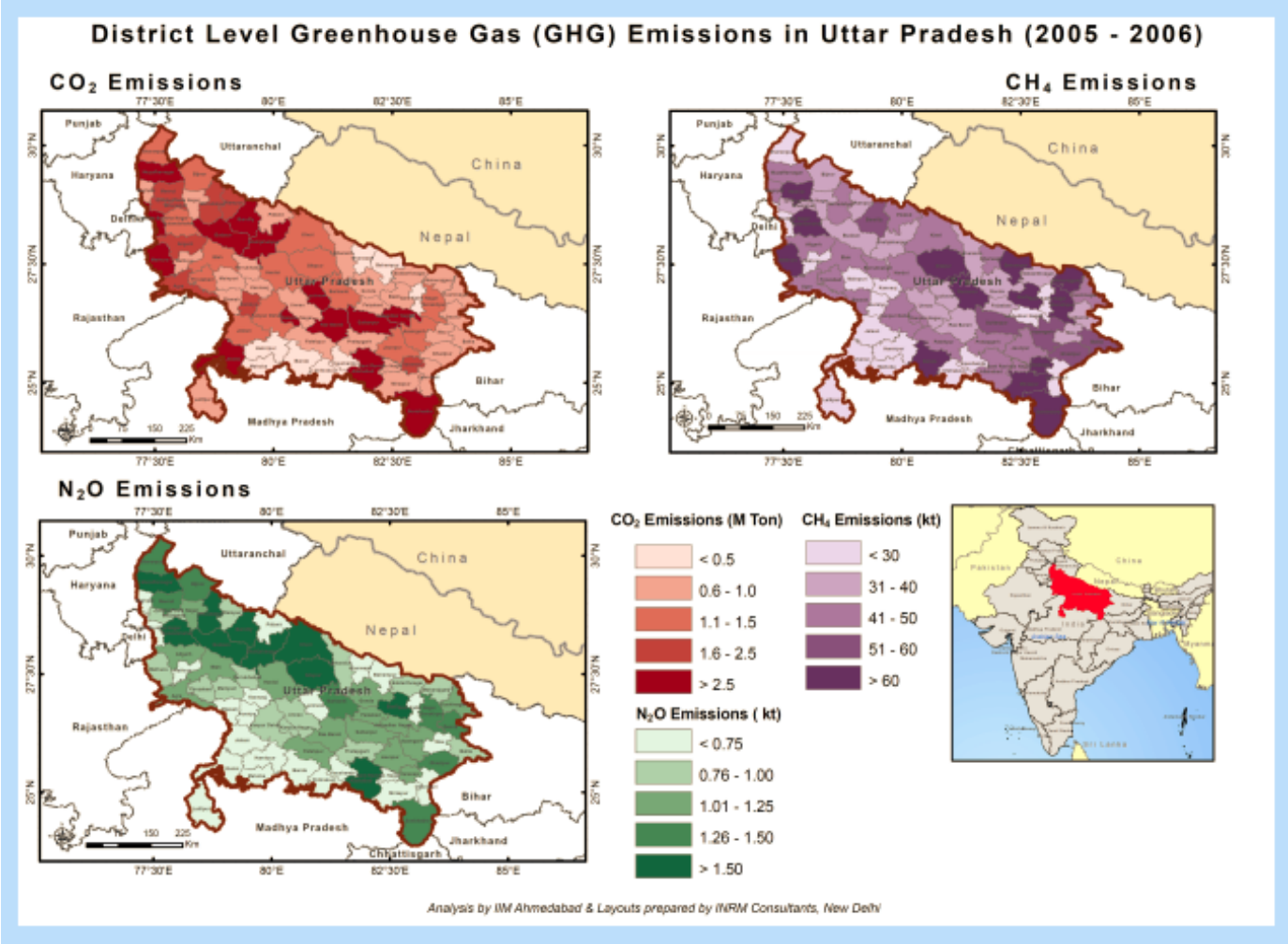



Figure 22 District level GHG emission

## 4.2 ASSESSMENT OF EXISTING GHG EMISSIONS BY SECTOR

About 68% of GHG emissions from Uttar Pradesh come from energy category. This category includes emissions due to fossil fuel and biomass burning within power plants, manufacturing industries, transport sector and residential sector. Ammonia and aluminum production as well as limestone consumption are the major source of industrial process and product use emissions. Agriculture sector contributes about 77% and 88% of $CH_4$ and N2O emissions of the state. Majority of $CH_4$ emissions occur from enteric fermentation of livestock (50%) followed by rice cultivation (19%) and biomass burning (10%). While majority of N2O emissions occur from application of synthetic nitrogenous fertilizer (56%) followed by decaying of crop residues left on field (13%) and indirect emissions from soil (13%). Municipal solid waste and domestic waste water treatment contribute about 3% and 2% to $CH_4$ and N2O emissions of the state respectively. Emissions from various categories and source activities with their relative share in Uttar Pradesh emissions are shown in Figure 23.

GHG emissions (excluding LULUF) from Uttar Pradesh during 2005 (Tg)

| | CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|
| Energy | 180 | 0.62 | 0.006 | 195 |
| Industrial processes & product use | 16 | 0.07 | | 17 |
| Agriculture | | 2.65 | 0.061 | 74 |
| Waste | | 0.11 | 0.001 | 3 |
| Total | 196 | 3.44 | 0.069 | 289 |

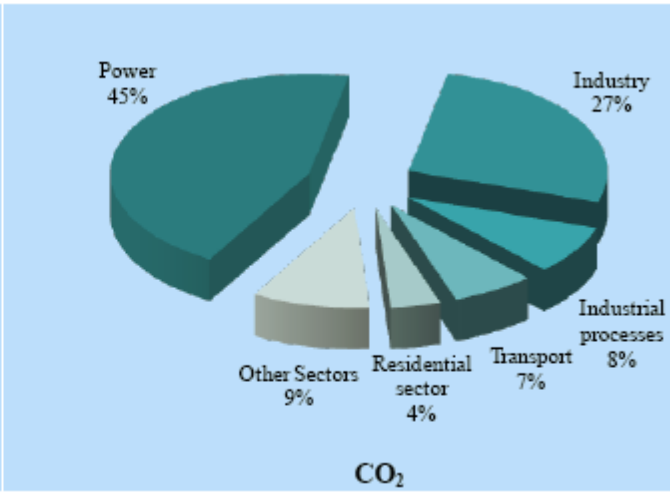
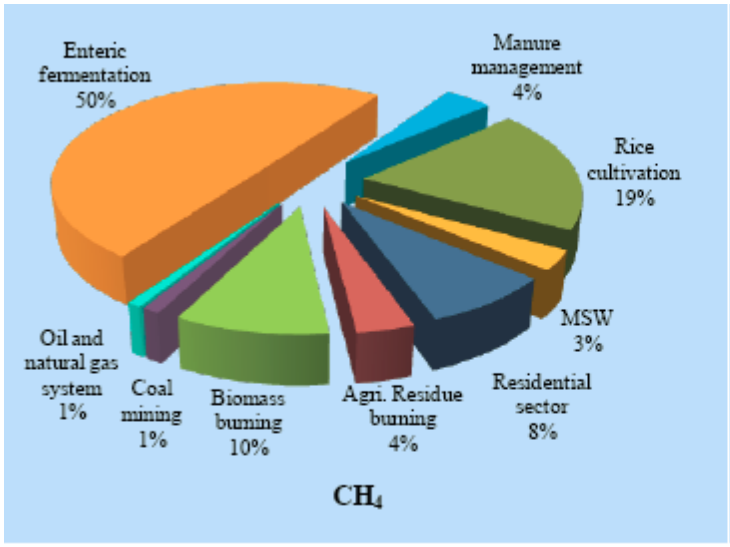



Figure 23 Category wise GHG emission in UP, 2005



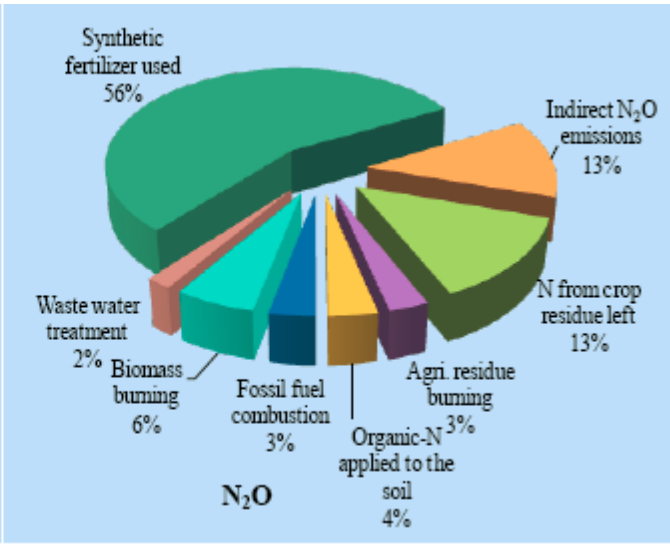




Figure 24 Sectorwise GHG emission, UP, 2006

# 5 SUSTAINABLE AGRICULTURE MISSION

## 5.1 OVERVIEW OF AGRICULTURE IN UP

In Indian agriculture, Uttar Pradesh has a significant role as it contributes about 20% food grains to the national food basket. The state is a major producer of wheat (34%), rice (13%), pulses (14%), sugarcane (35%), potato (37%), vegetables (16%) and milk (18%o in the country (Table 4). In Uttar Pradesh, about 25 percent of Gross Domestic Product (GDP) is contributed by agriculture and 68 percent of the population subsists on this sector. Out of a total population of 19.96 crores, about 13.56 crores is subsisting on agriculture sector, hence, agriculture is very vital and needs to be addressed properly.

Table 4 Contribution of Uttar Pradesh in Agriculture Production of India

| Crops | Production (lakh metric tons) | | % Share |
|---|---|---|---|
| | India | U.P. | |
| **Food Grains (2011-12)** | 2574 | 517 | 20 |
| **Wheat ( 2011-12)** | 939 | 317 | 34 |
| **Rice (2011-12)** | 1043 | 140 | 13 |
| **Pulses (2011-12)** | 172 | 24 | 14 |
| **Sugar Cane (2011-12)** | 3577 | 1255 | 35 |
| **Potato (2009-10)** | 366 | 134 | 37 |
| **Vegetable (2009-10)** | 1093 | 255 | 16 |
| **Milk (2009-10)** | 1125 | 202 | 18 |

Source: Department of Agriculture, Govt. of Uttar Pradesh

The contributions of Uttar Pradesh in the national food grain basket is well recognized, but, slow pace in productivity increase in rice, oilseeds and pulses in the recent past decade has become the major cause of concern. Agricultural production has been fluctuating over the years and there has not been much growth in the last decade. Total productions of rice and pulses in 2010-11 have been less than what had been achieved in the year 2001-02 (Table 5).

Table 5 Agricultural Production over the last ten years (000 tonnes)

| Crop | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Paddy** | 12856 | 9596 | 13022 | 9559 | 11119 | 11083 | 11503 | 13001 | 10715 | 12226 | 13963 |
| **Wheat** | 25498 | 23748 | 25567 | 22514 | 23574 | 25444 | 26041 | 28977 | 27518 | 30921 | 31662 |
| **Pulses** | 2377 | 2182 | 2380 | 2366 | 2176 | 1927 | 1576 | 1998 | 1901 | 2012 | 2426 |
| **Total Foodgrains** | 44187 | 38373 | 44438 | 37803 | 39839 | 41504 | 44113 | 47382 | 43099 | 49314 | 51662 |
| **Oilseeds** | 1110 | 851 | 928 | 946 | 1042 | 1019 | 1177 | 1125 | 1200 | 1357 | 938 |

Source: Department of Agriculture, Govt. of Uttar Pradesh

Productivity of major crops in the state has been given below:

Table 6 Productivity in Agriculture in UP

| Crop | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 06-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | **21.17** | **18.41** | **21.87** | **17.90** | **19.96** | **18.78** | **20.63** | **21.71** | **20.84** | **21.19** | 23.58 |
| Wheat | **27.55** | **25.91** | **27.94** | **25.02** | **25.72** | **27.66** | **28.17** | **30.02** | **28.46** | **31.13** | 32.59 |
| Pulses | **8.86** | **8.26** | **8.90** | **8.50** | **8.15** | **7.3** | **7.31** | **8.99** | **7.48** | **8.29** | 9.91 |
| Total foodgrain | **21.63** | **19.99** | **21.95** | **19.60** | **20.37** | **20.92** | **22.06** | **23.66** | **22.42** | **23.35** | 25.63 |
| Oilseeds | 8.69 | 7.72 | 8.19 | 8.4 | 9.72 | 11.58 | 8.56 | 8.65 | 7.53 | 8.49 | 8.29 |

Source: Department of Agriculture, Govt. of Uttar Pradesh

## 5.2 CLIMATE IMPACT IN STATE AGRICULTURE

### 5.2.1 AGRO-CLIMATIC ZONES IN THE STATE

Agriculture performance varies greatly across regions in the state. The western region is agriculturally the most progressive; the largest chunk of the state's agriculture output comes from this region (around 50 per cent). The eastern region contributes around 28 per cent, next to the western region, of the total value of the state's agriculture output. The Bundelkhand accounts for only 4 per cent of the state's gross value of agriculture output. This has strong linkages to the agro-climatic conditions in these regions.

Under the National Agricultural Research Project (NARP), the concept zoning was mainly based on ecological land classification, recognizing various components like soils, climate, topography, vegetation and crops as major influencing factors. The zones were selected as contiguous areas within the state boundary and having homogeneous physical characteristics such as topography, rainfall, soils and cropping patterns. Accordingly on the basis of rainfall, terrain and soils, Uttar Pradesh has been divided into nine agro-climatic zones.

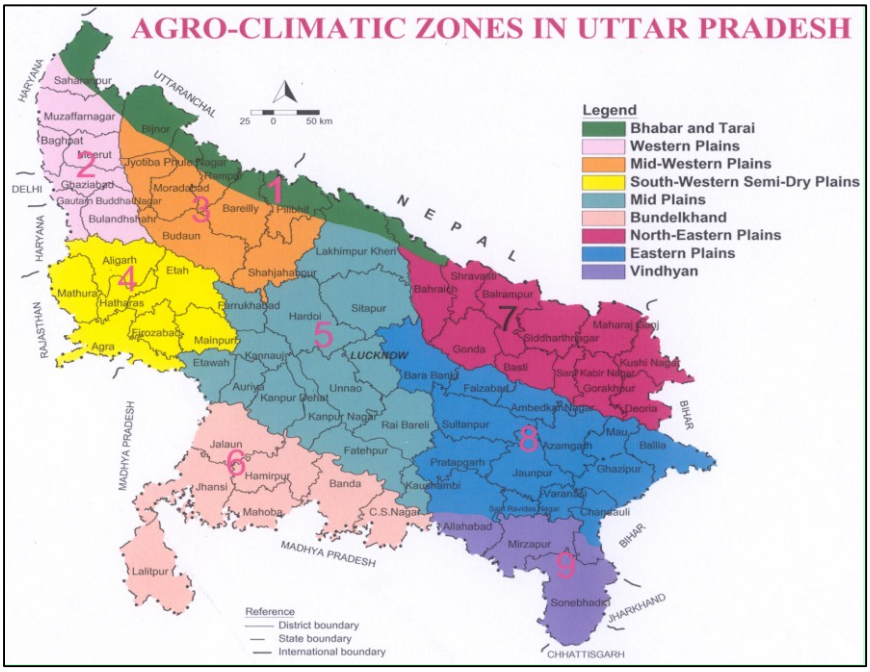
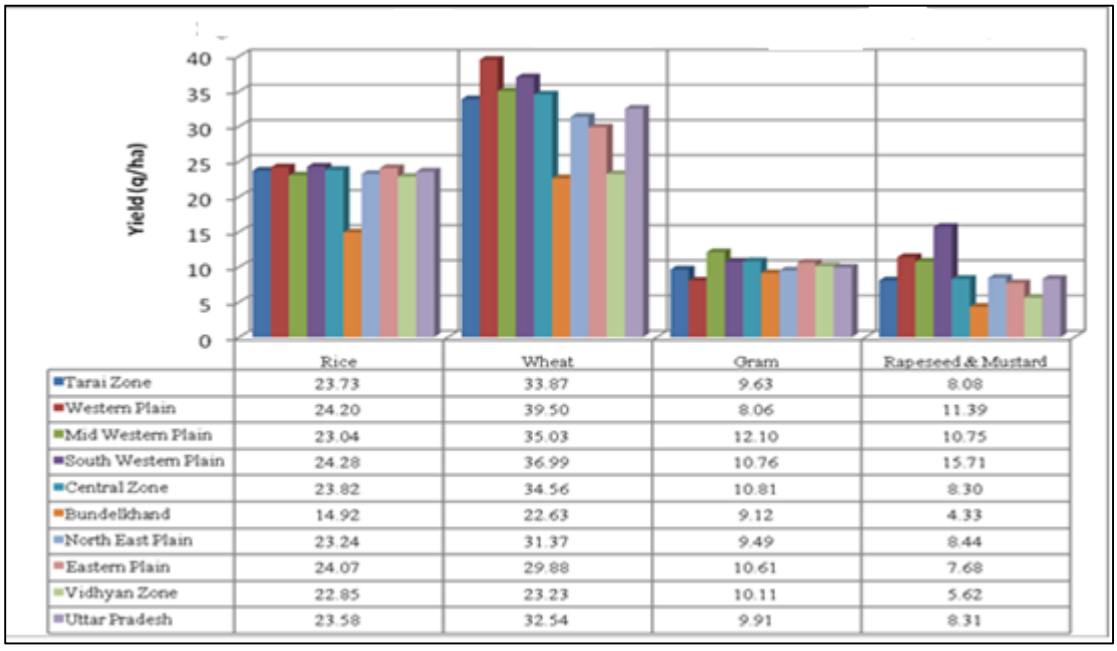



Figure 25 Agro-climatic zones in UP




| | Rice | Wheat | Gram | Rapeseed & Mustard |
|---|---|---|---|---|
| Tarai Zone | 23.73 | 33.87 | 9.63 | 8.08 |
| Western Plain | 24.20 | 39.50 | 8.06 | 11.39 |
| Mid Western Plain | 23.04 | 35.03 | 12.10 | 10.75 |
| South Western Plain | 24.28 | 36.99 | 10.76 | 15.71 |
| Central Zone | 23.82 | 34.56 | 10.81 | 8.30 |
| Bundelkhand | 14.92 | 22.63 | 9.12 | 4.33 |
| North East Plain | 23.24 | 31.37 | 9.49 | 8.44 |
| Eastern Plain | 24.07 | 29.88 | 10.61 | 7.68 |
| Vidhyan Zone | 22.85 | 23.23 | 10.11 | 5.62 |
| Uttar Pradesh | 23.58 | 32.54 | 9.91 | 8.31 |

Figure 26 Yield variation zone wise

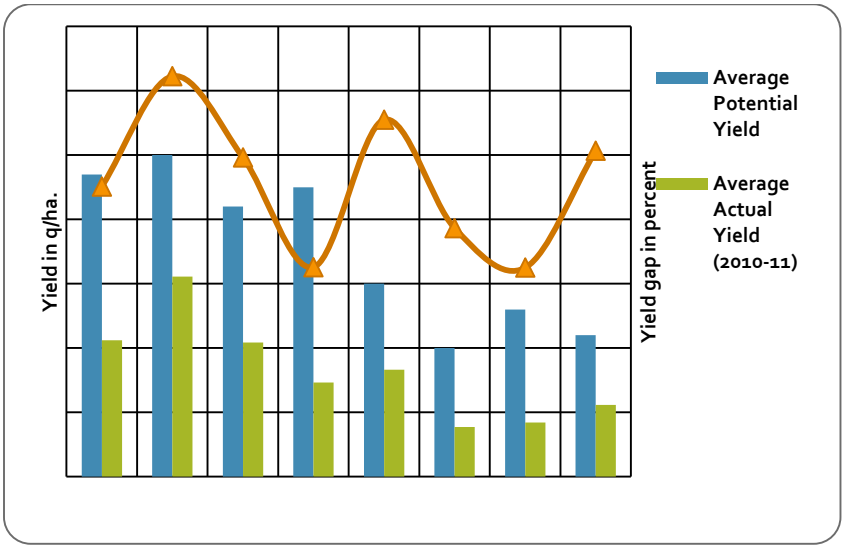



Figure 27 Yield potential

Due to agro climatic variations, availability of various natural and family resources, a large variation in yield of major crops grown under these zones has been observed. The yield variations recorded in major crops namely, rice, wheat, gram and rapeseed and mustard have been shown in **Figure 26**. Except in Bundelkhand zone which is climatologically not ideal for rice cultivation, the variation in rice yield under different agro climatic zones is not substantial. Hence, efforts are needed consistently to increase the rice productivity in all the agro-ecological zones. However, in case of wheat productivity existing wide variations need to be bridged. Similarly, the variations in gram, rapeseed & mustard and other crops also required to be narrowed down.

In general, the production and productivity of crops can be enhanced substantially, if the existing gap in potential and actual yield realized at farmers field is bridged by ensuring timely supply of quality inputs and dissemination of available production technologies. It is evident from the yield data for the year 2010-11 shown through **Figure 27,** that hardly 50 percent of potential yield is being realized except in case of wheat.

### 5.2.2 IMPACT OF MONSOON

Indian climate is dominated by the south-west monsoon, which brings most of the region's rains. As per the climate change scenario predicted for the Indian subcontinent, an increase in mean maximum and minimum surface air temperature of 0.7 °C and 1 °C over land in the 2040 with respect to the 1980 is expected. Further, the warming over land is projected to be lower in magnitude than that over the adjoining ocean; hence the land-sea thermal contrast that drives the monsoon mechanism could possibly decline. There is considerable uncertainty in the projected magnitude of change in temperature, precipitation and $CO_2$ levels during Rabi (Winter) and kharif (Summer) for India.

Table 7 Projected changes in temperature, precipitation and $CO_2$ levels.

| Climate factor | Rabi (winter) | | Kharif (summer) | |
|---|---|---|---|---|
| | 2010 | 2070 | 2010 | 2070 |
| **Temperature increase °C** | 0.3-0.7 | 1.1- 4.5 | 0.1-0.3 | **0.4-2.0** |
| **Precipitation change in south-west monsoon %** | 0 | ± 10 | 0 | **+ 10** |
| **$CO_2$ ppm(368 ppm in 2000)** | **397-416** | **605-755** | **397-416** | **605-755** |

Emissions of $CO_2$ (mainly from burning coal, oil and natural gas), methane and nitrous oxide (from agriculture sector) and long-lived industrial gases viz; CFCs, HFCs and PFCs are changing the atmosphere's energy absorption pattern. An assessment made during 1990 and 2000 period and a projection of greenhouse gas emission from India shows that it grew at the rate of 4.2 percent per annum and likely to grow further to meet the national developmental needs Indian climate is dominated by the south-west monsoon, which brings most of the region's rains. As per the climate change scenario predicted for the Indian subcontinent, an increase in mean maximum and minimum surface air temperature of 0.7 °C and 1 °C over land in the 2040 with respect to the 1980 is expected. Further, the warming over land is projected to be lower in magnitude than that over the adjoining ocean; hence the land-sea thermal contrast that drives the monsoon mechanism could possibly decline. There is considerable uncertainty in the projected magnitude of change in temperature, precipitation and $CO_2$ levels during Rabi (Winter) and kharif (Summer) for India (**Table 7**).

Emissions of $CO_2$ (mainly from burning coal, oil and natural gas), methane and nitrous oxide (from agriculture sector) and long-lived industrial gases viz; CFCs, HFCs and PFCs are changing the atmosphere's energy absorption pattern. An assessment made during 1990 and 2000 period and a projection of greenhouse gas emission from India shows that it grew at the rate of 4.2 percent per annum and likely to grow further to meet the national developmental needs. Deforestation and change in land use pattern make the forests a net source of $CO_2$. As far agriculture is concerned, it accounts for over 20 percent of total GHG emission. Intensive agriculture practices such as submerged rice cultivation, use of fertilizers and chemicals and livestock rearing emits about 58 percent of human methane related and nitrous oxide. Further, 33% of total GHG emission was of methane and a major fraction of it contributed by agricultural activities.

Country is facing very unpredictable weather for last few years. Analysis of different meteorological variables available from weather stations shows an upward trend in release of $co_2$, mean monthly temperature particularly during winter months, total quantum of rainfall and downward trend in number of wet days in a year. States like Assam, Bihar, U.P. and part of Karnataka are experiencing dry spells, whereas Maharashtra, Andhra Pradesh, Southern part of Gujarat and part of Bihar and U.P. are being hit by the floods. During the year 2006, the Kashmir Valley witnessed the most severe summer. Cherapunji, known for highest rainfall, had less rains in 2005. While Mumbai for consequent 3-4 years, had heavy down pour, almost paralyzing the city life. Unusual heavy down pour (60 cm) in 5 days, August, 19-23, 2006 in Barmer district of Rajasthan was a record. The pace and extend of heat waves and warming across the India is wide spread, but North India is relatively more affected. The problems are compounded by shrinking natural and non-renewal resources and increasing stress on various biotic and abiotic resources.

Almost once in every third year in western part and once in five years in eastern part, drought is experienced by Uttar Pradesh. Monthly rainfall data presented in **Table 8** shows that during the recent past decade, normal rainfall (947mm) was witnessed only in one year (2008-09). During this period average annual rainfall decreased from 947mm to 737 mm. Further, of the total 10 years, 6 years received even below the decadal average i.e. 737mm. The distribution of seasonal rainfall has been highly erratic affecting cropping pattern, selection of crops and their varieties and over all agricultural production.

**Table 8 Monthly average rainfall (mm) received during last decade in Uttar Pradesh**

| Year | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | JAN | FEB | MAR | APRIL | MAY | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2001-02** | 182 | 268 | 150 | 96 | 51 | 1 | 0 | 13 | 28 | 1 | 1 | 21 | 812 |
| **2002-03** | 39 | 70 | 224 | 224 | 14 | 0 | 4 | 13 | 36 | 2 | 7 | 4 | 639 |
| **2003-04** | 83 | 266 | 231 | 277 | 4 | 0 | 11 | 24 | 1 | 0 | 14 | 21 | 931 |
| **2004-05** | 111 | 164 | 200 | 90 | 42 | 0 | 0 | 15 | 16 | 13 | 2 | 7 | 660 |
| **2005-06** | 53 | 285 | 173 | 152 | 17 | 0 | 2 | 0 | 0 | 12 | 5 | 27 | 727 |
| **2006-07** | 93 | 245 | 106 | 64 | 6 | 1 | 1 | 0 | 38 | 28 | 2 | 21 | 606 |
| **2007-08** | 76 | 231 | 176 | 101 | 5 | 0 | 1 | 2 | 1 | 0 | 5 | 25 | 622 |
| **2008-09** | 229 | 340 | 242 | 99 | 10 | 3 | 0 | 1 | 2 | 2 | 4 | 12 | 945 |
| **2009-10** | 22 | 151 | 200 | 139 | 72 | 9 | 3 | 3 | 13 | 0 | 0 | 12 | 623 |
| **2010-11** | 21 | 239 | 234 | 239 | 13 | 9 | 2 | 6 | 12 | 3 | 0 | 29 | 807 |
| Average | **91** | **226** | **194** | **148** | **23** | **2** | **2** | **8** | **15** | **6** | **4** | **18** | **737** |
| Normal | **95** | **281** | **276** | **178** | **36** | **5** | **7** | **18** | **20** | **10** | **7** | **15** | **947** |

The region wise long term rainfall analysis (**Fig 28)** reveals that the maximum decline in total rainfall has been recorded in western part followed by eastern and central parts of the state. The Bundelkhand region, which is basically rainfed and recognized as drought prone area had comparatively less decline in total rainfall received.

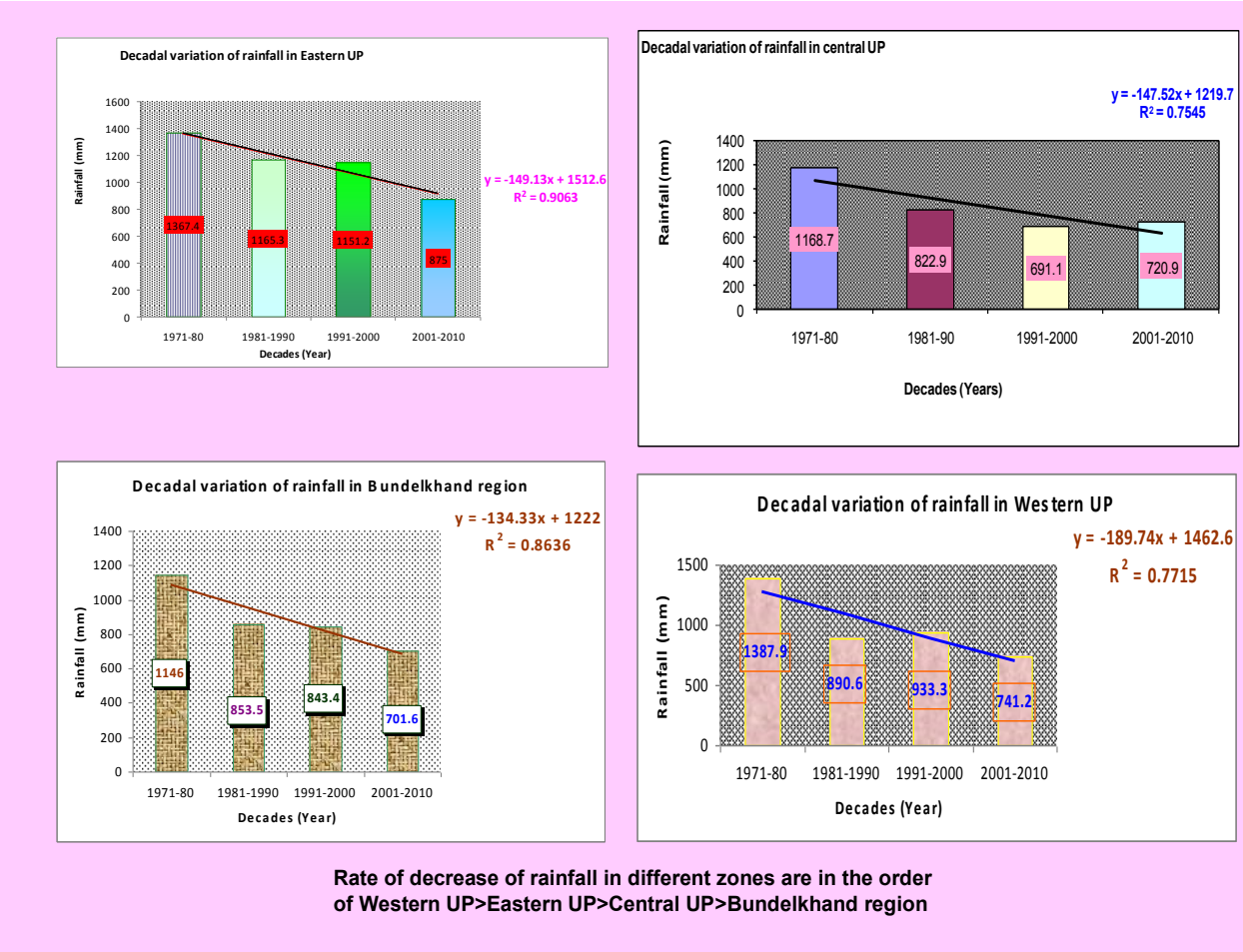



Figure 28 Long term regional rainfall trend

**Source: Tripathi, Padmakar (2012), NDUAT, Faizabad**

Over the period, extensive irrigation network including both; the public and private irrigation system has developed in the state. However, maximum area is being irrigated by the private tubewells and majority of these tubewells are diesel operated. Due to higher prices of diesel, small and marginal farmers which constitutes above 92% of the total operational holdings use their pumping sets mainly for protective irrigation during kharif season. Normally, nursery/ seedling preparation is started with the help of pumping sets but, rice planting is speeded only on the onset of monsoon. Among various kharif crops, rice is an important crop as it is being planted in about 60 lakh hectare area. In spite of irrigation facilities, area under rice and production and productivity of rice is very much influenced by the rainfall and its distribution pattern. The effect of rainfall received during the recent past decade on coverage of area under rice, production and productivity of rice has been given in **Figure 29.** In general, if the rainfall data presented in Table 7 are corroborated with production and productivity of wheat, pulses, foodgrains, and oilseeds data given in Table 2 and 3, it is clear that in rain deficit years significant reduction has been recorded. Further, the distribution of rainfall has

more crucial role on coverage of area, production and productivity of rice. In general, June and July month rains not only affected the coverage of area under rice but also affected its production and productivity (**Figure 29**).

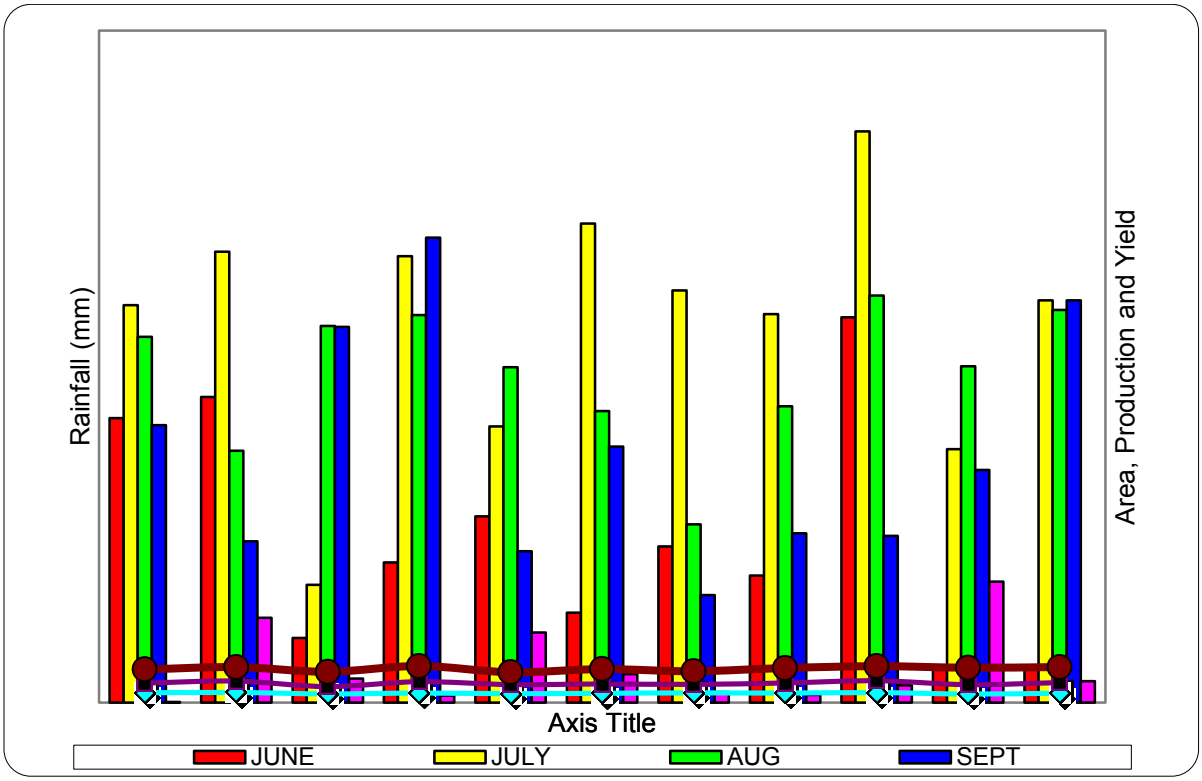



Figure 29 Effect on rainfall on rice cultivation

Due to changes in above weather parameters, selection of crops and their varieties, timing of planting and sowing and other agronomic practices are being influenced substantially. Therefore, area specific crop planning and identification of appropriate crops and their varieties is needed to protect the farmers especially small and marginal from the adverse weather aberrations. Therefore, farmers have to be provided accurate and precise weather forecasting and Agro-advisories on regular basis through various dissemination methods and techniques. Agriculture being a state subject, long term and short term strategies and area specific contingent plans has to be developed and implemented by trained specialists.

### 5.2.3 IMPACT DUE TO PROJECTED CLIMATE CHANGE

Agriculture sector plays a major contribution in greenhouse gas emission. Methane levels have already increased by 2.5 times during the industrial era. The main source of methane is agriculture sector, notably sub-merged rice fields and expanding herds of cattle. Emission from waste dumps and leaks from coal mining and natural gas production also contribute.

The Inter-governmental Panel on Climate Change (IPCC) report considers agriculture sector as highly vulnerable to impact of climate change as crop production and aquaculture would be threatened by rise in temperature and sea level, increased flooding and drought frequencies and biotic stresses. However, the extent of effect of global warming on Indian agriculture would depend upon the actual change in temperature, precipitation and other climatic features together with adaptation and mitigation strategies. The inter and intra annual variations in weather has a significant effect on the year to year fluctuation in crop yields. The cool temperature during the crop growing period, high temperature, heavy rains, frost during ear growth, dry spells and drought during grain filling and wet weather at harvest will affect crop yields adversely. There are three ways in which Greenhouse effect may be important for agriculture; (i) Increased $CO_2$ concentration can have direct effect on the crop growth and its yield and infestation of diseases, pests and weeds. (ii) Increased $CO_2$ levels may alter precipitation, sunshine and temperature that can influence crop and animal productivity, and (iii) rise in sea level may lead to loss of farm-land by inundation and to increasing salinity of ground water in coastal areas.

However, the impact of change on agriculture would depend on the period and on the extent by which temperature and rainfall would change. The critical climate changes predicted for the lower latitude (0-30 °N and S) are increases in temperature by about 2 °C, precipitation by about 10%, increase in intensity and frequency of heavy rainfall and reduced soil water availability. If emission of greenhouse gases continue at their present rate, the global surface temperature will rise by 1.5 °C to 5 °C by 2100 (IPCC, 2001). Increases of more than 2 °C could increase evapotranspiration rates to a point where reduced crop water availability begins to limit the crop growing season, crop growth period and crop yield. It is estimated that a 2 °C in mean air temperature could decrease rice yield by about 7.5 qt/ha in the high yield areas and by about 0.6 qt/ha in the low yield coastal regions. Further, a 0.5 °C increase in winter season temperature would reduce wheat crop duration by a week and reduce yield by 4.5 q/ha (10%) in the high yield state viz. Punjab, Haryana and Western Uttar Pradesh.

In general, at mid latitudes, evaporation increases by 5% for each degree centigrade mean annual temperature rise. Increased evaporation from the soil and accelerated transpiration in the plant themselves will cause moisture stress. At low and mid latitude, increase in temperature results in reducing the total duration of the crop by inducing early flowering and shortening the grain filling period and thereby decreases yield. Further, temperature increase may extend the geographic range of some insect pests presently limited by low temperature particularly during rabi season. Longer favourable period will enable insects to complete more number of reproductive cycles during the season.

Higher temperature is likely to accelerate the natural decomposition process of organic matter and to increase the rates of other soil activities that affect soil fertility and its productivity. The continual

cycling of plant nutrients-carbon, nitrogen, phosphorus, potassium and sulphur in the soil- plant-atmosphere is also likely to accelerate in warmer conditions. enhancing $CO_2$ and $N_2$ O greenhouse emission.

Heat stress during summer season has also been found to affect animal productivity both of male and female. Heat affects fertility in most of the animal species. However, exotic animals are more vulnerable to heat stress. Increased disease incidence, poor performance in terms of growth, milk production, and reproductive efficiency is reflection of poor acceptability of cross breeding programmes. Land-based eco systems play an important rate both positively by acting as a sink for carbon (sequestering carbon through photosynthesis) and negatively as a source of carbon (through deforestation, decomposition, soil erosion).

## 5.3 KEY PRIORITIES IN AGRICULTURE

The contribution of Uttar Pradesh in the national food grain basket (about 19%) is well recognized, but, stabilization in food grains productivity during the recent past decade has become the major cause of concern. Further, climate change will have an adverse impact on food security. Disadvantaged regions and socially and economically backward people will be affected more as food cost will increase due to its less availability. Available trends indicate that agricultural productivity will decline up to 25% in irrigated areas which could be as much as 50% in rainfed areas. Dominance of small and marginal farmers (about 92%) with small land holdings will make Uttar Pradesh more Vulnerable to climate change. Inconsistent and erratic monsoon and water scarcity has substantially affected the crop yields, cropped area and livestock in Bundelkhand region during the last 4-5 years.

Therefore, considering the increasing population and limited availability of natural resources, agricultural productivity needs to continuously increase to meet the growing demand of food despite the adverse impacts of changing climate. It is therefore, imperative to have the proper perspective plan and implement them judiciously to cope-up with the changed climate. Therefore, in the State Agriculture and Climate Change Plan, following activities/programmes are proposed for sustainable development of agriculture sector.

### AGR-1 Establishment of climate change and agriculture cell

The Crop Weather Watch Group (CWWG) established by the Uttar Pradesh Government under the Chairmanship of Director General, U.P. Council of Agricultural Research (UPCAR) is issuing the Agro-advisories according to variation in weather situations in different agro-climatic regions of state. Constituted Crop Weather Watch Group is quite competent to address envisaged activities as the Director, IMD, Lucknow, Professor of Department of Agro-Meteorology of State Agricultural Universities (SAUs), concerned scientists of Remote Sensing Application Centre (RSAC), Central Soil Salinity Research Institute (CSSRI), Regional Station, IISR and officials of line departments namely; Agriculture, Horticulture, Animal Husbandry, Fisheries, Sericulture, etc. are the member of this group. Krishi Vigyan Kendra's (KVKs) to be linked are also having the requisite expertise. For precise and accurate weather data, Automatic Weather Stations (AWS) are being established by UPCAR at KUK's under the XI Fiver Year Plan. The KVKs will be having the networking with UPCAR. The weather data of AWS located under different situations will be used for developing precise agro-

advisories. Therefore, to avail the benefit of weather information available from these AWS for development of short and long term strategies and action plans for changed climate, it is proposed that a Climate Change and Agriculture Cell (CCAC) be established at UPCAR with following objectives:

(i) To collect and compile data and other information on climate change and agriculture to enhance the current understanding of the subject.
(ii) To build capacity in different government departments/agencies through trainings, seminars, exposure visits etc. to effectively address various dimensions of climate change and agriculture.
(iii) To assess the vulnerability of agriculture to climate change and develop strategies to address them effectively.
(iv) To coordinate and monitor the programmes to be implemented by different organizations.

## AGR-2 Identification of Vulnerable areas and assessing Vulnerability

Being large in size, state is divided into 9 agro climatic zones. Considering the sizeable contribution of Uttar Pradesh in the national food basket, any adverse effect on state agriculture has direct impact on large scale imports of food grains in the country. Therefore, understanding and assessing the extent of vulnerability as and when required is important for responding climate change induced impacts. Broadly, flood and drought affected areas namely eastern part and Bundelkhand region respectively are known, but micro-level analysis is required to facilitate the habitat to cope with climate change. The information on Physical (climate data, geographical situation), social (land holdings, population density, literacy etc.) and economic (productivity of crops, development index etc.) themes would be collected and analysed to draw appropriate policies and develop action plans. The studies will be conducted by UPCAR with the assistance of consultants or be awarded to some technical organization.

## AGR-3 Establishment of Climate Field Schools (CFS)

To improve the extension support to farmers at local level, Farmers Field Schools (FFS) have been established under Diversified Agriculture Support Project (DASP) and U.P. Sodic Land Reclamation Programme (UPSLRP) in the state. Considering the success of skillfully farmer field schools, establishment of climate field schools to increase farmer's knowledge on using climate information in managing their soil, water, agro-chemicals and crop resources for higher agricultural production are proposed. In areas where Farmer's Field Schools (FFSs) are functional, these schools will be upgraded and strengthened. In first phase these schools may be established/ upgraded on pilot basis in more vulnerable areas namely; Bundelkhand and north-eastern parts of the state which are frequently affected due to drought and floods respectively. These schools have to be provided the proper communication facilities (internet/ mobile) to make use of available information on climate change. The information will influence the decision making process and equip them to cope with changed climate. The climate field schools may have internet connectivity with Automatic Weather Stations for information on weather and advisories issued for changed weather conditions. Regular

feedback will be collected to review the progress/ achievements made by these schools and appropriate training programmes be organized for CFS's/ KVKs staff to upgrade their knowledge base. Technical assistance from institutions having expertise in capacity building in the area of adaptation and mitigation to climate changes will be obtained. Thus, support to establish these schools under the guidance of KVK's and department of agriculture is needed.

### AGR-4 Promotion of Carbon Sequestration Agricultural Practices

It is possible to sequester carbon and other GHG gases either direct cultivation, inter-cropping and many other means. Some pilots like planation of perennial fruit trees in degraded areas, shade plants, medium canopy floriculture, agro-forestry can be taken up apart from other management practices described in subsequent sections.

### AGR-5 Use of organic manures

Organic agriculture is considered to be the steadiest approach for sustainable agricultural production. Improving soil carbon has beneficial effects on increased soil productivity and biodiversity and reduced land degradation. Carbon sequestration includes increasing carbon pools of both biomass and soil carbon and capture and store carbon emissions reaching the atmosphere. Soil carbon could be increased by application of organic and green manures and recycling of crop residues into soil. The microbial population and their activity, physical and chemical properties of soils are determined by organic matter available in the soil. Improved soil structure by application of organic matter enhances water holding capacity, root penetration, soil aeration and drainage. Whereas, reduction of soil organic matter and microbial activities, reduce the capacity of soil to adjust to the toxic effect of applied phytotoxic compounds. Therefore, efforts be made to increase the organic content in soil through green manuring, incorporation of crop residues and applications of FYM, NADEP, Vermi compost, etc. Therefore, it is proposed that each Krishi Vigyan Kendra (KVK) will adopt a village preferably the village identified for establishment of climate field school and develop it as a bio-village. The number of villages may be increased subsequently. It is also proposed that efforts being made by agriculture department for promoting organic farming under Macro-mode, NFSM, RKVY and other schemes need to be strengthened. Adopted/ identified villages have to be developed as a model village to establish as a Centre of Excellence and all Conservation Agriculture (CA) techniques proposed under different sub-components namely; use of organic manure, crop residue management, green manuring, soil management practices, crop rotation and diversification, farming system, farm mechanization will be demonstrated. Financial support to organic farming and develop bio-villages is solicited.

### AGR-6 Soil Management Practices

Soil can remove carbon dioxide from atmosphere by minimum tillage or zero-tillage practice, which should increase soil organic carbon (SOC). Climate change also alters the microbial activity and its population in the soil that causes the breakdown of organic matter at faster rates and results in greater release of carbon dioxide. Crop rotation is also an established practice which helps in improving the poor soil condition. In-situ crop residue management with the help of rotavator has

been found very beneficial as the plant nutrients are added after its decomposition. Atmosphere polluted due to burning of crop residues is also saved. Therefore, resource conservation technologies and appropriate farm machineries need to be popularized. On-going efforts to promote farm machineries viz; Laser leveller, Micro Irrigation Systems (drip/ sprinklers, HDPE pipes), /Zero-tillage, rotavator, seed drill, weeders etc. need to be strengthened. Therefore, the required costly farm machines are proposed to be provided to Climate Farm Schools/ Cooperative/ Panchayat/ Rural Youth of the selected villages to lend them on custom hiring basis from these Custom Hiring Centres (CHC's). Small implements such as Animal drawn 3-row seed drill, Animal drawn Patela harrow developed by Central Institute of Agricultural Engineering (CIAE) will also be promoted to optimize the in-situ moisture available. The Climate Smart Village models of NICRA will also be considered and tested.

### AGR-7 Farming system approach for diversifying incomes and livelihoods

Farmers' first priority is to seek opportunities to make their existing livelihoods, namely agriculture, more resilient. The second priority is to seek alternative livelihoods, like additional income generating activities. Livestock as an integrated component have the potential to mitigate some of the adverse effects of climate change. Livestock is a key component especially in small scale farming systems. Poultry, fish farming, bee keeping, vegetable cultivation and fruit farming are some of the activities which make agriculture more resilient, while at the same time help diversify livelihood options and thus reduce the probable risks coming from climate change. Farmers need only to take small steps to adapt new enterprises to benefit fully, while also contributing to climate change mitigation. Thus, suitable farming system modules for different farm sizes situated under different agro-climatic zones of U.P. need to be developed and popularized. The SAUs will be involved in development and validation of farming modules, while the responsibility of their popularization will rest on Agriculture Department. Farming System models developed by the PDFSR, Modipuram, Meerut and other institutions will also be validated and refined for different situations. Support to develop and popularize these farming system modules is desired.

### AGR-8 Diversification of cropping systems and promotion of stress tolerant crop varieties

In more vulnerable areas, higher plant diversity in the form of crops and trees would mean more efficient conversion of $CO_2$ to organic form during photosynthesis, thus reducing the chances of global warming and climate change. The advantage of crop diversification is that it will ensure some income even if one of the crops fails due to pests, diseases, drought, flood or any other calamity. Cultivation of vegetables, fruit trees, climbers, legumes, oilseeds etc. could all be grown in a unit area. Therefore, crop combinations or cropping systems suitable for different situations need to be identified and promoted.

Further, crop varieties suitable for both i.e. biotic and a biotic stress conditions need to be promoted. For flood affected and waterlogged areas; Swarna sub-1, Jalnidhi, Jalmagn, Jalpriya varieties and for drought prone areas Sahbhagy Dhan, Shushk Samrat and IR-64, sub-1 varieties of rice need to be promoted. Similarly, for very late and warmer winter/conditions, Halna and improved Halna varieties

of wheat need to be promoted. **Stress tolerant varieties will be promoted in collaboration with SAU's and Research Institutions.**

### AGR-9 Popularization of aerobic rice cultivation methods

Uttar Pradesh has about 60 lac hectare area under rice cultivation and of this maximum area is irrigated and has puddled situation. Methane emissions that have a warming potential 21 times that of carbon dioxide are common and significant in puddled, anaerobic paddy fields and also when crop residues are burnt. Out of total carbon dioxide equivalent GHG emitted from agricultural sector, 25% ($CH_4$ 4070 or $CO_2$ equivalent 85470 Gg) is coming from puddled rice fields alone. Since the state has about 14% of the country's total area under rice, it is estimated that about 14% of the total emission is coming from rice fields. This Green House Gas emission from rice fields can be mitigated by shifting to an aerobic cultivation methods e.g. System of Rice Intensification (SRI) system. Direct Seeded Rice (DSR) fields will also reduce methane emission. Thus, SRI and direct seeding of rice need to be popularized. Proper drainage network and use of coated nitrogenous fertilizer and use of ammonium sulphate as an alternative are also helpful in reducing $CH_4$ emission. Support to cono weeder, marker, zero-ferti-seed drill, drum seeder etc. is pre-requisite to promote aerobic rice cultivation. The programme is proposed to be implemented by Department of Agriculture. Expertise and technologies on aerobic rice cultivation available at ICAR institutes and other organizations will also be validated and promoted after desired improvements/ modifications.

### AGR-10 Popularization of Agro-forestry

In agro forestry, all the weather elements are modified and with proper selection of species and tree management techniques, it is possible to optimize the micro-climate of intercrops. Since, yield of field crops is affected by tree species, therefore, adequate knowledge about choice of tree species, tree canopy architecture, pruning intensity and other management practice has to be imparted. Considering the small size of land holdings and dominance of small and marginal farmers (91%) in the state, the agro forestry species should be suitable for boundary planting. Based on the choice of species, Agro-forestry as fence also serves several other functions- a windbreak, a habitat for beneficial birds source of forage, fuel and timber wood. Therefore, considering the advantages of agro forestry, it is proposed that various agro forestry systems developed by NRCA, Jhansi, IGFRI, State Agricultural Universities and other research institutions be promoted with necessary refinements in different agro climatic zones of the state.

### AGR-11 Climate responsive research programmes

To develop effective and efficient policies to overcome the challenges imposed by climate change, regular research back-up has to be provided for sustainable agriculture. Therefore, to develop risk management strategies as the agricultural sector faces several risks in the form of climatic extreme events, infestation by pests and diseases, research programmes on following themes are proposed. The programme will be implemented by SAUs, ICAR and other research organizations. Projects on identified themes will be funded following CARP (Competitive Agricultural Research Programme) mode.

(i) Develop more $CO_2$ responsive crop varieties especially of $C_3$ plants e.g. rice, wheat using biotechnological tools to sustain thermal stresses.
(ii) Development of water and nitrogen use efficient crops to enhance tolerance to drought, water logging, sodicity, pest and disease infestation following different breeding approaches including recombinant DNA techniques.
(iii) Research on off-season farming.
(iv) Develop and implement region specific contingency plans for different vulnerability and risk scenarios.
(v) Development and validation of weather derivative models.
(vi) Development and validation of crop simulation models to simulate impacts of climate changes on agricultural crops.
(vii) Development of nutritional strategies for managing heat stress in dairy animals under changed climatic conditions.
(viii) Research on poultry and fisheries under changing climate.
(ix) Research on improvement of efficiency of pumping sets and other energy operated farm machineries.

The Council (UPCAR) has well defined CARP guidelines for funding research proposals on identified priority area's to address the location specific problems. According to CARP guidelines, first of all priority research areas are advertised in widely published prominent newspapers to invite the synopsis. Received synopses are reviewed and shortlisted by a committee constituted under the chairmanship of Director General, UPCAR. Beside UPCAR officials and scientists, committee also has three renowned experts of subject concern as a member. After short listing, detailed research project proposals are invited from selected Principal Investigators. Theme wise detailed research proposals received are sent to three Peer Reviewers to assess their suitability and necessary comments and suggestions. In light of comments and suggestions made by Peer Reviewers, revised project proposals recommended for financial support are called. These revised project proposals are presented by Principal Investigator before the Research Advisory Committee (RAC) constituted under the chairmanship of Chairman, UPCAR/ Agriculture Production Commissioner (APC), Govt of Uttar Pradesh. On the approval of RAC, project is considered for financial support. As per CARP guidelines, Memorandum of Understanding (MoU) is signed between UPCAR and implementing agency. The prescribed CARP approach is completed in defined time frame.

Since CARP guidelines are systematic, time bound and transparent, hence, will also be followed for awarding the research projects on researchable issues identified under the programme. Detailed project proposals on identified issues will be invited from competing scientists once this proposal is accepted principally. Under CARP procedure, selection/ identification of implementing agencies in advance at this stage is not possible. However, research projects will largely be executed by SAUs, ICAR and CSIR institutions and other research organizations operating in the state. In general, ICAR addresses the national issues, while under RKVY, issues pertinent more to the Uttar Pradesh conditions will be addressed.

Further, under National Initiative on Climate Resilience Agriculture (NICRA), in Uttar Pradesh strategic Research programme is confided only to ICAR institutions namely; IIPR, IIVR, PDFSR and IVRI. Demonstration of various technologies under NICRA are also being restricted to only four drought prone districts viz; Jhansi, Chitrakoot, Hamirpur and Sonabhadra and five flood affected districts namely; Bahraich, Gorakhpur, Maharajganj, Gonda and Kushinagar and that too on very small scale. The state is very large and having vast agro-ecological variability, therefore, up scaling of programme is essential to develop conservation agriculture technologies and refine them for specific situations and growing environment. However, all precautions will be taken to avoid any type of duplication with ongoing ICAR programmes.

## 5.4 BUDGET FOR SUSTAINABLE AGRICULTURE MISSION

The total budget for this mission in identified key activities is expected to be Rs 102.75 crore for the 2014-18 period. This is largely climate additional as many business-as-usual activity have not been included.

# 6 SOLAR ENERGY MISSION

## 6.1 OVERVIEW OF THE POWER SECTOR IN UP

Power is one of the most important infrastructure ingredients for the development of an economy. The state has introduced its energy policy, 2009 which focuses on providing reliable, quality and affordable power to the dwellers of the state. Uttar Pradesh has a power deficit of 15%, which is significantly higher than the national power deficit of 8.5% during FY2010. Whereas the per capita power consumption stands at around 348 KWh, which is lower than the national level of around 779 KWh (FY2010). On the other hand, transmission and distribution loss posted by the state stands around 31%, which is comparatively higher than the national level of around 25% during FY2009.

The state has introduced Input Based Franchisee system in some selected cities to improve the power distribution system, which has already been implemented in Agra. An arrangement of Rs. 23928 crore has been made in the annual budget of FY2014 under various schemes for improving power scenario within the state.

Table 9 Power generation in UP

| Installed Capacity | in MW | 10780.93 |
|---|---|---|
| State generated | % | 45.20% |
| Central generated | % | 43.10% |
| Private IPP | % | 11.700% |
| Coal based | % | 88.70% |
| Hydro | % | 4.80% |
| Other (biomass, renewable etc.) | % | 6.50% |

Source: PHDCCI

It is clear from the above table that the power sector is fossil intensive. The focus related to climate change thus has been to enhance solar energy generation in the state and also exploring options in energy efficiency.

## 6.2 IMPACT OF CLIMATE CHANGE ON ENERGY SECTOR

Uttar Pradesh houses the largest number of energy poor in India and climate change would enhance stresses on them. Developmental needs such as health for all, housing for all, education for all, potable water for all, and meeting other Millennium developmental goals and national and state planning targets would require more energy to be consumed and thus produced. Climate change would also enhance the space cooling and heating requirements, industrial energy demand, as well change the energy supply mix. Uttar Pradesh needs to assess these implications using appropriate methodologies, including modelling.

Solar Policy of Uttara Pradesh

Applicable for projects of minimum 5 MW capacity in case of grid connected solar power.

Solar power plants of above 5 MW capacity for captive use will also be eligible for incentives under this policy.

Time Limit for commissioning of Solar PV projects – within 13 months & 28 months in case of solar thermal projects from the date of signing of PPA.

Special Incentives by State Government on case to case basis for establishing Solar Farms with an investment of more than INR 500 Cr.

.All the incentives applicable under the Uttar Pradesh Infrastructure and Industrial Investment Policy 2012 also applicable for power plants based on solar energy.

Expenditure on the construction of transmission line and substation will be borne by the state government on for all the projects in the Bundelkhand Region.

.UPNEDA will act as single window clearance agency for Solar Power Projects.

Electricity is the basic need for social and economic development of urban and rural areas of any State. Apart from shortfall in total energy requirements, the shortage of peak power is more acute in Uttar Pradesh. Peak period gap is over 25 percent of the availability. 88.1 percent villages were electrified by the end of the year 2007-08, while the corresponding national figure was 82.3 percent. With a view to achieve the goal of electricity for all households of the state by 2012, significant provisions have been made in the Eleventh Five year plan. The quantity and quality of power is also to be enhanced in the state, for which additional investments would be required.

The state is mainly dependent on thermal power which provides bulk of energy to the state. In addition, hydroelectric and nuclear power also contributes to the energy requirements of the state. The state's hydro potential has been assessed as 15000 MW against which about 1504 MW has been harnessed so far with the state's share of 236 MW. Thus the total installation available to the state is in about **83:17 thermal hydro mix, which needs to be augmented in favour of hydropower to bring it closer to the ideal 60:40 mix which will also have implications for GHG emissions mitigation**, enhancing adaptation to climate change through flood and draught control, and reducing risks of an **imposed carbon constraint on coal consumption**.

Use of solid fuels in households for energy purposes results in indoor air pollution related health impacts. Open and uncontrolled burning of biomass also contributes to black carbon emissions. Diesel consumption in private generator sets, to cover for power shortages, also contributes to GHG emissions, and local pollutants emissions including **black carbon**. Uttar Pradesh also simultaneously needs to estimate these emissions using appropriate measurements, activity data collection and modelling. Modern energy resources and choices have to be provided to these vast populations.

Uttar Pradesh is also witnessing **developments in biomass based power generation** and also looks forward to higher blends of ethanol and biodiesel for its petroleum products. Assessment of biomass potential (technical, economic and market) would need to be conducted for the state. Its implications for energy security, employment enhancement, green cover enhancement and water connectivity needs to be estimated in an integrated impact assessment framework under climate change.

## 6.3 KEY PRIORITIES UNDER SOLAR MISSION

### SSE-1 Promotion of solar water heating system

Solar water-heaters even if used as a backup system can significantly reduce the usage of conventional power. The state has several places of tourist attractions and resorts. There are also large number of public buildings and new real estate projects. Use of solar water heating systems can be made mandatory through amendment in local bodies building bye-laws. Estimated cost of 100 liters per day capacity solar water heating system is Rs 30000/-. Presently 30% subsidy is available under National Solar Mission, estimated cost for 05 years 2014 to 2018 Rs 60 crores and for 10 years is Rs 120 crores.

### SSE-2 Promotion and implementation of standalone solar systems

This includes solar street lighting systems for use in institutions, communities and especially rural areas with no access or little access to conventional power. Estimated cost of solar street lighting system is Rs 20000/per system, State subsidy of Rs 7100/- per system and maximum 30% subsidy is available from GoI under National Solar Mission. Remaining to be borne by beneficiary community. Estimated cost for 05 years 2014 to 2018 is Rs 350 crores and for 10 years is Rs 750 crores. It is possible to install 35000-40000 systems/year with a proper battery recycling and maintenance programme. This can be organized under National Skill Development program.

### SSE-3 Deployment of solar pumps in agriculture

The power availability in rural areas are low and quality of power is also not good. This has impact on pumping systems and survival of crops. Deployment of solar pumps for irrigation purposes as a replacement of diesel and electrical pumps being used by individual farmer or owned by Government can reduce the emission. Cost per pump Rs 274911/- maximum 30% subsidy provided by GoI under Solar Mission and 45% subsidy is being provided under Rashtriya Krishi Vikas Yojna by agriculture department Govt. of U.P. Estimated cost for 05 years 2014 to 2018 is Rs 137.45 crores and for 10 years is Rs 343.633 crores. For the first five years 5000 pumps can be installed and a higher target of 7500 can be set for next five years.

### SSE-4 Megawatt-scale solar plant

This will help in bridging the gap between demand and supply of conventional grid power promotion of Solar Grid power through installation of Megawatt scale Solar Power Plants. The enabling notification from Government of India has been made and letters have been issued to state to identify land and check viability. Estimated cost is now dropped from Rs 8.5 crore to Rs 7 crore per Megawatt. State can have a target of 500 MW under this scheme. Estimated cost for 05 years 2014 to 2018 is Rs 3500 crores and for 10 years is Rs 7000 crores.

### SSE-5 Rooftop solar power generation

Rooftop solar generation will cut down conventional energy cost. This will get a boost if the UPREC notifies the enabling policy with regard to net metering and also solar power obligations. Estimated cost is Rs 80000.00 per KW for first five years 2014 to 2018 (2 MW) and is Rs 16 crores and for 10 years (5 MW) is Rs 56 crores.

## 6.4 BUDGET UNDER SOLAR MISSION

The total budget under solar mission for 2014-18 will be in the range of Rs 449.75 crore.

# 7 ENERGY EFFICIENCY MISSION IN UP

## 7.1 OVERVIEW

There are huge scope of energy efficiency improvement in the state of Uttar Pradesh in agriculture, municipalities and small industries sector.

In the state of Uttar Pradesh, the major population of **agriculture pumps** is diesel operated. The energy saving potential assessment has been carried out only for agricultural pump sets, whereas other allied areas have not been considered. Based on several studies carried out on agricultural pump set efficiency, it has been found that the pump efficiency varies from 25 - 35% due to various factors. By adopting BEE star labeled agricultural pump sets, the efficiency can be enhanced up to 50 - 52%. It is estimated that, by replacement of existing pumps with the BEE star labeled pumps, the achievable saving potential is 30 -40% and sectoral saving potential works out to be 1.7 Billion Unit per year.

As per an assessment conducted by BEE (2009-10)[2] the annual electricity sale to public lighting and public water works & sewage works out to 1.183 BU. For the 13 major **Municipalities and Municipal Corporations** considered, annual electricity consumption for street lighting is 0.361BU and annual consumption for water & sewage pumping is 0.696 BU. Based on sample studies, the energy savings potential for street lighting in above municipalities & corporations is assessed to be 25% and works out to 0.09 BU per annum, while the energy savings potential for water works & sewage in municipalities & corporations is assessed to be 20% and works out to 0.139 BU per annum. The aggregate sectoral saving potential among the above works out to 0.229 BU.

Similarly for the **SME cluster**; seven energy intensive clusters have been identified in Uttar Pradesh, namely; Cold Storages, Carpet, Pottery, Brass, Foundry and Glass Clusters for energy savings assessment is estimate at 9206 tonnes of oil equivalent.

The major avenues for energy savings in rural **domestic sector** include: Replacement of GLS bulbs with CFLs Adoption of BEE star labeled domestic appliances like ceiling fans, refrigerators, AC units, tube lights etc. The savings potential in rural segment by adopting CFLs and BEE star rated products is 40-50%. The savings potential in urban segment by adopting BEE star rated products is 15 - 20%. On the whole, the energy savings potential in domestic sector is estimated 20 - 25% which accordingly works out to 2.74 BU per year.

In addition the state has undertaken huge capital investment programme with DISCOMs for AT&C loss reduction.

[2] http://www.emt-india.net/eca2009/14Dec2009/CombinedSummaryReport.pdf

## 7.2 KEY PRIORITIES UNDER ENERGY EFFICIENCY SUB MISSION

### SSEE-1 Energy Audits should be strictly enforced for all government buildings.

Suitable guidance should be provided to file annual audit reports of these buildings and compliance. Energy Audits of Government Buildings may be done in phased manner. Energy Audit Reports in government buildings suggest the following salient points

- Installation of APFC (Automatic Power Factor Corrector)
- Use of LED Lights
- Use of star rated energy efficient fans
- Use of star rated Air Conditioners
- Use of solar systems

All of the above should be made mandatory in all-government buildings. Rate Contract for APFC, LED Lights, Star Rated Fans, Star Rated Air Conditioners and Solar Roof Top Systems may be made. Timelines may be fixed for installations of the above in government Buildings.

### SSEE-2 Sensors/Timers in the Street Lights should be made mandatory

Sensors/Timers to switch off the lights when not in use/not required are not in vogue in the buildings. Suitable sensitization programmes have to be launched. Time Lines may be fixed for installation of sensors/timers. ESCOs need to be engaged in pilot programmes.

### SSEE-3 Reduction of Transmission & Distribution Losses in Power Sector

40% T&D losses were reported in the revenue filings of UPPCL. Government Orders to be made to spend 5% of revenue earned by each Distribution Division to strengthen existing system of 11KV/440 Volts by 33KV/440 Volts (HVDC). Input based franchisee system also can be scaled up.

### SSEE-4 Mandatory use of solar devices

This can be used both as stand-alone system for DSM measures. The use of Solar Water Heaters, Solar Water pumps & Solar Street Outer Building Lights should be made mandatory for buildings above the load of 500KVA.

### SSEE-5 Energy Conservation Building Codes

Energy conservation Building Code (ECBC) can be made mandatory for New Government office Buildings and all new commercial buildings. Suitable modifications in related departments such as works, urban development (development regulation), general administration, housing, energy etc. should be pursued.

### SSEE-6 Fiscal Concession

Government Taxes & Duties may be lowered on energy efficient technologies like LED, Solar etc. This can be done in consultation with Finance Department and other related departments. Concerned departments can make such provisions though suitable administrative order.

### SSEE-7 Rainwater harvesting

Individual houses, commercial complexes are to be taken into the ambit of this mandate. This may be mandatory for public buildings, commercial complexes and for individual residential houses either concessions in holding tax can be provide. Development and Town Planning authorities, realtors and architects need to be sensitized.

### SSEE-8 Demonstration projects on off grid electricity supply to villages

Decentralized Renewable Energy (DRE) based micro grids can serve as an important electricity supply option for villages in UP. Some pilots have been initiated through SELCO and DA[3] in in Faizabad, Ambedkar Nagar, Sultanpur, Jaunpur, Basti, Siddharth Nagar, Gonda, Bara Banki, Sitapur, Hardoi, Farrukhabad, Jhansi, Mahoba and Hamirpur.

### SSEE-9 Green Building and plantations

Even though GRIHA and LEED rating can be introduced in phased manner for new public and large commercial constructions; it is important to raise plantations around and on the roof tops of government buildings.

### SSEE-10 Star rating of pumping system

As described in overview there is huge scope of improvement in energy efficiency in this segment. All types of Electrical motors, drinking water pumps and private tube wells should be BEE star rated pumps.

### SSEE-11 Ceiling Fans and Air Conditioners should be BEE rated

Many small towns and villages in UP use poor quality fans and air conditioners which uses at least 30-40% more energy than the rated ones. There should be awareness programs on cost-benefit.

[3] Off grid interventions
http://www.smartpowerindia.org/Publications/Press_Release_%28English%29_UP_villages_to_go_power_packed_with_solar_energy.pdf

## 7.3 BUDGET UNDER ENERGY EFFICIENCY SUB-MISSION

The state designated agency has only proposed policy actions and no budget has been provided by the State Designated Agency for 2014-18 period.

# 8 GREEN UP MISSION

## 8.1 OVERVIEW OF FOREST IN UP

The forests and biodiversity in UP are important in many ways: as source of fuel and fodder, as source of industrial inputs, habitat for thousands of plant and animal species, as carbon sink, and as a protective cover for its soils. Forests are also important as they provide several ecosystem services. Bifurcation of Uttaranchal State from UP in 2000 has reduced the number of ecological zones in UP to three (Terai, the Gangetic plains, Vindhyan rages) from the earlier six. There are three major forest types in UP viz. tropical moist deciduous, tropical dry deciduous and tropical thorn forests. These forests are spread over in the Northern, Northeastern and Southern parts of the state. While the Terai region has mostly moist tropical forests of sal, Eastern UP has dry deciduous mixed forest, Eastern and Western UP generally have teak or mixed forest, and the Budelkhand region is covered widely with thorny scrub forests.


Figure 30 Forest Cover map of UP, FSI 2013

Forests in Uttar Pradesh are among the most important natural resources, which have played a fundamental role in supporting the livelihood of the people, mainly the poor rural masses. Historically, the forests provided the basic resources for survival and economic development. However, in recent years, factors such as rapid increase in human and cattle population, incidence of

poverty and industrial growth have resulted in a situation where in the demand trends are far outstripping the forest's natural ability to sustain the frequently conflicting needs. Even with the increased pace of plantations, the forest resource supply is not likely to meet demand. This will result into further accelerated degradation of the forest resources.

Pressure is also mounting to recognize the forest as source of other social and environmental services. Forest resource in Uttar Pradesh, as per changing public expectations, should be managed, not just as a source of raw materials, but as means to secure poverty alleviation for the forest-fringe dwelling communities, as habitat for wildlife, for recreational/aesthetic uses and for protection of ecological functions. The changing social values are forcing the forestry institutions in Uttar Pradesh to reorient the nature and scope of their role as forest resource managers.

**Vision of the Forest Department** is to *endeavour nurturing forests through world-class forest management practices for conservation of biodiversity, accrual of sustained goods and services and large-scale plantations for green cover extension, to provide a clean and green environment to society at large. It also aspires to adopt innovative approaches for inculcating conservation ethics in the minds of the people*.

Forest Survey of India regularly estimates the forest cover in the country through remote sensing techniques. It is pertinent to note that the 'forest area' is the area recorded as forests by the Government as per revenue records. However; 'forest cover' refers to all lands more than one hectare in area, having a tree canopy density of more than 10%. Thus, the term 'forest area' denotes the legal status of the land as per the Government records, whereas the term 'forest cover' indicates presence of trees over any land.

## State Forest Policy

i. Improvement of existing natural and planted forests by conservation, development and scientific and thoughtful management;

ii. Formulation and implementation of schemes of afforestation and soil conservation in different types of degraded lands of state viz. usar, khader, ravines and blank forest areas;

iii. Increase of tree cover by social and agro forestry plantations on community, institutional and private lands;

iv. To endeavor for the reduction of siltation of water and reservoirs and effects of floods and drought through control measures over soil erosion and denudation for soil and water conservation in the catchment areas of rivers, lakes and rivers, lakes and reservoirs;

v. To take measure to increase the existing forest cover and it's productivity;

vi. To reduce the gap between the demand and supply of forest produce for meeting the needs of fuel, fodder, minor forest produce and timber for rural poor and tribal;

vii. To reduce the biotic pressure on forests by proper utilization of timber and other forest produce and to promote the use of alternate materials;

viii. To prepare and implement strategies for conservation and improvement of biodiversity and wild life in the state;

ix. To promote mass movement in the state especially with the active participation of women and rural people residing near forest areas so as to meet all the above objectives.

As per State of Forest Report,2013 published by Forest Survey of India the status of forest cover in Uttar Pradesh is as follows:

| Forest Cover Change Matrix | | | | | | (Area in km²) |
|---|---|---|---|---|---|---|
| 2011 Assessment | 2013 Assessment | | | | | Total |
| | VDF | MDF | OF | Scrub | NF | 2011 |
| Very Dense Forest | 1,623 | 0 | 1 | 0 | 2 | **1,626** |
| Moderately Dense Forest | 0 | 4,550 | 2 | 0 | 7 | **4,559** |
| Open Forest | 0 | 0 | 8,129 | 0 | 24 | **8,153** |
| Scrub | 0 | 0 | 19 | 723 | 3 | **745** |
| Non Forest | 0 | 0 | 25 | 83 | 225,737 | **225,845** |
| **Total 2013** | **1,623** | **4,550** | **8,176** | **806** | **225,773** | **240,928** |
| Net Change | -3 | -9 | 23 | 61 | -72 | |

Figure 31 Forest cover change matrix, FSI, 2013

The open forest category and scrub forest category have increased showing successful planation and conservation measures. The agro climatically diverse terai, vindhyan, ravenous and indo-gangetic plains areas harbor very widely varied life formers. For strengthening the conservation of these, the state has declared a new sanctuary, namely the Pilibhit wild life sanctuary spread over 603 sq.km. in 2014. With this the total area under the protected area network has risen to 6317 sq.km. which is about 2.62% of the geographical area of the State.

## 8.2 IMPACT OF CLIMATE CHANGE ON FOREST IN UP

An assessment of the impact of projected climate change on forest ecosystems in Uttar Pradesh is made using the following:

- Climate change scenario; A1B scenario
- Period of assessment; short-term (2021-2050) and long-term (2071-2100) periods.
- Climate impact model; global dynamic vegetation model IBIS
- Period of assessment; short-term (2021-2050) and long-term (2071-2100) periods.
- Input data; monthly mean cloudiness (%), monthly mean precipitation rate ( mm/day), monthly mean relative humidity (%), monthly minimum, maximum and mean temperature (C) and wind speed (m/s), soil parameter (percentage of sand, silt and clay) and topography.

The impacts of projected climate change are assessed at regional climate grid scales (about 50 X 50 km).The dynamic global vegetation model (IBIS) has been validated by IISc for its suitability to Indian conditions. The dynamic vegetation model outputs show that during the short-term period of 2030s, out of the 752 forested grids in Uttar Pradesh, 53 (7.04%) will be impacted by climate change. Similarly a higher percentage (35.64%) of the forested grids is projected to be impacted by 2080s. The distribution of forested grids projected to be impacted by climate change is presented in Fig 32 for 2030s and 2080s. A change in forest types is projected in the southern part of Chandauli, Chitrakoot and Mirzapur, north-western part of Khetri, Sonbhadra and parts of Pilibhit, Agra and Lalitpur districts. Thus the forests in some of the districts of Uttar Pradesh are projected to be adversely impacted by climate change by 2030.

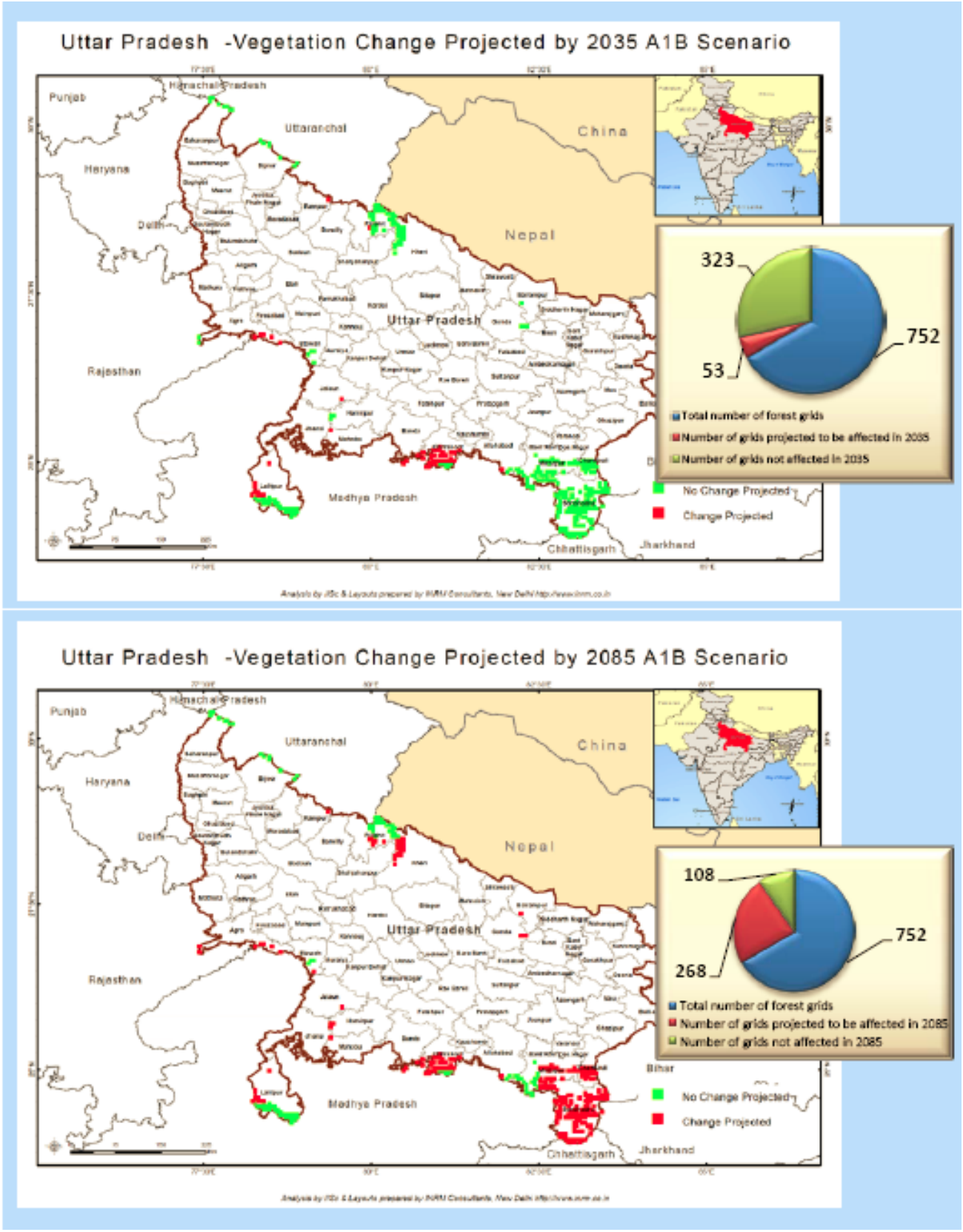



Figure 32 Projected Change in UP forest under emission scenarios

Any short-term or long-term fluctuations of climate can have dramatic effects on the forest productivity and impact forest dependent communities and their livelihoods. Increased climatic variability and prolonged droughts and higher temperatures can result in increased fire incidence and lead to forest degradation. Other impacts could potentially include advancing/late unfolding, blossoming, and ripening in the leaves and fruit of wild plants; and of patterns of hibernation, migration, and breeding of wildlife in mountain regions and changes in synchronous relationships between predators and prey, as well as those between insects and plants, proliferation of existing weeds and evolution of new phenotypes, even the formation of novel species' associations and other ecological surprises.

Other Anthropogenic issues need attention are dependence on fuel wood and livestock grazing.

Table 10 Quantity of wood used in house construction, furniture and agricultural implements: (in Million cum)

| House Construction | Furniture | Agricultural Implements |
|---|---|---|
| **42.018** | 15.107 | 4.255 |

Table 11 Annual Consumption of fuelwood

| No. of persons using fuel wood (millions) | No. of persons using fuel wood from forests (millions) | Quantity of Fuel wood used (million tonnes) | Quantity of fuel wood used from forests (million tonnes) | % of previous column w.r.t. column left of it |
|---|---|---|---|---|
| 175.096 | 10.495 | 19.063 | 1.294 | 6.79 |

Table 12 Dependency of livestock on Forests:

| Total Live Stock | Live Stock Dependent on Forests | Total Adult Cattle unit | Total Adult Cattle Unit dependent on Forest | % of previous column w.r.t. column left of it |
|---|---|---|---|---|
| 58.92 Million | 10.05 Million | 54.20 million | 9.73 million | 17.95% |

## 8.3 ONGOING PROGRAMMES

Some of the on-going programmes and works of the Forest Department have been listed below.

**Social Forestry Scheme**: It is a scheme for raising plantations in forest areas as well as community lands, road sides, canal sides and other government lands. It is funded under district sector of state plan. It includes schemes under special component plan as well as tribal sub plan.

**Green belt development scheme**: It is a flag ship scheme of state government aimed at raising green belts in all the districts of state. Areas of 50/100 acres are earmarked for this scheme and hundred percent survival of plants is ensured. Under this scheme a block of 1000 acres has been planted in Etawah district of state.

**National Afforestation Programme**: It is the flagship scheme of NAEB, in so much as it provides support, both in physical and capacity building terms, to the Forest Development Agencies (FDAs) which in turn are the main organs to move forward institutionalization of Joint Forest Management. Under Entry Point Activities, community assets are created with a 'care and share' concept. Presently it is being implemented in the state and we have 2223 JFMCs. A sum of Rs 23.99 crores have been earmarked for this scheme in the current financial year.

Details of plantations raised by the forest department during last five years under various schemes are as follows:

Table 13 Plantations raised by Forest Department

| Year | Plantation (ha.) | | No. of Plants (In lacs) | |
|---|---|---|---|---|
| | Target | Achievement | Target | Achievement |
| 2009-10 | 66683.58 | 80597.40 | 597.08 | 812.81 |
| 2010-11 | 40300.00 | 67427.18 | 261.31 | 646.86 |
| 2011-12 | 41000.00 | 74181.85 | 266.50 | 564.72 |
| 2012-13 | 45000.00 | 51884.87 | 292.50 | 393.33 |
| 2013-14 | 49500.00 | 57097.29 | 321.75 | 456.67 |

Other government departments have also contributed in this and their efforts during last five years are reflected as follows:

Table 14 Plantation under convergence with other departments

| Year | Plantation (ha.) | | No. of Plants (In lacs) | |
|---|---|---|---|---|
| | Target | Achievement | Target | Achievement |
| 2009-10 | 14700.00 | 15764.47 | 110.55 | 122.49 |
| 2010-11 | 14700.00 | 15465.09 | 95.55 | 132.68 |
| 2011-12 | 14600.00 | 15765.19 | 94.90 | 140.20 |
| 2012-13 | 16450.00 | 14835.12 | 106.92 | 97.97 |
| 2013-14 | 18100.00 | 21755.82 | 117.65 | 143.24 |

**Uttar Pradesh Participatory Forest Management and Poverty Alleviation Project:** It is under implementation in the 20 forest divisions spread over 14 districts of the state of Uttar Pradesh. The project is being funded through a soft loan provided by the Japan International Cooperation Agency, JICA (formerly Japan bank for International Cooperation). It aims at restoring degraded forests, augmenting forest resources and improving livelihood for and empower the local forest dependent communities.

**Bamboo Mission:** The Project objectives are to promote the growth of bamboo sector through an area based regionally differentiated strategy, to increase the coverage of area under bamboo in potential areas, with suitable species to enhance yields, to promote marketing of bamboo and bamboo based products including handicrafts, to establish convergence and synergy among stakeholders for the development of bamboo, to improve economic level and generate employment opportunities for skilled and unskilled poor people especially unemployed youths: - Clearing dead, damaged, and entangled bamboo shoots, doing the necessary ground clearance and soil culture and mounding the rhizomes. These operations help in the regeneration of the clumps and growth of strong shoots and increase the productivity of the bamboo forests. It is being run with the support from Ministry of Agriculture, Government of India.

**Bundelkhand Package**: This project is aimed at intensive management and eco restoration of ravine areas of Bundelkhand. The activities include watershed management in forest land, soil& moisture conservation works, assisted natural regeneration works etc.

| Item | Released Amount | Physical achievement (ha.) | Financial (Rs. In lacs) |
|---|---|---|---|
| Water shed management in forest land | 3007.40 | 25386.5 | 2960.395 |
| | 533.48 | 4491 | 533.476 |
| | 3156.00 | 26574 | 3156.00 |
| Soil and water conservation in forest land | 5000.00 | 28948 | 3467.81 |
| **Total-** | **11696.88** | | **10117.68** |

**Green India Mission**: Multiple objectives including improved quality of forest cover, increased forest/ tree cover, improved ecosystem services, increased forest based livelihood income, and enhanced annual carbon sequestration, with bottom-up participatory approach with Gram Sabha/Joint Forest Management Committees (JFMCs) at the helm of planning, decision making and implementation, involvement of local educated youth. State has adopted a landscape based approach and five landscapes have been identified in Uttar Pradesh in its five agro climatic zones. Preparatory activities including awareness, outreach and communications, micro-plans, landscape survey, detailed mapping, nursery development, etc. are underway.

Department has submitted fourteen bridge plans for three L1 areas out of which one was sanctioned by Government of India and a sum of Rs 119.50 lacs was released. After completion of approved works ten micro plans have been submitted and total financial requirement is Rs. 918.53 lacs. The sanction of this amount is still awaited. Apart from this sanction of following bridge plans are also awaited:

**Table 15 Investment Programmes under GIM**

| SN | Name of L-1 | Name of L2 | No. of L3 |
|---|---|---|---|
| 1 | Eastern Gangetic Plains | Shankar Garh | 16 |
| | | Koraon | 13 |
| | | Meja | 16 |
| 2 | Western Gangetic Plains | Arawalai Hillls | 4 |
| | | Yamuna Chambal Basin 1 | 3 |
| | | Yamuna Chambal Basin 2 | 10 |
| | | Meerut District | 9 |
| | | Bagpat District | 16 |
| 3 | Vindhya Area | Son 1 | 3 |
| | | Son 2 | 4 |
| | | Kanhar 1 | 1 |
| | | Kanhar 2 | 3 |
| | | Rihand 1 | 3 |
| | | Rihand 2 | 4 |
| **Total** | **3** | **14** | **105** |

Table 16 Capacity Building Programmes under GIM

| SN | Item | No. | Rate ( Rs in lacs) | Total (Rs in lacs) |
|---|---|---|---|---|
| 1 | Training workshops | 5 | 4.00 | 20.00 |
| 2 | Nursery Development | 14 | 5.00 | 70.00 |
| 3 | Landscape Survey | 14 | 6.00 | 84.00 |
| 4 | Entry point activities and soil and moisture conservation works | 105 | 10.00 | 1050.00 |
| 5 | Preparation of Micro plans | 105 | 0.25 | 26.25 |
| 6 | Outreach Activities | 105 | 0.02 | 21.00 |
| 7 | Misc. administrative expenses | | LS | 8.75 |
| | **Total** | | | **1280.00** |

**State CAMPA:** Under the provisions of Forest Conservation Act,1980 various agencies who get permission to use forest land for non-forestry purposes pay for compensatory afforestation and also the Net Present Value of the land as per orders of Hon Supreme Court. This money is with Ad- Hoc CAMPA Committee of GOI and state share is released to State CAMPA on yearly basis. Different forestry and other activities are undertaken in this program. The works done so far are summarized as follows:

### Table 17 Progress under CAMPA

| Year | Item of Works | Achievements | |
|---|---|---|---|
| | | Phy. | Fin. (Rs. In lacs) |
| **A-Compensatory Afforestation (CA)** | | | |
| 2009-10 | Plantation (ha.) | 1672.31 | 2175.10 |
| | Strip Plantation (km.) | 2 | |
| | Plantation in Brick guard/Tree guard/Barbed wire fencing (Saplings) | 91649 | |
| 2010-11 | Plantation (ha.) | 1586.23 | 846.43 |
| | Strip Plantation (km.) | 2 | |
| | Plantation in Brick guard/Tree guard/Barbed wire fencing (Saplings) | 91609 | |
| **B-Net Present Value (NPV)** | | | |
| 2009-10 | Solar Lights | 300 | 71.54 |
| 2010-11 | Strengthening of Forest Road Network (Km.) | 300 | 89.55 |

| Year | Item of Works | Achievements | |
|---|---|---|---|
| | | Phy. | Fin. (Rs. In lacs) |
| | Maintenance of Fire Lines (Km.) | 500 | 12.00 |
| 2011-12 | Strengthening of Forest Road Network (Km.) | 782 | 234.60 |
| | Maintenance of Fire Lines (Km.) | 485 | 11.64 |
| | Construction of Fire Watch Towers (No.) | 15 | 29.86 |

**Project Tiger:** This is a centrally sponsored scheme where in management of important tiger habitat like Dudhwa Tiger Reserve and its buffer is being carried out. Activities like strengthening of infrastructure, maintenance of Wildlife Habitat, development of eco-tourism activities etc. are being taken up in areas under the project.

**Project Elephant:** This centrally sponsored scheme is being implemented in the areas of elephant reserve. The activities include protection and conservation of elephant habitat, reducing situations of man animal conflict, controlling wildlife crimes and involving local communities in wildlife conservation through awareness program.

**Lion Breeding Programmes, Etawah**: The facility is being established in an area of 350 ha of which 50 ha will serve as the Safari and the remaining 300 ha will serve as the buffer.

**Integrated Development of Wildlife Habitat:** Under this centrally sponsored scheme management and conservation of wildlife sanctuaries of the state are taken up.

**National Plan for Conservation of Aquatic Ecosystem:** This is also a centrally sponsored scheme in which Ministry of Environment and Forests, Govt. of India releases financial help for conservation and management of identified wetlands of state. Thirteen major wetlands have been declared as Wildlife Sanctuaries for better management and conservation of wildlife specially birds of these areas. In these sanctuaries management and conservation activities are carried out according to approved management plan. Apart from these wetlands there are many more wetlands outside the jurisdiction of Forest Department. State level wetland steering committee of Uttar Pradesh directed the district level committees to identify the important wetlands in the district by the help of concern departments. There are around 1808 such wetlands which will also be taken up under this project. In these wetlands habitat manipulation activities, tourism development activities, protection and conservation activities. Awareness & people participation activities will be carried out. Such important activities include catchment area treatment; protection & monitoring; restoration measures; desilting & dredging; water management; biodiversity conservation; sustainable resources development; weed infestation & its control; alternate livelihood; environmental education & awareness.

**Supply/distribution of seedlings**: In order to create an interest among people and encourage greening of/ afforestation in non-forest areas, saplings are supplied at concessional rates through this programme, which is operational in all the districts of the state.

**Plantation along highways, district, and rural roads**: Such plantations are being raised to increase green cover.

## 8.4 KEY STRATEGY AND PRIORITIES FOR FOREST SECTOR

### 8.4.1 STRATEGIES

The overarching approach to the forests and biodiversity sector under the State Action Plan for Climate Change will be to foster an integrated approach that treats forests and non-forest public lands as well as private lands simultaneously, while identifying and leveraging opportunities for mitigation and adaptation measures that enhance ecosystem goods and services, particularly carbon stocks, water, and meet biodiversity conservation and livelihood security needs at the unit/landscape or sub-landscape/watershed or sub-watershed levels.

The State Action Plan for Climate Change will focus on restoration of native bio-diverse species mix while at the same time enhancing carbon sink in forests and other ecosystems, while being informed by sensitivity to the ecological nature and value of resources, for instance avoiding dense plantations in grasslands which have other values like fodder, watershed etc. Habitats of animals and plants will be preserved, especially the mosaic of different vegetation types that maximize niches for diverse life forms.

While undertaking greening, its scope of greening will not be limited to just trees and plantations; rather, emphasis will be placed on restoration of ecosystems and habitat diversity e.g. grassland and pastures, wetlands and other critical ecosystems. It will not only strive to restore degraded forests, but would also contribute in protection/enhancement of forests with relatively dense forest cover. Drivers of degradation, such as firewood needs and livestock grazing will be addressed using inter sectoral convergence (e.g. livestock, forest, agriculture, rural development, energy etc.).

The State Action Plan for Climate Change will ensure a key role for local communities in project governance and implementation. Gram Sabha and its various committees/groups including JFMCs, etc. will be strengthened as institutions of decentralized forest governance, and capacity building for adaptive forest management and livelihood support activities e.g. community based NTFP enterprises will be accorded high priority.

These will indicatively include both Short term (5 years) and Long Term (20 years) initiatives.

In the short term, focus will be on:

1. Climate change related sensitization, awareness generation and capacity building of Forest Department Staff and allied forestry institutions and others for adaptive forest management and livelihood support activities e.g. community based NTFP enterprises;

2. Research studies to categorize vulnerability and potential as criteria for intervention, and intervention priorities ;
3. Development and/or fine-tuning/strengthening of institutional arrangements and mechanisms for decentralized forest governance and maximizing resilience of forest dependent/fringe communities through micro-planning and landscape approach/management;
4. Preparation and Implementation of the State Biodiversity Action Plan including documentation and dissemination of the State's biodiversity resources;
5. Intensification of protection of the State's protected area network and improvement of facilities and management infrastructure. Key interventions in the protected areas will indicatively include :
    i. Improved protection through capacity building of relevant personnel, increased strength of frontline staff and improved/enhanced infrastructure including those for enhanced mobility, rapid response, and anti-poaching units;
    ii. Fencing of strategic areas to protect wildlife and control encroachments;
    iii. Appropriate zonation into multiple use categories including core, buffer, tourism zones, etc.;
    iv. Development/improvement/augmentation of visitor facilities and nature/wildlife interpretation and promotion of protected areas as a favored wildlife and eco-tourism destination;
    v. Control of invasive species including weeds;
    vi. Treatment of catchment areas where required; and
6. Development and initiation of a strategy to protect and preserve the State's wetlands based on prioritization of wetlands of high ecosystem value or those under high risk. Interventions in these would include :
    i. Protection measures on a priority basis including fencing, training/capacity building of relevant personnel, increased strength of frontline staff and improved/enhanced infrastructure;
    ii. Treatment of catchment areas, support to compatible land use practices, water quality monitoring, and other measures infrastructure and equipment needed to ensure sustained water balance, optimal wetland hydrology, and all-season water availability;
    iii. Extensive community education/awareness building on the importance of these wetland areas and the need to protect/conserve them and formation of community conserved zones around these wetlands for enhanced protection; and
    iv. Capacity building for, promotion of, and supporting infrastructure provision/ enhancements for enterprise linked community conservation efforts such as eco-tourism, birding, and bird photography, especially during migratory bird seasons.
7. Reducing Emissions from Deforestation and Forest Degradation (REDD) is the global endeavor to create an incentive for developing countries to protect, better manage, and

save their forest resources, thus contributing to the global fight against climate change. REDD+ goes beyond merely checking deforestation and forest degradation, and includes incentives for positive elements of conservation, sustainable management of forests and enhancement of forest carbon stocks. REDD+ conceptualizes flow of positive incentives for demonstrated reduction in deforestation or for enhancing quality and expanse of forest cover. It works on the basis of creating a financial value for the carbon stored and enhanced in biomass and soil of standing forests. Countries that reduce emissions and undertake sustainable management of forests will be entitled to receive funds and resources as incentives. REDD+ approach incorporates important benefits of livelihoods improvement, biodiversity conservation, and food security services. India and its States potentially stand to gain a lot from a global REDD+ mechanism16. It has specifically opened the possibilities for the country to expect compensation for its pro-conservation approach and sustainable management of forests resulting in even further increase of forest cover and thereby its forest carbon stocks. Sustained efforts for conserving and expanding our forest and tree resources have the possibility of being rewarded for providing carbon service to the international community in addition to providing traditional goods and services to the local communities. The incentives so received from REDD+ would be passed to the local communities involved in protection and management of the forests. This will ensure sustained protection of our forests against deforestation. It is estimated that a REDD+ programme for India could provide capture of more than 1 billion tons of additional $CO_2$ over the next 3 decades and provide more than US$ 3 billion as carbon service incentives under REDD+.As such, the Forest Department will proactively carry out a scoping study to examine the possibility of leveraging REDD+ opportunities, as also CDM, etc., and

8. Developing/refining the State's policies and initiatives for eco-tourism (especially in protected and other wilderness areas) through a critical re-examination/appraisal of existing plans, programs, and activities.

### 8.4.2 KEY PRIORITIES

Identified key priorities for the sector have been given below:

**FOR-1 Increase in the area under forest**

Culturable Waste Land includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other . Such land may be either fallow or covered with shrubs and jungles which are not put to any use. This area is about 440 thousand hectares and can be taken up for plantations by Forest Department. Scrub forest area 74500 ha should also be taken up for plantations. Similarly Fallow Lands other than Current Fallows include all land which was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years. The total of such area available is 540 thousand hectares. This area can be brought under plantations by the land owners or by forest department by taking recourse under section 8 and 9 of UP Tree Protection Act, 1976. If the target period is 20 years the target of plantations should be as follows:

Table 18 Targets to increase forest and agro-forestry plantation

| | Target for 20 Years | Target per year |
|---|---|---|
| **Plantation by Forest Department** | 514,500 ha | 25725 |
| **Plantation by Private Land owners** | 540,000 ha | 27000 |

### FOR-2 Plantations along canals embankments and road sides

The State will examine the possibility of raising plantations on these sites by using suitable species. The state has a network of 190601 kms of road length and 72180 kms of operational canals. Out of this around 27835 kms of road length and 15910 km of canal side (taking one row kms as approximately 0.5 kms on each side). Department should strive to cover all the strips with trees in next 20 years. This will give us a yearly target of planting approximately 8000 kms of road length and 2800 kms of canal sides every year.

### FOR-3 Enhancement of plantation through agro-forestry

Agro-forestry have immense potential in Uttar Pradesh, which is pre-eminently an agricultural State. As such, the Forest Department, in coordination with the Agriculture Department and other appropriate agencies will plan and undertake agroforestry initiatives including development of large-scale nurseries of high quality tree/plant material; distribution of plants free of cost to farmers, making available extension and support services through research and other initiatives such as training for post plantation care, visits by forest department staff, agroforestry specialists/scientists from institutions such as the National Research Centre for Agroforestry (NRCAF) and other centres/universities.

Area under active agriculture is 1641700 ha. To increase tree cover department will promote agroforestry in a big way. The target for next 20 years should be to bring 1/3 rd area under agro forestry. Considering this our yearly target should be to bring approximately 80000 ha under agro forestry. This can be achieved by providing saplings to farmers (600 plants/ha).

### FOR-4 Conversion of Moderately Dense Forest, Open Forest and Scrub into Very Dense Forest up to maximum possible extent

In the forest cover density analysis it is needed to undertake the density improvement of 1271200 ha of forest cover under Moderately Dense Forest and Open Forests. The target per year for next 20 years under this program should be 63560 ha per year.

A. **Moderately dense forests**: Moderately dense forests typically face a number of threats including recurring forest fire, invasive species, unregulated heavy grazing, local fuel wood cutting and head loading, etc. It is proposed to improve the condition of these forest areas through:

a) Better protection by increased strength of frontline staff and improved/enhanced infrastructure;
b) Improved/enhanced fire management through prevention, detection and control measures as well as improvement of infrastructure;
c) Regulated grazing;
d) Eradication of invasive species;
e) Soil and moisture conservation through watershed management; and
f) Gap plantation adopting indigenous species.

It is envisaged that sustainable management of these forests would lead to increase in stocking density, enhanced biomass and carbon sinks.

B. **Open forests**: These typically have immense potential for meeting the fodder, fuel wood, water, small timber, and many other minor forest produce but are degrading due to immense biotic pressure. The Forest Department proposes to improve these forests through:

a) Large-scale gap plantation of indigenous species;
b) Regeneration of rootstock;
c) Soil, and moisture conservation, run off reduction, and integrated watershed management;
d) Consultation with communities and plantation of multi-purpose and fast growing small timber yielding and other tree species to fulfil the requirement of local people such as fuel wood, fodder, NTFPs, agricultural implements, etc.;
e) Constitution/re-vitalisation of forest protection committees/JFMCs and capacity building of these to develop community conserved areas and similar local protection regimes;
f) Development and deployment of other innovative incentive based conservation measures involving local communities.

Besides other works the main focus will be density improvement of 1272600 ha of forest cover under Moderately Dense Forest and Open Forests. ***The target per year for next 20 years under this program should be 63630 ha per year.***

## FOR-5 Intervention in scrub forest encouraging private plantation

**Scrub Forests**: Typically these forests are highly degraded due to heavy grazing and biotic pressure. The Forest Department aims to improve the condition and productivity of these forests through:

a) Planting small timber producing plants/trees;
b) Fodder, fuel wood producing plants;
c) Developing grass land and pasture land for local people within the carrying capacity of the scrub forest areas;

d) Constitution/re-vitalization of forest protection committees/JFMCs and capacity building of these to develop community conserved areas and similar local protection regimes to encourage re-generation of trees;
e) Provision/promotion of efficient cook-stoves among local village households; and
f) Development and deployment of other innovative incentive based conservation measures involving local communities.

Besides other activities Scrub forest area of 80600 ha will also be taken up for plantations.

## FOR-6 Management of dense forests, protected areas and wetlands

**Interventions in very dense forests**: These have remarkable capacity to sequester and store carbon. As such, interventions will focus on enhancing storage and reducing emissions by ensuring full stocking, maintaining health, reducing losses due to tree mortality, natural calamities, wildfires, insects and diseases, and stand density management by prudent tree removal. It is envisaged that this will provide a renewable source of products including timber, engineered composites, paper, and energy even as the stand continues to sequester carbon. These forests will continue to be protected rigorously against all threats. Most of these areas are under protected area network. Various activities planned to be undertaken in such areas are as follows: **Interventions in very dense forests**: These have remarkable capacity to sequester and store carbon. As such, interventions will focus on enhancing storage and reducing emissions by ensuring full stocking, maintaining health, reducing losses due to tree mortality, natural calamities, wildfires, insects and diseases, and stand density management by prudent tree removal. It is envisaged that this will provide a renewable source of products including timber, engineered composites, paper, and energy even as the stand continues to sequester carbon. These forests will continue to be protected rigorously against all threats. Most of these areas are under protected area network. Various activities planned to be undertaken in such areas are as follows:

a) **Identification of Corridors**: Due to ever increasing anthropogenic pressure the large stretches of forest that existed in the terai Vindhyan and Bundelkhand areas have now got fragment into small chunks. The flow of genetic material of animals has thus been adversely impacted. These isolated populations are now faced with possible annihilation due to negative impacts consequent to inbreeding. There are some tenuous links between the high forests that provide some for animals to move from one large chunk of forest to another. These corridors if strengthened can provide much needed support to survival of many species. The following are the important corridors in the state which need to be strengthened to be contagious link between the different forest blocks :
    - Lagga Bagga, Tartar ganj, Haripur Forests in Pilibhit Forest Division.
    - Dudhwa, Kishanpur, Corridor in Kheri districts.
    - Dudhwa, Katerniaghat corridor along Mohan and along Suheli.
    - Garh corridor to connect Mala & Deoria forest area in Pilibhit Forest Division.

Apart from these corridors research studies will be initiated to identified other important wildlife corridors.

b) **Management of Corridors:** The identified corridors will be developed in order to provide ideal habitat for free movement of wildlife. An area 0.3 million ha will be taken up under this project.
c) **Management of Protected Areas:** There are 26 Sanctuaries and one National Parks in State of Uttar Pradesh. Management of these protected areas will be carried out under these projects. An area of approximately 0.5 million ha. @ Rs. 10000/ha. with total cost of Rs. 5000 million is proposed in this project.
d) **Managing Human-Animal Conflict:** For dealing with the situation arising due to conflict between human and animal will be financed under this project. An amount of Rs. 1000 million is proposed under this project.

**Wetlands**: Since Uttar Pradesh is rich in wetlands and aquatic resources many of these areas are rich ecosystems with exceptionally high biodiversity, the Forest Department aims to intensify efforts to protect, maintain, and improve these wetland areas, as well as strengthening the measures in the key wetland areas. Community based conservation and management approaches will be adopted.

***All the important wetlands with an area of approximately 2 lac ha will be taken up for management & conservation***. An area of approximately 0.2 million @ Rs. 8000/ha is total cost of Rs. 1600 million is proposed in this project

**Wastelands and Fallow lands**: Culturable Waste Land includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other. Such land may be either fallow or covered with shrubs and jungles which are not put to any use. ***This area is 440 thousand hectares and can be taken up for plantations by Forest Department with yearly target of 22 thousand ha.*** Similarly Fallow Lands other than Current Fallows include all land which was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years. The total of such area available is 540 thousand hectares. This area can be brought under plantations by the land owners or by forest department by taking recourse under section 8 and 9 of UP Tree Protection Act, 1976. ***The yearly target can be 27 thousand ha per year.***

**Urban and peri-Urban areas** (including institutional lands): Urban forests are an exciting opportunity to mitigate climate change; ameliorate air and dust pollution; help in improving overall water regime; and nurture bio-diversity in urban environments. As such, the Forest Department will leverage all opportunities for urban greening by various interventions categorizing urban forest in following broad categories:

a) Recorded or notified forest patches: In urban areas where large or medium forest patches are available, it will be notified as protected forest and fenced;
b) Open spaces/green spaces like parks/wood lots: Open Spaces/Green spaces such as parks/wood lots should be raised on municipal lands to enhance the vegetative cover;

c) Avenue plantations: In urban areas road side avenue plantations will be raised at least in two rows on both sides of the road where land is available; and
d) Plantation on institutional lands: In urban areas, many government institutions have large open campuses. Sufficient land is available in these -- where suitable species of trees/plants can be raised.

**Summary of plantation related activities:**

1. The yearly estimated demand for plantations, density improvement works and raising of saplings by forest department are as follows:

| S.N. | Activity | Rate in lac Rs per ha | Total yearly target for next 20 yrs | Total Cost Rs. (in crores) |
|---|---|---|---|---|
| 1 | Plantation by Forest Department | 1.61025 | 26030 ha | 419.15 |
| 2 | Road side/canal side plantation | 1.59964 | 10800 ha | 172.76 |
| 3 | Agro Forestry | 0.30438 | 8000 ha | 24.35 |
| 4 | Density Improvement | 0.6884 | 63630ha | 438.02 |
| | | | TOTAL | 1054.28 |

2. The yearly estimated expenditure to be incurred by private land holders for raising plantations in their fallow lands will be:

| S.N. | Activity | Rate in lac Rs per ha | Total yearly target | Total Cost Rs. (in crores) |
|---|---|---|---|---|
| 1 | Plantation by Private Land owners | 0.6884 | 27000 | 185.87 |

3. The estimated budgetary needs for works in protected area network and wetlands are as follows :

| **Category** | **Area (in million ha)** | **Unit Cost** | **Total (Rs. in crores)** |
|---|---|---|---|
| Identification of corridors | 0.3 | 300/ha | 9 |
| Management of corridors | 0.3 | 175000/ha | 5250 |
| Management of Protected Areas | 0.5 | 10000/ha | 500 |
| Management of Wetland | 0.2 | 8000/ha | 160 |
| Managing Human-Animal Conflict | LS | LS | 100 |
| **Total :** | | | **6019** |

Rs 300.95 crores per year

## FOR-7 Other outreach, pilot and research interventions

**Other interventions**: A range of other interventions will also be undertaken. These will include:

a) The use of timber in house construction, furniture and agricultural implements etc. is around 61.38 million cum. By using alternatives we can reduce this which in turn will result in reduction in tree felling.

b) The fact that we receive 10,000-15,000 times more solar energy on the Earth than we use, opens up amazing possibilities for the use of the sun's energy to meet our needs. Today, fuel wood accounts for almost a fifth of the world's primary energy consumption. In most Indian villages, local people are heavily dependent on forests mainly for fuel wood which is the only dependable energy alternative they have, sometimes it also works as potential cash earning sources for households. As per the study of WWF a one-year field test in South Africa revealed that using a solar stove, an average family can save 30 litres of kerosene, 30 kg of LPG and about 1 tonne of firewood per year, which comes to an estimated 1 tonne of carbon dioxide reduction annually. In context to State of Uttar Pradesh 10.495 million people are using fuelwood from forests. Taking an average family size of 5 persons per family we can conclude that 2.1 million families are directly dependent on forests for fuel wood. By giving them alternative sources of energy we can contribute towards reduction in Carbon dioxide to the tune of 2.1 million tonnes annually. In the areas where the people are not directly dependent on forests for fuel wood such activity can be taken up by NEDA.

c) We can decrease the dependency of livestock on forests by incentivizing stall feeding and also by developing the pasture lands available in the state. We have 65000 ha under permanent pasture and grazing lands. This included all grazing land whether it is permanent pasture and meadows or not. Village common grazing lands are included under this. These areas can be enriched by planation of high quality grasses.

d) Total Computerization till range offices to reduce use of paper.

e) Extensive measures to be taken by using both traditional as well as modern inputs to contain forest fires. With increase in temperature forests are likely to be more prone to fires. Hence, wildfire management will to be taken up at a priority basis to combat increased frequency and intensity of wildfires in future;

f) Activating the State Biodiversity Board and transforming it into a fully functional institution undertaking the full range of activities to survey, identify, catalogue, document, protect, and improve/enhance the status of biodiversity in the State including producing, in a time bound manner, flagship publications on Uttar Pradesh's biodiversity;

g) Developing and implementing a proactive and on-going programme of research and documenting studies relating to forestry and wildlife in the state including for example (but not limited to):

i. Studies on indigenous trees species to assess their vulnerability to climate change;
ii. Assessing and documenting additional threats to biodiversity and wildlife.
iii. Population dynamics and movement of wildlife;
iv. Obtaining access to updated knowledge on climate change science and policy developments; and
v. Monitoring carbon stock and biodiversity at regular intervals etc.

Additionally, the Forest Department recognises that the private sector can play a role in many forestry related activity such as for example, incentivizing collection and value addition of NTFPs, growing of medicinal plants by people, promoting agro-forestry, and thus enhancing livelihood opportunities. As such, the Forest Department will actively examine the creation of enabling mechanisms for increased roles for the private sector in selected operations/activities.

**Summary of Other interventions:**

Demand for other activities is as under

| Item | Demand per year Rs (in Crores) |
|---|---|
| Training activities | 2.50 |
| Research | 10.00 |
| Extension & Publicity | 2.50 |
| Distribution of solar energy equipment | 1.50 |
| Reinforcement of forest boundaries | 10.00 |
| Eco Tourism activities | 8.50 |
| Soil and Moisture Conservation works | 120.00 |
| | 155.00 |

## FOR-8 Decreasing the use of timber in house construction, furniture and agricultural implements etc.

The use of timber in house construction, furniture and agricultural implements etc. is around 61.38 million cum. By using alternatives we can reduce this which in turn will result in reduction in tree felling.

## FOR-9 Decreasing dependency of people on fuel wood and $CO_2$ emission reduction

The fact that we receive 10,000-15,000 times more solar energy on the Earth than we use, opens up amazing possibilities for the use of the sun's energy to meet our needs. Today, fuel wood accounts for almost a fifth of the world's primary energy consumption. In most Indian villages, local people are heavily dependent on forests mainly for fuel wood which is the only dependable energy

alternative they have, sometimes it also works as potential cash earning sources for households. As per the study of WWF a one-year field test in South Africa revealed that using a solar stove, an average family can save 30 litres of kerosene, 30 kg of LPG and about 1 tonne of firewood per year, which comes to an estimated 1 tonne of carbon dioxide reduction annually.

In the context of State of Uttar Pradesh 10.495 million people are using fuel wood from forests. Taking an average family size of 5 persons per family it can be concluded that 2.1 million families are directly dependent on forests for fuel wood. By giving them alternative sources of energy it will be possible to reduce Carbon dioxide to the tune of 2.1 million tonnes annually. In the areas where the people are not directly dependent on forests for fuel wood such activity can be taken up by NEDA.

**FOR-10 Decreasing the dependency of livestock on forests by incentivizing stall feeding and enhancement of green fodder cultivation.**

It is possible to decrease the dependency of livestock on forests by incentivizing stall feeding and also by developing the pasture lands available in the state. In UP, about 65000 ha under permanent pasture and grazing lands is available. This included all grazing land whether it is permanent pasture and meadows or not. Village common grazing land is included under this. These areas can be enriched by planation of high quality grasses.

## 8.5 BUDGET FOR GREEN UP MISSION

The total budget under this mission for the period of 2014-18 could be 8480.5 crore. For long term programs (20 years) proportionate budget for 5 years have been taken.

# 9 JAL MISSION

## 9.1 OVERVIEW OF WATER RESOURCES SECTOR IN UP AND ISSUES

Uttar Pradesh is India's fourth largest State and is endowed with bountiful water resources, both surface and underground. The lands are fertile and climate favourable for extensive and intensive agriculture practices. Perennially flowing rivers, viz Ganga, Yamuna, Ramganga, Gomti, Sarda, Ghaghra, Rapti, Gandak, Sone, Ken Betwa and Tons contribute to the surface water potential of the state and also provide natural drainage in the state.

Uttar Pradesh with a population of about 166.0 million is the most populous state in the country and has a dominant rural base. Numbers of large canal systems have been developed for irrigation with massive investments during the pre-plan period as well as under the successive five year plans. Some of the irrigation systems are not only large in their command but are more than 100 years old. Most of these systems were designed as protective irrigation schemes with fairly low irrigation intensities. The maximum irrigation intensity proposed in Sarda Sahayak Project is limited to 67 % in Kharif crop season and 48% in Rabi crop season. The canal system are not providing either full irrigation to an individual crop or to all the crops grown in its' entire command. In the canal command areas the crops also suffer for want of assured irrigation and are rain dependent. Existence of ground water though provides an alternative source in Canal Commands but its exploitation is limited to private domain only. A majority of the canal systems, thus; are under heavy water demand pressure from cultivators and also there is a large gap between the created and utilized potentials. These systems are underperforming and therefore require rehabilitation/ modernization. Irrigation systems are to be reorganized with concept of integrated management of surface and ground water resources on priority to achieve sustainable efficiency in water use and its management.

The economy of Uttar Pradesh, with a geographical area of 24.093 million hectares, is agriculture dominated with about approximately 80% of total geographical area as agriculture land. The agriculture sector contributes about 40% of the State GDP and 75% of employment. An estimated 35% of the State population is living below poverty line. About 70% of agriculture is dependent on irrigation. The net and gross sown area in the State is 16.68 and 25.52 million hectares respectively. The net and gross irrigated areas from all sources are 13.12 and 18.94 million hectares respectively with about 11.7 million of crops land currently irrigated by surface water systems at an average cropping intensity of about 100%. The performance of agriculture and thereby its share in the economy of the state is declining due to its sub optimal performance and deficient management. The agriculture sector has grown only at 1% annually whereas the growth should have been around 3% or more to meet the demands of growing population and alleviate poverty. Increase in agricultural production and productivity demands intensive and diversified agricultural practices for which a well-functioning and financially sustainable integration of surface and ground water resources for irrigation water delivery and management system together with appropriate agriculture / farm practices is considered essential.

In view of fast growing population there is a need for more agricultural production, for which it is required to bring more agricultural area under irrigation fast. Besides, the demand of water for industrial and drinking purpose is increasing. The decadal rate of growth of population of Uttar Pradesh is about 25 percent. With this trend of population growth there is a likely competition in demand of water in various use sectors, particularly in drinking, domestic use and industrial sector. Therefore water availability for irrigated agriculture is likely to get reduced. This situation will need to be addressed on priority. An integrated approach is required for surface and ground water, the two major vital resources for irrigation in planning, development and management of the water resources so as to improve the performance efficiency of the system in a sustainable manner.

Notwithstanding the fact that significant progress has been achieved in bringing vast tracts of fertile lands under canal irrigation and development / exploitation of ground water, large gaps exists in development and utilization caused due to sub optimal performance and lack of an integrated approach in the management of irrigation systems; This is one of the major area of concern in the irrigated agriculture sector. At present there are approximately 74000 Km of canals, 28 Major and Medium lift canals, 245 Minor lift canals, 65 reservoirs/bundhis and 29016 running State tubewells. The irrigation potential created upto Xth Plan was 120.73 lakh ha. And during XIth Plan 5.42 lakh ha potential was created. Hence the total potential created upto XIth Plan is 126.15 lakh ha.

**Table 19 Water Resources of UP at a Glance**

| | |
|---|---|
| Estimated annual Precipitation (including snow fall and 947.5mm of Normal Annual Rainfall) | 23.54 Mham |
| Runoff received from upper hilly region and other boundary states | 10.01 Mham |
| Average Annual Natural Flow in rivers as per CWC | 33.55 Mham |
| Estimated utilizable water a) Surface water b) Ground water | 161.70 BCM<br>68.57 BCM |
| Water utilization a) Irrigation b) Reserve for Drinking Industry Energy and other | 71.60 BCM<br>24.70 BCM |

It is estimated that for domestic, industrial and irrigations needs of growing population, the level of ground water exploitation will increase from 49.48 BCM to 72.06 BCM by 2025 which will increase the requirement of ground water from the present level. Tubewells are the major source of irrigation followed by canals, ponds and lakes which makes the dependency upon ground water larger than the dependency on surface water. The impacts of climate change will further impinge on this critical situation and act as an additional stressor.

Increased demand of water for various purposes has led to adverse effects on surface water resources like rivers and lakes in the state. The human settlements and public effluent sources are the chief factors for the degradation of lakes, particularly the urban lakes and ponds.

Another major issue regarding the use of surface water resources in the state is that of **water logging** which is prominent in canal command areas. Total waterlogged area in Uttar Pradesh is 8.10 lac ha (about 6% of geo area) whereas an area of 4.3 lac ha falls under 8 major canal commands spread over 32 districts. The severity of the twin problem - water- logging and salinity in different irrigation commands is not similar and varies from one project to another due to variation in slope, soil type, water distribution practices, cropping patterns, farm water management, drainage etc. The problem of water logging is more serious in lower reaches of the commands of the new irrigation projects such as Sharda Sahayak, Gandak and Saryu because they pass through low surface gradient areas whereas the problem of salinity/alkalinity is more serious in commands of old irrigation projects such as Ramganga and Sharda because of long term effect of water-logging. If surface drainage is not introduced in the waterlogged area, thousands of hectares of land will be submerged and salinised in the long run. With research studies indicating that surface water resources will get more limited in the future due to impacts of climate change, there is a need to manage and use the surface water resources more effectively and optimize the use of water rather than it being lost due to water logging.

**Water Use Efficiency:** Central Water Commission (CWC) has identified the causes of low water use efficiency. These are:

- Poor maintenance of canal and distribution network resulting in growth of weeds
- and vegetation
- Siltation of canals
- Damaged lining
- Distortions or slumping of canal slopes
- Leakages in gates and shutters
- Non-provision of lining in permeable strata (high seepage losses)
- No gates on minor canal head regulators leading to uneven water distribution
- Over-irrigation due to lack of control structures in distribution system
- Poor management practices and lack of awareness by farmers

The National Water Mission (NWM) Comprehensive Mission Document states that there is a need to increase water use efficiency by 20%, whilst it also advocates a policy of "more crop per drop".

Over-exploitation of groundwater: Hydro-geologically, the States can be divided into five units namely:

I. Bhabar
II. Tarai
III. Central Ganga plains
IV. Marginal Alluvial plains
V. Southern Peninsular zone

Ground water is the main sources for drinking and irrigation in major parts of the state. Dependency of ground water has increased tremendously during the last three decades. Owing to its features like easy access to the source, no legal interference for owning the source, fresh and good quality of

water, less prone to pollution, etc. the ground water has developed without any proper control during the recent past. The lack of knowledge about the availability and management of ground water has made the things worse.

Table 20 Region-wise ground water condition

| SN | DISTRICT /REGION | CATEGORISATION OF BLOCK | | |
|---|---|---|---|---|
| | | OVEREXPLOITED | CRITICAL | SEMICRITICAL |
| 1 | 2 | 3 | 4 | 5 |
| 1 | BUNDELKHAND REGION | 3 | 3 | 5 |
| 2 | CENTRAL REGION | 0 | 6 | 19 |
| 3 | EASTERN REGION | 7 | 13 | 44 |
| 4 | WESTERN REGION | 66 | 10 | 39 |
| | STATE TOTAL | 76 | 32 | 107 |

Source: CGWB assessment, 2009

Comparison of blocks under successive assessment has been given below:

Table 21 Groundwater condition: comparative

| Category | Numbers of Blocks | | |
|---|---|---|---|
| | 31 March, 2000 | 31 March, 2004 | 31 March, 2009 |
| Over Exploited | 22(Critical Included) | 37 | 76 |
| Critical | | 13 | 32 |
| Semi Critical | 53 | 88 | 107 |
| Safe | 745 | 682 | 605 |
| Total | **820** | **820** | **820** |

Table 15 clearly shows the worsening of the ground water situation in the state.

**Deteriorating water quality:** The quality of ground water has also progressively deteriorated. Tremendous use of ground water has brought adverse changes in the geochemistry of water. Natural contaminates such as fluoride, iron and nitrate are increasing in ground water making it unfit for drinking and posing risk to health. Climate change will further increase ground water extraction due to less availability of surface water and rising demand which could further deteriorate ground water quality and have serious effects on health of people. The districts affected with contaminants are given in the table below:

Table 22 Contamination of ground water

| Ground Water Quality Problems | |
|---|---|
| **Contaminants** | **Districts affected (in part)** |
| **Salinity** (EC > 3000 µS/cm at 25 ° C) | Agra, Aligarh, Firozabad, Hamirpur, Kashganj, Kanpur Nagar, Mathura, Rae Bareli, Unnao |
| **Fluoride** (>1.5 mg/l) | Agra, Aligarh, Firozabad, Hamirpur, Kashganj, Kanpur Nagar, Mathura, Rae Bareli, Unnao |
| **Iron** (>1.0 mg/l) | Agra, Aligarh, Badayun, Bulandshahar, Chandauli, Etah, Farukhabad, Firozabad, GautamBudh Nagar, Jaunpur, Kannauj, Lalitpur, Mahamaya Nagar, Mainpuri, Mathura, Mau, SantRavidas Nagar, Varanasi |
| **Nitrate** (>45 mg/l) | Agra, Aligarh, Allahabad, Ambedkar Nagar, Auraiya, Azamgarh, Badaun, Baghpat, Balrampur, Banda, Barabanki, Bareilly, Basti, Bijnor, Bulandsahr, Chitrakoot, Etah, Etawah, Fatehpur, Firozabad, GB Nagar, Ghaziabad, Ghazipur, Hamirpur, Hardoi, Hathras, Jaunpur, Jhansi, Kannauj, Kanpur Dehat, Lakhimpur, Mahoba, Mathura, Meerut, Mau, Moradabad, Muzaffarnagar, Mirzapur, Raebarelli, Rampur, SantRavidas Nagar, Shajahanpur, Sitapur, Sonbhadra, Sultanpur, Shravasti, Siddarth Nagar, Unnao |

**Agriculture and Water use:** State has a total of 19.13 mha of culturable land out of which about 17.8 mha. Is presently under agriculture. For a projected population of 270 million by the year 2020 the food grain requirement has been assessed as 63 million tones. With the present irrigation and other inputs productivity level of about 2.39 t/ha has been achieved. Productivity level of 3.4 t/ha will have to be achieved to meet the projected food grain requirements. In order to achieve this target, in addition to other inputs, irrigation facilities shall have to be adequately provided by harnessing the untapped potential and also by bringing about improvement in the management of water resources.

Sectoral policies like subsidies for irrigation (water, power, pumps) and other inputs in agriculture sector indirectly have adverse impact on water resources. The environmental cost arising out of wasteful water use practices are not internalized. The farmers at the head end region of irrigation projects tend to over irrigate and also shift their cropping patterns towards water intensive crops, exerting pressure on limited water resources of the state. The demand for increase in agricultural production has led to increased use of chemical / inorganic fertilizers, pesticides, high yielding varieties and mechanization of agriculture. The use of chemical fertilizers has been steadily increasing. This has led to water pollution and causing water quality problems having repercussions for human health.

**Urbanization and water supply issue**: The population of the State is predominantly rural; the share of urban population in the State is lower (22%) than most of its neighbors and the national average (28%) [2011 census]. In absolute terms, however, Uttar Pradesh's urban population (19.98 crore) is the second largest in India next only to Maharashtra, and is larger than the population of several countries. The urban population is not only large, but rising rapidly too. During 2001-11 the urban population has increased 22.27%. The trend is likely to continue. Since per capita water demand for

domestic use is higher in urban areas, growing urbanization implies greater pressure on existing resources; water infrastructure and management. Further the effects of climate change are going to make the situation even worse.

## 9.2 LIKELY IMPACT OF CLIMATE CHANGE ON WATER RESOURCES OF UTTAR PRADESH

### 9.2.1 OBSERVED TRENDS

**Precipitation:** The climate of the State is tropical monsoon with variations because of difference in altitudes. The average temperature varies in the plains from 3 to 4°C in January to 43 to 45°C in May and June. There are three distinct seasons - winter from October to February, summer from March to mid-June, and the rainy season from June to September. Mean annual rainfall is between 1000 to 2000 mm in the east of the state and 600 to 1000 mm in the west. Most of the rain is received during the south west monsoon (June to September). The monsoon rain accounts 70-80% of the total rainfall in a year.

- Average number of rainy days in the state during the south west monsoon is about 45 days and varies from 30 days to 60 days.
- Days when there is high rainfall events range from 1 to 4 days
- And similarly the extreme rainfall days are less and are about 1 to 2 days.
- Average number of rainy days in the state during the post monsoon (winter) is about 3 days and varies from 2 days to 4 days.
- Days when there is high and extreme rainfall events are very few and is about 1 to 2 days

**Temperature:** Uttar Pradesh shows a large spatial as well as temporal variability.

- Spatial pattern of trends in the mean maximum annual temperature shows marginal negative (decreasing) trend over most parts of the north east Uttar Pradesh and mean minimum annual temperature shows significant positive (increasing) trends over most parts of north east and central part of Uttar Pradesh.
- Average maximum temperature is higher and is more in monsoon season and ranges between 30 to 40°C. Season wise, maximum rise in mean maximum temperature is observed during the monsoon season (0.3°C).
- Rise in maximum temperature is appreciably higher during monsoon months.
- Rise in minimum temperature is appreciably higher than that of maximum temperature over northern plains. The rise is nearly 1°C in the northern plains during winter followed by post monsoon season (0.8°C) and pre monsoon season (0.6°C).
- Inter-annual variation is higher during winter and post monsoon seasons.
- Seasonal extreme hot days are highest during pre-monsoon period in south western part and the northern part shows a large inter annual variation.

**Related Extreme events: Drought and Flood**

**Drought:** Shortage of rain during the highly variable Monsoon season causes droughts in U.P. leading to severe loss to man and property. The recurrence of a major deficiency in annual rainfall follows a 6-8 years cycle in Eastern U.P. whereas in Western U.P., it is a 10 years cycle. Droughts are experienced due to deficient rainfall in the certain parts of the state. Bundelkhand and part of Mirzapur and Allahabad commissionaires' are the most drought prone areas. The 2002 and 2004 drought related financial estimates have been reported to be 75.4 billion (US$1.2 billion) and 72.92 billion (US$1.2 billion). Climate is projected to increase drought occurrence in the state which would impact not only water resources but also have a cascading effect on other dependent sectors. Increased drought conditions can also severely affect agricultural and pastoral livelihoods and increase vulnerability and risks for farmers, pastoralists and people depending on such livelihoods. For farmers who are strongly dependent on rainfall for agricultural activities, crop failure caused by drought can lead to household food insecurity. For pastoralists and agro-pastoralists whose livelihoods and food security depend on livestock, drought conditions can cause malnutrition or disease in livestock because of insufficient fodder and deterioration in pastoral lands.

**Floods:** Extreme conditions exist in the state- there are floods followed by droughts. Due to excess rains on the foot hills of Himalayas and trans-boundary flows from the rivers originating from Nepal and other neighboring states floods occur in certain parts. Floods are the most common annual occurrences in the state, due to overflowing of its main rivers like Ganga, Yamuna, Ramganga, Gomti, Sharda, Ghaghra Rapti and Gandak, affecting one or the other part of the state the most affected being Eastern Uttar Pradesh and the Tarai region. It has been estimated that 7.336 Mha of area is flood prone and this constitute 30.45 % of the total geographical area of the state (24.093Mha).Out of total flood prone area about 5.872Mha is protectable. During last 60 years 2.114 Mha areas has been protected from floods 3.758 Mha areas is still to be protected. Estimated annual losses due to floods in U.P. are 4.32 billion (US$70 million). Major flood management efforts have been undertaken to mitigate the risk. Most of these floods occur due to the Monsoon rains and overflowing of rivers during the rainy periods.

### 9.2.2 PROJECTED SCENARIO FOR THE WATER SECTOR IN UP

Climate change poses uncertainties to the supply and management of water resources. According to the IPCC (2007)40 "Many semi-arid and arid areas are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources (high confidence)". Changes in climate variables like temperature increases can affect the hydrologic cycle by directly increasing evaporation of available surface water and vegetation transpiration. Consequently, these changes can influence precipitation amounts, timings and intensity rates, and indirectly impact the flux and storage of water in surface and sub-surface reservoirs i.e. lakes, soil moisture, and groundwater. Climate change can impact surface water resources directly through changes in the major long-term climate variables such as air temperature, precipitation, and evapotranspiration.

The relationship between the changing climate variables and groundwater is more complicated. Greater variability in rainfall could result in frequent and prolonged periods of high or low groundwater levels, and saline intrusion in aquifers. Thus groundwater resources are related to climate change through the direct interaction with surface water resources, such as lakes and rivers, and indirectly through the recharge process. The direct effect of climate change on groundwater resources depends upon the change in the volume and distribution of groundwater recharge.

*Methods and Models:* An assessment of the impact of projected climate change on water resources in Uttar Pradesh is made using the hydrologic model SWAT (Soil and Water Assessment Tool). The model requires information on terrain, soil profile and land-use of the area as input which have been obtained from the global sources. These three entities are assumed to be static for future as well. The Ganga River basin which is the main river system in Uttar Pradesh has been modelled using the following:

Spatial data and the source of data used for the study areas include:

- Digital Elevation Model: SRTM, of 90 m resolution
- Drainage Network – Hydroshed
- Soil maps and associated soil characteristics (source: FAO Global soil)
- Land use (source: Global land use)

The Hydro-Meteorological data pertaining to the river basin required for modelling, includes daily rainfall, maximum and minimum temperature, solar radiation, relative humidity and wind speed.

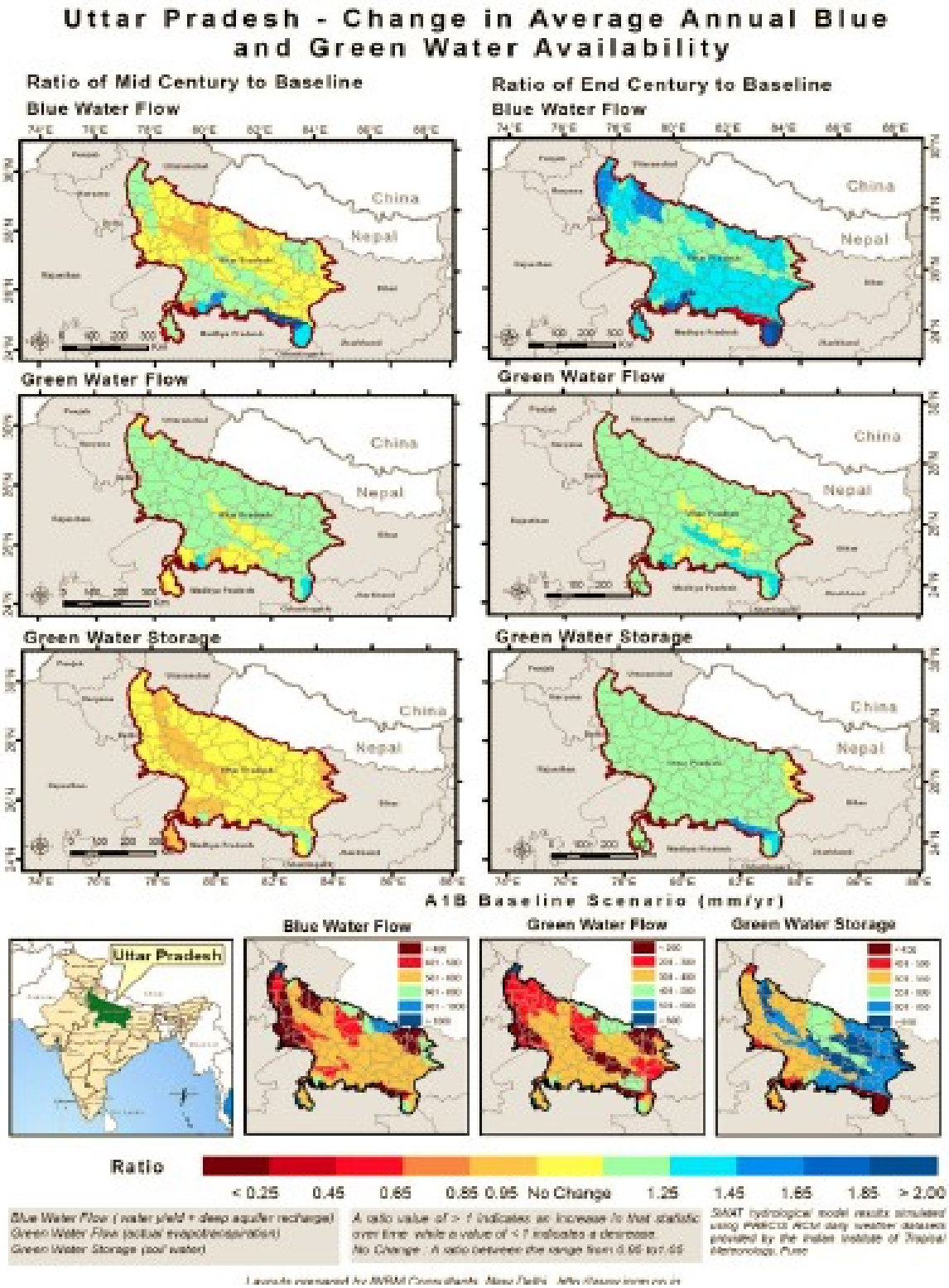
Climate Change PRECIS Regional Climate Model outputs for Baseline (1961–1990, BL), near term (2021-2050, MC) and long term or end-century (2071-2100, EC) for A1B IPCC SRES scenario (Q14 QUMP ensemble) has been used.

The climate change impact assessment on water resources of UP has been taken from the study conducted (Gosain et. Al., 2011) as part of the NATCOM Phase II study of MoEF, as has been mentioned in the report of Uttar Pradesh State Action Plan on Climate Change prepared by GIZ, New Delhi. For the present analysis pertains to the modeling of River Ganga using the hydrologic model SWAT.

The study determines the present water availability in space and time without incorporating any man made changes like dams, diversions, etc. The same framework is then used to predict the impact of climate change on the water resources with the assumption that the land use shall not change over time. A total of 90 years of simulation have been conducted; 30 years belonging to IPCC SRES A1B baseline (BL), 30 years belong to IPCC SRES A1B near term or mid-century (MC) climate scenario and 30 years belong to IPCC SRES A1B long term or end century (EC) climate scenario. While modelling, the river basin has been further subdivided into reasonable sized sub-basins so as to account for spatial variability of inputs under the baseline and GHG scenarios. Detailed analyses have been performed to quantify the possible impacts on account of the climate change.

Analysis for the Ganga basin reveals an increase in the annual precipitation of 2.5% for MC and 23.0% for EC from the BL. The outcome of the SWAT hydrological modeling has predicted a consequent reduction of water yield by 0.5% under MC and an increase by 27.0% under EC from the BL water yield. The situation of the actual evapo-transpiration is an increase by 7.0% under MC and by 16.0% under EC from the actual evapo-transpiration under BL respectively.

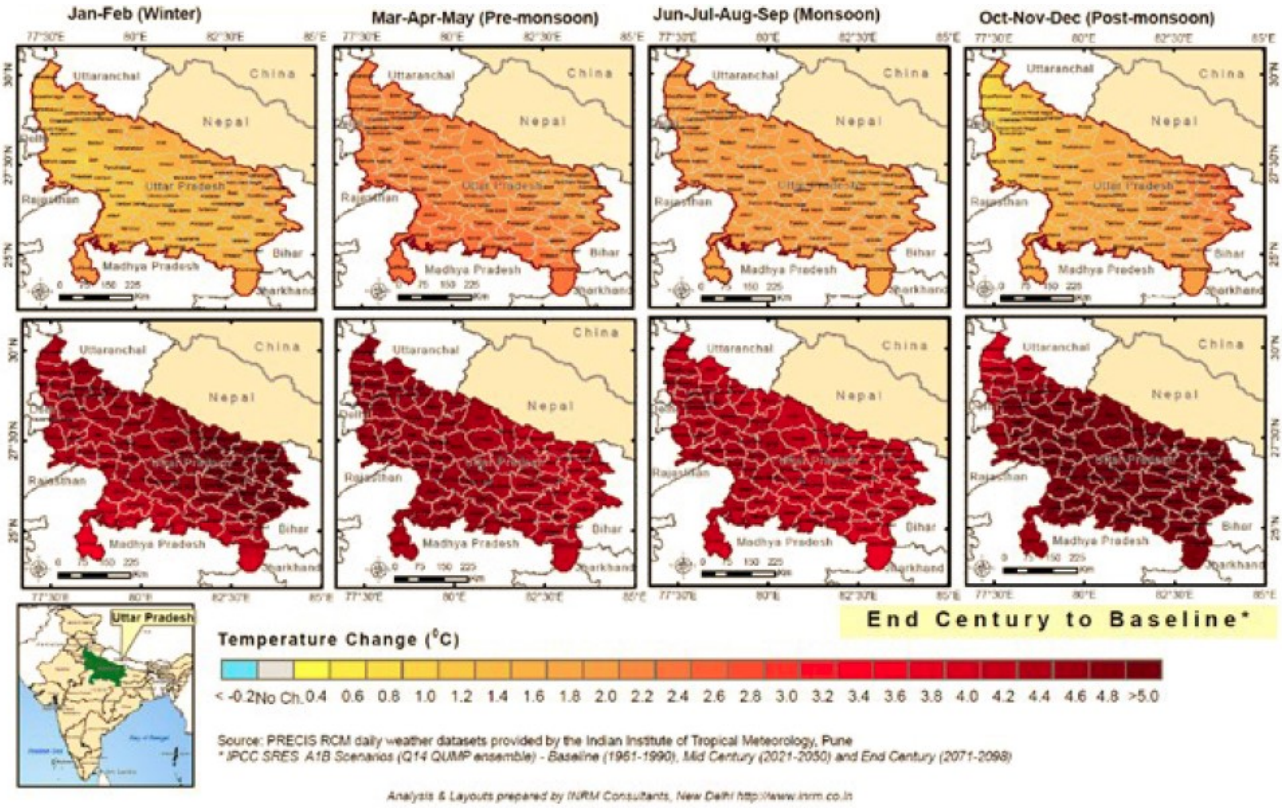
Detailed assessment of the different components of freshwater availability both in space and time is critical for identifying the vulnerable regions/hotspots. This enables a proper development/identification of the adaptation and mitigation strategies in addressing climate change coping mechanisms. Freshwater components i.e., blue water flow (i.e., water yield plus deep aquifer recharge), green water flow (i.e., actual evapo-transpiration), and green water storage (i.e., soil water) has been estimated at a sub-basin level with daily weather data for Ganga basin under baseline as well as GHG scenarios (Model A). This depiction is important in understanding the general availability of blue and green water across the basin. The change in blue water availability show spatial variation from marginal reduction (5%) to 20 % increase across the state towards 2050's as compared to the baseline and there is almost 40 to 50% increase towards 2080's. The green water flow also shows increase but the magnitude is marginal under both MC and EC scenario and may increase to 25% for some of the area. The situation of Green water storage has deteriorated in many places under MC scenario and shows a marginal improvement in EC scenarios. The green water storage can potentially benefit the agriculture in months with little or no precipitation. This information is quite helpful in planning cropping season and helps to model scenarios of changing cropping seasons and patterns and arriving at appropriate adaptation measures.



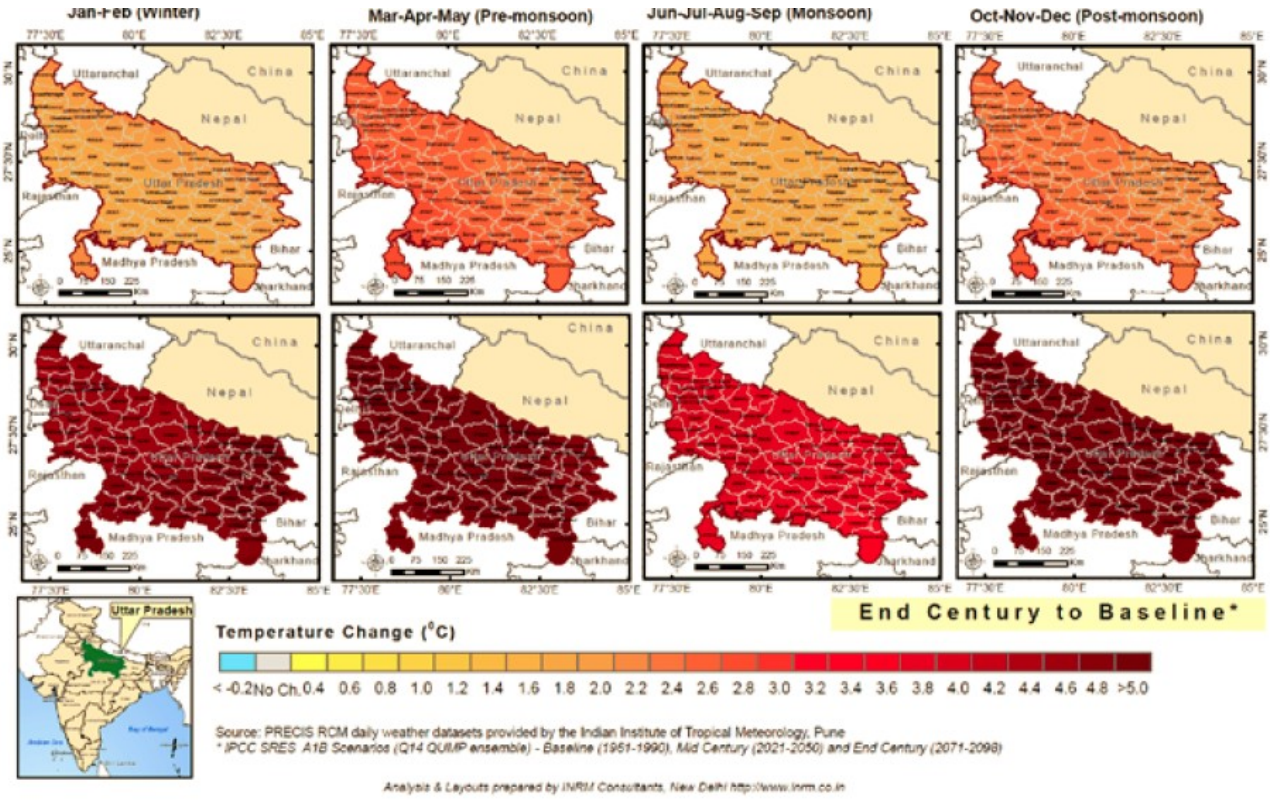

**Model A: Green water and blue water availability**

**Model Projections:** The projected climate change in 2030 (average of 2021-2050) and in 2080 (average of 2071-2098) over Uttar Pradesh have been studied by GIZ, New Delhi. Figure below shows the annual rainfall statistics and the spatial variability:

- Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%).
- Inter annual variability is higher towards 2080's. Change in seasonal rainfall for 2050's and 2080's as compared to the baseline is shown in Figures (B&C) below.
- Season wise decrease in rainfall is predicted during winter and pre monsoon and increase in post monsoon period for both 2050's and 2080's as compared to baseline.
- Monsoon rainfall shows no significant change towards 2050's and show increase to the tune of 25% to 35% towards 2080's.
- Inter annual variation in the seasonal rainfall is lower in 2050's than 2080's as compared to the baseline.
- Model B and C depict the annual maximum and minimum temperature statistics for the mid-century and end century period.
- There is an increase in maximum as well as minimum temperature as compared to the baseline both towards 2050's and 2080's.
- The increase is around 2°C towards 2050's and about 4.5°C towards 2080's.




**Model B : Change in Average Minimum Temperature during Winter, Pre-monsoon, Monsoon & Post-monsoon seasons across U.P.**




**Model C: Change in Average Maximum Temperature during Winter, Pre-monsoon, Monsoon & Post-monsoon seasons across U.P.**

Model B and C depict: Change in Average Maximum Temperature during winter, pre-monsoon, monsoon and post-monsoon seasons across Uttar Pradesh.

- Maximum temperature is predicted to increase by 2.1°C during pre-monsoon followed by monsoon (1.8°C) towards 2050's.
- Predicted increase in maximum temperature during post monsoon (5.3°C) followed by winter (4.5°C) towards 2080's.
- Inter annual variability in maximum temperature is predicted to increase towards 2050's and the variability is higher during the winter season.
- 2080's shows comparatively less inter annual variability and predicted to be similar to inter annual variability of the baseline.

Change in Average Minimum Temperature during winter, pre-monsoon, monsoon and post-monsoon seasons across Uttar Pradesh.

- Season wise, maximum rise is in minimum temperature for both the scenarios.
- The increase in minimum temperature is observed during pre-monsoon season (2.5°C) followed by post monsoon season (2.3°C).
- Predicted increase in minimum temperature during pre-monsoon (5.3°C) followed by post monsoon (5.0°C) towards 2080's.

- Inter annual variability in minimum temperature show less inter annual variability and predicted to be similar to inter annual variability of the baseline.

### 9.2.3 SUMMARY OF CLIMATE CHANGE IMPACT ON WATER SECTOR IN UP

Climate change poses uncertainties to the supply and management of water in the State. The following summarize the critical situation of water resources in the state and how climate change will act as an additional stressor:

- Many semi-arid and arid areas are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources.
- Changes in climate variables like temperature increases can affect the hydrologic cycle by directly increasing evaporation of available surface water and vegetation transpiration.
- Changes in climate variables can influence precipitation amounts, timings and intensity rates, and indirectly impact the flux and storage of water in surface and sub-surface reservoirs i.e. lakes, soil moisture, and groundwater.
- Climate change can impact surface water resources directly through changes in the major long-term climate variables such as air temperature, precipitation, and evapo-transpiration.
- Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%). Inter annual variability is higher towards 2080's.
- Greater variability in rainfall could result in frequent and prolonged periods of high or low groundwater levels, and saline intrusion in aquifers.
- The direct effect of climate change on groundwater resources depends upon the change in the volume and distribution of groundwater recharge.
- The change in blue water availability show spatial variation from marginal reduction (5%) to 20 % increase across the state towards 2050's as compared to the baseline and there is almost 40 to 50% increase towards 2080's.
- The green water flow also shows increase but the magnitude is marginal under both MC and EC scenario and may increase to 25% for some of the area.
- The green water storage can potentially benefit the agriculture in months with little or no precipitation. This information is quite helpful in planning cropping season and helps to model scenarios of changing cropping seasons and patterns and arriving at appropriate adaptation measures.

## 9.3 KEY PRIORITIES FOR WATER SECTOR

Key **strategies** include the following:

**(a) Enhancement of Observational Infrastructure and Flood Management**

- An "early warning system" should be provided in rivers originating from
- Uttarakhand and Nepal and the infrastructure for monitoring water flows in
- rivers as well as the weather parameters should be strengthened.
- Mapping of areas likely to experience floods, establishing hydraulic and
- hydrological models and developing comprehensive schemes for flood
- management and reservoir sedimentation.
- Encourage and enforce flood plain zoning in flood prone rivers.

**(b) Enhancing Water Conservation Measures**

- Ponds should be developed to store the rain/flood waters in river basins to maintain the minimum water flow in rivers.
- Promotion of traditional system of water conservation – expeditious implementation of programme for repair, renovation and restoration of water bodies in areas/situations sensitive to climate change by (i) increasing capacity of minor tanks, and (ii) rehabilitating water bodies with changed focus.
- Pressure should be continuously made on the senior most level regarding pending projects in view of increase in water storage capacity.

**(c) Means for Saving Water and Improving Water Use Efficiency**

- Strategy to promote water efficient crops should be adopted.
- Water efficient "drip and sprinklers" irrigation system should be promoted.
- To promote the use of PVC pipes to prevent water losses due to leakages during distribution.
- A time bound strategy should be adopted at State level to save water losses during transmission and distribution.
- Research in area of increasing water use efficiency and maintaining its quality in agriculture, industry and domestic sector.
- Strict enforcement of provisions in respect of waste water treatment.
- Incentivize use of efficient irrigation practices and fully utilize the created facilities.

**(d) Groundwater Management with Focused Attention on Over Exploited Areas**

- More effective measures should be undertaken to regulate ground water extraction in the State.
- Comprehensive reassessment of the ground water resources up to Block level.
- Expeditious implementation of minor irrigation schemes including schemes for ground water development by the state in areas/situations sensitive to climate change.

- Expeditious implementation of programme for conservation of water through recharge of ground water including rain water harvesting in areas/situations sensitive to climate change.
- Promotion of a village/block/district level model for ground water regulation.
- Rain water harvesting and artificial recharge to ground water.
- Expansion of program for recharge of ground water through dug wells by State Government and CGWB.

**(e) Enhancing Preparedness for Drought Monitoring, Drought Mitigation and Development of Early Warning System**

- Carry out mass drive for renovating the traditional rain water harvesting structures/water storage structures like village ponds, bawris, etc. as they are important source of water in periods of drought and have a strong significance in the lives and livelihoods of drought prone regions.
- Conducting feasibility studies for water and soil moisture conservation practices like contour bunding, vegetative barriers and percolation ponds/trenches in drought prone areas, to reduce evaporation losses from soil.
- In order to reduce evaporation losses from water bodies adopting measures like reducing surface area by increasing storage depth; by storing the water in a compartmented reservoir and pumping the water from one compartment to another as the water is used, so that there are some full compartments and some empty, instead of a single shallow sheet when the reservoir is partly used; planting shelter belts of suitable tree species around water bodies or by artificially shading of water surfaces.
- Developing an integrated drought monitoring system, that includes climate, water, soil parameters and socio-economic indicators, to fully characterize the spatial extent and potential impact of drought situation, enabling proper planning of adaptation strategies for the state. This should be complimented with designing effective delivery systems for disseminating the information for early warning systems for droughts at district level for timely planning and management of water resources in drought-prone regions.
- Developing a drought management and mitigation policy for the state which would integrate climate change concerns like increased frequency of drought events and have elements like pre-positioning of relief resources, to ensure timely response for drought vulnerable populations.
- Allocation of irrigation water on a volumetric basis, with a focus on generating a contingency quota, for withdrawal during droughts.
- Actively engaging communities in management and use of water resources.
- Educating farmers about matching land use systems with water availability by adopting water efficient practices and low water requiring crops for agriculture.

Detailed departmental priorities have been summarized below:

### SWM-1 Reducing Gap between Irrigation Potential Created and Utilized through Restoration of Old Projects

The gap between the potential created and utilized is a major cause of concern. Up to March, 2014 irrigation potential created through major & medium and minor irrigation projects is 126.15 lakh ha, whereas actual irrigation recorded in the year 2013-14 is 75.91 lakh ha. Thus there is a gap of 50.24 lakh ha. in irrigation potential created and utilized. The completion of new projects and restoration/remodeling of ongoing projects by the department will minimize the gap between potential created and its utilization.

### SWM-2 Increasing Water Use Efficiency through Lining of Canals

Surface water in the canals of the state is limited. Most of the storage dam sites on rivers are in Nepal. Construction of such reservoirs is not possible without the consent of Nepal Government. So, due to limited availability of water in the canals of the state it is important to save water for further use. The National Water Mission (NWM) Comprehensive Mission Document states that there is a need to increase water use efficiency by 20%, whilst it also advocates a policy of "more crop per drop". The desired outcome for an improvement by 20 percent in the efficiency of irrigation water can be achieved if 20 percent less water is lost in conveying water from the source to the crop root zone and this can be done by proper lining of canals. For this in the first stage Rs 300.00 Cr has been proposed for the lining of 60 Km canals. Schemes of water conservation through lining of canals will also be taken up in subsequent years.

### SWM-3 On-farm water management (OFWM)

OFWM will focus primarily enhancing water use efficiency by promoting efficient on-farm water management technologies and equipment. This will not only focus on application efficiency but, in conjunction with RAD component, also will emphasize on effective harvesting and management of rainwater. Assistance will be extended for adopting water conservation technologies, efficient delivery and distribution systems etc. Emphasis will also be given to manage and equitably distribute the resources of commons by involving the water users associations, etc. To conserve water farm itself, farm ponds may be dug using MGNREGA funds and earth moving machinery (to the extent manual digging under MGNREGA is not feasible). OFWM will focus on enhancing water use efficiency by promoting appropriate technological interventions like drip and sprinkler technologies efficient water application and distribution system secondary storage and drainage development (also as described in SWM-18 for convergence with Agriculture department). The water resources developed through watershed development programmes/ MGNREGA in the demonstration area should invariably be linked with the activities of OFWM component for its potential use. Project areas under national Food Security Mission (NFSM), National Mission on Oilseed and Oil Palm (NMOOP), National Mission on Horticulture (NHM), National Livestock Mission (NLM) may also take the advantage of this component for improving water use efficiency, if this component has not been utilized from the parent scheme.

### SWM-4 Water sector restructuring project

Various measures/schemes have been taken up by the Irrigation Department of Uttar Pradesh under the Uttar Pradesh Water Sector Restructuring Project (UPWSRP) Phase-II: Present infra-structure for monitoring water flows in rivers has to be strengthened. Real Time Data Acquisition system (RTDAS) has been proposed to be established for management of discharge and silt in canals. Necessary and required actions are in progress in this regard in the Irrigation Department of Uttar Pradesh Govt.

- Like other States, a Lake Development Authority should be constituted in the State.
- Setting up of "Climate Change Cell" in the state.
- Aquifer mapping should he undertaken to constitute the State Level Aquifer Management Authority.
- Irrigation, Minor Irrigation and Ground Water Departments should be comprehensively re-organized and strengthened.
- State Geology Department should be re-organized and strengthened

### SWM-5 Completion of 11 no of new and ongoing projects

To reduce regional imbalance ad improve water availability 14 nos new and ongoing projects (major irrigation) 21 under minor irrigation have been planned to enhance water availability with an investment of Rs 7303 crore in 4 years. By completing these projects potential restoration of 1558.88 thousand ha will be done. This will minimize the gap between potential created and utilized.

### SWM-6 and SWM-7 Survey and investigation and Research and Development

These are ongoing tasks of the department to identify potential area and undertake projects that enhance water availability without damaging the environment. This is undertaken in association with Central Ground Water Board and the department of the state.

### SWM-8 Institutional Reform and Capacity Building

Uttar Pradesh Irrigation Department reforms & capacity building component of UPWSRP seeks to translate into action the GoUP vision to have modern, financially-sustainable institution with appropriate human resources and analytical tools to deliver efficient, environmentally & socially sustainable and cost effective irrigation and drainage services. A cadre restructuring for enhanced usage of IT is going on. Other reform initiatives include establishment of a water regulatory authority for water pricing, developing private sector participation through the strengthening of the Water User Associations and also undertaking extensive training and capacity building under Integrated Watershed Management Program. Proper training will be provided and awareness will be created to the beneficiaries of each structure through NGO's.

### SWM-13 Masonary check dam

Minor Irrigation Department is the pioneer agency in the state for construction of masonry Check Dams: a type submerged weir. These check dams after completion will irrigate about 62000 hectare. of land and augment ground water to the tune of 5450 hectare.m. per year capable of irrigating additional 15570 hectare. It is proposed that detail project report will be prepare for each district after conducting proper survey and investigation of each site and cost may change accordingly. Focus will be on over exploited/critical blocks however there will be no restriction in other blocks.

### Convergence programme with agriculture department, fisheries department, NEDA and urban development

Integrated water resource management as a concept requires effective and efficient utilization of water resource. It requires coronation and convergence. The following components have been planned with the above departments. Integrated water resources management is very important for a sustainable water resources development programme as well as for agriculture and fish production. This can be achieved through the following programmes:

- Conservation of water from various sources.
- Conservation of water from traditional system.
- Conservation of water in wetland.
- Efficient water use.
- Awareness in farmers about water efficient crop adoption.
- Conservation practices e.g. No tillage / less tillage.
- Integrated farming system
- Cropping pattern.
- Organic Farming.
- Efficient water use.
- Integrated Plant Nutrient management

**Fisheries** Management Act, 2014 has been finalized and proposed by the department of Fisheries for management of water bodies within the boundaries of Uttar Pradesh. Apart from agriculture and industry, animal husbandry is also very much dependent on water. Fishes do not need any extra water for its growth and survival, however 1.5m to 2.0m water depth is essential round the year for the survival of fishes. The department will ensure this much depth of water in the water bodies to promote fisheries. Similarly the key priorities like water quality monitoring, water metering and storm water management have been covered under **urban development** department. Installation of solar pumps will be done through **NEDA**.

### SWM 22-SWM 23 Integrated Basin Management Plan and impact of climate change

A State Water Resources Agency (SWaRA) has been set up since October 2002 to develop and provide a State-level capability for inter-sectoral water allocation, planning, management and optimal use of surface and groundwater based on comprehensive and environmentally sustainable river basin plans. SWaRA aims for the development of River Basin Assessments and Plans for all major eight river basins in Uttar Pradesh under Uttar Pradesh Water Sector Restructuring Project Phase. Besides this SWaRA proposes to develop an Adaptation Strategy and formulate a programme for Adaptation to the Climate Change in order to adopt new policies and practices so as to secure development goals of the State in the face of climate change and its associated impacts.

### SWM-24 Development of Water Resources Information System & subsequent implementation of Integrated Water Resources Management (IWRM) in UP

In Uttar Pradesh, water resources are being planned, developed and managed by different departments. Surface/canal water up to the level of outlets is managed by Irrigation Department and beyond outlets by Command Area Development Authorities. Ground water based irrigation supplies are arranged by Minor Irrigation Department and Groundwater Department is engaged with resource estimation, investigation and planning. Whereas, drinking water supplies in rural and urban areas are developed and managed by U.P. Jal Nigam. Water resources are also utilized in other sector of the state like power, industries, tourism, transport etc. In view of the diversified water resources data including meteorological, surface & ground water, there is a need to develop Water Resources Information System & subsequent implementation of Integrated Water Resources Management (IWRM) in the State. For the purpose of acquiring water data base, Government of Uttar Pradesh has decided to develop an Integrated Water Resources Information System (IWRIS).

### Convergence with UP Vidyut Utpadan Nigam

Apart from co-ordination for hydro-power generation, the sectoral convergence is necessary for ash-water recirculation, effluent treatment and meeting the water requirement of large scale solar plants under solar mission to maintain adequate PLF, grid frequency and parity.

## 9.4 BUDGET FOR JAL MISSION

The total budget for this mission including the convergence component is estimated to be Rs 24,400.67 crore for 2014-18 period.

# 10 STRATEGIC KNOWLEDGE MISSION

## 10.1 OVERVIEW

The State of Uttar-Pradesh is on the path of development with the challenge of sustaining economic growth while ensuring environmental conservation. Climate change is a serious environmental threat to habitats with possible adverse impacts on agriculture, natural resources, health and socio-economy of the state. The state of UP is vulnerable to climate change, as a large population dependent on agriculture, forestry and water resources for livelihood. Since, state's economy depends on natural resources and any adverse impact on these will hamper the efforts to alleviate poverty and ensure sustainable livelihood for the population. This is an opportune time to integrate the concerns of climate change into our policies and ensure ultimate objective of sustainable development with inclusive growth. The State Action Plan on Climate change has been prepared keeping in mind the objective of sustainable inclusive growth incorporating the actions on climate change in Govt. policies and plans.

Therefore, it is aimed to develop well-researched and formulated mitigation and adaptation strategies to respond effectively to the possible impacts of climate change.

The issue of climate change is multidisciplinary and demands cross-sectoral convergence which requires interdepartmental coordination as well as constructive engagement with all the concerned stakeholders by knowledge dissemination to them.

The Department of Environment is the nodal department for Strategic Knowledge Mission and entrusted the task to mainstream climate change know-how across all the sectors for achieving the objective of sustainable development.

State Mission on Strategic Knowledge for Climate Change **will promote a better understanding of climate science, impacts and challenges through research and development**. It calls for the establishment of a new Climate Science Research Fund under Climate Change authority for improved climate modeling, and increased national and international collaboration and cooperation. It will also foster private sector initiatives aimed at developing adaptation and mitigation technologies through venture capital funds.

Knowledge is one of the key determinants of the capacity to adapt and mitigate climate change. A focused knowledge system is therefore necessary for the design of suitable interventions to respond to climate change. Further, the very abundance and diversity of existing knowledge, which is often conflicting, inconsistent or outdated, may pose a barrier to its usefulness. The situation is compounded by the low capacity of many stakeholders to assess the credibility and relevance of the available knowledge. Also, enhanced local research capacity is essential if evidence – based policy to address climate change is to be implemented.

**The state mission on strategic knowledge on climate change intends to create a dynamic knowledge system that would help take actions to reduce vulnerabilities as well as take advantage of the mitigation opportunities. Strategic Knowledge on Climate change is therefore, the system of knowledge that is required by various stakeholders to respond to climate change.**

Information and knowledge requirements of the stakeholder groups are as diverse as the groups themselves. Consequently, the mission is cross cutting in nature and is intended to serve as a support mission for generating and providing strategic knowledge to all other 6 missions on Climate Change, in consistence with the National Mission on Strategic Knowledge for Climate Change.

The mission not only focuses on key knowledge requirements but also on knowledge management and dissemination followed by its monitoring and evaluation.

Dissemination and capacity building activities that is critical for any strategic knowledge system. The constitution of core mission is given in Annexure B of this report. The schematic representation above presents a broad conceptual framework of the mission.

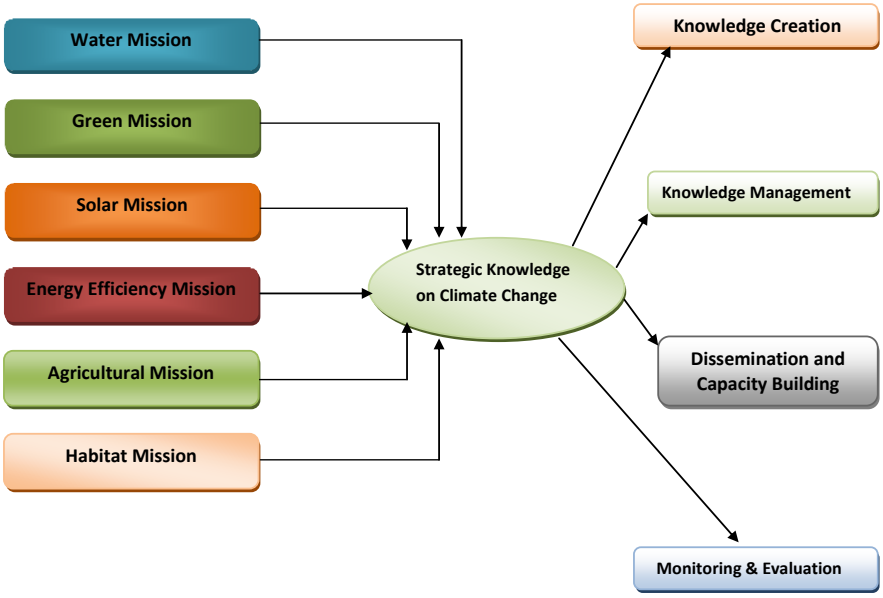



Figure 33 Conceptual framework for Strategic Knowledge Mission

## 10.2 STRATEGIES TO ADDRESS CONCERNS DUE TO CLIMATE CHANGE IN STRATEGIC MISSION

A comprehensive strategy has been drawn out to address climate change concerns under this mission. This has been highlighted in the figure below.


Figure 34 Knowledge Strategy

1. **Knowledge Creation:**

   Need is felt to enhance the comprehension of climate change at policy level which could inadvertently help the decision making at all levels. State of the art research is needed to provide policy makers with tools to evaluate and respond to the threat of climate change. A Sectoral GHG inventorization and generation of climate modeling and tools for each sector is envisaged to be done and a Climate Change status report to be generated every five years to take an account of the change of climatic parameters for the State.

2. **Knowledge Management**
   - Documentation, authentication and mainstreaming traditional science. National Science Centre, Lucknow will work on it.
   - Popularization of scientific research, remote sensing applications, information technology, etc. in schools, colleges, panchayati raj institutions, voluntary organizations, etc. for dissemination of information
   - Technological up-gradation of monitoring tools like MIS and advanced satellite monitoring technologies like Remote Sensing needs to be strengthened within vulnerable departments.
   - In order to impart knowledge to stakeholders, it envisaged to establish a state level climate change cell at DoE working under State Climate Change Authority

3. **Knowledge Dissemination:**
   - Increase of general awareness of people by educating them about climate change: More awareness is required to be generated among the masses for better implementation of adaptation and mitigation efforts.
   - Capacity building of Policy makers, officials, media, NGOs, etc. on mitigation and adaptation to climate change to be imparted by experts in order to promote best practices in the state for effective and better planning
   - Workshops or other interactive sessions to be organized at District level Centres and a Climate Change Resource material on each centre to be developed for sensitizing the communities on CC issues and respective vulnerabilities so that Climate Change concerns could be integrated and addressed at planning level.

4. **Monitoring and Evaluation:**
   - Commissioning of Baseline studies for sector is required to evolve appropriate sectoral criteria/ indicators for M&E in association with respective departments
   - Regular monitoring of critical ecological parameters, such as air, water, forests, etc.
   - Regular monitoring and documentation of urban landscape (including change in land-use pattern), population growth, settlements (especially slums) is required to ensure a sustainable habitat development

## 10.3 KEY PRIORITIES

### KNOWLEDGE CREATION

**SKN-1 Primary data generation with surveys, studies, research, modeling (about 15 identified studies and budget for responding to needs of other departments)**

There are crucial knowledge and data gaps in some areas. Knowledge creation that responds to real demands of the state to respond to climate is necessary. There is an inadequate knowledge on the impacts of climate change in different sectors of the state while; the information available in various domains is incomplete or conflicting. Insufficient observational and scientific information database pose drawback to assess the climate change implications for the state. Further there is a lack of clear understanding of important processes like desertification, which requires the monitoring of various parameters such as changes in water quality & quantity, biomass, biodiversity, soil salinity etc. No specific studies have been conducted to monitor this process in the state. There is no data available on present resource use, technology use or energy consumption from the industries. Very few R&D work has been done on climate change in UP.

The understanding of impacts and vulnerabilities is available at the national level but not at state and district levels. A significant amount of conceptual and empirical work is required to better understand local and regional climate impacts. Such an understanding is necessary to provide a better background for developing differentiated but linked responses to the different types of impacts. However, other than increasing efforts to promote energy efficiency and renewable energy there is a lack of understanding of the low carbon development pathways. Many existing options and opportunities are under—utilized due to absence of research and analysis especially tailored to state specific social, ecological.

With regards to knowledge creation, it is not only important to emphasize on data requirements but also identify which data is already collected, what is missing, at what scales they should be collected, and in what format these need to be collected and what their use will be. Table-2 identifies some key data requirements to foster action on climate change.

Table 23 Key knowledge requirement

| Database | Components | Rationale |
|---|---|---|
| **Meteorology** | Precipitation (Daily), maximum and minimum temperature (Daily), solar radiation, Wind speed, Relative humidity, Evaporation data etc. are and also for. | Essential input to sectoral impact assessment models such as DSSAT, SWAT or CROPWAT Extreme event analyses. This information is critical for various early warning systems and decision support systems. |
| **Land Surface** | Land surface data at appropriate scales. Hydro--geological maps inclusive of: contour, drainage, Digital Elevation Models (DEM), soil type, depth, texture and physical, characteristics (composition of silt, sand, clay, | Essential for various sectoral impact assessment models of agriculture, surface water, and ground water etc. Extreme event assessments Land use plans Disaster planning and Management Important input for assessments pertaining to |

| Database | Components | Rationale |
|---|---|---|
| | rocks), drainage network, watershed boundary, Hydraulic conductivity, LRDP (land resource development plan)<br><br>Time series remote sensing data on land use land cover (decadal or five year interval data. | forestry, water resources, and urban systems amongst others. |
| **Hydrological** | Stream gauge stations, water level and discharge, river cross section, reservoir/water bodies characteristics etc.<br><br>Aquifer-type, depth, extent, lithological variation, information, transmissivity, hydraulic conductivity, specific yield, storage coefficient, well-location, well type, well depth, water table data, groundwater consumption | Feed into surface water runoff models such as MODFlow, SWAT<br><br>Feed into ground water assessment methods such as the GALDIT.<br><br>Hydrological data is an important input to agricultural models. |
| **Agriculture and Livestock** | A detailed Agro zone wise inventory on cultivar name, planting date/method/distribution, crop management practices, crop level diseases, incidence of livestock diseases, invasive species inventory, fertility factor percentage organic carbon and nitrogen content, area under cultivation (for different crops and on the basis of land holdings) yield (farm and crop level) and types of crops cultivated is important.<br><br>Socio economic data relevant to agriculture like irrigation infrastructure, details on land holdings (cereals, pulses, fodder, commercial, etc.) alternative livelihood sources, tenancy, access to market, utilization of agricultural credit and insurance as well as information on traditional crop varieties and indigenous animal breeds and their special features | This inventory could help understand the impact of climate change on various crops.<br><br>Critical to assess the adaptive capacity of the sector and design appropriate interventions. |
| **Socio Economic data** | Socio economic information inclusive of information on the institutions and governance.<br><br>Vital Statistics (Total population, male female ratio, adult dependency ratio, crude death rate, crude birth rate, average life expectancy at birth, etc.), Education information, Occupational Structure – formal and informal, State Govt. spending on credit and insurance support including rural banking density, Number of non-financial, spread and activities of such institutions and livestock insurance participation level of industrialization and | Essential for vulnerability assessments and also for socio economic scenario building both of which are critical for responding to climate change.<br><br>For designing efficient interventions for climate change adaptation |

| Database | Components | Rationale |
|---|---|---|
| | urbanization are important. Rehabilitation and relief measures as well as direct economic losses, indirect losses, etc. due to extreme events are equally important.<br><br>Coverage of and access to drinking water source, Coverage of sanitation facilities data. | This is essential for not just to plan for water scarcity but also for interventions in the health sector. |
| **Forests and bio diversity** | Geographical distribution of vulnerable habitats and species, information about invasive species. | Important to understand the impacts of climate change on the forestry sector. |
| **Health Related data** | Health statistics including morbidity/mortality data, distribution/Risk maps for climate sensitive diseases like diarrhoea and malaria, health infrastructure, prevalence of malnutrition etc. | For understanding health sector vulnerability to climate change. |
| **Energy** | Energy information on consumption patterns and conservation potential. It should include information on urban infrastructure like transport and buildings.<br><br>Composition, quantum, and sources of waste | Help the state to take advantages of the low carbon development opportunities under the CDM mechanisms of the UNFCCC.<br><br>Help in design of waste to energy projects |

**Existing Research capabilities in U.P.:** In U.P. there are several institutes who are involved in scientific research and resource centre related to Environment and Climate Change. Mainly are following:-

1. IIT Kanpur.
2. BHU, Banaras.
3. AMU, Aligarh.
4. MNR, Allahabad.
5. Biotech Park .
6. Birbal Sahni Institute of Palaeobotany, Lucknow.
7. Central Drug Research Institute.
8. Central Ground water Board.
9. U.P. Pollution Control Board.
10. Central Institute of Medicinal And Aromatic Plants, Lucknow.
11. Central Institute of Plastic Engineering & technology.
12. Central Institute for Subtropical Horticulture, Lucknow.
13. Council of Science Technology, U.P.
14. Defense Research and Development Organization.
15. Geological Survey of India.
16. Indian Institute of Sugarcane Research, Lucknow.
17. Indian Institute of Toxicology Research.
18. Indian National Science Academy, Lucknow.

19. Ministry of Earth Science.
20. National Academy of Science, India
21. The National Bureau of Fish Genetic Resources.
22. National Botanical Research Institute.
23. National Council of Science Museums.
24. National Research Laboratory for Conservation of Cultural Property
25. Research Designs & Standards Organization.
26. Remote Sensing Application Centre U.P.
27. Sanjay Gandhi Postgraduate Institute Of Medical Sciences.
28. U.P. Academy of Science.
29. Vigyan Prasar New Delhi.
30. Amity University, Lucknow.
31. King George Medical University.
32. Lucknow University.
33. SRM University Lucknow.
34. Centre of Environment Education.
35. Regional office Ministry of Environment and forest.

The State Remote Sensing Application Centre of the Government of UP is generating a number of databases related to natural resources in the state using remote sensing techniques. The centre has produced natural resource atlas, watershed atlas, ground water atlas, water harvesting structure master plan, hydro geological mapping, waste land mapping, lift irrigation master plan, ravines mapping, urban land use mapping , map wetlands, land use/ land cover.

National agencies such as the central water commission houses basin wide information, whereas the Central Ground Water Board/UP Ground water Board has data and information for ground water resources.

In last decade following studies pertaining to Environment research had been completed with the funding and support of Environment of Directorate.

1. Bio-remediation of Polluted water bodies of Lucknow 2002
2. Inventorization of distillery waste in U.P, 2005.
3. Inventorization of tannery waste in U.P. 2006.
4. Inventorization of Utilization of Fly ash generating units in U.P. 2007.
5. Preparation of Environment status report of U.P. 2009
6. Preparation of Environment status report of Gautam Budh Nagar.

Further quite a few relevant studies are currently ongoing in the state. The state Pollution Control Board is also involved in conducting the studies. The survey of the river basins is underway and State pollution control board regularly conducts water quality monitoring at designated The study intends to assess the current water scenario in the state, current water balance in the state and thereby arrive at interventions to improve the water situation in the state. Few of the identified research projects that can be undertaken under this mission are following:

**Studies and Research for data generation:**

1. **Flood mapping, flood forecasting and downscaled climate change projections modeling**

   **(20 lac)**

   Recent years the State of Uttar Pradesh has witnessed floods in many districts which had caused loss of habitats, livelihood, epidemics and other socio-economic hardships in these flooded districts. Due to non-availability of sound alarming system and lack of flood modeling and forecasting studies carried out by state of UP many lives could not be saved. With climate change, extreme flood events are expected to increase in frequency and intensity. This can lead to flooding of low laying areas specially villages in UP that may cause loss to agriculture, livelihood and loss of flora and fauna. To be prepared for these situations, flood modeling - mapping and forecasting –may be extremely beneficial. This needs to be done through the scaling down of the global circulation models/other available models as applicable to the state of UP. As a part of this initiative, such modeling studies will be undertaken. Once in place, these models will be used to strengthen preparedness. In addition to this, the traditional knowledge of adaptation will be documented and incorporated.

2. **Study of impact of global warming on the biodiversity of wetland and arid ecosystem with special emphasis on flagship species.**

   **(15 lac)**

   There is a likelihood of climate change impacting the unique mangroves – a flagship biodiversity species - of UP. With a focus on the climate change modeling studies will be done to predict the impact on the mangrove diversity. Using the findings of these studies, further biodiversity conservation measures will be planned to protect the flagship species from climate change impacts. Convergence will be done with State Bio-Diversity Board to carry out such studies in UP.

3. **Hazard risk mapping and climate modeling**

   **(20 lac)**

   There aren't many hazard risk mapping and climate modeling analysis studies available for UP. A further in-depth detailed study for extreme climate especially in terms of rainfall, temperature and wind extremes by the use of dynamic high resolution regional climate modeling is advised. Detailed study has to be undertaken to study the effect of these extreme weather events at settlement level. While presenting any modeling output study a proper peer review should be carried out and uncertainty in data and model outputs should be reported. For validating the modeling outputs, high number of observations network is imperative and the data gaps associated with these should be addressed.

4. **Research on disease early warning system relevant to livestock**

   **(20 lac)**

   Climate change may have implications for livestock development in the state through the outbreak of diseases. To reduce the magnitude of casualties, there is a need to better understand the inter-linkage between weather / climate variations and diseases. Data will be collected, models will be developed and analysis will be made to determine the linkage. Under this initiative, a particular area will be selected for closer study / research. Based on the outcomes, the relevance of the findings will be extrapolated to across the state.

5. **GIS based Green House Gas inventory for the Transport Sector in major cities in UP.**

   **(25 Lac)**

   Very few data on Green-house gas inventory from Transport Sector is available. The Transport sector contribute maximum Greenhouse gases in UP. Further it requires model prediction with GIS dynamic system to update on regular basis. Initially 5 districts have been chosen viz, Lucknow, Meerut, Bareily, Moradabad, Kanpur.

6. **Estimation of extent of emissions and impacts from power sector**

   **(20 lac)**

   While all individual sectors recognize the climate change relevance, there is no data/information to the extent to their sector contributes to the overall emissions. There is also no data/information to the extent the sector has to adapt to climate change impacts. Such estimation is a common need. Studies can be carried out through UPPCB.

7. **Developing models of urban storm water flows and capacities of existing drainage systems with climate change**

   **(50 Lac)**

   With climate change and the associated vagaries of rainfall/precipitation, maintenance of the river health and its ecosystems becomes vitally important. Under this initiative, a research study will be done in different river basins to determine the environmental flow that will be required to sustain the health and the aquatic ecosystems. As far as possible community monitoring will be encouraged to reduce water thefts. Based on the outcomes of this research study, the thrust actions will be identified; planned and implemented Efforts should be made to develop a plan to catch the water where it falls.

**Other studies that may also be conducted are**

1. Climate change vulnerability assessment and strategies for better preparedness in the state of UP (for a detailed analysis and case studies in all agro zones in UP) (30 lac)
2. Understanding low carbon development pathways (for all sectors of relevance to the state) (25 Lac)

3. Increasing the scale and spatial distribution of the data (for stations in 75 districts of the state and other instrumentation)(80 lac)
4. Rivers Cross section and time flow modeling (20 lac)
5. Networking of River Quality Data and Modelling (25 lac)
6. Clean Development Mechanism in Industries. (30 lac)
7. Evaluation of Zero discharge technologies in Industries. (15 lac)
8. Inventory of Solid and Industrial waste management in UP. (25 lac)

**Table 24 Indicative budget under knowledge creation**

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Research, studies, modeling, data collection etc. | Nil | 1. Flood mapping, flood forecasting and downscaled climate change projections modeling<br>2. Study of impact of global warming on the biodiversity of wetland and arid ecosystem with special emphasis on flagship species.<br>3. Hazard risk mapping and climate modeling<br>4. Research on disease early warning system relevant to livestock<br>5. Other studies will be carried out as per the need of other core group missions<br><br>Total Cost = 500 Lacs | 1. Waste of energy options.<br>2. Environmental performance rating of sugar, Tanneries, Paper and Distilleries.<br>3. Demography and population control.<br>4. Livestock and climate change.<br>5. Resilience studies.<br>6. Other studies will be carried out as per the need of other core group missions<br><br>Total Cost = 500 Lacs | 1. Impact Evaluation Studies<br>2. Socio Economic Studies<br>3. Benchmarking studies<br>4. CDM in Uttar Pradesh<br>5. Inventory of Solid and Industrial waste management in UP.<br>6. Other studies will be carried out as per the need of other core group missions<br><br>Total Cost = 500 Lacs | |

Above studies will be conducted by inviting RFP as consultancy assignment or single source such as eminent institutes as stated above. After following all state procurement rule studies will be awarded. Studies and data generated will be kept in digital form at Climate change cell or Authority for access to all.

## SKN-2 Funding from Climate change research fund to Dedicated Research Centers at Universities/Colleges

The Strategic Knowledge mission will fund 5 Universities/colleges in the first year to set up dedicated Climate change research centre inside their premises. This funding will be used to provide scholarships/financial assistance/awards to Ph.D/Masters/Bachelors/diploma in Climate change and maintenance of laboratories and other related infrastructure involved in climate change research. In next 15 years 15 such institutions will be identified for research funding. The each centre will have full-fledged research laboratory with software section and library. Dedicated manpower will be deployed there. Mobile labs can also be funded to carry out the samples. Assistance from private agencies/associations may be taken.

Table 25 Indicative funding from climate research fund

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Funding climate change research from climate change research fund to Universities and colleges for setting up of new climate change research centers jointly with private sector. | Nil | 5 Crores + 5 Centers<br><br>Total Cost = 500 Lacs | 15 Crores + 5 Centers<br><br>Total Cost = 1500 Lacs | 15 Crores + 5 Centers<br><br>Total Cost = 1500 Lacs | Universities/ Colleges/ Industry association/I ndustry |

## KNOWLEDGE MANAGEMENT

### SKN-3 Use of Information Technology in managing the data developing MIS and website

Information on the climate change impacts/implications of different sectors is not readily available - climate projections) as well as bottoms-up (from collecting empirical data / information) approach is required for all core groups that are impacted due to climate change, e.g. water resources, agriculture ,forests, energy, habitat. The strategic Knowledge mission will work as a nodal point for all missions for data management and its transfer to manage the knowledge data base collected through research and information from the other institutions and departments. Latest update on technology and other adaptation and mitigation on all sectors will be maintained by the SKM cell. The centre will also have knowledge inputs from national and international organizations like TERI, UNFCC ,GIZ, World Bank and other key resource centres. This information and knowledge could be ranging from climate science and impacts to; mitigation and low carbon development paths. The system will be able to integrate and organize information and assessments from multiple sources at various scales and present it to stakeholders in a useful. The focus will be to adapt existing knowledge and systematically organize knowledge products. Further, an arrangement for real time data sharing among various data sources will be made for building strategic actions based on knowledge-led paths. The aim will be to create a systemic web based mechanism for collating, synthesizing and delivering knowledge products for decision making on climate change.

Meteorological data has to be available at adequate scales for models to provide outputs that are policy relevant. There is little or no meteorological data available at the district level. A high number of observations network is essential for validating the modelling outputs. The centre will aim to expand no of observation networks across UP.

Socio economic information containing in district statistical handbook is not available in digital format for all years as well as the GIS and remotely sensed data prepared by the Remote Sensing Agency. There is a digitized database at the state level, but there are no such databases at the district level for socio economic data. The SKM will therefore, aim to develop digital data base at each district level.

Table 26 Indicative budget for IT and MIS integration

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Procurement of Hardware and Software | Nil | Procurement of Hardware and Software<br><br>Total Cost 100 Lacs | Design and development of software for climate change research cell.<br>Total Cost 200 Lacs | Continue O & M<br><br>Total Cost 200 Lacs | Directorate of Environment<br>Contractual manpower shall be required |

## SKN-4 Documentation of Industry- Specific documents (in association with industries, associations and private sector)

Best practices on clean development and pollution abatement practices will be collected with the help of CII, ASSOCHAM, Industrial Associations and State Pollution Control Board and MoEF. Field visits and exposure visits may be made in this regard.

## SKN-5 Setting up Editorial Board and start publication of data in journals

The endeavor will be to link various data sources and existing databases that are relevant for climate change research and policy making. It is proposed to Set-up Editorial Board and start publication of data in journals published by Climate change cell. The cell will compile and manage the date in MIS system and work as technology transfer centre of the state.

Table 27 Indicative Budget for publications

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Publication of Journal, Reports and Research documents on Climate Change. | A quarterly newsletter is being published regularly under ENVIS Scheme which addresses various Environmental issues. | Set up Editorial Board and start publication<br><br>Total Cost = 25 Lacs | Continue<br>24 pages/1000 copies/half yearly = 1,00,000<br>Rs 5000 per article/20 Article for one year = 1,00,000<br>Postage 50,000/-<br>Contractual Manpower 12,000/-per Month=1,50,000<br>Cost=5,00,000 per year X 5<br>Publication of reports and documents Rs. 20 Lacs per Report/document per year<br><br>Total Cost = 125 Lacs | Continue<br>Same with 20% - incremental Cost =Rs. 6,00,000/-per year<br>Publication of reports and documents Rs. 20 Lacs per Report/document per year<br><br>Total Cost = 125 Lacs | Directorate of Environment<br>Contractual manpower shall be required |

### SKN-6 Preparation of Environmental Status Reports (State & District wise)

The DoE will prepare Environment Status report for districts in UP incorporating all issues related to climate change mitigation and existing scenario highlighting all impacts and vulnerabilities across all sectors. This report will also discuss the important issues such as water, land, biodiversity, urbanization, tourism, health, energy, rural development, transportation, industrial development, pollution, environmental governance, climate change etc. and tries to give the status and identifies the pressures, impacts and responses.

### SKN-7 Documentation of Bio-diversity status and traditional environmental knowledge

The DOE will maintain the data and document it and collect and maintain the traditional environment knowledge from entire state. NGO;s help will be taken to catch and document such information at one point. DoE will have convergence with Bio-Diversity board to access to all information related to bio-diversity and will manage this information in form of audio and visuals, CDs etc.

## KNOWLEDGE DISSEMINATION AND CAPACITY BUILDING

Awareness is the first step. The next is to build the capacity – knowledge, skills and resources – to be able to address climate change concerns. This is again a need across all the individual sectors. Strengthen the capacity of local communities to manage forests, biodiversity and wetlands using participatory approach.

A dissemination mechanism that serves the diverse needs of the stakeholders is an integral element in the strategic knowledge system. Dissemination of knowledge helps bridge information asymmetry that is critical for any action on climate change. Timely dissemination of information could help enhance the adaptive capacities of vulnerable communities, it could help government to better mobilize resources and money during a climatic extreme. However, Low capacity of many stakeholders to assess the credibility and relevance of the available knowledge has been a barrier to respond appropriately to challenges of climate change. Therefore training and capacity building activities are equally critical for the strategic mission to create awareness among the masses.

## SKN-8 & SKN-9 Information, Education and Communication Activities

The attempt will be disseminate information on climate change through state television programmes and awareness programmes in the radio etc. Further, attempts will also be made to mainstream climate change concerns into current programmes in science communication and popularization through science clubs. Wide publicity will be done through TV, AIR, hoarding and buses and other cultural events. Best IEC tools will be applied to spread dissemination of Knowledge and awareness. Convergence will be made through the National Green corps program in Up and children will be involved and best 100 clubs will be developed as centre for excellence.

**Table 28 Indicative Budget**

| Activity | Present Status | 1st Year | 2 to 6 Year<br>(Total 5 Years) | 7 to 11 Year<br>(Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Publicity through TV/AIR/Hoardings & Buses | Nil | Roads/Buses/Hoardings<br>Rs. 5,00,00,000/- per year<br>Total Cost = 500 Lacs | T.V. Programmes<br>Rs. 5,00,00,000/- per year<br>Total Cost = 2500 Lacs | To continue<br>Rs. 6,00,00,000/- per year<br>Total Cost = 3000 Lacs | Ail Mission Heads to allocate resources to<br>Directorate of Environment |
| Integrate Climate Change agenda with National Green<br>Corps activities and District Plan activities. | Nil | 2 best clubs in each district to be established as centers of excellence.<br>10,000x2x75 = 15 lakh | 50 clubs in each districts<br>3.75 Cr/year<br>Total Cost = 1875 Lacs | 100 clubs in each district<br>7.5 Cr/year<br>Total Cost = 3750 Lacs | Pollution Control Board, Directorate of Environment and Govt. of India |

## SKN-10 and 11 Training, Conferences, Seminars etc.

The goal of the programme will be to build capacities of key stakeholders in the government to better understand climate change dynamics. Officials from Departments of Environment & Forests, Industries, Energy, Urban Development, Agriculture, Water Resources & Irrigation, Education, Revenue, Science and Technology amongst others could be targeted.

Table 29 Indicative budget for training and conference

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Training programmes for administrators, policy makers, development departments, students and other stake holders regarding Climate Change | Nil | Rs. 1,00,00,000/- per year<br>Total Cost = 100 Lacs | Rs. 1,00,00,000/- per year<br>Total Cost = 500 Lacs | Rs. 1,00,00,000/- per year<br>Total Cost = 500 Lacs | Key resource centres to be identified such as IIT's, TERI etc. |
| Organize Seminars, conferences and workshops on Climate Change | Nil | 1. General<br>2. Strategic Knowledge<br>Venue 5 lakh Travel and Stay 5 lakh Stationary and publishing 5 lakh<br>30 lakh for 02 conferences per year<br>Total Cost = 30 Lacs | One annual conference each year for all missions and one National Integrated Nodal Workshop<br>30 lakh for 02 conferences per year<br>Total Cost = 150 Lacs | One annual conference each year for all missions, one National conference<br>30 lakh for 02 conferences per year<br>Total Cost = 150 Lacs | Mission heads Directorate of Environment Industry Partnership |

## SKN-12 Setting up of Knowledge Centres

The attempt will be to assimilate the traditional knowledge systems and reference them to the social contexts of the region. Further the focus will also be on integration of perceptions and practices of people with scientific analysis to validate, standardize and scaling up of these traditional knowledge systems. The inventory will be made available to all stakeholders through a web database. It will aimed to Create Climate Change awareness centre at National parks, Sanctuaries, Zoo and other public places on prominent cities. Total 10 centres will be created across the UP. NGOs/CBOs working on climate change issues should be identified and encouraged to document indigenous practices that enhances adaptation to climate change. Replica of natural progression (degradation or conservation) models can be kept in these places for people to learn and understand the climate change issues. Photo-documentation and gallery can be developed in association with professionals.

Table 30 Indicative Budget for Knowledge Centre

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Create Climate Change awareness centre at National parks, Sanctuaries, Zoo and other public places on prominent cities | Nil | 2 Centers<br>Rs. 1,00,00,000/- per center (with recurring cost upto 05 years)<br>Total Cost = 200 Lacs | 08 Centers<br>Rs. 1,00,00,000/- per center (with recurring cost upto 05 years)<br>Total Cost = 800 Lacs | 10 Centers<br>Rs. 1,00,00,000/- per center (with recurring cost upto 05 years)<br>Total Cost = 1000 Lacs | All Mission heads to contribute |

## SKN-13 Technical capacity building for the advancement of research on climate change

Directed efforts by the state create manpower with skills in advanced computing systems to run Global Climate Models (GCMs) and Regional Climate Models (RCMs), GIS and remote sensing applications, Hydrological Modeling (of groundwater, surface water and basin hydrology). Equal importance should also be placed to create manpower with skills in Trans-disciplinary Concepts and Methods that are essential to address unstructured problems like climate change. This will be achieved through a constitution of state climate change fellowships that will provide researchers with an opportunity to learn skills from important institutions in the domain. It will be aimed to establish a hard and 'e' library at Directorate dedicated to Climate Change.

Training programme on climate change for high school teachers-This will be an attempt to sensitize teachers in the state on various aspects of climate change through a short training programme. This could have cascading effecting on the students and through them to the larger society as a whole. It will be aimed to promote Centers for excellence in College/Universities/Institutions.

Table 31 Indicative budget for promoting climate change research partnership

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Promote Centers for excellence in College/Universities/Institutions | Nil | Identify and create 01 center.<br>1,00,00,000/- per center<br>Total Cost = 100 Lacs | 04 center<br>1,00,00,000/- per center<br>Total Cost = 400 Lacs | 05 center<br>1,00,00,000/- per center<br>Total Cost = 500 Lacs | Directorate of Environment |

## SKN-14 Strengthening of ENVIS Centre at Directorate of Environment

Environmental Information System (ENVIS) is the first web-enabled information network for establishing a comprehensive nation-wide network of Store House of Information in disaggregated Mode in Institutions and Organizations for collection, collation, storage, retrieval and dissemination of information related to environment in the country for dissemination of information online in real-time basis in the field of environment and its associated areas to decision makers, policy planners, researchers, scientists, environmentalists, students and the general public.

The main objectives of the scheme are:-

- To build up a repository and network of dissemination centres in environmental science and engineering;
- To adopt modern technologies of acquisition, processing storage, retrieval and dissemination of information of environmental nature; and
- To support and promote research, development and innovation in environmental information technology.

The Centre will regularly update the website on various subjects related to climate change.

- In compliance to above mandate, we have been coordinating with several government departments, institutions and other related agencies to get authenticated data. In this continuation, we also feel need to identify and widen our domain of sources for information. We intend to seek help of various universities, area specific centers, and experts etc. to enrich our information base. It is also planned to start a e-forum on our website to get expert comments on the contents of the website and advice regarding data sources for the enrichment of the contents of website.
- In the process of data collection and updation a lot of difficulties is often experienced as there is no nodal point in departments to provide information.
- We also would like to request for the timely release of funds in order to enhance the creativity and progress of the ENVIS centre.
- The status of the environment and the contribution of conventional development strategies to achieve sustainable development have been a matter of increasing concern over the last few decades. Economic development while fulfilling the genuine needs, aspirations and demands of the present generation should also conserve the natural resource base and help in the regeneration process to fulfill the demands of the future generations. The state of environment is largely a replication of how people interact with the available natural resource base. Very often, environmental degradation is due to over population and poor socio-economic conditions. Indiscriminate industrialization and urbanization can also rapidly degrade the environmental status. The sustainable development challenge is to optimize often conflicting needs and demands.
- Remote sensing technology and geographic information systems are undeniable valuable tools for gathering and analyzing environmental information. But for the most part, these information technologies are not "accessible" to general users. That is, they are not in of themselves able to bring the information content to a wide range of users. For that we need to develop application

software tools accessible via intranet or internet browsers. This implies some preprocessing of the information so that it can be easily, presented, displayed, manipulated, and downloaded. Recently Internet has been catching the imagination of the scientific community, which when merged with GIS has resulted in the next technological innovation "Internet GIS". This is a cost-effective technology in which the user does not have to spend on buying GIS software and maintaining them. Moreover it has become a commonly utilized tool for easy access and dissemination of spatial and non-spatial information.

- In this context, the state of the environment report when presented and displayed as a web interface framework becomes more user friendly and dynamic. The thematic maps when presented in a framework of Pressure, State, Impact, Response (PSIR) framework become a very vital document. In this connection the Directorate of Environment, Uttar Pradesh is willing to propose to prepare the Environmental Atlas for the state of Uttar Pradesh.
- The State of Environment Atlas has a large pool of potential users for both the monitoring and reporting functions of the system. This includes the general public; certain specific community interest groups; schools and other educational institutes; industry groups; Government decision-makers; natural resource planners and managers.
- We also planning for well-equipped (audio-visual environment) ENVIS library on 22 issues related material as designed by the Ministry of Environment & Forests.
- We also envisaged to connect with Climate change program for which Directorate of Environment, Uttar Pradesh has been made nodal department with regards to preparation of State Action Plan for Climate Change (SAPCC) and its implementation.
- The ENVIS program and its website shall be instrumental in preparation of this plan. We also aim to be mutually benefited in this process and the purpose and contents of the ENVIS program shall be strengthen and intensified.

## SKN-15 Development of E Library

It is proposed to establish a hard and 'e' library at Directorate dedicated to Climate Change at DoE under this mission.

Table 32 Indicative Budget for e-library

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Establish a hard and 'e' library at Directorate dedicated to Climate Change | | Initiate proposal and arrange for funds inaugurate library<br>Rs. 50,00,000/- year<br>Total Cost = 50 Lacs | Strengthen and maintain.<br>Rs. 10,00,000/- year<br>Total Cost = 50 Lacs | Strengthen and maintain.<br>Rs. 10,00,000/- year<br>Total Cost = 50 Lacs | Environment Directorate |

## MONITORING AND EVALUATION

The objective of a monitoring and evaluation (M&E) framework is to measure and assess the performance in order to effectively manage outputs and outcomes of the key strategies of each target sector mission. The focus of the this M&E framework is to assess the implementation process with respect to the targets envisioned, financial resources used and strategies accomplished.

Task forces drawing up monitoring plans for the strategies identified under respective thrust area. Such monitoring plans are expected to identify quantifiable milestones covering both physical and financial targets. This would require an effective reporting system at the level of the departments acting as nodal entities for the task forces and centralized coordination by the Department of Environment and Forests. It is desirable to have regular annual reporting of the implementation of strategies on the basis of performance/process indicators that may serve as the milestones in the implementation timeline. Reporting and monitoring should be accompanied by periodic evaluation of the impacts of strategies identified and implemented under the SAPCC. Such evaluations should assess the relevance and achievement of objectives, and implementation performance in terms of effectiveness and efficiency, and the nature, distribution and sustainability of impacts.

The design of an appropriate M and E framework for the State of UP would need to be accompanied by a regular capacity building program for the agencies as well as personnel involved in the related tasks.

### SKN-16 Setting up of Climate Change Authority supported by Climate Change Cell at Environment Directorate

There is a greater need for both vertical and horizontal integration. Need to coordinate with national level institutions and state nodal departments such as the IMD, NIDM, NCMRWF, NDMA, MoA, ICAR,MoSP, MoRD, Central Water Commission, BEE etc. as well as different state level departments like DoE, DoST, Met Dept, DES, Revenue Dept and institutions such as IITs etc.

The typical **role of the Climate Change Authority** shall be as follows:

- Develop, in collaboration with relevant agencies, strategy, action plan and policy and legal instruments related to climate change in Uttar Pradesh;
- Conduct an assessment of potential GHG mitigation/inventory in Uttar Pradesh and develop in association with relevant agencies of the state a low carbon growth strategy (mitigation unit);
- Conduct assessment of vulnerability and adaptation (V&A) to climate change and promote implementation of climate change adaptation project in the state (adaptation unit);
- Promote mainstreaming of climate change in the state plan and sectoral plans;

- Work with line departments to promote research, education, dissemination, training, workshop and meeting to promote awareness on climate change and motivate participation of local communities in implementation of climate change response project;
- Facilitate the preparation of the Mission Documents to be submitted to various missions for resource mobilization Government of India by procuring experts and ensuring coordination with line departments and perform secretarial role for the national climate change coordination committee;
- Cooperate with line agencies for the development and management of climate change fund and carbon credit policy;
- Coordinate with line departments to monitor the implementation of all climate change related project and programs in the state;
- Develop report of activities and progress of work for submission to the government, ministry of environment and forest, national and international agencies and relevant development partners;
- Enhance collaboration with national agencies, development partners, civil society, and private sector for effective implementation of response measures to climate change.

**Table 33 Indicative Budget for State Climate Change Authority**

| Activity | Present Status | 1st Year | 2 to 6 Year (Total 5 Years) | 7 to 11 Year (Total 5 years) | Responsible Agency |
|---|---|---|---|---|---|
| Establishment of State Climate Change Authority and Strengthening of Climate Change Nodal Cell | Nil | Establishment of Climate Change Authority with **Capital of Rs. 5000 lacs**<br><br>Establishment and Initiate Strengthening of climate change cell<br>contractual Manpower/equipment<br>50 Lacs per year to be met from Climate Change Authority fund | 75% at the end of 5th year<br><br>25 Lacs (per year to be met from Climate Change Authority fund | 100% in the beginning of 7th year.<br><br>25 Lacs per year to be met from Climate Change Authority fund | Establishment of State Climate Change Authority and Strengthening of Climate Change Nodal Cell |

**Strengthening of Directorate:**

Keeping in view, the nature and magnitude of the environmental problems of the State as well as responsibilities and functions assigned to the Directorate and also in view of the fact that the Directorate is presently functioning with only eight scientific/technical officers, a significant strengthening is imperative. In order to satisfactorily carry out the increased responsibilities in the areas of air, water and soil quality monitoring, environment management training and awareness, proactive interaction with industry, consultants, NGOs, schools, local communities, media, regulatory surveillance, wetland conservation, research and development, Environment Impact Assessment, setting up & management of Natural History Museum and setting up of State air and water Laboratory, it is proposed to develop man power and infrastructure at head quarter as well as field levels.

Besides above staff, office furniture and vehicles along with POL will also be required. Provision for computer facilities has been made under computerization of Directorate.

## 10.4 BUDGET FOR STRATEGIC KNOWLEDGE MISSION

The total budget for the 2014-18 period under Strategic Knowledge Mission is Rs 136 crore.

# 11 SUSTAINABLE URBAN HABITAT MISSION

This mission has three components (a) Sustainable Habitat (b) Sustainable Transport (c) Health issues relating to climate change.

## 11.1 OVERVIEW

There are 630 urban local bodies in Uttar Pradesh (16% of all India). 22% of the state's population reside in urban areas. 13 of the 630 urban local bodies of the state are Municipal Corporations. By 2016, almost 30 percent of the state population would be residing in urban areas. As the rest of the country, urbanization in Uttar Pradesh is top-heavy i.e., a few large cities and metropolises comprise a large proportion of the urban population. The six cities of Uttar Pradesh (Kanpur, Lucknow, Agra, Varanasi, Meerut and Allahabad) having million plus population each comprises over one-fourth (28 per cent) of the urban population of the state. The other 47 cities which have a population of over a lakh account for a third (35 per cent) of the urban population. The remaining 652 towns are inhabited by the remaining 40 per cent of the state's urban population.

Urban poverty is a big challenge and many migrants and dwellers in city slums are most vulnerable to climate change. They also remain in sub-optimal hygienic condition. The population policy of Uttar Pradesh recognizes the poor health conditions of the slum dwellers and inadequacy of health services for the urban poor inhabitations. It envisages the following measures for the improvement of the health of the urban poor in Uttar Pradesh. The Uttar Pradesh state government has formulated its own policy level mandate related to issues of mother and child health. The UP Population Policy sets out specific targets with a goal of reaching replacement level fertility by 2016. It aims to achieve a contraceptive prevalence rate by modern methods of 52% from 22% by creating an encouraging environment for greater demand and access to RCH services. Some of the objectives laid down are to reduce IMR to 73 infant deaths per 1000 live births by 2006 and to 67 by 2011; and MMR to 394 for every 100,000 live births by 2010 and 2016 respectively.

The key attributes of a sustainable city evolves from a proper land use plan, improved basic civic facilities, clean drinking water supply, decongested and well planned roads / streets that address the growth of city as well as reduces congestion, drainage, sanitation, waste disposal, sewerage system, street lighting, parks, clean environment, etc. In addition to decrease private transport mas rapid transit systems are being planned. The seasonable city planning also include Environmental Protection (air and water quality management) monitoring health of rivers / lakes, pollution control etc. are being carried out.

As per Jal Nigam, out of 623 towns of the State only 55 towns have partial sewerage facility and out of 51 towns having population more than 1 lac as per 2001 census, 14 towns still do not have sewerage system at all. Sewage treatment plants in 15 important towns located along rivers Ganga, Yamuna & Gomti have been constructed under **Ganga Action Plan** launched in the year 1985. Under this a perspective plan (upto 2050) has been prepared. Ganga touches 23 districts and 26 towns in the state and its tributaries touch another 19 towns. Based on the population projection total sewage is expected to be 2547.97 MLD Current treatment capacity is 598.06 MLD and 832.06 MLD capacity work is in progress. Additional capacity of 1121.15 MLD can be created with Rs 6726.9 Crore.

## 11.2 ONGOING PROGRAMMES

Programs which are currently operational are Urban Infrastructure and Governance, Basic Services for Urban Poor, Urban Infrastructure Development Scheme for Small and Medium Towns, Integrated Housing and Slum Development Programme, Manyavar Shree KanshiRam ji Shahari Garib Awas Yojna , National Urban Renewal Mission (JNNURM),

U.P. Urban Infrastructure Development Fund managed by U.P. Urban Infrastructure Development Corporation is being created. The State Government has launched an ambitious and pioneering program known as "Housing for All" to provide housing to different sections of society.

Efforts made for increasing the Private investment: Municipal laws are being amended to facilitate private partnership in various areas of urban services and management.

Under the Rural Housing, programs like Indira Awaas Yojana (IAY), Maha Maya Awas Yojana, Maha Maya Sarvajan Awas Yojana and Rural Water Supply under Rajiv Gandhi National Drinking Water Mission (RGNDWM) are being taken up actively.

Lucknow Metropolitan Authority has been entrusted with the Lucknow metro-plan and it is expected to be completed by 2017. This will make a difference to road congestion and this mass rapid transit system will ensure a healthy modal shift discouraging private transport. To handle bus rapid transit system 1310 buses have been mobilized and an SPV has been formed to partner with operators in a PPP mode.

Urban Water supply Programme, Agra Water Supply Scheme (Gangajal JBC), Ganga Acton Plan-Phase –II, Lake Conservation Plan, Ganga Pollution Project are some of the ongoing programs. Under Ganga Action plan 1270.13 MLD surface water and 99.88 from ground water potential is to be harnessed to meet 1370 MLD drinking water requirement in 2050. Total fund requirement for drinking water supply is about Rs 3325.13 crore and for sewage treatment requirement is 6726.90 crore and total fund requirement of Rs 10052.02 to meet the requirement of 1.84 people.

## 11.3 KEY PRIORITIES

The following key priorities have been identified and are being addressed by the state.

### SSU-1 Urban water supply and sewerage scheme including solid waste management (SSU-8) taking in to account the climate change related vulnerability

JNNURM-UIG scheme covered 33 water supply, sewerage and solid waste management projects in the state. The period was for 2005-14. Amount Released (Including Centage) is Rs 6029.96 Cr of which Rs 5240.91 Cr has been utilised as on March 2014.

The state has 64 **water supply** projects under UIDSSMT Component covering 46 cities. Net Released amount is ( ACA: Rs 830.53 + State: Rs 241.90+ ULB : Rs 115.02) Cr Rs 1187.45Cr excluding unspent balance. Rs 1093.23 crore has been utilised. The balance amount of these two components have been taken into calculation for 2014-18 period (Rs 883 crore) while new sources of fund (post JNNURM) are being identified.

**Solid waste management**: The solid waste management programme have been launched in 26 cities of the state to provide better amenities in the Urban Areas. The cities are Lucknow, Varanasi, Allahabad, Meerut, Gorakhpur, Moradabad Aligarh, Jhansi, Mathura, Agra, Kanpur, Muzaffar Nagar, Firozabad, Etawah, Rae Bareily, Mirzapur, Loni (Ghaziabad),Mainpuri, Basti, Barabanki, Kannauj, Ballia, Fatehpur, Badaun, Sambhal (Moradabad) and Jaunpur. The project comprises of door to door collection, primary storage, secondary collection, transportation up to processing plant, installation of processing plant and development of sanitary engineered landfills.

Out of 26 projects, 10 projects viz Kanpur, Kannauj, Muzaffarnagar, Moradabad, Etawah, Mainpuri, Mathura, Aligarh, Barabanki and Raebareli have been completed. The plants at Fatehpur, Agra and Allahabad are almost (85-90%) completed. Speedy land acquisition process / physical work is in progress in other cities except in Loni and Firozabad. STPOs

Intensive monitoring of STPs is being taken up by the PCB while issuing NOC if the drainage and sewage systems are in place.

### SSU-2 Sustainable city roads and buildings with proper low carbon habitation plan: housing for all, transit corridors, parking (Awas bandhu)

Housing and Urban development department has mandated all hotels, guest houses, banquets halls, military and para-military facilities above >500 sq. mt. to install solar water heater vide GO 3894 dated 09-08-2004. Rain water harvesting has been mandated since 2008 keeping natural water bodies, parks, etc. (to keep 5% land) for recharge.

Other programmes include affordable low cost housing, for sustainable and balanced growth of the city using land pooling scheme, transferable development right. To de-congest city roads, developing transit corridors, bye-passes, foot over bridges and a comprehensive mobility plan. This

will include cycle tracks, pedestrian pathway and subways. Promoting Green building and rooftop rainwater harvesting in suitable public and private buildings.

### SSU-3 Modification of building bye-laws for implementing energy conservation building codes

Under the provisions of the Energy Conservation Act-2001, Uttar Pradesh Power Corporation Ltd has been designated to function as State Designated Agency, Uttar Pradesh. SDA UP is assisting the Bureau of Energy Efficiency (BEE), Ministry of Power, and Government of India to implement the Energy conservation Act 2001 in Uttar Pradesh- India. Department will work with SDA, town planning authorities and other agencies to implement energy conservation building code.

### SSU-4 Modification of municipal laws for encouraging PPP projects in water supply, sanitation and affordable climate proof housing

To encourage PPP and strengthening of the ULBs, attempt has been made to create enabling policy framework to encourage private participation in urban infrastructure projects in water supply, transportation, housing, waste management, waste to energy and public transport. Necessary amendments in municipal bye laws and development regulations are being facilitated.

### SSU-5 Water Metering to improve efficiency

To minimize wastage and economic use of water for domestic purpose and to instil sense of responsibility in the consumers, water metering is proposed to be made a compulsory tool. 1049037 house connections are being targeted by 2020. The total estimate is Rs 270.42 crore. Half of this amount may be spent by 2018.

### SSU-6 Creation of Urban Infrastructure Fund

The fund has a corpus of Rs 225 crore and will be used for projects related to urban infrastructure such as transport under viability gap funding scheme. A committee headed by Chief Secretary monitors the fund.

### SSU-7 Management of Storm Water

The department is under process of developing models, based on simulations, of storm water flows and sewage flows in urban areas to assess drainage capacities. On the basis of that requirement of type and length of drains for various towns/cities is being worked out. Further need of sewage treatment plants for big cities is being evaluated. 36 STPs with 378.22 MLD capacity and with 78608 km of open drain and combined sewer of 35 Km has been planned with an estimate of Rs 2259 crore; 50% of which is likely to be used by 2018.

### SSU-9 Four-lining of roads to connect district headquarters and avoid traffic congestion and improved city mobility plan

46 district head quarter towns will have four-laning to avoid traffic congestion. The total sanctioned amount for 3512.55 km road is Rs 19441.06 crore of which balance work R 906.33 crore remain to be covered by 2018.

## SSU-10 Bus Rapid Transit system

Under JNNURM component 1310 city buses are being operated through an SPV route with a total sanctioned amount of Rs 326.89 crore in mission cities. In addition PPP projects are also being planned in major cities.

**Operation of city bus service in selected cities**

- Project - It relates to Financing, Operations & Maintenance of city bus services in selected cities of state under JNNURM of Govt. of India.
- The selected cities are Lucknow, Kanpur, Meerut, Varanasi, Allahabad, Agra and Mathura.
- The process for selection of developers was undertaken twice by the department, but it could not be materialized.
- The project was put up before the Hon'ble CM during PPP project review meeting held on 27.04.2012.
- It was directed to run the project under PPP.
- To implement the scheme under PPP mode, matter is being considered afresh.
- At present, the city buses in mission cities are being operated through SPV by UPSRTC.

## SSU-11 Energy efficient street lighting plan

**Upgradation, Operation & Maintenance of street lights in city zone Ghaziabad**

- Project - It relates to upgradation, operation and maintenance of street lights in city zone Ghaziabad by replacing existing lighting system by introducing HPSV. Besides energy as well revenue saving. It is also proposed to obtain carbon credits by implementing this projects.
- Preparation of RFQ for developers is under process.
- The project was put up before the Hon'ble CM during PPP project review meeting held on 27.04.2012 and it was directed to undertake the project and also explore the possibilities of solar energy based lamps.

### SSU-12 Avenue tree plantation for carbon sequestration (covered under Green UP)

This activity will be taken up in association with the forest department and the budget for this has been included in Green UP budget. However, it is important to do a perspective plan taking into view the future road expansion so that the planted trees should not be cut again.

### SSU-13 Conversion of all Community Health Centre (CHC) into First Referral Unit (FRU) in climate vulnerable areas

Climate change often carries with it complex disease burden. The infrastructure during extreme events must be geared to handle such exigencies. Apart from vector borne diseases there are other climate linked events related to health are heat stress, cold wave, etc. Therefore, it has been proposed to convert all CHCs to first referral units as per Indian Public Health Standard. The estimate for this is being worked out by the health department and some part may be covered under urban health mission.

### SSU-14 Vector borne disease control and early warning systems

Some of the vector borne diseases such as Dengue, Chikungunya, Kalazar, Filaria, etc. have strong prevalence in UP. However, meningitis seems to have reduced due to massive campaign. The total yearly allocation is about Rs 25-26 crores including IEC, survey, treatment, etc.

### SSU-15 Developing standard operating procedures to tackle extreme weather events

Extreme weather events like heat waves and cold waves are becoming more frequent as per the fifth assessment report of IPCC. Standard operating procedure to tackle such events is a multi-agency effort and can be codified in association with state disaster management authority. This will include a whole range of adaptive options (e.g. provision of water during heat wave conditions, change of school timing and working hours, advisory relating to precautions as well in the event someone is affected with a how to bulletin, etc.

### SSU-16 Integrated disease surveillance project

This project that covers most areas of the state including the disaster prone areas operates out of 10 medical colleges and has an annual budget of Rs 8 crore.

## 11.4 BUDGET FOR SUSTAINABLE HABITAT

The total budget for sustainable habitat is about Rs 13376 crore.

# 12 CONCLUSION AND WAY FORWARD

## 12.1 CROSS CUTTING ISSUES

Mainstreaming climate change agenda in the policy and planning at the state level is still in a formative stage. Mainstreaming requires not only cross-cutting policy approach but also both horizontal and vertical integration and systemic scrutiny to avoid duplication of effort. Mainstreaming also requires to examine all existing policy from a climate vulnerability lenses and design climate smart response. Ideally to integrate climate variability concerns, the schemes and programs relating to adaptation and mitigation have to be integrated in state plans.

There are certain sectors that have strong linkage across all segments of climate change adaptation and mitigation are as below:

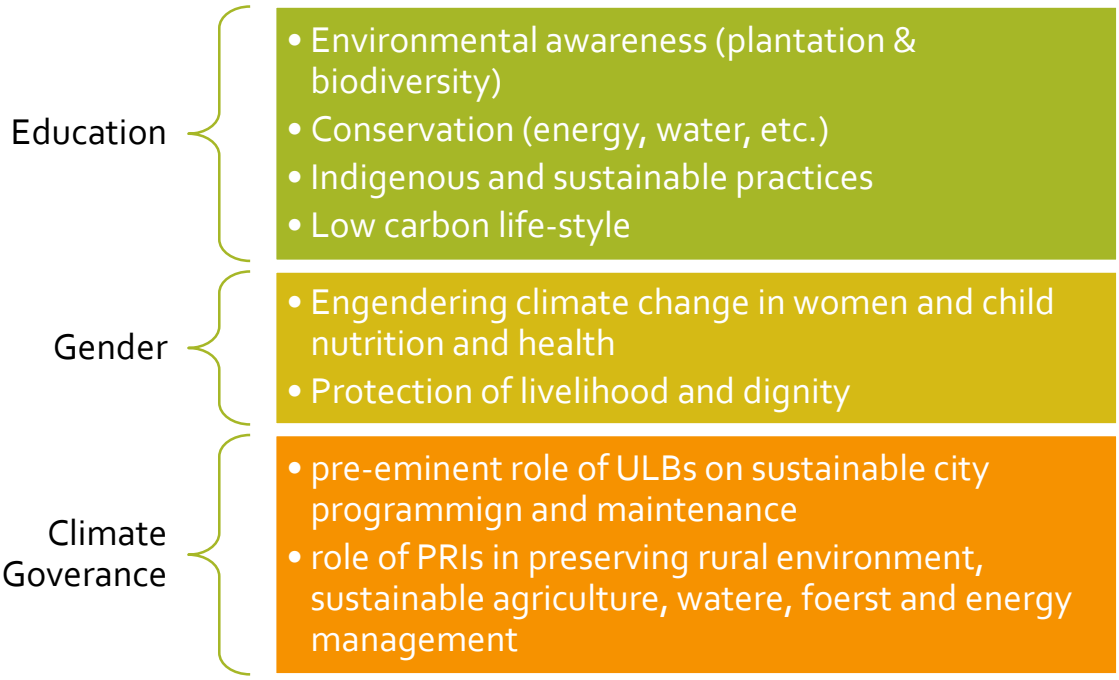



Figure 35 Cross-sectoral issue triggers

## 12.2 INSTITUTIONAL DEVELOPMENT AND CAPACITY BUILDING

It is important to simultaneously work on institutional development as a parallel activity of policy development. New sets of institutions will be required to address climate related vulnerability and implement climate smart approaches.

A schema for this has been presented below:

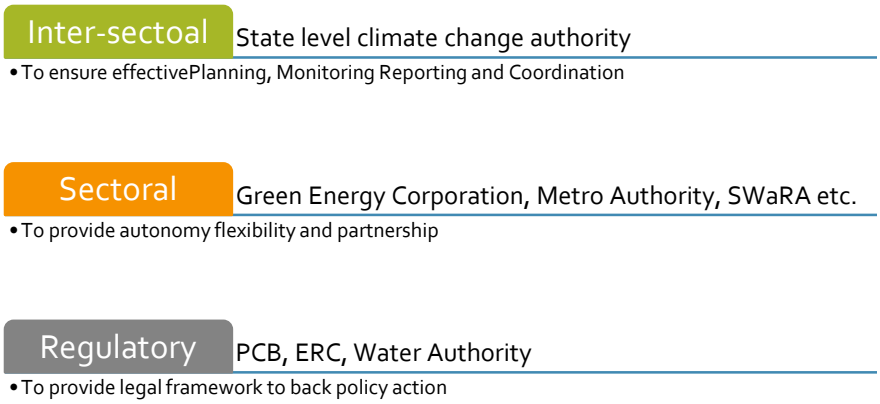



Figure 36 Institutional schema

**Capacity Building**

There is certainly a capacity gap that exists in tackling climate change issues at all levels (a) government, (b) private sector and (c) civil society. Massive awareness campaign is needed to bridge this gap. The state administrative training institute can develop special modules for officers. The industry associations like CII, FICCI, PHDCCI, ACC can be roped in to partner with government for **carbon conscious development.**

A significant role will be played by the **strategic knowledge mission** to enhance the research bases and build institutional partnerships.

**Green Jobs**

Green Jobs" within economic transformation processes leading to sustainable "Green Economies" will be created by companies and business sectors. These stakeholders have to be involved in the development of new or adaptation to existing occupational profiles that result from requirements of change towards a "green" economy. Some examples include certified energy auditors, social auditors, solar installers, green architects, etc.

## 12.3 MONITORING AND EVALUATION

The state has identified 93 key priorities in seven mission. Each of them will have their own progress and indicators need to capture this over a period of time. A typical framework for the monitoring and evaluation of climate change related programs has been presented in the figure below.

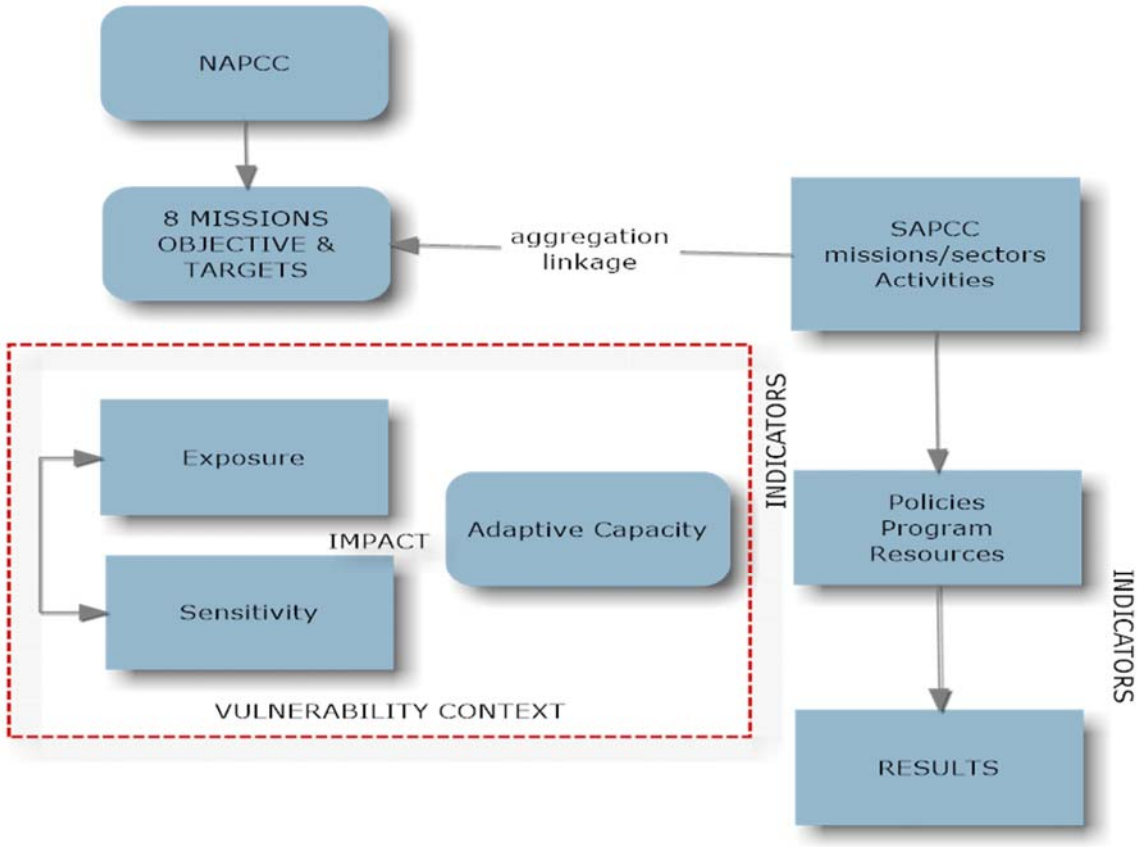



Figure 37 M&E Framework

This framework combines the vulnerability context, both process and outcome based indicators apart from regular physical and financial monitoring the government is used to do. Monitoring and evaluating the integration of mitigation and adaptation actions into projects will require several actions. First, the implementation of the options identified (activity stream) will need to be specifically monitored. This will involve assessing whether the identified options are actually put in place, what unexpected problems arose in the implementation process (process monitoring). In case of adaptation, whether the options had any adverse (mal adaptation) or positive impacts on other sectors or regions, and whether costs of adaptation exceeded those anticipated. In case of mitigation actions, energy efficiency achieved and the GHG emission reduced with respect to the base line need to be assessed and monitored through the project cycle and after it is over. In both the cases, evaluation should assess whether the project delivered the intended benefits (outcome or result) and whether it caused adverse outcomes that were not anticipated. This last intervention can also contribute to providing suggestions for improving future mitigation and adaptation planning and design.

State climate change authority can take a lead on this and there are several actions proposed in strategic mission that can feed in to this M&E process.

## 12.4 FINANCIAL BUDGET

The total proposed budget for seven missions for 2014-18 works out to be Rs 46,946 crore. This is not entirely climate additional. It is of the predominant view of the stakeholders that since no separate federal budget specific to climate change is available it is better to capture activities that have climate change link even though some of these activities are business-as-usual. This is visible in Jal mission, green UP mission and sustainable habitat mission. Solar Mission and Sustainable Agriculture Mission have made projection in line with climate additionality. While sustainable energy mission has proposed only policy actions with no projected fund requirement.

A separate exercise may be needed to identify additionality and source of fund for each mission. The current projections are based on the input provided by each mission and are not firm numbers which may undergo change based on evolving needs and available resources.

The mission wise budget has been given in the table below:

Table 34 Financial Budget (in Rs Crore) for the SAPCC- UP (2014-18)

| Mission | Adaptation | Mitigation | Both | Total | No of Priorities |
|---|---|---|---|---|---|
| Sustainable Agriculture Mission | ₹ 74.75 | ₹ 21.50 | ₹ 6.50 | ₹ 102.75 | 11 |
| Solar Mission | ₹ - | ₹ 449.75 | ₹ - | ₹ 449.75 | 5 |
| Energy Efficiency Mission | ₹ - | ₹ - | ₹ - | ₹ - | 11 |
| Green UP Mission | ₹ 4,469.85 | ₹ - | ₹ 4,010.65 | ₹ 8,480.50 | 7 |
| Strategic Knowledge Mission | ₹ 136.00 | ₹ - | ₹ - | ₹ 136.00 | 16 |
| Jal Mission | ₹ 24,175.77 | ₹ 224.90 | ₹ - | ₹ 24,400.67 | 27 |
| Sustainable Habitat Mission | ₹ 1,524.53 | ₹ 11,851.37 | ₹ - | ₹ 13,375.90 | 16 |
| TOTAL | ₹ 30,380.89 | ₹ 12,547.52 | ₹ 4,017.15 | ₹ 46,945.56 | 93 |

## 12.5 WAY FORWARD

It is important to note that formulation of SAPCC is a complex exercise. It requires commitment at all levels. This document should not be cast in stone and should be dynamic. Departments while formulating their departmental action plan and budget should make active effort to mainstream the key priorities listed here.

There should be robust institutional framework and capacity building should be initiated with sectoral officers (who are not likely to shift frequently) and can function as counterparts to state climate change authority and core groups.

The state must create multi-stakeholder platform with research institutions, experts and form a permanent mechanism of dialogue at least twice a year.

# ANNEXURE

A Budget

B Core groups

C Reference

# Annexure A: BUDGET
# Summary Budget (in Rs Crore)

| Mission | Adaptation | Mitigation | Both | Total | No of Priorities |
|---|---|---|---|---|---|
| Sustainable Agriculture Mission | ₹ 74.75 | ₹ 21.50 | ₹ 6.50 | ₹ 102.75 | 11 |
| Solar Mission | ₹ - | ₹ 449.75 | ₹ - | ₹ 449.75 | 5 |
| Energy Efficiency Mission | ₹ - | ₹ - | ₹ - | ₹ - | 11 |
| Green UP Mission | ₹ 4,469.85 | ₹ - | ₹ 4,010.65 | ₹ 8,480.50 | 7 |
| Strategic Knowledge Mission | ₹ 136.00 | ₹ - | ₹ - | ₹ 136.00 | 16 |
| Jal Mission | ₹ 24,175.77 | ₹ 224.90 | ₹ - | ₹ 24,400.67 | 27 |
| Sustainable Habitat Mission | ₹ 1,524.53 | ₹ 11,851.37 | ₹ - | ₹ 13,375.90 | 16 |
| **TOTAL** | **₹ 30,380.89** | **₹ 12,547.52** | **₹ 4,017.15** | **₹ 46,945.56** | **93** |

# MISSION AGRICULTURE

₹ 10275,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PRIORITY ACTIONS | | | BUDGET | | |
| KEY PRIORITY NO | DESCRIPTION | NATURE | FOR 2014-15 IN RS | FOR FULL PERIOD IN RS | PERIOD (SPECIFY FOR HOW MANY YEARS) |
| AGR-1 | Establishment of climate change and agriculture cell/ Coordination & Monitoring | 1 | ₹ 100,00,000 | ₹ 900,00,000 | 5 |
| AGR-2 | Identification of Vulnerable areas and assessing Vulnerability | 1 | ₹ 25,00,000 | ₹ 225,00,000 | 5 |
| AGR-3 | Establishment of Climate Field Schools (CFS) (One in each block) | 1 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |
| AGR-4 | Promotion of Carbon Sequestration Agricultural Practices (PILOT) | 2 | ₹ - | ₹ - | 1 |
| AGR-5 | Use of organic manures (One village per block per year) | 2 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |
| AGR-6 | Soil Management Practices (Farm machineries in adopted villages) | 1 | ₹ 40,00,000 | ₹ 200,00,000 | 5 |
| AGR-7 | Farming system approach for diversifying incomes and livelihoods (10 farmers from each identified village) | 1 | ₹ 75,00,000 | ₹ 375,00,000 | 5 |

# MISSION AGRICULTURE

₹ 10275,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| AGR-8 | Diversification of cropping systems and promotion of a biotic stress tolerant crop varieties in identified villages | 1 | ₹ 10,00,000 | ₹ 70,00,000 | 5 |
| AGR-9 | Popularization of aerobic rice cultivation methods in identified rice villages | 2 | ₹ 30,00,000 | ₹ 150,00,000 | 5 |
| AGR-10 | Popularisation of Agro-forestry in identified villages | 3 | ₹ 15,00,000 | ₹ 105,00,000 | 5 |
| AGR-11 | Climate responsive research programmes | | | | |
| | Develop more $CO_2$ responsive plants using biotechnological tools to sustain thermal stresses . | 1 | ₹ 200,00,000 | ₹ 1900,00,000 | 5 |
| | Development of water and nitrogen use efficient crops to enhance tolerance to drought water logging, sodicity, pest and disease infestation through recombinant DNA techniques. | 3 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |
| | Research on off-season farming. | 1 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |

# MISSION AGRICULTURE

₹ 10275,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PRIORITY ACTIONS | | | BUDGET | | |
| KEY PRIORITY NO | DESCRIPTION | NATURE | FOR 2014-15 IN RS | FOR FULL PERIOD IN RS | PERIOD (SPECIFY FOR HOW MANY YEARS) |
| | Develop and implement region specific contingency plans for different vulnerability and risk scenarios. | 1 | ₹ 50,00,000 | ₹ 250,00,000 | 5 |
| | Development and validation of weather derivative models. | 1 | ₹ 100,00,000 | ₹ 700,00,000 | 5 |
| | Development and validation of crop simulation models to simulate impacts of climate changes on agricultural crops. | 1 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |
| | Development of nutritional strategies for managing heat stress in dairy animals under changed climatic conditions. | 1 | ₹ 100,00,000 | ₹ 900,00,000 | 5 |
| | Research on poultry and fisheries under changing climate | 1 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |
| | Research on improvement of efficiency of pumping sets and other energy operated farm machineries | 2 | ₹ 100,00,000 | ₹ 1500,00,000 | 5 |
| Totals | | | ₹ 1445,00,000 | ₹ 10275,00,000 | |

# MISSION AGRICULTURE

₹ 10275,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PRIORITY ACTIONS | | | BUDGET | | |
| KEY PRIORITY NO | DESCRIPTION | NATURE | FOR 2014-15 IN RS | FOR FULL PERIOD IN RS | PERIOD (SPECIFY FOR HOW MANY YEARS) |
| | | In Crore | 14.45 | 102.75 | |
| | | Adaptation | | 74.75 | |
| | | Mitigation | | 21.50 | |
| | | Both | | 6.50 | |

# MISSION SOLAR ENERGY

₹ 44975,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PRIORITY ACTIONS | | | BUDGET | | |
| KEY PRIORITY NO | DESCRIPTION | NATURE | FOR 2014-15 IN RS | FOR FULL PERIOD IN RS | PERIOD (SPECIFY FOR HOW MANY YEARS) |
| SSE-1 | Promotion of solar water heating systems to result in saving of conventional energy. Use of solar water heating systems to be made mandatory through amendment in local bodies building bye-laws (@ 20 lakh lit/day capacity for 1st five years) | 2 | | ₹ 6000,00,000 | 5 |
| SSE-2 | Promotion and implementation of standalone systems like solar street lighting systems for use in institutions, communities and especially rural areas with no access or little access to conventional power (35,000 units/yr for 1st five year) | 2 | ₹ 7000,00,000 | ₹ 35000,00,000 | 5 |
| SSE-3 | Deployment of solar pumps for irrigation purposes as a replacement of Diesel and electrical pumps being used by individual farmer or owned by Government (5000 pumps) | 2 | ₹ 100,00,000 | ₹ 500,00,000 | 5 |

# MISSION SOLAR ENERGY

₹ 44975,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| SSE-4 | To support in bridging the gap between demand and supply of conventional grid power promotion of Solar Grid power through installation of Megawatt scale Solar Power Plants (500 MW in five years) | 2 | ₹ 375,00,000 | ₹ 1875,00,000 | 5 |
| SSE-5 | Promotion of grid interactive Solar Rooftop Power Plants (2 MW in five years) | 2 | | ₹ 1600,00,000 | 4 |
| **Totals** | | | **₹ 7475,00,000** | **₹ 44975,00,000** | |
| | | **in Crore** | **₹ 74.75** | **₹ 449.75** | |
| | | **Adaptation** | | **₹ -** | |
| | | **Mitigation** | | **₹ 449.75** | |
| | | **Both** | | **₹ -** | |

# MISSION ENERGY EFFICIENCY

₹ -

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| SSEE-1 | Energy Audits should be strictly enforced for all government buildings | | ₹ - | ₹ - | 5 |
| SSEE-2 | Sensors/Timers in the Street Lights should be made mandatory | | | ₹ - | 3 |
| SSEE-3 | Reduction of Transmission & Distribution Losses in Power Sector | | | | 5 |
| SSEE-4 | The use of Solar Water Heaters, Solar Water pumps & Solar Street Outer Building Lights should be made mandatory for buildings above the load of 500KVA | | ₹ - | ₹ - | 5 |
| SSEE-5 | Energy conservation Building Code (ECBC) may be made mandatory for New Government office Buildings and all new commercial buildings | | ₹ - | ₹ - | 3 |
| SSEE-6 | Government Taxes & Duties may be lowered on energy efficient technologies like LED, Solar etc. | | ₹ - | ₹ - | 3 |
| SSEE-7 | Rain Water Harvesting mandatory for all buildings | | ₹ - | | |

# MISSION ENERGY EFFICIENCY

₹ -

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| SSEE-8 | Demonstration projects on off grid electricity supply to villages | | | | |
| SSEE-9 | Plantations around and on the roof tops of government buildings should be made compulsory | | | | 5 |
| SSEE-10 | All types of Electrical motors, drinking water pumps and private tube wells should be BEE star rated pumps | | | | 5 |
| SSEE-11 | Ceiling Fans and Air Conditioners should be BEE rated | | | | 5 |
| **Totals** | | | ₹ - | ₹ - | |
| | | **in Crore** | ₹ - | ₹ - | |
| | | **Adaptation** | | | |
| | | **Mitigation** | | | |
| | | **Both** | | | |

# MISSION GREEN-UP

₹ 848050,00,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD (2014-18) IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| FOR-1 | Plantation by Forest Department | 3 | ₹ 41915,00,000 | ₹ 209575,00,000 | 20 |
| FOR-2 | Road side/canal side plantation | 3 | ₹ 17276,00,000 | ₹ 86380,00,000 | 20 |
| FOR-3 | Agro Forestry | 3 | ₹ 2435,00,000 | ₹ 12175,00,000 | 20 |
| FOR-4 | Density Improvement | 1 | ₹ 43802,00,000 | ₹ 219010,00,000 | 20 |
| FOR-5 | Private Plantation by Land Owners | 3 | ₹ 18587,00,000 | ₹ 92935,00,000 | 20 |
| FOR-6 | Works in protected area network and wetlands | 1 | ₹ 30095,00,000 | ₹ 150475,00,000 | 5 |
| FOR-7 | Outreach and demo/pilot activities | 1 | ₹ 15500,00,000 | ₹ 77500,00,000 | 5 |
| **Totals** | | | **₹ 169610,00,000** | **₹ 848050,00,000** | |
| | | **In crore** | **₹ 1,696.10** | **₹ 8,480.50** | |
| | | **Adaptation** | | **₹ 4,469.85** | |
| | | **Mitigation** | | | |
| | | **Both** | | **₹ 4,010.65** | |

# JAL MISSION
# SUSTAINABLE WATER

**₹ 2440066,50,000**

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD (2014-18) IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| | **Major and medium Irrigation** | | | | |
| SWM-1 | Reducing Gap between Irrigation Potential Created and Utilized through Restoration of Old Project | 1 | ₹ 116386,00,000 | ₹ 350790,00,000 | 4 |
| SWM-2 | Increasing Water Use Efficiency (through lining of canal) | 1 | ₹ 6000,00,000 | ₹ 19000,00,000 | 4 |
| SWM-3 | Increasing Water Use Efficiency (on-farm water management) | 1 | ₹ 20000,00,000 | ₹ 60000,00,000 | 4 |
| SWM-4 | Water sector restructuring project (phase II) | 1 | | ₹ 464300,00,000 | 4 |
| SWM-5 | Completion of New and Ongoing Projects | 1 | ₹ 289151,00,000 | ₹ 380521,00,000 | 4 |
| SWM-6 | Survey and Investigation | 1 | ₹ 1000,00,000 | ₹ 3000,00,000 | 4 |
| SWM-7 | Research and development | 1 | ₹ 400,00,000 | ₹ 1200,00,000 | 4 |
| SWM-8 | Training and Capacity Building | 1 | ₹ 200,00,000 | ₹ 600,00,000 | 4 |
| | **Minor Irrigation** | | | | 4 |
| SWM-9 | Restoration project (canal, bandhi, lift, tubewells, etc.) | 1 | ₹ 12114,00,000 | ₹ 38023,00,000 | 4 |
| SWM-10 | Increasing Water Use Efficiency (through R&M) | 1 | ₹ 15935,00,000 | ₹ 40480,00,000 | 4 |

# JAL MISSION
# SUSTAINABLE WATER

**₹ 2440066,50,000**

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD (2014-18) IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| SWM-11 | Completion of New and Ongoing Projects | 1 | ₹ 32285,00,000 | ₹ 89457,00,000 | 4 |
| SWM-12 | Flood Control and drainage | 1 | ₹ 155000,00,000 | ₹ 480000,00,000 | 4 |
| | **Other Minor Irrigation Interventions** | | | | |
| SWM-13 | Masonary Checkdam, HDPE Integration and Injection walls | 1 | ₹ 31103,00,000 | ₹ 159199,00,000 | 5 |
| | **UP Jal Nigam** | | | | |
| SWM-14 | Laboratory and ancillary for water quality monitoring | 1 | | ₹ 1284,50,000 | 10 |
| SWM-15 | Water Metering (covered under habitat mission) | 1 | | | 10 |
| SWM-16 | Management of urban storm water and STP (covered under Habitat Mission) | 1 | | | 10 |
| | **Convergence with Agriculture dept.** | | | | |
| SWM-17 | Integrated water resource management in over exploited areas | 1 | ₹ 5179,50,000 | ₹ 25897,00,000 | 5 |
| SWM-18 | Increasing water used efficiency by 20% (sprinkler, drip, etc.) | 2 | ₹ 1120,00,000 | ₹ 5600,00,000 | 5 |

# JAL MISSION
# SUSTAINABLE WATER

**₹ 2440066,50,000**

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD (2014-18) IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| SWM-19 | Capacity building and admin | 1 | ₹ 344,97,000 | ₹ 1725,00,000 | 5 |
| | **Convergence with Fisheries dept.** | | | | |
| SWM-20 | Wetland conservation and development | 1 | | | 5 |
| | **NEDA** | | | | |
| SWM-21 | Installation of solar pumps | 2 | | ₹ 2632,00,000.00 | 5 |
| | **State water resource agency** | | | | |
| SWM-22 | Consultancy work for preparing basin plans | 1 | | ₹ 1000,00,000 | 5 |
| SWM-23 | Assessment of impact of climate change on water resources of Uttar Pradesh | 1 | | ₹ 100,00,000 | 3 |
| | **State Water Resources Data and Analysis Centre** | | | | |
| SWM-24 | Development of Water Resources Information System & subsequent implementation of Integrated Water Resources Management (IWRM) in UP | 1 | | ₹ 1000,00,000 | 5 |

# JAL MISSION
# SUSTAINABLE WATER

₹ 2440066,50,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD (2014-18) IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| | **Uttar Pradesh Vidyut Utpadan Nigam** | | | | |
| SWM-25 | Construction of ash water Recirculating system | 2 | | ₹ 12343,00,000 | 4 |
| SWM-26 | Affluent treatment plant | 2 | | ₹ 1915,00,000 | 4 |
| SWM-27 | Rain water harvesting structures | 1 | | | 3 |
| **Totals** | | | **₹ 686218,47,000** | **₹ 2440066,50,000** | |
| | | **In Crore** | **₹ 6,862.18** | **₹ 24,400.67** | |
| | | **Adaptation** | | **₹ 24,175.77** | |
| | | **Mitigation** | | **₹ 224.90** | |
| | | **Both** | | **₹ -** | |

# MISSION STRATEGIC KNOWLEDGE

₹ 13600,00,000

BUDGET ESTIMATE

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PRIORITY ACTIONS | | | BUDGET | | |
| KEY PRIORITY NO | DESCRIPTION | NATURE | FOR 2014-15 IN RS | FOR FULL PERIOD (2014-18) IN RS | PERIOD (SPECIFY FOR HOW MANY YEARS) |
| | Knowledge Creation | | | | |
| SKN-1 | Primary data generation with surveys, studies, research, modelling (about 15 identified studies and budget for responding to needs of other departments) | | ₹ 500,00,000 | ₹ 500,00,000 | 5 |
| SKN-2 | Funding from Climate change research fund to Dedicated Research Centers at Universities/Colleges | | ₹ 500,00,000 | ₹ 1500,00,000 | 5 |
| | Knowledge Management | | | | |
| SKN-3 | Use of Information Technology in managing the data developing MIS and website | | ₹ 100,00,000 | ₹ 200,00,000 | 5 |
| SKN-4 | Documentation of Industry- Specific documents (in association with industries, associations and private sector) | | | ₹ - | 5 |
| SKN-5 | Setting up Editorial Board and start publication of climate change related data and studies in journals | | ₹ 25,00,000 | ₹ 125,00,000 | 5 |

# MISSION STRATEGIC KNOWLEDGE

₹ 13600,00,000

BUDGET ESTIMATE

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PRIORITY ACTIONS | | | BUDGET | | |
| KEY PRIORITY NO | DESCRIPTION | NATURE | FOR 2014-15 IN RS | FOR FULL PERIOD (2014-18) IN RS | PERIOD (SPECIFY FOR HOW MANY YEARS) |
| SKN-6 | Preparation of Environmental Status Reports (State & District wise) | | | | 5 |
| SKN-7 | Documentation of Bio-diversity status and traditional environmental knowledge | | | ₹ - | 5 |
| | Knowledge Dissemination and Capacity Building | | | | |
| SKN-8 | Publicity through TV/AIR/Hoardings & Buses | | ₹ 5,00,000 | ₹ 2500,00,000 | 5 |
| SKN-9 | Integrate Climate Change agenda with National Green Corps activities and District Plan activities | | ₹ 15,00,000 | ₹ 1875,00,000 | 1 |
| SKN-10 | Training programmes for administrators, policy makers, development departments, students and other stake holders regarding Climate Change | | ₹ 100,00,000 | ₹ 500,00,000 | 5 |
| SKN-11 | Organize Seminars, conferences and workshops on Climate Change | | ₹ 30,00,000 | ₹ 150,00,000 | 5 |
| SKN-12 | Setting up of Knowledge Centres | | ₹ 200,00,000 | ₹ 800,00,000 | 5 |

# MISSION STRATEGIC KNOWLEDGE

₹ 13600,00,000

BUDGET ESTIMATE

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD (2014-18) IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| SKN-13 | Technical capacity building for the advancement of research on climate change (centres in university/instn) | | ₹ 100,00,000 | ₹ 400,00,000 | 5 |
| SKN-14 | Strengthening of ENVIS Centre at Directorate of Environment | | | | |
| SKN-15 | Establish a hard and 'e' library at Directorate dedicated to | | ₹ 50,00,000 | ₹ 50,00,000 | 5 |
| | Monitoring and Evaluation | | | | |
| SKN-16 | Establishment of State Climate Change Authority and Strengthening of Climate Change Nodal Cell | | ₹ 5000,00,000 | ₹ 5000,00,000 | 5 |
| **Totals** | | | **₹ 6625,00,000** | **₹ 13600,00,000** | |
| | | **in Crore** | **₹ 66.25** | **₹ 136.00** | |
| | | **Adaptation** | | **₹ 136.00** | |
| | | **Mitigation** | | **₹ -** | |
| | | **Both** | | **₹ -** | |

# MISSION SUSTAINABLE HABITAT

₹ 1337589,50,000

BUDGET ESTIMATE:2014-18

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **PRIORITY ACTIONS** | | | **BUDGET** | | |
| **KEY PRIORITY NO** | **DESCRIPTION** | **NATURE** | **FOR 2014-15 IN RS** | **FOR FULL PERIOD IN RS** | **PERIOD (SPECIFY FOR HOW MANY YEARS)** |
| | SUB-MISSION ON HABITAT | | | | |
| SSU-1 | Urban water supply and sewerage scheme including solid waste management under UIDSSMT taking in to account the climate change related vulnerability | 2 | | ₹ 88327,00,000 | 5 |
| SSU-2 | Sustainable city roads and buildings with proper low carbon habitation plan: housing for all, transit corridors, parking (Awas bandhu) | 2 | ₹ 240000,00,000 | ₹ 960000,00,000 | 4 |
| SSU-3 | Modification of building bye-laws for implementing energy conservation building codes | 1 | | | 5 |
| SSU-4 | Modification of municipal laws for encouraging PPP projects in water supply, sanitation and affordable climate proof housing | 1 | | | 5 |
| SSU-5 | Water Metering to improve efficiency | 2 | | ₹ 13521,00,000 | |
| SSU-6 | Creation of Urban Infrastructure Fund | 1 | | ₹ 22500,00,000 | 5 |
| SSU-7 | Management of Storm Water | 1 | | ₹ 112952,50,000 | 5 |
| SSU-8 | Management of Solid waste (covered under SSU-1) | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | SUB-MISSION ON TRANSPORT | | | | |
| SSU-9 | Four-laning of roads to connect district head quarters and avoid traffic congestion and improved city mobility plan | 2 | | ₹ 90600,00,000 | 5 |
| SSU-10 | Bus rapid transit systems (1310 buses) | 2 | | ₹ 32689,00,000 | 5 |
| SSU-11 | Energy efficient street lighting plan | 2 | | | |
| SSU-12 | Avenue tree plantation for carbon sequestration (covered under Green UP) | 2 | | | 5 |
| | SUB-MISSION ON HEALTH | | | | |
| SSU-13 | Conversion of all Community Health Centre (CHC) into First Referral Unit (FRU) in climate vulnerable areas | 1 | | | 3 |
| SSU-14 | Vector borne disease control and early warning systems | 1 | ₹ 2600,00,000 | ₹ 13000,00,000 | 5 |
| SSU-15 | Developing standard operating procedures for extreme weather conditions (heat wave, cold wave) | 1 | | | |
| SSU-16 | Disease surveillance and infrastructure in flood prone areas (water borne diseases, anti-venom) | 1 | ₹ 800,00,000 | ₹ 4000,00,000 | 5 |
| **Totals** | | | **₹ 243400,00,000** | **₹ 1337589,50,000** | |
| | | **in Crore** | **₹ 2,434.00** | **₹ 13,375.90** | |
| | | **Adaptation** | | **₹ 1,524.53** | |
| | | **Mitigation** | | **₹ 11,851.37** | |
| | | **Both** | | **₹ -** | |

# Annexure B

## COMMITTEE MEMBERS OF THE CORE GROUPS FOR THE FORMULATION OF SAPCC

### *Apex Committee*

| | | |
|---|---|---|
| **1.** | **Chief Secretary, Govt. of U.P.** | **Chairman** |
| **2.** | Commissioner, Infrastructure & Industrial Development | Member |
| **3.** | Principal Secretary, Department of Finance | Member |
| **4.** | Principal Secretary, Department of Planning | Member |
| **5.** | Principal Secretary, Department of Non Conventional Development Energy | Member |
| **6.** | Principal Secretary, Department of Energy | Member |
| **7.** | Principal Secretary, Department of Housing | Member |
| **8.** | Principal Secretary, Department of Agriculture | Member |
| **9.** | Principal Secretary, Department of Irrigation | Member |
| **10.** | Principal Secretary, Department of Forests | Member |
| **11.** | Principal Secretary, Department of Environment | Member Secretary |

### *Solar Energy Mission*

| | | |
|---|---|---|
| **1.** | **Secretary, Department of Non Conventional Development Energy, Govt. of U.P.** | **Chairman** |
| **2.** | Secretary/Principal Secretary, Department of Energy, Govt. of U.P. | Member |
| **3.** | Secretary/Principal Secretary, Department of Environment, Govt. of U.P. | Member |
| **4.** | Chairman, U.P. Administration and Management Academy | Member |
| **5.** | Representative of Tata Energy Institute | Member |
| **6.** | Representative of Indian Institute of Technology, Kanpur | Member |
| **7.** | Representative of Moti Lal Nehru, National Institute of Technology, Allahabad | Member |
| **8.** | Representative of H.B.T.I., Kanpur | Member |
| **9.** | Representative of Institute of Engineering & Technology, Lucknow | Member |

### *Enhanced Energy Mission*

| | | |
|---|---|---|
| **1.** | **Secretary, Department of Energy, Govt. of U.P.** | **Chairman** |
| **2.** | Nominee of Secretary, Dept. of Non Conventional Development Energy, Govt. of U.P. | Member |
| **3.** | Nominee of Principal Secretary, Department of Transport, Govt. of U.P. | Member |
| **4.** | Nominee of Principal Secretary, Department of Forests, Govt. of U.P. | Member |
| **5.** | Nominee of Principal Secretary, Department of Horticulture, Govt. of U.P. | Member |
| **6.** | Nominee of Secretary, Department of Animal Husbandry, Govt. of U.P. | Member |
| **7.** | Nominee of Principal Secretary, Department of Land Development & Water Resources, Govt. of U.P. and Technical Officer from SWARA, | Member |
| **8.** | Nominee of Secretary, Department of Secondary Education, Govt. of U.P. | Member |
| **9.** | Nominee of Secretary, Department of Primary Education, Govt. of U.P. | Member |
| **10.** | Nominee of Principal Secretary, Department of Environment, Govt. of U.P. | Member |
| **11.** | Nominee of Chairman, U.P. Administration and Management Academy | Member |
| **12.** | Nominee of G.S.I./Remote Sensing | Member |
| **13.** | Nominee of TERI, IIT Kanpur, Moti Lal Nehru, National Institute of Technology, Allahabad, H.B.T.I., Kanpur | Member |

*Mission on Sustainable Habitat*

| | | |
|---|---|---|
| **1.** | **Principal Secretary, Department of Housing & Urban Planning/Representative** | **Chairman** |
| **2.** | Principal Secretary, Department of Transport/Representative | Member |
| **3.** | Principal Secretary, Department of Urban Development/Representative | Member |
| **4.** | Principal Secretary, Department of Environment, Govt. of U.P. /Representative | Member |
| **5.** | Principal Secretary, Department of Energy, Govt. of U.P. /Representative | Member |
| **6.** | Principal Secretary, Dept. of Non Conventional Development Energy/Representative | Member |
| **7.** | Principal Secretary, Department of Forest/Representative | Member |
| **8.** | Principal Secretary, Department of Horticulture/Representative | Member |
| **9.** | Principal Secretary, Department of Agriculture/Representative | Member |
| **10.** | Director, U.P. Administration and Management Academy | Member |
| **11.** | Commissioner Housing, U.P. Housing and Development Council | Member |
| **12.** | U.P. Chief Town and Country Planner | Member |
| **13.** | Representative of Moti Lal Nehru, National Institute of Technology, Allahabad | Member |
| **14.** | Representative of T.E.R.I. | Member |
| **15.** | Representative of Indian Institute of Technology, Kanpur | Member |
| **16.** | Representative of U.P. RADCO | Member |
| **17.** | Representative of SWARA | Member |
| **18.** | Director, Awas Bandhu | Coordinator |

*Water Mission*

| | | |
|---|---|---|
| **1.** | **Principal Secretary, Irrigation, U P Govt.** | **Chairman** |
| **2.** | Principal Secretary, Ground Water/Minor Irrigation or nominated representative | Member |
| **3.** | Principal Secretary, Land Development and Water Resources or nominated representative | Member |
| **4.** | Chairman, U P Administration and Management Academy, Lucknow or nominated representative | Member |
| **5.** | Irrigation and Drainage Expert, State Water Resources Agency. | Member Secy |
| **6.** | Principal Secretary, Dept. of Non Conventional Development Energy/Representative | Member |
| **7.** | Director, Environment | Member |
| **8.** | Representative of Director General, TERI Member | Member |
| **9.** | Representative of Indian Institute of Technology Kanpur/ Delhi/Roorkee | Member |
| **10.** | Representative of Moti Lal Nehru National Institute of Technology, Allahabad | Member |

*Mission for a Green UP*

| | | |
|---|---|---|
| **1.** | **Principal Secretary, Department of Forests** | **Chairman** |
| **2.** | Principal Secretary, Department of Horticulture/Representative | Member |
| **3.** | Principal Secretary, Department of Agriculture/Representative | Member |
| **4.** | Principal Secretary, Department of Environment, Govt. of U.P. /Representative | Member |
| **5.** | Director General , U.P. Administration and Management Academy/Representative | Member |
| **6.** | Director, National Botanical Research Institute, Lucknow./Representative | Member |
| **7.** | Vice Chancellor, Naini University, Allahabad./Representative | Member |
| **8.** | Vice Chancellor, Kumarganj Agriculture University, Faizabad./Representative | Member |
| **9.** | Principal Chief Forest Conservator, U.P., Lucknow | Member |
| **10.** | Principal Chief Forest Conservator, Wild Life U.P., Lucknow | Member |
| **11.** | Additional Principal Forest Conservator, Social & Agro-Forestry, Lucknow | Member |
| **12.** | Sri. S.R.K. Varshney, Chief Conservator of Forest , Bamboo Mission | Member |

*Sustainable Agriculture Mission*

| | | |
|---|---|---|
| **1.** | **Principal Secretary, Department of Agriculture, Govt. of U.P.** | **Chairman** |
| **2.** | Director, Department of Horticulture, U.P., Lucknow. | Member |
| **3.** | Director, Animal Husbandry, U.P., Lucknow | Member |
| **4.** | Director, Fisheries, U.P. Lucknow | Member |
| **5.** | Director, Silk Husbandry, U.P., Lucknow | Member |
| **6.** | Director, Milk Production, U.P., Lucknow | Member |
| **7.** | Chief Conservator of Forests, U.P., Lucknow | Member |
| **8.** | Commissions, Sugar Cane, U.P., Lucknow | Member |
| **9.** | Director, Department of Agriculture, U.P., Lucknow | Member |

*Strategic Knowledge Mission*

| | | |
|---|---|---|
| **1.** | **Principal Secretary, Environment** | **Chairman** |
| **2.** | Director, Zoological Survey of India | Member |
| **3.** | Director, Meteorological Science of India, Lucknow | Member |
| **4.** | Director, Remote Sensing Lucknow | Member |
| **5.** | Additional Director, CPCB, Lucknow. | Member |
| **6.** | Member Secretary, UPPCB, Lucknow. | Member |
| **7.** | Director of Environment, Lucknow | Member |
| **8.** | State Chief, CII, Plot no- A, Vibuti Khand, Gomti Nagar, Lucknow. | Member |
| **9.** | State Chief, PHD Chamber of Commerce, Lucknow | Member |
| **10.** | In charge Officers, Centre of Environment Education | Member |

*Advisory Committee for Strategic Knowledge Mission*

| | | |
|---|---|---|
| 1. | Director, Environment Directorate, U.P., Lucknow | Chairman |
| 2. | Vice Chancellor, U.P. Technical University, Lucknow/Representative | Member |
| 3. | Director, Ministry of Environment & Forests, Govt. of India, Regional Office, Kendriya Bhawan, Aliganj Lucknow | Member |
| 4. | Representative of Director, Indian Institute of Technology, Kanpur | Member |
| 5. | Director, Science & Technology Council, Lucknow/Representative | Member |
| 6. | Director, Remote Sensing Institute, Lucknow/Representative | Member |
| 7. | Director, Indian Institute of Toxicology Research, Lucknow /Representative | Member |
| 8. | Director, National Botanical Research Institute, Lucknow/Representative | Member |
| 9. | Member Secretary, U.P. Pollution Control Board, Lucknow | Member |
| 10. | Joint Director Cum Chief Appraisal, Environment Directorate, U.P., Lucknow | Member-Coordinator |

*Himalayan Ecology Mission*

| | | |
|---|---|---|
| **1.** | **Principal Secretary, Department of Environment, Govt. of U.P.** | **Chairman** |
| **2.** | Director General, U.P. Administration and Management Academy/Representative | Member |
| **3.** | Deputy Director General, Geological Survey of India, Aliganj, Lucknow. | Member |
| **4.** | Director, Remote Sensing Institute, Lucknow | Member |
| **5.** | Director, Directorate of Geology and Mining, Lucknow | Member |
| **6.** | Chief Engineer, Department of Irrigation, U.P., Lucknow | Member |
| **7.** | Director, Agriculture, U.P., Lucknow | Member |
| **8.** | Director, G.B. Pant Himalyan Environment Research Institute, Katarmal, Almora | Member |
| **9.** | Regional Director, Environment Training Centre (Himalaya), North Region 19/323, Indira Nagar, Lucknow | Member |
| **10.** | Representative of Director General, Tata Energy Research Institute, Darbari Seth Block, I.H.C. Complex, Lodhi Road, New Delhi. | Member |
| **11.** | Representative of Director, Indian Institute of Technology, Kanpur | Member |
| **12.** | Representative of Director, Wadia Institute of Himalayan Geology, 33 General Mahadev Singh Road, Dehradun | Member |
| **13.** | Prof. A.R. Bhattacharya, Ex. Head of Department, Geology Department, Lucknow University. | Member |
| **14.** | Representative of Regional Office of Central Water Commission, Government of India | Member |
| **15.** | Director, Environment Directorate, U.P., Lucknow | Member - Coordinator |

# Annexure C

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