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Scoping Assessment For Climate Change Adaptation Planning in Uttar Pradesh

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FOREWORD

Uttar Pradesh by virtue of its geography and fragile ecology experiences the fury of nature every year causing loss of precious human lives and property. The state is particularly susceptible to major floods, drought, and earthquakes on account of higher seismicity of the region. Increasing pace of population growth, urbanization, pollution, water scarcity is therefore throwing up challenges for which adequate planning is necessary for effective climate action strategy if these do occur. Hence, there is an urgent need to improve capacity building in this area.

As climate action is a very specialized job, so there is a need to develop a technical and professional approach in handling extreme climate events. in the existing scenario, there is a wide gap in the knowledge and skills of the climate managers as well as vulnerable population to cater to climate change events. Thus, it is important to have capacity building strategy for vulnerable groups, regions, and sectors_ I strongly believe that scoping assessment is the first and foremost step in this direction.

This Scoping Assessment Document prepared by the Department of Environment, Forest & Climate Change, Government of Uttar Pradesh in collaboration with German Development Cooperation (GIZ), New Delhi is a maiden effort, and I am sure would help the line departments and vulnerable target groups in devising their training and capacity building calendar. I hope all the stakeholders will take advantage of this scoping assessment document and will prepare training modules as per the requirement in the field of climate action. I appreciate the efforts made in compiling the document as a first step to develop abilities of both the vulnerable target groups and the organizations to proactively deal with climate change impact in the state.

(Manoj Singh)

Ashish Tiwari (IFS)
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MESSAGE

Increasing vulnerabilities due to climate change are multi-dimensional and interlinked. It is varying across location, sectors, communities, households, and individuals. The state of Uttar Pradesh is not left untouched by this emerging problem. Over the past decades, Uttar Pradesh has witnessed recurrent hydro-meteorological hazards like floods, droughts, heat waves, cold waves, extreme rainfall that have not only affected the people but also the development indices of the state.

Though climate change impacts, are common throughout the world, their adverse impact on the land and society is not uniform. While on one hand, the developing countries are affected in terms of mortality due to climate induced disasters, the developed countries on other hand observe huge loss of property and infrastructure due to climate extreme events.

Various forums at the National, State, and local levels need to be addressed through training, research and capacity building for an effective climate action strategy, Sector specific scoping assessment is an important aspect of an effective climate action at ground level. Scoping assessment for capacity building should cut across all the identified sectors accentuating the areas, so that need of vulnerable target groups properly addressed in a coordinated and multidisciplinary manner.

To further strengthen the implementation of climate action through capacity building, the Government of Uttar Pradesh prepared a Scoping Assessment report for the vulnerable target groups with the technical assistance of German Development Cooperation (GIZ), New Delhi. The outcome of the document helped us in assessing the capacity building needs of vulnerable target groups to combat the threat due to climate change in the state. I hope that this document would be useful for all the vulnerable target groups in knowing their broad needs so that sector and region-specific capacity building could be generated in the state to prepare them to face climate change threats in the times to come.

(Ashish Tiwari)

Dr Ashish Chaturvedi

Director, Climate Change and Circular Economy

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Preface

The report on 'Scoping Assessment in Uttar Pradesh' is developed under the Indo-German Development Cooperation project on 'Climate Change Adaptation and Finance in Rural Areas ofIndia (CAFRI)', being implemented by GIZ, on behalf of the German Federal Ministry for EconomicCooperation and Development (BMZ), in partnership with the Ministry of Environment, Forest &Climate Change (MoEF&CC) and Department of Environment Government of Uttar Pradesh. The scoping assessment has undertaken a rich and comprehensive vulnerability assessment of different agro-climatic regions in Uttar Pradesh to identify the most vulnerable regions, the priority sectors and target groups which are highly impacted by climatechange to draw on actions for integrating climate adaptation. The report will enable practitionersand policy decision makers improve their interventions by incorporating capacity building aspectson climate change in planning development interventions.On behalf of GIZ, I would like to express my sincere thanks to the officials from Directorate of Environment and State Institute of rural development for providing their guidance in finalising the study. I would also like to thank the experts from GEAG Dr Shiraz Wajih, Dr Bijay Singh, and Ms NiveditaManiin successfully conducting the study.

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Abbreviations

AAP	Absolute Agricultural Prices
ABHY	Atal BhujalYojana
ADO	Agriculture Development Officer
ADO-Ag	Assistant Development Officer - Agriculture
AHI	Assistant Horticulture Inspector
AIBP	Accelerated Irrigation Benefit Programme
ATMA	Agricultural Technology Management Agency
BIRD	Bankers Institute of Rural Development
BMTPC	Building Materials and Technology Promotion Council
BMZ	Federal Ministry of Economic Cooperation and Development
BPO	Block Programme Officer
BRP	Block Resource Person
CAD & WM	Command Area Development for Water Management
CAFRI	Climate Adaptation and Finance in Rural India
CCA	Climate Change Adaptation
CCC	Centre for Climate Change
CCCR	Centre for Climate Change Research
CDD	Consecutive Dry Days
CIPMC	Central Integrated Pest Management Centres
COVID-19	Coronavirus Disease
CVI	Composite Vulnerability Index
CVO	Chief Veterinary Officer

CWC	Central Water Commission
DAC	Department of Agriculture and Cooperation
DAHDF	Department of Animal Husbandry, Dairying and Fisheries
DAO	District Agriculture Officer
DD-Ag	Deputy Director-Agriculture
DDMA	District Disaster Management Authority
DDMP	District Disaster Management Plan
DFO	District Forest Officer
DoLR	Department of Land Resources
DPO	District Programme Officer
FIG	Farmers' Interest Groups
FPO	Farmer Producer Organisation
FRI	Forest Research Institute
GEAG	Gorakhpur Environmental Action Group
GEN	General Category
GIZ	Deutsche Gesellschaftfür Internationale Zusammenarbeit
GPDP	Gram Panchayat Development Plan
HI	Horticulture Inspector
ICAR	Indian Council of Agricultural Research
IFS	Integrated Farming System
IGFRI	Indian Grassland and Fodder Research Institute
INDC	Intended Nationally Determined Contributions
IITM	Indian Institute of Tropical Meteorology
IMD	Indian Meteorological Department
INDC	Intended Nationally Determined Contributions

IPCC	Intergovernmental Panel on Climate Change
ISET	Institute for Social and Environmental Transition
IWMP	Integrated Watershed Management Programme
JFM	Joint Forest Management
JFMC	Joint Forest Management Committees
KVK	Krishi Vikas Kendra
MFP	Minor Forest Produce
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIDH	Mission for Integrated Development of Horticulture
MKSP	MahilaKisanSashaktikaranProgramme
MME	Multi-Model Ensemble
MoEFCC	Ministry of Environment, Forest & Climate Change
MoWR, RD&GR	Ministry of Water Resources, River Development & Ganga Rejuvenation
MSME	Micro Small and Medium Enterprise
NABARD	National Bank for Agriculture and Rural Development
NAP	National Afforestation Program
NAPCC	National Action Plan on Climate Change
NEDA	New & Renewable Energy Development Agency
NFHS	National Family Health Survey
NGO	Non-Governmental Organisation
NHM	National Horticulture Mission
NITI	National Institution for Transforming India
NMAET	National Mission on Agricultural Extension & Technology
NMAET	National Mission on Agricultural Extension & Technology
NMOOP	National Mission on Oilseeds & Oil Palm

NMSA	National Mission for Sustainable Agriculture
NMSA	National Mission on Sustainable Agriculture
NRHM	National Rural Health Mission
NRLM	National Rural Livelihood Mission
NRSC	National Remote Sensing Center
NTFP	Non-Timber Forest Produce
OFWM	On-Farm Water Management
PGWM	Participatory Groundwater Management
PIM	Participatory Irrigation Management
PKVY	Paramparagat Krishi Vikas Yojna
PKVY	Pradhan Mantra Krishi Vikas Yojna
PMFBY	Pradhan Mantri Fasal Beema Yojna
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PRA	Participatory Rural Appraisal
PRI	Panchayati Raj Institution
PROM	Phosphorus Rich Organic Manure
RCP	Representative Concentration Pathway
RMK	Rashtriya Mahila Kosh
SAME	Sub-Mission on Agricultural Extension
SAPCC	State Action Plan on Climate Change
SC	Scheduled Caste
SDMA	State Disaster Management Authority
SDMP	State Disaster Management Plan
SFAC	Small Farmers Agribusiness Consortium
SFRI	State Forest Research Institute

SFTI	State Forestry Training Institute
SHG	Self Help Group
SHM	State Horticulture Mission
SIRD	State Institute of Rural Development
SLD	Shared Learning Dialogue
SMAET	Sub Mission on Agricultural Extension & Technology
SRLM	State Rural Livelihood Mission
ST	Scheduled Tribe
UNEP	United Nations Environment Programme
UP	Uttar Pradesh
UPCAR	UP Council of agriculture research
UPSRLM	UP State Rural Livelihood Mission
UPSRSAC	Uttar Pradesh State Remote Sensing Application Centre
VDMC	Village Disaster Management Committee
VDMP	Village Disaster Management Plan
WG	Working Group
WLMI	Water and Land Management Institute
WRIS	Water Resource Information System
WSP	Water Security Plan
WUA	Water Users Association

Executive Summary

Climate change is not a distant, potential threat. It is already affecting millions of lives across the globe. The most devastating impact of climate change and extreme weather is being manifested in the loss of human life, besides its impact on ecosystems, communities and the global economy which is dreadful too.

The adoption of the Paris Agreement at the 21st session of the Conference of the Parties (CoP21) to the UN Framework Convention on Climate Change in November 2015 was a landmark achievement, with 195 countries endorsing an ambitious climate change agreement that includes a global goal on adaptation. More robust information on adaptation needs, costs, and finance is however, needed to guide and inform the successful implementation of the Paris Agreement.

In the lead-up to CoP21, parties to the UNFCCC prepared Intended Nationally Determined Contributions (INDCs), wherein countries publicly outline the post-2020 climate actions and agendas they plan to implement under a new international climate agreement, with a strong focus on climate adaptation.

The Global Climate Risk Index 2020 of the German think-tank Germanwatch, ranks India as the 5th most at-risk country by climate change. The report further states that India is particularly vulnerable to extreme heat due to low per capita income, social inequality and a heavy reliance on agriculture. Climate change has been posing greater risks for vulnerable communities, majorly dependent on natural resources. Consequently, India's NDCs aim at reducing climate risks for vulnerable population groups and sectors towards reducing national emissions and enhancing climate change adaptation.

GIZ, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), has been partnering with the Ministry of Environment, Forest & Climate Change (MoEFCC) in implementing Indo-German Technical Cooperation projects on climate change. The Climate Adaptation and Finance in Rural India (CAFRI) project is part of the action field "Climate Adaptation and Financing" of the programme "Climate and Environment in Rural Areas of India". This project contributes to minimising the risks of climate change and indirectly improving the sustainable management of natural resources as well as increasing productivity, income and employment in rural areas.

In Uttar Pradesh, CAFRI is working with the Department of Environment as the nodal partner. The project focuses on enhancing ownership through locally appropriate, gender inclusive adaptation solutions which in turn will support mainstreaming of climate actions. This will be ensured by engaging and capacitating local/community groups, institutions (such as women's group, Farmers Producers' Organisation and Panchayati Raj Institutions) and knowledge networks. The project further targets that local needs and formats for the participation of target groups are included in the guidelines of the funding schemes as an important criterion for approval of project proposals in order to ensure the quality and ownership by the target groups.

A Scoping Assessment in Uttar Pradesh was undertaken under the CAFRI Project by Gorakhpur Environmental Action Group, supported by GIZ India, with an objective to identify vulnerable target groups, regions and sectors (at least 3 priority sectors) in the context of climate change impacts and identify adaptation needs. The assessment is further aimed at mapping relevant state and centrally funded schemes and departments/ institutions vis-à-vis identified vulnerable sectors and target groups and develop capacity building strategies to support mainstreaming of climate adaptation in development planning process.

Key highlights

Scoping assessment study for identification of vulnerable target groups, priority regions and sectors impacted by climate change impacts in the state of Uttar Pradesh

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District level vulnerability assessment by computation of a universal Composite Vulnerability Index (CVI)

Region level vulnerability categorisation within the sate of Uttar Pradesh: Bundelkhand region emerged as the most vulnerable agro-climatic region

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Mapping of priority sectors w.r.t sensitivity and adaptive capacity relevant for protecting the vulnerable communities of the state

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Identification of vulnerable communities and target group based on the Climate Resilience Framework, developed by ISET International

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Mainstreaming of climate adaptation actions in local planning emerged as a key strategic option for climate action in Uttar Pradesh

Identification of Vulnerable Regions

Increasing vulnerabilities due to climate change are multi-dimensional and interlinked. It is varying across location, sectors, communities, households and individuals (gender). The state of Uttar Pradesh is not left untouched by this emerging problem. Over the past decades, Uttar Pradesh has witnessed recurrent hydro-meteorological hazards like floods, droughts, heatwaves, cold waves, extreme rainfall that have not only affected the people but also the development indices of the state. The present scoping assessment attempts to assess the vulnerability of all the 75 districts of Uttar Pradesh to climate induced risks, its sensitivity and adaptive capacity through computing the Composite Vulnerability Index (CVI) of current and future climate change scenario (RCP 4.5 and RCP 8.5) of mid-century using 26 indicators. The computation of CVI was based on the Intergovernmental Panel on Climate Change (IPCC) approach using exposure, sensitivity and adaptive capacity indicators. Indicators were normalised to make sure that all the indicators are comparable. Accordingly, the districts were classified as high, moderate and less vulnerable based on the magnitude of the CVI.

The CVI of all the 75 districts of the state reveals that 27 districts are in the category of highly vulnerable to climate risks; 28 districts as moderately vulnerable; and 20 districts less vulnerable. The district level vulnerability mapping at current scenario showed that the highest potential impact of climate change exposure and sensitivity is observed in Chitrakoot (1.02), followed by Jhansi(1.00), Kannauj (0.99) and Farrukhabad (0.98), while the potential impact was the lowest in Kushinagar(0.66), followed by Deoria (0.67) and Lucknow (0.70). The lowest vulnerability in Kushinagar, Deoria and Lucknow are mainly due to its less exposure combined with less sensitivity. Chitrakoot district leads the vulnerability score owing to its highest sensitivity index (0.59) and low adaptive capacity (0.79) although its exposure index (0.43) is low. In future, both the scenarios of climate change (low emission scenario-RCP 4.5 and high emission scenario-RCP 8.5) reveals that the state's average CVI is projected to increase during the mid-century due to increasing exposure index. This is an issue of serious concern.

At the regional level, in all the three climate change scenarios (current, future-RCP 4.5 and future-RCP 8.5), the Bundelkhand region is identified as the most vulnerable agro-climatic region in terms of climatic exposure, sensitivity and adaptive capacity. All the districts of the region are found above the average state CVI. The next two most vulnerable agro-climatic regions (as per the extent of vulnerable areas and number of districts above the state's average CVI) are the North-eastern Plains in the current scenario and the Vindhyan region in the projected climate change scenario of both RCP 4.5 and RCP 8.5. Altogether, these three agro-climatic regions have high exposure and high sensitivity indices along with inadequate adaptive capacity. Conversely, the districts in Western Plain, South-western semi-arid zone and Bhabhar and Terai region (excluding Shravasti district) are comparatively less vulnerable. The Mid-western region, Eastern region and Central regions are moderately vulnerable.

Therefore, considering the above scenarios of climate change, there is an urgent need to focus on developing regional (agro-climatic) level adaptation strategies followed by appropriate capacity-building measures towards safeguarding the livelihood of rural communities in the vulnerable regions. Special emphasis also needs to be laid on local people's indigenous knowledge on climate-induced risks including traditional practices to cope-up with vulnerability.

Identification of priority sectors

The analysis of current and future climate exposure with respect to sensitivity and adaptive capacity of the state/indicates that climate change will particularly affect vulnerable communities especially those who are directly dependent on natural resources and primary production activities. Therefore, it becomes imperative to understand and prioritise those sectors which are relevant for vulnerable communities in different agro-climatic regions and are also most impacted by climate change to devise appropriate climate actions. To assess the priority sectors, various sectors and sub-sectors mentioned under different Missions of the UP-SAPCC are mapped and a total of 15 such sectors/ sub-sectors, which are directly relevant to the missions, are identified. Besides this, suggestions from the Directorate of Environment and GIZ on the priority sectors from the perspective of the state's priority and ease of implementing government programmes are also considered.

Out of the total 26 indicators used for assessing the vulnerable agro-climatic region, those 18 indicators were selected to analyse sectoral vulnerabilities whose value is greater than the average

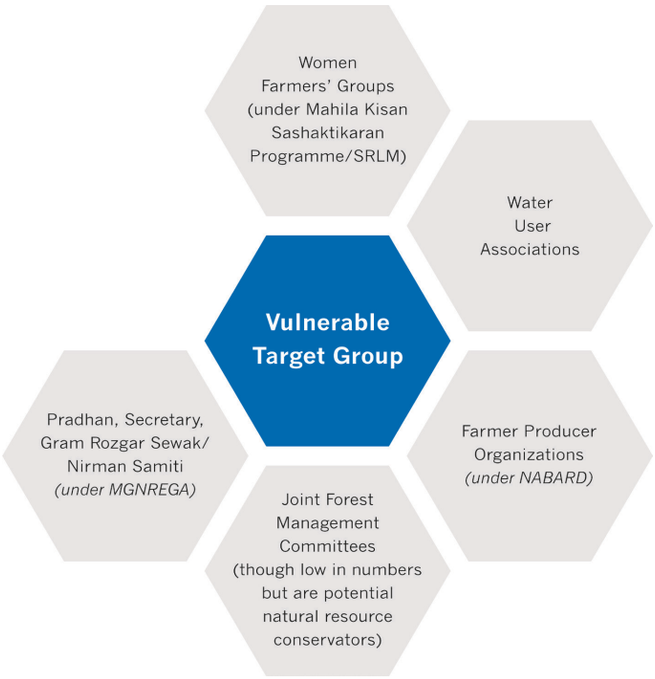
value of all the indices in the region. This was done to understand the functional relationship with the identified sectors, vis-à-vis the vulnerability indicators. The scoring method was adopted to allocate scores to the sector which either had a direct impact of the vulnerability aspect (indicators) on them or did not have a direct impact.

From the analysis of priority sectors, Agriculture & Allied, Water Resources and Disaster Management emerged as priority sectors, which are majorly impacted by climate change and needs urgent actions for adaptation.

Identification of vulnerable target groups

The Climate Resilience Framework, developed by ISET International (though developed in an urban context, has also been extensively tested in rural settings), is one of the widely recognised resilience frameworks which outlines that actors or target groups can respond to climatic impacts depending on their experience and learning. The key capacities that contribute to resilience and adaptation of the target groups like Resourcefulness, Responsiveness and Capacity to Learn were considered for identifying vulnerable target groups. In addition, target groups who also contribute to resource conservation were also considered as a criterion.

According to identified vulnerable sectors viz Agriculture and Allied, Disaster Management and Water Resources, the most affected (vulnerable) community groups were listed, followed by identification of formal entities (target groups) representing these community groups. These target groups, representing the most vulnerable communities, were rated on the resilience characteristics and accordingly those groups were identified which have the best potential for integration of climate adaptation actions. The identified target groups represent the most vulnerable communities with high potential for mainstreaming climate change concerns in local planning processes and further implement climate action on the ground. The identified vulnerable target groups are as below:



Devising Strategic Options

Each of the three identified vulnerable regions under the Scoping Assessment has its own uniqueness in terms of agro-ecology and geo-climate conditions. The resilience interventions need to be developed according to its specific situation. The direct and indirect impacts of climate change on the identified priority sectors - agriculture and allied, water resources and disaster management were assessed. Based on this, the strategic options were evolved. The strategic options suggested are to be considered in the local ecological context.

Capacity building needs and institutional arrangements

The scoping assessment tried to understand the specific training needs of the different target groups, based on which training content has been developed against the strategic options. Further, the existing flagship programmes and schemes are also mapped that can address the assessed needs of vulnerable target groups across the priority sectors in the selected regions vis-à-vis the evolved strategic options for climate adaptation. The actors and processes at block, district and state levels engaged in these programmes and schemes are also identified.

In light of the identified vulnerable target groups and their training needs under the priority sectors, a review of the existing training institutional set ups in Uttar Pradesh is also undertaken to understand their training mandate, target trainees and the modalities. The key training institutions that can be instrumental in designing and delivering climate adaptation integrated training programmes for various development sectors in the rural areas include DeendayalUpadhyaya State Institute of Rural Development, State Forest Training Institute, Bankers Institute of Rural Development and Panchayati Raj Institute of Training. It is expected that even these institutions will need capacity-building on relevant aspects to play the desired role effectively in promoting climate change adaptation in the state.

Mainstreaming climate adaptation actions into local planning will require a well-defined capacity building strategy for the vulnerable target groups vis-à-vis the available programmes and funding schemes. A comprehensive gender sensitive training package also needs to be designed with tools tailored to the concerned target groups so that it maximises both the transfer of technical knowledge and empowerment of participants.

1 Introduction

Impacts from climate change are happening now and are projected to worsen. These impacts extend well beyond an increase in temperature, affecting ecosystems and communities in and around the world, many a time manifesting in increased climate variability and extremes. Things that we depend upon and value - water, energy, wildlife, agriculture, ecosystems, transportation and human health- are experiencing the effects of a changing climate. The UNEP Adaptation Gap Report 2016 warns of increasing impacts and resulting increases in global adaptation costs by 2030 to about two to three times more than current global estimates.

The Global Climate Risk Index 2020 of the German think-tank Germanwatch, ranks India as the 5th most at-risk country by climate change. The report further states that India is particularly vulnerable to extreme heat due to low per capita income, social inequality and a heavy reliance on agriculture. Climate change has been posing greater risks for vulnerable communities, majorly dependent on natural resources. Consequently, India's Nationally Determined Contributions (NDCs) aims at reducing climate risks for vulnerable population groups and sectors towards reducing national emissions and enhancing climate change adaptation.

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2 Objectives of the Scoping Assessment

The objectives of the scoping assessment assignment were envisaged as follows:

- To identify vulnerable target groups, regions and sectors (at least 3 priority sectors) in the context of climate change impacts and identify adaptation needs

- Mapping of relevant state and centrally funded schemes and departments/ institutions vis-à-vis identified vulnerable sectors and target groups

- To develop a concept for a capacity-building package for the identified target groups and associated intermediary institutions/organisations stakeholders to support mainstreaming CCA into development planning with a focus on the following elements:

o Awareness and training of stakeholders on needs-based, gender-responsive participatory adaptation planning and adaptation project development.

o Engagement with local administration and line departments in priority areas to leverage financing from ongoing schemes/ developmental programmes and support implementation of adaptation-related projects.

- The scoping assessment will help to identify vulnerable regions, sectors and groups which are prone to climate risks and accordingly develop capacity building strategies for intermediary organisations and target groups to support mainstreaming of climate adaptation in the development planning process.

3 Methodology & Approach

The scoping assessment included an integrated approach for sourcing data and information and carrying out the analysis for prioritising vulnerable regions, sectors and target groups, impacted by climate change. While the methodology for identifying the vulnerable regions, priority sectors and the vulnerable target groups is explained in further sections of the report, we provide an overview of the methodology here:

Sourcing Data and Visualisation

The selection of vulnerable regions and sectors entailed collecting relevant data on climate change exposure, sensitivity and adaptive capacity parameters. Current climate exposure data is sourced from

- Indian Meteorological Department (IMD)
- Building Materials and Technology Promotion Council's (BMTPC) Vulnerability Atlas, 3rd Edition (2019)
- Central Water Commission (CWC)
- National Remote Sensing Center (NRSC)
- State and District Disaster Management Authorities (SDMA/DDMA)
- Uttar Pradesh State Remote Sensing Application Centre, and
- Geo portals (Bhuvan, India - WRIS)
- Multi-Model Ensemble (MME) -based climate data analysis was done to derive future projections on two scenarios - low emission scenario (RCP 4.5) and high emission scenario (RCP 8.5).

For indicators on sensitivity and adaptive capacity, which includes biophysical vulnerabilities to climate change and socio-economic development parameters, data is majorly sourced from various published reports and authentic websites of the national and state government like National Family Health Survey (NFHS-4), Office of the Registrar General & Census Commissioner, India and Directorate of Economics and Statistics, Government of Uttar Pradesh.

In addition, information on relevant schemes and programmes in the state for integrating climate actions in identified priority sectors has been collected from respective government departments.

Desk-based Research

In order to build ground understanding on the climate and hazard vulnerabilities of different regions in Uttar Pradesh, a thorough and in-depth review of secondary literature is carried out which includes the UP-State Action Plan on Climate Change (SAPCC), State Disaster Management Plans (SDMP), NITI Aayog indicators and sectoral vulnerability reports. Secondary researches and reports were also studied to understand sectoral vulnerabilities in the state and the community groups that are most impacted by climate change (Gosain, A. K and Rao, S, 2018, Kumar, S, et.al, 2018, Deo K, et.al, 2016, Maurya, A, 2018, Balaganesh, G, et al, 2020). Relevant government programmes and schemes were also studied where the proposed project interventions could be plugged in later.

Regional Consultations

In at least two of the three identified vulnerable regions to gain insights on local adaptation needs of the selected target groups and avenues for mainstreaming climate actions in related government schemes and programmes.

Expert Consultations

With thematic experts to understand types of intermediary organisation, their structure and scale of presence in the state, and their capacity needs for mainstreaming climate change.

Shared Learning Dialogue

Shared learning is an approach to participatory planning and problem solving in complex situations, characterised by non-extractive, and mutual learning. The concept of shared learning is straightforward: fostering iterative deliberation and sharing sector- or group-specific knowledge and experience, as well as knowledge from both local practitioners and external experts, will improve the quality and effectiveness of decision-making. The SLD approach aided the prioritisation of vulnerable regions and sectors.

Key Informant Interviews

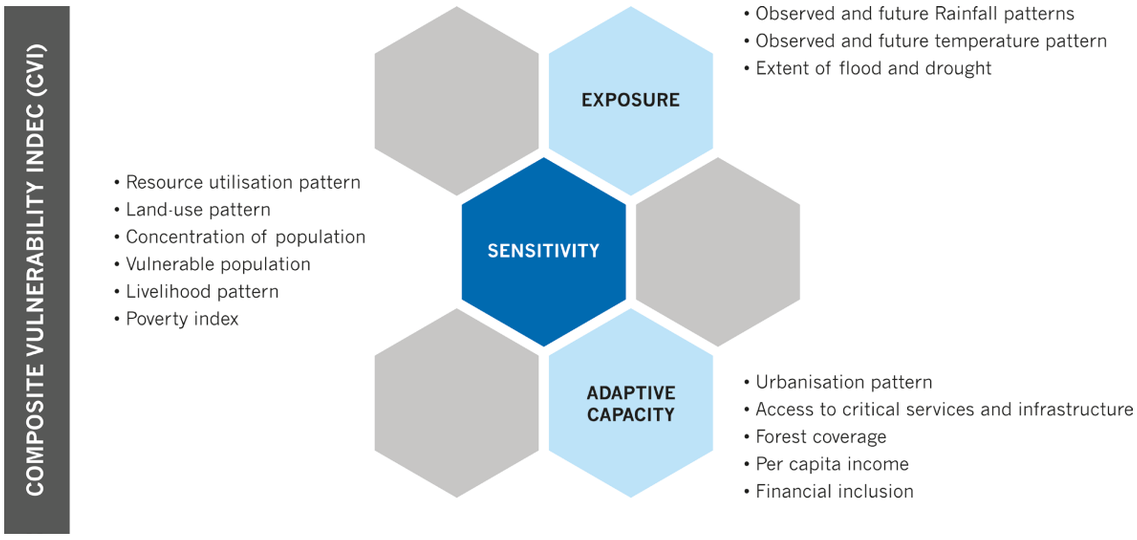
With select groups such as small-marginal and women farmers, PRI members, Civil Society Organisations, FPO members and Directors for field-level insights on climate change adaptation needs vis-a-vis schemes being implemented in their regions.

4 Applying IPCC Framework under Climate Change for Scoping Regions, Sectors & Target Groups

One of the key aspects in addressing climate change impacts is to reduce the risks to natural and social systems. In this regard, the impact-risk framework of the Intergovernmental Panel on Climate Change (IPCC) Working Group (WG II) Report on Climate Change - Impacts, Adaptation and Vulnerability (IPCC AR4 2007) provide the most comprehensive and scientific assessment of the impacts of climate change, the vulnerability of the natural and human environment and the potential for response through adaptation. Such an assessment is practically more useful, as the results and the indicators selected can be analysed to identify and prioritise the drivers of vulnerability to be addressed.

Under the scoping assessment, a spatial Composite Vulnerability Index (CVI) is developed through selecting indicators of Exposure, Sensitivity and Adaptive Capacity. Indicator selection at the district level ensured they are easy to interpret, comparable across different hazard types, and appropriate with the objectives of the study. Using the IPCC Framework for Risk Assessment (AR4 2007), vulnerability assessment[1] is conducted considering the following set of indicators on exposure, sensitivity and adaptive capacity. The list also provides information on related data sets.

For sectoral analysis, the UP SAPCC is referred to draw upon the major sectors impacted by climate change. Target groups are identified based on a range of climate change resilience characteristics that change resilience characteristics that the target groups possess and the potentiality to integrate climate actions in their interventions.



1 Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001b, Glossary).

SHARED LEARNING DIALOGUE - Department of Environment, Forest and Climate Change, Govt of UP and GIZ, India

A Shared Learning Dialogue (SLD) was organised with the officials of the Department of Environment, Forest and Climate Change, Govt of Uttar Pradesh and GIZ India on 29th July 2020 in Environment Directorate, Lucknow.

Iterative deliberations were fostered between the participants and sectoral knowledge/experience was mutually shared on climate change impacts on agriculture and other sectors, which helped in getting insights on the priority regions and key sectors for implementing related programmes in Uttar Pradesh.

Key discussions

1. Selection of vulnerable regions in Uttar Pradesh (UP) to be based on a vulnerable mapping done across the 9 Agro Climatic Zones. Since the districts are not clearly divided as per agro-climatic zones, it was resolved that if districts with more than 60% of the area falling in a specific agro-climatic zone will be considered under that agro-climatic zone.

2. Terai, Bundelkhand and Vindhyan are high priority regions for the Government of UP, mainly because the impacts of climate change and disaster losses is quite significant in these regions. However, the selection of regions will be based on data analysis of a set of indicators related to hazards, exposure, vulnerability and adaptive capacity.

3. The priority sectors within the regions which are highly impacted by climatic impacts and need urgent attention include Agriculture (photosensitive), Agro-Forestry, Medicinal and Aromatic Plants, Minor Forest Produce, Water Resources, Health, Environment, Disaster Management.

4. The most vulnerable target groups in these regions and under identified sectors, could be groups who are “Resource Conservators” such as Pani Panchayats, Fallow Land Users, etc. Farmer Producer Organisations, SHGs, PRI members, Migrant Workers (owing to COVID-19) should also be given priority.

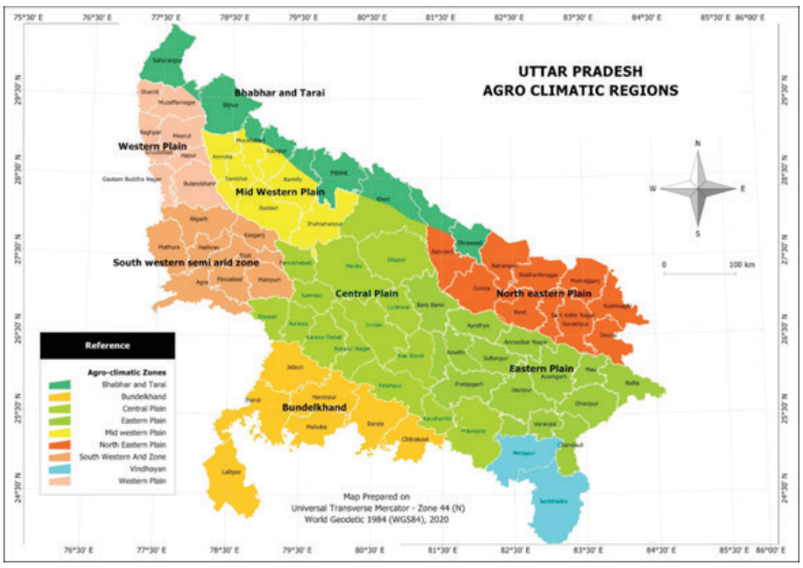
5 Identification of Vulnerable Regions

Over the past decades, the state of Uttar Pradesh has witnessed recurrent hydro-meteorological hazards like floods, droughts, heatwaves, cold waves, extreme rainfall that have not only affected the people but also the development indices in the state (Parida et al 2015). The state has 75 districts distributed across nine agro climatic regions (Fig 1). Despite development in secondary and tertiary sectors, the agriculture sector remains the major source of livelihood for around 68 per cent of the population (Census 2011). Most of the rural and low-income communities are majorly reliant on agriculture and allied activities for their livelihoods.

South-west monsoon is the major rainfall season in the state (SAPCC, 2014). The state has a tropical climate along with marked variability between summer and winter temperatures and monsoonal rain. In the last few decades, the variability and extremes in rainfall have impacted the agriculture and water resources sectors manifested through acute water shortages and droughts in the southern parts and excessive water/ floods in the northern districts (SAPCC, 2014).

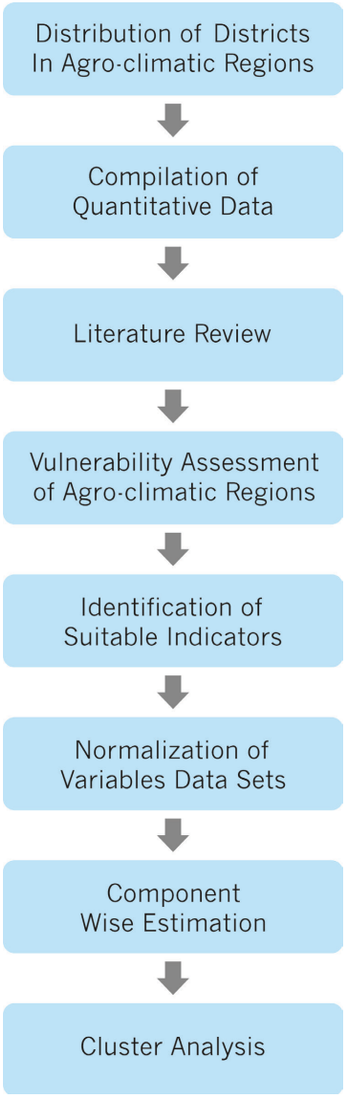
This section of the scoping assessment focuses on identifying vulnerable districts and agro-climatic regions of the state to climatic change.

Figure 1 : Agro-climatic zones in Uttar Pradesh



(Source : http://upagripardarshi.gov.in/)

Methodology



Vulnerabilities arising out of climate change are multi-dimensional and interlinked, varying across location, sectors, communities, households and individuals (gender). The scoping assessment adopted the following approach for the identification of vulnerable regions:

Distribution of districts in agro-climatic regions

The 75 districts of Uttar Pradesh are spread over nine agro climatic zones with some districts spanning across more than one agro-climatic zone (Singh P, 2014). Such districts are mainly in Bhabhar and Terai, and Vindhyan regions; posing challenges in compiling data at the region al level. As resolved in the project inception meeting, this issue was addressed by considering a district part of that agro-climatic zone in which more than 60 per cent of its area falls. This way, in Bhabhar and Terai region, only Saharanpur, Bijnour, Pilibhit and Shravasti district is recognised in the Terai region while in the Vindhayan region, the part of southern Prayagraj and Kaushambhi districts is included in the central plain region.

Compilation of quantitative data

A detailed list of variables related to climate exposure (temperature, precipitation and extreme climate events), biophysical sensitivities/ factors (related to soil, agriculture, forest, land-use and water resources) and socio economic-related variables (social groups, workforce, infrastructure and human development) for the 75 districts of Uttar Pradesh were compiled. The baseline climate-exposure data of all the 75 districts for the recent 30 years (1981-2010) was sourced from the authentic web portals of the Centre for Climate Change Research (CCCR), and the Indian Institute of Tropical Meteorology (IITM). For the future climatic scenario and extreme events of rainfall and temperature, Multi-Model Ensemble (MME) data of two different scenarios (Low Emission Scenario) RCP 4.5 and (High Emission Scenario) RCP 8.5 of Mid-century (2050) was compiled from the GIZ web portal (http://climatevulnerability.in).

For variables on biophysical and socio-economic parameters, data is sourced from various published reports and authentic websites of the state government:

- District-wise Development Indicator Reports, 2019 downloaded from the web portal of Directorate of Economics and Statistics, Govt of Uttar Pradesh
- Census 2011, Office of the Registrar General & Census Commissioner, Govt of India
- CRISIL Report 2018
- Published research articles (Maurya, A et al, and Alkire, S, Oldiges, C, Kanngaratnam, U, 2018).

- The flood exposure data is sourced from:
- Building Materials and Technology Promotion Council's (BMTPC) Vulnerability Atlas of India, 3rd Edition (2019)
- National Remote Sensing Center (NRSC)
- State and District Disaster Management Authorities (SDMA/DDMA)
- Uttar Pradesh State Remote Sensing Application Centre (UPSRSAC)
- Geo portals (Bhuvan, India Water Resource Information System (WRIS).

The vulnerability of a region is also linked with the availability, utilisation and governance of natural resources. In the scoping study, the data on the status of resources utilisation like the status of groundwater utilisation, percentage of forest coverage (by districts), and percentage of area irrigated of 2018 are taken from authentic websites/ portal of the Central Water Commission (CWC), Govt of India and Directorate of Economics and Statistics, Govt of Uttar Pradesh.

Literature Review

The purpose of the literature review for the scoping study was to comprehend the current state of research on a selected topic and assess the existing gaps in identifying region's vulnerabilities through indicators based vulnerability assessment. For this study, several reports/ studies were reviewed including the UP State Action Plan on Climate Change (SAPCC), UP State Disaster Management Plan (SDMP), NITI Aayog indicators report and sectoral vulnerability reports. Finally, relevant government programmes and schemes were also studied to shape the content of capacity building packages for various target groups.

Vulnerability Assessment of Agro-climatic Regions:

Vulnerability is the extent to which a system is prone to, or unable to cope with adverse effects of climate change, which includes climate variability and extremes. It is the function of the character, magnitude and rate of climate variation to which a system is exposed, the sensitivity and its adaptive capacity (IPCC AR4 2007). The assessment adopted the Intergovernmental Panel on Climate Change (IPCC) risk framework for computing Composite Vulnerability Index using exposure, sensitivity and adaptive capacity indices. The process for computing district level Composite Vulnerability Index to climate change risks is presented below:

Identification of suitable indicators on exposure, sensitivity and adaptive capacity

Selection of an appropriate and comprehensive set of variables (or sub-indicator) under each indicator on exposure, sensitivity and adaptive capacity to climate change risks is critical for vulnerability assessment. Hence, the variables under the three indicators are first identified through reviewing the published literature and subsequently have been finalised in consultations with experts. An important characteristic of a variable is to understand its "functional relationship"; positive if an increase in value of the variable increases vulnerability and vice versa. In addition, to avoid complexities in vulnerability assessment, a balanced weight is assigned to each variable for computing the composite value of the indicator and adding up the values of each indicator by assigning the same weight to arrive at composite vulnerability.**a. Variables related to climate exposure and functional relationship**

Exposure is the nature and degree to which a system is exposed to climate change. Table 1 depicts the current and future climate exposure variables and also show their functional relationship to the vulnerability index of the districts/ regions. The literature review did not suggest any fixed/ discreet criteria for the selection of variables of exposure for assessing the vulnerability of any region or area. However, this study has largely used exposure variables from key reports such as UP-SAPCC and GIZ's framework for climate change vulnerability assessment.

Table 1 : Exposure indicators and their functional relationship

Indicators	Variables	Unit	Functional Relation	Baseline Period
Current Climate Exposure	Number of Heavy Precipitation Days (R10mm)	Days	Positive	1981-2010
	Extremely Wet Days (R99p)	mm	Positive	1981-2010
	Consecutive Dry Days (CDD)	Days	Positive	1981-2010
	Average JJAS Precipitation	mm	Negative	1981-2010
	Warm Days (TX90p)	Percentile	Positive	1981-2010
	Cool Nights (TN10p)	Percentile	Positive	1981-2010
	Percentage of Area Prone to Flood	Per cent	Positive	2019
	Coefficient of variation in Maximum Temperature	Coefficient of trend	Positive	1981-2010
	Coefficient of variation in Minimum Temperature	Coefficient of trend	Positive	1981-2010
Future Scenarios of Climate Exposure (RCP 4.5 & 8.5)	Changes in the number of heavy rainfall days of mid-century (2021-50) to Baseline	Days	Positive	1981-2010
	Change in Extremely wet days of Mid-Century (2021-50) to Baseline	mm	Positive	1981-2010
	Change in consecutive dry days of Mid-Century (2021-50) to Baseline	days	Positive	1981-2010

Indicators	Variables	Unit	Functional Relation	Baseline Period
Future Scenarios of Climate Exposure (RCP 4.5 & 8.5)	Changes in Monsoonal Rainfall in Mid-Century to baseline 4.5 and 8.5	mm	Negative	1981-2010
	Ratio of Mid Century (2021-50) to Baseline of Annual Max Temperature	°C	Positive	1981-2010
	Ratio of Mid-Century (2021-50) to Baseline of Annual Minimum Temperature	°C	Positive	1981-2010
	Changes in Warm Days of MidCentury (2021-50) to Baseline	% days	Positive	1981-2010
	Changes in Cool Nights of MidCentury (2021-50) to Baseline	% days	Positive	1981-2010

b. Variables related to sensitivity and functional relationship

Sensitivity is the degree to which a system is adversely affected by climate change. For sensitivity assessment, the following variables were considered (Table 2).

Table 2 : Sensitivity indicators and their functional relationship

Indicators	Variables	Unit	Functional	Baseline
Sensitivity	No of critical, semi-critical and over-exploited blocks in groundwater utilisation	Number	Positive	2017
	Percentage of barren and uncultivable land to the reporting area	%	Positive	2015-16
	Density of population in Sq. Km.	Ratio	Positive	2011
	Percentage of gross irrigated area to gross area sown	%	Negative	2015-16
	Percentage of child and old age population in the age group 0–6, and 65+	%	Positive	2011
Sensitivity	Percentage of landholding below 1 hectare	%	Positive	2011
	Dependency on agriculture sector	%	Positive	2011
	Multidimensional poverty index[2]	Index	Positive	2018

C. Variables related to Adaptive capacity with their functional relationship

Adaptive capacity is the capability of a production system or region to better adjust to climate change (IPCC, 2007). Adaptive capacity variables and their functional relationship have been given in Table 3.

Table 3 : Adaptive capacity indicators and their functional relationship

Indicators	Variables	Unit	Functional Relation	Baseline
Adaptive capacity	Crop diversity Index	Index	Negative	2017
	Percentage of net sown area to reporting area	%	Negative	2018-19
	Level of Urbanisation	%	Negative	2011
	% of population dependent on Non-farm activities	%	Negative	2011
	Total length of pucca roads per lakh population (in km) 2018-19	Km	Negative	2018-19
	Livestock development centre per lakh of livestock	Number	Negative	2018-19
	Per capita net domestic product in Rs. {at current prices} (base year 2011-12)	INR	Negative	2018-19
	Composite Index of Financial Inclusion	Index	Negative	2017
	Percentage of Forest coverage	%	Negative	2017
	Number of MSME per lakh population	Number	Negative	2016-17

Normalisation of variables datasets

Normalisation refers to the transformation of indicator values measured on different scales and in different units into unitless or dimensionless values on a common scale (Vincent, 2004; Varadan and Kumar, 2015; Kale et al., 2016; Kumar et al., 2016; Ponnusamy et al., 2016; Mahida and Sendhil, 2017; Sendhil et al., 2018). There are several methods of data normalisation. For this assessment, the variables are normalised by applying the Min-Max method. This method transforms all values

2 Multi-dimensional Poverty Index includes the contribution of deprivation of Health (Nutrition and Child Mortality), Education (Years of schooling and Child school attendance) and living standard facilities/ services (Cooking Fuel, Sanitation, Drinking water, Electricity, Housing and Assets)

into scores ranging from 0 to 1 by subtracting the minimum score and dividing it by the range of the indicator values. For the indicators having a positive functional relationship with their respective vulnerability index, the normalisation has been done with the following equation

$= X1 - X_{Min} / X_{Max} - X_{Min}$.....(1)

Where, X_1 Represents the individual data point to be transformed

X_{Min} The lowest value for that indicator

X_{Max} The highest value for that indicator and

X i,0 to 1 The new value we wish to calculate, i.e. the normalised data point within the range of 0 to 1.

On the other hand, if a negative functional relationship occurs, then the following equation is used for normalisation:

$Xi\ 0\ to\ 1 = X_{Max} - X_1 / X_{Ma}x - X_{Min}$.....(2)

Along with Composite Vulnerability Index, exposure, sensitivity and adaptive capacity indices are also calculated separately by using their variables (sub-indicators).

District-wise variables under each indicator (exposure, sensitivity or adaptive capacity) for each of the three scenarios (current, Future RCP 4.5 and RCP 8.5) are first normalised to calculate indicator-wise vulnerability scores. For this, the normalised score value of exposure, sensitivity and adaptive capacity of each district of the state is separately added. This added values of each indicator are divided by the number of variables in it to get the average value using the following equation:1. Exposure Index = ∑ 0-N of exposure variables / Number of variables of exposure

2. Sensitivity Index = ∑ 0-N of sensitivity variables / Number of variables of sensitivity
3. Adaptive capacity Index = ∑ 0-N of Adaptive capacity variables / Number of variables of Adaptive capacity

Cluster analysis for categorising districts

Based on the computed vulnerability index, the districts in Uttar Pradesh were categorised as high, moderate and low using mean and standard deviation (SD) norms[3]. The categorisation is as follows:

- High = Index > (Mean + 0.5 SD) ..... (3)
- Moderate = (Mean – 0.5 SD) < Index < (Mean + 0.5 SD) ..... (4)
- Low = Index < (Mean – 0.5 SD) ..... (5)

3 Ayyoob et al., 2013; Rana et al., 2015; Kale et al., 2016; Sendhil et al., 2018

Observations

The detailed analysis of the current scenario of Exposure, Sensitivity, Adaptive Capacity and Composite Vulnerability Index of all the 75 districts in UP are explained as below:

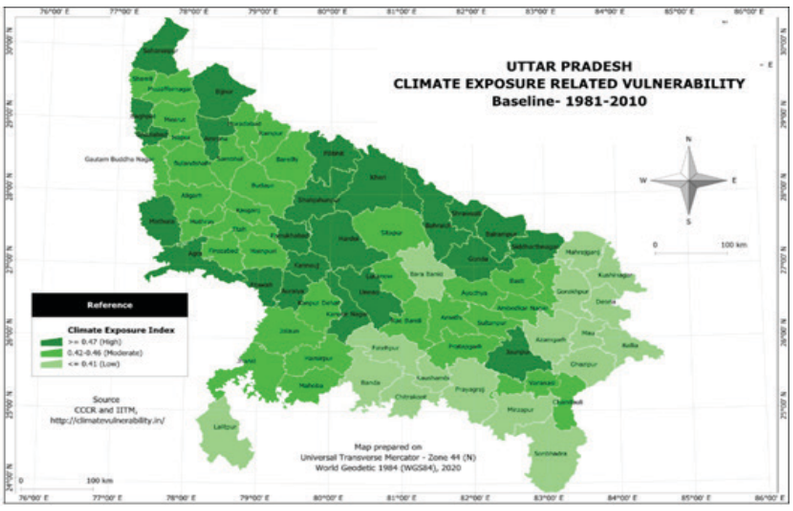
a. Exposure

The spatial pattern of climate exposure of current (baseline) and the future scenario (mid-century) for 75 districts of Uttar Pradesh was assessed under the scoping study through comprehensive data analysis (Annexure-1). In the following section, the baseline and future scenario of climate exposure and its spatial pattern are explicitly presented.

Baseline scenario

In the baseline scenario (1981-2010), the highest exposure is observed in Baghpat district (0.59), while the lowest is in Sonbhadra (0.27) with the mean index of 0.46 and SD of 0.06. A range (the difference between maximum index value and minimum index value) of 0.32 has been observed. 23 districts fall under high exposure, 35 districts in moderate exposure and only 17 districts are under the low exposure category (Fig-2). The regional exposure indicates explicitly that 8 districts in the Central Plains (Farukhabad, Kannauj, Etawah, Auraiya, Kheri, Hardoi, Unnao and Kanpur Nagar), 4 districts in the Bhabhar and Terai region (Saharanpur, Bijnor, Pilibhit and Sravasti), 4 districts of North-eastern Plains (Bahraich, Balrampur, Gonda and Siddharthnagar), 2 districts in Western Plains (Baghpat and Ghaziabad), 2 districts in Mid-western Plains (Amroha and Shajahanpur), 2 districts of South-western and semi-arid zone (Mathura and Agra) and one district in Eastern Plains (Jaunpur) agro-climatic zones of UP fall under the high exposure category. The reasons for the high exposure of the above mentioned districts is due to erratic temperature and precipitation and an increasing number of consecutive dry days. However, most of the districts in Bundelkhand, Vindhyan and Eastern plains come under less exposure because of good annual rainfall and little variations in maximum and minimum temperature.

Figure 2 : Climate exposure related vulnerability (Baseline 1981-2010)



These inferences of climate exposure of baseline data of the state were also corroborated with the most recent study of IMD conducted in 2020 over UP regarding rainfall variability and changes over the state (Guhathakurta et al, 2020). It is interesting to note that the inference which we draw from the analysis matches with the study of IMD.

Future Scenario

The projected meteorological risks due to climate change in 2050 (average of 2021-2050) over Uttar Pradesh using multi-model ensemble data in low emission (RCP 4.5) and high emission (RCP 8.5) scenario have been used to assess the level of future exposure of all the 75 districts in the mid-century period.

In the low emission scenario (RCP 4.5), the highest projected exposure index is of Rampur district while Maharajganj district is least exposed (Fig-3).

However, in a high emission scenario (RCP 8.5), the Sonbhadra district has high exposure (Fig-4) This may be due to factors like increasing minimum-maximum temperature, increasing consecutive dry days and decreasing annual rainfall in the district.

At the state level, the mean exposure index in mid-century (2050) is projected to increase to 0.47 in low emission scenario and 0.54 in high emission scenario from the current scenario (average of 1981-2010) of mean exposure index of 0.44.

Figure 3 : Climate exposure related vulnerability (Future Scenario RCP 4.5)

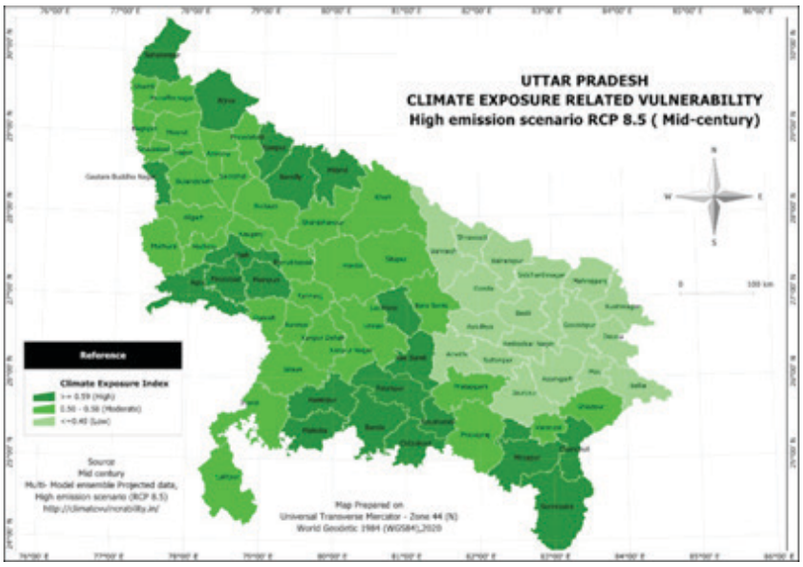
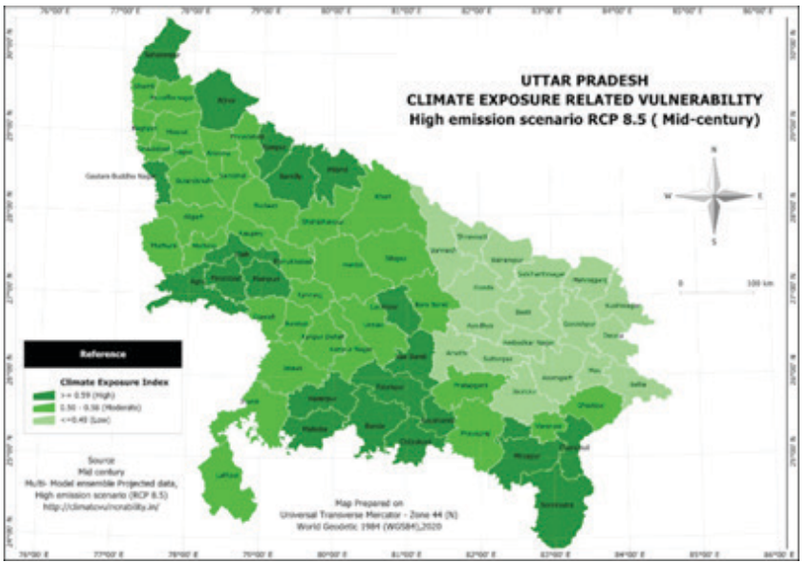


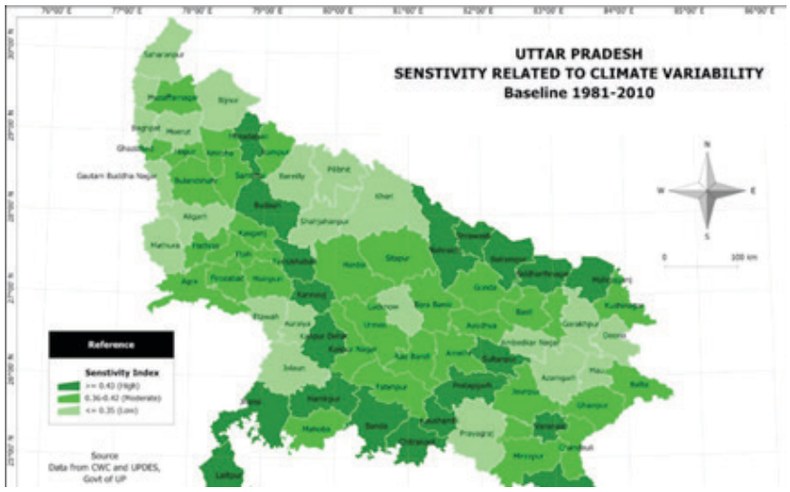
Figure 4 : Climate exposure related vulnerability (Future Scenario RCP 8.5)



b. Sensitivity

The Sensitivity index of 75 districts of Uttar Pradesh (Annexure-1) reveals that Chikrakoot bears the highest sensitivity (0.59) while Lucknow has the lowest Lucknow (0.24) with a mean index of 0.39 and SD of 0.07. (Fig-5) A high value of divergence of 0.35 has been found in sensitivity due to its wider range across various districts. 20 districts are categorised as highly sensitive, 33 districts as moderately sensitive and 22 districts as less sensitive. About 70.6 per cent districts of the state from the nine agro-climatic regions fall under high to moderate sensitivity. The reason could be due to cumulative effects of several sub-indicators including, a higher number of districts falling under critical or overexploitation of groundwater resources, a higher percentage of barren and uncultivated land, less irrigated areas, large proportion of the vulnerable population, a large proportion of the population having smaller landholding size (below 1 hectare), higher dependency on agriculture and most important the high index of multidimensional poverty index. Conversely, many districts in the Western and Central Plain zone and few districts of Mid-Western Plain, Eastern plain and North-eastern plain are less sensitive due to lower values of the sub-indicators. It is also evident that the highly sensitive districts like Farrukhabad, Kannauj, Bahraich, Shravasti, Balrampur and Siddharthnagar are also identified under the high exposure category. Hence, remedial measures must be taken to reduce the exposure and sensitivity of the regions. However, districts like Prayagraj, Gorakhpur, Deoria, Azamgarh and Mau, are classified under both less exposure and less sensitive category, which is a good indication.

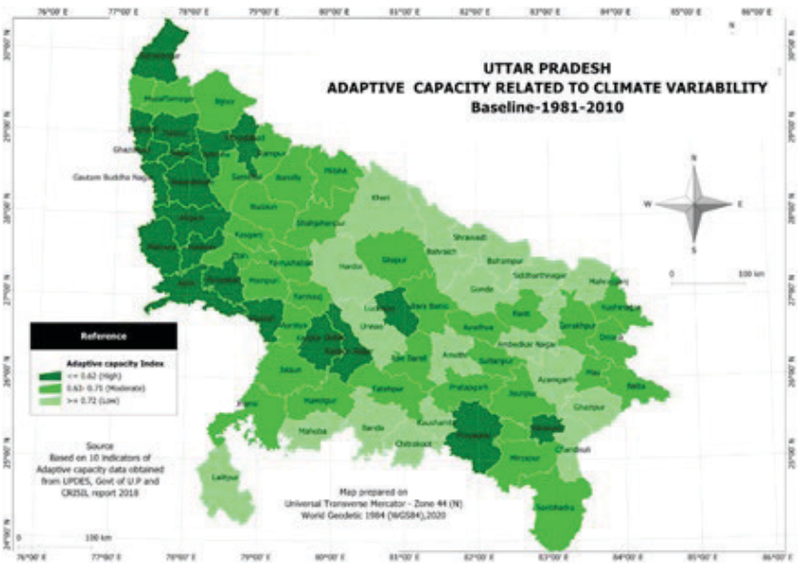
Figure 5 : Sensitivity related to climate variability



c. Adaptive Capacity

The Adaptive Capacity index for 75 districts of Uttar Pradesh is as shown in (Annexure-1). The highest adaptive capacity is found in Gautam Buddha Nagar (0.37), while the lowest was observed in the Shravasti district (0.84) with a mean index of 0.67 and SD of 0.09. 20 districts are identified as having high adaptive capacity, 35 districts as moderately adaptive and 20 districts possess the low adaptive capacity to respond to climate change impacts. The districts in Western Plain, Southwestern semi-arid zone and Central Plain zones have come under high adaptive capacity (Fig-6). The reason may be higher net sown areas, higher level of urbanisation, a large proportion of the population engaged in non-farm activities, high net domestic product higher composite index of financial inclusion and presence of a large number of MSMEs. However, many districts in Bundelkhand, North-eastern Plain and Eastern Plain zones are in low adaptive capacity due to lower values of the above factors.

Figure 6 : Adaptive capacity related to climate variability



d. Composite Vulnerability Index (CVI)

The Composite Vulnerability Index of all the 75 districts of the state is derived from the summation of normalised scores of exposure, sensitivity and adaptive capacity variables, divided by the total number of variables. In the current scenario, a divergence (0.20) in CVI magnitude with a mean index of 0.52 and SD of 0.04 is noted.

The Lowest vulnerability is observed in Lucknow (0.40), followed by Gautam Buddha Nagar (0.41) and Meerut (0.43), while it is highest in Chitrakoot (0.60), followed by Bahraich (0.59), Shravasti (0.59) and Siddharthnagar (0.59) and Badayun (0.58).

Moderate vulnerability is observed in 28 districts. About 27 districts are categorised as highly vulnerable to climate risk; 28 districts as moderately vulnerable; and, 20 districts less vulnerable. The highest potential impact indicated through the sum of values of exposure and sensitivity is observed in Chitrakoot (1.02), followed by Jhansi (1.00), Kannauj (0.99) and Farrukhabad (0.98), while the potential impact was lowest in Kushinagar (0.66), followed by Deoria (0.67) and Lucknow (0.70). The lowest vulnerability in Kushinagar, Deoria and Lucknow are mainly due to its less exposure combined with less sensitivity. Chitrakoot district leads the vulnerability score owing to its highest sensitivity index (0.59) and low adaptive capacity (0.79) despite its low exposure index (0.43) (Fig-7).

In future (low emission scenario-RCP 4.5) (Annexure-2), the state average CVI is projected to increase to 0.53 due to increasing exposure index. The divergence between the highest CVI index and lowest CVI index increases from 0.20 to 0.24 from the baseline (average of 1985-2010) to the mid-century (average of 2021-2050) (Fig-8).

Figure 7 : Composite Vulnerability Index (Baseline – 1981-2010)

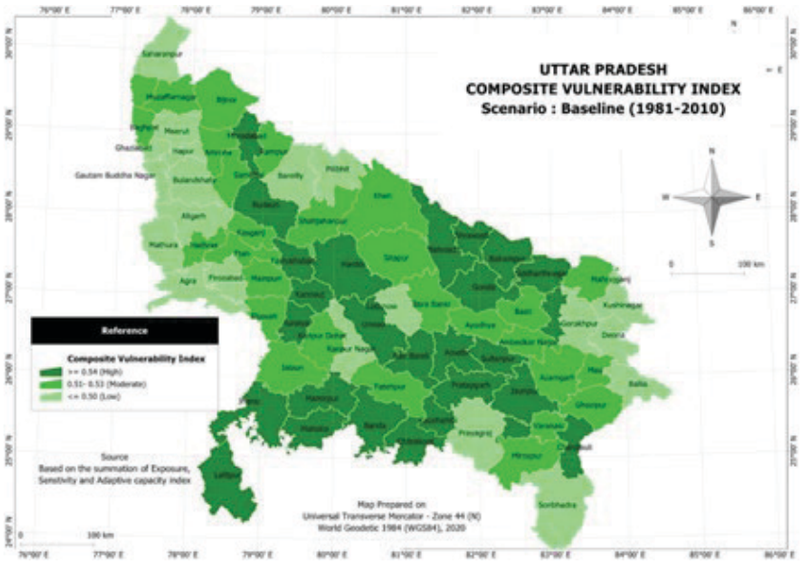
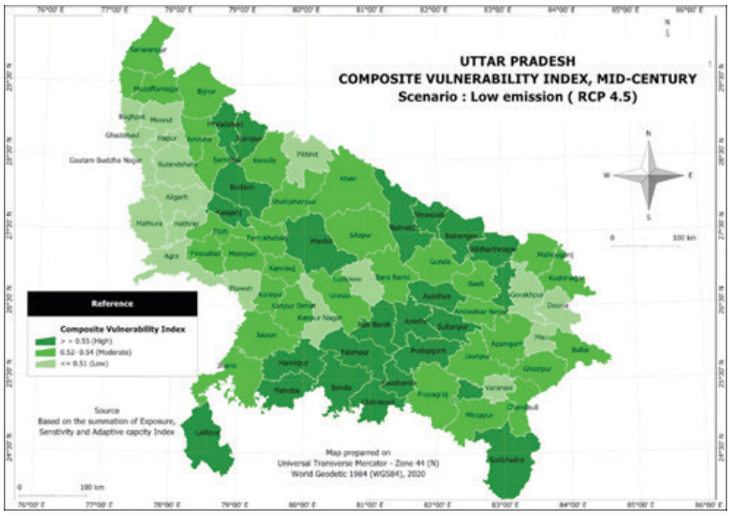
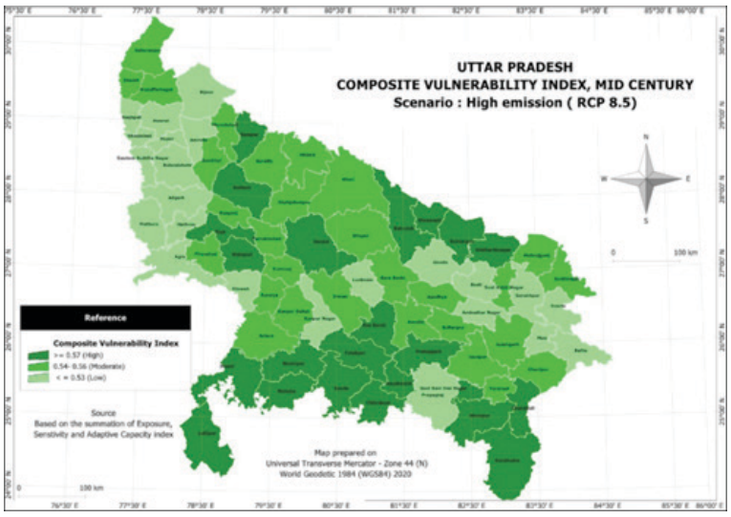


Fig-8: Composite Vulnerability Index (Mid-Century, RCP 4.5)



The analysis of indicators in high emission scenarios (RCP 8.5) (Annexure-3) shows the increase in climatic exposure risk which can increase the vulnerability of the districts. In the high emission scenario, the state average CVI index is projected to increase to 0.55. Exposure index increases from 0.46 (current scenario) to 0.54 (Mid-century) (Fig-9).

Figure 9 : Composite Vulnerability Index (Mid-Century, RCP 8.5)



d. Most Vulnerable Agro-Climatic Regions in all three climate scenarios

In all three climate scenarios (current, future-RCP 4.5 and future- RCP 8.5), the districts whose CVI is greater than or equal to the average CVI of that scenario are marked. For example, in the current scenario, the average CVI index is 0.53. So out of 75 districts, 29 districts are marked whose CVI value is greater or equal to the state CVI of 0.53.

Subsequently, the proportion of total areas of all the marked districts in each region to the area of the region is computed. For ranking the zones, we considered the values of the proportions thus calculated for each scenario.

Table 4 : Prioritisation of vulnerable agro climate zones of Uttar Pradesh to climate risks

S. No	Agro Climate Zones	Total Area_ ACZ	No of districts	No of districts with CVI >=0.53	% of districts	Area of vulnerable zones	% of vulnerable area to total reporting area	No of districts with CVI >= 0.54	% of districts	Area of vulnerable zones	% of vulnerable area to total reporting area	No of districts with CVI> =0.56	CVI> =0.56 % of districts	Area of vulnerable zones	% of vulnerable area to total reporting area
1	Western plain zone	16584	8	0	0	0	0	2	25	5071	30.58	0	0	0	0
2	Mid western plain	24463	7	2	28.57	8886	36.32	4	57.14	13706	56.03	4	57.14	15641	63.94
3	Central Plain zone	57294	15	7	46.67	30020	52.4	6	40	26387	46.06	8	53.33	33038	57.66
4	Bundelkhad	31297	7	6	85.71	26732	85.41	6	85.71	26732	85.41	6	85.71	26732	85.41
5	Eastern Plain zone	41563	14	7	50	21151	50.89	4	28.57	14572	35.06	4	28.57	10650	25.62
6	North eastern Plain zone	31536	10	6	60	20082	63.68	4	40	13127	41.63	3	30	11481	36.41
7	Bhabhar and Tarai	13576	4	1	25	1640	12.08	1	25	1640	12.08	1	25	1640	12.08
8	South Arid zone	22424	8	0	0	0	0	1	12.5	1955	8.72	3	37.5	7146	31.87
9	Vindhayan	11310	2	0	0	0	0	1	50	6905	61.05	2	100	11310	100

As it can be seen from above Table-4, in all the three climate scenarios (current, future-RCP 4.5 and future- RCP 8.5), the Bundelkhand region is the most vulnerable agro-climatic region in terms of climatic exposure, sensitivity and adaptive capacity. Its six out of the seven districts are found above the average CVI.

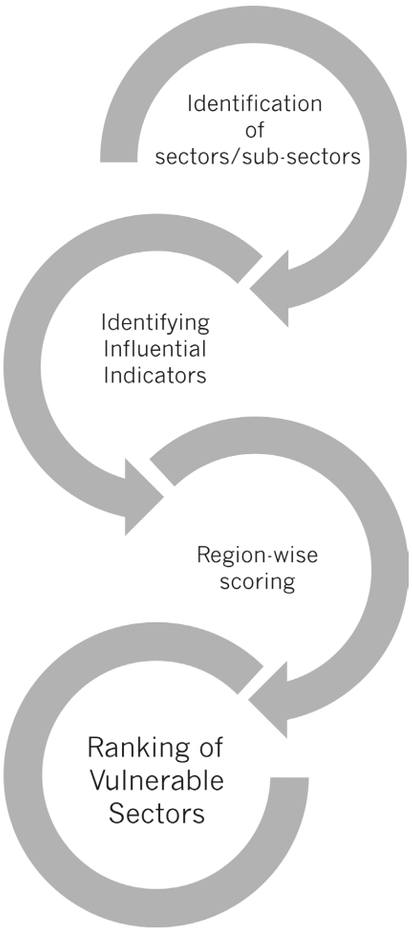
- The next two most vulnerable agro-climatic regions (as per the extent of vulnerable areas and a number of districts above the state's average CVI) are North-eastern Plain in the current scenario and the Vindhyan region in the projected climate change scenario of both RCP 4.5 and RCP 8.5.
- These three agro-climatic regions have high exposure and high sensitivity indices along with inadequate adaptive capacity. Conversely, the districts in Western Plain, South-western semi-arid zone and Bhabhar and Terai region (excluding Shravasti district) are less vulnerable.
- The Mid-western region, Eastern region and Central region is moderately vulnerable.

6 Identification of Priority Sectors

The analysis of current and future climate exposure with respect to sensitivity and adaptive capacity[4] of the state indicates that climate change will challenge the available resources and further impact rural livelihoods in Uttar Pradesh. It becomes imperative to understand and prioritise various sectors that are most impacted by climate change at the state level for devising appropriate climate actions. This assessment has a component to develop a systematic methodology for identifying the key vulnerable sectors from the perspective of climate change risks in the identified vulnerable regions.

Methodology

As in the previous section, the Bundelkhand, Vindhyan and North-eastern Plains regions are the most vulnerable agro climatic regions in Uttar Pradesh. The process adopted for prioritising the vulnerable sectors impacted by climate change and that need urgent adaptation measures is as below:



Step 1 : Identification of sectors and sub-sectors

As the first step for identifying priority sectors in Uttar Pradesh, the State Action Plan on Climate Change (SAPCC) was referred. The UP State Action Plan on Climate Change (SAPCC) has formulated an 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, and has covered 93 priorities under these missions.

Various sectors and sub-sectors mentioned under different Missions of the SAPCC were mapped and a total of 15 sectors and sub-sectors, which are directly relevant to the missions, are identified in Table-5. Besides this, we considered the suggestions from the Directorate of Environment and GIZ on the priority sectors from the perspective of priority and ease of implementing government programmes:

4 Sensitivity and adaptive capacity are not modelled for the future (Mid-century)

Table 5 : SAPCC Missions and sectors/sub-sectors

SAPCC Missions	Identified Sectors/Sub-sectors
Sustainable Agriculture	Agriculture
Sustainable Agriculture	Horticulture
Sustainable Agriculture	Fisheries
Sustainable Agriculture	Animal Husbandry
Sustainable Agriculture	Land development and soil management
Jal Mission	Groundwater
Jal Mission	Irrigation
Jal Mission	Surface water (Rivers, Wetlands)
Solar Energy	Energy
Green UP	Forest
Other Relevant Sectors	Nutrition
Other Relevant Sectors	Health
Other Relevant Sectors	Sanitation
Other Relevant Sectors	Education
Cross cutting sector	Disaster Risk

Step 2 : Identifying influential indicators

As mentioned above that a total of 26 indicators were used to analyse the vulnerability of the region. However, these indicators do not necessarily have equal influence on the respective vulnerability component (Exposure, Sensitivity and Adaptive Capacity) or overall vulnerability of the districts and region. Some of these indicators are playing a more important role in increasing the vulnerability of the area while some are less. Therefore, to understand the contribution of each indicator, an attempt has been made to quantify the value of each indicator in determining the value of the composite vulnerability Index.

After this analysis, to understand the functional relationship with the identified sectors, only those indicators were selected whose value is greater than the average value of all the indices in the district. Using the example of Sonbhadra and Mirzapur district of Vindhayan region, the quantification of influential indicators (marked in red) using statistical analysis is depicted in the table below:

Table 6 : Contribution of variables in determining vulnerability of the Vindhayan region

Average	3.85	3.84	3.85
No of MSME per lakh of population	7.39	8.03	7.71
Percentage of Forest coverage (2017	3.81	0.00	1.90
Composit index of Financial Inclusion 2017	4.64	4.41	4.53
Per capitanet domestic product in Rs. {at current prices}(base year 2011-12)	7.24	7.49	7.36
livestock development centre per lakh of livetock	5.42	7.21	6.31
Total length of pucca roads per lakh population (in km) 2018-19	3.89	0.00	1.94
% of population dependent on Non farm activities	4.73	6.62	5.67
Level of Urbanisation (In %) 2011	6.49	6.65	6.57
Percentage of net sown area to reporting area	5.06	8.06	6.56
Crop Siversity	3.63	1.11	2.37
Multidimen sion poverty index 2018	3.13	4.25	3.69
Dependency on agriculture secor in % 2011	4.73	6.62	5.67
Percentage of land holding below 1 hectare	4.75	3.36	4.05
Percentage of child and old age population in the age group 0–6, and + 65	2.59	2.91	2.75
Percentage of gross Irrigated areas to gross area sown 2015-16	3.26	7.44	5.35
Density of Population in sq Km	0.65	0.06	0.36
Percentage of barren and uncultivable land to reporting area 2015-16	2.10	2.40	2.25
No of critrical, semicritical and over expolited block in ground water utilisation	0.94	5.58	3.26
Coeeficient of Variation in Mini Temperature	1.18	0.97	1.08
Coeeficient of Variation in Max Temperature	2.30	2.19	2.25
Percentage of area prone to Flood (In %)	1.31	0.00	0.66
Percentrage of Cool night (1981-2010) (% days)	3.00	1.61	2.31
Percentage of Warmdays 1981-2010) (% days)	4.51	0.00	2.25
No of Consecutive dry days (1981-2010) (in adays)	5.56	4.37	4.97
Extremely wet days (1981-2010) in mm	3.24	2.93	3.08
Number of heavy rainfall days (1981-2010) (in days	4.46	5.34	4.90
District	Mirzapur	Sonbhadra	
Agro Climatic Region	Vindhyan Zone	Vindhyan Zone	

From the above table, it is clear that the 13 indicators like No. of heavy rainfall days (4.90%), No of consecutive dry days (4.97%), percentage of gross irrigated areas to gross area sown (5.36%), percentage of landholding below 1 hectare (4.05%), dependency on agriculture sector (5.67%), percentage of net sown area to reporting area(6.56%), level of urbanisation (6.57%), percentage of population dependent on non-farm activities (5.67%), number of livestock development centre per lakh of livestock population (6.31%), per capita net domestic product (7.36%), a composite index of financial inclusion (4.53%) and number of MSME per lakh of the population (7.31%) have a higher value than the district average (3.85) in the Vindhyan region. This means these indicators are playing important role in aggravating the vulnerability of the region and influencing the performance of sectors existing in the region. The same process of identifying key indicators was adopted in Bundelkhand and Northeastern plain region and 14 key indicators were identified. The region and vulnerable component-wise key indicators are given in table-7:

Table 7 : Region-wise variable which has higher contribution in Composite vulnerability index

Region	Exposure	Sensitivity	Adaptive Capacity
Bundelkhand	No of Consecutive dry days	Percentage of landholding below 1 hectare No of critical, semi critical and over-exploited block in groundwater utilisation Percentage of net sown area to reporting area Percentage of gross Irrigated areas to gross area sown Percentage dependency on the agriculture sector	Level of Urbanisation (In %) 2011 % of population dependent on Non-farm activities Per capita net domestic product in Rs. {at current prices} (base year) Composite index of Financial Inclusion Percentage of forest coverage Total length of pucca roads per lakh population (in km Livestock development centre per lakh of livestock No of MSME per lakh population
Vindhyan	No. of heavy rainfall days in days No. of Consecutive dry days	Percentage of landholding below 1 hectare No of critical, semi critical and over-exploited block in groundwater utilisation Percentage of net sown area to reporting area Percentage of gross Irrigated areas to gross area sown Percentage dependency on the agriculture sector	Level of Urbanisation (In %) 2011 % of population dependent on Non-farm activities Per capita net domestic product in Rs. {at current prices} (base year) Composite index of Financial Inclusion Livestock development centre per lakh of livestock No of MSME per lakh population

Region	Exposure	Sensitivity	Adaptive Capacity
Northeastern Plain	No. of heavy rainfall days in days Extremely wet days Percentage of Warm days	Percentage of landholding below 1 hectare Percentage de pendency on the agriculture sector	Level of Urbanisation (In %) 2011 % of population dependent on Non-farm activities Per capita net domestic product in INR. {at current prices} (base year) Composite index of Financial Inclusion Crop diversity Percentage of forest coverage Total length of pucca roads per lakh population (in km) Livestock development centre per lakh of livestock No of MSME per lakh population

Step 3 : Region-wise scoring

The 18 vulnerability indicators selected as above were considered for analysing sector vulnerabilities. Through sectoral expert consultations, in each identified vulnerable agro-climatic region, a scoring method was adopted to allocate scores to the sector which either had a direct impact on the vulnerability indicators on them or did not have a direct impact. The vulnerability indicators directly contributing to the sector were rated as 1 and those notdirectly related were rated as 0 to establish functional relationship[5] between identified sectors and key indicators, which are responsible for increasing the vulnerability of the region. For instance, in the Bundelkhand region, the indicator on the number of consecutive dry days has a direct bearing on agriculture and hence is scored as 1 whereas the percentage of the level of urbanisation does not have a direct impact on agriculture and hence, it was scored as 0. This helped in evolving a matrix ranking the most vulnerable sectors by region.

The understanding of the direct relationship between sectors and indicators was developed based on the observations in different Missions of SAPCC.

Step 4 : Ranking of vulnerable sectors

The derived scores were aggregated and using statistical tools the most vulnerable sectors were ranked in different agro-climatic zones.

5 The technical term is used to analyse and symbolise a relationship between variables. It indicates how the value of the dependent variable depends on the value of independent or other variables.

Region-wise Observations

The concept of vulnerability is relative and dynamic. It varies with place and time. From the matrix analysis it can be noted that 13 and 12 indicator-set of Exposure, Sensitivity and Adaptive Capacity are directly relevant to the key sectors in Bundelkhand and North Eastern Plain regions, and the Vindhyan region, respectively.

Table 8 : Priority Sectors in Bundelkhand Region

S.No	SAPCC Mission	Sectors	No of Consecutive dry days (indays)	Percentageof land	No of critrical, semi	Percentage of gross	Dependency on agriculture secor in%	Level of Urbanisation (In%) 2011	% of population	Per capita net	Composit in	Percentage of Forest coverage	Total length of pucca	Livestock	Number of MSME per lakh population	Total	Priority Sectors
1	"Sustainable Agriculture Mission"	Agriculture	1	1	1	1	1	0	0	1	1	0	0	0	1	8	"Agriculture and allied (animal husbandry, horticulture)"
6	"Sustainable Agriculture Mission"	Horticulture	1	1	1	1	1	0	0	1	1	0	0	0	1	8	
16	"Cross cutting sector"	Disaster Risk	1	1	1	1	1	0	0	1	1	0	1	0	0	8	"Disaster Management"
4	"Sustainable Agriculture Mission"	"Animal Husbandry"	1	1	0	0	1	0	0	1	1	1	0	1	0	7	
9	"Jal Mission"	Groundwater	1	0	1	1	1	1	0	0	0	1	0	0	0	6	"Water Resources (including irrigation)"

S.No	SAPCC Mission	Sectors	No of Consecutive dry days (indays)	Percentageof land	No of critrical, semi	Percentage of gross	Dependency on agriculture secor in%	Level of Urbanisation (In%) 2011	% of population	Per capita net	Composit in	Percentage of Forest coverage	Total length of pucca	Livestock	Number of MSME per lakh population	Total	Priority Sectors
7	"Solar Energy Mission"	Energy	1	0	1	1	0	0	1	1	0	0	0	0	1	6	
11	Jal Mission	Irrigation	1	0	1	1	1	0	0	1	0	0	0	0	0	5	
13	"Other Relevant Sectors"	Nutrition	1	1	0	1	1	0	0	1	0	0	0	0	0	5	
12	"Other Relevant Sectors"	Health	1	0	0	0	0	1	0	1	1	0	1	0	0	5	
10	Jal Mission	"Surface water Rivers, Wetlands)"	1	0	1	1	1	0	0	0	0	0	0	0	0	4	
8	"Green UP Mission"	Forest	1	0	0	0	0	0	1	1	0	1	0	0	0	4	

S.No	SAPCC Mission	Sectors	No of Consecutive dry days (indays)	Percentageof land	No of critrical, semi	Percentage of gross	Dependency on agriculture secor in%	Level of Urbanisation (In%) 2011	% of population	Per capita net	Composit in	Percentage of Forest coverage	Total length of pucca	Livestock	Number of MSME per lakh population	Total	Priority Sectors
14	"Other Relevant Sectors"	Sanitation	0	0	1	0	0	1	0	1	0	0	0	0	0	3	
15	"Other Relevant Sectors	Education	0	0	0	0	0	1	0	1	0	0	1	0	0	3	
5	"Sustainable Agriculture Mission"	Fisheries	1	0	0	0	0	0	0	1	1	0	0	0	0	3	
3	"Sustainable Agriculture Mission"	Land development and soil management	1	0	0	0	1	0	0	0	0	0	0	0	0	2	

Table 9: Priority Sectors in Vindhyan Region

S.No	SAPCC Mission	Sectors	Number of heavy rain fall day sindays	No of Consecutive dry days (indays)	Percentage of land holding below1 hectare	Percentage of net sown area to reporting area	Percentage of gross Irrigated areas to gross area sown	Dependency on agriculture secorin%	Level of Urbanisation (In%)2011	% of population dependent on Non farm activities	Per capita net domestic productin Rs.{atcurrentprices}(baseyear	Composit index of Financial Inclusion	Livestock development centre per lakh of live tock	Number of MSME per lakh population Total Priority Sectors	Total	Priority Sectors
1	Sustainable Agriculture Mission	Agriculture	1	1	1	1	1	1	0	0	1	1	0	1	9	Agriculture and allied (animal husbandry, horticulture)
6	Sustainable Agriculture Mission	Horticulture	1	1	1	1	1	1	0	0	1	1	0	1	9	
16	Cross cutting sector	Disaster Risk	1	1	1	1	1	1	0	0	1	1	0	0	8	Disaster Management
9	Jal Mission	Groundwater	1	1	0	1	1	1	1	0	0	0	0	0	6	Water Resources (Groundwater + Surface Water) - including irrigation

S.No	SAPCC Mission	Sectors	Number of heavy rain fall day sindays	No of Consecutive dry days (indays)	Percentage of land holding below1 hectare	Percentage of net sown area to reporting area	Percentage of gross Irrigated areas to gross area sown	Dependency on agriculture secorin%	Level of Urbanisation (In%)2011	% of population dependent on Non farm activities	Per capita net domestic productin Rs.{atcurrentprices}(baseyear	Composit index of Financial Inclusion	Livestock development centre per lakh of live tock	Number of MSME per lakh population Total Priority Sectors	Total	Priority Sectors
11	Jal Mission	Irrigation	1	1	0	1	1	1	0	0	1	0	0	0	6	
4	Sustainable Agriculture Mission	Animal Husbandry	0	1	1	0	0	1	0	0	1	1	1	0	6	
7	Solar Energy Mission	Energy	0	1	0	0	1	0	1	1	1	0	0	1	6	
13	Other Relevant Sectors	Nutrition	0	1	1	1	1	1	0	0	1	0	0	0	6	
10	Jal Mission	Surface water (Rivers, Wetlands)	1	1	0	0	1	1	0	0	0	0	0	0	4	

S.No	SAPCC Mission	Sectors	Number of heavy rain fall day sindays	No of Consecutive dry days (indays)	Percentage of land holding below1 hectare	Percentage of net sown area to reporting area	Percentage of gross Irrigated areas to gross area sown	Dependency on agriculture secorin%	Level of Urbanisation (In%)2011	% of population dependent on Non farm activities	Per capita net domestic productin Rs.{atcurrentprices}(baseyear	Composit index of Financial Inclusion	Livestock development centre per lakh of live tock	Number of MSME per lakh population Total Priority Sectors	Total	Priority Sectors
3	Sustainable Agriculture Mission	Land development and soil management	1	1	0	1	0	1	0	0	0	0	0	0	4	
12	Other Relevant Sectors	Health	0	1	0	0	0	0	1	0	1	1	0	0	4	
8	Green UP Mission	Forest	0	1	0	0	0	0	0	1	1	0	0	0	3	
14	Other Relevant Sectors	Sanitation	1	0	0	0	0	0	1	0	1	0	0	0	3	
15	Other Relevant Sectors	Education	1	0	0	0	0	0	1	0	1	0	0	0	3	
5	Sustainable	Fisheries	0	1	0	0	0	0	0	0	1	1	0	0	3	

Table 10 : Priority Sectors in North-eastern Plain Region

S.No	SAPCC Mission	Sectors	Number of heavy rain fall days indays	Extremely wet days	Percentage of Warm days% days)	Percentage of land holding below 1 hectare	Dependency on agriculture secor in %	Level of Urbanisation (In%) 2011	% of population dependent on Non farm activities	Per capita net domestic productin Rs.(at current prices)(baseyear	Composite index of Financial Inclusion	Crop diversity	Percentage of Forest coverage	Total length of puccaroads per lakh population (in km)	Number of MSME per lakh population Total Priority Sectors	Total	Priority Sectors
1	Sustainable Agriculture Mission	Agriculture	1	1	1	1	1	0	0	1	1	1	0	0	1	9	Agriculture and allied (animal husbandry, horticulture)
6	Sustainable Agriculture Mission	Horticulture	1	1	1	1	1	0	0	1	1	1	0	0	1	9	
16	Cross cutting sector	Disaster Risk	1	1	1	1	1	0	0	1	1	1	0	1	0	9	Disaster Management
9	Jal Mission	Groundwater	1	1	1	0	1	1	0	0	0	0	1	0	0	6	Water Resources (Groundwater + Surface Water) - including irrigation

S.No	SAPCC Mission	Sectors	Number of heavy rain fall days indays	Extremely wet days	Percentage of Warm days% days)	Percentage of land holding below 1 hectare	Dependency on agriculture secor in %	Level of Urbanisation (In%) 2011	% of population dependent on Non farm activities	Per capita net domestic productin Rs.{at current prices}(baseyear	Composite index of Financial Inclusion	Crop diversity	Percentage of Forest coverage	Total length of puccaroads per lakh population (in km)	Number of MSME per lakh population Total Priority Sectors	Total	Priority Sectors
11	Jal Mission	Irrigation	1	1	1	0	1	0	0	1	0	1	0	0	0	6	
4	Sustainable Agriculture Mission	Animal Husbandry	0	0	1	1	1	0	0	1	1	0	1	0	0	6	
7	Solar Energy Mission	Energy	0	0	1	0	0	1	1	1	0	0	0	0	1	5	
10	Jal Mission	Surface	1	1	1	0	1	0	0	0	0	1	0	0	0	5	
12	Other Relevant Sectors	Health	0	0	1	0	0	1	0	1	1	0	0	1	0	5	
15	Other Relevant Sectors	Education	1	0	1	0	0	1	0	1	0	0	0	1	0	5	

S.No	SAPCC Mission	Sectors	Number of heavy rain fall days indays	Extremely wet days	Percentage of Warm days% days)	Percentage of land holding below 1 hectare	Dependency on agriculture secor in %	Level of Urbanisation (In%) 2011	% of population dependent on Non farm activities	Per capita net domestic productin Rs.{at current prices}(baseyear	Composite index of Financial Inclusion	Crop diversity	Percentage of Forest coverage	Total length of puccaroads per lakh population (in km)	Number of MSME per lakh population Total Priority Sectors	Total	Priority Sectors
13	Other Relevant Sectors	Nutrition	0	0	0	1	1	0	0	1	0	1	0	0	0	4	
3	Sustainable Agriculture Mission	Land development and soil management	1	1	0	0	1	0	0	0	0	1	0	0	0	4	
8	Green UP Mission	Forest	0	0	1	0	0	0	1	1	0	0	1	0	0	4	
14	Other Relevant Sectors	Sanitation	1	1	0	0	0	1	0	1	0	0	0	0	0	4	
5	Sustainable Agriculture Mission	Fisheries	0	0	1	0	0	0	0	1	1	0	0	0	0	3	

The priority sectors identified are:

Bundelkhand

The increasing numbers of consecutive dry days, depleting groundwater table, low percentage of irrigated areas to the gross sown area, low urbanisation rate, higher dependency on agriculture, poor financial inclusion index are the key factors for making this region most vulnerable in the state. The matrix analysis of sectoral vulnerability (Table-8) in the Bundelkhand region clearly shows that Agriculture, Disaster Management and the Water Resources sector are majorly impacted by climate change and need urgent attention. Horticulture and Animal Husbandry sectors also emerged as vulnerable sectors in the region. Both these sectors are closely linked with agriculture as allied activities so these were clubbed under Agriculture and Allied activities. Due to changes in the rainfall pattern and increasing, maximum temperature Irrigation systems in the region are severely impacted and thus emerged as an important vulnerable sector. Since the water resources sectors was prioritised as one of the most vulnerable sector in the region so the irrigation sector was merged with Water Resources.

Bundelkhand and **Vindhyan** region's have similar agro-climatic characteristics and hence, the climate change impacts on the priority sectors – agriculture, water resources and disaster management in these two regions are also not different. Marked by being water-stressed with scanty rainfall and low groundwater recharge, both the regions suffer from droughts, hitting the agriculture sector the hardest. High evapotranspiration due to the increase in temperature leads to an increase in aridity index-which ultimately impacts the water availability adversely. The declining trend in rainfall leads to an increase in migration, public adversities and bad agricultural growth. Not only the decrease in the amount of rainfall is observed but there the number of rainy days have also significantly decreased in the regions which urgently calls for efficient irrigation practices. The increase in dry spells has adversely impacted the soil quality in the regions. (Source: Regional Expert Consultations in Bundelkhand and Vindhyan regions)

Vindhyan Region

In the Vindhyan region too, due to climate change impacts, the region is experiencing drought and floods both due to the increasing trend of heavy rainfall episodes in a short period and increasing dry spells during the monsoons. Both these factors have affected rural livelihoods and the resources utilisation pattern in the region, harshly. The changes in future projections of the rainfall pattern (more dry days and erratic rainfall) and the increasing maximum and minimum temperature, show up prominently. Altogether, increasing climate exposure and higher dependency on agriculture, poor irrigation systems and low levels of urbanisation, etc. Have further exacerbated the vulnerability of the region. Thus, from the sector vulnerability analysis (Table-9), Agriculture, Disaster Management and Water Resources were identified as major sectors impacted by climate change which needs to be taken on a priority for planning climate interventions. Horticulture and Animal Husbandry were also identified as vulnerable sectors which were clubbed under Agriculture and Allied activities. Irrigation also emerged as one of climate affected sectors which was clubbed with the Water Resources portfolio which included surface and groundwater and irrigation. Irrigation also emerged as one of climate affected sector which was clubbed with the Water Resources portfolio which included surface and groundwater and irrigation.

North-eastern Plains

This region is prone to recurrent floods and is highly dependent on the agriculture sector. The sectoral analysis (Table-10) in the North-eastern Plains identified Agriculture and Horticulture as the most vulnerable sectors which were clubbed under Agriculture and Allied activities including Horticulture and Animal Husbandry. Disaster Management was another sector that emerged in this region which needed priority attention. The third affected sector was Water Resources – including irrigation which was impacted by climate change and requires needed interventions.

The average rainfall in the North-eastern Plain region has not changed much in the recent years, however, untimely and uneven rainfall pattern has resulted in acute waterlogging and flooding situations. This has resulted in agricultural losses and impact on livelihoods of small marginal and woman farmers in the region. Due to high water table in the region, groundwater contamination occurs leading to adverse health impacts. (Source: Regional Expert Consultations in North-eastern Plain region)

To sum up, the three priority sectors identified in the vulnerable agro climatic regions are:

- Agriculture and Allied Sectors (Agriculture, Horticulture and Animal Husbandry)
- Water Resources (Groundwater, Surface water and Irrigation)
- Disaster Management (cross-sectoral in nature)

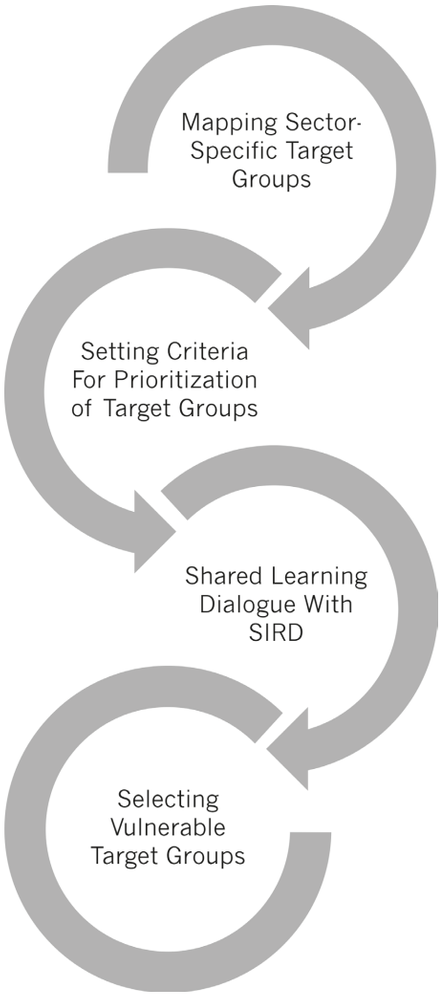
7 Identification of Vulnerable Target Groups & Intermediary Organisations

Climate change poses disproportionate risks to human systems due to differences in vulnerability and exposure. People who are socially, economically, culturally, politically, institutionally, or otherwise marginalised are especially vulnerable to climate change (IPCC, 2014). The rural poor and marginalised communities especially women, within these communities, have limited adaptive capacity due to their social and economic status, thereby making them more vulnerable than other members of the society.

Top down and model driven climate adaptation assessments focus on vulnerable systems exposed to climate hazards. However, it does not provide the needed information to identify vulnerable groups and communities for a specific region. Additional considerations are therefore required to identify key vulnerable groups and communities and prioritise them in adaptation planning and implementation. Once the vulnerable target groups have been identified, it becomes easier to make specific recommendations and identify priorities for the adaptation plans, frameworks and institutional arrangements.

Methodology

Methodologically, under the scoping assessment, the identification of specific target groups and the related intermediary organisations involved the following steps:



1. Mapping sector-specific target groups

In the identified priority sectors/sub-sectors (specifically, Agriculture and allied, Water Resources and Disaster Management) in all the three vulnerable regions, the anecdotal evidence of climate change impacts at the local level experienced by the vulnerable groups and communities are mapped in regional consultations and Shared Learning Dialogues, including women's groups as they have limited rights against more responsibilities and are most often differentially impacted by climate change. These identified groups are presented in table 11 below:

Table 11 : Mapping target groups

Identified Vulnerable Sectors	Sub-Sectors	Vulnerable Community Groups
Agriculture and Allied Disaster Management (Hydro-Met) Water Resources	Animal Husbandry	Cattle Rearers
	Agro-Forestry	Farmers in Agro-Forestry
Agriculture and Allied Disaster Management (Hydro-Met) Water Resources	Aromatic and Medicinal Plants	Entrepreneurs/Farmers in Aromatic and Medicinal Plants growing
	Horticulture (Vegetable Cultivation) (Olericulture)	Vegetable Growers
	Small Landholding Farming	Small-Marginal Farmers
	Health Services	Agricultural Labourers (Landless)
	Sanitation	Women Farmers
	Drinking Water	Frontline Health Functionaries
	Irrigation	Migrant Workers
	Groundwater Development	Dryland Farmers

2. Setting criteria for prioritisation of target groups

The Climate Resilience Framework[6], developed by ISET International (though developed in an urban context, has also been extensively tested in rural settings), is one of the widely recognised resilience frameworks which outlines that actors or target groups have differentiated interests and can change their behaviour to respond to climatic impacts depending on their experience and learning. The key capacities that contribute to resilience and adaptation of the target groups include the capacity to organise and re-organise in response to threat or disruption, the capacity to visualise and act, and the capacity to learn[7]. It also involves the resourcefulness of actors/target groups, including their access to and their ability to mobilise financial and other resources.

6 https://www.i-s-e-t.org/publications-and-resources-1/catalysing-urban-climate-resilience%3A-applying-resilience-concepts-to-planning-practice-in-the-acccrn-program

7 Diduck, A. (2010), The Learning Dimension of Adaptive Capacity: Untangling the Multilevel Connections, in Adaptive Capacity and Environmental Governance, edited by D. Armitage and R. Plummer, pp. 199-221, Springer: Berlin.

Apart from the above characteristics, an additional criterion has also been considered as per the suggestion of the Director, Environment Directorate that was to include those target groups which are Resource Conservators. Resource Conservators refers to entities engaged in sustainable management and conservation of natural resources such as protection and restoration of water sources, promoting water use optimisation, promoting soil conservation, conserving forests and biodiversity, recycling and re-use of waste and so on. Hence, the criterion of Resource Conservator is also considered.For prioritising target groups, a set of these climate change resilience characteristics of target groups, as described below, are considered based on which their vulnerability is assessed:

- Responsiveness: capacity to organise and re-organise in an opportune fashion; ability to establish function, structure, and basic order in a timely manner both in advance of and immediately following a disruptive event or organisational failure.
- Resourcefulness: capacity to identify and anticipate problems; establish priorities, and mobilise resources for action. This includes the capacity to visualise and plan, which may require collaboration. It also includes the ability to access financial and other resources, including those of other agents and systems.
- Capacity to learn: the ability to internalise past experiences, avoid repeated failures, and innovate to improve performance.
- Resource conservation: engaged in activities that entail conservation of natural resources (water, forests, natural ecosystems etc.)

3. Shared Learning Dialogue with State Institute of Rural Development, Uttar Pradesh

The Deendayal Upadhyaya State Institute of Rural Development (SIRD), Uttar Pradesh is an apex institution in the state dedicated to training and research for enhancing the effectiveness of the implementation of various rural developments programmes. SIRD plays an important role in building capacities of a range of target groups such as self-help groups, water user associations, and so on and plays a catalytic role in the implementation of various rural development programmes.

A Shared Learning Dialogue (SLD) was organised with the officials and sectoral experts of SIRD and GIZ to share the criteria for identification of vulnerable target groups under three prioritised sectors (Agriculture, Water Resources and Disaster Management) in three identified regions (Bundelkhand, Northeastern Plains and Vindhyan) who are impacted by climate change and to identify relevant actors/intermediary organizations, capacity needs of the organisations/actors vis-à-vis linked programmes and schemes for capacity building.

It emerged in the SLD that formalised groups of the identified communities (as mentioned in Table-4) need to be considered who can be further capacitated under related training programmes. Also, these formalised groups can disseminate the learning at the village level.

4. Selecting vulnerable target groups

For the selection of vulnerable target groups, a matrix was evolved with the identified target groups across the priority sectors and the climate change resilience characteristics of target groups as in table 12:

Table 12 : Identifying target groups vis-à-vis resilience characteristics

Identified Prioritised Sectors	Target Groups	Climate Change Resilience (Characteristics)				Scale	Total Score
		Resourceful-ness	Capacity	Responsive-ness	Resource Conservators	Nos.	L=1, M=2, H=3
Agriculture Water Resources Disaster Management	Panchayati Raj Committees (Pradhan, Gram Panchayat Members, etc.)	High	Medium	High	Medium	High	10
	Pradhan, Secretary, Gram Rozgar Sewak/ Nirman Samiti (MGNREGA)	High	Low	Low	Medium	High	7
	SHGs/Women Farmers (Mahila Kisan Sashaktikaran Programme/ SRLM)	Medium	Low	Low	Low	High	5
	Advanced Farmers/ Farmer Producer Organisations	High	Medium	Low	Low	High	7
	Joint Forest Management Committee and Eco Development Committee	Low	Low	Low	Medium	Low	5
	Milk Federation Committee	High	Low	Low	Low	Low	6
	Water User Associations	Low	Low	Low	Medium	Medium	5
	Watershed Committees	Low	Medium	Low	Medium	Medium	6
	VDMC	Low	Medium	Medium	Low	Medium	6

The above matrix has been analysed considering:

1. The Total Score by aggregating the High, Medium, Low scores accorded to each under target group under the selected climate change resilience characteristics and the parameter on resource conservators.

2. The "scale" was an additional criterion considered to understand the extent in terms of the numbers of these target groups present in UP. However, the Scale was not aggregated in the Total Score

Observations

According to identified vulnerable sectors viz Agriculture and Allied, Disaster Management and Water Resources, the most affected community groups were listed (table 11 and 12), followed by identification of formal entities (target groups) representing these community groups. These target groups, representing the most vulnerable communities, were rated on the resilience characteristics and accordingly those target groups were identified which have the best potential for integration of climate adaptation actions. The identified target groups represent the most vulnerable communities with high potential for driving the need for mainstreaming climate change concerns in local planning processes and further implement climate action on the ground. The identified vulnerable target groups are as below:

1. Women Farmers' Groups (under Mahila Kisan Sashaktikaran Programme/SRLM)
2. Farmer Producer Organisations (under NABARD)
3. Water User Associations
4. Pradhan, Secretary, Gram Rozgar Sewak/Nirman Samiti (under MGNREGA)
5. Joint Forest Management Committees (though low in numbers but are potential natural resource conservators)

A brief profile of the selected groups in UP is presented as below:

1. Women Farmers' Groups (under Mahila Kisan Sashaktikaran Programme of National Rural Livelihood Missio

The Mahila Kisan Sashaktikaran Programme (MKSP) is a sub component of the Deendayal Antodaya Yojana-NRLM (DAY-NRLM). The programme aims at empowering women in agriculture by strengthening community institutions of poor women farmers and leveraging their strength to promote sustainable agriculture.

MKSP Outreach: The MKSP programme spans 44 Districts in UP, covering 310 blocks, 6274 Gram Panchayats and 8050 villages. As of September 2020, 2.76 lakh women farmers have been associated with this programme through a range of projects focusing on sustainable agriculture and livelihoods (Source: NRLM MIS).

The following table 13 shows the scale of the MKSP programme in the districts that fall in the identified vulnerable regions of Bundelkhand, Vindhyan and North-east Plains:

Table 13 : Woman farmers covered under MKSP

Identified Vulnerable Agro Climatic Zone	Districts	No. of we man farmers under MKSP
Bundelkhand	Jalaun	8901
Bundelkhand	Jhansi	5262
Bundelkhand	Lalitpur	5772
Bundelkhand	Hamirpur	11232
Bundelkhand	Mahoba	5850
Bundelkhand	Banda	10862
Bundelkhand	Chitrakoot	4697
Northeastern plain zone	Bahraich	12395
Northeastern plain zone	Balrampur	7833
Northeastern plain zone	Siddharthnagar	3440
Northeastern plain zone	Basti	7845
Northeastern plain zone	Gorakhpur	10510
Northeastern plain zone	Deoria	7541
Vindhyan Zone	Mirzapur	7307
Vindhyan Zone	Sonbhadra	8360

(Source: NRLM MIS)

2. Farmer Producer Organisations

Farmer Producer Organisations (FPOs) are farmers' collectives with membership mainly comprising of small and marginal farmers (about 70 to 80%) and registered under appropriate legal statute i.e. as a Co-operative/Society/Producer Company, etc. The objective of FPOs is to take advantage of the economies of scale by way of produce aggregation, value addition and collective marketing, thus realising the optimal returns of their produce, besides enhancing the farming efficiency and improving the bargaining power of farmers.

FPO Outreach: As of August 2020, 408 FPOs are registered in UP which is being promoted by various financing institutions such as NABARD, UP Bhumi Sudhar Nigam (UPBSN), Small Farmers' Agribusiness Consortium (SFAC), Bio-Energy Board and other NGOs.

3. Water User Associations

Under the UP Participatory Irrigation Management Act, 2009, Water Users' Associations (WUA) have been given an effective role in:

- equitable distribution of water and its efficient and optimum use
- operation and maintenance of irrigation and drainage systems
- promotion of conjunctive use of surface and groundwater
- command area development
- assessment and recovery of water charges
- protection of environment and ecology

WUA Outreach

Table 14 : Spread of WUAs in UP

Zonal Offices	Irrigation Zones	No. of WUAs
Lalitpur	Betwa Sangathan	45
Kanpur	Ram Ganga Sangathan	914
Lucknow	Sharda Sahayak Sangathan	602
TOTAL		**1561**

(Source: Expert Consultation with Mr S K Bhaskar, Executive Engineer, PIM Prakoshth, Irrigation Dept, Lucknow)

4. Pradhan, Secretary, Gram Rozgar Sewak/Nirman Samiti (under MGNREGA)

The MGNREGS aims at enhancing the livelihood security of people in rural areas by guaranteeing hundred days of wage employment in a financial year to a rural household whose adult members volunteer to do unskilled manual work.

Under the MGNREGS, various activities have been identified which have the potential to integrate climate change adaptation action such as:

- Drought proofing
- Flood control and prevention
- Micro-irrigation
- Water conservation
- Renovation of traditional waterbodies

5. Joint Forest Management Committees (JFMC)

Joint Forest Management (JFM) is an approach and program initiated in the context of the National Forest Policy of 1988 wherein state forest departments support local forest dwelling and forest fringe communities to protect and manage forests and share the costs and benefits from the forests with them. In UP, it was initiated in 1992.

Joint Forest Management Committees are a democratic, decentralised and transparent local institution of forest and forest fringe dwelling communities, that is part of the Gram Sabha fully or partially and set up as per the provisions of applicable JFM rules/guidelines of the state.

JFMC Outreach:

- Total JFMCs in UP: 2683

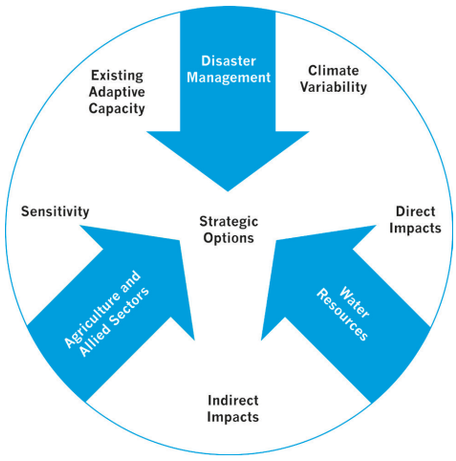
(Source: Expert consultation with Mr Deepak Kumar, Chief Conservator of Forests, Lucknow on 26th November 2020)

8 Devising Strategic Options

The strong trends in climate change already evident, the likelihood of further changes occurring, and the increasing scale of potential climate impacts especially in rural areas point out to urgency to addressing adaptation more coherently and strategically. Adaptation to climate change is a priority issue because many community groups lack the awareness, resources and skills necessary for tackling climate change adaptation effectively and successfully. While climate change affects the economy as a whole, its impact is felt more severely by the poor, who are highly sensitive to such impacts and also have the least adaptive capacity.

India's National Action Plan on Climate Change (NAPCC) clearly outlines its first principle as "protecting the poor and vulnerable sections of the society through an inclusive and sustainable development strategy, sensitive to climate change". Proactive strategies for climate change adaptation can substantially reduce many of the adverse impacts, and thus contribute to securing the livelihoods of the vulnerable rural population. Further, India has submitted its Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) and is committed to better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management. It also further propagates a healthy and sustainable way of living based on traditions and values of conservation and moderation.

Based on the expert consultations the identified Strategic Options vis-à-vis the climatic variability factors, and the direct/indirect impacts of climate change on agriculture and allied activities have been evolved. These strategic options need to be understood in the light of the below:



1. The climate variability mentioned is according to the local regional context, viz., Bundelkhand, North-eastern Plain and Vindhyan.

2. However, the climate change direct and indirect impacts in Bundelkhand and Vindhyan are largely the same as evolved in the consultations.

3. The strategic options suggested are to be considered in the local ecological context. For instance, the promotion of resilient seeds is one of the suggested strategic options which means that in north-eastern plain region, a flood-resilient variety of seeds need to be promoted whereas, in the Bundelkhand region, drought-resilient seeds need to be adopted.

4. Strategic options which are specific to a particular region has been highlighted in bold.

1. Agriculture and Allied Sectors

The impact of climate change on agriculture, as already evident, varies in different agro-geo-ecological situations which get affected adversely because of alterations in the amounts of rainfall and the timing of precipitation. This results in problems with food security and may threaten the livelihood activities upon which much of the population depends. Climate change can affect crop yields, shift cropping patterns, as well as the types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation and the needed energy, as well as the prevalence of insects and pests.

In Uttar Pradesh, especially in the north-eastern plains region, the climate change impacts are accelerating, impacting agriculture and allied activities in several ways. There are dry spells for 10 to 20 days during the monsoon, smaller rivers are causing floods and there are hot winds during winter. Erratic rainfall events are resulting in increased waterlogging. Besides, in the Bundelkhand region, the constant decrease in the amount of average rainfall is leading to droughts every year resulting in crop and livelihood losses. Climate change impacts on agriculture are increasing the vulnerability of those dependent on natural resources for their livelihoods, especially the small and marginal farmers and woman farmers. The degradation of natural resources as a result of climate change has a more drastic impact on women's livelihood since they are more dependent on the 'natural capital' to make a living. However, they have very limited control and decision making powers over these resources because of socio-cultural norms and lack of land ownership. Moreover, their participation in developing plans and programmes and capacity building mechanisms are quite restricted compared to men.

Climate Resilient Strategic Options for Agriculture and Sectors

At the farmer's level, especially for the majority of small-marginal and women farmers, agriculture is a group of activities including horticulture, poultry, livestock, fisheries and so on which constitutes the farm systems. Climate change affects these sub-systems collectively for which adjustments amongst these elements are also made at the farmer level. Agriculture, therefore, is considered in this scoping assessment as comprising of allied activities.

Adapting to climate change entails taking the right measures to reduce the negative effects of climate change by making the appropriate adjustments and changes.

The Strategic Options were worked out in response to relevant climate vulnerability indicators. The strategic options were evolved with the help of shared learning dialogues and the following four such dialogues helped in this process:

- Shared learning dialogue with officials in the state Directorate of Environment (29th July 2020)
- Shared Learning Dialogues with officials/sectoral experts at the State Institute of Rural Development (SIRD), Lucknow (2nd September 2020)
- Regional Consultations for Bundelkhand and North Eastern Plain with sectoral experts and resource persons working in specific regions (Virtual consultations held on 21st September 2020)

Table 15 : Strategic Options – Agriculture and Allied Sector

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
Bundelkhand Region					
The region is experiencing a decreasing trend in annual rainfall amount. 42 % area has experienced decreasing annual rainfall with High Confidence during the last 68 years (1951-2018) The average annual rainfall amount is projected to decrease by 5.95% during the Mid-century in RCP 4.5 scenario The region experienced annual consecutive dry days ranging between 125 to 132 days (State average is 101 days)	Groundwater table in all the districts of the region is going down rapidly due to decreasing rainfall amount 42% area in the region is marked as semi-critical, critical and overexploited categories in groundwater utilisation. Gross irrigated area to gross sown area in the region varies between 22.2 to 58 % High dependency on the Agriculture sector (more than 72%)	The Bundelkhand region accounts for only 4 per cent of the state's gross value of agriculture output. Low level of urbanisation. Only 20% of the population lives in urban areas. Only 28% (Average) of the population is engaged in non-farm activities Low per capita net domestic product Less number of MSME per lakh population Poor composite index of financial inclusion Low forest coverage areas (7.81 %)	Increased Aridity Index due to high evapotranspiration reduced the soil moisture and hence demand for irrigation water. Decrease in residual moisture content increased frequency in irrigation and hence input costs in farming Decreased amount of rainfall affected agriculture production Pre-sowing in the Rabi season for better prices getting difficult due to low soil moisture content Reduction in cattle rearing as hybrid varieties are not able to sustain extreme heat Decreased base flows impacted the quality of crop production (pesticide contamination)	Increased Migration Stray cattle increased ignificantly Loss of Bio-Diversity Ecosystem Services negatively impacted causing increased input costs in agriculture	**Evolving Local Solutions:** Promotion of R&D provisions to evolve resilient solutions in specific agro-ecological contexts with the hand holding support of national (CIPMC, ICAR, FRI, IGFRI, CAFRI, SFRI), state (UPCAR) and regional (Universities, RIRD, KVK, ATMA and resource organisations) institutions. Promotion of climate resilient and robust farm systems with the integration of farm sub-systems e.g. livestock, poultry, kitchen garden

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
The no. of consecutive dry days is projected to increase in 71 % areas of the region ranging between 1 to 5 days by the mid-century (2050) 29 % area of the region is projected to have a decreasing trend in Consecutive dry days from 3 to 10 days by the mid-century No. of warm days is projected to increase by 23% and 31 % in the mid-century in 4.5 and 8.5 scenarios respectively Max temperature (32.45 0C) is projected to increase by 1 0C by the mid-century		Poor infrastructure facilities for livestock development			Promotion of diversity in farm systems and recycling amongst various subsystems to ensure resource efficiency and enhance resilience Promotion of Crop Planning and Water Budgeting, especially in Bundelkhand and Vindhyan regions, for residual moisture conservation. **Natural Resource Management (Ecosystem Services):** Natural Resource Management interventions (community forests, waterbodies, organic farming, agroforestry) to be integrated as part of GPDP and JFMC's micro plans

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Enhancing Agriculture productivity through Rainwater Harvesting Protection, Conservation and Development of Forest Resource and Eco-system Promotion of Agroforestry to conserve the Soil erosion, retention of soil moisture and biomass production Resilient Extension Promotion of resilient seeds (mainly according to weather regimes and diseases), especially vegetable seeds and fodder seeds should be part of flagship programmes like National Horticulture Mission and Sub Mission on Agroforestry.

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Promotion of Participatory Technology Development, with the synergy of science and technology and indigenous traditional knowledge, to encourage a culture of innovation and also self-reliance in target communities Revival of pulses and oilseed crops especially in flood prone areas Livestock development to be taken up as per the climate stress of specific agro-ecology (drought, dry and warm days, floods, water logging) and breeds of local varieties need to be promoted Short term weather agro-advisories to be promoted.

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Access to crop and livestock insurance by small landholding and women farmers to be taken on a priority Market Linkages Farmer Producer Organisations (FPOs), in specific agro-ecological zones, need orientation for augmenting resilience measures in the supply of inputs, production, processing and value addition measures Credit linkages and access to KCC to be promoted amongst women farmers. Certification methods and mechanisms for the sale of organic products to be promoted
					Agro-Forestry and Medicinal Plants to be taken-up on a priority with dual objectives of both resource conservation and enhancing farmer's income

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
Vindhyan Region					
50% area of the region has experienced an increasing trend in heavy rainfall events while the remaining 50 % have witnessed decreasing trend during last 30 years (1981-2010.) No. of extreme rainfall events (days with heavy rainfall) is projected (scenario RCP 4.5 and RCP 8.5) to increase with low confidence from 0.3 to 2.3 days by the mid- century	Low percentage (47%) of gross irrigated areas to gross area sown 72% of the population have landholding below 1 hectare 64% population is dependent on farming and related activities	Low urbanisation level (15%) 36% population is dependent on non-farm activities Poor livestock infrastructure facilities for livestock development. The region has just 2 livestock development centres for every one lakh of livestock population	Increased Aridity Index due to high evapotranspiration reduced the soil moisture and hence demand for irrigation water. Decrease in residual moisture content increased frequency in irrigation and hence input costs in farming Decreased amount of rainfall affected agriculture production	Increased Migration Stray cattle increased ignificantly Loss of Bio-Diversity Ecosystem Services negatively impacted causing increased input costs in agriculture	**Evolving Local Solutions:** Promotion of R&D provisions to evolve resilient solutions in specific agro-ecological contexts with the hand holding support of national (CIPMC, ICAR, FRI, IGFRI, CAFRI, SFRI), state (UPCAR) and regional (Universities, RIRD, KVK, ATMA and resource organisations) institutions. Promotion of climate resilient and robust farm systems with the integration of farm sub-systems e.g. livestock, poultry, kitchen garden

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
The trend of consecutive dry days has increased during 1981 to 2010 The number of consecutive dry days is projected to increase by 8 to 19 days (average number of consecutive dry days is 106 days) by the mid of century		Poor composite index of financial inclusion There is only 2 MSMEs for every one lakh population Poor per capita contribution in net domestic product	Pre-sowing in Rabi season for better prices getting difficult due to low soil moisture content Reduction in cattle rearing as hybrid varieties are not able to sustain extreme heat Decreased base flows impacted quality of crop production (pesticide contamination)		Promotion of diversity in farm systems and recycling amongst various sub systems to ensure resource efficiency and enhance resilience. **Promotion of Crop Planning and Water Budgeting, especially in Bundelkhand and Vindhyan regions, for residual moisture conservation.** **Natural Resource Management (Ecosystem Services):** Natural Resource Management interventions (community forests, waterbodies, organic farming, agro-forestry) to be integrated as part of GPDP and JFMC's Micro Plans

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Promotion of water conserving and efficient non-conventional energy based irrigation systems, affordable to small land-holding farmers. Enhancing Agriculture productivity through Rainwater Harvesting Protection, Conservation and Development of Forest Resource and Eco-system Promotion of Agro forestry to conserve the Soil erosion, retention of soil moisture and biomass production **Resilient Extension**

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Promotion of resilient seeds (mainly according to weather regimes and diseases), especially vegetable seeds and fodder seeds should be part of flagship programmes like National Horticulture Mission and Sub Mission on Agro Forestry. Promotion of Participatory Technology Development, with the synergy of science and technology and indigenous traditional knowledge, to encourage culture of innovation and also self-reliance in target communities Revival of pulses and oilseed crops especially in flood prone areas

Agriculture and Allied Activities					
Climatic variability	Sensitivity	Existing Adaptive capacity	Direct impacts	Indirect impacts	Suggested Adaptive Strategic Options
					Livestock development to be taken up as per the climate stress of specific agro-ecology (drought, dry and warm days, floods, water logging) and breeds of local varieties need to be promoted Short term weather agro-advisories to be promoted. Access to crop and livestock insurance by small landholding and women farmers to be taken on a priority **Market Linkages** Farmer Producer Organizations (FPOs), in specific agro-ecological zones, need orientation for augmenting resilience measures in supply of inputs, production, processing and value addition measures

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Credit linkages and access to KCC to be promoted amongst women farmers Certification methods and mechanisms for sale of organic products to be promoted Agro-Forestry and Medicinal Plants to be taken-up on a priority with dual objectives of both resource conservation and enhancing farmer's income
North Eastern Plain					
The region has experienced heavy rainfall events of 41-55 days annually during 30 years (1981-2010)	More than 45% of the region is prone to flood and water logging More than 85% land holdings ae below 1 hectare About 72 percent population is dependent on agriculture activities	60 % area of the region have poor crop diversity index Low level of urbanisation (8%) Only 28% of population are engaged in non-farm activities Low density of road network.	Increase events of intense rain falls enhanced waterlogging negatively impacting post monsoon crops (Rabi season) Increased damage of crops due to water logging in monsoon	Increased migration Responsi-bility of Farming shifting to women and hence increased their work load	Evolving Local Solutions: Promotion of R&D provisions to evolve resilient solutions in specific agro-ecological contexts with the hand holding support of national (CIPMC, ICAR, FRI, IGFRI, CAFRI, SFRI), state (UPCAR) and regional

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
Though the trend of heavy rainfall days during 1981-2010 in the region was decreasing (with low confidence) but it remained above the state average (32.65 days) Heavy rainfall days is projected to decrease by 1-3 days by the mid of century (2050) 80 % area of the region has experienced increasing trend (with low confidence) of extreme wet days during 1981-2010		Poor per capita contribution in net domestic product Poor composite index of Financial Inclusion Poor forest coverage (only 5% of total area) The number of MSME is below 1 of every per lakh of population	Quality of agriculture production negatively impacted Lesser rainy days increased demand of irrigation in monsoon months and hence increased input costs Increased number of humid days increased pests and perishability of cash crops (like vegetables) Crop losses due to flash floods increased Pulses crops significantly reduced	Loss of water bodies reduced water holding capacity Low priority to drainage in developmental programmes enhanced 'water-locking' Loss of bio-diversity, agro-forestry and ecosystem services High input, chemical (pesticides, fertilizers) intensive farming increased	(Universities, RIRD, KVK, ATMA and resource organizations) institutions. Promotion of climate resilient and robust farm systems with the integration of farm sub-systems e.g. livestock, poultry, kitchen garden. Promotion of diversity in farm systems and recycling amongst various sub systems to ensure resource efficiency and enhance resilience. **Natural Resource Management (Ecosystem Services):** Natural Resource Management interventions (community forests, waterbodies, organic farming, agro-forestry) to be integrated as part of GPDP and JFMC's Micro Plans

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
The extreme wet day events are projected to decrease in 70 to 80% area in the region while in remaining 30 to 20 % area the extreme wet days are expected to increase. Spatial pattern of trends in the mean maximum annual temperature shows marginal negative (decreasing) trend over most parts of region The number of warm days in the region is projected to increase from 19 to 23 percent by the mid of the century					Promotion of water conserving and efficient non-conventional energy based irrigation systems, affordable to small land-holding farmers. Enhancing Agriculture productivity through Rainwater Harvesting Protection, Conservation and Development of Forest Resource and Eco-system Promotion of Agro forestry to conserve the Soil erosion, retention of soil moisture and biomass production

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Resilient Extension Promotion of resilient seeds (mainly according to weather regimes and diseases), especially vegetable seeds and fodder seeds should be part of flagship programmes like National Horticulture Mission and Sub Mission on Agro Forestry. Promotion of Participatory Technology Development, with the synergy of science and technology and indigenous traditional knowledge, to encourage culture of innovation and also self-reliance in target communities

Agriculture and Allied Activities					
Climatic variability	Sensitivity	Existing Adaptive capacity	Direct impacts	Indirect impacts	Suggested Adaptive Strategic Options
					Revival of pulses and oilseed crops especially in flood prone areas Livestock development to be taken up as per the climate stress of specific agro-ecology (drought, dry and warm days, floods, water logging) and breeds of local varieties need to be promoted Short term weather agro-advisories to be promoted. Access to crop and livestock insurance by small landholding and women farmers to be taken on a priority **Market Linkages** Farmer Producer Organizations (FPOs), in specific agro-ecological zones, need orientation for augmenting resilience

Agriculture and Allied Activities					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					measures in supply of inputs, production, processing and value addition measures Credit linkages and access to KCC to be promoted amongst women farmers. Certification methods and mechanisms for sale of organic products to be promoted Agro-Forestry and Medicinal Plants to be taken-up on a priority with dual objectives of both resource conservation and enhancing farmer's income

2. Water Resources

According to the IPCC, AR-4, the most significant consequences of climate change is its impact on the hydrological cycle. These impacts are already experienced in India, as also in UP. Changes in precipitation intensity, duration and frequency are the main factors altering the hydrological cycle leading to more floods and droughts. Climate change impacts the extent and productivity of both irrigated and rainfed agriculture, in turn, posing an additional threat to the food production systems. Increasing water demand, as a result of climatic impacts, significantly influences agriculture by limiting crop productivity and by reducing water availability in areas where irrigation is most needed or has comparative advantage.

In UP, agricultural yields, health and livelihoods are also affected by climate-related impacts on the quantity and quality of water resources. As temperatures increase, the need for irrigation increases in those areas projected to become warmer/ hotter. Especially the Bundelkhand and Vindhyan regions in UP are witnessing an increasing trend in water stress due to declining average rainfall and increasing evapotranspiration due to the increase in temperature leading to increase in aridity index.

Climate Resilient Strategic Options for Water Resources Sector

Given the climatic impacts on water resources in UP, it is imperative to adapt to climate change in water management without delay. Vulnerable water resources strongly are posing serious consequences for poor communities and ecosystems.

Based on the expert consultations, the identified Strategic Options for the Water Resources sector vis-à-vis the (guiding)

vulnerability indicators can be summarized in table 16:

Table 16 : Strategic Options - Water Resources Sector

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
Bundelkhand Region					
The region is experiencing decreasing trend in annual rainfall amount42 % area have experienced decreasing annual rainfall with High Confidence during last 68 years (1951-2018) The average annual rainfall amount is projected to decrease by 5.95 % during Mid-century in RCP 4.5 scenario The region experienced 125 -132 days of consecutive dry days annually (State Average is 101 days)	Ground water table in all the districts of the region is going down rapidly due to decreasing rainfall amount. 42% areas in the region is marked as semi critical, critical and overexploited categories in ground water utilisation. Gross irrigated area to gross area sown in the region varies between 22.26 to 58% High dependency on Agriculture sector (more than 72%)	Low level of urbanisation. Only 20 % of population lives in Urban areas. Only 28% (Average) of population is engaged in non-farm activities Low per capita net domestic product Less number of MSME per lakh population Poor composite index of financial inclusion Low forest coverage areas (7.81%) Poor infrastructure facilities for livestock development	Reduced base flows affect soil moisture and quality of agricultural production Irrigation canals getting dried up early- increasing dependence on ground water Re-charge of aquifers severely impacted Waterbodies getting dried and hence encroached affecting water availability for irrigation and cattle	Deep bore wells increased. Ground water extraction increased Culture of farm ponds getting lost Increased work load on women for fetching water Water in rivers and streams significantly decreased	**Natural Resource Management (Ecosystem Services)** Watershed approach to be integrated in overall developmental planning specially in water stressed regions. **Farm ponds to be implemented scientifically and on massive scale to saturate large masses of area for efficient groundwater recharge in Bundelkhand and Vindhyan regions.** Database generation on base flows in rivers, rejuvenation and re-charging of ponds and waterbodies, rainwater harvesting and revival of water streams need to be considered as indicators in developmental monitoring

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
Number of consecutive dry days is projected to increase in 71 % area from 1 to 5 days by the mid-century (2050) 29 % area is projected to have decreasing trend in Consecutive dry days from 3 to 10 days by mid-century No of warm days is projected to increase by 23% and 31 % in mid-century in 4.5 and 8.5 scenario respectively Max temperature (32.45 0C) is projected to increase by 1 0C by the mid-century					Promotion of Methods of in-situ soil moisture conservation, scientific approach in construction of farm ponds and waterbodies rejuvenation and conservation **Conjunctive Use of Water Resource (Surface and Ground Water)** **Aquifer mapping and recharge provisions for groundwater development to be integrated in developmental activities such as NREGA esp in Bundelkhand and Vindhyan regions** Efficient Irrigation system according local to agro-ecology Water budgeting and conservation activities need to be integrated with GPDP.

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Long term planning for in-situ soil moisture and water conservation methods to be adopted and integrated with MGNREGA activities and be part of GPDP esp in Bundelkhand and Vindhyan regions. Institutions like Water User Associations in canal irrigated areas need to be oriented on water conservation and re-charge of ground water, efficient irrigation, agro-forestry, etc. Resilient Crop varieties as per flood/drought situations and able to sustain climate variations.

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
Vindhayan Region					
50 % area of the region have experienced increasing trend in heavy rainfall events while the remaining 50 % have witnessed decreasing trend during 30 years (1981-2010) The number of extreme rainfall events (days with heavy rainfall) is projected (scenario RCP 4.5 and RCP 8.5) to increase with low confidence from 0.3 to 2.3 days by the mid of century. The trend of consecutive dry days has increased during 1981 to 2010	Low percentage (47) of gross irrigated areas to gross area sown 72 % of population have land holding below 1 hectare 64 % population is dependent on farm level activities (agriculture)	Low urbanisation level (15 %) 36% population is dependent on non- farm activities Poor livestock infrastructure facilities for livestock development. The region has just 2 livestock development centre for every one lakh of livestock population Poor composite index of financial inclusion There is only 2 MSMEs for every one lakh population Poor per capita contribution in net domestic product	Reduced base flows affect soil moisture and quality of agricultural production Irrigation canals getting dried up early- increasing dependence on ground water Re-charge of aquifers severely impacted Waterbodies getting dried and hence encroached affecting water availability for irrigation and cattle	Indirect Deep bore wells increased. Ground water extraction increased Culture of farm ponds getting lost Increased work load on women for fetching water Water in rivers and streams significantly decreased	**Natural Resource Management (Ecosystem Services)** Watershed approach to be integrated in overall developmental planning specially in water stressed regions. **Farm ponds to be implemented scientifically and on massive scale to saturate large masses of area for efficient groundwater recharge in Bundelkhand and Vindhyan regions.** Database generation on base flows in rivers, rejuvenation and re-charging of ponds and waterbodies, rainwater harvesting and revival of water streams need to be considered as indicators in developmental monitoring

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
The number of consecutive dry days is projected to increase by 8 to 19 days (average number of consecutive dry days is 106 days) by the mid of century					Promotion of Methods of in-situ soil moisture conservation, scientific approach in construction of farm ponds and waterbodies rejuvenation and conservation **Conjunctive Use of Water Resource (Surface and Ground Water)** **Aquifer mapping and recharge provisions for groundwater development to be integrated in developmental activities such as NREGA esp in Bundelkhand and Vindhyan regions** Efficient Irrigation system according local to agro-ecology Water budgeting and conservation activities need to be integrated with GPDP.

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
					Long term planning for in-situ soil moisture and water conservation methods to be adopted and integrated with MGNREGA activities and be part of GPDP esp in Bundelkhand and Vindhyan regions. Institutions like Water User Associations in canal irrigated areas need to be oriented on water conservation and re-charge of ground water, efficient irrigation, agro-forestry, etc Resilient Crop varieties as per flood/drought situations and able to sustain climate variations.

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
North Eastern Plain					
The region has experienced heavy rainfall events of 41-55 days annually during 30 years (1981-2010) Though the trend of heavy rainfall days during 1981-2010 in the region was decreasing (with low confidence) but it remained above the state average (32.6 days) Heavy rainfall days is projected to decrease by 1-3 days by the mid century (2050)	More than 45 % of the region is prone to flood and water logging More than 85 % land holdings ae below 1 hectare About 72 percent population is dependent on agriculture activities	60 % area of the region have poor crop diversity index Low level of urbanisation (8%) Only 28% of population are engaged in non-farm activities	Water logging increased – both duration and affected areas Frequent irrigation increased load on ground water Loss of smaller rivers due to low water level/no water negatively impacting natural drainage	Shift to solar irrigation and increasing tendency of over irrigation Low priority to drainage in evelopmental programmes increased 'water-locking	**Natural Resource Management (Ecosystem Services)** Watershed approach to be integrated in overall evelopmental planning specially in water stressed regions. Database generation on base flows in rivers, rejuvenation and re-charging of ponds and waterbodies, rainwater harvesting and revival of water streams need to be considered as indicators in developmental monitoring

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
80 % area of the region has experienced increasing trend (with low confidence) of extreme wet days during 1981-2010 The region has witnessed extreme wet days of 71 mm to 111 mm of rainfall in 24 hours during 1981-2010 Spatial pattern of trends in the mean maximum annual temperature shows marginal negative (decreasing) trend over most parts of the region		Low density of road network Poor per capita contribution in net domestic product Poor composite index of Financial Inclusion Poor forest coverage (only 5% of total area) The number of MSME is below 1 of every per lakh of population	Increased events of flash floods Contamination of ground water	Increasing land pressure encroachments on water bodies and hence reduced water holding capacity at local level Increased land pressure reduced open spaces/green areas thereby reducing local water holding capacity causing spread of storm water	Promotion of Methods of in-situ soil moisture conservation, scientific approach in construction of farm ponds and waterbodies rejuvenation and conservation **In flood and waterlogging affected areas (North eastern Plains), GIS-based drainage planning need to be considered at village level. Conjunctive Use of Water Resource (Surface and Ground Water)** Efficient Irrigation system according local to agro-ecology Water budgeting and conservation activities need to be integrated with GPDP.

Water Resources					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic Options**
The extreme wet day events are projected to decrease by 70 to 80 % area in the region while in remaining 30 to 20 % area the extreme wet days will increase. The number of warm days in the region is projected to increase from 19 to 23 percent by the mid of the century					Institutions like Water User Associations in canal irrigated areas need to be oriented on water conservation and re-charge of ground water, efficient irrigation, agro-forestry, etc. Resilient Crop varieties as per flood/drought situations and able to sustain climate variations.

3. Disaster Management

The number and impact of disasters, particularly climate-induced disasters, is increasing significantly. Disasters such as floods and drought result in significant economic and social losses with the most severe consequences on vulnerable, poor and agricultural-dependent communities. The disaster risk reduction across sectors calls for a more proactive preventative action and investment rather than a reactive response approach.

Disasters impact the agriculture or water resource sectors. However, risk-informed agriculture and water management does improve disaster resilience. The small marginal and women farmers and natural ecosystems/ forest-dependent communities are direct custodians of the environment; the way they manage natural resources can mitigate natural hazards from becoming crises.

Therefore, it is critically important to integrate disaster risk reduction and climate change adaptation into sectoral development plans of agricultural and water management sectors and accordingly evolve resilience strategies.

Climate Resilient Strategic Options for Disaster Management Sector

Given the need for integration of climate change adaptation in disaster risk reduction, the expert consultations identified the following Strategic Options for the Disaster Management sector against the (guiding) vulnerability indicators: as shown in Table 17.

Table 17 : Strategic Options - Disaster Management Sector

Disaster management					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic**
Bundelkhand Region					
The region is experiencing decreasing trend in annual rainfall amount. 42 % area have experienced decreasing annual rainfall with High Confidence during last 68 years (1951-2018) The average annual rainfall amount is projected to decrease by 5.95% during Mid-century in RCP 4.5 scenario	Ground water table in all the districts of the region is going down rapidly due to decreasing rainfall amount. 42% areas in the region is marked as semi critical, critical and overexploited categories in ground water utilisation. Gross irrigated area to gross area sown in the region varies between 22.26 to 58 % High dependency (more 72%) on weather based livelihood i.e Agriculture sector.	Low level of urbanisation. Only 20 % of population lives in Urban areas. Only 28% (Average) of population is engaged in non-farm activities Low per capita net domestic product Less number of MSME per lakh population Poor composite index of financial inclusion Low forest coverage areas (7.81 %) Poor infrastructure facilities for livestock development	Droughts increased significantly impacting primary production based livelihood Vector and water borne diseases increased Availability and quality of drinking water adversely impacted In-situ soil moisture content has become serious problem Agriculture and allied sector severely impacted	Increased malnutrition in men, women and children Increased work load on women Increased out migration Loss of bio-diversity Increased energy demand	**Climate Smart Disaster Planning-Development Linkages** Village Disaster Management Committees to be activated and climate-smart VDMPs to be developed, considering local thresholds of extreme events. JFMCs should be oriented on developing Climate Smart Micro Plans considering local thresholds of extreme events.

Disaster management					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic**
The region experienced 125 -132 days of consecutive dry days (State Average is 101 days) The no of consecutive dry days is projected to increase in 71 % areas from 1 to 5 days by the mid-century (2050) 29% areas is projected to have decreasing trend in Consecutive dry days from 3 to 10 days by mid-century No of warm days is projected to increase by 23% and 31 % in mid-century in 4.5 and 8.5 scenario respectively					VDMPs need to be integrated in GPDP for long term preparedness and risk reduction. Resilient Agriculture and water management issues need to be covered in such VDMPs District Disaster Management Plans (DDMPs) need to be climate informed while considering impacted social sectors which enhance the vulnerability of people especially socio-economically weaker communities **Short Term Forecast/ Weather Advisories**

Disaster management					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic**
Max temperature (32.45 0C) is projected to increase by 1 0C by the mid century					Weather forecast and agro-advisories developed from sourcing data from locally (tehsil level) installed weather stations to be provided to farmers (men and women) on shorter (weekly) frequency
Vindhayan Region					
50 % area of the region have experienced increasing trend in heavy rainfall events while the remaining 50 % have witnessed decreasing trend during 30 years (1981-2010.)	Low percentage (47) of gross irrigated areas to gross area sown 72 % of population have land holding below 1 hectare 64 % population is dependent on farm level activities (agriculture)	Low urbanisation level (15 %) 36 % population is dependent on non- farm activities Poor livestock infrastructure facilities for livestock development. The region has just 2 livestock development centre for every one lakh of livestock population	Droughts increased significantly impacting primary production based livelihood Vector and water borne diseases increased Availability and quality of drinking water adversely impacted In-situ soil moisture content has become serious problem Agriculture and allied sector severely impacted	Increased malnutrition in men, women and children Increased work load on women Increased out migration Loss of bio-diversity Increased energy demand	**Climate Smart Disaster Planning-Development Linkages** Village Disaster Management Committees to be activated and climate-smart VDMPs to be developed, considering local thresholds of extreme events. JFMCs should be oriented on developing Climate Smart Micro Plans considering local thresholds of extreme events.

Disaster management					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic**
The number of extreme rainfall events (days with heavy rainfall) is projected (scenario RCP 4.5 and RCP 8.5) to increase with low confidence from 0.3 to 2.3 days by the mid of century. The trend of consecutive dry days has increased during 1981 to 2010 The number of consecutive dry days is projected to increase by 8 to 19 days (average number of consecutive dry days is 106 days) by the mid of century		Poor composite index of financial inclusion There is only 2 MSMEs for every one lakh population Poor per capita contribution in net domestic product			VDMPs need to be integrated in GPDP for long term preparedness and risk reduction. Resilient Agriculture and water management issues need to be covered in such VDMPs District Disaster Management Plans (DDMPs) need to be climate informed while considering impacted social sectors which enhance the vulnerability of people especially socio-economically weaker communities **Short Term Forecast/ Weather Advisories** Weather forecast and agro-advisories developed from sourcing data from locally (tehsil level) installed weather stations to be provided to farmers (men and women) on shorter (weekly) frequency

Disaster management					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic**
North Eastern Plain					
The region has experienced heavy rainfall events of 41-55 days annually during 30 years (1981-2010) Though the trend of heavy rainfall days during 1981-2010 in the region was decreasing (with low confidence) but it remained above the state average (32.65 days) The heavy rainfall days is projected to decrease by 1-3 days by the mid of century (2050)	More than 45 % of the region is prone to flood and water logging More than 85 % land holdings ae below 1 hectare About 72 percent population is dependent on agriculture activities	60 % area of the region have poor crop diversity index Low level of urbanisation (8%) Only 28% of population are engaged in non-farm activities Low density of road network. Poor per capita contribution in net domestic product Poor composite index of Financial Inclusion Poor forest coverage (only 5% of total area) The number of MSME is below 1 of every per lakh of population	Increased events of intense rainfalls, flash floods Increased duration and areas of water logging Increased humidity adversely impacting crops, human and livestock health; Increase in vector and water borne diseases Increased losses of crop production and deterioration in quality of farm products Increased loss of assets like house and livestock	Increase in Male Migration Increase on work load of women Increased malnutrition impacting health and livelihoods	**Climate Smart Disaster Planning-Development Linkages** Village Disaster Management Committees to be activated and climate-smart VDMPs to be developed, considering local thresholds of extreme events. JFMCs should be oriented on developing Climate Smart Micro Plans considering local thresholds of extreme events. VDMPs need to be integrated in GPDP for long term preparedness and risk reduction. Resilient Agriculture and water management issues need to be covered in such VDMPs

Disaster management					
Climatic variability	**Sensitivity**	**Existing Adaptive capacity**	**Direct impacts**	**Indirect impacts**	**Suggested Adaptive Strategic**
80 % area of the region have experienced increasing trend (with low confidence) of extreme wet days during 1981-2010 The region has witnessed extreme wet days of 71 mm to 111 mm of rainfall in 24 hours during 1981-2010 The extreme wet day events are projected to decrease by 70 % to 80 % area in the region while in remaining 30 to 20 % area the extreme wet days will increase. The number of warm days in the region is projected to increase from 19 to 23 percent by the mid of the century					District Disaster Management Plans (DDMPs) need to be climate informed while considering impacted social sectors which enhance the vulnerability of people especially socio-economically weaker communities **Short Term Forecast/ Weather Advisories** Weather forecast and agro-advisories developed from sourcing data from locally (tehsil level) installed weather stations to be provided to farmers (men and women) on shorter (weekly) frequency

The identified priority sectors, especially Agriculture and Water Resources are quite inter-linked and do have inter-complementarities. Also, the third priority sector – Disaster Management is more of cross-cutting in nature and thus, related DRR measures need to be considered in agriculture development and water resources management. The sectoral strategic options as evolved above, though are specifically mentioned under each sector, but are closely interlinked and hence the synergy should be considered at district, block and village levels in programme operationalization for climate resilience.

- The linked actors and intermediary organizations (MNREGA, FPO, MKSP, JFMC and Water User Associations) under the three priority sectors have significant inter-complementarity at ground level in terms of their objectives, mandates and resources. For climate resilience, the synergy amongst these actors/intermediary organizations at programme planning and implementation level can be an effective strategy – contributing to resource sharing and collective resilience outputs.
- Village level institutional mechanisms are important to be strengthened. Convergence of programmes at Gram Panchayat, GPDP, community institution level can provide sustainability and local ownership of resilience actions
- There are overlaps amongst strategic options for different sectors (Agriculture and Allied activities, Water Resources, Disaster Management). The options have been segregated according to sectors but few of these may be relevant to more than one sector
- Small - Marginal Farmers, Agriculture labors and Women farmers are severely affected groups due to climate change and need to be involved in decision making related to planning and implementation of resilience building interventions. Households which have migrant workers will need specific attention.

9 Capacity Building Needs & Needed Support Mechanism

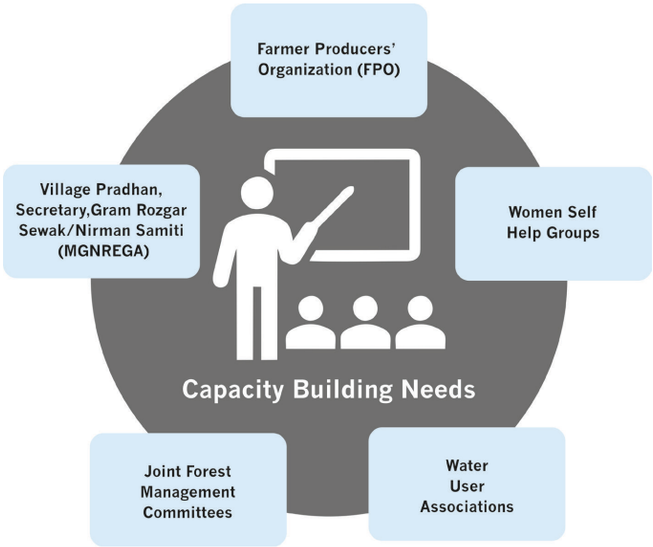
As evident from the analysis in the previous sections of this report, various agro-climatic regions in UP are affected by the adverse impacts of climate-induced disasters, posing challenges to agricultural production, water management and disaster risk reduction.

Towards this, the action needed involve strengthening natural resources and man-made physical capital, and the human capital, i.e. the capacity of people as effective and productive change agents is critical for agricultural and rural development. The schemes and programmes which can directly and indirectly support these priorities need to be identified and the actors involved in such programmes be capacitated for favorable actions on ground.

Capacity building is essential not only in improving knowledge and skills to mitigate climatic impacts but also to foster building and strengthening linkages between community groups and related stakeholders, and intermediary organisations. Small and marginal farmers and women farmers need to be encouraged for participation in such capacity building programmes as they operate in limited resources and are also impacted majorly by climate change. Special emphasis need to be on the capacity building of women farmers who play an important role in contributing to all agricultural activities and are disconnected from the mainstream agricultural programmes.

Further, capacity building initiatives and the resultant climate-resilient interventions will be effective with long lasting impacts only if the components of resilience are mainstreamed in the existing government schemes, plans, actions and are implemented at various levels. Within the broader framework of programmes and schemes, such mainstreaming will be possible if the actors have capacity to comprehend the need and understand the required actions in this regard.

Each of the three identified vulnerable regions under the Scoping Assessment have its own uniqueness in terms of agro-ecology and geo-climate conditions. The resilience interventions need to be developed according to its specific situation. In the current scoping assessment, strategic options were identified for climate resilience around the identified sectors in the three regions. Training needs are required to be identified for the five priority target groups, i.e., Farmers Producer Organizations (FPOs), Women's Groups under the Mahila Kisan Sashaktikaran Pariyojna (MKSP), Water User Associations (WUA), Pradhan, Secretary, Gram Rozgar Sewak/Nirman Samiti under MGNREGA and Joint Forest Management Committees that can help them in addressing strategic options. These groups have been identified as they have the potential scope to integrate climate change adaptation in their areas of operations and can also work as knowledge brokers to disseminate the acquired knowledge down the line to the ground-level communities for enhancing climate resilience.



This part of the report covers specific training needs, based on which training content has been developed for the identified priority groups against the strategic options-explained earlier. Further, the existing flagship programmes and schemes are also mapped that can address the assessed needs of vulnerable target groups across the priority sectors in the selected regions vis-à-vis the evolved strategic options for climate adaptation. If the suggested training needs/ programmes and schemes are relevant to any specific agro-ecological zone, they are mentioned separately. The actors and processes at block, district and state levels engaged in these programmes and schemes are also mapped.

1. Farmer Producers' Organization (FPO)

FPOs which include farmer's federations, cooperatives and producer companies have the potential to better adopt and promote local adaptation strategies at scale that could reduce the impact of short-term climate variability as well as long-term climate change issues on smallholder agriculture. Conventionally FPOs have been mainly engaged in marketing related activities, though their roles go beyond just marketing. In the light of the role that they play in sourcing agricultural inputs, production, processing and value addition, there is significant scope of integrating climate adaptation aspects, helping farmers in better gains and profitability.

Training Needs for Climate Resilience

Evolving Local Solutions

- Orientation on climate change, especially in the local agro-ecological context, short and long term impacts on farming, major resilience strategies related to inputs, crop-diversification, production, processing and value addition Concept, need and methods of developing resilient inputs (viz seeds, bio-manure, bio-pesticides); Certification Methods/Mechanisms for Organic products; Production and Marketing of new crops like Medicinal Plants; produce Water Efficient Irrigation Systems based on non-conventional energy including uses, availability, subsidy etc affordable to small land holding farmers (Bundelkhand and Vindhyan regions)

Resilient Extension

- Orientation on the relevance of short term weather and agro advisories, accessing advisories, and its uses at ground level decision making
- Crop Insurance: access, rights, benefits and claim processes
- Role of Resource and technical Institutions (CIPMC, ICAR, KVK, Agri Universities, RIRD, NGOs), especially located in the region, in providing technical know-how, evolving local demos/solutions to climate change impacts and developing R&D capacities for Participatory Technology Development

Marketing Linkages

- Certification Methods/Mechanisms for Organic products
- Production and Marketing of Medicinal Plants/produce

Suggested Training Content

- The identified vulnerable target groups need to adopt climate resilience measures in their activities. This requires capacity building of the target communities, intermediary organizations working with the target groups and functionaries who are involved in programmes and schemes that can help communities in climate adaptation process.
- Following is the suggested content which may be considered in modules and training programmes for Farmer Producer Organizations:

a. Concept : Climate change impacts and resilience

- Impact of Climate Change (and induced disasters) on Agriculture. Specific impacts on small land holding and women farmers in UP/region
- Climate Change impacting quality of agri-products
- Principles and Approaches of Climate Resilience in Farming and farm System

b. Climate Resilient Agriculture

- Resilient Farm Planning (diversity, complexity, recycling, integration of farm sub-systems, Inter-cropping and crop rotation, Time and Space Management, Water and Nutrient management – in-situ moisture and nutrient conservation)

c. Resilient Extension

- Weather advisories
- Methods of producing resilient farm inputs (seeds, bio-manures, bio-pesticides etc)
- Insurance Schemes

d. Post-harvest linkages

- Mechanisms of reducing perishability of products and safe storage
- Value addition in resilient products- enhancing marketability (organic certification etc)

Relevant Flagship Programmes & Schemes

Based on the evolved training needs of FPOs and the suggested training content for further capacity building programmes, the following flagship programmes and schemes are identified which can be instrumental in addressing the identified capacity gaps for enhancing climate adaptation.

a. Paramparagat Krishi Vikas Yojna (Nodal: Agriculture Department)

PKVY is a 3-years scheme to support farmers under identified cluster in several blocks in a district. The scheme promotes the following activities which are very suitable for climate adaptation interventions:

- 20-hectare demonstration of organic production.
- Organic seed management
- Traditional bio/organic inputs like Jeevamrit, green manuring,
- Botanical extract bio repellent promotion
- Liquid bio fertilizer promotion
- Waste decomposer for crop residue management
- Phosphorus Rich Organic Manure (PROM)
- Crop residue test for nutritional element test
- Organic land conversion (bund formation, bund plantation, deep ploughing etc.), promotion of indigenous pest control
- Organize capacity building program at cluster level (training, farmer exposure etc.)
- Certification of organic production

b. National Mission on Sustainable Agriculture (Nodal: Agriculture Department)

20 model villages for conducting soil testing, training on soil health management, and establish 1-hectare demo plot per village.

c. Promotion of Agriculture Mechanization for in-situ Management of Crop Residue (Nodal: Agriculture Department)

Mechanization promotion through FPO, SHGs and individual farmers in managing crop residue for conservation of environment and ecosystem

d. Pradhan Mantri Fasal Beema Yojna Related Department (Nodal: Agriculture Department)

Registering individual farmers through online portal to get benefits of crop insurance for flood damages.

e. Rajya Sector Yojana (Nodal: Horticulture Department)

To support SC and ST community specially for promoting vegetable production and support in marketing for generating wealth. Under this scheme, government supports in establishing 0.1 - 0.2 ha demo plots for each farmer.

f. National Horticulture Mission (Nodal: Horticulture Department

To support horticulture crop plantation such as banana, guava, rabi season vegetables and mechanization support, poly house promotion, banana ripening chamber, bee keeping

g. Kusum Scheme (Nodal: Agriculture Department/ New & Renewable Energy Development Agency, NEDA)

To support solar irrigation pump among the farmers for saving energy, conserving environment and reducing input cost

Intermediary Organisations

Following intermediary organizations have been identified for FPOs who could be the target groups for training on climate adaptation interventions

- Krishi Vigyan Kendra
- NGO engaged with promotion of FPOs
- Block Development Office (ADO Agriculture and Horticulture Inspector)
- Regional Agriculture University
- Seed Certification Agency (Regional Director, Field Inspectors)
- NABARD District Office
- Extension Agencies (District Extension Officer and Block level officials)

The sustainable livelihoods framework helps to organize the factors that constrain or enhance livelihood opportunities and shows how they relate to one another. A central notion is that different households have different access to livelihood assets, which the sustainable livelihood approach aims to expand. The livelihood assets, which the poor must often make trade-offs and choices about, comprise:

» Human capital, e.g., health, nutrition, education, knowledge and skills, capacity to work, capacity to adapt

» Social capital, e.g., networks and connections (patronage, neighborhoods, kinship), relations of trust and mutual understanding and support, formal and informal groups, shared values and behaviors, common rules and sanctions, collective representation, mechanisms for participation in decision-making, leadership

» Natural capital, e.g., land and produce, water and aquatic resources, trees and forest products, wildlife, wild foods and fibers, biodiversity, environmental services

» Physical capital, e.g., infrastructure (transport, roads, vehicles, secure shelter and buildings, water supply and sanitation, energy, communications), tools and technology (tools and equipment for production, seed, fertilizer, pesticides, traditional technology)

» Financial capital, e.g., savings, credit and debt (formal, informal), remittances, pensions, wages

Training Institutions

The following training institutions were mapped which can support in providing relevant trainings for FPOs to integrate climate adaptation interventions:

- Krishi Vigyan Kendra (local level)
- Regional/District Institute of Rural Development, RIRD/DIRD (District level)
- Central Integrated Pest Management Training Centre (Regional level)
- Food Processing Training Centre (District level)
- Bankers Institute of Rural Development, BIRD (State level)

2. Women Self Help Groups (Mahila Kisan Sashaktikaran Pariyojna)

The Mahila Kisan Sashaktikaran Pariyojna (MKSP) aims at empowering women in agriculture by strengthening community institutions of poor women farmers and leverage their strength to promote sustainable agriculture. The Village Organizations (Self Help Groups under MKSP), Cluster Level Federations and UPSRLM are the three main levels in operational mechanism of the programme. Pashu Sakhi and Krishi Sakhi, selected on every 70 SHG members, play an important role in providing service and information.

With the defined objectives of enhancing women's participation and productivity by establishing local resources for sustainable agriculture based livelihoods the suggested strategies include adoption of locally and environment-friendly technologies and resource cons ervation. Ignoring climate resilience dimensions in the activities can compromise achievements on objectives of the programme. Integrating climate resilience will need adequate capacity building of functionaries involved with planning and management of programmes along with women farmers.

Training Needs for Climate Resilience

Self-Reliance in Resilience

- Farm planning- diversity/complexity in farm sub-systems, bio-input production (manure, seeds, bio-pesticides), time and space management, agro-forestry
- (in-situ soil conservation in Bundelkhand and Vindhyan regions)
- Participatory Resilient Technology Development with the synergy of science and technology, local wisdom and local resources
- Time and space management in small farms for reduced losses and resilience (multi-tier, agro-forestry, crop rotation, etc.) (esp in North Eastern region)

Enhancing Ecosystem Services

- Role of natural resources and linkage of farm with ecosystem services and need to conserve natural resources (waterbodies, green areas etc) (both in drought and flood affected regions for varying roles)

Resilient Extension

- Training of Trainers for developing women Master Trainers for Resilient Farming
- Relevant programmes and schemes helpful in resilience building including required institutional credits
- Crop and livestock Insurance: access, rights, benefits and claim processes
- Orientation on relevance and linkage with climate services- weather forecasts and advisories with adequate focus on actions to be taken

Suggested Training Content

1. Concept: Climate Change and Impacts on Women Farmers

- Impact of Climate Change (and induced disasters) on Agriculture, Horticulture and Livestock (including poultry). Specific impacts on small land holding and women farmers
- Dimensions of differential impacts of climate change on women and, men, farmers (income, livelihood, increasing work pressures, social aspects etc.)

2. Climate Resilience in Agriculture Based Livelihoods

- Principles and Approaches of Climate Resilience in Agriculture and allied activities (livestock, poultry, fisheries, agriculture based entrepreneurship etc)
- Resilient Farm Planning (diversity, complexity, recycling, integration of farm sub-systems, Inter-cropping and crop rotation, Time and Space Management, Water and Nutrient management – in-situ moisture and nutrient conservation, Agro-Forestry)

3. Climate Resilience and Natural Resource Management

- Contribution of Natural Ecosystems and conservation needs
- Watershed/Landscape Management

4. Resilient Extension

- Access and Use of weather advisories
- Methods of producing resilient farm inputs (seeds, bio-manures, bio-pesticides etc): Linkages with resource institutions
- Immunization and care of livestock (in the context of climate shocks and stresses)
- Insurance Schemes

5. Post-Harvest care and Marketing

- Mechanisms of reducing perishability of products and safe storage
- Value addition, Certification (organic, food products)
- Collective Marketing- access to better price

Communication skills of trainers and women farmers on climate resilient practices (esp Krishi Sakhi and Pashu Sakhi) in agriculture-based livelihoods should also be included as part of the training content.

Relevant Flagship Programmes & Schemes

Based on the evolved training needs of women's groups under the MKSP and the suggested training content for further capacity building programmes, the following flagship programmes and schemes were identified which can be instrumental in addressing the identified capacity gaps for enhancing climate adaptation.

1. Paramparagat Krishi Vikas Yojna (Nodal: Agriculture Department)

PKVY is a 3-years scheme to support farmers under identified cluster in several blocks in a district. The scheme promotes the following activities which are very suitable for climate adaptation interventions:

- 20-hectare demonstration of organic production.
- Organic seed management
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- Waste decomposer for crop residue management
- Phosphorus Rich Organic Manure (PROM)
- Crop residue test for nutritional element test
- Organic land conversion (bund formation, bund plantation, deep ploughing etc.), promotion of indigenous pest control
- Organize capacity building program at cluster level (training, farmer exposure etc.)
- Certification of organic production

2. National Mission on Sustainable Agriculture (Nodal: Agriculture Department)

20 model villages for conducting soil testing, training on soil health management, and establish 1-hectare demo plot per village.

3. Promotion of Agriculture Mechanization for in-situ Management of Crop Residue (Nodal: Agriculture Department)

Mechanization promotion through FPO, SHGs and individual farmers in managing crop residue for conservation of environment and ecosystem

4. Pradhan Mantri Fasal Beema Yojna Related Department (Nodal: Agriculture Department)

Registering individual farmers through online portal to get benefits of crop insurance for flood damages.

5. Rajya Sector Yojana (Nodal: Horticulture Department)

To support SC and ST community specially for promoting vegetable production and support in marketing for generating wealth. Under this scheme, government supports in establishing 0.1 - 0.2 ha demo plots for each farmer.

6. National Horticulture Mission (Nodal: Horticulture Department

To support horticulture crop plantation such as banana, guava, rabi season vegetables and mechanization support, poly house promotion, banana ripening chamber, bee keeping

7. Kusum Scheme (Nodal: Agriculture Department/ New & Renewable Energy Development Agency, NEDA)

To support solar irrigation pump among the farmers for saving energy, conserving environment and reducing input cost.

Intermediary Organisations

Following intermediary organizations have been identified for FPOs who could be the target groups for training on climate adaptation interventions:

- Krishi Vigyan Kendra
- NGO engaged with promotion of FPOs
- Block Development Office (ADO Agriculture and Horticulture Inspector)
- Regional Agriculture University
- Seed Certification Agency (Regional Director, Field Inspectors)
- NABARD District Office
- Extension Agencies (District Extension Officer and Block level officials)

Training Institutions

The following training institutions were mapped which can support in providing relevant trainings for FPOs to integrate climate adaptation interventions:

- Krishi Vigyan Kendra (local level)
- Regional/District Institute of Rural Development, RIRD/DIRD (District level)
- Central Integrated Pest Management Training Centre (Regional level)
- Food Processing Training Centre (District level)
- Bankers Institute of Rural Development, BIRD (State level)

2. Women Self Help Groups (Mahila Kisan Sashaktikaran Pariyojna)

The Mahila Kisan Sashaktikaran Pariyojna (MKSP) aims at empowering women in agriculture by strengthening community institutions of poor women farmers and leverage their strength to promote sustainable agriculture. The Village Organizations (Self Help Groups under MKSP), Cluster Level Federations and UPSRLM are the three main levels in operational mechanism of the programme. Pashu Sakhi and Krishi Sakhi, selected on every 70 SHG members, play an important role in providing service and information.

With the defined objectives of enhancing women's participation and productivity by establishing local resources for sustainable agriculture based livelihoods the suggested strategies include adoption of locally and environment-friendly technologies and resource cons ervation. Ignoring climate resilience dimensions in the activities can compromise achievements on objectives of the programme. Integrating climate resilience will need adequate capacity building of functionaries involved with planning and management of programmes along with women farmers.

Training Needs for Climate Resilience

Self-Reliance in Resilience

- Farm planning- diversity/complexity in farm sub-systems, bio-input production (manure, seeds, bio-pesticides), time and space management, agro-forestry
- (in-situ soil conservation in Bundelkhand and Vindhyan regions)
- Participatory Resilient Technology Development with the synergy of science and technology, local wisdom and local resources
- Time and space management in small farms for reduced losses and resilience (multi-tier, agro-forestry, crop rotation, etc.) (esp in North Eastern region)

Enhancing Ecosystem Services

- Role of natural resources and linkage of farm with ecosystem services and need to conserve natural resources (waterbodies, green areas etc) (both in drought and flood affected regions for varying roles)

Resilient Extension

- Training of Trainers for developing women Master Trainers for Resilient Farming
- Relevant programmes and schemes helpful in resilience building including required institutional credits
- Crop and livestock Insurance: access, rights, benefits and claim processes
- Orientation on relevance and linkage with climate services- weather forecasts and advisories with adequate focus on actions to be taken

Suggested Training Content **1. Concept: Climate Change and Impacts on Women Farmers**

- Impact of Climate Change (and induced disasters) on Agriculture, Horticulture and Livestock (including poultry). Specific impacts on small land holding and women farmers
- Dimensions of differential impacts of climate change on women and, men, farmers (income, livelihood, increasing work pressures, social aspects etc.)

2. Climate Resilience in Agriculture Based Livelihoods

- Principles and Approaches of Climate Resilience in Agriculture and allied activities (livestock, poultry, fisheries, agriculture based entrepreneurship etc)
- Resilient Farm Planning (diversity, complexity, recycling, integration of farm sub-systems, Inter-cropping and crop rotation, Time and Space Management, Water and Nutrient management – in-situ moisture and nutrient conservation, Agro-Forestry)

3. Climate Resilience and Natural Resource Management

- Contribution of Natural Ecosystems and conservation needs
- Watershed/Landscape Management

4. Resilient Extension

- Access and Use of weather advisories
- Methods of producing resilient farm inputs (seeds, bio-manures, bio-pesticides etc): Linkages with resource institutions
- Immunization and care of livestock (in the context of climate shocks and stresses)
- Insurance Schemes

5. Post-Harvest care and Marketing

- Mechanisms of reducing perishability of products and safe storage
- Value addition, Certification (organic, food products)
- Collective Marketing- access to better price

Communication skills of trainers and women farmers on climate resilient practices (esp Krishi Sakhi and Pashu Sakhi) in agriculture-based livelihoods should also be included as part of the training content.

Relevant Flagship Programmes & Schemes

Based on the evolved training needs of women's groups under the MKSP and the suggested training content for further capacity building programmes, the following flagship programmes and schemes were identified which can be instrumental in addressing the identified capacity gaps for enhancing climate adaptation.

1. National Mission on Agricultural Extension & Technology (NMAET) – Sub-Mission on Agricultural Extension (SAME) (Nodal: Agriculture Department)

- Support for Women Food Security Groups (FSGs)
- Groups exclusively of women farmer established and supported under ATMA Cafeteria as a mandatory activity @ Rs.0.10 lakh per group/year to achieve food security at the domestic/ house hold level through setting up of kitchen garden, promoting off farm activities such as piggery, goat-rearing, bee-keeping etc. Support available for at least 2 FSGs/Block.

2. National Mission on Oilseeds & Oil Palm (NMOOP) (Nodal: Agriculture Department)

- Promoting Women Groups.
- SHGs/ FIGs/FPOs/Women groups/Co-operatives etc.to be involved by the States in distribution of
- Certified Seeds.
- State Government to setup/start joint venture/lease out seed gardens to farmers' Self Help Groups/ FIGs/Women Group / Cooperative Societies/FPOs.
- States to support Farmer's association/Self Help Groups /Farmer Groups/Women Groups /Cooperative Societies for this component under AAP.
- Farmers associations / FPOs/ FIGs / SHGs / Women Groups, cooperatives /federations would be eligible for assistance for installation of Pre-processing, Processing and oil extraction equipment/devices under Mini Mission -III for the prescribed TBOs.
- Provision available under the Mission for involvement of Co-operative Societies, Self Help/ Women Groups/FIGs/FPOs etc., in implementation of the Mission

3. Scheme/Programme: National Mission for Sustainable Agriculture (NMSA) (Nodal: Agriculture Department)

- At least 50% of the allocation is to be utilized for small, marginal farmers of which at least 30% are women beneficiaries/farmers. For Soil & water conservation; Water use efficiency; Soil health management and Rain-fed Area Development

4. Mahila Haat (Nodal: Department of Women and Child Development)

- Mahila Haat is an initiative for meeting aspirations and needs of women entrepreneurs. It is an online marketing platform for women, where participants can display their products. It is an initiative for women across the country as a part of 'Digital India' and 'Stand Up India' initiatives. The platform has been set up by the Ministry of Women and Child Development, Government of India under Rashtriya Mahila Kosh (RMK).

5. Backyard Poultry Development Program under National Livestock Mission (Nodal: Animal Husbandry Department)

- Under the Department of Animal Husbandry, Dairying and Fisheries (DADF), poultry development programmes are implemented through state authorities.
- The national government's rural backyard poultry development scheme, meanwhile, is a centrally sponsored programme where the government contributes to supplying chicks to farmers who are below the poverty line. In case of north-eastern states, the government provides 100 percent support for this provision.
- As per government guidelines, about 25 percent of funds have to be spent on promoting backyard poultry among qualifying groups of farmers, whereas 30 percent of the allocation must be earmarked for women beneficiaries. Under the scheme, state authorities are to ensure adequate health coverage while implementing the programme.

6. National Horticulture Mission (NHM) (Nodal: Horticulture Department)

- This is one of the sub schemes of Mission for Integrated Development of Horticulture (MIDH) which is being implemented by State Horticulture Missions (SHM) in selected districts of 18 States and 6 Union Territories. For availing benefits and assistance under the scheme, farmers / beneficiaries should contact the Horticulture Officer of concerned district.
- The scheme recommends preference be given to small, marginal and women farmers and beneficiaries on Nursery rising of vegetable and fruit plant.

Intermediary Organisations

Following intermediary organizations have been identified for women groups under MKSP who could be the target groups for training on climate adaptation interventions:

- NGOs working in SRLM
- Gram Panchayat
- Krishi Vigyan Kendra
- Block Development Office (Youth Professional Agriculture- specially deputed for MKSP, ADO Panchayat and Horticulture Officer)
- Animal Husbandry Department
- Regional Agriculture University
- Extension Agencies (District Extension Officer and Block level officials)
- Banks related to credit of SHGs/MKSP groups

Training Institutions

The following training institutions were mapped which can support in providing relevant trainings to women's groups under MKSP to integrate climate adaptation interventions:

- State Institute of Rural Development (SIRD) – linked State Resource Persons for MKSP (State); District Resource Persons (District) and Block Resource Persons (BRP)
- Regional/District Institute of Rural Development (Agriculture related trainings) (District)
- Krishi Vigyan Kendra (Regional)
- National Institute of Rural Development, Hyderabad (National)

3. Village Pradhan, Secretary, Gram Rozgar Sewak/Nirman Samiti (MGNREGA)

The Village Pradhan, Secretary, Gram Rozgar Sewak/Nirman Samiti) are key to plan and implement MGNREGA activities at the grass-root level for the improvement of rural life and economy. Though under the MGNREGA scheme, climate change components are not explicitly

stated to respond to climate-induced risks and provide more resilient livelihoods or assets. However, the inherent features or activities being conducted under the scheme contributes significantly to reduce climate-induced vulnerabilities if implementation mechanisms are made sensitive to climate resilience needs at ground level.

There are 260 combinations of activities that are permissible under MGNREGA of which 181 are associated with natural resources management and 164 are related to agriculture and allied activities. Most of these activities are critical from the perspective of climate resilience. So considering the provisions under the program and its inherent characteristics, mainstreaming climate resilience components into the planning process of Gram Panchayat Development Plan and developing climate resilient assets under the MGNREGA would be a critical initiative. However, such integration/ mainstreaming in the programme requires strong coordination among these grassroots level

key functionaries and needs large scale awareness and capacity building components to translate their plans into climate-sensitive action and assets creation.

Training Needs for Climate Resilience

Participatory climate risk analysis and the identification of mitigation and adaptation actions that can be leveraged through MGNREGS resources (e.g. plantation, drainage improvement, check dams, waterbodies)

- Integration of climate change components into Gram Panchayat Development Plans.
- Database generation on groundwater level, rainfall and water quality for water budgeting and preparation of Water Security Plan
- Integration of natural resource management for long term GPDP planning.
- Capacity building on disaster resilient agriculture and water management techniques

Suggested Training Content

Considering the above-mentioned training needs and existing intermediary groups/organizations, the training content and its sub contents are designed with the objectives to enhance the skill of the target group and intermediary organization/group. This will help the target group to introduce climate-resilient design, planning, selection, and maintenance of the assets created under the MGNREGA, and set themselves on a path out of poverty and into climate-resilient livelihoods.

The training contents may be grouped into two broad categories:

1. **Differential impacts of climate change on women and, men, farmers (income, livelihood, increasing work pressures, social aspects etc.)**

2. **Climate smart local area development planning**

   - Concept of climate smart local area planning
   - Participatory climate risk analysis
   - Identification of mitigation and adaptation actions (e.g. plantation, drainage improvement,

check dams, waterbodies) and avenues to leverage fund through MGNREGS resources

- Develop planning and financing mechanisms for integrated and climate-adapted management of water resources in rural areas. Integration of climate change components into Gram Panchayat Development Plans.
- Database generation on groundwater level, rainfall and water quality for water budgeting and preparation of Water Security Plan in water stress regions (Bundelkhand and Vindhyan)
- Dimensions related to gender budgeting

3. Strengthening ecosystem services for resilient livelihoods

- Integration of natural resource management for long term GPDP planning of resource (soil and water) conservation and management
- Promote demonstrations on climate-adapted approaches on integrated management of water resources at local level
- Strengthen private sector cooperation for integrated and climate-adapted management of water resources at local levels.
- Capacity building on disaster resilient agriculture and water management techniques

Relevant Flagship Programmes & Schemes

The program MGNREGS is itself a National flagship scheme that has a well-established mechanism for planning, delivering and monitoring expenditure for developing durable assets creation and resource generation through the hand of poor rural households. It has immense scope to converge with other key schemes to generate guaranteed wages to build climate resilient rural infrastructure, rural institutions, and new skills. The schemes are as under:

1. **Pradhan Mantri Krishi Sinchayee Yojana:**

The programme is being implemented by the Ministries of Agriculture, Water Resources and Rural Development. PMKSY has combined ongoing schemes viz. Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Water Resources, River Development & Ganga Rejuvenation (MoWR, RD&GR), Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DoLR) and the On-Farm Water Management (OFWM) of Department of Agriculture and Cooperation (DAC). It focuses on rejuvenation of old canals, irrigation tank, construction of farm pond, drainage line treatment, soil and moisture conservation, rain water harvesting, nursery raising, afforestation, horticulture, pasture development, livelihoods for asset-less persons, and earthen dam etc. There is a huge scope of convergence with the MGNREGA programme to incorporate climate-resilient infrastructure development with the fund of IWMP. The group may be aware to use the fund of IWMP for assets building at a local level whereas the wage component can be leveraged from MGNREGA

2. **Fourteenth Finance Commission grants:**

The 14th Finance Commission also grants fund to local bodies (gram panchayat) for local areas development planning and delivering of basic services like water supply, storm water drainage management, maintenance of community assets, and maintenance of road, etc.

3. **National Horticulture Mission (NHM):**

This mission is being implemented by the Horticulture Division in the Department of Agriculture & Cooperation. The mission aims to enhance horticulture production, income support to farm households, create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth, and promote resilient farming technologies, with the synergy of traditional wisdom and modern scientific knowledge. The mission has scope to converge with MGNREGS and undertake activities for long term planning of natural resource management. Apart from this, the mission has a provision to distribute resilient seeds and bio fertilizers from NRHM to farmer whose land has been improved using MGNREGA funds.

4. **National and State Rural Livelihood Mission (NRLM and SRLM):**

NRLM and SRLM is being implemented by the Department of Rural Development of National and State government. It aims to alleviate rural poverty and create sustainable livelihood opportunities for the rural poor. The mission has provision to provides skills training to learn new trades, receive training to launch entrepreneurial activities or learn skills to improve existing agricultural livelihoods to individuals from MGNREGS households.

5. **Program on Water security and climate adaptation in rural areas (WASCA):**

The Programe aims towards improving rural water resource management with regard to enhance water security and climate adaptation at the national level and in four States namely Rajasthan, Madhya Pradesh, Uttar Pradesh and Tamil Nadu. The programme focusses on to develop comprehensive water database in public domain and assessment of the impact of climate change on water resource, promotion of citizen and state actions for water conservation, augmentation and preservation, increasing water use efficiency by 20% and focused attention to vulnerable areas including over-exploited areas.

Intermediary Organisations

Following intermediary organizations have been identified for MGNREGA who could be the target groups for training on climate adaptation interventions:

- Block Office (Programme Officer/Block Development Officer)
- District Panchayat office (District Programme Coordinator)
- Civil Society Organizations
- District key line departments (Agriculture, Panchayati Raj, Department of Rural Development, Department of Land Resources and Department of Drinking Water and Sanitation), and Self-Help Groups (SHGs)
- State Employment Guarantee Council (at state level)

Training Institutions

- The following training institutions were mapped which can support in providing relevant trainings to MGNREGA to integrate climate adaptation interventions:
- Panchayat Resource Centre
- District Institute of Rural Development
- Regional Institute of Rural Development
- State Institute of Rural Development & Panchayati Raj

4. Water User Associations

Farmer groups have come together to form Water User Associations (WUAs) for Participatory Irrigation Management (PIM) to mitigate climate risk by building, maintaining and managing water-harvesting structures and irrigation management processes and systems. Some of these associations are further facilitating farmers by bringing additional dimensions like forward and backward linkages in agriculture value chains. Beyond their role as 'water user', there is ample scope of their active role as 'water conservators' also. Given that the WUAs play a predominant role in participatory management of water resources, there is ample scope for integrating climate adaptation aspects through appropriate training and capacity building of the WUAs and the related intermediary organisations.

Training Needs for Climate Resilience

The evolved training needs of WUAs include:

- Watershed management: Training on watershed management concepts (scientific and social), soil moisture conservation, natural resources management, community ownership and sustainability
- Participatory Groundwater Management: Training on participatory groundwater management (PGWM) and aquifer mapping with clear understanding of scientific concepts and local knowledge, augmentation of local water sources for recharging, developing water security plans, integration of PGWM with NREGA activities
- Farm Ponds: Training on scientific methods of constructing farm ponds as per local ecology; mobilizing communities for promoting farm ponds which are helpful for agricultural purposes and also for groundwater recharge (especially in Bundelkhand and Vidhyan regions); economic activities that can be promoted through farm ponds.
- Water Budgeting: Training on participatory water budgeting and conservation; crop water budgeting tools
- (promoted by India Observatory), integration of water budgeting activities with GPDP plans for mainstreaming and implementation
- Soil moisture conservation: Training on various methods that promote in-situ soil moisture conservation such as mulching techniques, use of trenches, farm bunds, etc. and its integration with NREGA activities and in GPDP plans
- Conservation of waterbodies: Training on mapping and geo-tagging of waterbodies, monitoring base flows and water levels in waterbodies, rejuvenation and re-charging of ponds and waterbodies, rainwater harvesting and revival of water streams
- Drainage improvement: Training on Participatory GIS-based microplanning for drainage improvement/ development at village level according to the local flood/waterlogging thresholds.
- Conjunctive use of water resources (surface and ground water), efficient irrigation mechanisms, promotion of agro-forestry, resilient crop varieties (as per drought/flood situations)

Suggested Training Content

1. Dimensions of differential impacts of climate change on women and, men, farmers (income, livelihood, increasing work pressures, social aspects etc.)
2. Natural resources management considering short and long term climate variability and impacts

- Watershed – local area development approach
- In-situ soil moisture conservation
- Scientific methods of constructing farm ponds
- Waterbody conservation

3. Conjunctive use of water resources (surface and ground water)

- Efficient irrigation mechanisms
- Operation and maintenance of irrigation and drainage systems
- Resilient crop varieties (as per drought/flood situations)
- Agriculture extension and farmers' training on efficient water use
- Promotion of Agro-Forestry

Relevant Flagship Programmes & Schemes

1. Atal Bhujal Yojana under National Groundwater Management Improvement Scheme (Nodal: Water Resources

Department): The development objective of Atal Bhujal Yojana (ABHY) - National Groundwater Management Improvement Program for India is to improve the management of groundwater resources in selected states. The activities under the program are mapped to the two results areas. Activities under Results Area 1 focusses on:

(a) introducing bottom-up planning of groundwater interventions through community-led Water Security Plan (WSPs);

(b) improving government spending through the planning process; and

(c) implementing participatory groundwater management, including both supply and demand side measures.

2. Command Area Development for Water Management (CAD&WM) Programme (Nodal: Water Resources

Department): The main objective of CAD&WM Programme is to enhance utilization of irrigation potential created and improve agriculture productivity and production on a sustainable basis through integrated and coordinated approach involving multidisciplinary team.

3. Pradhan Mantri Krishi Sinchayee Yojana (Nodal: Agriculture Department) :

The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation 'Har Khet ko pani' and improving water use efficiency 'More crop per drop' in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities.

Intermediary Organisations

- Kulaba Samiti (Outlet Level Committee)
- Alpika Samiti (Minor Irrigation Committee)
- Rajbaha Samiti (Distributary level Committee)
- Agriculture department
- Horticulture department

- Irrigation department
- NGOs (called as “Social Facilitators”)

Training Institutions

The following training institutions were mapped which can support in providing relevant trainings to Water User Associations to integrate climate adaptation interventions:

- Water and Land Management Institute (WALMI)
- State Institute of Rural Development
- District/Regional Institute of Rural Development

5. Joint Forest Management Committees

The impacts of climate change are making the natural resources extremely vulnerable and more so, the people

who are dependent on it. While forests provide rich biological diversity and sustenance to many forest dwelling

communities in the state, they are now under severe pressure to supply goods and services due to the declining

quality of the forest area that has become a major concern. The Joint Forest Management has a critical role to play in increasing adaptation at the local level. However, JFM/JFMCs in its current form has limitations in delivering

adaptive strategies. Empowering communities through increased legal rights and ownership of resources along with an enabling environment for sharing of knowledge and resources will help JFM in delivering adaptation strategies and making local systems resilient to climatic changes.

Training Needs for Climate Resilience

1. Members to be oriented on climate change, especially promote adaptation and mitigation measures that increase sequestration in sustainably managed forests and other eco-systems, adaptation of vulnerable species/ ecosystems
2. Identification of resilient fodder seeds, plant species as per agro-climatic zone
3. Hands on training on cultivation of Minor Forest Produce (MFP), medicinal plants, nursery development, pasture development for fodder and plantation of fruit trees/ orchards
4. Production, processing and marketing of medicinal plants/produce
5. Linkage with resource and technical Institutions like Forest Research Institute, Central Grassland Research Institute, Integrated Grassland and Fodder Research Institute, Central Agro forestry Research Institute for providing technical know-how, evolving local demos/ solutions to climate change impacts and developing R&D capacities for Participatory Technology Development
6. Participatory Rural Appraisal (PRA) is the instrument for preparing the micro plan, so training on PRA tools and techniques for preparing the micro plan is essential for JFMC members

7. JFMC Members to be oriented on the integrated farming system (IFS)

8. Subject specialized training program on agro forestry, livestock, agriculture, fishery etc.

9. JFMC Members to be oriented on Natural Resource Management like soil, forest, water body, organic farming etc. in the face of climate change

10. Training on local breed animal rearing, animal epidemic diseases

11. Orientation on non-timber forest produce (NTFP) activities and Sustainable Forest Development

12. Orientation on farm bund plantation and barren land plantation

13. Training on Seed orchard, Plus trees, Managing Small Forestry Enterprises

14. Training to integrate participatory watershed approach in micro planning of JFM supporting the entire livelihood system of the local community

15. Training /orientation to promote water harvesting structures such as check dams, nala bund, farm ponds, tanks etc on massive scale to saturate large masses of area for efficient groundwater recharge

16. Orientation on water budgeting process and its integration in their micro plan

17. Training of JFMC members especially SHGs on structure of water user associations, their active participation and leadership, efficient irrigation, re-charge of ground water and agro-forestry

18. Orientation to integrate climate change components into JFM Micro Plans.

19. Capacity building of the JFMCs members on disaster resilient techniques and water management issues

Suggested Training Content

1. Climate Change and its Impact on Forestry and Forest dwellers

- The role of forests in climate change adaptation and mitigation
- Impact of climate change (and induced disasters) on Forestry, Agro- Forestry, and forest eco-systems,
- Impact of climate change on forest dwellers and forest base livelihood
- Differential impacts of climate change on women and, men, farmers (income, livelihood, increasing work pressures, social aspects etc.)

2. Climate Resilience in Forest dependent Livelihoods systems

- Principles and Approaches of Climate Resilience in forest-based livelihood activities (cultivation of Minor Forest Produce (MFP), Agro forestry, medicinal plants, nursery development, pasture development for fodder and plantation of fruit trees/ orchards)
- Approaches of integrated farming system (IFS), Natural Resource Management like soil, forest, water body, organic farming etc. in the face of climate change
- Non-timber forest produce (NTFP) activities and Sustainable Forest Development

3. Climate resilient micro planning

- Concepts of climate resilient micro planning
- PRA as an instrument for preparing resilient micro plan

4. Linkages with resource institutions

- Access and use of weather advisories
- Methods of producing resilient inputs e.g. resilient fodder seeds, Plus tree, plant species as per agro-climatic zone
- Linkages with schemes & Program

5. Marketing of MFPs

- Mechanisms of reducing perishability of products and safe storage
- Value addition, Certification
- Collective Marketing- access to better price

Relevant Flagship Programmes & Schemes

1. Social Forestry (Nodal: Department of Environment, Forest and Climate Change):

This is a major scheme funded by State Government of UP for tree plantation. Plantations is carried out on various type of community land, canals, rail, and on land available on road side to ensure the availability of timber, fuel wood, fodder, small forest produce etc., in rural areas of all the districts in the state. This ensures the availability of raw material for small timber industries for rural people.

2. Green belt development scheme (Nodal: Department of Environment, Forest and Climate Change):

Green belt development scheme is a high priority scheme of the Govt of UP. In view of this tree plantations are carried out from the year 2012-13 through the financing from forest corporation and green belt development scheme has been started in the year 2013-14. This is scheme implemented in the entire state.

3. **Sub mission on Agro forestry (Under National Mission for Sustainable Agriculture) (Nodal: Department of Agriculture, Cooperation and Farmers Welfare):**

Agroforestry is known to have the potential to mitigate the climate change effects through microclimate moderation, conservation of natural resources and creation of additional source of livelihood and income opportunities. The Sub-Mission on Agroforestry under NMSA is an initiative to expand the tree coverage on farmland in complementary with agricultural crops. The mission is focused to achieve the quantifiable benefits such as increase tree cover to enhance carbon sequestration, enrichment of soil organic matter, availability of quality planting material, improvement in livelihood, productivity enhancement of crop and cropping systems, development of an information system etc.

4. **National afforestation program (NAP) (Nodal: Forest Development Agency):**

scheme is to develop the forest resources with people's participation, with focus on improvement in livelihoods of the forest-fringe communities, especially the poor. NAP Scheme aims to support and accelerate the ongoing process of devolving forest protection, management and development functions to decentralized institutions of JFMCs at the village level, and Forest Development Agency at the forest division level.

The NAP is being implemented through a 2-tier structure of Forest Development Agency at the forest division level and JFMCs at the village level.

Intermediary Organisations

- Chief Forest Conservator, State Forest Department
- District Forest Officer (DFO)
- Range Office (Ranger, Van Daroga)
- DRDA

Training Institutions

The following training institutions were mapped which can support in providing relevant trainings to JFMCs to integrate climate adaptation interventions:

- State Forest Training Institute
- NABARD

Summarizing Training Institutions vis-à-vis Intermediary Organisations

The below table 18 summarizes the training institutions which impart trainings to various intermediary organizations in UP.

Table 18 : Training Institutions vis-à-vis Intermediary Organisations

Training Institution	Intermediary Organizations
State Institute of Rural Development (SIRD)/ Regional Institute of Rural Development/District Institute of Rural Development	Block Development Office (ADO Agriculture, ADO Panchayat and Horticulture Inspector, Professional Agriculture deputed for MKSP District key line departments (Agriculture, Panchayati Raj, Department of Rural Development, Department of Land Resources and Department of Drinking Water and Sanitation), Extension Agencies (District Extension Officer and Block level officials) NGOs working in SRLM Gram Panchayat Water User Association Committees (Kulaba Samiti, Alpika Samiti, Rajbaha Samiti) Irrigation Department CSOs associated with Water User Associations (Social Facilitators)
State Forest Training Institute, Uttar Pradesh	Divisional Forest Officer (DFO) Range Officers (Ranger, Van Daroga) JFM Committees
Bankers Institute of Rural Development, Uttar Pradesh	NGO engaged with promotion of FPOs NABARD District Office Banks related to credit of SHGs/MKSP groups
Panchayati Raj Institute of Training, Uttar Pradesh	Gram Panchayat ADO Panchayat

Actors in Various Programmes/Schemes Across Priority Sectors

In operationalizing the programmes and schemes related to FPOs, SHGs under MKSP, Water User Associations, Pradhan, Secretary, Gram Rozgar Sewak/Nirman Samiti under MGNREGA, and JFMCs as listed above, various actors are involved at different levels who are engaged in the process of operationalization of these schemes. As purpose and objectives of the target groups have some commonalities, a number of schemes are common with overlaps. Hence, the actors for the identified target groups are being provided in following table:

Table 19 : Mapping actors across schemes and programmes

Scheme/Programme	Actors: Block level	Actors: District level	Actors: State Level
Pradhan Mantra Krishi Vikas Yojna (PKVY)	Assistant Development Officer, Agriculture (ADO, Ag)	Deputy Director Agriculture (DD Ag)	Joint Director Agriculture (JDA)
National Mission on Sustainable Agriculture(NMSA)	Assistant Development Officer, Agriculture (ADO-Ag)	District Agriculture Officer (DAO)	Director, Agriculture
Promotion of Agriculture Mechanization for in-situ Management of Crop Residue	Assistant Development Officer, Agriculture (ADO-Ag)	Deputy Director Agriculture(DD Ag)	Joint Director Agriculture (JDA), Engineering Section
Pradhan Mantri Fasal Beema Yojna (PMFBY)	Assistant Development Officer, Agriculture(ADO-Ag)	Deputy Director Agriculture (DD Ag)	Joint Director Agriculture (JDA) Statistics
Rajya Sector Yojana	Assistant Horticulture Officer	District Horticulture Officer	Director of Horticulture and Food Processing Department
National Horticulture Mission (NHM)	Horticulture Inspector(HI) & Assistant Horticulture Inspector(AHI)	District Horticulture Officer (DHO)	Director, Horticulture/Mission
Kusum Scheme	Assistant Development Officer, Agriculture(ADO, Ag)	Deputy Director Agriculture (DD Ag)	Joint Director Agriculture (JDA), Engineering Section
National Mission on Agricultural Extension & Technology (NMAET) – Sub- Mission on Agricultural Extension (SAME)	Assistant Development Officer, Agriculture (ADO, Ag)	District Agriculture Officer (DAO)	Director, Agriculture
National Mission on Oilseeds & Oil Palm (NMOOP)	Assistant Development Officer, Agriculture(ADO, Ag)	District Agriculture Officer (DAO)	Director, Agriculture

Scheme/Programme	Actors: Block level	Actors: District level	Actors: State Level
Backyard Poultry Development Program under National Livestock Mission	Veterinary Officer	Chief Veterinary Officer(CVO)	Director, Animal Husbandry
Pradhan Mantri Krishi Sinchayee Yojana	Assistant Development Officers (Agriculture)	Deputy Director Agriculture (DD-Agri)	Director Agriculture), Agriculture department
Fourteenth Finance Commission grants	Assistant development officer (Panchayat)	District Panchayati Raj Officer (DPRO)	Secretary Panchayati Raj, Govt. of U.P.
National Horticulture Mission (NHM)	District Horticulture Inspector, Assistant Horticulture Inspector	District Horticulture Officer	Director (Horticulture) Horticulture and food processing , Govt. of U.P.
State Rural Livelihood Mission	Block Programme Officer (BPO)	District Programme officer (DPO)	State Mission Director & Principal Secretary, Rural Development, Govt. of Uttar Pradesh
Atal Bhujal Yojana	ADO, Panchayat	District Collector - District Program Management Unit Coordinator, Support Organisations (NGOs), Executive Engineer	State Inter-Departmental Steering Committee (SISC), headed by Chief Secretary; Project Director - State Program Management Unit
Command Area Development for Water	Junior Engineer/ Water User Associations	Executive Engineer, Social Facilitators	Principal Secretary (Irrigation) & WRD
Sub mission on Agro forestry	Assistant Development Officers (Agriculture)/ Forest Range Officer	Deputy Director Agriculture (DD Ag)/ District Forest Officer	Director (Agriculture) Agriculture department/ Chief Forest Conservator
Social Forestry	Assistant Development Officers Panchayat)/ Forest Range Officer	District Panchayati Raj Officer/ District Forest Officer	Director (Panchayati Raj)/ Chief Forest Conservator

Scheme/Programme	Actors: Block level	Actors: District level	Actors: State Level
Green Belt Development Scheme	Forest Range Officer	District Forest Officer	Chief Forest Conservator
State Rural Livelihood Mission	Block Program Officer (BPO)	District Program officer (DPO)	State mission director & Principal Secretary, Rural Development, Govt. of Uttar Pradesh
National Afforestation Program	Forest Range Officer	District Forest Officer	Chief Forest Conservator

10 Institutional Set-up for Capacity Building in Uttar Pradesh

The actors responsible for implementation of development schemes and programmes along with their intermediary organisations and other decision makers are confronted with the problem of proactively dealing with the effects of climate change in their area of responsibilities. Often a set of critical factors constrain integration of adaptation in development planning. These factors include: the lack of thorough understanding of the decision-making process on the potential impacts of climate change; understanding on various adaptation measures and how adaptation can go hand-in-hand with development planning. Integrating climate change adaptation into development programmes and identifying appropriate measures is a daunting task and needs systemic thinking and collaborative efforts from all allied stakeholders and sectors who share a common understanding and concern about climate related issues. Effective adaptation actions, to a great extent, depends on the capacities of the individuals and institutions/organisations responsible for steering the implementation processes. The political will and the capacities of the higher-level officials also help in creating enabling conditions for implementing climate actions. Since adaptation is also perceived as a term interchangeable with good development, it is essential that a holistic thinking and planning to avoid mal-adaptation is integrated at different stages of programme implementation.

In light of the identified vulnerable target groups and their training needs under the priority sectors, a review of the existing training institutional set ups in Uttar Pradesh is also undertaken to understand their training mandate, target trainees and the modalities. Below we suggest the key training institutions that can be instrumental in designing and delivering climate adaptation integrated training programmes for various development sectors in the rural areas. We believe even these institutions will need capacity building on relevant aspects to play the desired role effectively in promoting climate change adaptation in the state:

Deendayal Upadhyaya State Institute of Rural Development, Uttar Pradesh

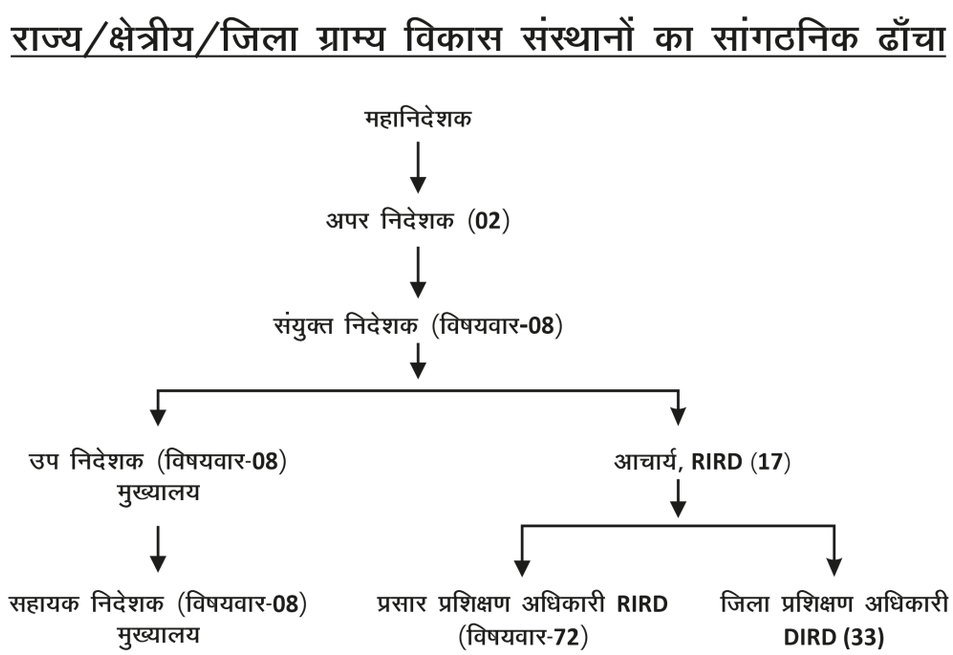
The State Institute of Rural Development (SIRD) is an apex institute of the State Government of U.P, dedicated to the activities of training, research and consultancy for enhancing the effectiveness of the implementation of various rural developments programmes. SIRD focusses on people centric equitable development through capacity building of institutions and individuals for effective public service. The institute strives to achieve comprehensive augmentation of basic skills of human resource in various sectors at multiple layers of governance, including that of elected representatives of local Self Government.

SIRD plays an instrumental role in building capacities at all levels for fulfilling the objectives of rural development programmes, viz., mitigation of existing socio-economic disparities; facilitation of access to basic civic amenities and up gradation of infrastructural development, thereby achieving an over-all amelioration in the living conditions of the common man residing in rural area.

SIRD has a large network of Regional and District Centres in UP as below:

Regional Institute of Rural Development (17)	Agra, Baghpat, Etawah, Jhansi, Mau, Raebareli, Ayodhya, Bulandshahar, Ghazipur, Lucknow, Pratapgarh (Afim ki Kothi) Pratapgarh (Kalakankar), Bulandshahar (Lakhawati), Saharanpur, Badayun, Gorakhpur, Mainpuri
District Institute of Rural Development (31)	Aligarh, Banda, Basti, Fatehpur, Hamirpur, Jaunpur, Kasganj, Mathura, Muzzaffar Nagar, Rampur, Sultanpur, Bahraich, Barabanki, Bijnor, Gautam Budh Nagar, Hardoi, Kannauj, Lakhimpur, Mirzapur, Pilibhit, Shahjahanpur, Ballia, Bareilly, Deoria, Gonda, Jalaun, Kanpur, Moradabad, Prayagraj, Sitapur, Varanasi

Organizational Set-up



Training Programmes

SIRD organizes a range of training programmes on different thematic areas concerning rural development such as agriculture-based livelihood promotion, integrated watershed management, disaster management, and so on. The Institute also organizes capacity building programmes for functionaries responsible for implementation of various government schemes and prigrammes such as MGNREGA, Indira Awas Yojana, SRLM, Sansad Adarsh Gram Yojana, etc.

State Forest Training Institute, Uttar Pradesh

The State Forestry Training Institute (SFTI), Kanpur, was established in 1988 in the erstwhile undivided Uttar Pradesh in Kidwai Nagar, Kanpur.

SFTI imparts trainings to Forest Rangers/Forest Area Officers. The recent developments in horticulture techniques, unprecedented development in information and technology field, amendments in the laws of Indian Forest Act, etc. have made it very important that the regular training to different level of officers/ employees of Forest and Wildlife Department, members of village forest committees, people associated with different aspects of forests/natural resources, is imparted through this institute.

Bankers Institute of Rural Development, Uttar Pradesh

The Bankers Institute of Rural Development (BIRD) is a premier institute offering training, research and consultancy services for undertaking activities in the field of agriculture and rural development banking.

BIRD provides training support to supplement Human Resource Development efforts of the Banks, Government Departments, Development Agencies as also Non-Governmental Organisations by organizing and sponsoring training programmes. Based on specific requirements of the organizations concerned, customized on location programmes are also conducted by the Institute. Besides formal training, it also conducts non-conventional HR interventions like Organisation Development etc.

Further, BIRD offers consultancy services to Banks, Government of India, State Governments, Development Agencies, NABARD, Non-Government Organisations, International Agencies and others in the fields relating to agriculture, rural development, rural banking, micro finance, training etc.

In the light of the need for focussed attention on capacity development in the areas of climate finance among the stakeholders, NABARD took an initiative to establish a Centre for Climate Change (CCC) at BIRD in July 2018. The objectives of the CCC are to address capacity building needs of stakeholders concerned, climate finance, policy advocacy, promoting nation and international collaborations. GIZ is the knowledge partner and is also providing financial assistance to support the Centre of Excellence for Capacity Development on Climate Finance as part of the CCC. Since its establishment, CCC has conducted various training programmes on climate change project formulation, green financing, environmental and social impact assessment and gender mainstreaming for government departments, NGOs and banks.

Panchayati Raj Institute of Training, Uttar Pradesh

Following the 73rd Constitutional Amendment, Uttar Pradesh adopted 3 level Panchayati Raj arrangements. To provide information related to their rights, roles and responsibilities to elected representatives of Panchayati Raj Institutions at three levels, State Panchayati Raj Institute of Training (PRIT) was established in the year 2016.

11 Way Forward

The scoping assessment in Uttar Pradesh has provided insights into the climate vulnerabilities in different agro climatic regions of Uttar Pradesh wherein Bundelkhand, Vindhyan and North-eastern Plains have been identified as most vulnerable regions. In-depth analysis on the most vulnerable sectors which are highly impacted by climate change led to the conclusion that agriculture, water resources and disaster management should be looked into as priority sectors to address the climate adaptation needs. The vulnerable target groups in the priority sectors were also identified and their capacity needs were assessed which will help to integrate climate adaptation actions in their activities.

Moving forward, mainstreaming climate adaptation actions into local planning will require a well-defined capacity building strategy for the vulnerable target groups vis-à-vis the available programmes and funding schemes. A comprehensive gender sensitive training package also need to be designed with tools tailored to the concerned target groups so that it maximises both the transfer of technical knowledge and empowerment of participants.

ANNEXURE-1

Current exposure, sensitivity, adaptive capacity and composite vulnerability index for the districts of Uttar Pradesh

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
1	Bhabhar and Terai	Saharanpur	0.50	High	0.31	Low	0.61	High	0.49	Low
2	Western Plain	Muzzafarnagar	0.50	Moderate	0.37	Moderate	0.65	Moderate	0.53	Moderate
3	Western Plain	Shamli	0.50	Moderate	0.34	Low	0.65	Moderate	0.52	Moderate
4	Bhabhar and Terai	Bijnor	0.55	High	0.26	Low	0.69	Moderate	0.52	Moderate
5	Mid-western Plain	Moradabad	0.47	Moderate	0.50	High	0.61	High	0.54	High
6	Mid-western Plain	Sambhal	0.47	Moderate	0.40	Moderate	0.64	Moderate	0.53	Moderate
7	Mid-western Plain	Rampur	0.43	Moderate	0.38	Moderate	0.71	Moderate	0.53	Moderate
8	Mid-western Plain	Amroha	0.54	High	0.39	Moderate	0.60	High	0.53	Moderate

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
9	Western Plain	Meerut	0.48	Moderate	0.27	Low	0.48	High	0.43	Low
10	Western Plain	Baghpat	0.59	High	0.34	Low	0.58	High	0.53	Moderate
11	Western Plain	Ghaziabad	0.52	High	0.43	Moderate	0.43	High	0.48	Low
12	Western Plain	Hapur	0.46	Moderate	0.39	Moderate	0.53	High	0.48	Low
13	Western Plain	G.B Nagar	0.49	Moderate	0.31	Low	0.37	High	0.41	Low
14	Western Plain	Bulandshahar	0.50	Moderate	0.35	Moderate	0.58	High	0.50	Low
15	South western semi-arid	Aligarh	0.45	Moderate	0.33	Low	0.52	High	0.46	Low
16	South western semi-arid	Hathras	0.49	Moderate	0.37	Moderate	0.58	High	0.50	Moderate
17	South western semi-arid	Mathura	0.53	High	0.26	Low	0.60	High	0.49	Low

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
18	South western semi-arid	Agra	0.53	High	0.36	Moderate	0.53	High	0.49	Low
19	South western semi-arid	Firozabad	0.48	Moderate	0.39	Moderate	0.56	High	0.50	Low
20	South western semi-arid	Etah	0.49	Moderate	0.39	Moderate	0.64	Moderate	0.53	Moderate
21	South western semi-arid	Kasganj	0.45	Moderate	0.41	Moderate	0.68	Moderate	0.53	Moderate
22	South western semi-arid	Mainpuri	0.47	Moderate	0.43	Moderate	0.64	Moderate	0.53	Moderate
23	Mid-western Plain	Badaun	0.44	Moderate	0.52	High	0.71	Moderate	0.58	High
24	Mid-western Plain	Bareilly	0.45	Moderate	0.34	Low	0.62	Moderate	0.49	Low
25	Bhabhar and Terai	Pilibhit	0.45	High	0.28	Low	0.72	Moderate	0.49	Low
26	Mid-western Plain	Shahjahanpur	0.47	High	0.34	Low	0.71	Moderate	0.53	Moderate

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
27	Central Plain	Farrukhabad	0.53	High	0.45	High	0.63	Moderate	0.55	High
28	Central Plain	Kannau	0.55	High	0.44	High	0.68	Moderate	0.57	High
29	Central Plain	Etawah	0.53	High	0.33	Low	0.61	High	0.50	Moderate
30	Central Plain	Auraiya	0.53	High	0.35	Low	0.68	Moderate	0.54	High
31	Central Plain	Kheri	0.45	High	0.35	Low	0.79	Low	0.54	Moderate
32	Central Plain	Sitapur	0.43	Moderate	0.38	Moderate	0.72	Moderate	0.53	Moderate
33	Central Plain	Hardoi	0.50	High	0.39	Moderate	0.75	Low	0.57	High
34	Central Plain	Unnao	0.50	High	0.36	Moderate	0.74	Low	0.55	High
35	Central Plain	Lucknow	0.45	Moderate	0.24	Low	0.47	High	0.40	Low

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
36	Central Plain	Rae Bareli	0.45	Moderate	0.40	Moderate	0.72	Moderate	0.54	High
37	Central Plain	Kanpur dehat	0.48	Moderate	0.47	High	0.60	High	0.53	Moderate
38	Central Plain	Kanpur Nagar	0.51	High	0.38	Moderate	0.40	High	0.45	Low
39	Central Plain	Fatehpur	0.44	Low	0.37	Moderate	0.70	Moderate	0.53	Moderate
40	Eastern Plain	Barabanki	0.40	Low	0.36	Moderate	0.69	Moderate	0.50	Moderate
41	Bundelkhand	Jalaun	0.49	Moderate	0.34	Low	0.65	Moderate	0.51	Moderate
42	Bundelkhand	Jhansi	0.52	Moderate	0.48	High	0.66	Moderate	0.56	High
43	Bundelkhand	Lalitpur	0.42	Low	0.51	High	0.77	Low	0.57	High
44	Bundelkhand	Hamirpur	0.50	Moderate	0.44	High	0.69	Moderate	0.56	High

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
45	Bundelkhand	Mahoba	0.47	Moderate	0.42	Moderate	0.78	Low	0.57	High
46	Bundelkhand	Banda	0.45	Low	0.49	High	0.72	Low	0.57	High
47	Bundelkhand	Chitrakoot	0.43	Low	0.59	High	0.79	Low	0.60	High
48	Eastern Plain	Pratapgarh	0.49	Moderate	0.45	High	0.72	Moderate	0.57	High
49	Central Plain	Kaushambhi	0.41	Low	0.53	High	0.73	Low	0.57	High
50	Central Plain	Prayagraj	0.40	Low	0.34	Low	0.61	High	0.47	Low
51	Eastern Plain	Ayodhya	0.44	Moderate	0.42	Moderate	0.70	Moderate	0.54	Moderate
52	Eastern Plain	Ambedkar nagar	0.47	Moderate	0.34	Low	0.72	Low	0.53	Moderate
53	Eastern Plain	Sultanpur	0.45	Moderate	0.50	High	0.67	Moderate	0.56	High

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
54	Eastern Plain	Amethi	0.45	Moderate	0.41	Moderate	0.74	Low	0.55	High
55	North Eastern Plain	Bahraich	0.46	High	0.50	High	0.78	Low	0.59	High
56	Bhabhar and Terai	Shrawasti	0.42	High	0.50	High	0.84	Low	0.59	High
57	North-eastern Plain	Balrampur	0.44	High	0.49	High	0.76	Low	0.57	High
58	North-eastern Plain	Gonda	0.46	High	0.40	Moderate	0.76	Low	0.56	High
59	North-eastern Plain	Siddharth Nagar	0.45	High	0.47	High	0.80	Low	0.59	High
60	North-eastern Plain	Basti	0.45	Moderate	0.36	Moderate	0.70	Moderate	0.53	Moderate
61	North-eastern Plain	Santkabir Nagar	0.41	Moderate	0.43	Moderate	0.76	Low	0.56	High
62	North-eastern Plain	Maharajganj	0.35	Low	0.43	High	0.80	Low	0.54	Moderate

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
63	North-eastern Plain	Gorakhpur	0.37	Low	0.34	Low	0.65	Moderate	0.47	Low
64	North-eastern Plain	Kushinagar	0.28	Low	0.38	Moderate	0.71	Moderate	0.48	Low
65	North-eastern Plain	Deoria	0.35	Low	0.32	Low	0.71	Moderate	0.49	Low
66	Eastern Plain	Azamgarh	0.40	Low	0.34	Low	0.75	Low	0.52	Moderate
67	Eastern Plain	Mau	0.42	Low	0.32	Low	0.70	Moderate	0.51	Moderate
68	Eastern Plain	Ballia	0.34	Low	0.41	Moderate	0.67	Moderate	0.50	Low
69	Eastern Plain	Jaunpur	0.56	High	0.38	Moderate	0.71	Moderate	0.57	High
70	Eastern Plain	Ghazipur	0.39	Low	0.37	Moderate	0.72	Low	0.52	Moderate
71	Eastern Plain	Chandauli	0.45	Moderate	0.42	Moderate	0.76	Low	0.55	High

S. No.	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
72	Eastern Plain	Varanasi	0.46	Moderate	0.43	High	0.57	High	0.51	Moderate
73	Eastern Plain	Bhadohi	0.49	Moderate	0.41	Moderate	0.70	Moderate	0.56	High
74	Vindhyan	Mirzapur	0.42	Low	0.37	Moderate	0.72	Moderate	0.51	Moderate
75	Vindhyan	Sonbhadra	0.27	Low	0.51	High	0.68	Moderate	0.47	Low
76		Mean CVI	0.44		0.39		0.67		0.52	

Note: Colour coding indicates Dark red – highly vulnerable, orange- moderately vulnerable and green- low vulnerable.

ANNEXURE-2

Future exposure, sensitivity, adaptive capacity and composite vulnerability index for the districts of Uttar Pradesh based on low emission scenario (RCP 4.5)

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
1	Bhabhar and Terai	Saharanpur	0.58	High	0.31	Low	0.61	High	0.51	Moderate
2	Western Plain	Muzzafarnagar	0.58	High	0.37	Moderate	0.65	Moderate	0.55	High
3	Western Plain	Shamli	0.58	High	0.34	Low	0.65	Moderate	0.54	Moderate
4	Bhabhar and Terai	Bijnor	0.59	High	0.26	Low	0.69	Moderate	0.53	Moderate
5	Mid-western Plain	Moradabad	0.57	High	0.50	High	0.61	High	0.58	High
6	Mid-western Plain	Sambhal	0.57	High	0.40	Moderate	0.64	Moderate	0.56	High
7	Mid-western Plain	Rampur	0.63	High	0.38	Moderate	0.71	Moderate	0.59	High

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
8	Mid-western Plain	Amroha	0.57	High	0.39	Moderate	0.60	High	0.54	Moderate
9	Western Plain	Meerut	0.53	High	0.27	Low	0.48	High	0.45	Low
10	Western Plain	Baghpat	0.52	High	0.34	Low	0.58	High	0.50	Low
11	Western Plain	Ghaziabad	0.48	Moderate	0.43	Moderate	0.43	High	0.47	Low
12	Western Plain	Hapur	0.40	Low	0.39	Moderate	0.53	High	0.46	Low
13	Western Plain	G.B Nagar	0.46	Moderate	0.31	Low	0.37	High	0.40	Low
14	Western Plain	Bulandshahar	0.49	High	0.35	Moderate	0.58	High	0.50	Low
15	South western semi-arid	Aligarh	0.49	Moderate	0.33	Low	0.52	High	0.47	Low
16	South western semi-arid	Hathras	0.48	Moderate	0.37	Moderate	0.58	High	0.50	Low

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
17	South western semi-arid	Mathura	0.44	Moderate	0.26	Low	0.60	High	0.46	Low
18	South western semi-arid	Agra	0.51	High	0.36	Moderate	0.53	High	0.48	Low
19	South western semi-arid	Firozabad	0.51	Moderate	0.39	Moderate	0.56	High	0.51	Low
20	South western semi-arid	Etah	0.51	Moderate	0.39	Moderate	0.64	Moderate	0.54	Moderate
21	South western semi-arid	Kasganj	0.51	Moderate	0.41	Moderate	0.68	Moderate	0.55	Moderate
22	South western semi-arid	Mainpuri	0.48	Moderate	0.43	Moderate	0.64	Moderate	0.54	Moderate
23	Mid-western Plain	Badaun	0.55	High	0.52	High	0.71	Moderate	0.62	High
24	Mid-western Plain	Bareilly	0.56	High	0.34	Low	0.62	Moderate	0.53	Moderate
25	Bhabhar and Terai	Pilibhit	0.49	Moderate	0.28	Low	0.72	Moderate	0.51	Low

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
26	Mid-western Plain	Shahjahanpur	0.49	Moderate	0.34	Low	0.71	Moderate	0.54	Moderate
27	Central Plain	Farrukhabad	0.49	Moderate	0.45	High	0.63	Moderate	0.54	Moderate
28	Central Plain	Kannau	0.43	Low	0.44	High	0.68	Moderate	0.54	Moderate
29	Central Plain	Etawah	0.44	Low	0.33	Low	0.61	High	0.48	Low
30	Central Plain	Auraiya	0.42	Low	0.35	Low	0.68	Moderate	0.51	Low
31	Central Plain	Kheri	0.46	Moderate	0.35	Low	0.79	Low	0.55	Moderate
32	Central Plain	Sitapur	0.44	Low	0.38	Moderate	0.72	Moderate	0.54	Moderate
33	Central Plain	Hardoi	0.46	Low	0.39	Moderate	0.75	Low	0.56	Moderate
34	Central Plain	Unnao	0.41	Low	0.36	Moderate	0.74	Low	0.52	Low

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
35	Central Plain	Lucknow	0.43	Low	0.24	Low	0.47	High	0.40	Low
36	Central Plain	Rae Bareli	0.46	Low	0.40	Moderate	0.72	Moderate	0.55	Moderate
37	Central Plain	Kanpur dehat	0.45	Low	0.47	High	0.60	High	0.53	Low
38	Central Plain	Kanpur Nagar	0.42	Low	0.38	Moderate	0.40	High	0.42	Low
39	Central Plain	Fatehpur	0.49	Moderate	0.37	Moderate	0.70	Moderate	0.55	Moderate
40	Eastern Plain	Barabanki	0.48	Moderate	0.36	Moderate	0.69	Moderate	0.53	Moderate
41	Bundelkhand	Jalaun	0.51	Moderate	0.34	Low	0.65	Moderate	0.52	Low
42	Bundelkhand	Jhansi	0.60	High	0.48	High	0.66	Moderate	0.59	High
43	Bundelkhand	Lalitpur	0.58	High	0.51	High	0.77	Low	0.63	High

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
44	Bundelkhand	Hamirpur	0.52	Moderate	0.44	High	0.69	Moderate	0.57	High
45	Bundelkhand	Mahoba	0.54	High	0.42	Moderate	0.78	Low	0.60	High
46	Bundelkhand	Banda	0.54	High	0.49	High	0.72	Low	0.60	High
47	Bundelkhand	Chitrakoot	0.53	High	0.59	High	0.79	Low	0.64	High
48	Eastern Plain	Pratapgarh	0.44	Low	0.45	High	0.72	Moderate	0.56	Moderate
49	Central Plain	Kaushambhi	0.54	High	0.53	High	0.73	Low	0.62	High
50	Central Plain	Prayagraj	0.53	High	0.34	Low	0.61	High	0.51	Low
51	Eastern Plain	Ayodhya	0.44	Low	0.42	Moderate	0.70	Moderate	0.54	Moderate
52	Eastern Plain	Ambedkar nagar	0.40	Low	0.34	Low	0.72	Low	0.51	Moderate

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
53	Eastern Plain	Sultanpur	0.42	Low	0.50	High	0.67	Moderate	0.55	Moderate
54	Eastern Plain	Amethi	0.42	Low	0.41	Moderate	0.74	Low	0.55	Moderate
55	North Eastern Plain	Bahraich	0.49	Moderate	0.50	High	0.78	Low	0.60	High
56	Bhabhar and Terai	Shrawasti	0.40	Low	0.50	High	0.84	Low	0.59	High
57	North-eastern Plain	Balrampur	0.41	Moderate	0.49	High	0.76	Low	0.56	High
58	North-eastern Plain	Gonda	0.36	Low	0.40	Moderate	0.76	Low	0.53	Moderate
59	North-eastern Plain	Siddharth Nagar	0.32	Low	0.47	High	0.80	Low	0.56	High
60	North-eastern Plain	Basti	0.37	Low	0.36	Moderate	0.70	Moderate	0.51	Moderate
61	North-eastern Plain	Santkabir Nagar	0.36	Low	0.43	Moderate	0.76	Low	0.54	High

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
62	North-eastern Plain	Maharajganj	0.29	Low	0.43	High	0.80	Low	0.52	Moderate
63	North-eastern Plain	Gorakhpur	0.36	Low	0.34	Low	0.65	Moderate	0.48	Low
64	North-eastern Plain	Kushinagar	0.34	Low	0.38	Moderate	0.71	Moderate	0.50	Moderate
65	North-eastern Plain	Deoria	0.37	Low	0.32	Low	0.71	Moderate	0.50	Low
66	Eastern Plain	Azamgarh	0.37	Low	0.34	Low	0.75	Low	0.51	Moderate
67	Eastern Plain	Mau	0.39	Low	0.32	Low	0.70	Moderate	0.50	Low
68	Eastern Plain	Ballia	0.45	Moderate	0.41	Moderate	0.67	Moderate	0.54	Moderate
69	Eastern Plain	Jaunpur	0.39	Low	0.38	Moderate	0.71	Moderate	0.52	Moderate
70	Eastern Plain	Ghazipur	0.42	Low	0.37	Moderate	0.72	Low	0.53	Moderate

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
71	Eastern Plain	Chandauli	0.40	Low	0.42	Moderate	0.76	Low	0.53	Moderate
72	Eastern Plain	Varanasi	0.37	Low	0.43	High	0.57	High	0.48	Low
73	Eastern Plain	Bhadohi	0.37	Low	0.43	High	0.57	High	0.48	Low
74	Vindhyan	Mirzapur	0.50	Moderate	0.37	Moderate	0.72	Moderate	0.53	Moderate
75	Vindhyan	Sonbhadra	0.50	Moderate	0.37	Moderate	0.72	Moderate	0.53	Moderate
		Mean CVI	0.47		0.39		0.67		0.53	

Note: Color coding indicates Dark red – highly vulnerable , orange- moderately vulnerable and green- low vulnerable

ANNEXURE-3

Future exposure, sensitivity, adaptive capacity and composite vulnerability index of Mid-Century (2050) for the districts of Uttar Pradesh based on High emission scenario (RCP 8.5)

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
1	Bhabhar and Terai	Saharanpur	0.59	High	0.31	Low	0.61	High	0.51	Low
2	Western Plain	Muzzafarnagar	0.55	Moderate	0.37	Moderate	0.65	Moderate	0.55	Moderate
3	Western Plain	Shamli	0.55	Moderate	0.34	Low	0.65	Moderate	0.54	Moderate
4	Bhabhar and Terai	Bijnor	0.59	High	0.26	Low	0.69	Moderate	0.53	Low
5	Mid-western Plain	Moradabad	0.54	Moderate	0.50	High	0.61	High	0.57	Moderate
6	Mid-western Plain	Sambhal	0.54	Moderate	0.40	Moderate	0.64	Moderate	0.55	Moderate
7	Mid-western Plain	Rampur	0.62	High	0.38	Moderate	0.71	Moderate	0.59	High

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
8	Mid-western Plain	Amroha	0.54	Moderate	0.39	Moderate	0.60	High	0.53	Low
9	Western Plain	Meerut	0.58	Moderate	0.27	Low	0.48	High	0.46	Low
10	Western Plain	Baghpat	0.50	Moderate	0.34	Low	0.58	High	0.50	Low
11	Western Plain	Ghaziabad	0.57	Moderate	0.43	Moderate	0.43	High	0.50	Low
12	Western Plain	Hapur	0.55	Moderate	0.39	Moderate	0.53	High	0.51	Low
13	Western Plain	G.B Nagar	0.62	High	0.31	Low	0.37	High	0.45	Low
14	Western Plain	Bulandshahar	0.54	Moderate	0.35	Moderate	0.58	High	0.51	Low
15	South western semi-arid	Aligarh	0.56	Moderate	0.33	Low	0.52	High	0.49	Low
16	South western semi-arid	Hathras	0.56	Moderate	0.37	Moderate	0.58	High	0.53	Low

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
17	South western semi-arid	Mathura	0.58	Moderate	0.26	Low	0.60	High	0.50	Low
18	South western semi-arid	Agra	0.63	High	0.36	Moderate	0.53	High	0.52	Low
19	South western semi-arid	Firozabad	0.60	High	0.39	Moderate	0.56	High	0.54	Moderate
20	South western semi-arid	Etah	0.63	High	0.39	Moderate	0.64	Moderate	0.57	High
21	South western semi-arid	Kasganj	0.56	Moderate	0.41	Moderate	0.68	Moderate	0.57	Moderate
22	South western semi-arid	Mainpuri	0.60	High	0.43	Moderate	0.64	Moderate	0.58	High
23	Mid-western Plain	Badaun	0.59	Moderate	0.52	High	0.71	Moderate	0.63	High
24	Mid-western Plain	Bareilly	0.65	High	0.34	Low	0.62	Moderate	0.56	Moderate
25	Bhabhar and Terai	Pilibhit	0.66	High	0.28	Low	0.72	Moderate	0.56	Moderate

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
26	Mid-western Plain	Shahjahanpur	0.57	Moderate	0.34	Low	0.71	Moderate	0.56	Moderate
27	Central Plain	Farrukhabad	0.57	Moderate	0.45	High	0.63	Moderate	0.57	Moderate
28	Central Plain	Kannau	0.53	Moderate	0.44	High	0.68	Moderate	0.57	Moderate
29	Central Plain	Etawah	0.54	Moderate	0.33	Low	0.61	High	0.51	Low
30	Central Plain	Auraiya	0.57	Moderate	0.35	Low	0.68	Moderate	0.55	Moderate
31	Central Plain	Kheri	0.55	Moderate	0.35	Low	0.79	Low	0.57	High
32	Central Plain	Sitapur	0.52	Moderate	0.38	Moderate	0.72	Moderate	0.56	Moderate
33	Central Plain	Hardoi	0.56	Moderate	0.39	Moderate	0.75	Low	0.59	High
34	Central Plain	Unnao	0.55	Moderate	0.36	Moderate	0.74	Low	0.57	Moderate

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
35	Central Plain	Lucknow	0.59	High	0.24	Low	0.47	High	0.44	Low
36	Central Plain	Rae Bareli	0.62	High	0.40	Moderate	0.72	Moderate	0.60	High
37	Central Plain	Kanpur dehat	0.56	Moderate	0.47	High	0.60	High	0.56	Moderate
38	Central Plain	Kanpur Nagar	0.53	Moderate	0.38	Moderate	0.40	High	0.46	Low
39	Central Plain	Fatehpur	0.65	High	0.37	Moderate	0.70	Moderate	0.60	High
40	Eastern Plain	Barabanki	0.56	Moderate	0.36	Moderate	0.69	Moderate	0.56	Moderate
41	Bundelkhand	Jalaun	0.55	Moderate	0.34	Low	0.65	Moderate	0.53	Moderate
42	Bundelkhand	Jhansi	0.55	Moderate	0.48	High	0.66	Moderate	0.58	High
43	Bundelkhand	Lalitpur	0.57	Moderate	0.51	High	0.77	Low	0.63	High

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
44	Bundelkhand	Hamirpur	0.61	High	0.44	High	0.69	Moderate	0.59	High
45	Bundelkhand	Mahoba	0.64	High	0.42	Moderate	0.78	Low	0.63	High
46	Bundelkhand	Banda	0.65	High	0.49	High	0.72	Low	0.64	High
47	Bundelkhand	Chitrakoot	0.64	High	0.59	High	0.79	Low	0.67	High
48	Eastern Plain	Pratapgarh	0.52	Moderate	0.45	High	0.72	Moderate	0.58	High
49	Central Plain	Kaushambhi	0.64	High	0.53	High	0.73	Low	0.65	High
50	Central Plain	Prayagraj	0.57	Moderate	0.34	Low	0.61	High	0.53	Low
51	Eastern Plain	Ayodhya	0.42	Low	0.42	Moderate	0.70	Moderate	0.53	Moderate
52	Eastern Plain	Ambedkar nagar	0.35	Low	0.34	Low	0.72	Low	0.50	Low

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
53	Eastern Plain	Sultanpur	0.42	Low	0.50	High	0.67	Moderate	0.55	Moderate
54	Eastern Plain	Amethi	0.42	Low	0.41	Moderate	0.74	Low	0.55	Moderate
55	North Eastern Plain	Bahraich	0.47	Low	0.50	High	0.78	Low	0.60	High
56	Bhabhar and Terai	Shrawasti	0.43	Low	0.50	High	0.84	Low	0.59	High
57	North-eastern Plain	Balrampur	0.44	Low	0.49	High	0.76	Low	0.57	High
58	North-eastern Plain	Gonda	0.34	Low	0.40	Moderate	0.76	Low	0.52	Low
59	North-eastern Plain	Siddharth Nagar	0.37	Low	0.47	High	0.80	Low	0.57	High
60	North-eastern Plain	Basti	0.32	Low	0.36	Moderate	0.70	Moderate	0.49	Low
61	North-eastern Plain	Santkabir Nagar	0.34	Low	0.43	Moderate	0.76	Low	0.54	Moderate

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
62	North-eastern Plain	Maharajganj	0.39	Low	0.43	High	0.80	Low	0.55	Moderate
63	North-eastern Plain	Gorakhpur	0.35	Low	0.34	Low	0.65	Moderate	0.47	Low
64	North-eastern Plain	Kushinagar	0.42	Low	0.38	Moderate	0.71	Moderate	0.53	Low
65	North-eastern Plain	Deoria	0.44	Low	0.32	Low	0.71	Moderate	0.52	Low
66	Eastern Plain	Azamgarh	0.43	Low	0.34	Low	0.75	Low	0.53	Moderate
67	Eastern Plain	Mau	0.45	Low	0.32	Low	0.70	Moderate	0.52	Low
68	Eastern Plain	Ballia	0.45	Low	0.41	Moderate	0.67	Moderate	0.54	Moderate
69	Eastern Plain	Jaunpur	0.45	Low	0.38	Moderate	0.71	Moderate	0.54	Moderate
70	Eastern Plain	Ghazipur	0.56	Moderate	0.37	Moderate	0.72	Low	0.58	High

S. No	Agro Climatic Region	District	Exposure		Sensitivity		Adaptive capacity		CVI	
			Index	Category	Index	Category	Index	Category	Index	Category
71	Eastern Plain	Chandauli	0.62	High	0.42	Moderate	0.76	Low	0.60	High
72	Eastern Plain	Varanasi	0.58	Moderate	0.43	High	0.57	High	0.55	Moderate
73	Eastern Plain	Bhadohi	0.63	High	0.41	Moderate	0.70	Moderate	0.60	High
74	Vindhyan	Mirzapur	0.65	High	0.37	Moderate	0.72	Moderate	0.58	High
75	Vindhyan	Sonbhadra	0.80	High	0.51	High	0.68	Moderate	0.64	High
		Mean CVI	0.54		0.39		0.67		0.55	

Note: Color coding indicates Dark red – highly vulnerable, orange- moderately vulnerable and green- low vulnerable

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