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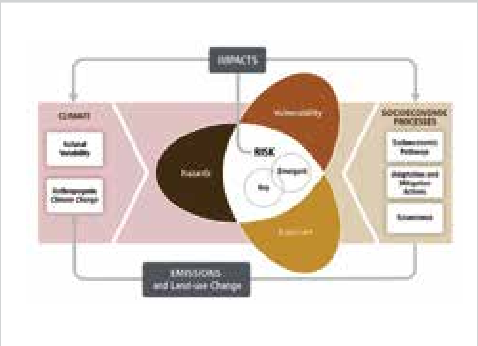
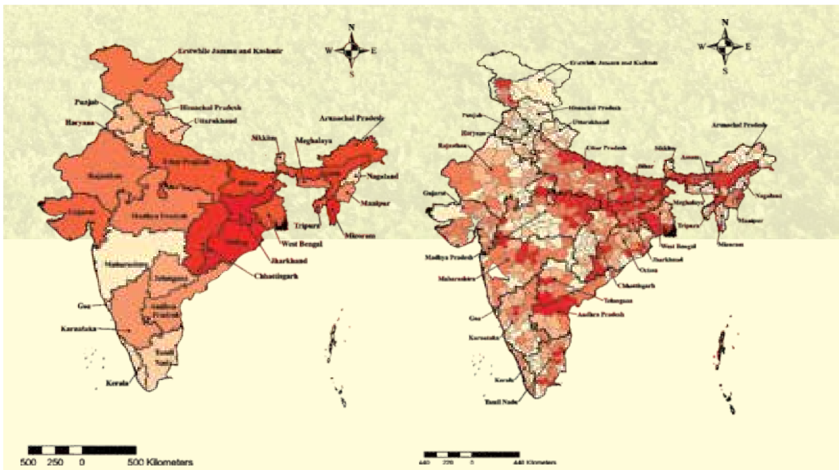


Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework



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Cover photo: Farmers in Dhamoon Panchayat in Shimla, Himachal Pradesh

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Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework

Submitted by
Indian Institute of Technology Mandi and Indian Institute of Technology Guwahati

In collaboration with
Indian Institute of Science, Bengaluru

Under the project
Climate vulnerability and risk assessment at the national level using a common framework

2019-2020

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Message from the Secretary, DST

Climate change is the global phenomenon especially caused by human activities and is a growing challenge to humanity and sustainable development. The effect of climate change on the biophysical and social systems are expected to vary significantly in different parts of India and will be determined by both global and local factors. The impact of climate change and climate hazards is not uniform across space and time. It varies across regions due to differences in the level of exposure and vulnerability of various systems, be it ecosystems, economic sectors, or social groups. For these reasons, assessment of the vulnerability of a system is one of the critical steps to identify appropriate adaptation measures to adapt to climate change risks as also to cope with current climate risks.

In response to the serious threats posed by climate change to the development process and the limitations that India is facing, the Government of India as part of its comprehensive National Action Plan on Climate Change has a dedicated mission for development of appropriate institutional and human resource capacity for this purpose under the National Mission on Strategic Knowledge for Climate Change (NMSKCC), being coordinated by the Department of Science & Technology.

This report presents the initiatives being taken up by the DST in collaboration with Swiss Agency of Development and Cooperation (SDC) to strengthen the capacities of all the state Climate Change Cells and other relevant departments on conducting a vulnerability and risk assessment, which is a vital input towards adaptation planning. This report portrays a tremendous coordination and collaborative efforts by the state departments to develop their vulnerability maps which are not only useful to understand the entry-point of adaptation interventions, but also useful to understand the sectors and locations that require special attention for overall development planning. Additionally, the report also synoptic view would help in climate change adaptation linked decision-making processes at both the State and national level.

I wish to compliment the efforts made by the Indian Institute of Technology (IIT) Mandi, Indian Institute of Technology (IIT) Guwahati and Indian Institute of Science (IISc) Bengaluru, Climate Change Programme (CC) - SPLICE Division, DST and the Swiss Agency for Development and Cooperation (SDC) for bringing out this report and initiating capacity building on vulnerability and risk assessment.

Prof. Ashutosh Sharma
Secretary, Department of Science and Technology

Foreword

There is no denying that climate change is one of the greatest concerns today. It goes without saying that it needs to be addressed through collective actions. While there are multiple biophysical and socioeconomic channels through which the impact of climate change is likely to be felt in various parts of India, there are ample opportunities to take up appropriate adaptation strategies that would also cater to the holistic and sustainable development of the country. Needless to say, the requirements of adaptation to climate change are varying in different parts of the country.

Recognising the need for a coordinated effort towards climate change adaptation and to better understand the linkages between climate change and the Himalayan ecosystem for improved management of a fragile ecosystem, the Government of India launched a National Mission for Sustaining the Himalayan Ecosystem (NMSHE) as part of National Action Plan on Climate Change (NAPCC). The Department of Science & Technology (DST) has been the coordinating and implementing the mission in collaboration with several other central ministries. In 2018-19, DST in partnership with Swiss Agency for Development and Cooperation (SDC), Indian Institute of Technology Guwahati (IIT Guwahati), Indian Institute of Technology Mandi (IIT Mandi) and Indian Institute of Science, Bengaluru (IISc, Bengaluru), the 12 Himalayan States produced a first of its kind vulnerability map and report for the entire Himalayan region. Following the success of the project as gauged by the feedback from the State Governments regarding the usefulness of the exercise, it was decided to expand its scope to an all-India level.

I am delighted to know that this project jointly supported by DST and SDC has successfully resulted in development of all-India state-level and district level vulnerability maps. What is most heartening is to see the concept of cooperative federalism in action wherein a common framework for assessing the climatic vulnerability was used by all the states in India to develop their own district-level vulnerability maps. This will also help the states to update their revised State Action Plan on Climate Change. Let me also take this opportunity to thank SDC for their continued collaboration and partnering with India for taking up such an important exercise.

India is a world leader in addressing the challenge of climate change. This effort at district, state and national level to develop vulnerability profiles will assist all in devising strategies and prioritizing locations for adaptation interventions to reduce vulnerability to climate risks as envisaged in the NDC of India. I take this opportunity to congratulate and thank the DST, SDC and IIT Mandi, IIT Guwahati, IISc, Bengaluru and all the State Governments, who contributed to the preparation of the report.

Dr. Akhilesh Gupta
Head, SPLICE
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Preface

Climate change is a serious threat to socio-economic development globally and in India. Adapting to the present and future impacts of climate change is crucial to secure hard won gains and increase the resilience of vulnerable communities, in particular for those living in the fragile mountain ecosystems.

To foster and support adaptation in the Indian Himalayan region, the Government of India and the Government of Switzerland, through the Swiss Agency for Development and Cooperation (SDC), have implemented a bilateral project called the Indian Himalayas Climate Adaptation Programme (IHCAP). IHCAP has supported the implementation of the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) by strengthening the capacities of research institutions, decision makers and communities to adapt to the varying climatic conditions, and by facilitating the exchange of knowledge and expertise.

The multiplicity of challenges in a diverse country such as India calls for a coordinated and integrated approach to adaptation planning. A comprehensive understanding of the key risks and vulnerabilities based on robust research can also help prioritize action. Therefore, the development and application of a common framework for vulnerability and risk assessment for the Indian Himalayan Region was organized under IHCAP.

Following the positive feedback received from State governments of the Himalayan region regarding the usefulness of the assessment, SDC and the Department of Science and Technology (DST), Government of India, rolled out the climate vulnerability assessment at the national level. A series of workshops were organized to develop a uniform understanding of the risks, availability of datasets, and to map the vulnerabilities. The present nation-wide vulnerability assessment report represents a significant contribution to India's National Action Plan on Climate Change (NAPCC), and in particular to the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) and the National Mission on Strategic Knowledge for Climate Change (NMSKCC).

SDC would like to take this opportunity to congratulate the Government of India, all involved States and Union Territories and all involved stakeholders on the launch of this milestone report. We look forward to continuing and further strengthen our excellent collaboration in the future.

Ms. Corinne Demenge
Head of Cooperation in India
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We are indeed extremely grateful to Prof Ashutosh Sharma, Secretary, DST for constantly supporting our programme and graciously motivating our efforts. We sincerely appreciate the confidence he has shown towards our team ad encouraging guidance that has helped us tremendously in achieving these goals.

I am grateful to Dr. Akhilesh Gupta, Head, SPLICE-CCP, DST who has been leading this programme since its inception in 2009. He has been the motivating force behind the planning and implementation of this programme.

On behalf CCP-SPLICE Division DST, I would like to acknowledge with sincere gratitude the efforts of Prof N.H. Ravindranath of IISc Bengaluru, Prof Anamika Barua of IIT Guwahati and Dr. Shyamasree Dasgupta of IIT Mandi for developing the common framework and, coordinating this unique exercise which has provided the vulnerability scenario of the entire country.

I would like to extend my thanks to the State Climate Change Cells and other line departments of the state governments for their active participation in the training programmes and the development of assessments for their respective states. This report could not have been completed without their enthusiasm and cooperation.

We are extremely thankful to Ms. Corinne Demenge, Head, Swiss Agency for Development and Cooperation (SDC) in India, Embassy of Switzerland, Ms. Marylaure Crettaz, the previous Head of Swiss Agency for Development and Cooperation (SDC) in India, Embassy of Switzerland, Dr. Mustafa Ali Khan, Team Leader, SCA-Himalayas, SDC, and Ms. Divya Sharma, Senior Thematic Advisor, SDC and Dr. Yandup Lama, Project Associate, SCA-Himalayas, SDC for their immense support at various stages of the implementation of the project.

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I would also like to thank the DST CCP-SPLICE team Dr. Susheela Negi, Scientis-E, Dr. Rabindra Panigrahy, Scientist-D and Dr. Swati Jain, Scientist-C for providing their valuable support during the study. Finally, I would like to convey my sincere thanks to the research staff and administration of IIT Mandi, IIT Guwahati and IISc, Bengaluru for their contribution and support at various stages of execution of the project. I sincerely appreciate the efforts made by Mr. Rupam Bhaduri, research Scholar, IIT Guwahati and Mr. Kritishnu Sanyal, Research Scholar, IIT Mandi.

Dr. Nisha Mendiratta
Associate Head, SPLICE
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List of Acronyms

AV	Actual Value
BPL	Below Poverty Line
CRIDA	Central Research Institute for Dryland Agriculture
DST	Department of Science and Technology
GSDP	Gross State Domestic Product
IHR	Indian Himalayan Region
IISc, Bengaluru	Indian Institute of Science, Bengaluru
IIT Guwahati	Indian Institute of Technology Guwahati
IIT Mandi	Indian Institute of Technology Mandi
IMR	Infant Mortality Rate
IPCC	Intergovernmental Panel on Climate Change
NMSHE	National Mission for Sustaining the Himalayan Ecosystem
NRM	Natural Resource Management
NTFPs	Non-timber forest products
NV	Normalised Value
PMFBY	Pradhan Mantri Fasal Bima Yojana
RWBCIS	Restructured Weather Based Crop Insurance Scheme
SAPCC	State Action Plan on Climate Change
SDC	Swiss Agency for Development and Cooperation
UT	Union Territories
VBD	Vector borne Diseases
VI	Vulnerability Index
WBD	Waterborne Diseases

Key findings of the vulnerability assessment

- Based on an all-India assessment, this report identifies the **most vulnerable states and districts in India** with respect to current climate risk and the main drivers of vulnerability. The assessment is based on a set of common indicators and common methodology. States also carried out district-level vulnerability assessments individually.
- **State-level vulnerability indices developed in this report vary over a small range:** 0.42-0.67. This means **all states must deal with concerns related to vulnerability.**
- The states with a relatively high vulnerability, **Jharkhand, Mizoram, Orissa, Chhattisgarh, Assam, Bihar, Arunachal Pradesh, and West Bengal,** are mostly in the eastern part of the country, requiring prioritisation of adaptation interventions.
- **District-level vulnerability indices are also within a small range:** 0.34 - 0.75. **Assam, Bihar, and Jharkhand have over 60% districts in the category of highly vulnerable districts.**
- **Vulnerability indices are relative measures. This means, all districts or states are vulnerable, but some are relatively more vulnerable than others, requiring prioritised adaptation interventions.**

Application of the vulnerability assessment

- The vulnerability assessment can assist in **ranking and identification of the most vulnerable districts and states and help states prioritise adaptation planning and investments.**
- It is critical for **developing adaptation projects** for the Green Climate Fund, Adaptation Fund, and funds from multilateral and bilateral agencies.
- The vulnerability assessments carried out by the states could become **a chapter in their revised State Action Plan on Climate Change,** as per the outline provided by the Ministry of Environment, Forest and Climate Change.
- It will also facilitate **Nationally Determined Contributions, which aims to adapt better to climate change by enhancing investments in development programmes in sectors vulnerable to climate change,** particularly agriculture, water resources, health sector and regions such as Himalayan region, coastal regions, etc. It may also aid to plan disaster management.
- A vulnerability assessment contributes to reporting under the **Paris Agreement, Article-9** through the assessment of climate change impacts and vulnerability; the formulation and implementation of a National Adaptation Plan, monitoring and evaluation of adaptation plans, policies and programmes; and the development and implementation of resilience of socio-economic and ecological systems.

Way forward

- A vulnerability assessment is a first step towards adaptation planning. The following tasks are suggested for the future:
  - Need for development of climate change risk index, followed by risk ranking of states and districts, where: **Risk = f (Hazard, Exposure, Vulnerability).**
  - Development of a common framework, methodology and guidelines for risk assessment.
  - All **State Climate Change Centres** funded by the Department of Science and Technology, Government of India are interested in developing a Risk Index for states. It requires building capacity for risk assessment and adaptation planning.
  - Generation of data for risk assessment is important. There is need of a strategy for data generation for climate change risk and vulnerability assessment and adaptation planning.

Introduction

Introduction

There is now enough evidence that the earth's climate is changing, and it is adversely affecting both biophysical (mountains, rivers, forests, wetlands, etc.) and socio-economic systems (hill and coastal communities, agriculture, animal husbandry, etc.) (IPCC, 2014). According to The Germanwatch Global Climate Risk Index- 2019 India ranked 5th out of 181 countries, implying an extremely high exposure and vulnerability (Germanwatch, 2019). This ranking is based on quantified impacts of extreme weather events in terms of fatalities as well as economic losses that have occurred during 1999-2018. However, the impact of climate change and climate hazards is not uniform across space and time. It varies across regions due to differences in the exposure and vulnerability of various ecosystems, economic sectors, and social groups (O'Brien, 2008). For these reasons, assessment of the vulnerability of a system is one of the critical steps to identify appropriate adaptation measures to combat climate change as also to cope with current climate risks.

With support from the Department of Science and Technology, Government of India and the Swiss Agency for Development and Cooperation, the Indian Institute of Technology Mandi (IIT Mandi) and the Indian Institute of Technology Guwahati (IIT Guwahati), in collaboration with the Indian Institute of Science (IISc Bengaluru) worked towards the implementation of the project "Vulnerability Profiles for India: State and District Level (Using a Common Framework)" with objectives of developing all-India vulnerability profiles and capacity building of the states to carry out vulnerability assessments. The project was implemented during 2019-2020.

This project has been preceded by a vulnerability assessment of states in the Indian Himalayan Region (IHR) in 2018-19, undertaken by the same project team, as a part of the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) in the context of the National Action Plan on Climate Change. A key area identified by the NMSHE was to build capacities of the 12 IHR states for robust assessments of climate-related vulnerability and for adaptation planning and implementation. A series of consultations and workshops with representatives from 12 IHR states were organised during the previous project. It resulted in the development of a state-level vulnerability map of the IHR and separate district-level maps based on vulnerability assessments carried out by the states.

Following the success of these initial capacity building activities, the next round, i.e., the present round, saw an extension of the project to all states in India. In the same format, multiple rounds of consultation and capacity building workshops were conducted with state representatives. Vulnerability assessments were carried out at various levels: all-India state and district-level assessments carried out by the project team at IIT Mandi, IIT Guwahati and IISc, Bengaluru and state-specific district-level vulnerability assessments carried out by the states. Most of the IHR states carried out vulnerability assessments for agricultural sector, while few of them ventured block-level assessments.

The project and the present report are targeted to enhance the capacities of the government departments, academic and public institutions and to assist them in making informed decisions regarding adaptation planning and investment. The target group included national and state government departments, funding agencies, legislators, bureaucrats, local administration, and the general audience.

Objectives

Against this backdrop, the main objective of the present report is to carry out a current-climate state-level and district-level vulnerability assessment for India based on the starting point/contextual approach of vulnerability that has been discussed further. Using a Vulnerability Index (VI), derived for each state/district in India, the study identified and categorised the most vulnerable states and districts in the country and the major drivers of vulnerability. Identification of the most vulnerable states and districts along with the drivers is an essential first step for prioritising investment in climate adaptation. The project also aimed at building the capacity of states to carry out vulnerability assessments within a common methodological framework.

The report has the following 5 sections:

- Introduction
- **Part I:** Development of an all-India state-level current climate vulnerability profile, identification and ranking of the most vulnerable states and the main drivers of state-level vulnerability.
- **Part II:** Development of an all-India state-level current climate vulnerability profile, identification and ranking of the most vulnerable states and the main drivers of state-level vulnerability.
- **Part III:** Development of current climate vulnerability profiles of individual states at multiple scales such as districts/blocks/sectors.
- Achievements, utility of the report and way forward.

The state-level assessment was based on 29 states considering erstwhile Jammu and Kashmir. The district-level assessment was based on 612 districts, which covers the same geographical area as the current 718 districts. Some recent bifurcations of districts could not be taken into consideration due to lack of availability of data leading to a reduction in the number of districts.

Under objective I and II, the analysis was carried out by IIT Mandi, IIT Guwahati and IISc Bengaluru and the all-India vulnerability maps are prepared. The outcomes are then shared and discussed with the states. Objective III was achieved through a series of capacity building workshops involving state representatives. These state-level trained experts subsequently developed vulnerability profiles and maps of their respective states in consultation with the project team.

Conceptualising vulnerability based on IPCC-AR5 framework

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change, i.e., IPCC-AR5 (IPCC, 2014) defines the risk of climate change at the intersection of 'Hazard', 'Exposure' and 'Vulnerability'. In this modified risk-assessment framework, 'vulnerability' is conceptualised as an 'internal property of a system'. It represents the propensity or predisposition of the system to be adversely affected, independent of hazard and exposure (Figure 1). While the mitigation of climate hazards and the reduction of exposure are relatively long-term goals, governments and development agencies may address climate change adaptation most effectively by reducing vulnerability in the short and medium-term.

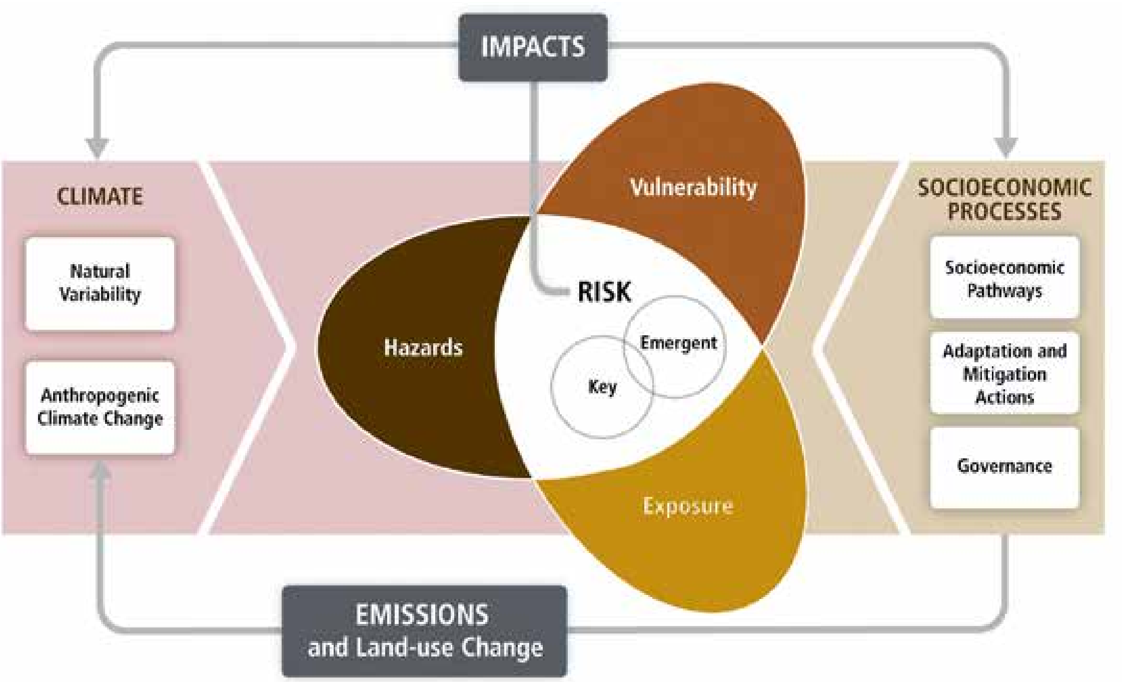

Figure 1: **IPCC-AR5 "Risk Management and Assessment Framework" depicting the risk arising at the intersection of Hazard, Vulnerability and Exposure**

Staring-point and end-point approach towards assessing vulnerability

The concept of vulnerability may be operationalised in two ways (O'Brien, 2007; Kelly, 2000)

- Starting point/contextual approach: Vulnerability of a system is considered a pre-existing condition in anticipation of a hazard.
- Endpoint/outcome approach: Vulnerability of a system is assessed before and after exposure to a hazard.

The present study adopted a starting point/contextual approach. It identified vulnerability based on pre-existing conditions in a contextual manner. In this way, in anticipation of a climatic hazard or a non-climatic stressor, the vulnerability of a natural ecosystem or socio-economic system is seen as a function of its 'sensitivity' (susceptibility to harm from a first-order impact of a hazard or stressor) and its lack of 'adaptive capacity' to overcome or cope with such situations.

Sensitivity and Adaptive Capacity

Sensitivity and adaptive capacities, in this regard, are defined in the following manner:

- Sensitivity: Sensitivity refers to the degree to which 'a system or species is affected, either adversely or beneficially by climate variability or change' (IPCC, 2014). This determines the first-order impact of a hazard or stressor on the system. The effect may be direct (e.g., change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).
- Adaptive capacity: Adaptive capacity is defined as 'the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences' (IPCC, 2014). For example, if a comprehensive crop insurance system is in place, farmers can cope with the damages to crops caused by hazards such as floods or drought.

Current-climate vulnerability

The IPCC-AR5 (IPCC, 2014) also states: 'The first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability'. A vulnerability assessment under the current climate risks provides information about the current weaknesses of a natural or socio-economic system along with the drivers of such weaknesses. This will enable the development of strategies to address the identified system weaknesses and to deal with or adapt to the drivers. Therefore, reducing vulnerability from the current climate variability is the first practical step to curtail losses and would be a reliable and 'no-regret' approach to reduce vulnerability and build long-term resilience under climate change scenarios.

Need for a common framework of vulnerability assessment

While various states in India had earlier developed vulnerability profiles of their states, these profiles are often not comparable, because the methods used by them varied. Various times, states used the IPCC-2007 definition and framework of 'vulnerability', which is different from the state-of-the-art methodology depicted in IPCC-2014. The focus, in many cases, was also on assessing future vulnerability to climate change rather than understanding current climate vulnerability. Further, states developed profiles or maps without any dialogue between them in most of the cases. So, the method used, the indicators chosen, and the outcome derived from the assessments were not comparable. But in order to achieve comparable results, it's important that the states follow a common methodology, that too the recent one.

Climate-change risk and vulnerability assessments are essential prerequisites for climate change adaptation. In the process of the State Action Plan on Climate Change (SAPCC) revision, each state must develop its vulnerability profile as one chapter is dedicated to the same. The present effort can give a head-start for such assessments. Such comparable outcomes are useful for government officials, implementers, decision- makers, funding agencies and development experts. It will be enabling them to assess which states or districts in the country are relatively more vulnerable, what has made them vulnerable and how they might address these vulnerabilities.

Approaches to capacity building in the state

Climate change poses unprecedented challenges to multiple communities and sectors and introduces a relatively large uncertainty. To reduce this uncertainty and plan for sustainable development it is essential to build the capacity of various concerned departments to assess vulnerability, with good knowledge of the local conditions and context. The goal of the current project is to achieve this by bringing together representatives of different departments working with state governments in a series of workshops to develop a uniform understanding of vulnerability and to map it. Not only the capacity of individual departments working with state governments has been developed, but also adopting a coordinated and common approach within all states in India has to be emphasised. This is important, because cooperation between states will enhance their understanding and assessment of vulnerability, and in turn their understanding of adaptive capacity and resilience to climate change.

Figure 2 presents the approach adopted in this project to bring together representatives of different state governments and their departments, and to build their capacity for carrying out vulnerability assessments.

Inception Meeting

A meeting was organised in September 2019 at IIT Guwahati to prepare the structure and timeline for the execution of the project. The selection of a preliminary set of indicators for vulnerability assessment was discussed. It was decided to have a series of capacity building workshops to be organised for various departments of the state governments including the State Climate Change Cells so that they are equipped to carry out their own vulnerability assessments at different levels and for different sectors. These workshops were meant to train state participants in the common methodological framework, develop a better understanding of the indicators to be used in vulnerability assessment, and create a dialogue between states.

Capacity Building Workshops

Two capacity building workshops were organised as a part of this project.

Their specific objectives were:

- Provide an overview of the evolution of the concept of vulnerability and the framework of assessment and its relevance for adaptation to climate change in India.
- Demonstrate a common methodological framework based on IPCC-2014 guidelines of vulnerability assessment under current climate conditions.
- Give hands-on training on methodological steps and challenges.
- Build an understanding of the resource pool (resource persons and reference material) to facilitate vulnerability assessments by state departments.
- Initiate a discussion on a common set of indicators for vulnerability assessment across states and to come up with a preliminary list of indicators in consultation with the participants.

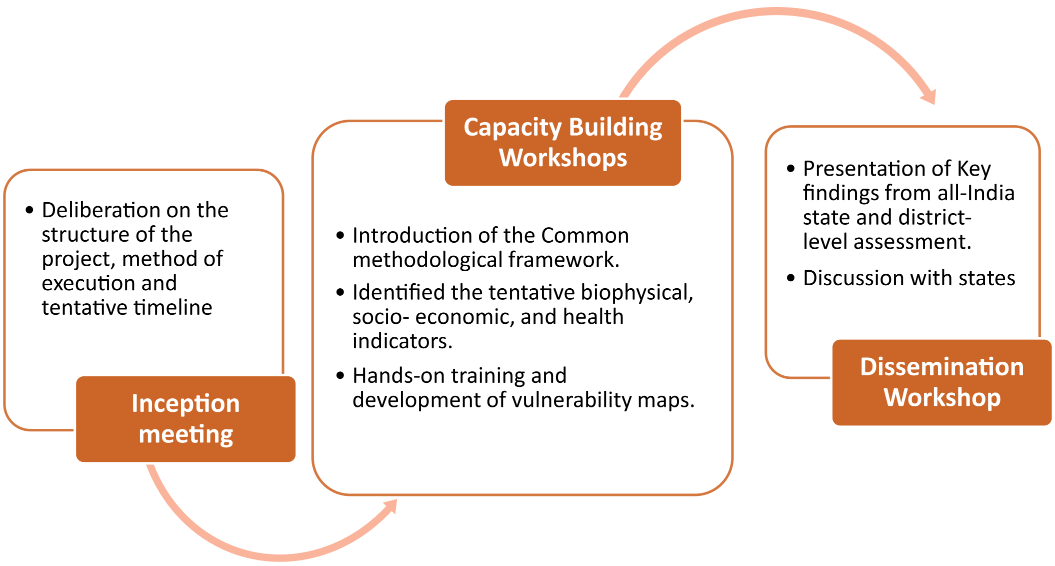

Figure 2: Approach followed under the project for state-level capacity building

The first workshop, called 'Vulnerability Profiles for India: State and District Level using a Common Framework', was held during February 2020 in New Delhi. A total of 55 representatives participated from the relevant state departments of 18 states and 3 Union Territories (UT). The second capacity building workshop was held in November 2020. Because of the COVID-19 pandemic, the workshop had to be held on a virtual platform with 22 participants from 8 states.

During the workshops, methodological steps were demonstrated to provide hands-on training to the participants with the data provided by the states. State representatives then collected data on the rest of the indicators as per the availability of the data. Later participants had hands-on experience on the data analysis. Step by step analysis was discussed with the participants. Emphasis was laid on the process of analysis, using a common methodological framework and visual representation of the key findings. On their return, they continued collection of data from their line departments to complete the vulnerability assessment.

As expected, as an outcome of the workshops, the state-representatives prepared draft comparative vulnerability maps at district level (and at block level, in the case of two states). They presented their work based on a preliminary assessment carried out during the workshop. Their presentation included description of indicators and data sources, a VI, and ranking of districts as well as maps based on this VI. Each state was requested to prepare a report on the outputs generated using a standard template shared with them. Part III of this report is based on the reports shared by the states, unless mentioned otherwise.

Dissemination workshop

A dissemination workshop was organised in December 2020, online. 58 representative participated from different state departments. The project team shared the results from the all-India state-level and district-level assessments and appraised the state representatives of the vulnerability ranking of states and districts. The results were also shared by the project team with the states. Participants shared their experiences and the challenges they had faced during the preparation of their state vulnerability profiles. They were mostly related to the (non-) availability of contemporary, uniform data for the indicators. People also observed that for any block-level assessment, data need to be collected from line departments. The current pandemic situation has posed an additional challenge in this regard.

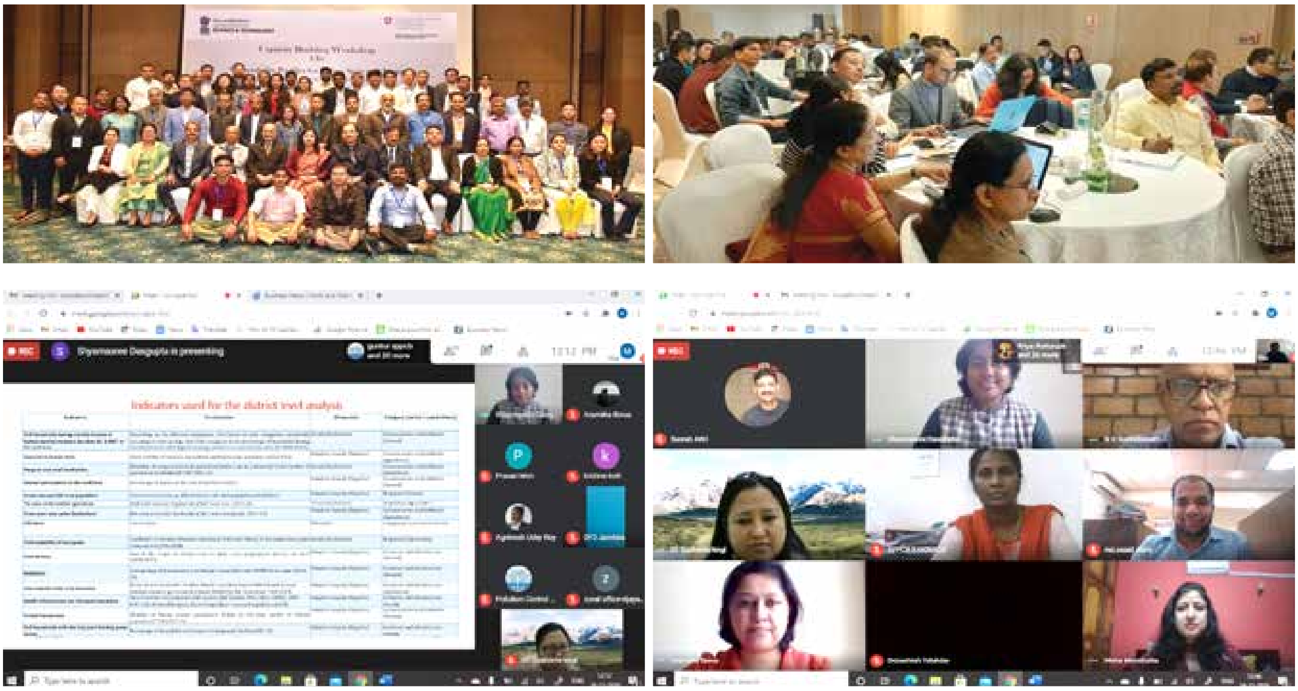

Figure 3: **Capacity building workshops for the states**
(top panel: in February 2020, Delhi; bottom panel: online workshop in November 2020)

Methodology and steps of assessment

Conducting a vulnerability assessment is a multi-step exercise and requires setting a clear goals and objectives that will determine the type of vulnerability assessment as well as the scale, sector, tier, indicators, and methods to be adopted. For this assessment, the main objective was to assess the relative vulnerabilities of states/districts/blocks based on a set of common indicators. A detailed discussion of the steps involved is available in the report Climate Vulnerability and Risk Assessment: Framework, Methods and Guidelines (developed under the Indian Himalayas Climate Adaptation Programme (IHCAP) and NMSHE in 2018 (Sharma, et. al., 2018), followed by its application in the report "Climate Vulnerability Assessment for the Indian Himalayan Region Using a Common Framework" under NHSHE and IHCAP in 2018-19 (Barua, et. al., 2019). The steps of assessment have been summarised in **Table 1.**

Use of the report

A detailed discussion on the achievements of the project and the utility of the report is provided in the final section of the report and in the Executive Summary. In brief, this assessment can assist in ranking and identification of the most vulnerable districts and states for adaptation intervention and investment. A vulnerability assessment is critical for preparing adaptation programmes and projects for the Green Climate Fund, Adaptation Fund, and funds from international and bilateral agencies. The vulnerability assessment reported on here will help states prioritise adaptation investments. The assessments carried out by states could become a chapter in their State Action Plan on Climate Change as per the outline provided by the Ministry of Environment, Forest and Climate Change. A detailed discussion on the use of the report and the way forward is presented in the final section of the report.

Table 1: Steps of vulnerability assessment

Steps in vulnerability assessment		Details of vulnerability assessment pertaining to this report
1	Setting of scope	To calculate vulnerability indices, rank the states and districts with these indices, and highlight the drivers of vulnerability. This is the first step in adaptation planning. Current climate vulnerability is considered.
2	Selection of type of vulnerability assessment	Integrated vulnerability assessment (based on biophysical, socio-economic, and institution and infrastructure-related vulnerability indicators).
3	Selection of Tier methods	Tier 1 (Tier 1: Based only on secondary data, Tier 2: A mix of primary and secondary data; Tier 3: based on primary data)
4	Selection of sector, spatial scale, community/ system, and period of vulnerability assessment	Sectors: Agriculture, forest, health, and general indicators Spatial scale: State-level and district-level assessment (2 block-level studies also presented) Period: Based on the availability of data, between 2011 and 2019
5	Identification, definition, and selection of indicators for vulnerability assessment	**Part I: All-India state-level assessment:** Initially 19 indicators were shortlisted but based on the availability of data and correlation analysis, 14 were finalised. **Part II: All-India district-level assessment:** This analysis, too, was based on 14 indicators. Some of the indicators are different from the state-level analysis due to (non-)availability of data. **Part III: State-specific assessment:** While the all-India assessments were based on sets of common indicators, state-specific assessments also used 2-3 separate indicators to capture state-specific characteristics.
6	Quantification and measurement of indicators	All indicators were quantified using secondary sources of data. The database used in the assessment along with its sources is provided in main report.
7	Normali sation of indicators	Normalisation is based on the indicators' functional relationship with vulnerability. For positively related indicators, i.e., where vulnerability increases with an increase in the value of the indicator, the following formula is used. $x^P_{ij} = \frac{Xij - Min_i\{Xij\}}{Max_i\{Xij\} - Min_i\{Xij\}}$ For negatively related indicators, i.e., where vulnerability decreases with an increase in the value of the indicator, the following formula was used: $x^N_{ij} = \frac{Max_i\{Xij\} - Xij}{Max_i\{Xij\} - Min_i\{Xij\}}$ Where X_{ij} is the value of j^{th} indicator for i^{th} district, $Min_i\{Xij\}$ is the minimum value of the j^{th} indicator across districts and $Max_i\{Xij\}$ is the maximum value of the j^{th} indicator. x^P_{ij} and x^n_{ij} are the normalised values of the indicators, respectively for positively and negatively related indicators. Normalised values of an indicator will lie between 0 and 1. The value 1 will correspond to a district with maximum vulnerability and 0 will correspond to a district with minimum vulnerability with respect to a particular indicator.
8	Assigning weights to indicators	A Principal Component Analysis (PCA)-based weight assignment technique was explored to assign differential weights to indicators. But results from PCA suggested almost equal weights for all indicators, resulting in similar vulnerability ranking as obtained with equal weights. Therefore, equal weights, i.e.1/14 = 0.071 were assigned to all indicators. Some states used PCA-based weights for their analysis.
9	Aggregation of indicators vulnerability index	Vulnerability indices are constructed by taking a simple arithmetic mean of all the normalised scores: K is the number of indicators.
10	Representation of vulnerability	Table, graphs, and spatial maps are used to represent vulnerability and its drivers. Arc-GIS software has been used to construct the maps.
11.	Vulnerability ranking	
12.	Identification of drivers of vulnerability for adaptation planning	

Part I: State-level vulnerability profile of India

Part I:
State-level vulnerability profile of India

This part of the report identifies and categorises the most vulnerable states in India and the main drivers of their vulnerability with respect to current climate risks. The objective is to assess the relative vulnerability of the states, based on a common set of indicators. A total of 29 states are considered for the analysis and that includes the erstwhile state of Jammu and Kashmir, given the nature of data availability. This all-India state-level vulnerability assessment will help policy-makers to prioritize the states for adaptation interventions and to formulate climate-resilient policies. The state-level analysis has been carried out by the research team IIT Mandi, IIT Guwahati and IISc Bengaluru and the outcomes are then shared and discussed with the states. It is fol-lowed by a district-level analysis in Part II of the report.

Conducting vulnerability assessment is a multi-step exercise and requires the identification of a clear set of goals and objectives that will determine the type of vulnerability assessment, scale, sector, tier, indicators, and methods to be adopted. The methodology opted to develop the state-level vulnerability indices (VI) is based on the IPCC-AR5 risk assessment framework (IPCC, 2014). The details of the methodology have been explained in a stepwise manner in the introduction of the report. A more detailed discussion on the methodology is available in the Common Vulnerability Framework and Guidelines developed under the IHCAP (IHCAP, 2018).

Paddy Harvesting in Jammu and Kashmir, Photo by- Mr. Majid Farooq

This part of the report provides a description of the indicators used for the analysis, the results obtained and the respective vulnerability maps. Given the diverse land-use pattern, socioeco-nomic and demographic features and available infrastructure in various states in India, it's im-portant to consider a range of indicators to construct the state-level VIs. State-level values of some of the important features are provided in the Appendix (Appendix_Table 1 and Appen-dix_Table 2).

1.1. Indicators for the state-level analysis

A set of 14 indicators of vulnerability was used in the assessment capturing both 'sensitivity' and 'adaptive capacity' of states. Table 2 presents the construction of these indicators, their relationship with vulnerability, and the rationale. The state-level values of all indicators and data source are provided in the Appendix (Appendix_Table 3 and Appendix_Table 4). Specifically, the indicators comprised the following elements:

1. **Socio-economic features and livelihood:** Percentage of population living below the poverty line (BPL), income share from natural resources, share of horticulture in agriculture, proportion of marginal and small landholdings, women's participation in the workforce.

2. **Biophysical aspects:** Yield variability of food grains, area under rainfed agriculture, forest area per 1000 rural population, incidences of vector-borne diseases and water-borne diseases.

3. **Institution and infrastructure:** Area covered under centrally funded crop insurance schemes (such as Pradhan Mantri Fasal Bima Yojna (PMFBY) and Revised Weather-based Crop Insurance Scheme (RWBCIS), implementation of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), road and rail-network, the density of healthcare workers.

Table 2: List of indicators, their construction, and rationale for their selection for the all-India state-level analysis

Indicators	Construction (year of data in parenthesis)	Dimension	Category (relevant sectors is in parenthesis)	Rationale for selection
Percentage BPL population	Percentage of population living below the poverty line. A person earning less than Rs. 965 per month in urban areas and Rs. 781 in rural areas are the poverty lines (2011)	Sensitivity (Positive)	Socio-economic features and livelihood (General)	People with extremely low incomes, are among the most vulnerable: they have little to no financial capital; so, they have the least capacity to adapt to impacts of climate risks (O'Brien, et. al., 2008)
Income shares from natural resources	Total value output from natural resources, i.e., agriculture, forestry, livestock, and fishery/ GSDP. (2015-16 and 2014-15 respectively with 2011-12 constant price)	Sensitivity (Positive)	Socio-economic and livelihood (General)	Climate variability and change directly affect the productivity of natural resources. Any alteration in the quality and availability of natural resources will have far-reaching implications on resource users and the extensive social and economic systems they support (Marshall, 2011). Thus, higher dependency on natural resources for income generation increases vulnerability.
Share of horticulture in agriculture	Value of output of horticulture/Value of agricultural output (2015-16)	Adaptive Capacity (Negative)	Socio-economic and livelihood (Agricultural)	Horticulture trees are hardy and more resilient to climate variations compared to agricultural crops. They provide alternate income sources to agriculture. Once established, they are far less sensitive to the impacts of climate risks, particularly rainfall variability and droughts (IHCAP, 2019).
Marginal and small landholdings	Number of marginal and small operational holdings, i.e., up to 2 hectares/Total number of operational holdings **(2015-16)**	Sensitivity (Positive)	Socio-economic and livelihood (Agriculture)	Marginal and smallholder farmers experience immediate hardship in face of any climatic hazard. They are unable to make adequate decisions about when to sow, what to grow, and how-to time inputs. (Sathyan, et. al., 2018). They also find it difficult to cope with the high food price and the fluctuations in the same.
Yield variability of food grains	Coefficient of Variation, (i.e., Standard Deviation divided by the arithmetic mean) calculated for 10 years of food grain yield data (2005-2016)	Sensitivity (Positive)	Biophysical (Agriculture)	A high variability in crop yields indicates fluctuations in agro-climatic conditions. The agriculture sector is extremely sensitive to climate fluxes, particularly rainfall variability (delayed rainfall, dry spells, drought, extreme rainfall, and floods) and this indicator captures this sensitivity (Davis, et. al., 2019)
Area covered under crop insurance	Crop area insured under PMFBY and RWBICS/ Net sown area (2017-18)	Adaptive Capacity (Negative)	Institution and infrastructure (Agriculture)	Crop insurance helps farming households mitigate losses caused by climate risks. This enhances their adaptive capacity (Swain, 2014).
Area under rainfed agriculture	(Net sown area- Net irrigated area)/ Net sown area (2015-16)	Sensitivity (Positive)	Biophysical (Agriculture)	Rainfed agriculture is highly sensitive to the vagaries of weather. Lack of irrigation indicates a lack of adaptive capacity to mitigate the impacts of climate risks, leading to increased crop loss and reduced income of households dependent on rainfed agriculture (Rani, et. al., 2011)
Forest area per 1,000 rural population	Area of total forest in km2 per 1,000 rural population (2019)	Adaptive Capacity (Negative)	Biophysical (Forest)	Forests are an important source of alternative livelihood and food through the extraction of non-timber forest products (NTFPs). Forests also provide essential ecosystem services for the sustainable productivity of rural economies and building of adaptive capacity (IHCAP, 2019).

Indicators	Construction (year of data in parenthesis)	Dimension	Category (relevant sectors is in parenthesis)	Rationale for selection
Women's participation in the workforce	Percentage of women in the overall workforce (2011)	Adaptive Capacity (Negative)	Socioeconomic and livelihood (General)	Women are known to be more sensitive to climate risks. As gender inequality remains a major barrier to human development, women's participation in the labour market is an important indicator of gender equality (HDR, 2019). Regions with more women in gainful employment would signify (some degree of) gender equality, enhanced purchasing power, and independence. Therefore, such working women are likely less vulnerable to climate change
MGNREGA	Average days of employment provided per household under MGNREGA in a year (2014-15 to 2015-16)	Adaptive Capacity (Negative)	Institution and infrastructure (General)	MGNREGA scheme as an alternative source of income helps in building adaptive capacity, particularly in dealing with unforeseen livelihood hazards (Adam, 2014). It acts as a safety net by providing any adult member of a household registered under the scheme with 100 days of wage labour a year and 150 days in case of hazards such as droughts, floods, cyclones, and hail. This provides households with a menial but essential source of additional income to help them tide over the impacts of hazards.
Road and rail density	The total length of surface road and length of rail tracks in km/Total geographical area in sq. km {(2016-17+2018-19)/2019}	Adaptive Capacity (Negative)	Institution and infrastructure (General)	Under extreme weather events, the role of transport becomes crucial (Ebinger and Vandycke, 2015). This indicator focused on accessibility and connectivity, which are essential in regions that are exposed to climate and disaster risks, to allow for relocation and provide support services. It also gave some idea of the overall development of a region, because with better connectivity comes better access to markets, essential services, a potential for industrialisation, etc.
The density of health care workers	Total number of health care workers (doctors, dental, nurses, pharma ancillary, and traditional health care workers per 1,00,000 population (2016)	Adaptive Capacity (Negative)	Institution and infrastructure (Health)	The availability of doctors and health care specialists at medical institutions represents the functionality of these institutions. Access to functional health care infrastructure is essential for the overall health and well-being of a community (IHCAP, 2019).
Vector-borne diseases (VBD)	Cases of VBD (dengue, chikungunya, kala-azar, acute encephalitis syndrome, Japanese encephalitis, malaria) per 1,000 population (2018)	Sensitivity (Positive)	Biophysical **(Health)**	Temperature and rainfall variations can foster higher VBD occurrence (Dhiman, et. al., 2010).
Water-borne diseases (WBD)	Cases of WBD (cholera, typhoid, acute diarrhoea) per 1,000 population (2018)	Sensitivity (Positive)	Biophysical (Health)	Lack of proper drainage, high incidence of open defecation, and frequent occurrence of floods lead to an increase in exposure to waterborne pathogens (Rastogi, 2019).

1.2. Composite vulnerability indices (VI) of Indian states

In this section the VIs developed for the states are presented and compared along with an assessment of drivers of vulnerability. Theoretically, VIs lie between 0 and 1; 0 being the lowest possible VI and 1 the highest.

1.2.1. Vulnerability ranking of 29 states

VI estimates show that the lowest value of a VI for the states obtained in this analysis is 0.42, i.e., even relatively less vulnerable states have high VI scores. This also implies that all 29 states are significantly vulnerable. Further, the values of VIs of states vary over a small range (0.42-0.67) and are more or less equally distributed. From a policymaking perspective, this means all states have to deal with concerns related to climate vulnerability.

The highest VI was obtained for Jharkhand (0.67) and the lowest for Maharashtra (0.42). The ranking of states based on VI values is given in Figure 4. It's worth mentioning that VIs are relative measures and that it does not imply that Maharashtra is not vulnerable in an absolute sense. It should also be noted that this vulnerability ranking is based on a set of indicators that were used in this assessment with a specific objective. These indicators predominantly focused on socio-economic drivers as well as those related to primary sector-based livelihood along with some biophysical and institutional factors. Thus, rankings may be different with the change in objective of an assessment and a change in indicators.

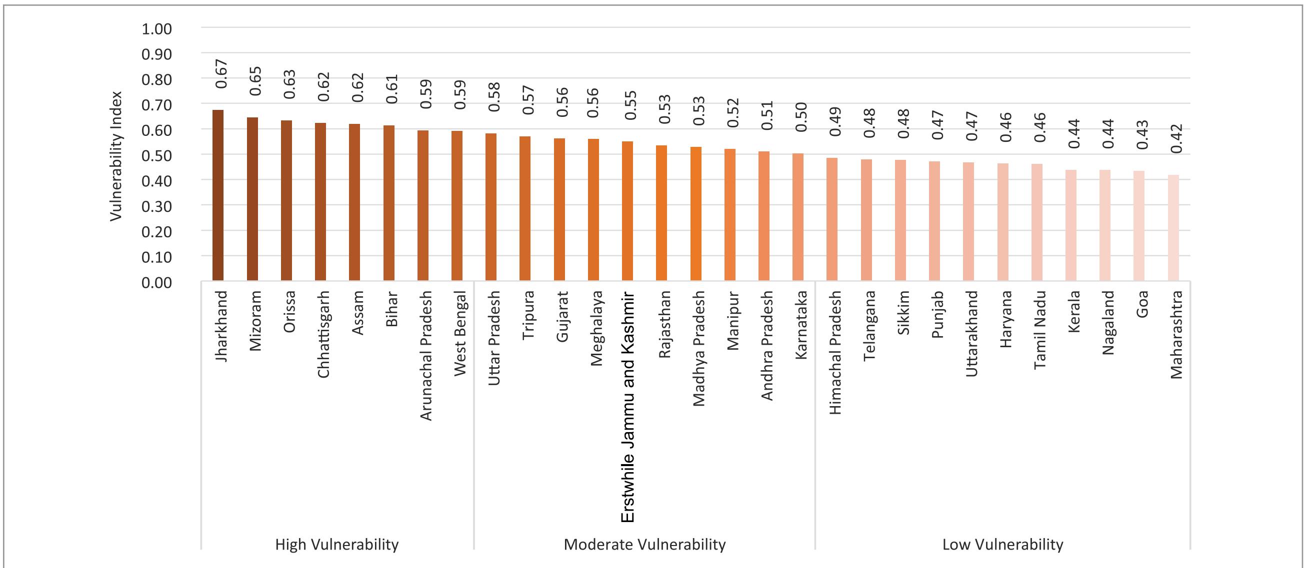

Figure 4: Vulnerability indices of the Indian states, their categorisation, and corresponding ranks

1.3. Categorisation of states based on Vulnerability Indices

1.3.1. Range-based categorisation of the states

The value of VI for Indian states suggests that all states are vulnerable to climate risks, but some are relatively more. Grouping of states helps to get a better idea of different categories of states in the context of the VI range. As mentioned earlier, VI values range between 0.42 – 0.67: the range may be divided into three equal intervals to obtain the following categories (Table 3):

- ***Relatively highly vulnerable states (VI: 0.58-0.67):*** Jharkhand, Mizoram, Orissa, Chhattisgarh, Assam, Bihar, Arunachal Pradesh, and West Bengal (8 states).
- ***Relatively moderately vulnerable states (VI: 0.50-0.58):*** Uttar Pradesh, Tripura, Gujarat, Meghalaya, Erstwhile Jammu and Kashmir, Rajasthan, Madhya Pradesh, Manipur, Andhra Pradesh, and Karnataka, (10 states).
- ***Relatively low vulnerable states (VI: 0.42- 0.50):*** Himachal Pradesh, Telangana, Sikkim, Punjab, Uttarakhand, Haryana, Tamil Nadu, Kerala, Nagaland, Goa, and Maharashtra (11 states).

1.3.2. Quartile-based categorizsation of states

Under Quartile-based categorization, 29 states are divided into four categories, i.e., Quartiles: each category containing an equal number (7-8) of states according to their order of ranking. Quartile I contains 25% of the most vulnerable states and Quartile IV the 25% least vulnerable.

- ***Top 25% most vulnerable states (Quartile I):*** This group contains 8 most vulnerable states in India (resultant VI: ~0.58-67)
- ***Upper middle 25% vulnerable states (Quartile II):*** This group contains 7 second most vulnerable states (resultant VI: ~0.52-0.58)
- ***Lower middle 25% vulnerable states (Quartile III):*** This group contains 7 vulnerable states after Quartile II (resultant VI: ~0.47-0.52)
- ***Bottom 25% vulnerable states (Quartile IV):*** This group contains 7 states with the lowest VIs (resultant VI: ~0.42-0.47)

The states in Quartile I coincide with the states in the 'relatively highly vulnerable category' of states. The states in each quartile are represented in Table 3.

1.4. Vulnerability maps

State-level vulnerability maps are developed to provide a visual representation of the categories of vulnerability (range-based: Figure 5, quartile-based: Figure 6, and vulnerability ranking-based: Figure 7). Geographically, most states with a relatively high vulnerability form a cluster in the eastern part of the India. They are Jharkhand, Mizoram, Orissa, Chhattisgarh, Assam, Bihar, Arunachal Pradesh, and West Bengal. Among these states, Mizoram, Assam, Arunachal Pradesh, and the hill districts of West Bengal are situated in the ecologically fragile Eastern Himalayan Region. The location of most of these states overlaps with disaster-prone areas according to multi-hazard maps prepared by the National Disaster Management Authority (NDMA, 2016). This puts those states in a doubly disadvantageous position.

1.5. Major drivers of vulnerability at state level

Identification of major drivers of vulnerability is perhaps the first step towards targeted adaptation planning. It leads to a better understanding of the sources of vulnerability of a state and contributes to developing targeted adaptation measures to address specific indicators of sensitivity and adaptive capacity. For each state, indicators with normalised values greater than or equal to 0.8 are identified as the main drivers of vulnerability. Barring a few states, this resulted in ~3-4 most important drivers for each state. The bar diagram in Figure 8 represents the frequency of an indicator that appears to be a driver across states, i.e., the number of states for which a particular driver is applicable. The list of drivers is provided in Table 4.

Notably, vulnerability is multidimensional because many indicators appear to be drivers for a single state in many cases. For states where more than 4 drivers are identified, they are divided into 2 categories – 3-4 major drivers and other drivers. The major drivers of vulnerability across states include a lack of forest area per 1000 population leading to a lack of alternative livelihood based on forest resources, a high proportion of area under rainfed agriculture, and a lack of coverage of central crop insurance schemes. All these indicators contribute to high vulnerability of the agricultural sector, further more than half of the Indian population depend on it.

Table 3: Vulnerability Indices of states, their ranking, and categorisation

	Vulnerability Indices	Ranking	Relative Vulnerability Category	Quartile (Q)-based categorisation of the vulnerability of states
Jharkhand	0.674	1	High vulnerability	Top 25% most vulnerable states (QI)
Mizoram	0.645	2	High vulnerability	Top 25% most vulnerable states (QI)
Orissa	0.633	3	High vulnerability	Top 25% most vulnerable states (QI)
Chhattisgarh	0.623	4	High vulnerability	Top 25% most vulnerable states (QI)
Assam	0.620	5	High vulnerability	Top 25% most vulnerable states (QI)
Bihar	0.614	6	High vulnerability	Top 25% most vulnerable states (QI)
Arunachal Pradesh	0.594	7	High vulnerability	Top 25% most vulnerable states (QI)
West Bengal	0.592	8	High vulnerability	Top 25% most vulnerable states (QI)
Uttar Pradesh	0.582	9	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Tripura	0.571	10	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Gujarat	0.562	11	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Meghalaya	0.560	12	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Erstwhile Jammu and Kashmir	0.550	13	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Rajasthan	0.535	14	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Madhya Pradesh	0.528	15	Moderate vulnerability	Upper-middle 25% vulnerable states (QII)
Manipur	0.520	16	Moderate vulnerability	Lower-middle 25% vulnerable states (QIII)
Andhra Pradesh	0.510	17	Moderate vulnerability	Lower-middle 25% vulnerable states (QIII)
Karnataka	0.503	18	Moderate vulnerability	Lower-middle 25% vulnerable states (QIII)
Himachal Pradesh	0.486	19	Low vulnerability	Lower-middle 25% vulnerable states (QIII)
Telangana	0.480	20	Low vulnerability	Lower-middle 25% vulnerable states (QIII)
Sikkim	0.477	21	Low vulnerability	Lower-middle 25% vulnerable states (QIII)
Punjab	0.472	22	Low vulnerability	Lower-middle 25% vulnerable states (QIII)
Uttarakhand	0.468	23	Low vulnerability	Bottom 25% vulnerable states (QIV)
Haryana	0.463	25	Low vulnerability	Bottom 25% vulnerable states (QIV)
Tamil Nadu	0.462	24	Low vulnerability	Bottom 25% vulnerable states (QIV)
Kerala	0.437	26	Low vulnerability	Bottom 25% vulnerable states (QIV)
Nagaland	0.437	28	Low vulnerability	Bottom 25% vulnerable states (QIV)
Goa	0.434	27	Low vulnerability	Bottom 25% vulnerable states (QIV)
Maharashtra	0.419	29	Low vulnerability	Bottom 25% vulnerable states (QIV)

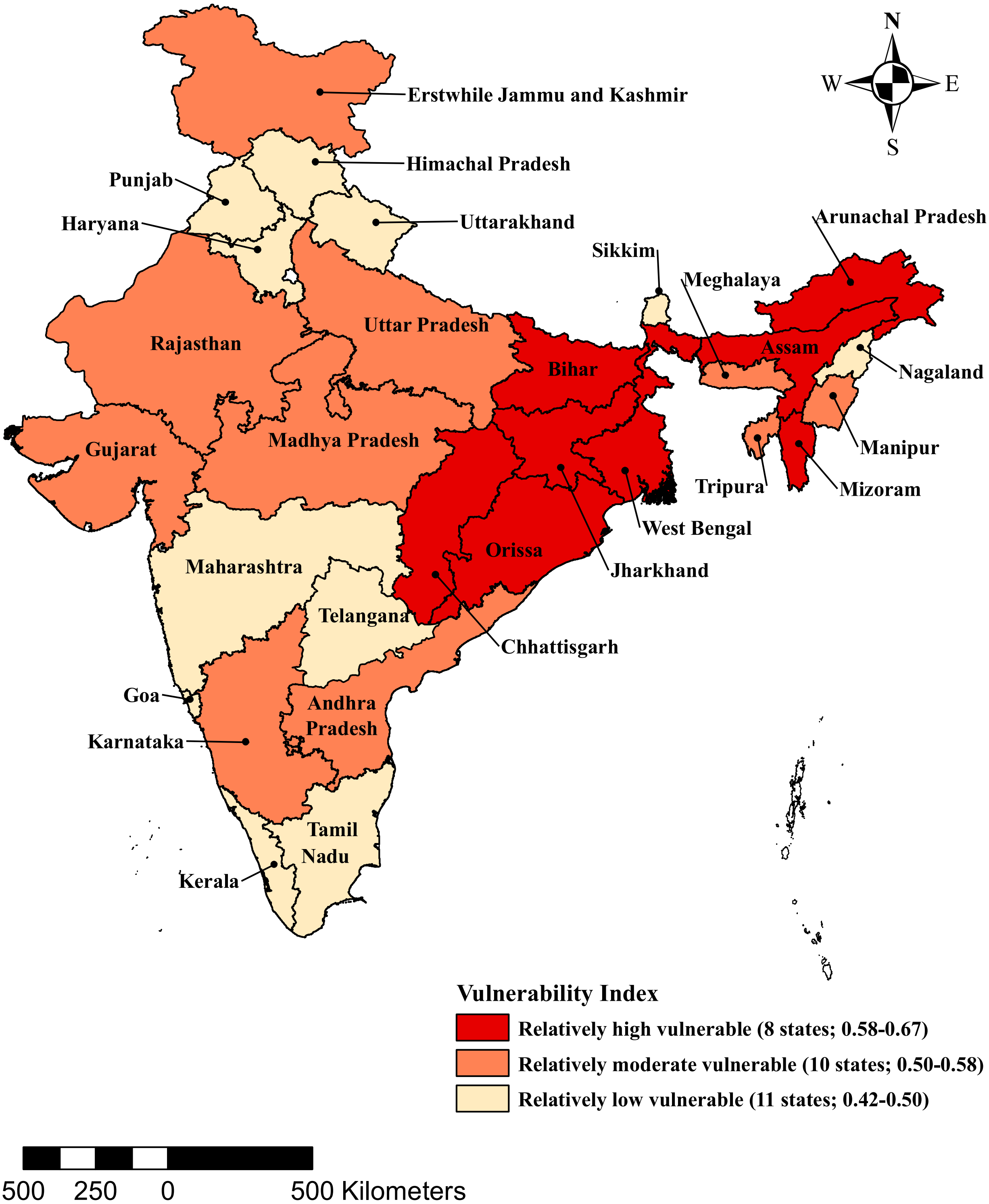

Figure 5: **Vulnerability profile of Indian states (based on the range of the vulnerability index): the range 0.67-0.42 is divided into three equal lengths and states under each category are identified**

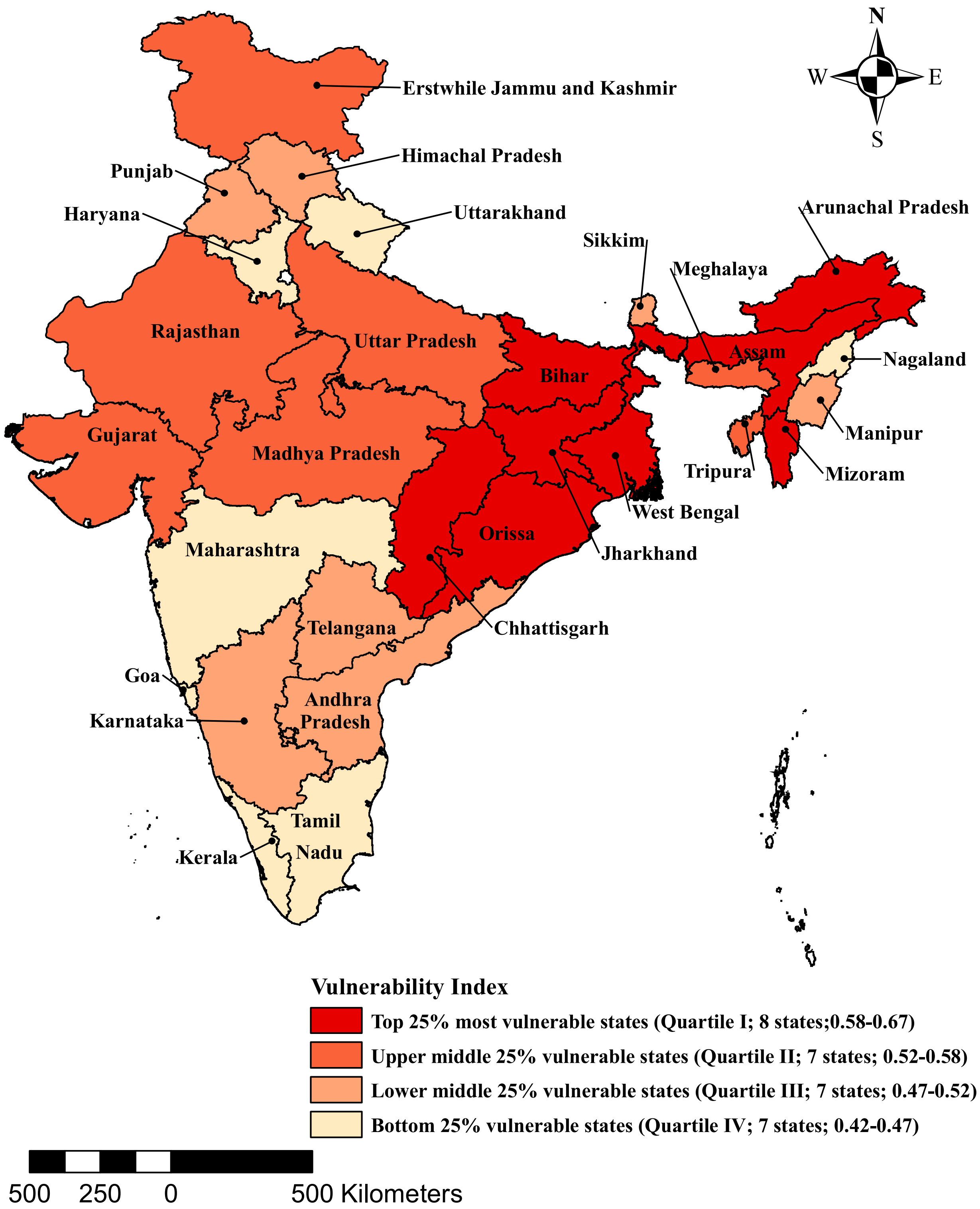

Figure 6: Vulnerability profile of Indian states (quartile based): all 29 states are divided into 4 categories, each containing 7-8 districts in the order of their vulnerability ranking

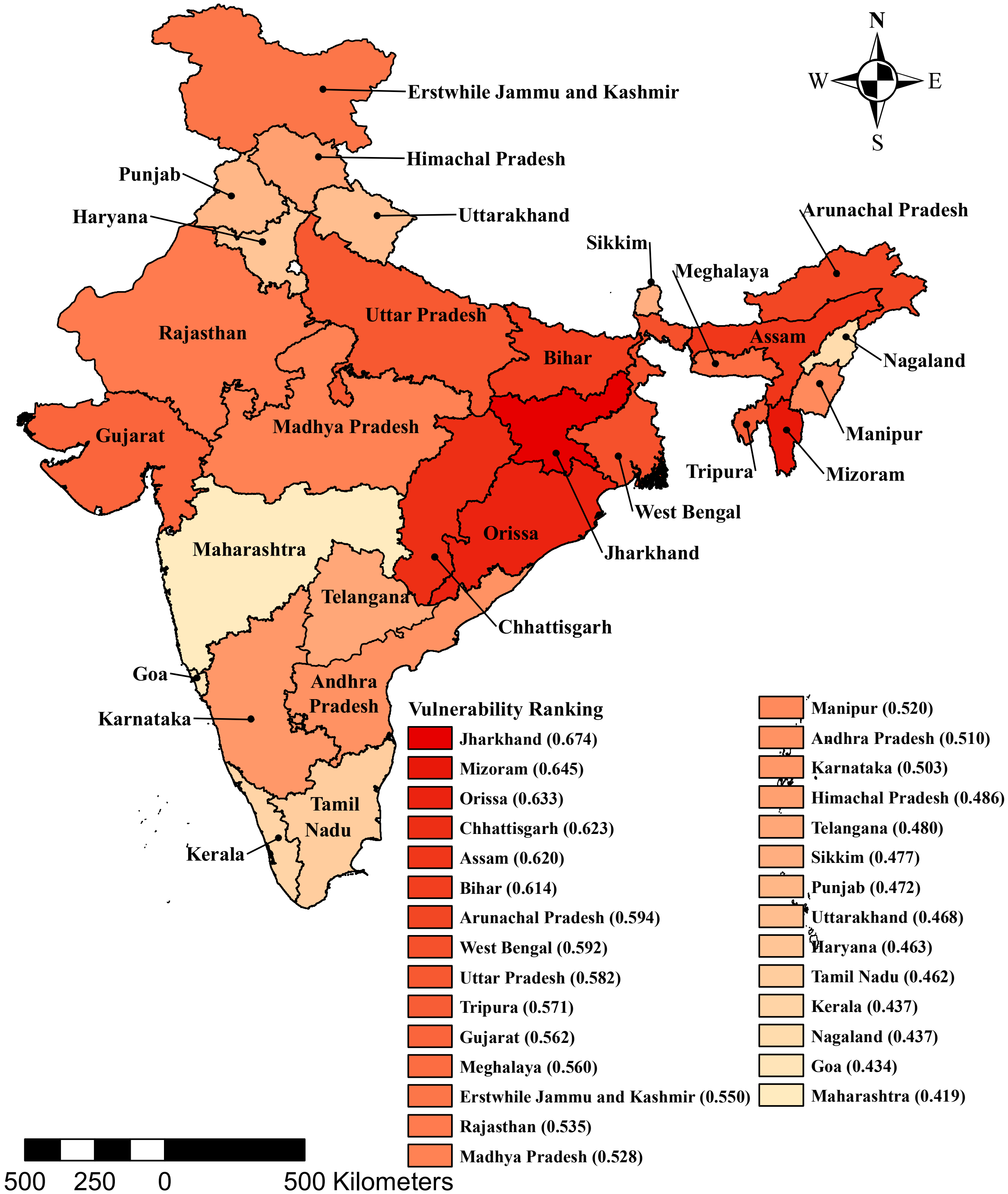

Figure 7: Vulnerability ranking of Indian states

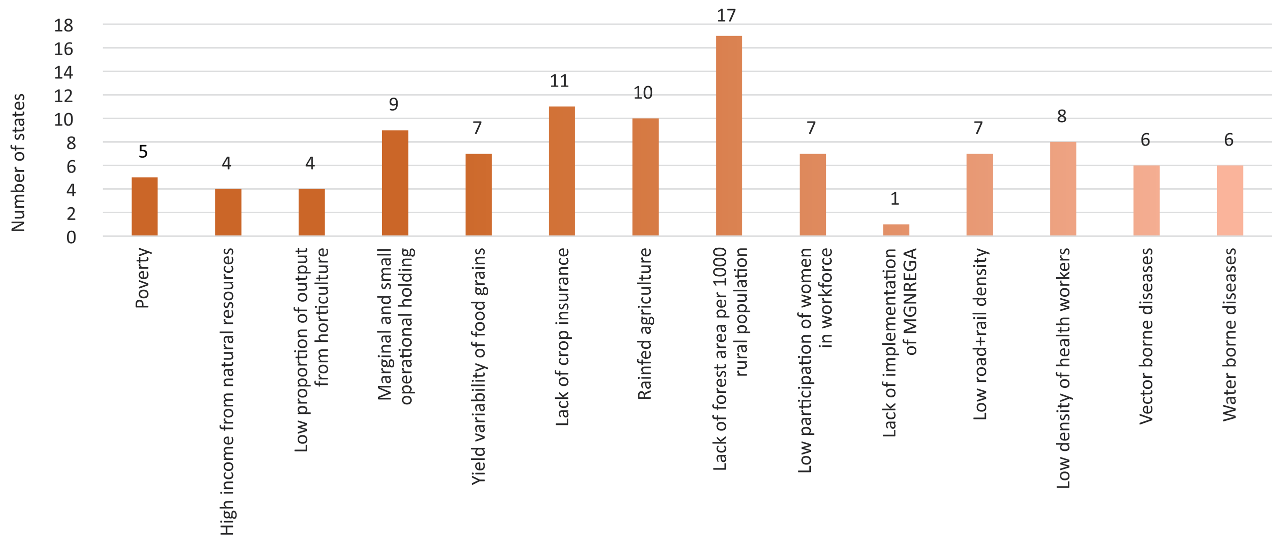

Figure 8: Major drivers of vulnerability for all states

Table 4: Drivers of vulnerability for all states

States	Ranking	Drivers
Jharkhand	1	**Major drivers:** High proportion of BPL population, prevalence of rainfed agriculture, and high incidence of vector-borne diseases. **Other drivers:** Lack of forest area per 1,000 rural population, high yield-variability of food grains, low road and rail density, low number of health care workers.
Mizoram	2	**Major drivers:** High yield-variability of food grains, very low coverage of crop insurance, prevalence of rainfed agriculture, high incidence of vector-borne diseases. **Other drivers:** High share of income from natural resources (agriculture and allied services), low road density, and lack of railway network. Note, despite highest density of health care workers per thousand population, less than 8% are doctors among them.
Orissa	3	**Major drivers:** Prevalence of marginal and small landholdings, lack of forest area per 1,000 rural population, and high incidence of vector-borne diseases.
Chhattisgarh	4	**Major drivers:** High proportion of BPL population, low road density and lack of railway network, low number of health care workers, and high incidence of vector-borne diseases.
Assam	5	**Major drivers:** Very low coverage of crop insurance, prevalence of rainfed agriculture, lack of forest area per 1,000 rural population, and low number of health care workers.
Bihar	6	**Major drivers:** Lack of forest area per 1,000 rural population, high yield-variability of food grains, and low number of health care workers. **Other drivers:** High proportion of BPL population, prevalence of marginal and small landholdings, and lack of women's participation in workforce.
Arunachal Pradesh	7	**Major drivers:** High proportion of natural resource-based income, very low coverage of crop insurance, lack of implementation of MGNREGA, low road density, and lack of rail network. **Other drivers:** High proportion of BPL population and prevalence of Rainfed agriculture.

States	Ranking	Drivers
West Bengal	8	**Major drivers:** High proportion of natural resource-based income, prevalence of marginal and small landholdings, lack of forest area per 1,000 rural population, lack of women's participation in workforce, and high incidence of water-borne diseases.
Uttar Pradesh	9	**Major drivers:** Prevalence of marginal and small landholdings, lack of forest area per 1,000 rural population, lack of women's participation in workforce, and low number of health care workers.
Tripura	10	**Major rivers:** Prevalence of marginal and small landholdings, very low coverage of crop insurance, high incidence of vector-borne diseases.
Gujarat	11	**Major drivers:** Lack of forest area per 1,000 rural population, low road density, and lack of railway network.
Meghalaya	12	**Major drivers:** Very low coverage of crop insurance, low number of health care workers, high incidence of both water and vector-borne diseases.
Erstwhile Jammu and Kashmir	13	**Major drivers:** Prevalence of marginal and small landholdings, lack of women's participation in workforce, low road density, lack of railway network, and high incidence of water-borne diseases.
Rajasthan	14	**Major drivers:** Low dependence on horticulture, especially perennial fruit trees in agriculture, lack of forest area per 1,000 rural population, and low number of health care workers. **Other drivers:** high yield-variability of food grains, low road density, and lack of railway network.
Madhya Pradesh	15	**Major drivers:** High proportion of natural resource-based income, high yield-variability of food grains, lack of forest area per 1,000 rural population, and low number of health care workers.
Manipur	16	**Major drivers:** High proportion of BPL population, very low coverage of crop insurance and prevalence of rainfed agriculture.
Andhra Pradesh	17	**Major drivers:** Lack of forest area per 1,000 rural population and high incidence of water-borne diseases.
Karnataka	18	**Major drivers:** Lower availability of forest area per 1,000 rural population.
Himachal Pradesh	19	**Major drivers:** Prevalence of rainfed agriculture and high incidence of water-borne diseases.
Telangana	20	**Major drivers:** Lack of forest area per 1,000 rural population.
Sikkim	21	**Major drivers:** Low dependence on horticulture, especially perennial fruit trees in agriculture, prevalence of rainfed agriculture, very low coverage of crop insurance, and high incidence of water-borne diseases.
Punjab	22	**Major drivers:** Low dependence on horticulture, especially perennial fruit trees in agriculture, very low coverage of crop insurance, lack of forest area per 1,000 rural population, and lack of women's participation in workforce.
Uttarakhand	23	**Major drivers:** Prevalence of marginal and small landholdings, very low coverage of crop insurance
Haryana	24	**Major drivers:** Low dependence on horticulture trees, lack of forest area per 1,000 rural populations, and lack of women's participation in workforce.
Tamil Nadu	25	**Major drivers:** High yield-variability of food grains, prevalence of marginal and small landholdings, and lack of forest area per 1,000 rural population.
Kerala	26	**Major drivers:** Prevalence of marginal and small landholdings and low coverage of crop insurance, **Other drivers:** Prevalence of Rainfed agriculture, lack of forest area per 1,000 rural population, and lack of women's participation in workforce.
Nagaland	27	**Major drivers:** Very low coverage of crop insurance and prevalence of rainfed agriculture.
Goa	28	**Major drivers:** Low coverage of crop insurance.
Maharashtra	29	**Major drivers:** Prevalence of rainfed agriculture and lack of forest area per 1,000 rural population.

1.5.1. Drivers in relatively highly vulnerable states (Jharkhand, Mizoram, Orissa, Chhattisgarh, Assam, Bihar, Arunachal Pradesh, and West Bengal)

- States with relatively high vulnerability are mostly poor states with a low per capita income and low Human Development Index, indicating a low overall adaptive capacity (Reserve Bank of India, 2018).
- A lack of forest cover, high sensitivity of the health sector (disease prevalence) coupled with a low adaptive capacity due to a lack of health care workers are the major drivers of vulnerability in these states.
- This is followed by a high percentage of BPL population, the prevalence of rainfed agriculture, and a lack of crop insurance, compounding agricultural vulnerability.
- Moreover, in many cases, vulnerability is multidimensional, and many indicators appear to be drivers of vulnerability for some states.
- The multidimensionality of vulnerability is evident in, for example, the most vulnerable states Jharkhand, Mizoram, and Bihar. They have multiple drivers of vulnerability (6-7 for each state) encompassing biophysical, socio-economic, livelihood, and institutional and infrastructure-based indicators. They perform relatively poorly with respect to many indicators, especially those capturing institutional development and infrastructure, which play important roles in building adaptive capacity.

1.5.2. Drivers of vulnerability in relatively moderately vulnerable states (Uttar Pradesh, Tripura, Gujarat, Meghalaya, Erstwhile Jammu and Kashmir, Rajasthan, Madhya Pradesh, Manipur, Andhra Pradesh, and Karnataka)

- The lack of forest area per 1000 rural population remains one of the major drivers of vulnerability in these states. While in Gujarat and Rajasthan it may not be biophysically possible to have a high forest cover, in states such as Uttar Pradesh, Madhya Pradesh, and Andhra Pradesh a higher forest cover could be achieved.
- At least one in three health indicators is also a driver of vulnerability in this category. Meghalaya, with a strong presence of both vector-borne and water-borne diseases and lack of health care workers, shows a high degree of vulnerability in this respect.
- What makes these states relatively less vulnerable than the most vulnerable states is the fact that a number of these states were able to develop some adaptive capacity in terms of a relatively low incidence of BPL population, better implementation of MGNREGA, and considerable road-rail network density.

1.5.3. Major drivers of vulnerability in relatively low vulnerable states (Himachal Pradesh, Telangana, Sikkim, Punjab, Uttarakhand, Haryana, Tamil Nadu, Kerala, Nagaland, Goa, Maharashtra)

- Unlike in relatively high-vulnerable states, here the drivers are limited.
- They are mostly arising from a lack of forest area per 1000 population, lack of crop insurance, and the prevalence of rainfed agriculture.
- There is a relatively low BPL population in these states. Other than Nagaland and Maharashtra, the proportion of the BPL population here is less than the national average (~20%). This gives a good prospect for building adaptive capacity to cope with any climatic hazard for limited numbers of households with a very poor resource base in these states.
- States in this category do not depend much on natural resources for income generation.
- They have an adaptive capacity through better functionality of institutions. This is reflected in a relatively higher rate of implementation of MGNREGA, a high road density and extensive railway network, a greater number of health care workers per 1000 population, and a low prevalence of vector-borne diseases. Only two states (Sikkim and Himachal Pradesh) have a health indicator (WBD) as a driver of vulnerability.

One significant observation is that in these states, the overall vulnerability is lower not because they have a smaller number of drivers, but because they have many indicators in which they performed extremely well. For example, one notable reason for a relatively low VI for Maharashtra is the presence of cities such as Mumbai and Pune that significantly contributed to the state's GSDP. This means that a low proportion of

GSDP is coming from the primary/ agricultural sector there. Also, it is a state that has excelled in institutional development along with a good implementation of MGNREGA and a low vulnerability of the health sector. Even so, not all parts of the state are less vulnerable, especially the drought-prone districts of Marathwada and Vidarbha. Maharashtra also has a severe agricultural vulnerability. A Central Research Institute for Dryland Agriculture study (CRIDA, 2019) reported that a large number of districts in the state suffer from a major agricultural vulnerability. The present report also found a high prevalence of rainfed agriculture as one of the major drivers of vulnerability there. In addition, on the one hand, this state is drought-prone (it was one of nine Indian states to have been officially declared drought-prone in 2015), and on the other, only 18% of its net cultivation area is under irrigation.

Nagaland, in turn, is highly dependent on natural-resource based income generation. It also almost entirely depends on rainfed agriculture, with no institutional crop insurance in place. Interestingly, these along with certain other institutional mechanisms have led to a lower VI. The state has almost no marginal and small farmers, but a high forest cover per 1000 population and the highest female workforce participation in the country. It also performs well in the health sector. The sensitivity to water and vector-borne diseases is low, while it also has a moderate adaptive capacity through the availability of health workers.

1.6. Use of state-level vulnerability assessment

Assessing vulnerability is important as it provides information on measures to be taken to adapt to climate change. Hence, a vulnerability assessment is the first step in adaptation planning. The purpose is to measure the comparable degrees of vulnerability for all Indian states for prioritization of the states for climate change adaptation planning and investment. The analysis also helps the states in understanding the major drivers of vulnerability and target the adaptation actions accordingly. The use of the report has been discussed in a more detailed manner in the final chapter of the report.

Part II: District-level vulnerability profile of India

Part II:
District-level vulnerability profile of India

The objective of Part II of the report is to carry out a current-climate district-level vulnerability assessment for India based on the starting point/contextual approach. Based on the vulnerability indices (VI) derived for each district in India, the study identifies and categorises the most vulnerable districts and the major drivers of vulnerability. Identification of the most vulnerable districts along with the drivers is an essential first step for prioritizing investment in climate-adaptation at the district level. The assessment is based on 612 districts, which covers the same geographical area as the current 718 districts; some of the recent bifurcations of districts could not be taken into consideration due to lack of availability of data for the indicators. The objectives could be summarised as follows: a) develop a current climate district-level vulnerability profile for India, b) categorise the districts into relatively high, moderate, and relatively low vulnerable, c) identify states with the prevalence of a large number of vulnerable districts, d) identify the major drivers of the vulnerability for each of the districts.

This all-India district level analysis is also carried out by the research team at IIT Mandi, IIT Guwahati and IISc Bengaluru and the outcomes were subsequently discussed in the states in the dissemination meeting.

2.1. Indicators used in district-level assessment

A set of 14 indicators of vulnerability was used in the assessment capturing both 'sensitivity' and 'adaptive capacity' of the districts with respect to current climate risks. These 14 indicators are not exactly that same as what have been used for the state-level analysis given non-availability of data at district-level. Table 5 presents a list of indicators along with the rationale behind their inclusion in the assessment. The source of data is provided in Appendix_Table 5 in detailed manner.

These indicators comprised:

- ***Socio-economic and livelihood-based indicators:*** Percentage of households having monthly income of the highest-earning member less than Rs. 5000/- in rural areas, the livestock to human ratio, the proportion of marginal and small landholders, women's participation in the workforce, the percentage of net sown area under horticulture, and the female literacy rate.
- ***Biophysical indicators:*** The yield variability of food grains, the proportion of area under rainfed agriculture, and the forest area per 100 rural population.
- ***Institution and infrastructure related indicators:*** The road density, the area covered under centrally funded crop insurance schemes (PMFBY and RWBCIS), the implementation of the MGNREGA, the health infrastructure per 1000 population, and the percentage of households with an improved drinking water source.

2.2. District-level vulnerability indices

VIs are found to range between 0.75 (Karimganj in Assam) to 0.34 (Lahul & Spiti in Himachal Pradesh). Since the VIs can theoretically lie between 0 and 1, with 0 the lowest possible VI and 1 the highest, this indicates all districts in India are vulnerable. None of the districts exhibit vulnerability as low as 0.2 or 0.1, in fact not even less than 0.3. The values of VIs vary over a small range of 0.34-0.75. Also, VIs of two districts consecutively ranked according to their vulnerability do not differ much. This means that, from a policy-making perspective, all districts have to deal with concerns related to vulnerability. The ranking of 50 most vulnerable districts based on VI values is represented in Table 6. 100 and 200 most vulnerable districts are presented in Figure 9. A list of all districts along with their VI and corresponding ranking is presented in Appendix_Table 6.

Table 5: List of indicators, construction of indicators, their dimensions and category, and rationale behind the selection of the indicator

Indicators	Construction	Dimension	Category (sector in parenthesis)	Rationale for selection
Percentage of households having monthly income of highest-earning members less than Rs. 5,000/- in the rural area	Depending on the different parameters, the Census of India categorises households according to their earnings. One category is the percentage of households having a monthly income of the highest-earning member in a rural area of less than Rs. 5000 (2011)	Sensitivity (Positive)	Socio-economic and livelihood (General)	Households in this category generally represent the poorest ones. In a bigger household with only one earning member poverty may also prevail, even if he/she earns more than Rs. 5000/-. Yet, this is the best available income-related indicator that may be found at district level in India. People with extremely low incomes are among the most vulnerable for they have little or no financial capital. So, they have the least capacity to adapt to impacts of climate risks (O'Brien, 2008)
Livestock to human ratio	Total number of livestock, equivalence applied/ Population (2019/2011)	Adaptive Capacity (Negative)	Socio-economic and livelihood (Agriculture)	Livestock acts as an alternative source of income/ asset. Agricultural loss due to climate events can be compensated by income earned from livestock. It is also an important asset that can be sold in times of need. By helping in compensating losses livestock contributes to the reduction of vulnerability (IHCAP, 2019)
Proportion of marginal and small landholders	Number of marginal and small operational holders (up to 2 hectares)/ Total number of operational landholders (2011-12)	Sensitivity (Positive)	Socio-economic and livelihood (Agriculture)	Marginal and smallholder farmers experience immediate hardship in face of any climatic hazard. They are unable to make adequate decisions about when to sow, what to grow, and how-to time inputs. They have a low adaptive capacity (Sathyan, et. al., 2018). They also find it difficult to cope with the high food price of fluctuations (Aryal, et al., 2020)
Women's participation in the workforce	Percentage of women in the overall workforce (2011).	Adaptive Capacity (Negative)	Socio-economic and livelihood (General)	Women are known to be more sensitive to climate risks. As gender inequality remains a major barrier to human development, women's participation in the labour market is an important indicator of gender equality (HDR, 2019) That is to say, regions with a more women in gainful employment would signify (some degree of) gender equality, enhanced purchasing power, and independence. Consequently, such working women are likely less vulnerable to climate change
Forest area per 100 rural population	Area of total forest in km2 per 100 rural population (2019/2011)	Adaptive Capacity (Negative)	Biophysical (Forest)	Forests are an important source of alternative livelihood and food through the extraction of NTFPs. Forests also provide essential ecosystem services for the sustainable productivity of rural economies and building of adaptive capacity (IHCAP, 2019).
The area under rainfed agriculture	(Net sown area- Net irrigated area)/Net sown area. (2015-16)	Sensitivity (Positive)	Biophysical (Agriculture)	Rainfed agriculture is highly sensitive to the vagaries of weather. Lack of irrigation indicates a lack of adaptive capacity to mitigate the impacts of climate risks, leading to increased crop loss and reduced income of households dependent on rainfed agriculture (Rani, et. al., 2011)
Proportion of net sown area under horticulture	Net sown area under horticultural/ Net sown area (2017-17)	Adaptive Capacity (Negative)	Socio-economic and livelihood (Agricultural)	Horticulture trees are hardy and more resilient to climate variations compared to field crops. They provide alternative income sources to agriculture. Once established, they are far less sensitive to the impacts of climate risks, particularly rainfall variability and droughts (IHCAP, 2019)

Indicator	Construction	Dimension	Category (sector in parenthesis)	Rationale for selection
Yield variability of food grains	Coefficient of Variation (i.e., Standard Deviation/ arithmetic mean) of major food grains over a period (2006-2018)	Sensitivity (Positive)	Biophysical (Agriculture)	A high variability in crop yields indicates fluctuations in agro-climatic conditions. The agriculture sector is extremely sensitive to climate fluxes, particularly rainfall variability (delayed rainfall, dry spells, drought, extreme rainfall, and floods) and this indicator captures this sensitivity (Davis, et. al., 2019)
Road density	Sum of the length of surface road (in km)/ Total geographical area (in km2). ((2011/2019)	Adaptive Capacity (Negative)	Institution and infrastructure (General)	Under extreme weather events, the role of transport becomes crucial (Ebinger and Vandycke, 2015). This indicator focused on accessibility and connectivity, which are essential in regions that are exposed to climate and disaster risks to allow for relocation and provide support services. It also gave some idea of the overall development of a region, because with better connectivity comes better access to markets, essential services, a potential for industrialisation, etc.
MGNREGA	Average days of employment provided per household under MGNREGA in a year (2018-19)	Adaptive Capacity (Negative)	Institution and infrastructure (General)	MGNREGA as an alternative source of income helps in building adaptive capacity, particularly in dealing with unforeseen hazards (Adam, 2014). It acts as a safety net, by providing any adult member of a household registered under the scheme with 100 days of non-climate sensitive wage labour a year and 150 days in case of hazards such as droughts, floods, cyclones, and hail This provides households with a menial but essential source of additional income to help them tide over the impacts of hazards
Area covered under crop insurance	[Crop area insured under PMFBY)and RWBCIS/ Net sown area] *100 (2019)	Adaptive Capacity (Negative)	Institution and infrastructure (Agriculture)	Crop insurance helps farming households mitigate losses caused by climate risks. This enhances their adaptive capacity (Swain, 2014). The risk and insurance market to promote adaptation to climate change in the agriculture sector is still not fully developed in South-Asian countries (Aryal, et. al., 2020)
Health infrastructure per 1000 population	Total number of functional health centres (Sub centres, PHCs, CHCs, HWCSC, HWC-PHCs, Sub-divisional hospitals, district hospitals) per 1000 population (2019)	Adaptive Capacity (Negative)	Institution and infrastructure (Health)	Access to functional health care infrastructure is essential for the overall health and wellbeing of a community (IHCAP, 2019).
Female literacy rate	(Number of literate women divided by the total number of literate people) *100 (2015-16)	Adaptive Capacity (Negative)	Socio-economic and livelihood (General)	The literacy rate has a direct relation to reducing vulnerability. As the number of literate women increases, better ways for livelihood will be adopted (IHCAP, 2019). In a correlation analysis for this assessment, it was also found that female literacy is significantly positively correlated with low infant mortality rate, better sanitation facilities, etc. It has also been checked that the indicator is not correlated with women's participation in the labour force.
% of households with an improved drinking water source	Percentage of households with proper drinking water facility (2015-16)	Adaptive Capacity (Negative)	Institution and infrastructure (Health)	Access to contaminated drinking water enhances the risk of diseases such as cholera, typhoid, and exposure to other waterborne pathogens. Therefore, potable and improved drinking water reduces health vulnerability substantially, particularly of children (Germanwatch, 2019).

Table 6: Vulnerability Indices, ranking, and the major drivers of vulnerability for 50 most vulnerable districts

Districts	States	VI	Rank	Drivers of vulnerability
Karimganj	Assam	0.753	1	Rainfed agriculture, lack of crop insurance, small area under horticulture, lack of improved drinking water sources
Goalpara	Assam	0.752	2	Yield variability of food grains, small area under horticulture, low forest area, lack of implementation of MGNREGA
Dhubri	Assam	0.734	3	Rainfed agriculture, small area under horticulture, low forest area
Darrang	Assam	0.732	4	Yield variability of food grains, small area under horticulture, low forest area
Katihar	Bihar	0.725	5	Marginal and small operational landholdings, lack of crop insurance, low forest area
Sonitpur	Assam	0.720	6	Rainfed agriculture, yield variability of food grains, lack of crop insurance, low forest area, low road density
Araria	Bihar	0.707	7	Marginal and small operational landholdings, lack of crop insurance, small area under horticulture, low forest area
Kishanganj	Bihar	0.707	8	Marginal and small operational landholdings, lack of crop insurance, low forest area
Golaghat	Assam	0.707	9	Rainfed agriculture, yield variability of food grains, lack of crop insurance, low forest area, lack of implementation of MGNREGA
Cachar	Assam	0.703	10	Rainfed agriculture
Barpeta	Assam	0.703	11	Yield variability of food grains, small area under horticulture, low forest area
Purnia	Bihar	0.701	12	Marginal and small operational holdings, yield variability of food grains, lack of crop insurance, low forest area
Jamui	Bihar	0.700	13	Marginal and small operational landholdings, lack of crop insurance, lack of area under horticulture, low forest area
Nuapada	Orissa	0.699	14	Low household income, marginal and small operational landholding, rainfed agriculture, lack of area under horticulture, lack of women's participation in workforce, low road density
Kokrajhar	Assam	0.699	15	Marginal and small operational landholdings, yield variability of food grains, low road density
Sahibganj	Jharkhand	0.696	16	Rainfed agriculture, small area under horticulture, low forest area
Sheohar	Bihar	0.694	17	Marginal and small operational landholdings, lack of crop insurance, small area under horticulture, low forest area
Tinsukia	Assam	0.693	18	Rainfed agriculture, yield variability of food grains, lack of crop insurance, lack of implementation of MGNREGA
Baksa	Assam	0.690	19	Rainfed agriculture, yield variability of food grains, small area under horticulture, low forest area, low road density
Perambalur	Tamil Nadu	0.688	20	Marginal and small operational landholdings, lack of crop insurance, small area under horticulture, low forest area, lack of implementation of MGNREGA
Morigaon	Assam	0.688	21	Rainfed agriculture, yield variability of food grains, low forest area, low road density
Ariyalur	Tamil Nadu	0.686	22	Marginal and small operational landholdings, small area under horticulture, low forest area, lack of implementation of MGNREGA
Dibrugarh	Assam	0.685	23	Rainfed agriculture, lack of crop insurance, small area under horticulture, lack of implementation of MGNREGA
Sivasagar	Assam	0.685	24	Rainfed agriculture, lack of crop insurance, small area under horticulture, low forest area, lack of implementation of MGNREGA
Hailakandi	Assam	0.684	25	Rainfed agriculture, high yield variability of food grains, low average person days per household employed under MGNREGA

Districts	States	VI	Rank	Drivers of vulnerability
Nagaon	Assam	0.683	26	Low percentage of net sown area under horticulture, low forest area per 100 rural population
Cooch Bihar	West Bengal	0.681	27	Marginal and small landholdings, lack of crop insurance, small area under horticulture, low forest area
Madhepura	Bihar	0.680	28	Marginal and small operational landholders, lack of crop insurance, low forest area, lack of health infrastructure
Jalpaiguri	West Bengal	0.679	29	Marginal and small operational landholdings, lack of crop insurance, small area under horticulture
Bahraich	UP	0.676	30	Marginal and small operational landholdings, small area under horticulture, low forest area
Purulia	West Bengal	0.676	31	Low household income, marginal and small operational landholdings, lack of crop insurance, small area under horticulture, low forest area, low road density
Lakhimpur	Assam	0.673	32	Rainfed agriculture, yield variability of food grains, small area under horticulture, low forest area
Purba Champaran	Bihar	0.673	33	Marginal and small operational landholdings, yield variability of food grains, lack of crop insurance, low forest area
Lakhisarai	Bihar	0.672	34	Marginal and small operational landholdings, lack of crop insurance, small area under horticulture, low forest area
Siwan	Bihar	0.669	35	Marginal and small operational landholdings, lack of crop insurance, low forest area, low road density
Sitamarhi	Bihar	0.668	36	Marginal and small operational landholdings, lack of crop insurance, low forest area, lack of health infrastructure
Ramban	Jammu & Kashmir	0.665	37	Marginal and small operational landholdings, rainfed agriculture, lack of crop insurance, small area under horticulture, low road density
Bishnupur	Manipur	0.665	38	Rainfed agriculture, lack of crop insurance, small area under horticulture, low forest area
Mewat Nuh)	Haryana	0.663	39	Small area under horticulture, low forest area
Ramanathapuram	Tamil Nadu	0.663	40	Marginal and small operational landholdings, yield variability of food grains, low livestock to human ratio, small area under horticulture, low forest area
Jorhat	Assam	0.663	41	Rainfed agriculture, low forest area
Chirang	Assam	0.662	42	Rainfed agriculture, low road density
Nayagarh	Orissa	0.661	43	Low household income, rainfed agriculture, small area under horticulture
Khagaria	Bihar	0.660	44	Marginal and small operational landholdings, lack of crop insurance, low forest area, low road density
Gopalganj	Bihar	0.659	45	Marginal and small operational landholding, lack of crop insurance, low forest area, low road density
Madhubani	Bihar	0.659	46	Marginal and small operational landholdings, lack of crop insurance, low forest area, low road density
Udalguri	Assam	0.659	47	Yield variability of food grains, low forest area, low road density
Balrampur	UP	0.659	48	Marginal and small operational landholdings, lack of crop insurance, small area under horticulture, low forest area, low road density
Giridih	Jharkhand	0.657	49	Marginal and small operational landholdings, small area under horticulture, low forest area, low road density
Nandurbar	Maharashtra	0.656	50	Lack of crop insurance, small area under horticulture
Buxar	Bihar	0.656	51	Lack of crop insurance, lack of forest area and low road density

2.2.1. Categorisation of districts based on VI

The assessment clearly shows that all districts in India are vulnerable to climate risks, but some are relatively more vulnerable. Grouping of districts helps to identify sets of districts falling under a specific category of vulnerability (relatively low, relatively high, etc.). In the present assessment, the districts were categorised in the following three different ways:

2.2.1.1. Quartile-based categorisation

612 districts were divided into four categories based on Quartiles. Each category contains an equal number (153) of districts, placed in order of ranking.

- Top 25% most vulnerable districts (Quartile I): This group contains 153 most vulnerable districts in India; the resultant range of VI is ~0.61-0.75.
- Upper middle 25% vulnerable districts (Quartile II): This group contains 153 second most vulnerable districts; the resultant range of VI is ~0.56-0.61.
- Lower middle 25% vulnerable districts (Quartile III): This group contains 153 vulnerable districts after Quartile II; the resultant range of VI for this group is ~0.51-0.56.
- The bottom 25% vulnerable districts (Quartile IV): This group contains 153 districts with the lowest VIs, the resultant range of VI for this group is ~0.34-0.51.

However, dropping seven major cities form the analysis results in some alteration of this distribution.

2.2.1.2. Decile-based categorisation

The 612 districts were also divided into 10 categories, Deciles, each category containing an equal number (61 or 62) of districts.

- **Decile I:** 10% most vulnerable districts (the resultant VI range: ~0.65-0.75; 62 districts)
- **Decile II:** 10% - 20% vulnerable districts (the resultant VI range: ~0.62-0.65; 61 districts
- **Decile III:** 20% - 30% vulnerable districts (the resultant VI range: ~0.60-0.62; 61 districts)
- **Decile IV:** 30% - 40% vulnerable districts (the resultant VI range: ~0.58-0.60; 61 districts)
- **Decile V:** 40% - 50% vulnerable districts (the resultant VI range: ~0.56-0.58; 61 districts)
- **Decile VI:** 50% - 60% vulnerable districts (the resultant VI range: ~ 0.55-0.56; 61 districts)
- **Decile VII:** 60% - 70% vulnerable districts (the resultant VI range: ~0.53-0.55; 61 districts)
- **Decile VIII:** 70% - 80% vulnerable districts (the resultant VI range: ~ 0.51-0.53; 61 districts)
- **Decile IX:** 80% - 90% vulnerable districts (the resultant VI range: ~0.48-0.51; 61 districts)
- **Decile X:** 10% least vulnerable districts (the resultant VI range: ~ 0.34-0.48; 62 districts)

2.2.1.3. Range-based categorisation

The range of VIs (0.34-0.75) was then divided into five equal intervals, and districts within each interval were identified. This representation led to an uneven distribution of districts across groups, but it is useful to identify districts with a relatively very high vulnerability. Also, this categorisation places districts on a relative scale: a district in the category of 'relatively very low vulnerability' does not necessarily have an absolute vulnerability that is also low.

The distribution of districts went as follows:

- **Relatively very highly vulnerable districts:** VI range: 0.67-0.75; 34 districts
- **Relatively highly vulnerable districts:** VI range: 0.59-0.67; 188 districts.
- **Relatively moderately vulnerable districts:** VI range: 0.51- 0.59; 258 districts.
- **Relatively low vulnerable districts:** VI range: 0.43-0.51; 120 districts.
- **Relatively very low vulnerable districts:** VI range: 0.34-0.43; 12 districts.

2.3. Vulnerability maps

District-level vulnerability maps are developed to provide a visual representation of the categorisation of districts based on Quartile, Decile, and Range divisions. Figure 9 shows the geographical location and spread of the 100 and 200 most vulnerable districts in India. Most districts in the category of 100 most vulnerable districts in India are in Assam (24 districts), Bihar (23 districts), and Jharkhand (11 districts). Other than that, Uttar Pradesh (8 districts), Orissa (7 districts), Madhya Pradesh (6 districts), Maharashtra, and West Bengal (5 districts each). In the Indian Himalayan Region, 4 districts in Jammu and Kashmir in the western part and 1 district each in Mizoram and Manipur in the eastern part also fall under this category. Finally, 3 districts in Tamil Nadu and 1 in Haryana and Telangana each belong to this group. Geographically, most of these 100 districts are in the Indo-Gangetic plain and the Brahmaputra river basin. Both areas are flood prone. The spread of the next 100 vulnerable districts is found in central India, Orissa and Maharashtra, as also in other states.

Maps based on Quartiles, Deciles, and ranges (Figure 10, Figure 12, Figure 13, respectively) have been developed with Arc-GIS. Since metropolitan cities have very different characteristics with regard to population density, cost of living, and infrastructure, another map (Figure 11) has been presented. It omits 7 major cities[1] (going by 2014 data), namely, Mumbai Urban, Chennai, Ahmedabad (including Bhavnagar), Bengaluru Urban, Hyderabad, Kolkata, and Pune. Delhi, as a Union Territory, has not been considered in the present study.

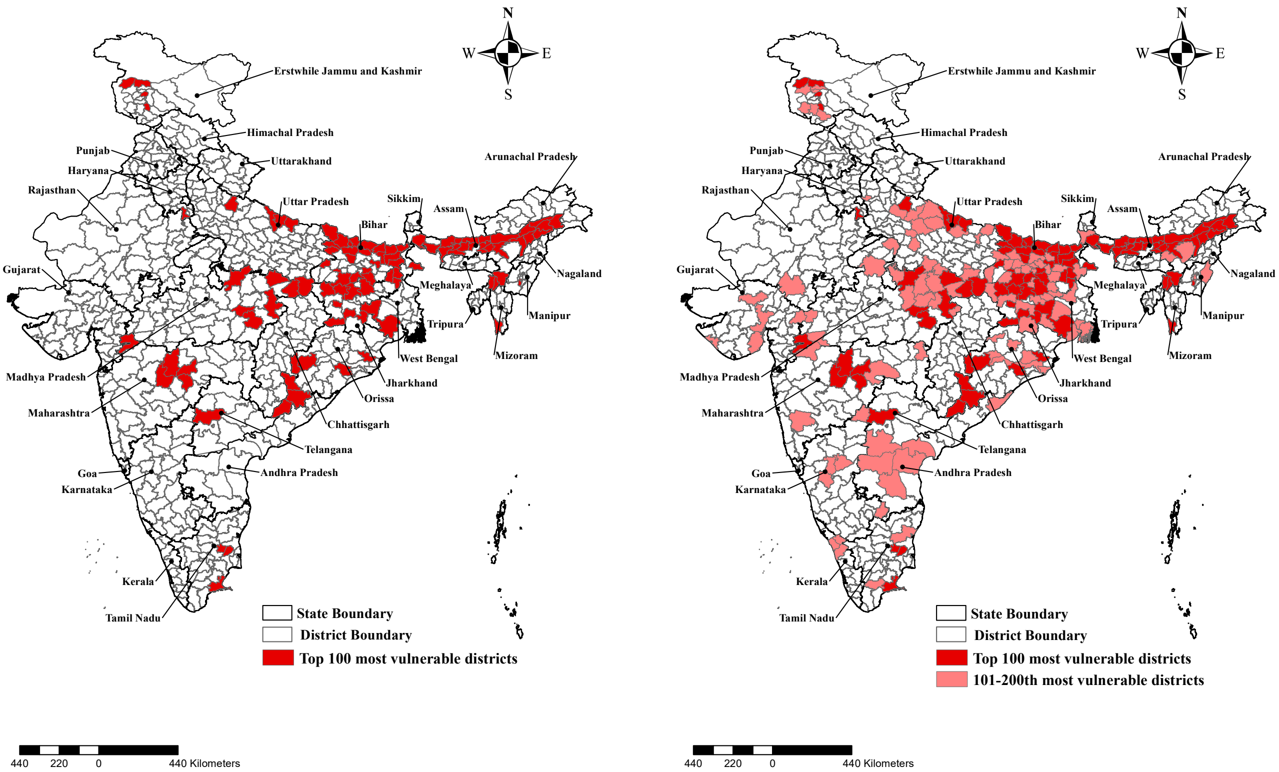

Figure 9: 100 most vulnerable districts (left panel) and 200 most vulnerable districts (right panel) in India

1 Since 2014, all previous classifications of cities have been revised to consider the categorisation made by the 6th Central Pay Commission. The previous classification of A-1, A, B-1, B2, C has been mapped as: A1 to X, A, B1 and B2 to Y and C and unclassified to Z. Ref: Department of Expenditure, 2008, https://dispur.nic.in/sixthpay/sixth-pay-allowances.pdf

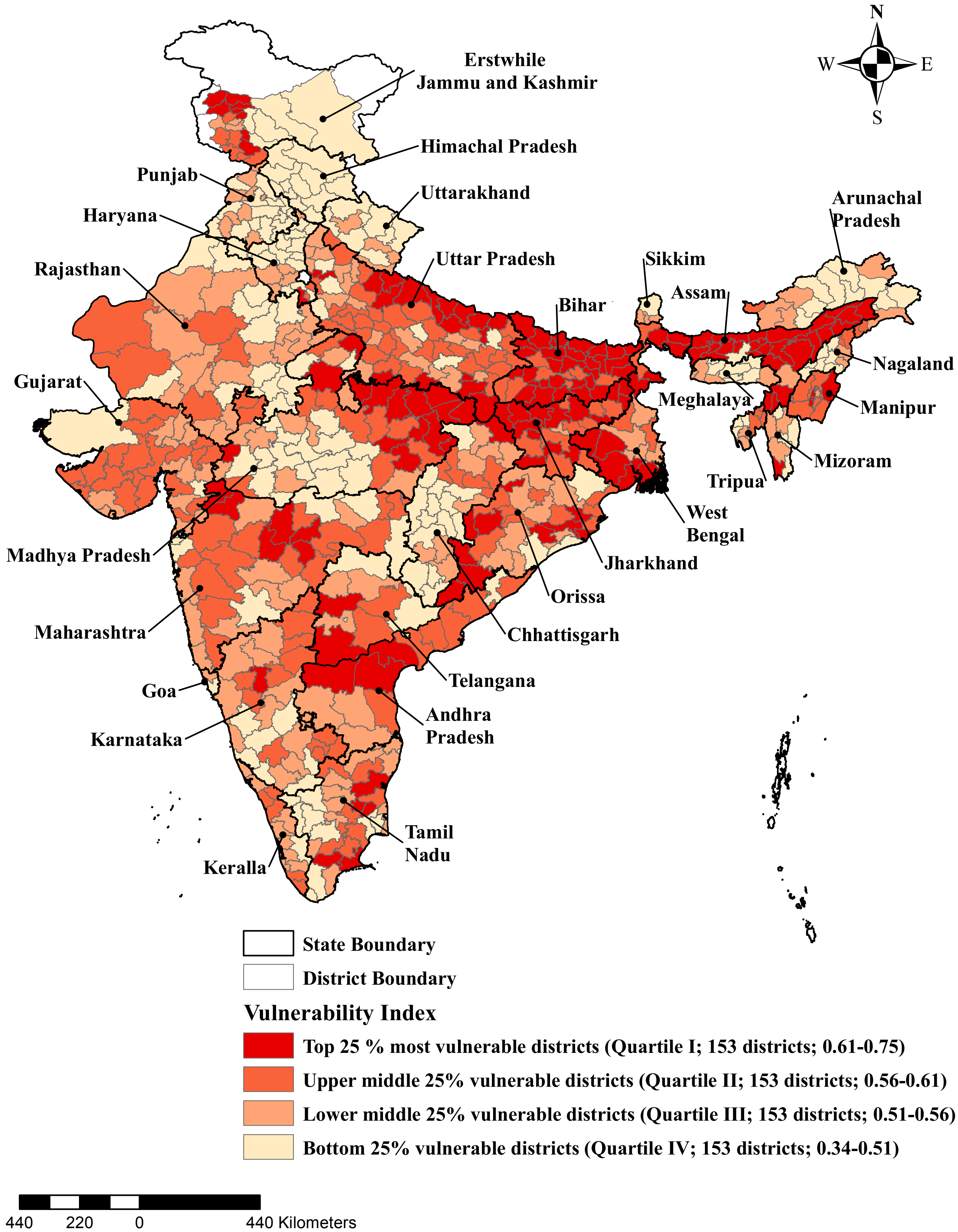

Figure 10: District-level vulnerability profile of India based on four Quartiles (Quartile I includes the 25% most vulnerable districts and Quartile IV includes the bottom 25% vulnerable districts)

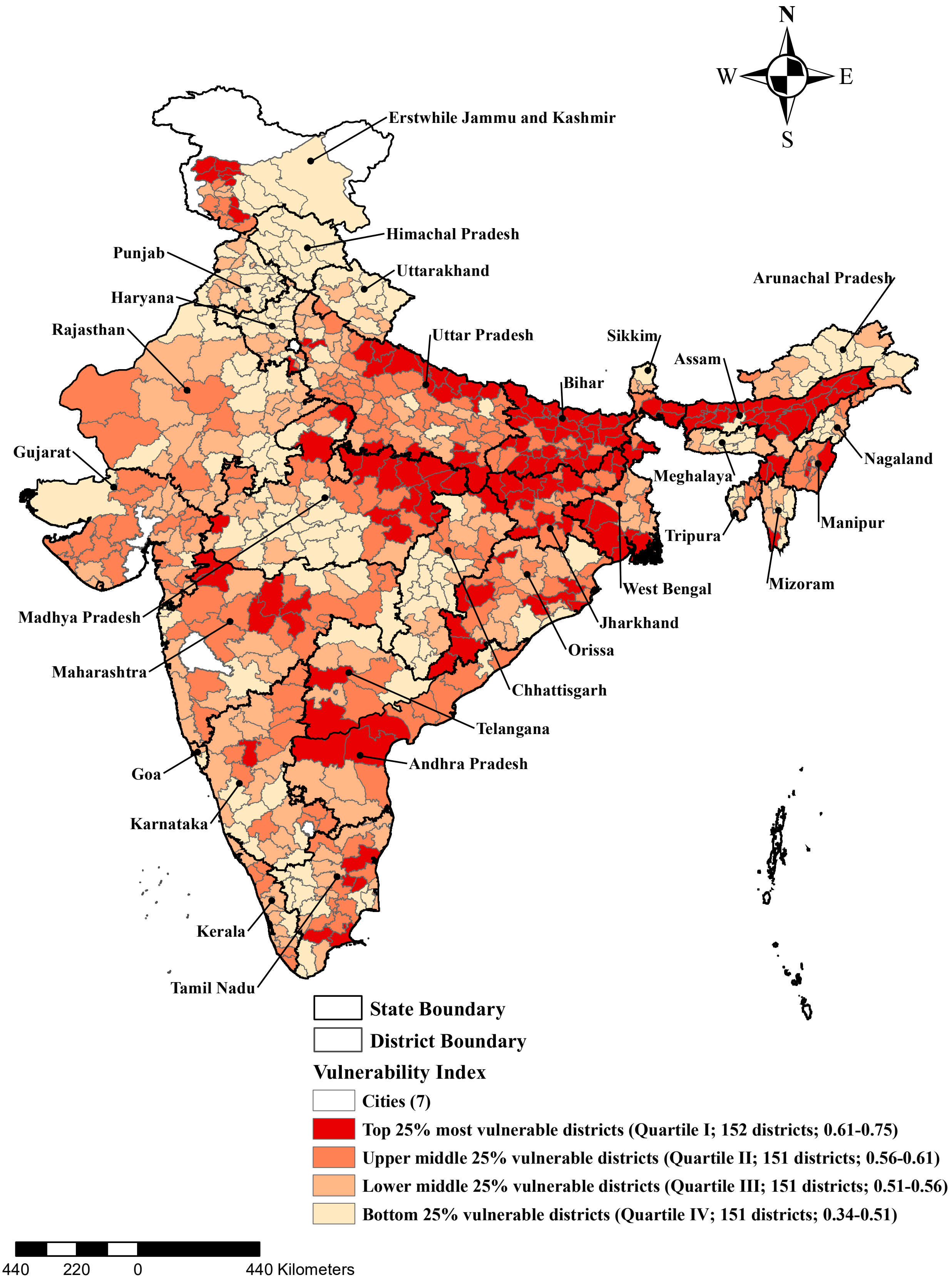

Figure 11: District-level vulnerability profile of India based on four Quartiles excluding seven major cities (Quartile I includes the top 25% most vulnerable districts and Quartile IV includes the bottom 25% vulnerable districts)

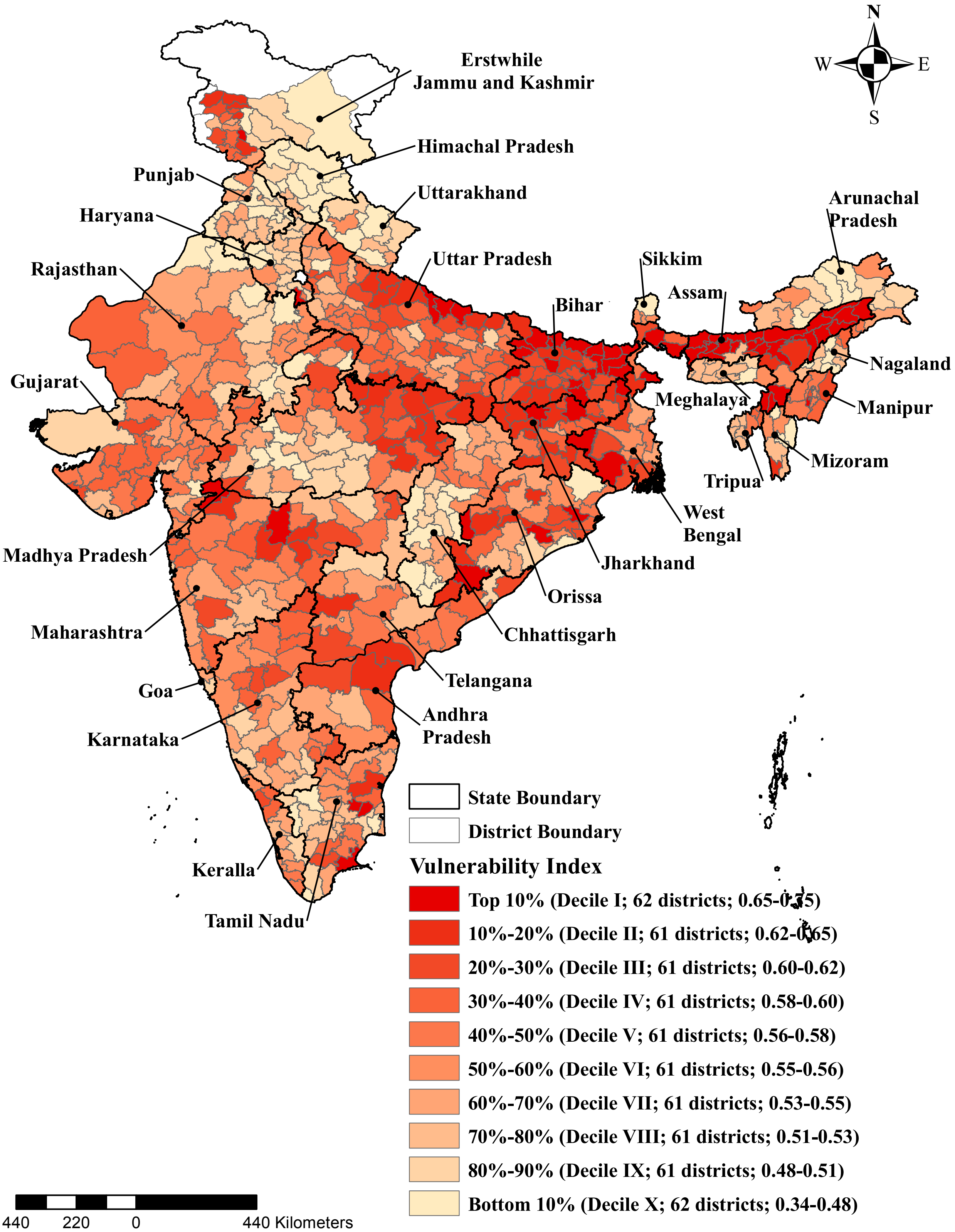

Figure 12: District-level vulnerability profile of India based on ten Deciles (Decile I includes the 10% most vulnerable districts and Decile X includes the bottom 10% vulnerable districts)

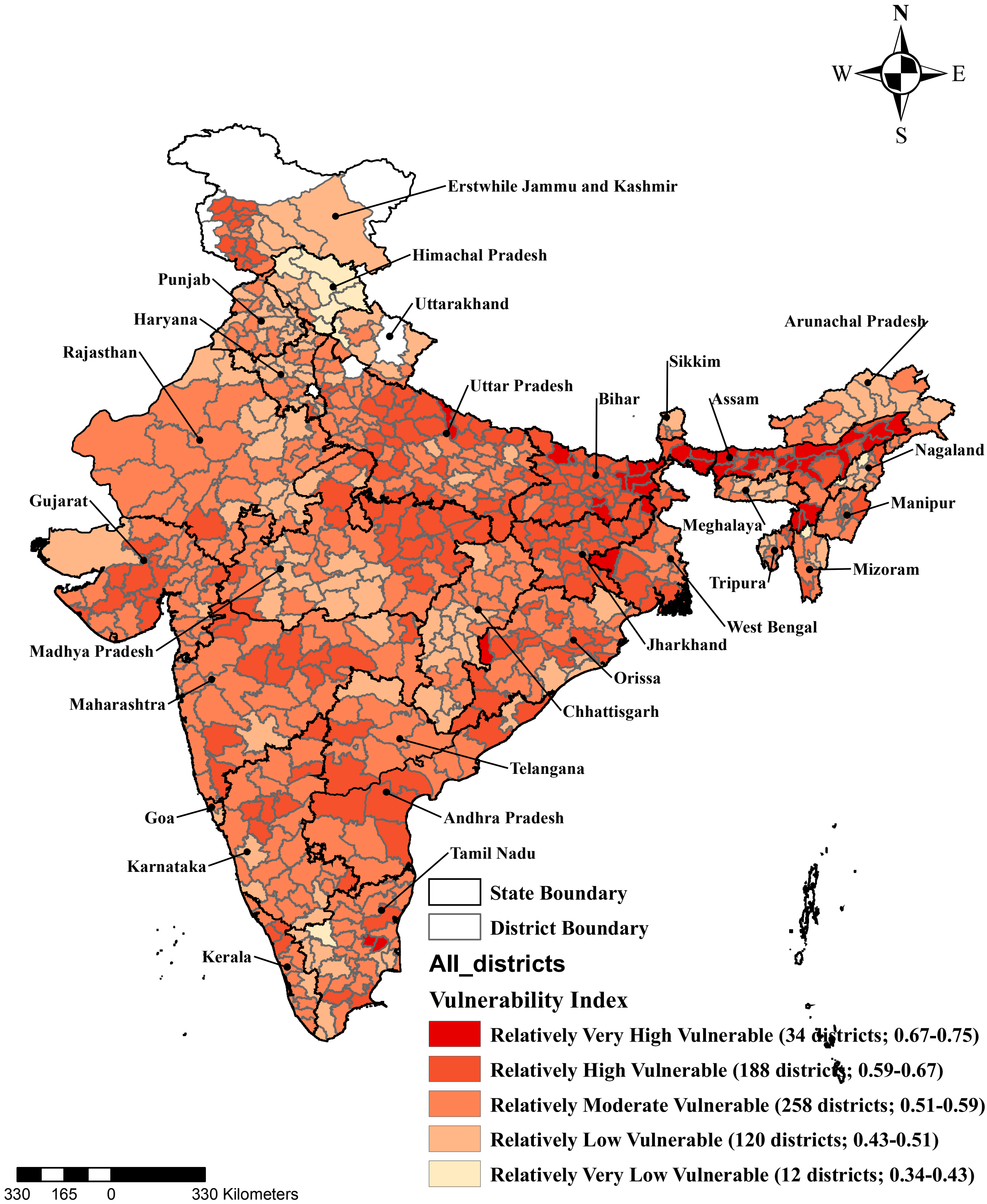

Figure 13: District-level vulnerability profile of India where districts are grouped into five categories with VI ranges

2.4. Proportion of vulnerable districts in different states

Categorisation of districts also helps in the identification of states with a high prevalence of vulnerable districts. Table 7 presents the distribution of districts in each state in different Quartiles. A state with a large proportion of districts in Quartile I requires high attention to adaptation planning.

The analysis shows that approximately 90% of districts in Assam, ~80% of districts in Bihar, and ~60% of districts in Jharkhand fall in Quartile I. So, they have a high level of vulnerability. In the state-level vulnerability assessment, these three states were also in the highly vulnerable category. Other than these three states, Andhra Pradesh, Gujarat, erstwhile Jammu and Kashmir, Maharashtra, Manipur, Orissa, Uttar Pradesh, and West Bengal also have more than 50% districts in Quartiles I and II combined reflecting the high vulnerability of a large number of districts. Other than Maharashtra, the rest of these states in the state-level vulnerability assessment were also either in high or moderately vulnerable categories.

A hypothesis presented in the state-level assessment on Maharashtra has been corroborated in this district-level assessment. The state-level report had observed that the presence of cities such as Mumbai and Pune significantly contributed to the state's GSDP leading to a relatively low vulnerability for Maharashtra at state level. It does not imply that all districts in the state have a low vulnerability, though. In the present assessment, over 50% of districts, especially the drought-prone Ones were found to be highly vulnerable and were either Quartile I or II.

While in the state-level assessment Mizoram and Chhattisgarh were found to be two of the most vulnerable states in the country, a relatively lower proportion of districts was found in Quartile I as per the present analysis. One reason is that these two states have a relatively smaller number of districts. There are only eight districts in Mizoram with Lawngtlai (0.64) the most vulnerable and Kolasib (0.42) the least. This indicates that the VIs of the districts in the state vary within a small range starting from 0.42 and hence add-up to a relatively high VI of the state as a whole.

Similar is the case of Chhattisgarh with 18 districts and VIs of these districts falling within a small range: 0.58 (in Raigarh)- 0.44 (in Bijapur). Gujarat is an interesting case, where no district is found in Quartile I. But more than 50% falls in Quartile II, which increases the overall vulnerability of the state.

2.5. Major drivers of vulnerability in district-level assessment

For the district-level assessment identification of major drivers of vulnerability was also considered a basic step towards informed decision-making for adaptation. It leads to a better understanding of the sources of the vulnerability of a district and assists in developing targeted adaptation measures to address specific indicators of sensitivity and/or adaptive capacity. From each district, indicators with normalised values greater than or equal to 0.85 were identified as the main drivers of vulnerability. Barring a few states, this resulted in ~3 - 4 most important drivers. The bar diagram in Figure 14 represents the number of districts for which a particular indicator is a major driver of vulnerability.

Major drivers of vulnerability across the districts included lack of area under horticulture (396 districts), lack of forest area per 100 of rural population indicating lack of alternative livelihoods based on forest products (336 districts), and lack of coverage of central crop insurance schemes (306 districts).

This indicates that a severe lack of adaptive capacity, especially of livelihood based on the primary sector, is the main source of vulnerability in many districts in India. When a climate hazard hits the primary sector, these districts will find it difficult to cope. It also shows that the major drivers are related to the agricultural sector particularly. It is the sector on which more than half of the Indian population depends for livelihood. A low road density, lack of irrigation facility (with a high proportion of rainfed area), and the prevalence of small and marginal landholdings also contribute to the vulnerability of more than 100 districts.

2.5.1. Major drivers in the districts in Quartile I

- If the net sown area is considered, then 109 districts out of the 153 most vulnerable districts show a low proportion of land used for horticulture. As mentioned, horticulture trees provide alternative income sources to agriculture, and once established, are far less sensitive to the impacts of climate risks, particularly rainfall variability and droughts. The lack of horticulture, as a biophysical characteristic, makes these districts more vulnerable to climate risks.

- Lack of forest area per 100 rural population is found to be a major driver in 99 districts in this category. This means a lack of alternative income opportunities from the forest in these areas leading to a lack of adaptive capacity in the case of climate hazards, especially those affecting income generation.
- The coverage of central crop insurance schemes are found to be low or absent in 80 districts. Literature also suggests that a lack of insurance is one of the major reasons behind the lack of adaptive capacity of the agricultural sector in South-Asian countries (Aryal et al., 2020).
- The prevalence of small and marginal landholders is also a major driver of vulnerability in 79 districts of this Quartile (Figure 15). Marginal and smallholder farmers experience immediate hardships in case of climatic hazards. They are unable to make adequate decisions about when to sow, what to grow, and how-to and lack of inputs along with low adaptive capacity.

Table 7: Number of districts in each state in Quartile I (top 25% vulnerable districts in India), Quartile II (upper-middle 25% vulnerable districts in India), Quartile III (lower middle 25% vulnerable districts in India), and Quartile IV (bottom 25% vulnerable districts in India); (% in parenthesis)

States	Number of districts in the state*	Number of districts in Quartile I	Number of districts in Quartile II	Number of districts in Quartile III	Number of districts in Quartile IV
Andhra Pradesh	13	3 (23.08%)	6 (46.15%)	3 (23.08)	1 (7.69%)
Arunachal Pradesh	14	0 (0.00%)	2 (14.29%)	5 (35.71%)	7 (50.00%)
Assam	27	25 (92.59)	0 (0.00%)	1 (3.70%)	1 (3.70%)
Bihar	38	31 (81.58%)	7 (18.42%)	0 (0.00%)	0 (0.00%)
Chhattisgarh	18	0 (0.00%)	3 (16.67%)	6 (33.33%)	9 (50.00%)
Goa	2	0 (0.00%)	0 (0.00%)	1 (50.00%)	1 (50.00%)
Gujarat	23	0 (0.00%)	12 (52.17%)	9 (39.13%)	2 (8.70%)
Haryana	21	1 (4.76%)	1 (4.76%)	6 (28.57%)	13 (61.90%)
Himachal Pradesh	12	0 (0.00%)	0 (0.00%)	0 (0.00%)	12 (100.00%)
Erstwhile Jammu and Kashmir	22	8 (36.36%)	6 (27.27%)	3 (13.64%)	5 (22.73%)
Jharkhand	24	15 (62.50%)	8 (33.33%)	1 (4.17%)	0 (0.00%)
Karnataka	30	1 (3.33%)	13 (43.33%)	9 (30.00%)	7 (23.33%)
Kerala	14	0 (0.00%)	5 (35.71%)	8 (57.14%)	1 (7.14%)
Madhya Pradesh	50	15 (30.00%)	11 (22.00%)	8 (16.00%)	16 (32.00%)
Maharashtra	35	6 (17.14%)	13 (37.14%)	10 (28.57%)	6 (17.14%)
Manipur	9	3 (33.33%)	5 (55.56%)	1 (11.11%)	0 (0.00%)
Meghalaya	7	0 (0.00%)	0 (0.00%)	3 (42.86%)	4 (57.14%)
Mizoram	8	1 (12.50%)	0 (0.00%)	3 (37.50%)	4 (50.00%)
Nagaland	11	0 (0.00%)	2 (18.18)	2 (18.18%)	7 (63.64%)
Orissa	30	10 (33.33%)	9 (30.00%)	8 (26.67%)	3 (10.00%)
Punjab	20	0 (0.00%)	0 (0.00%)	7 (35.00%)	13 (65.00%)
Rajasthan	33	0 (0.00%)	5 (15.15%)	17 (51.52%)	11 (33.33%)
Sikkim	4	0 (0.00%)	0 (0.00%)	3 (75%)	1 (25%)
Tamil Nadu	32	5 (15.63%)	6 (18.75%)	11 (34.38%)	10 (31.25%)
Telangana	9	2 (22.22%)	1 (11.11%)	3 (33.33%)	3 (33.33%)
Tripura	4	0 (0.00%)	2 (50%)	1 (25%)	1 (25.00%)
Uttar Pradesh	70	17 (24.29%)	31 (44.29%)	16 (22.86%)	6 (8.57%)
Uttarakhand	13	0 (0.00%)	1 (7.69%)	4 (30.77%)	8 (61.54%)
West Bengal	19	10 (52.63%)	4 (21.05%)	4 (21.05%)	1 (5.26%)

*Recent district boundaries could not be considered in some cases given non-availability of data.

2.5.2. Major drivers in the districts in Quartile II

- The lack of forest area per 100 of the rural population is the major driver in 101 districts.
- A low proportion of net sown area under horticulture is another significant driver in 98 districts followed by a high proportion of marginal and small landholders in 66 districts (Figure 16).

2.5.3. Major drivers of vulnerability in Quartile III

- Percentage of net sown area under horticulture is the leading driver in 91 districts followed by a lack of coverage of central crop insurance schemes such as Pradhan Mantri Fasal Bima Yojana (PMFBY) and Revised Weather-based Crop Insurance Scheme (RWBCIS)), in 82 districts.
- Lack of forest area per 100 of the rural population also contributes significantly to the vulnerability of 81 districts in this Quartile (Figure 17).

2.5.4. Major drivers of vulnerability in Quartile IV

- Unlike the other three Quartiles, there are fewer drivers in Quartile IV: only 394 drivers of vulnerability out of which percentage of the net sown area under horticulture is the leading driver in 94 districts followed by a lack of coverage of central crop insurance schemes such as Pradhan Mantri Fasal Bima Yojana (PMFBY) and Revised Weather-based Crop Insurance Scheme (RWBCIS)), in 68 districts.

The lack of a road network acts as a driver of vulnerability in 61 districts of this Quartile (Figure 18).

Since the major drivers of vulnerability are related to the primary sector and mostly agriculture, the results of this report are compared with a recent study carried out by the Central Research Institute for Dryland Agriculture (CRIDA, 2019) on the agricultural vulnerability of Indian districts. This study is also based on the Risk Management and Assessment Framework proposed by the IPCC AR5, which is similar to the present assessment. A total of 15 indicators were considered for the assessment of agricultural vulnerability in the CRIDA Report. The present assessment shows that more than 60% of the districts in Jharkhand fall in Quartile I (top 25% most vulnerable districts in India), exhibiting a high level of vulnerability. Most of the districts in this state were also identified by CRIDA to have a high agricultural vulnerability. The assessment found more than 90% of districts in Assam and 80% of districts in Bihar highly

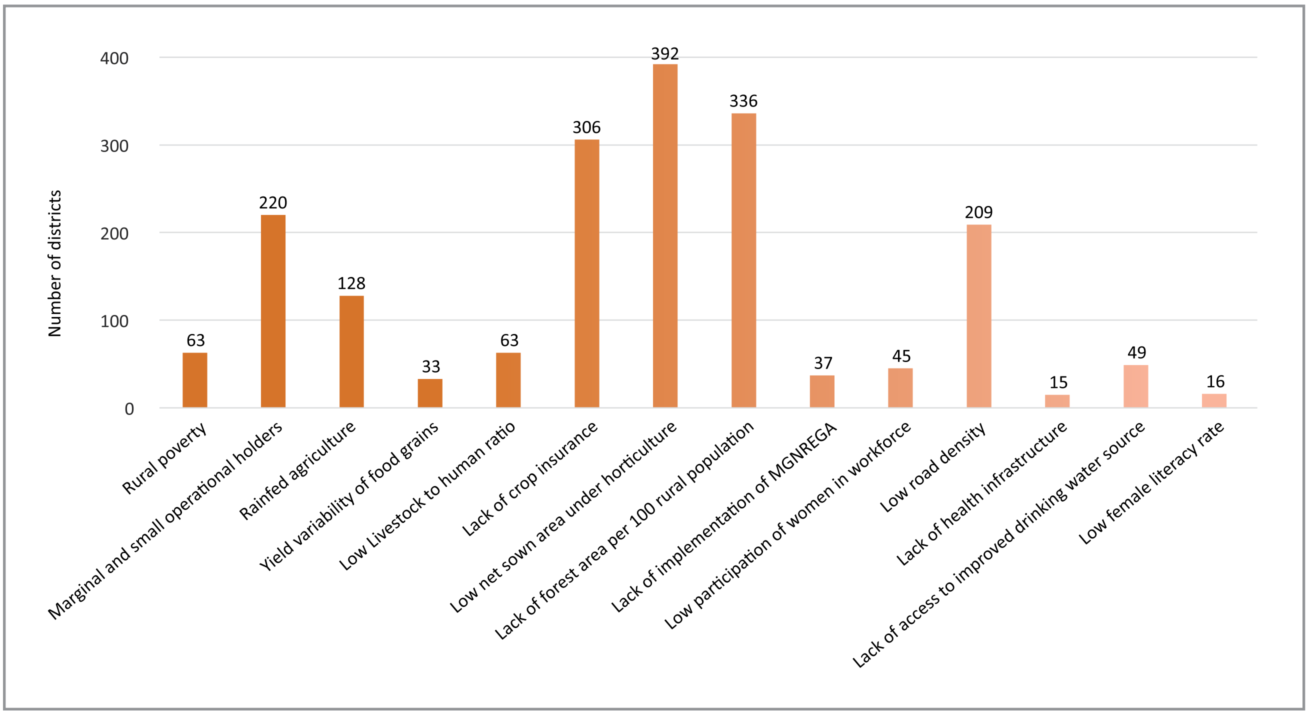

Figure 14: Bar diagram representing major drivers of vulnerability (indicators with normalised value>0.85) for all districts in India

vulnerable. In the CRIDA report a moderate number of districts in both states is also found to exhibit a high agricultural vulnerability. Andhra Pradesh, Maharashtra, and Orissa were found to have a large proportion of vulnerable districts in both studies.

2.6. Use of district-level vulnerability assessment

The report is aimed at policymakers and decision-makers as a first step to prioritise locations for addressing climate risk at a holistic level within a vulnerability-hazard-exposure framework. This would allow for better-suited climate adaptation actions by factoring in differentiating features of districts and assist in the following:

a. Providing baseline information for climate change adaptation planning of India at the district level.

b. Measuring the comparable degrees of vulnerability for all the districts in India and identifying the most vulnerable districts.

c. Prioritizing the districts for adaptation interventions and formulating climate-resilient policies and programs.

d. Aiding to the State Action Plan on Climate Change and its revision.

e. Prioritizing adaptation interventions and investments, for the government of India, State governments, NABARD, World Bank, etc.

f. Providing a basis to identify the entry-point of intervention for adaptation planning and investment at the district-level through the identification of priority sectors and major drivers of vulnerability.

A more detailed discussion is provided in the final chapter of the report. Finally, a vulnerability assessment is inherently a data-intensive process. Therefore, this assessment also plays a curial role in the identification of data-gaps for district-level analysis.

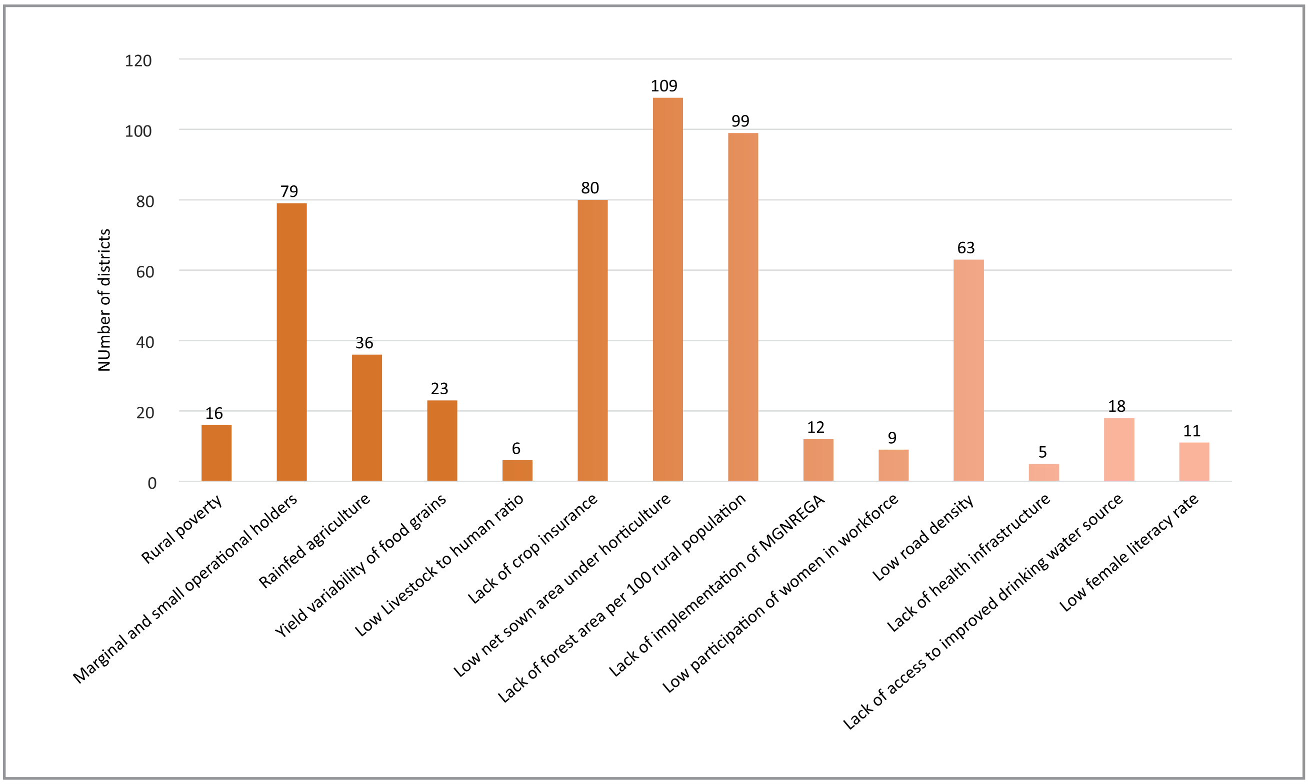

Figure 15: Bar diagrams representing major drivers (indicators with normalised value>0.85) in the districts in Quartile I (Top 25%, i.e., 153 most vulnerable districts)

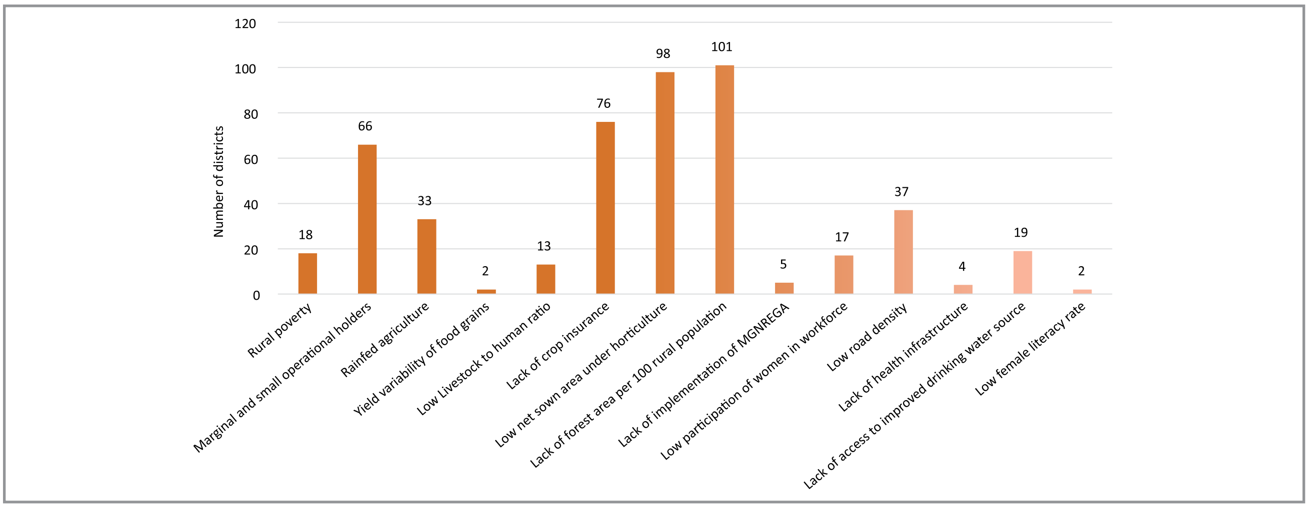

Figure 16: Bar diagram representing major drivers (indicators with normalised value>0.85) in the districts in Quartile II (25%-50%, i.e., 153 upper-middle vulnerable districts)

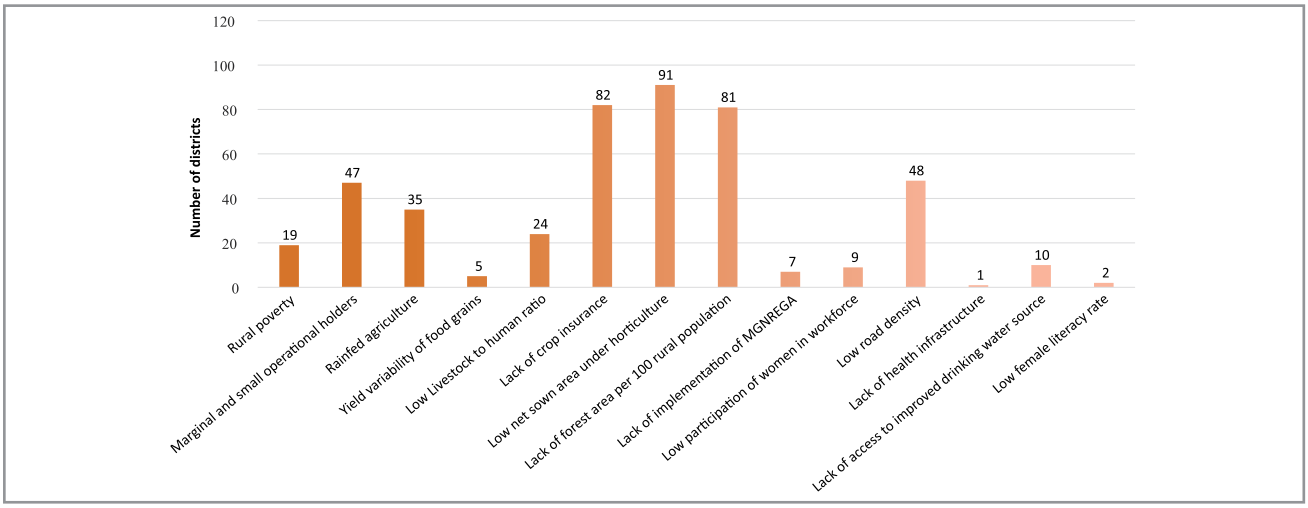

Figure 17: Bar diagram representing major drivers (indicators with normalised value>0.85) of vulnerability in Quartile III (50%-75%, i.e., 153 lower-middle vulnerable districts)

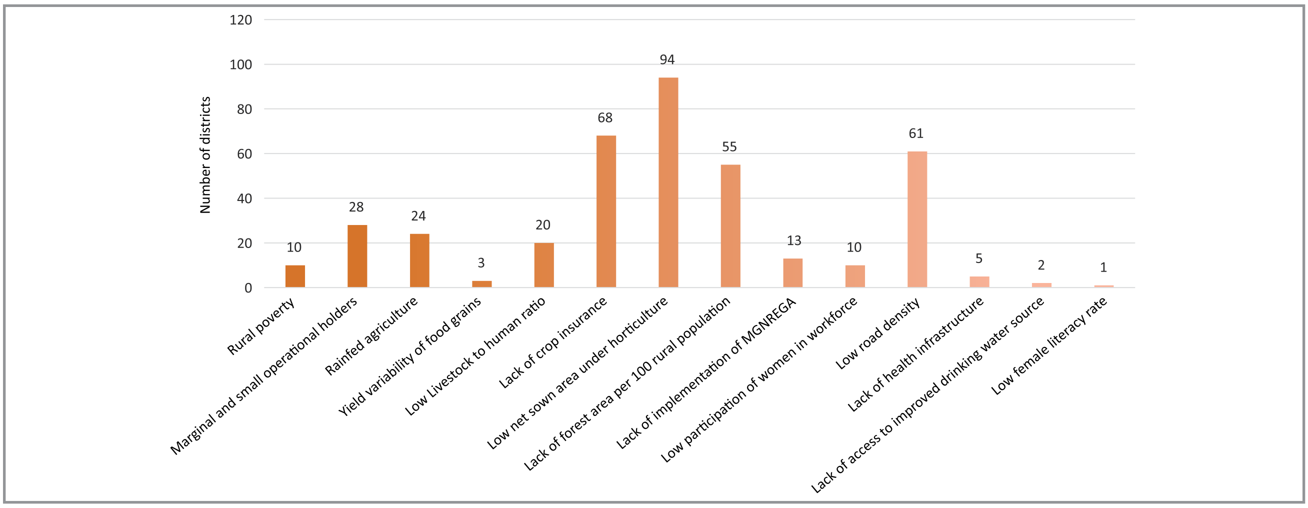

Figure 18: Bar diagram representing major drivers (indicators with normalized value>0.85) of vulnerability in Quartile IV (bottom 25% i.e., 153 least vulnerable districts)

Part III:
Vulnerability assessment by the states & UTs

Part III:
Vulnerability assessment by the states & UTs

Part III of the present report provides district-level vulnerability assessment of individual states. A major objective of the current project was capacity building of the state departments to carry out vulnerability assessments based on the common methodology. Participants from various states and union territories (UTs) were trained in the common methodology through several workshops and discussions. Subsequently, they carried out district/block/-level integrated/sectoral vulnerability assessments of their respective states. By engaging with the state officials continuously, the project also helped create a platform for interaction.

For most states, they represent integrated vulnerability assessments based on socio-economic, biophysical, and infrastructure-related indicators. Some states in the IHR carried out a sectoral assessment for the agricultural sector, since they already carried out an integrated assessment under the previous IHCAP project (IHCAP, 2019)[2]. In addition, two states (Meghalaya and West Bengal) carried out block-level vulnerability assessments. Some of the UTs also carried out the assessment, including the smaller ones, such as, Pondicherry. It is important to note here that for smaller states and UTs, district-level vulnerability assessments may not prove meaningful. Such states and UTs could carry out block and village level vulnerability assessments in the future. The exact nature of assessments carried out by the states/UTs are mentioned in the respective sections.[3]

The methodological framework used by the states is based on the IPCC-AR5 (IPCC, 2014) risk management and assessment framework that has been discussed in the introduction of the report. Apart from a set of common indicators, the states included few additional indicators for the assessment as they felt appropriate given the characteristics of the states. The set of indicators used by each of the states and their relationship with vulnerability are mentioned for each state. Normalised values (NV) of all indicators are calculated based on their actual values (AV) and the average of NVs are then taken as the VI. The ranking of districts/blocks, a map based on categorisation of districts in terms of VIs and the drivers of vulnerability are also presented. The categorisation is obtained by dividing the range of VIs into 3 or 5 equal intervals and identifying districts/blocks falling under each category, unless mentioned otherwise.

For each state NVs of the indicators are used to identify the drivers of vulnerability. Identification of the drivers of vulnerability is another important objective of the assessment. It gives a preliminary understanding of the entry-point for any adaptation intervention. To find the major drivers of vulnerability of a district, a threshold value of NV=0.80 was set and the indicators, for which the NVs exceeded the threshold values for a particular district/block, are the considered to be major driver of vulnerability for that district. The number of districts for which an indicator is a driver is also reported. This method is followed unless mentioned otherwise.

Many states reported that data acquired for the assessment were not always uniform in terms of time period. For example, data for two major drivers, road density and women's participation in the workforce, in case of most of the states, had been taken from the 2011 Census. So, if the assessment is carried out with recent data, the present status of the districts may vary. However, vulnerability assessment is a dynamic process, and the VIs are likely to change over the time with change in the indicator values. Also, in many cases, the most recent district boundaries couldn't be considered due to non-availably of data.

Inspite of few challenges, this effort is first of its kind where all the states in India have come up with their vulnerability assessment based on a common framework.

2 There may be some deviations in terms of results in the earlier IHR-based report (IHCAP, 2019) and in the current analysis. In the present study certain indicators, such as slope and population density, were omitted to make it more appropriate for an all-India analysis. Also, it assigned equal weights to indicators in many cases as opposed to unequal weights used in the previous study. Since a vulnerability assessment is a dynamic concept, the index values derived are likely to change as the indicators, objective and time period of study, and weights change.

3. For Andhra Pradesh, Maharashtra, Rajasthan, Tripura, Uttar Pradesh, and West Bengal district level vulnerability assessment is carried out by the project team at IIT Mandi, IIT Guwahati and IISc, Bengaluru.

3.1. Andhra Pradesh

Andhra Pradesh is located in the south-eastern part of India at 12°41’ and 19.07°N latitude and 77° and 84°40’E longitude. Currently, Andhra Pradesh State has 13 districts. Although the state is primarily agricultural, there is also some mining activity and a significant amount of industry.

In the state, summers are extraordinarily hot and humid, with maximum daily temperatures exceeding 35°C and even surpassing 40°C in the central portion. Winters are somewhat cooler, with maximum temperatures between 30°-35°C in all but the north-eastern areas. Winter lows go below 15°C only in the extreme north-east. The annual precipitation, which derives largely from the south-west monsoon rains, generally decreases toward the south-western plateau area. Coastal areas receive about 1,000 to 1,200 mm of rainfall per year, while the western most part of the plateau may receive only half that much.

The present vulnerability assessment of the state has been based on 12 indicators. The list of indicators, their dimensions, relevant sectors and functional relationships with vulnerability is presented in Table 8. Equal weights are assigned to each indicator to calculate the VIs. VIs and the corresponding rank of each district are represented in Figure 19. The values of VIs in various districts in Andhra Pradesh were found to lie in a very small range: 0.59 (in Chittoor)- 0.47 (in Y.S.R. Kadapa). The range of VI values (i.e., 0.47 – 0.59) was then divided into three equal intervals to identify districts with a relatively high (~0.55-0.59), moderate (~0.51- 0.55), and relatively low vulnerability (~0.47 -0.51). However, given minor differences between VIs of any two districts, this exercise might not prove significantly meaningful for Andhra Pradesh as a whole. Districts such as Chittoor, Krishna, Sri Potti Sriramulu Nellore (Nellore), Prakasam, Srikakulam and Anantapur fall under the first, Visakhapatnam, West Godavari and Kurnool under the second, and Guntur, East Godavari, Vizianagaram, and Y.S.R. (Kadapa) under the third category. Figure 20 represents the category-wise vulnerability map for Andhra Pradesh.

The major drivers of vulnerability were found to be the large proportion of marginal and small farmers in the agricultural sector and the lack of forest area per 1000 population (in 7 districts), followed by a lack of implementation of centrally funded crop insurance policies (in 6 districts), low road density (in 5 districts) and a lack of health infrastructure (in 4 districts). Figure 21 represents the drivers of vulnerability applicable for the state.

Table 8: List of indicators used for the assessment of district-level vulnerability assessment for Andhra Pradesh

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Percentage of marginal and small operational holders	Sensitivity	Positive
Forest area (in ha) per 1000 rural population	Adaptive Capacity	Negative
Percentage area covered under centrally funded crop insurance schemes	Adaptive Capacity	Negative
Proportion of rainfed agriculture	Sensitivity	Positive
Variability in food grain crop yield (ton/ha) for the past 10 years	Sensitivity	Positive
Women’s participation in the workforce	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Percentage households with access to electricity	Adaptive Capacity	Negative
Percentage households with improved drinking water source	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Infant mortality rate (IMR)	Sensitivity	Positive

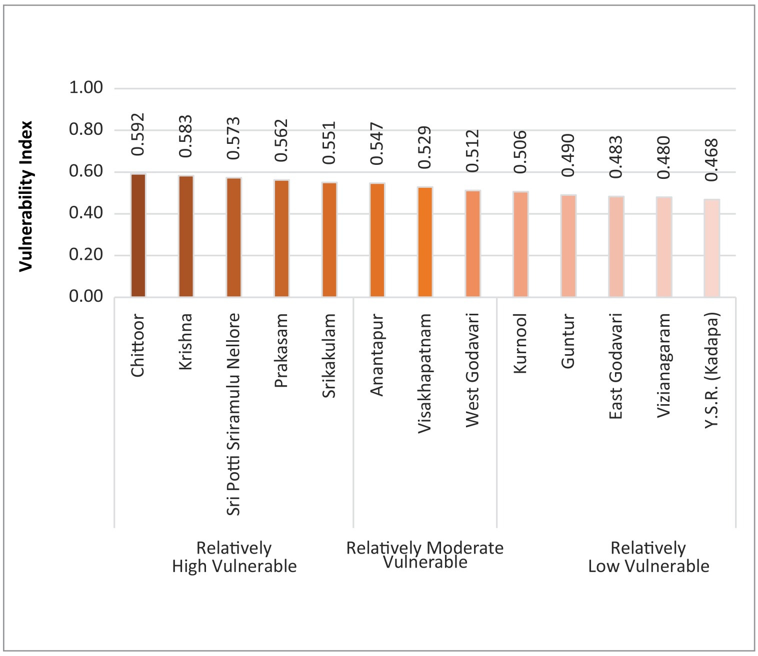

Figure 19: Vulnerability Indices (VIs) and ranking of districts in Andhra Pradesh

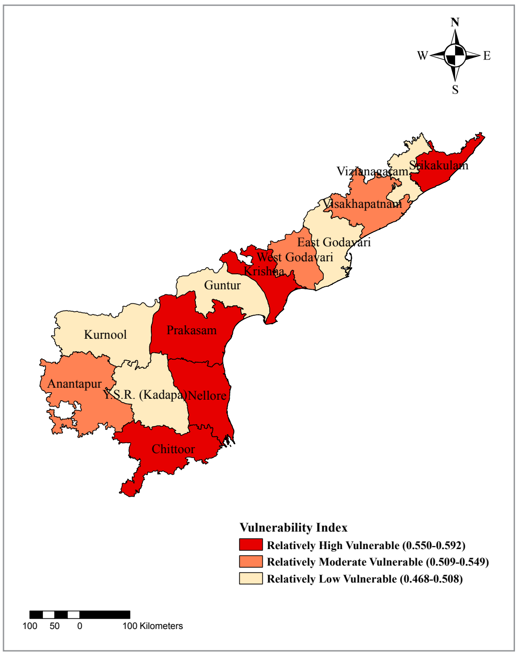

Figure 20: Categories of vulnerability of the districts in Andhra Pradesh

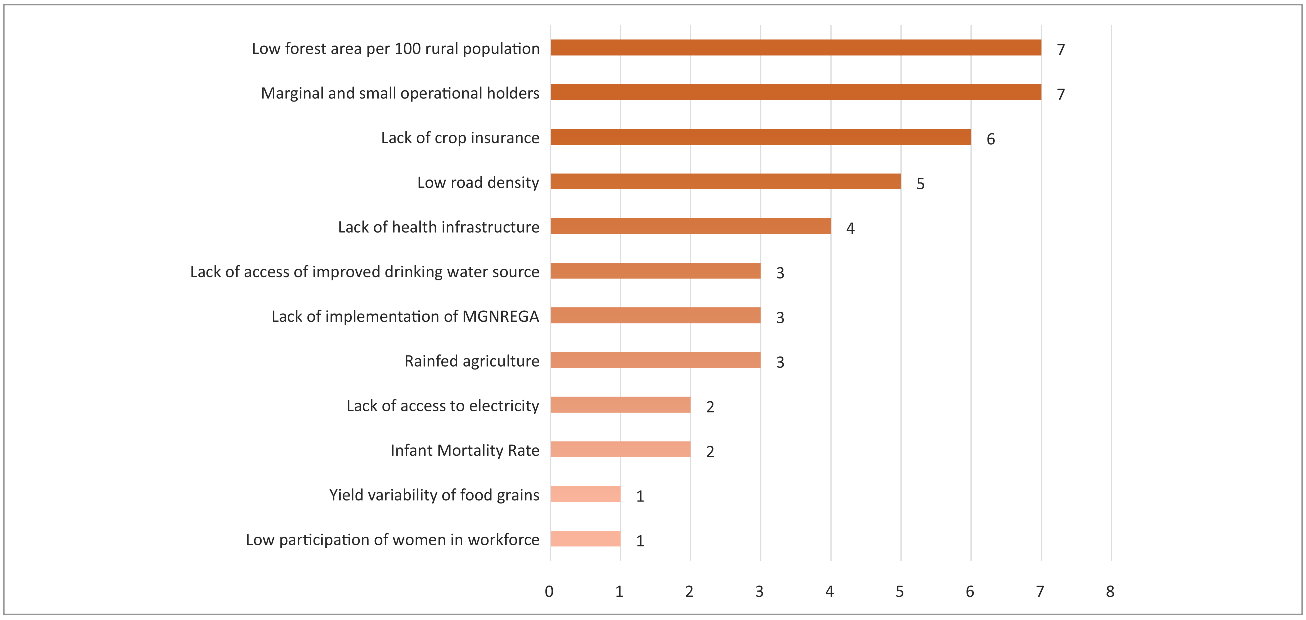

Figure 21: Drivers of vulnerability in the districts of Andhra Pradesh (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

Agricultural Field works Kanchipura, Tamil Nadu

3.2. Arunachal Pradesh

Arunachal Pradesh, with a geographical area of 83,743 km^2, is the largest state in North-East India. It is situated in the Indian Eastern Himalayan Region between latitudes 26° 30'N and 29° 30'N and longitudes 91° 30'E and 97° 30'E. It has varying elevations ranging from 50 m in the foothills to areas gradually ascending to 7000 m and above. At present, the state has 25 districts. However, the present vulnerability assessment was carried out based on 16 districts given the previous district boundaries. This had to be done, since most of the new districts have only been recently bifurcated from the old ones and the data for newly constructed districts are not always available.

The average temperature in Arunachal Pradesh ranges from15° to 21°C in winter, while the monsoon temperature ranges from 20° to 30°C. The rainfall there is among the heaviest in the country, with more than 3500 mm in a year. Nevertheless, the state is characterised by persistent water scarcity and periodic exposure to severe landslides, flash floods and droughts along with poverty and a non-diversified pattern of livelihood, making it highly vulnerable to climate change.

The economy is largely agrarian, based on terrace-farming and a few pockets of shifting cultivation. Agriculture and animal husbandry are the two predominant occupations of the rural communities. Since agriculture is the main source of livelihood in the state, the assessment focused particularly on agricultural vulnerability at district level. Indicators selected for the assessment along with their dimensions and functional relationships with vulnerability are presented in Table 9. Equal weights were assigned to all indicators for the assessment.

The values of the District Level VIs for the agricultural sector in the state lie between 0.74 (in Kurung Kumey) and 0.41 (in Lohit). This, again, shows that the range of values of the VIs is small and the values for different districts are close to each other. Here, too, the agricultural sector of most of the districts is vulnerable. Figure 22 represents the agricultural VIs calculated for the districts. Further, districts have been categorised into relatively highly (~0.63-0.74), moderately (~0.53-0.62) and relatively low (~0.41-0.52) vulnerability. Seven districts, Kurung Kumey, Upper Subansiri, Anjaw, Tirap, Dibang Valley, West Siang and West Kameng fall under the first category. Figure 23 represents the categories of agriculturally vulnerability of the districts.

Figure 24 represents the drivers of vulnerability. Major drivers contributing to agriculture vulnerability across districts are less number of Natural Resource Management (NRM)-based projects under MGNREGA per 1000 ha, leading to a lack of alternative livelihood: low road density and the lack of fair price shops, lack of availability of water (both in terms of ground water and water bodies as a whole) among other. Low road density has caused poor access to markets for the purchase and sale of agricultural products.

Table 9: List of indicators used for the assessment of agricultural vulnerability of Arunachal Pradesh

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Proportion of net area irrigated to net sown area	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive
Lack of water availability	Sensitivity	Positive
Drainage density	Sensitivity	Positive
Percentage of landless, marginal, and small farmers	Sensitivity	Positive
Percentage of water bodies	Adaptive Capacity	Negative
Groundwater availability	Adaptive Capacity	Negative
Crop diversity	Adaptive Capacity	Negative
Share of value of output of horticulture (only perennial) to the value of agricultural output	Adaptive Capacity	Negative
Total number of livestock per 1000 rural households	Adaptive Capacity	Negative
Fair price shops per 1000 population	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Diversity index of the main source of income for rural households	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Number of NRM Works per 1000 ha (MGNREGA)	Adaptive Capacity	Negative

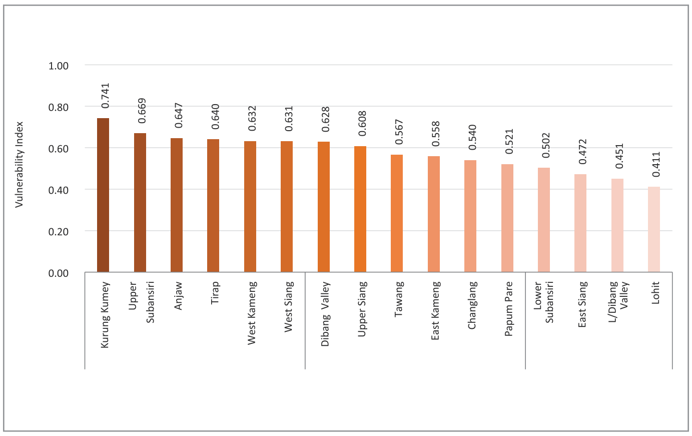

Figure 22: Agricultural vulnerability indices (VIs) of the districts of Arunachal Pradesh

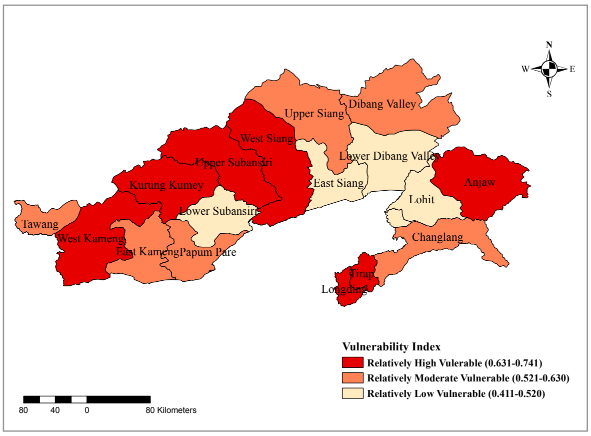

Figure 23: Map showing the categories of agricultural vulnerability of the districts in Arunachal Pradesh

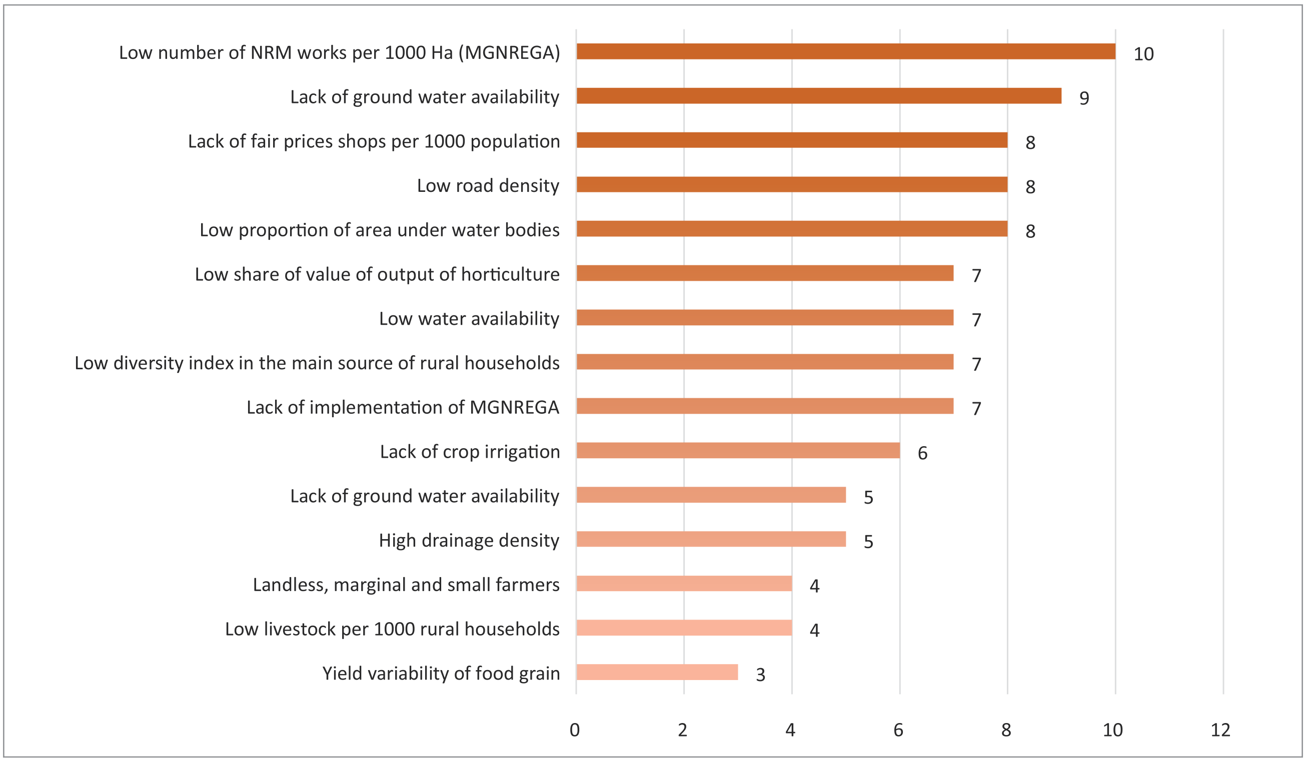

Figure 24: Major drivers of agricultural vulnerability in Arunachal Pradesh (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

Fishing, Manipur

3.3. Assam

Assam, the second largest state in Northeastern India, is situated south of the Eastern Himalayas along the Brahmaputra and Barak river valleys. The state has a geographical area of 78,438 km^2 between 24°07′ N to 28°00′ N latitude and 89°42′ E to 96°02′ E longitude. More than 80% of its population thrives on agriculture and allied activities. The total land under cultivation was 2.83 million ha in 2014-2015, which is almost 36% of the total land area of the state.

The climate of Assam is sub-tropical, with warm, humid summers and cool, dry winters. Because of its unique geographical location and varied physiography, it has an array of climatic conditions. In the plains, the maximum temperature does not go beyond 32° C, while winters may have a minimum temperature of about 8°C. The state is situated in the high rainfall zone and has an annual average rainfall of 2297.4 mm. While Assam is prone to floods; at times there are also drought-like situations with minimal rainfall. In 2016 it had received 2042.20 mm rainfall against a normal rainfall of 2295.80 mm- a departure of 7%.

The present report gives a district-level vulnerability profile of the state based on indicators mentioned in Table 10 (along with their dimensions and functional relationships with vulnerability). Equal weights were assigned to all indicators. Ranking of the districts, based on the VIs calculated, is given in Figure 25. The highest value of VI was noted for Dhubri district (0.75) and the lowest for Kamrup Metropolitan (0.42). The range of VIs was divided into three equal intervals to form categories: relatively highly vulnerable (~0.64 – 0.75), moderately vulnerable (0.53 – 0.64), and relatively low vulnerable (~0.42-0.53). Chirang, Tinkhukia, Morigaon, Hailakandi, Goalpara, Golaghat, Kokrajhar, Karimganj, Darang, and Dhubri fall under the first category. The map in Figure 26 represents the categories of vulnerability.

Major drivers of vulnerability are presented in Figure 27. Out of the 15 indicators 5 were found to be the main drivers of vulnerability in the state: a lack of availability of centrally funded crop insurance schemes, a high prevalence of rainfed agriculture, limited forest area per hundred rural population, a lack of women's participation in the workforce, and low road density. Of the 5 selected drivers, road density and forest area per 100 rural population has greater NVs than the threshold in 25 of the 27 districts. Further, a high proportion of rain-fed agriculture was observed to be accountable for the vulnerability of 12 districts. The lack of area covered under centrally funded crop insurance schemes and lack of women's participation in the workforce were found to be drivers contributing to vulnerability in 8 districts.

Table 10: List of indicators used for the vulnerability assessment for Assam

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Percentage of households having monthly income of highest earning household member less than Rs. 5,000 in rural area (Rural Poverty)	Sensitivity	Positive
Livestock to human ratio	Adaptive Capacity	Negative
Percentage of marginal and small operational holders	Sensitivity	Positive
Percentage of area covered under centrally funded crop insurance	Adaptive Capacity	Negative
Proportion of rainfed agriculture	Sensitivity	Positive
Forest area per 100 rural population	Adaptive Capacity	Negative
Women's participation in workforce	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Percentage of households with electricity	Adaptive Capacity	Negative
Percentage of households with improved drinking water source	Adaptive Capacity	Negative
Percentage of households with improved sanitation facility	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive

Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework

Lack of forest area per 100 rural population was also found to be a major driver of vulnerability despite the fact that the state has a forest cover of 42%. The probable reason behind this is a combination of factors; first, the rural population density. According to the 2011 Census, 85.91% of the population of Assam is rural. Then, the district-wise uneven distribution of forest area makes for a very small ratio of forest cover per 100 rural population. Third, since it is an agriculturally dominant state, 36% of its geographical area is used by agriculture and allied sectors. Another driver is the proportion of rain-fed agriculture, for which data were taken for the period 2015-2016. The vulnerability due to this factor may change if recent data are taken into consideration, as the irrigation system in the state has been improved and is being made more accessible to farmers through subsidised water pumps under different schemes.

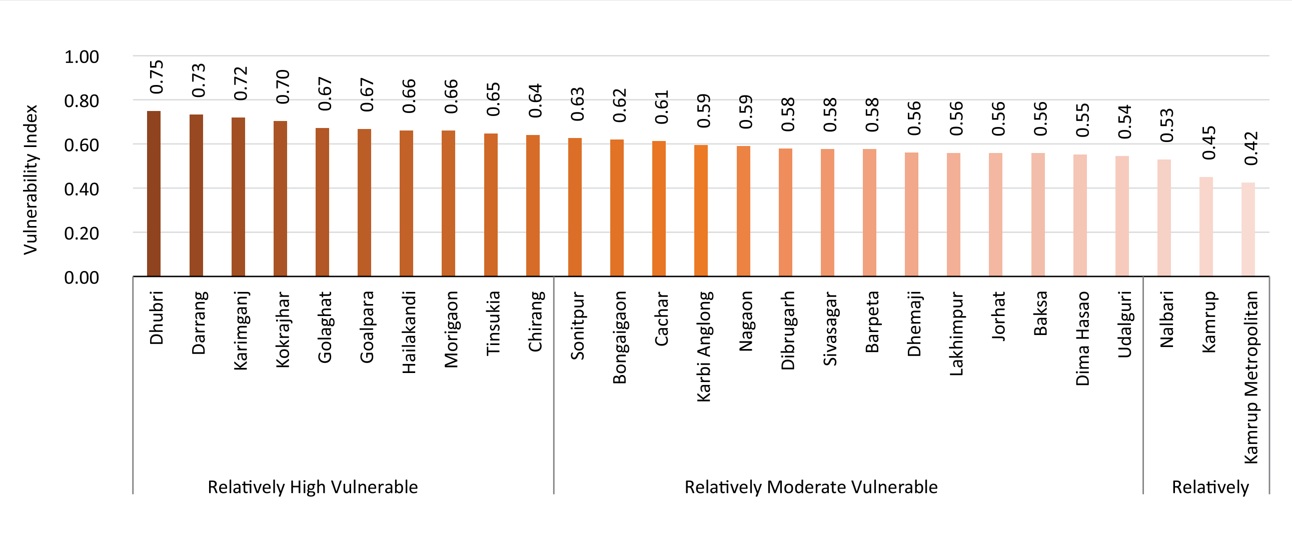

Figure 25: **Vulnerability Indices (VIs) and ranking of districts of Assam**

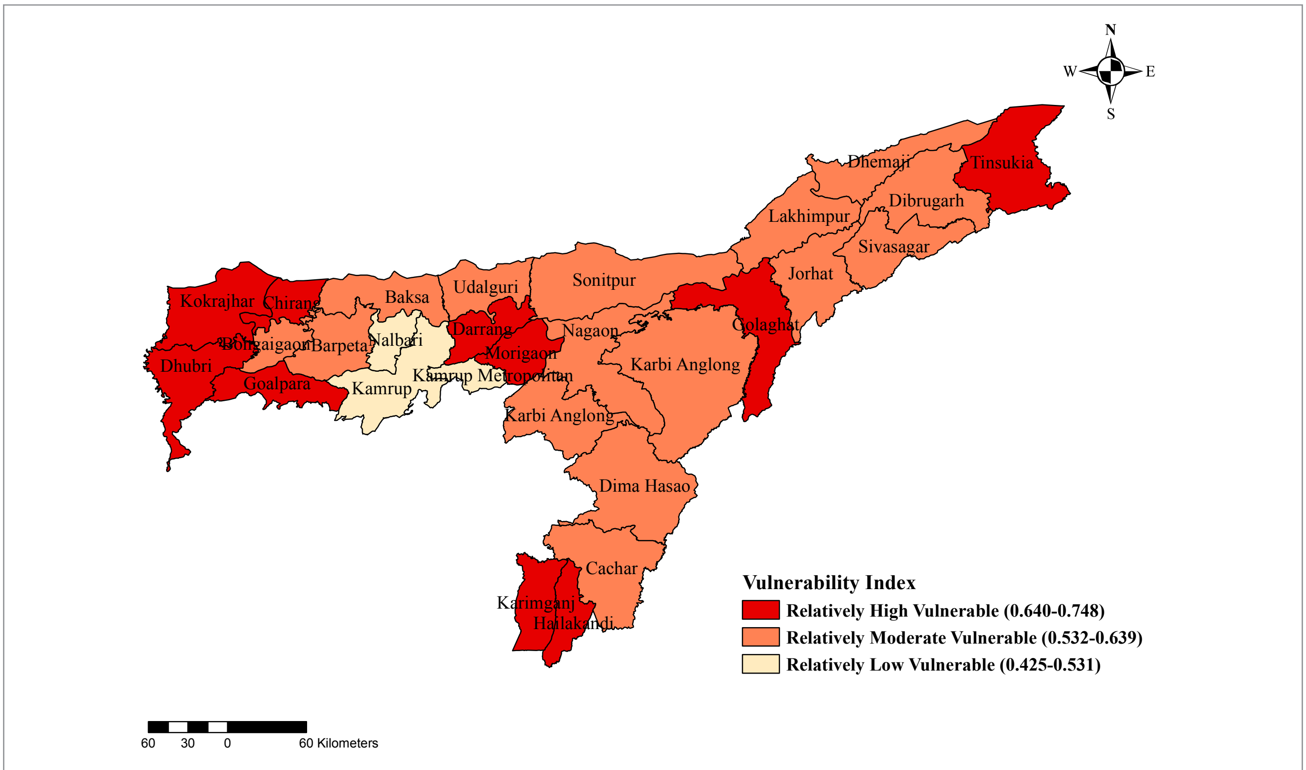

Figure 26: **Map of districts with vulnerability categories in Assam**

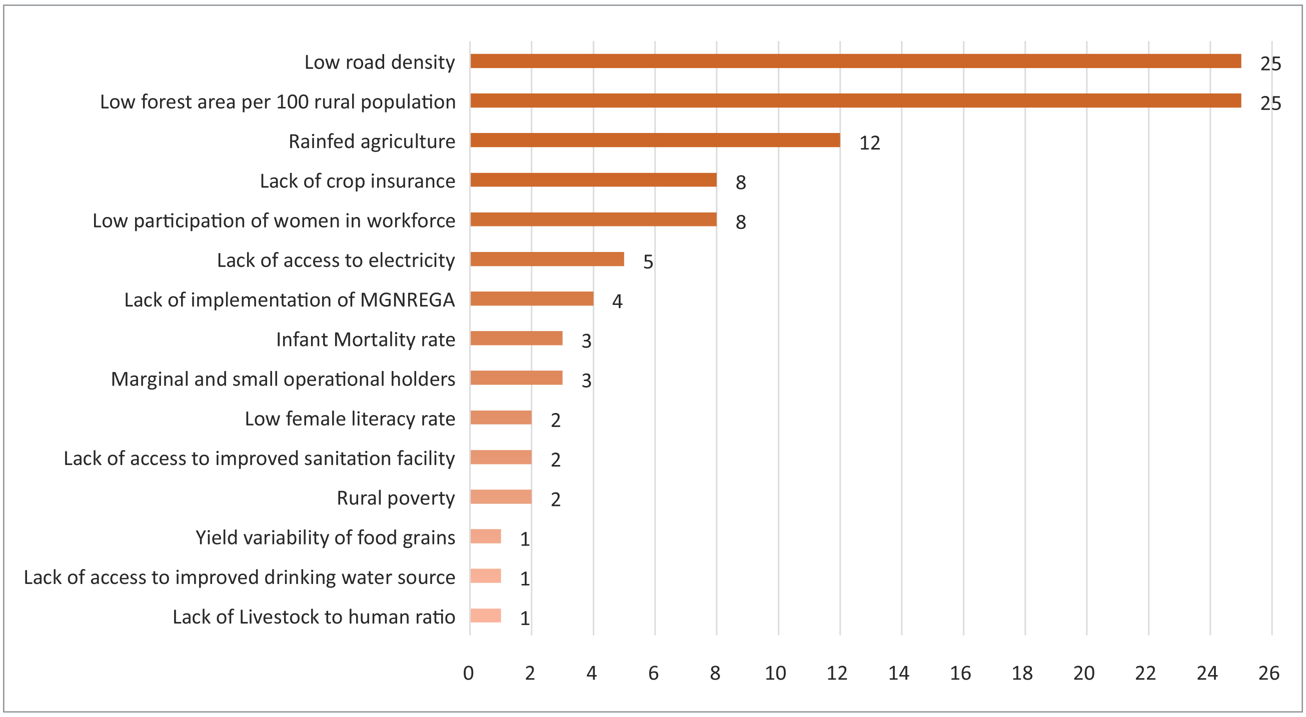

Figure 27: Drivers of vulnerability in districts of Assam (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.4. Bihar

Bihar is situated between 24°16′ N to 27°45′ N latitude and 83°16′ E to 88°30′ E longitude. The state has a total geographical area of 94,163 km^2. According to data over 2016, agriculture accounts for 23%, industry 17%, and services 60% of the state's economy. There are 38 districts in Bihar that have been considered for this assessment.

The indicators used in the present integrated, district-level vulnerability assessment are listed in Table 11 along with their functional relationships with vulnerability. Equal weights were assigned to all indicators. The VIs of the districts were found to be in the range from 0.73 (in Kishanganj) to 0.36 (in Rohtas). The VIs of the districts and their corresponding rankings are presented in Figure 28. and the map in Figure 29. By dividing the range of VIs into equal intervals, three categories were obtained: relatively highly vulnerable districts (~0.61-0.74), moderately vulnerable districts (~0.48-0.61), and districts with relatively low vulnerability (~0.36 – 0.48). Other than Kishanganj, Katihar, Purnia, Sitamarahi, Purba-Champaran, Darbhanga, and Araria are the districts falling under the first category. They are all situated in North Bihar.

Poor health infrastructure was found to be the key driver in 36 districts, followed by a high percentage of marginal and small operational holders in 24 districts. The lack of implementation of MGNREGA, causing a lack of alternative livelihood opportunities, appeared as a key driver in 14 districts, followed by a lack of women's participation in the workforce in 11 districts. This would mean that improvement in the health infrastructure and implementation of schemes like MGNREGA will reduce vulnerability in the state. Also, an increase in women's participation in the workforce will enhance the per capita income, which will further improve the adaptive capacity of people there. Figure 30 shows the key drivers of vulnerability in the districts of Bihar.

Table 11: List of indicators used for the assessment of district-level vulnerability for Bihar

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Percentage of marginal and small operational holders	Sensitivity	Positive
Proportion of rain-fed agriculture	Sensitivity	Positive
Women's participation in the workforce	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Percentage of households with improved drinking water source	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive

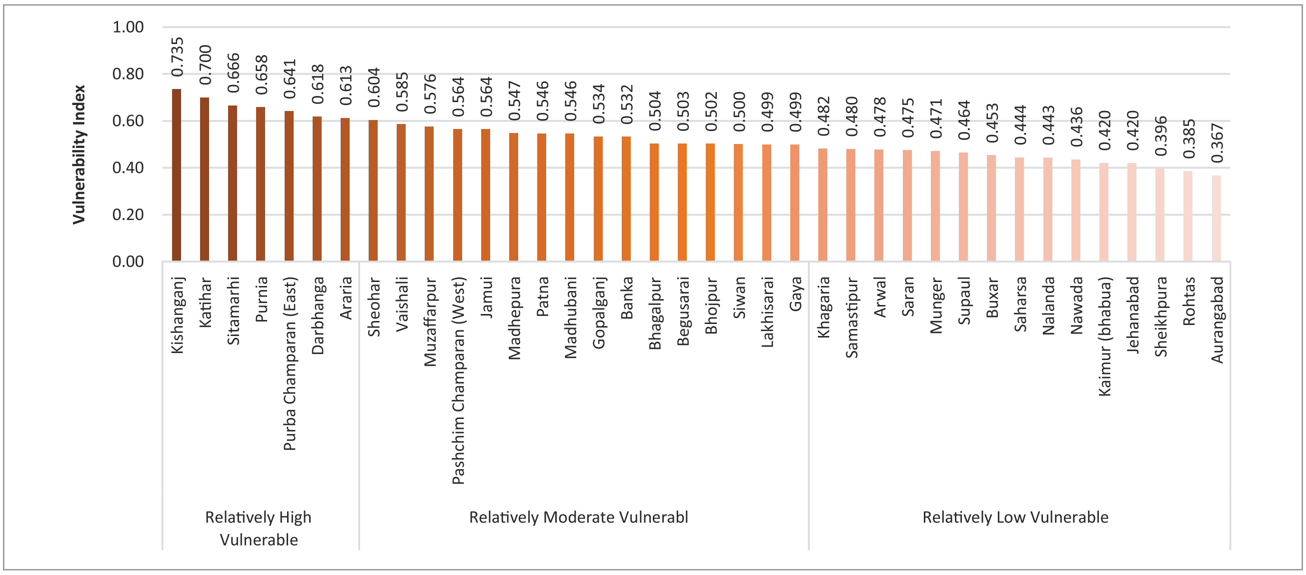

Figure 28: Vulnerability Indices (VIs) and ranking of districts in Bihar

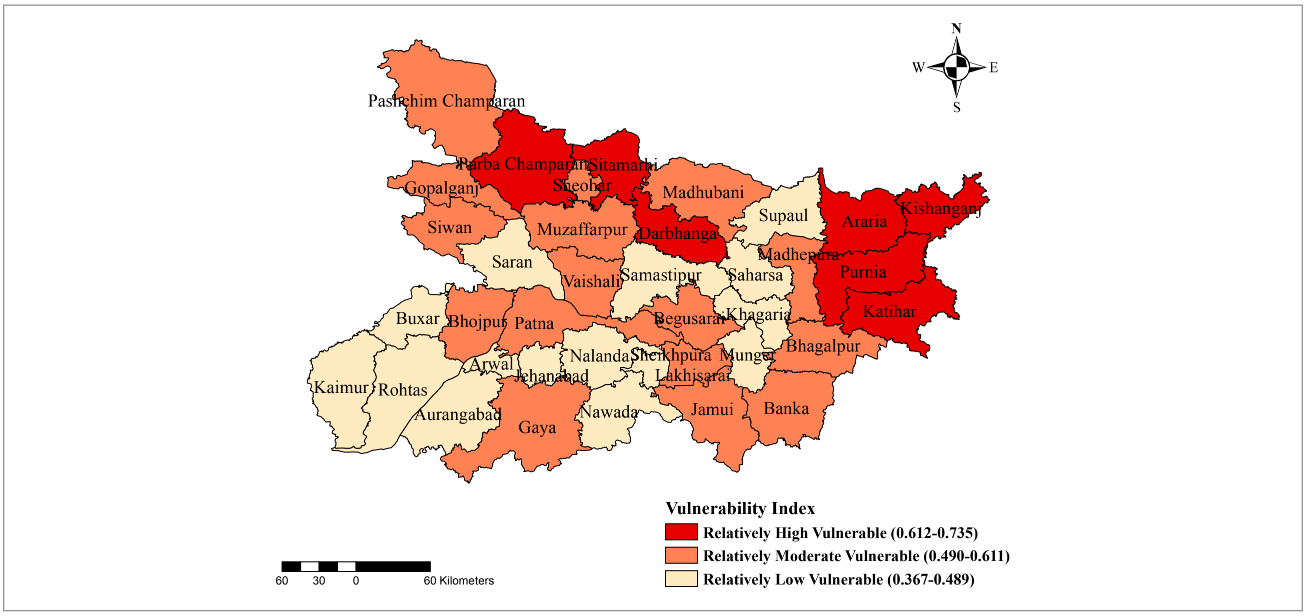

Figure 29: Map showing the categories of vulnerability of the districts in Bihar

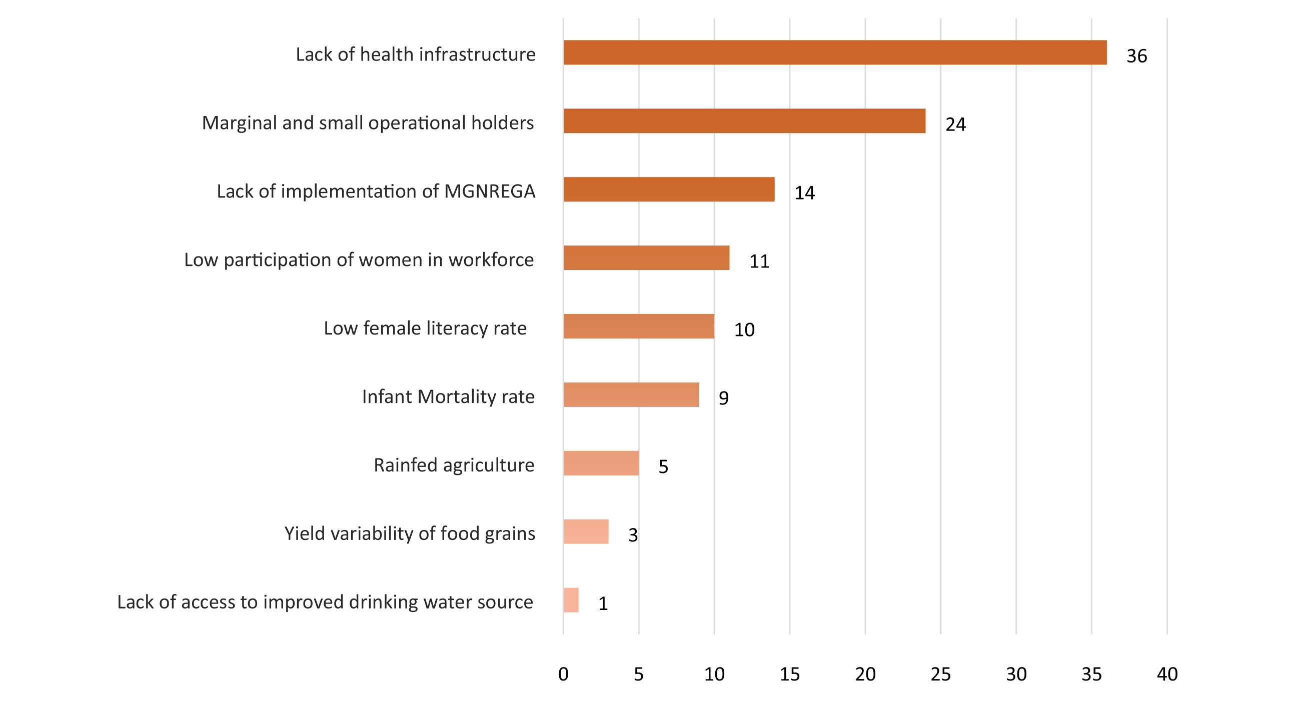

Figure 30: Key drivers of vulnerability in Bihar (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.5. Chhattisgarh

Chhattisgarh is located between the latitude of 21°15’ 0’’ N and 81°36’0’’ E longitude. Currently, there are 28 districts in Chhattisgarh. The newly formed district of Gaurela-Pendra-Marwahi was not considered for this assessment on account of data limitations.

The climate of Chhattisgarh is tropical. Summers (April to June) are generally hot and humid with temperatures varying between 30°C and 47°C. Winters are pleasant with low temperatures and less humidity and temperatures between 5°C and 25°C. Extremes have been observed with scales falling to less than 0°C and running higher than 49°C. The state receives an average annual rainfall of about 1,250 mm of which 90% is received during the southwest monsoon season (June to September).

The State Action Plan on Climate Change of the state has identified agriculture, forestry, mining, and energy as the most vulnerable sectors For a holistic representation of the biophysical and socio-economic systems of the state, the following sectors were considered for the vulnerability assessment: agriculture and allied activities (including crop cultivation, horticulture, livestock, and fisheries), forests, water resources, socio-economic (rural) development, transport, energy, industries and mining, and health.

Twenty-six indicators representing the above sectors were initially selected, but this had some limitations. The biggest challenge for quantifying the indicators selected was the availability of data for all 27 districts. While the state has added new districts over the years, several reports and statistical publications still contain data for only 16 or 18 districts. Post quantification of the indicators, a correlation matrix was constructed and indicators with moderate to high correlation (> 0.5) were excluded from the assessment. From this correlation analysis, the actual district-level integrated vulnerability assessment of the state was based on a set of 12 common indicators, listed in Table 12. Their dimensions and relationships with vulnerability are also presented. Equal weights were assigned to calculate VIs[4].

4 Prior to normalisation, outliers among the data needed to be identified and considered, because these would influence the overall Vulnerability Index value. Using the Interquartile Rule, outliers were identified and excluded from the normalisation process. For each indicator, Quartile 1 (Q1), Quartile 2 (Median: Q2), Quartile 3 (Q3) and the Inter-Quartile Range (IQR) were calculated. Any value less than Q1-1.5*IQR or more than Q3+1.5*IQR is an outlier according to the basic statistical principle of outlier detection.

The VIs for the districts of Chhattisgarh ranges from 0.35 in Kanker district to 0.76 in Mahasamund. The assessment of integrated vulnerability shows that 3 districts -Mahasamund, Baloda Bazar, and Mungeli- were ranked as relatively very highly vulnerable. This was based on five categories ranging from relatively very high (0.68-0.76), to high (0.60 – 0.68), moderate (0.51-0.60), relatively low (0.43 – 0.51), and relatively very low vulnerability (0.35 – 0.43). Kanker and Sukma were ranked as districts with a relatively low vulnerability. District-level VIs and related maps are presented in Figure 31-Figure 32.

Drivers of vulnerability are presented in Figure 33. 6 out of the 12 indicators were found to be the main drivers of vulnerability: the number of establishments (OAE, Estt. micro, small, and medium), percentage of rural households below the poverty line, dependency ratio, number of approved minor forest produce (MFP) Microenterprises, number of functional health care facilities, and the degree of forest dependence by rural tribal communities.

It is to be mentioned that the data acquired for the assessment was not uniform in terms of time (applicable for all assessments presented in the report). Data for 4 major drivers, percentage of BPL households (adjusted for inequalities), dependency ratio, number of functional health care facilities per 10,000 population, and forest dependence of rural tribal communities were taken from the 2011 Census.

Table 12: List of indicators used for the assessment of district-level vulnerability for Chhattisgarh

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Crop, livestock, and fish yield variability	Sensitivity	Positive
Percentage net area cultivated under horticulture	Adaptive Capacity	Negative
Available water resources under fish culture	Adaptive Capacity	Negative
Forest dependence of rural tribal communities	Sensitivity	Positive
Number of approved Minor Forest Produce micro-enterprises	Adaptive Capacity	Negative
Percentage of rural households below the poverty line	Sensitivity	Positive
Dependency ratio	Sensitivity	Positive
Access to an alternate employment source (MGNREGS)	Adaptive Capacity	Negative
Number of establishments (OAE, Estt., Micro, small and Medium)	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Number of functional health care facilities per 10,000 population	Adaptive Capacity	Negative
Households with any usual member covered by a health scheme or health insurance	Adaptive Capacity	Negative

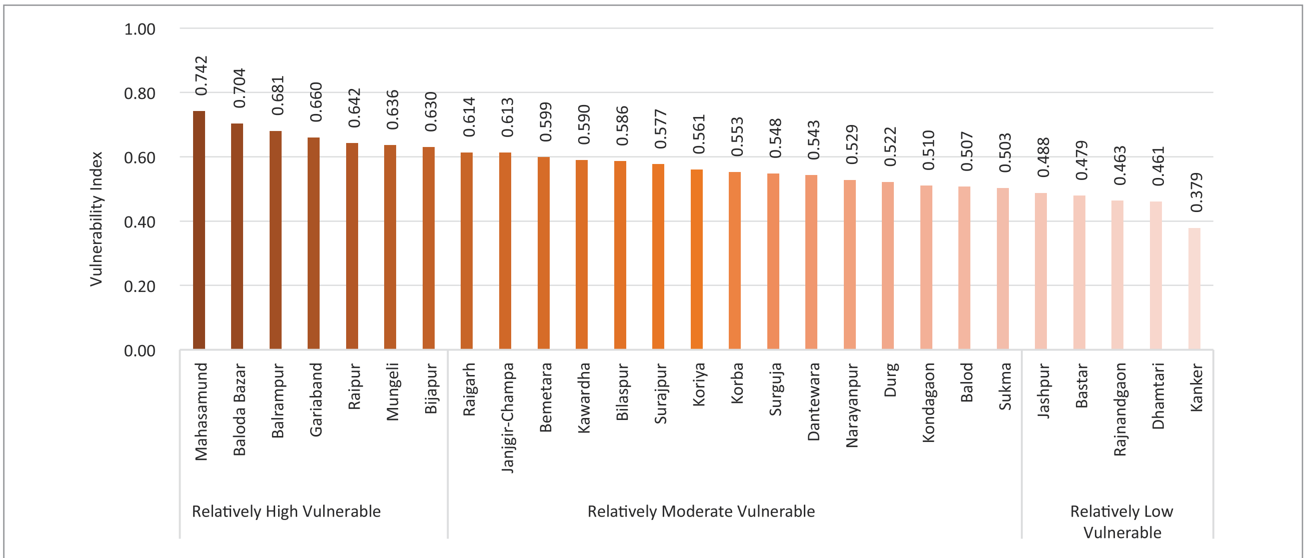

Figure 31: Vulnerability Indices (VIs) and ranking of districts in Chhattisgarh

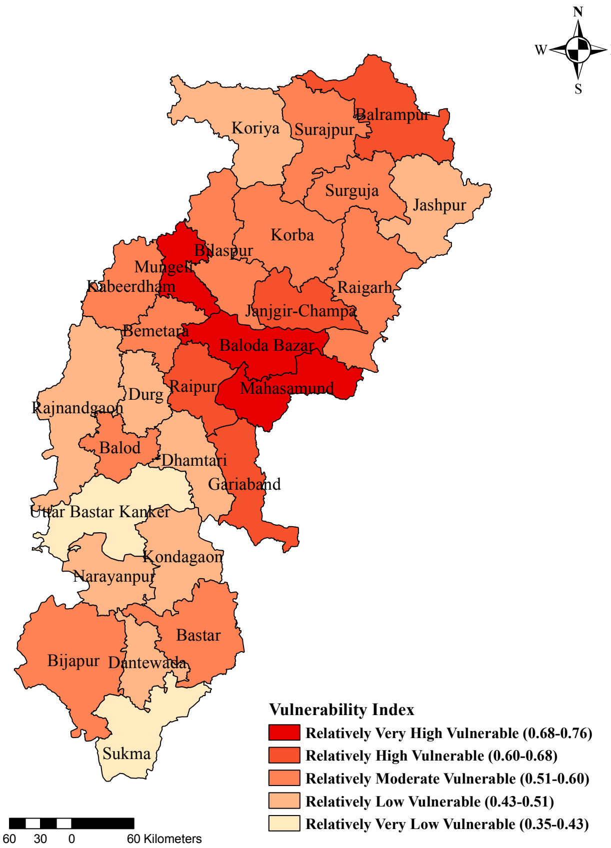

Figure 32: Map showing the categories of vulnerability of the districts in Chhattisgarh

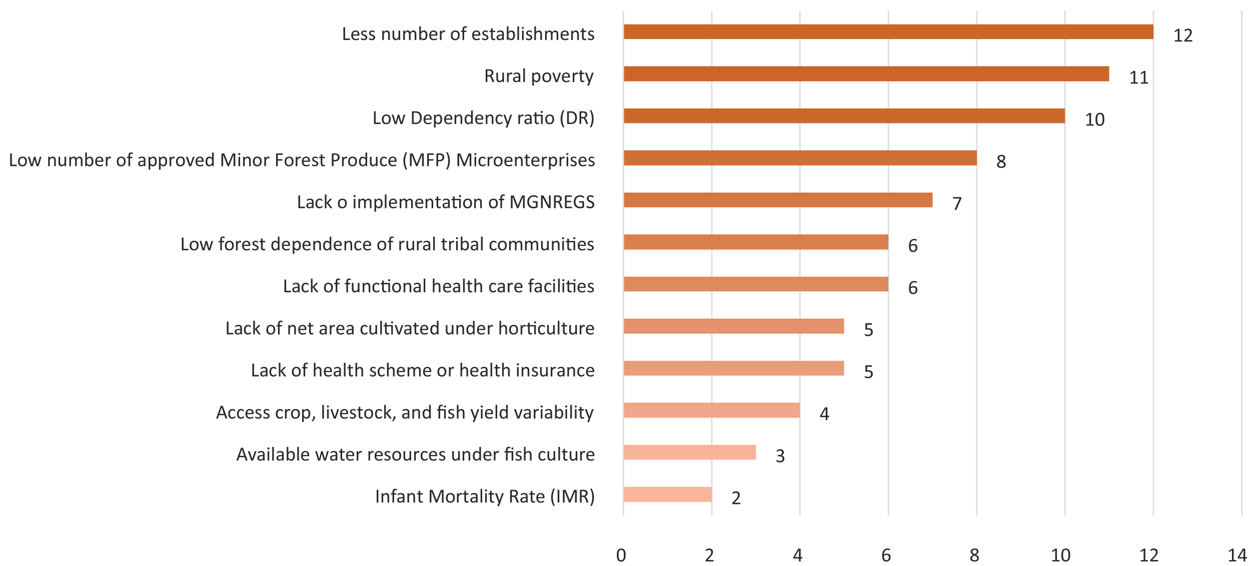

Figure 33: Drivers of vulnerability in districts of Chhattisgarh (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.6. Gujarat

Gujarat is the western most state of India, with a geographical area of 196,030 km2 and an estimated population of 6.38 crores, as of May 2020. Gujarat has the longest coastline of 1,663 km in the country. It is divided into 33 districts, however, the current assessment considered 23 districts, based on previous district boundaries.

The state falls in the subtropical climate zone and has a sub-humid climate in southern Gujarat (South of River Narmada), moderately humid climate in central Gujarat (between Narmada and Sabarmati rivers), humid and sultry climate in the coastal region (south facing coastal region of Saurashtra), dry climate in regions of central Gujarat (north of Ahmedabad and part of central Saurashtra) and arid and semi-arid climate in north Gujarat and Kachchh. There are 8 agro-climatic zones based on soil characteristics, rainfall, and temperature. The summer temperature varies between 25°C and 45°C, while the winter temperature ranges between 15°C and 35°C. The normal monsoon season runs from June to Sept, with a normal annual rainfall of 852 mm. But there is a wide annual variation: from 300 mm in the Western half of Kachchh to 2,100 mm in the Southern part of Valsad and the Dangs District.

The 15 indicators used in this district-level integrated vulnerability assessment are listed in Table 13. A correlation analysis had been carried out on an initially chosen to set of indicators and those with high correlation with one or more other indicators are omitted from the analysis. All indicators were assigned equal weights. It may be noted that this is not an exhaustive list of indicators to be used for a vulnerability assessment for the state. Such a list can be improved and made in line with the state's priorities after thorough discussion with functional and administrative heads of state departments and academia working in this field as well as other important stakeholders.

The VI range was observed to be 0.70 – 0.43, which is relatively narrow. Dahod had the highest relative vulnerability and Junagadh the lowest. The range of VIs was divided into three categories: highly vulnerable (0.61- 0.70) and moderately vulnerable (0.52-0.60), and low vulnerability (0.43 – 0.51). According to the assessment, only Dahod district falls under the first category, 10 districts under the next, while the remaining 11 have a relatively low vulnerability. The VI of Dahod is quite high (0.70) compared to the next vulnerable district, The Dangs (0.59). District-level VIs and related maps are presented in Figure 34 - Figure 35.

With the given set of indicators, this assessment goes with the ground scenario, except that a few vulnerable districts, for instance Kachchh, obtained a lower VIs in contrast with a general understanding of the districts. The district has a high rural-urban ratio, and most of its population has a critical dependence on natural resources for their livelihood. It also has a lower per capita income compared to other districts and few infrastructure facilities. Its long coastline makes it even more vulnerable. These factors are making Kachchh sensitive to vulnerability and indicate its low adaptive capacity.

This example brings out that choosing the right indicators for a vulnerability assessment is very important, although it may be constrained by data limitations. If indicators like coastal length, overall per capita income, household tap water connection, school-dropout rates, groundwater availability and quality, and percentage of the population dependent on natural resources for livelihood were all considered, the nature of vulnerability of the districts would change.

The major drivers of vulnerability are provided in Figure 36 (Gujarat used NV=0.85 as the threshold value). They include a low percentage of forest area, low road density, high proportion of small and marginal operational holders, low livestock- human ratio, rural poverty, a low number of women in the workforce, and a low female literacy rate. 16 districts (like Ahmedabad, Anand, Sabarkantha, and Surendranagar) have a relatively limited forest area as their key driver. Because of it, the adaptive capacity and earning capacity of tribal and forest-dependent households is low. One may note that the lack of forest cover in many parts of the state is a biophysical feature that is difficult to be altered. Road density is also found to be low in 9 districts (lowest in Kheda, Dang, and Kachchh).

Table 13: List of indicators used for the assessment of district level vulnerability for Gujarat

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Rural poverty (Percentage of households with a monthly income of highest earning member less than Rs. 5,000, in rural area)	Sensitivity	Positive
Livestock to human ratio	Adaptive Capacity	Negative
Percentage of marginal and small operational holders	Sensitivity	Positive
Proportion of rain-fed agriculture	Sensitivity	Positive
Percentage area under forest cover	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Women's' participation in the workforce	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Percentage of households with access to electricity	Adaptive Capacity	Negative
Percentage of households with improved drinking water source	Adaptive Capacity	Negative
Percentage of households with improved sanitation facility	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive

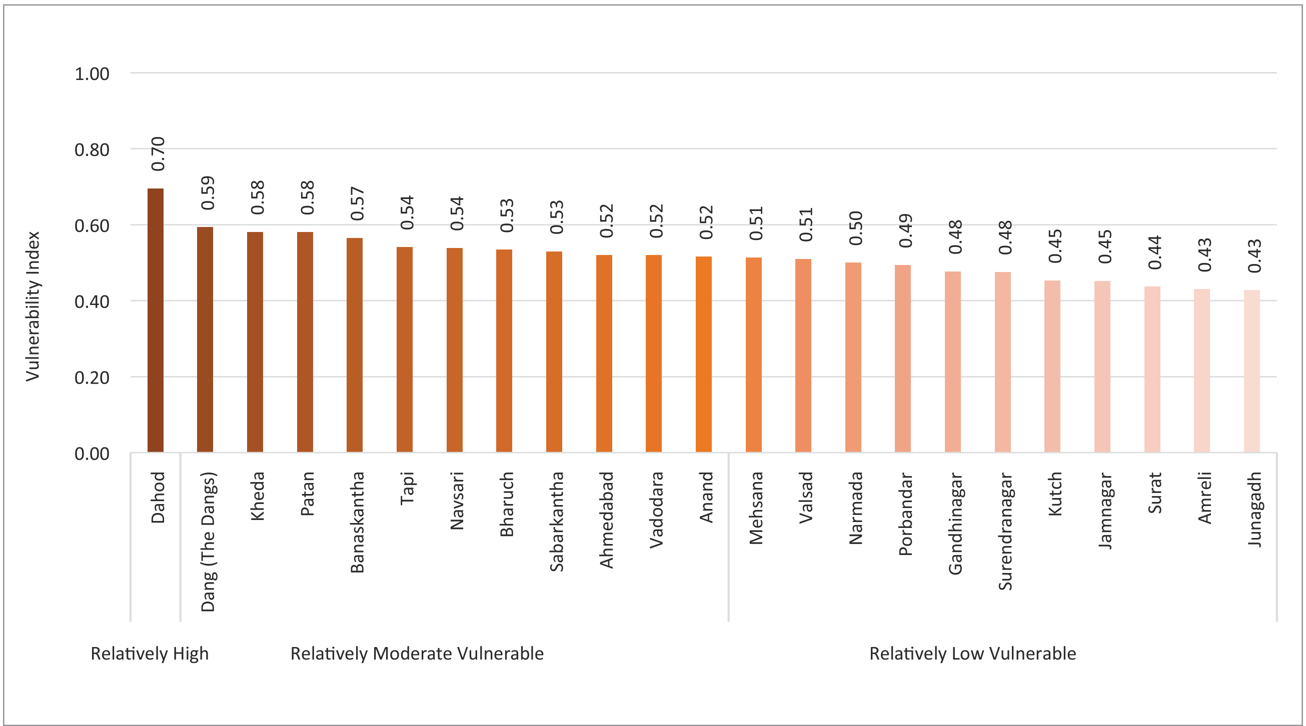

Figure 34: Vulnerability Indices (VIs) and ranking of districts in Gujarat

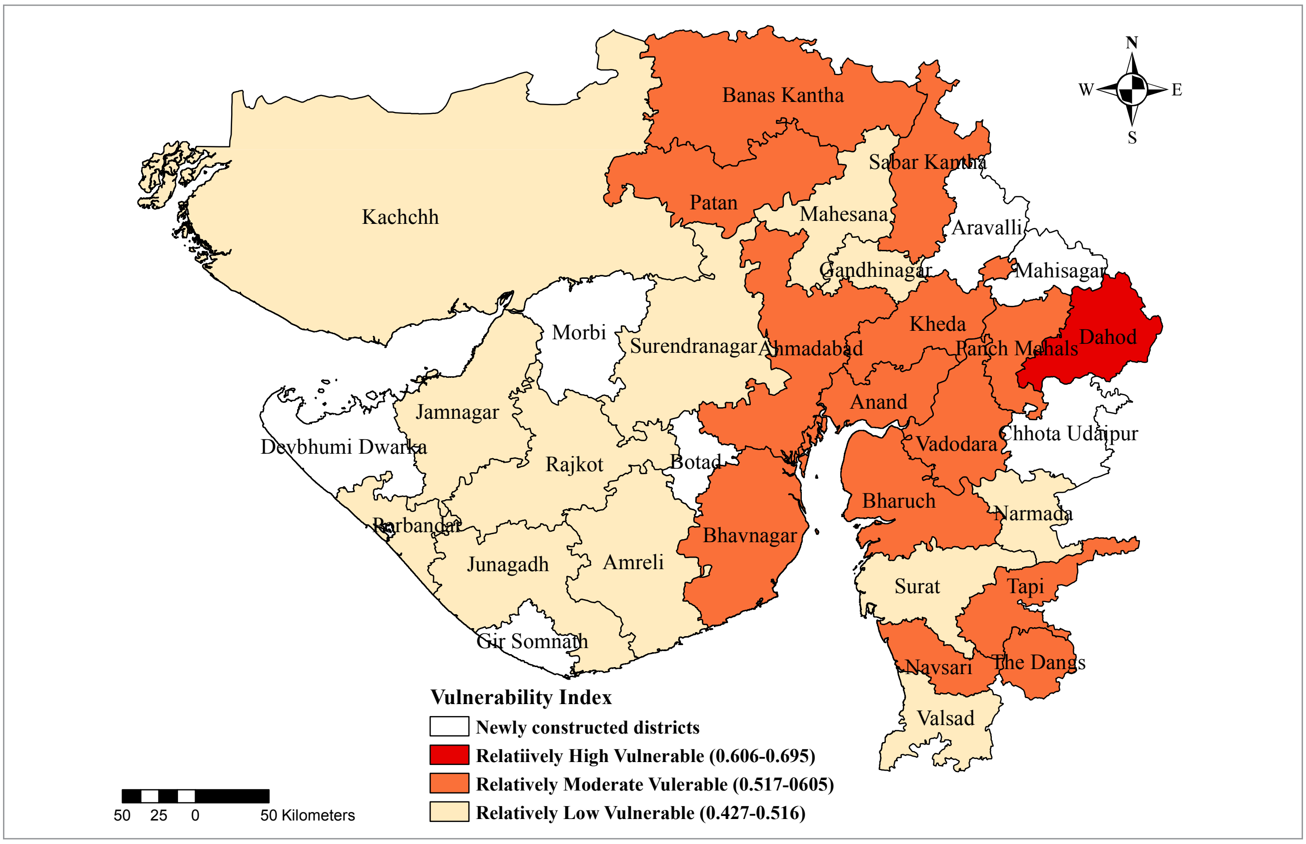

Figure 35: Map showing the categories of vulnerability of the districts in Gujarat

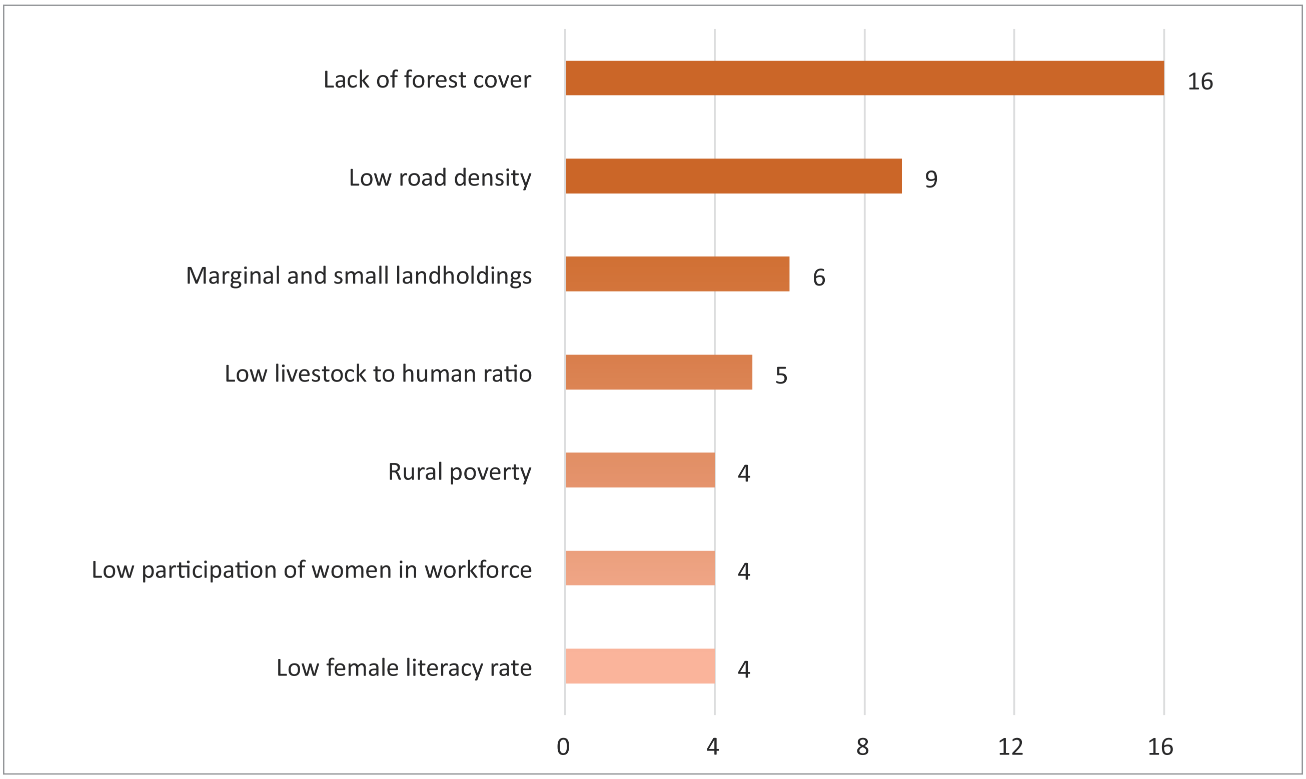

Figure 36: Drivers of vulnerability in districts of Gujarat (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.7. Haryana

Haryana is situated in the northern part of India between 27° 37' to 30° 35' N latitude and between 74° 28' and 77° 36' E longitude. It has 22 districts. Agriculture and related industries are the backbone of the local economy. Haryana is also an industrial state and has emerged as a base for the knowledge industry including IT and biotechnology.

The climate of Haryana is very hot in summer and cold in winters. Winter months have average temperatures in the range of 3° C to 9° C, while the summer months temperatures are in the range of 35° C to 48° C. About 80% of the rainfall occurs in the monsoon season during the months of July and September. Rainfall is varied, with the Shivalik Hills as the wettest and the Aravalli Hills as the driest regions.

The present district-level vulnerability assessment for Haryana was based on 16 indicators related to biophysical, socio-economic, institutional, and infrastructure-related indicators.

The list of indicators along with their functional relationships with vulnerability is presented in Table 14. A Principal Component Analysis (PCA) was run to calculate weights of the indicators. Since very little variation is found in results obtained based on PCA-determined weights and equal weights, hence the analysis was carried out based on equal weights assigned to each indicator.

The vulnerability ranking of districts in Haryana shows Mewat to be highly vulnerable with a VI value of 0.57, followed by Gurugram (0.51) and Faridabad (0.49). Fatehbad District is the least vulnerable (0.31), followed by Hisar (0.35) and Kaithal (0.36). Further, districts were divided into three categories, highly vulnerable (~0.48-0.57), moderately vulnerable districts (~0.40 – 0.48), and districts with a relatively low vulnerability (~0.31-0.40). Other than Sirsa, most of the relatively high and moderately vulnerable districts in the state spread over the eastern part. District-level VIs and related maps are presented in Figure 37- Figure 38.

Drivers of vulnerability are presented in Figure 39. The major drivers identified are lack of forest area (in ha) per 1000 rural population (in 20 districts), landless, marginal, and small farmers (16 districts), lack of crop insurance (10 districts), lack of implementation of MGNREGA (4 districts), and groundwater extraction (3 districts).

Table 14: List of indicators used for the assessment of district level vulnerability for Haryana

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Women's participation in the workforce	Adaptive Capacity	Negative
Percentage of households with electricity	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Marginal and small farmers (land < 5 acre)	Sensitivity	Positive
Yield Variability of food grain	Sensitivity	Positive
Average days of employment provided per household under MGNREGA	Adaptive Capacity	Negative
Proportion of rainfed agriculture	Sensitivity	Positive
Forest area (in ha)/1000 rural population	Adaptive Capacity	Negative
Per capita income	Adaptive Capacity	Negative
Livestock to human ratio	Adaptive Capacity	Negative
Number of functional health centers per 1000 population	Adaptive Capacity	Negative
Percentage of villages connected with paved roads	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Proportion of area under crop insurance	Adaptive Capacity	Negative
Total groundwater extraction per 1000 ha	Sensitivity	Positive

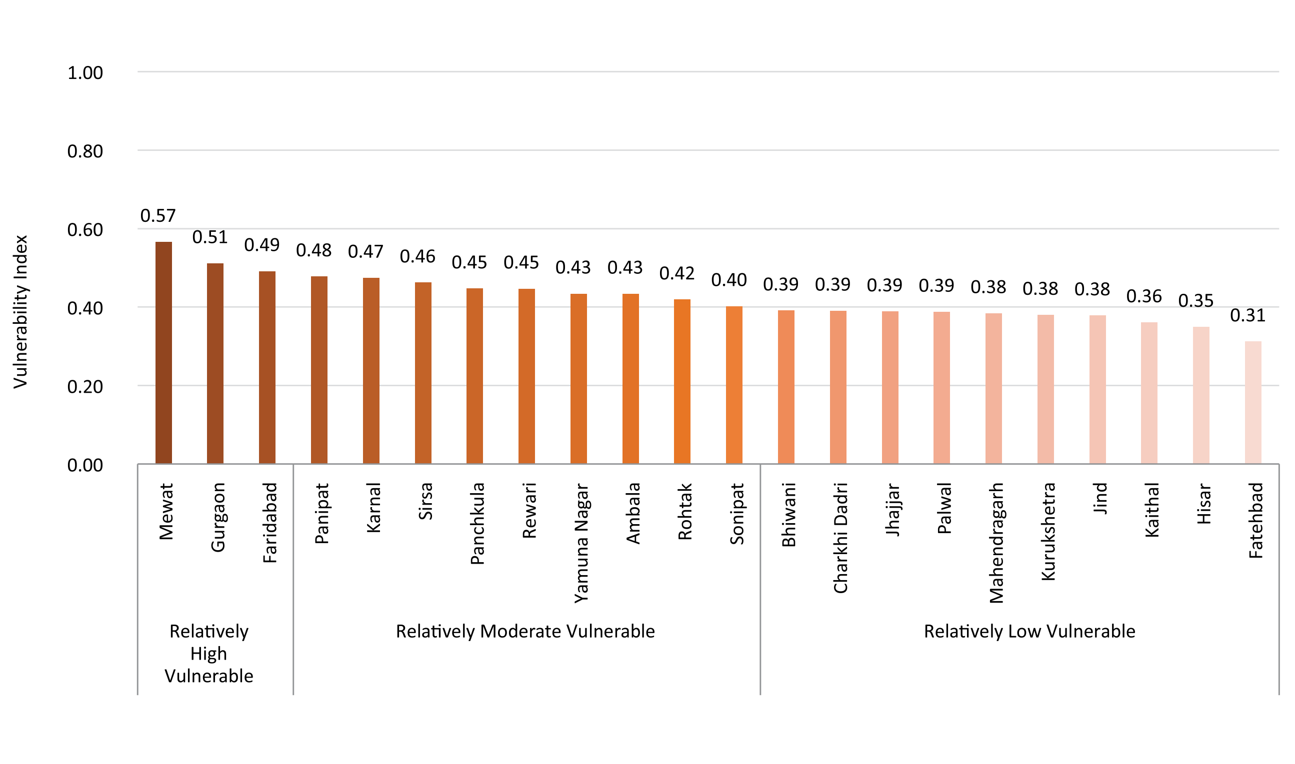

Figure 37: Vulnerability Indices (VIs) and ranking of districts in Haryana

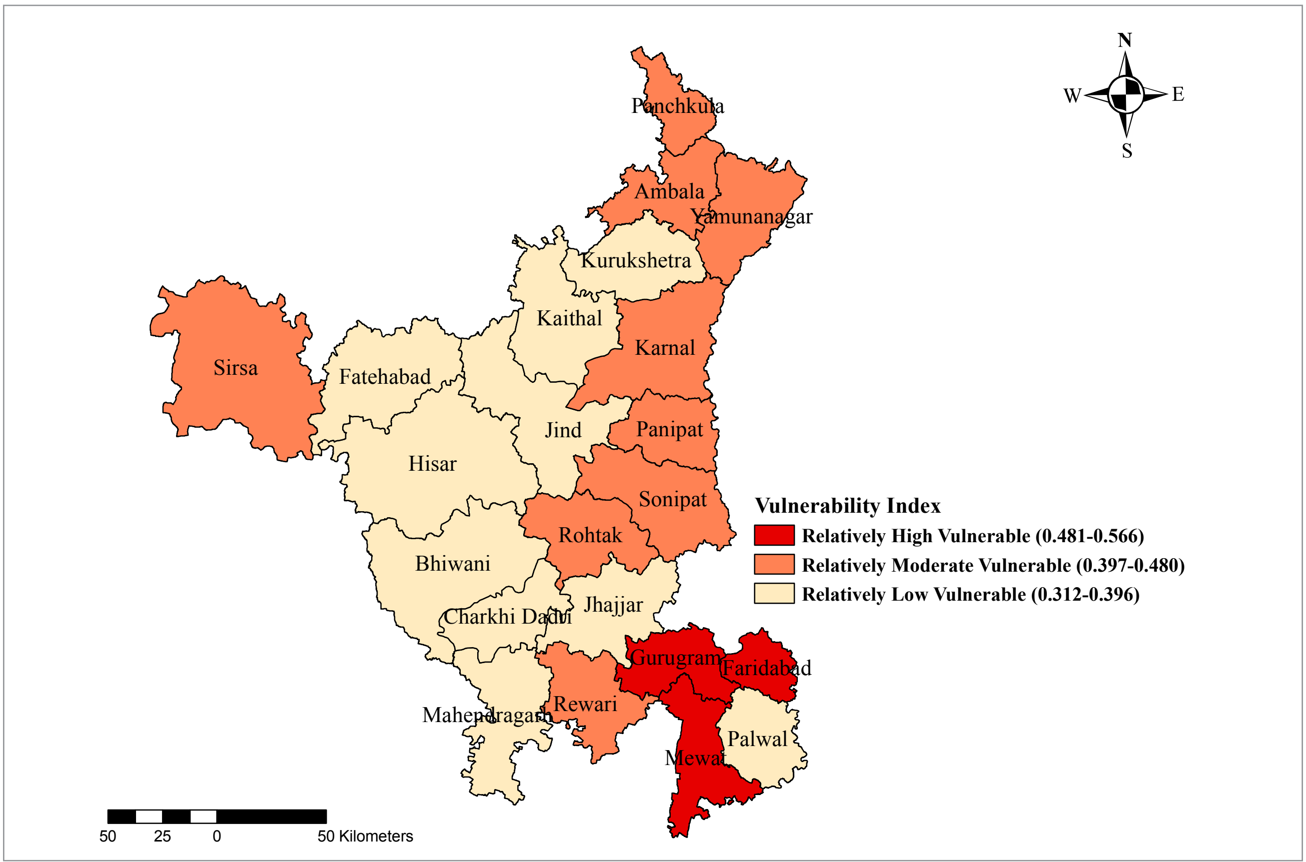

Figure 38: Map showing the categories of vulnerability of the districts in Haryana

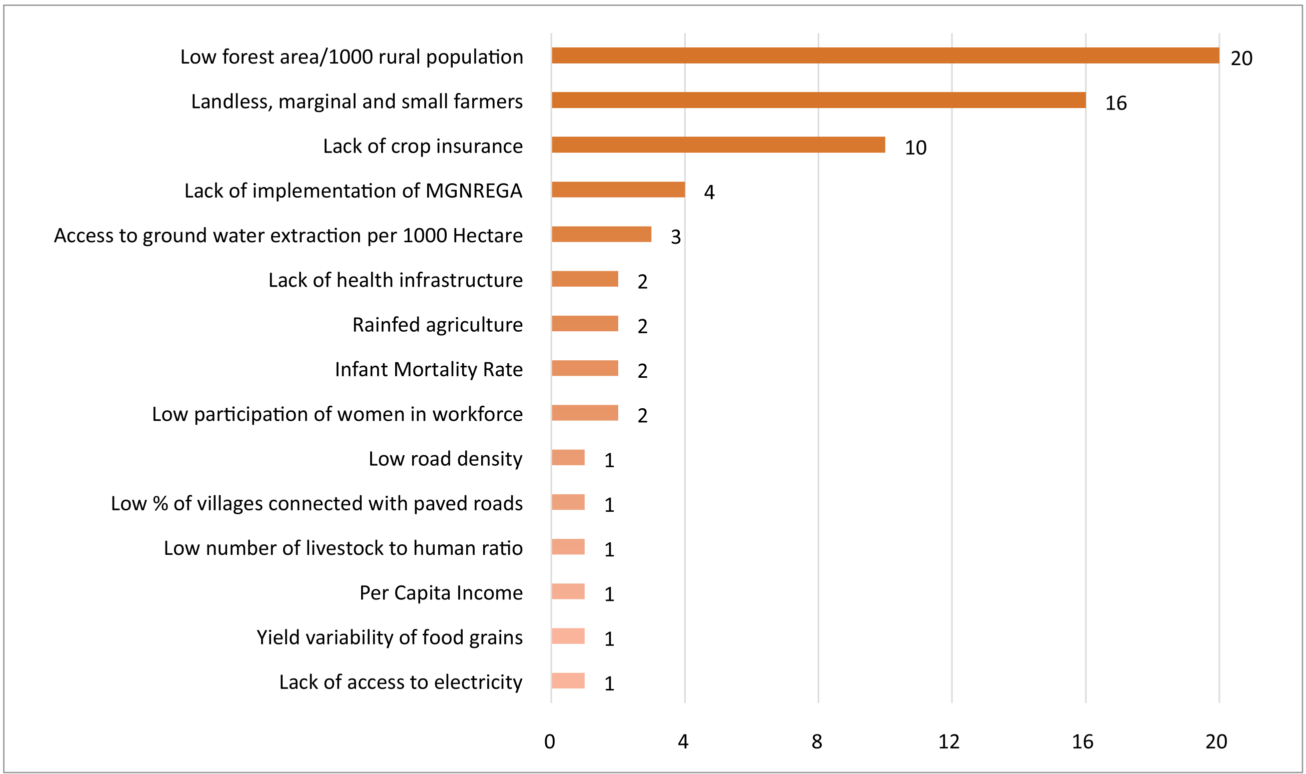

Figure 39: Drivers of vulnerability in districts of Haryana (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.8. Himachal Pradesh

Located in North India, Himachal Pradesh is a mountainous state and extends from the latitudes 30°22′40″ North to 33°12′40″ North and longitudes 75°45′ 55″ East to 79°04′ 20″ East. The entire state has a hilly and rugged terrain, with the altitude ranging from 350 m to 7000 m above sea level. With a geographical area of 55,673 kms^2 and population of 6.6 million, it accounts for 1.6 percent of the national geographical area and about 0.6 percent of India's population.

Historical, gridded data from the Indian Meteorological Department on daily temperature (maximum and minimum) and rainfall from 1951-2013 for the state show that its mean annual maximum temperature is 25.9° C. (range 24.5°C to 27.1°C) and the average annual rainfall is 1284.2 mm (range 704.7 - 2062.8 mm).

The present district-level vulnerability assessment was based on 13 indicators related to biophysical, socio-economic, institutional, and infrastructure related aspects. The list of indicators along with their functional relationships with vulnerability is presented in Table 15. The present analysis was based on equal weights assigned to each indicator.

The highest VI was obtained for Sirmaur district (0.63) and the lowest for Kinnaur (0.40). It shows that most districts fall within a small range and are almost equally vulnerable. All districts were divided into three categories, relatively highly vulnerable (0.63-0.40), relatively moderately vulnerable districts (0.48-0.56), and those with a relatively low vulnerability (0.40-0.48). Sirmaur, Solan, Kangra, Bilaspur, Mandi, Kullu, and Chamba are the highly vulnerable districts. District-level VIs and related maps are presented in Figure 40-Figure 41. Drivers of vulnerability are represented in Figure 42. The lack of health infrastructure (in 9 districts) and lack of crop insurance (8 districts) were found to be the major drivers in this state.

Table 15: List of indicators used for the assessment of district-level vulnerability for Himachal Pradesh

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Percentage of households having monthly income of highest earning member less than Rs. 5,000 in rural area	Sensitivity	Positive
Livestock to human ratio	Adaptive Capacity	Negative
Percentage area covered under centrally funded crop insurance schemes	Adaptive Capacity	Negative
Proportion of rainfed agriculture	Sensitivity	Positive
Forest area per 100 rural population	Adaptive Capacity	Negative
Women's participation in the workforce	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Percentage of household with improved drinking water source	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive

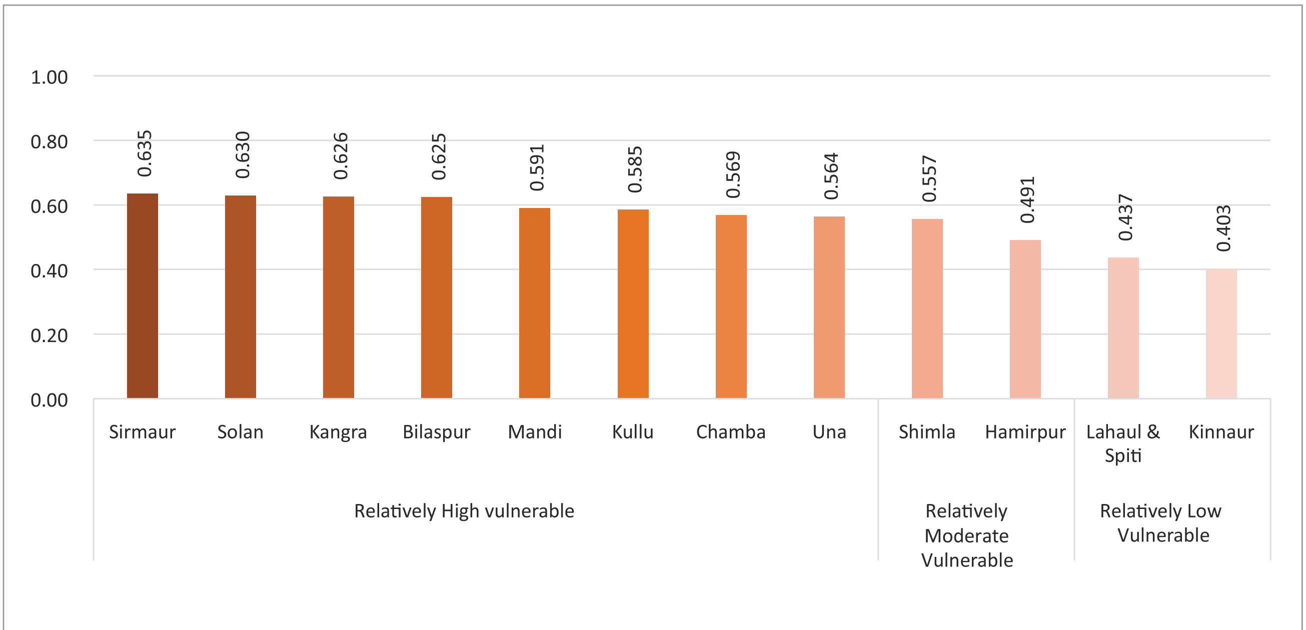

Figure 40: Vulnerability Indices (VIs) and ranking of districts in Himachal Pradesh

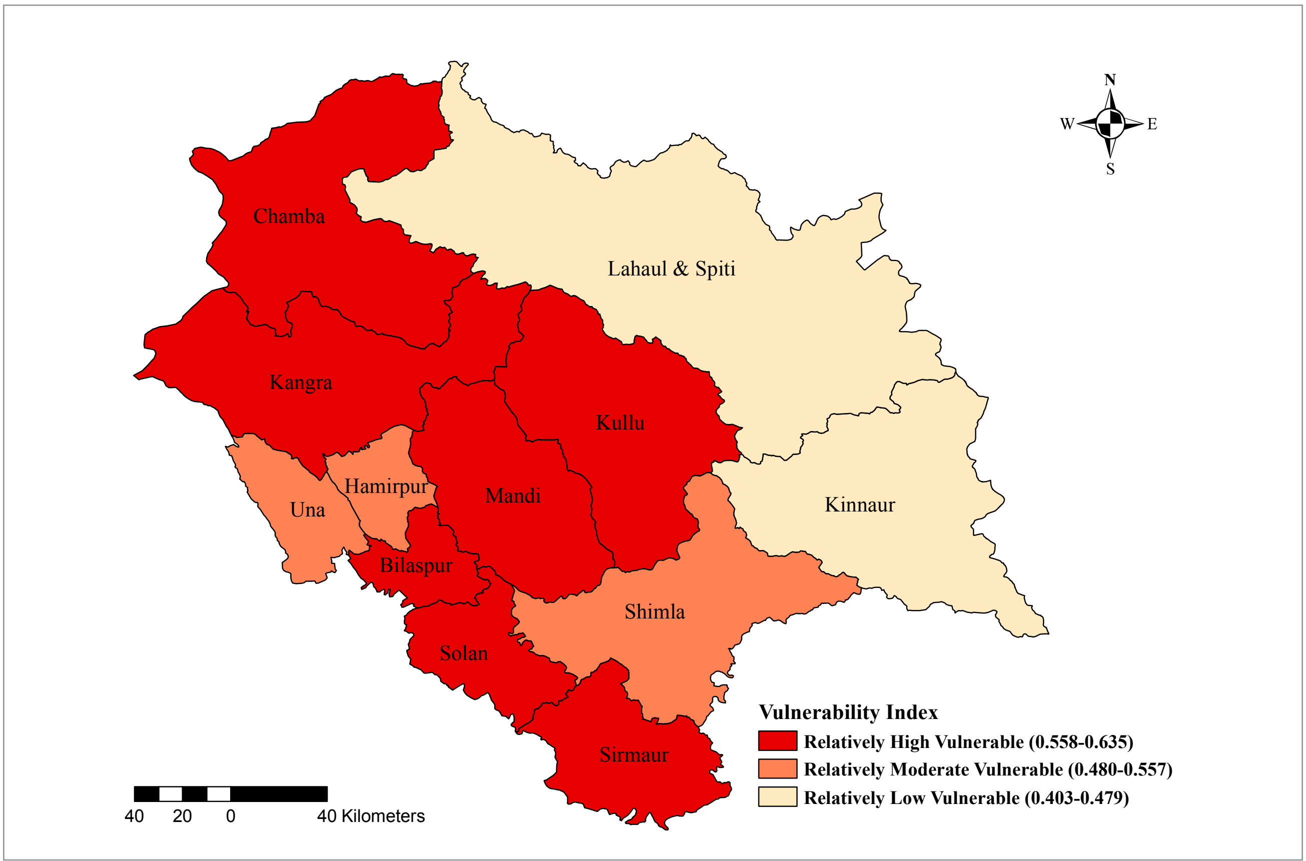

Figure 41: Map showing the categories of vulnerability of the districts in Himachal Pradesh

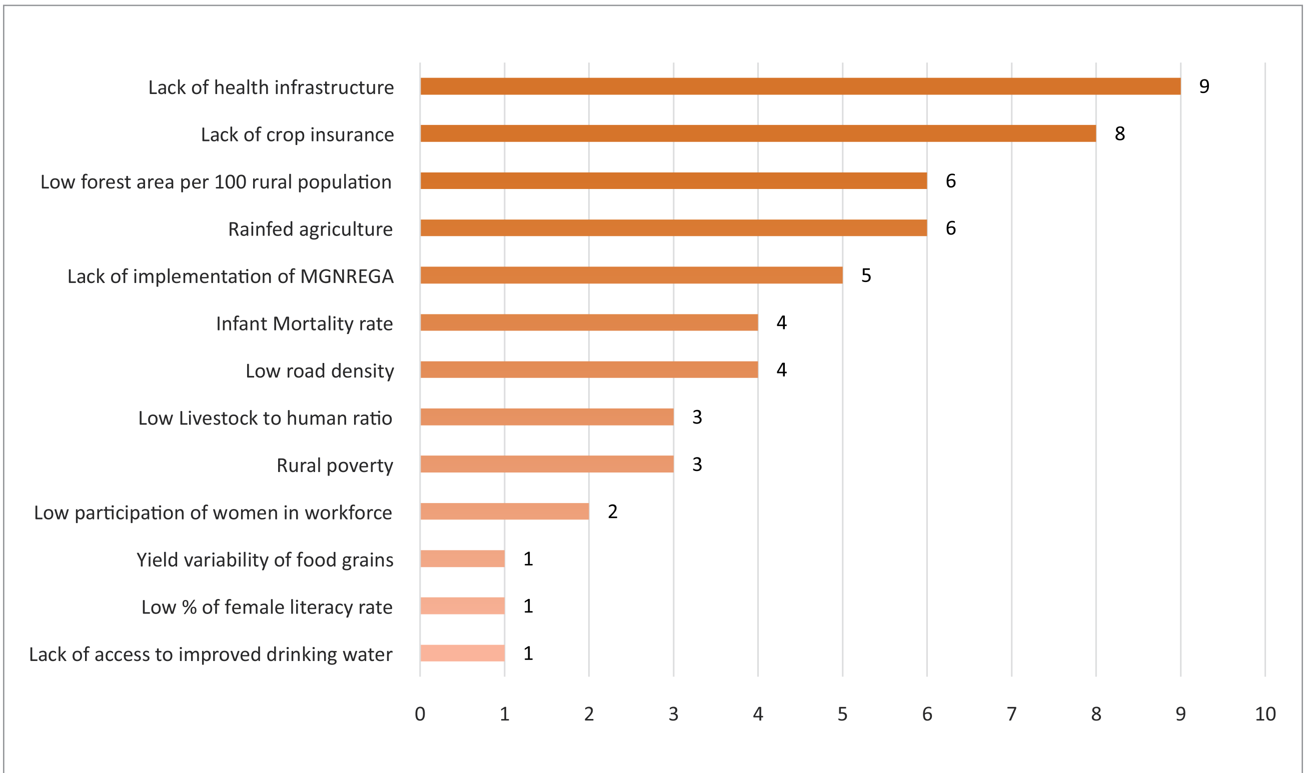

Figure 42: Drivers of vulnerability in districts of Himachal Pradesh (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.9. Jammu & Kashmir

Jammu & Kashmir (J&K) has a geographical area of 42,241 km^2. The Union Territory (UT) is situated in the Indian Eastern Himalayan Region between 73°55'E 32°18'N and 76°41'E 34°52"N, with varying elevations: from 247m in the foothills gradually ascending to above 5320 m. There are 20 districts with Doda as the largest and Ganderbal the smallest, respectively.

The average annual temperature in Jammu is 24.2°C, while in Kashmir it is 13.5°C. The average rainfall in the state is 1238 mm a year. According to the Meteorological Department, the average temperature in J&K in the last 100 years has increased by 1.2°C. It has even surpassed the average global temperature rise in the last 100 years of 0.8 to 0.9°C. The UT is also witnessing sudden changes in precipitation and snowfall pattern.

The local economy is predominantly (about 70%) dependent on agriculture and allied activities like animal husbandry. According to the Agriculture Census 2015-16, the total operational holding area in the whole area is 0.842 million ha. For marginal farmers (landholding below 1 ha) that comes to 0.397 million ha, small farmers 0.221 million ha, semi-medium farmers 0.154 million ha, medium farmers 0.059 million ha, and large farmers 0.011 million ha. There are four agro-climatic zones in the UT: subtropical, valley temperate, intermediate, and cold-arid. They determine the cropping pattern and productivity. 60% of agricultural land is rainfed with frequent moisture stress. The percentage of gross irrigated area out of gross cropped area was 43.01% in 2017-2018. J&K also cultivates various horticultural crops, plantation crops, and flowers. Approximately 0.67 million ha (80% of total operational holding) of agricultural land is subject to one or other disaster - including landslides, floods, and drought. This applies to 11 districts. The fact that 0.397 million ha of land belong to marginal farmers exacerbates the vulnerability of agricultural systems in the state.

Since agriculture is the main source of livelihood in the UT, this report presents a district-level agricultural vulnerability assessment. Indicators selected for the assessment, along with their dimensions and functional relationships with vulnerability are presented in Table 16. Equal weights were assigned to all indicators.

Figure 43 presents the agricultural VIs calculated for the districts. The values of VIs for the agricultural sector lie between 0.53 in Kulgam and 0.35 in Udhampur. It, again, shows that the range of the values is small and are close to each other. It indicates that most districts are more or less equally vulnerable with respect to the agricultural sector. Districts were also categorised into those with a relatively high (0.50 and above), moderate (~0.42-0.49) and relatively low (~0.35-0.41) vulnerability. Six districts, Bandipora, Ganderbal, Anantnag, Shopian, Kulgam, and Reasi, falls under the first category; Srinagar, Kupwara, Budgam, Pulwama, Poonch, Rajouri, Samba, Ramban, and Doda comes under the second; and Kathua, Udhampur, Jammu, Baramulla, and Kishtawar under the last category.

Figure 44 presents the categories of agricultural vulnerability of the districts.

Table 16: List of indicators used for the assessment of district-level agricultural vulnerability for Jammu and Kashmir

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Drainage density	Adaptive Capacity	Negative
Agricultural credit societies	Sensitivity	Positive
Yield variability of food grain	Sensitivity	Positive
Crop diversification Index	Sensitivity	Positive
Proportion of net irrigated area (of net sown area)	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Proportion of land holdings below 1 ha	Sensitivity	Positive
Fair price shops per 1000 population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Total number of livestock per 1000 rural households	Adaptive Capacity	Negative
Number of NRM works per 1000 ha (MGNREGA)	Adaptive Capacity	Negative

Drivers of vulnerability are represented in Figure 45. Drainage density is the major driver of agricultural vulnerability in the UT followed by the lack of agricultural credit societies, variability in food grains, crop diversification index, percentage net irrigated area to sown area.

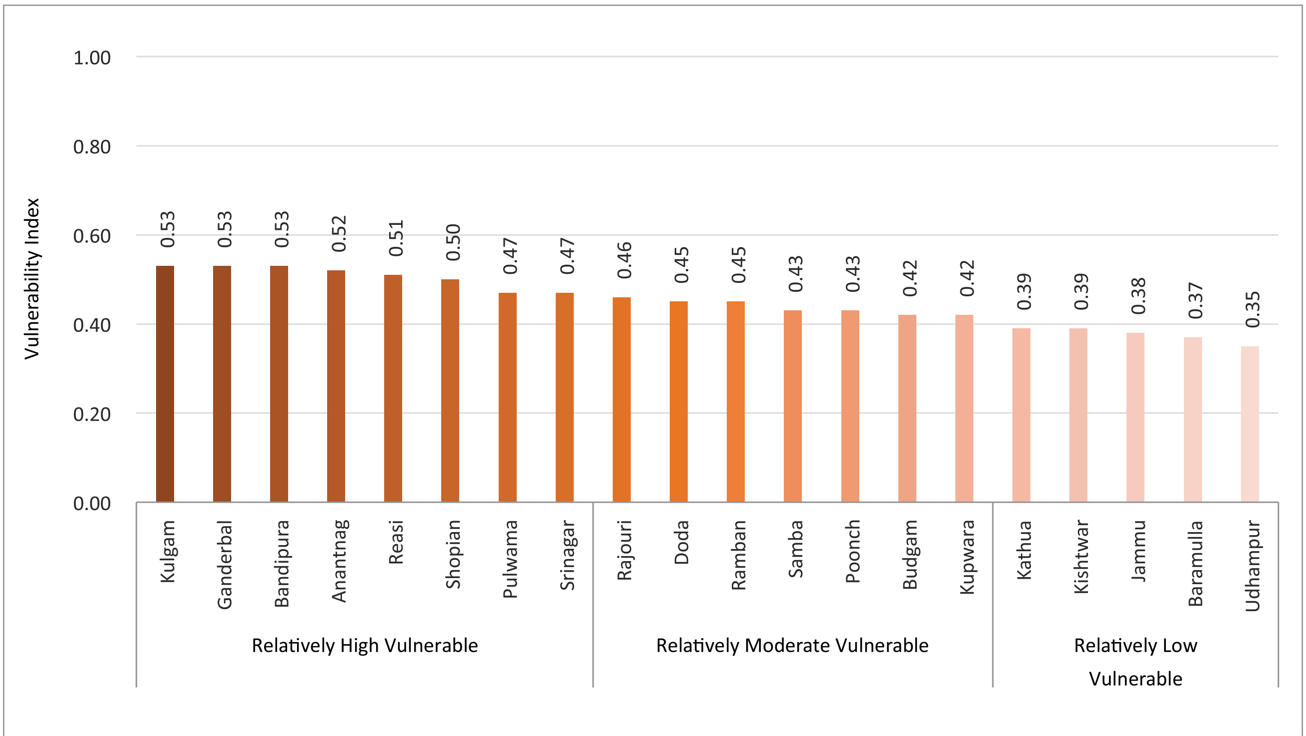

Figure 43: Vulnerability Indices (VIs) and ranking of districts of Jammu and Kashmir with respect to agricultural vulnerability

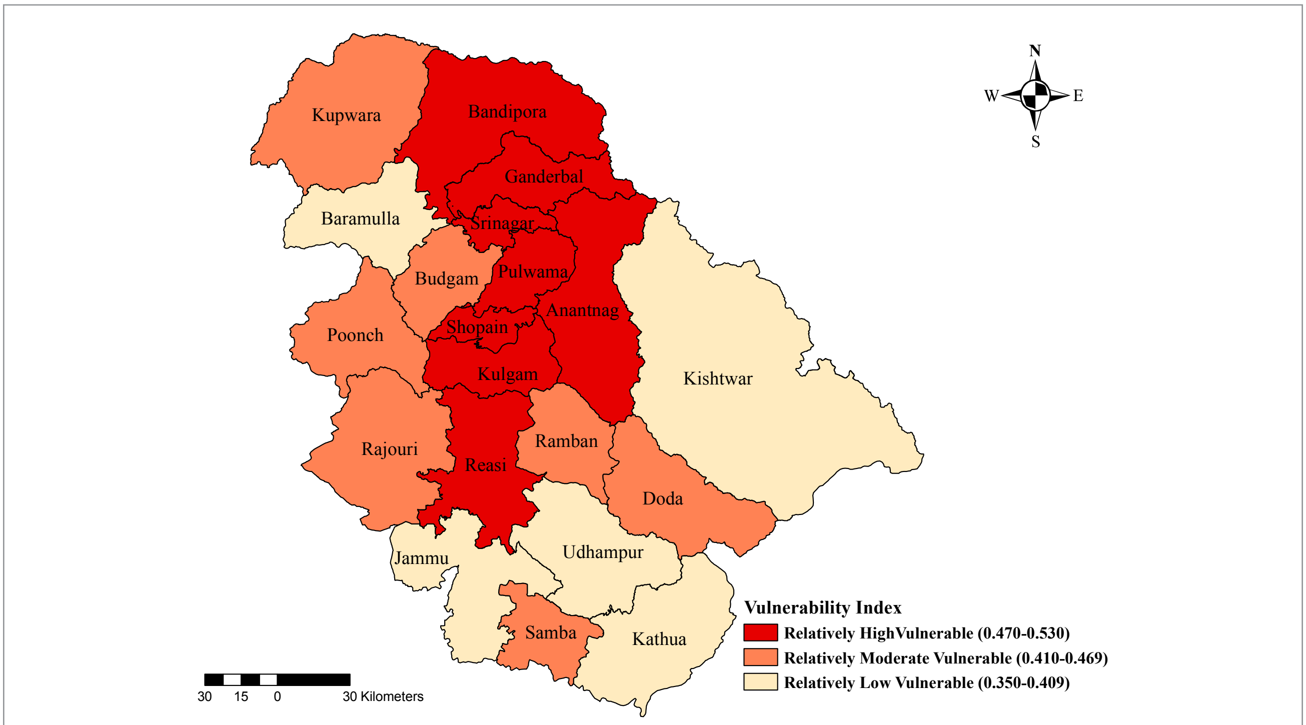

Figure 44: Map of districts in Jammu and Kashmir with categories of agricultural vulnerability

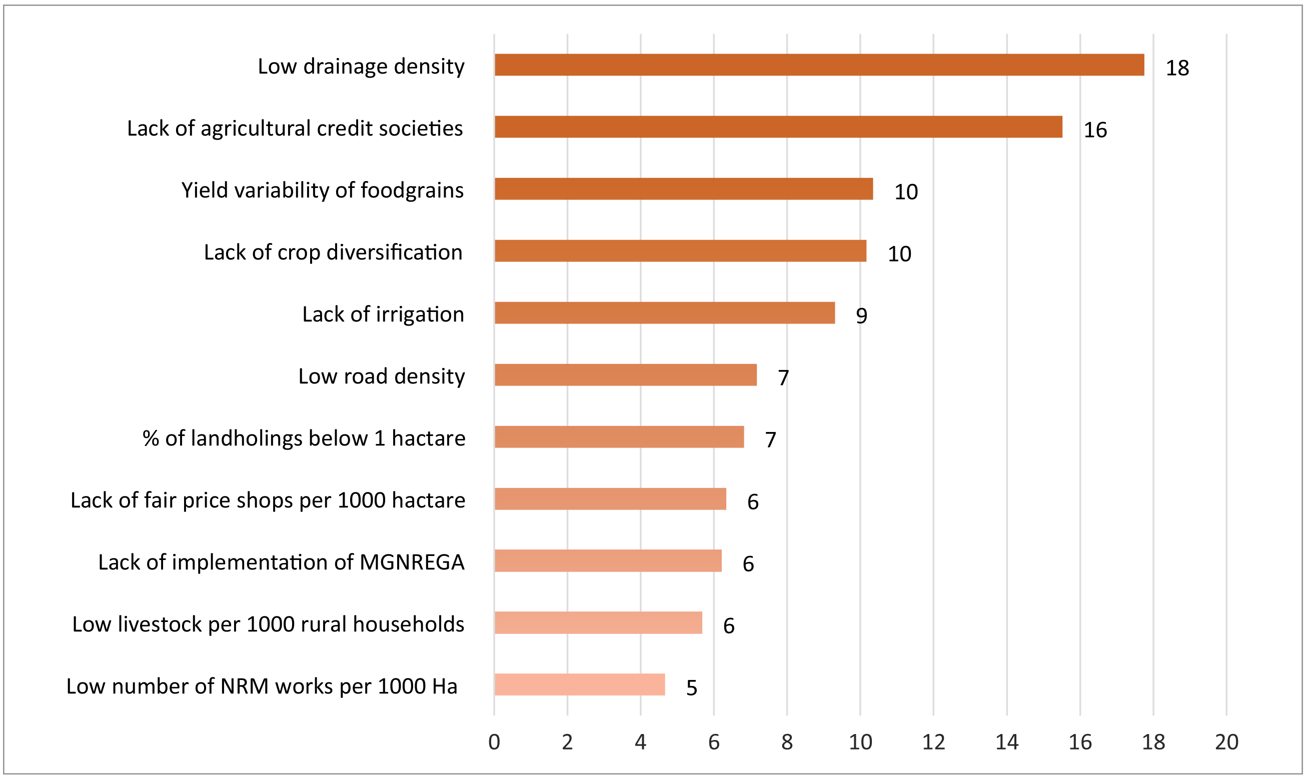

Figure 45: Drivers of agricultural vulnerability at the district level of Jammu and Kashmir (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.10. Jharkhand

Jharkhand, covering an area of 79,714 km^2, was created in 2000 by bifurcating the hilly and plateau regions of Bihar. It is situated at the latitude of 23° 21′ 0′′ N and longitude of 85° 19′ 48′′ E. Agricultural land with fallow and forest areas dominates the landscape. They occupy 49% and 30% of the total geographical area, respectively. The landholding size is comparatively small due to the undulating terrain. Built-up areas (urban and rural) with industrial and mining activities occupy 5% and wasteland and forest scrub 9% and 5%, respectively, of the total area.

Jharkhand has a tropical climate with an annual average rainfall of about 900 mm. There are 3 well-defined seasons. The hot-weather season lasts from March to mid-June. May, the hottest month, is characterised by daily high temperatures of around 37°C and low temperatures of 20-25°C. The cold-weather season, from November to February, is the most pleasant part of the year. The lowest temperature lies between-5°C and 0°C. The maximum rainfall takes place from July to September. It accounts for more than 90% of the total rainfall in the state.

Currently, the state has 24 districts, and the assessment is based on 10 indicators on those. The list of indicators along with their functional relationships with vulnerability is presented in Table 17. Six indicators -livestock to human ratio, women's participation in the workforce, road density, IMR, percentage of households with access to electricity, and percentage of households using improved sanitation facility- had been considered initially but were dropped because of their high correlation with other indicators. Equal weights were assigned to each indicator to calculate the VIs.

District-level VIs and related maps are presented in Figure 46 - Figure 47. The highest value of VI was obtained for Sahebganj district (0.72) and the lowest for Ranchi (0.36). The range of VIs was divided into three equal intervals to construct the categories: districts with a relatively high (0.60-0.72), a relatively moderate (0.48-0.60), and a relatively low vulnerability (0.36-0.48). It was found that 10 districts were falling under the first - Sahibganj, Pakur, Chatra, Garhwa, Palamu, Giridih, Hazaribag, Bokaro, Khunti, and Godda.

Major drivers of vulnerability are presented in Figure 48. Four out of the 10 indicators, proportion of rain-fed agriculture, percentage of area covered under centrally funded crop insurance, forest area per 100 rural population, and health infrastructure per 1000 population, were found as main drivers of vulnerability in the state. It might be counterintuitive to have lack of forest cover as a driver in the state. However, it arises from the fact that some of the districts have very high forest cover (such as Latehar, Pashchim Singbhum, etc.) as compared to others (such as Jamtara, Deoghar, etc.) indicating high scope of improvement in the later group.

Table 17: Indicators used for district-level assessment for Jharkhand

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Percentage of households having monthly income of highest earning household member less than Rs. 5,000 in rural area	Sensitivity	Positive
Percentage of marginal and small operational holders	Sensitivity	Positive
Percentage area covered under centrally funded crop insurance schemes	Adaptive Capacity	Negative
Proportion of rain-fed agriculture	Sensitivity	Positive
Forest area per 100 rural population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Percentage of household with improved drinking water source	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive

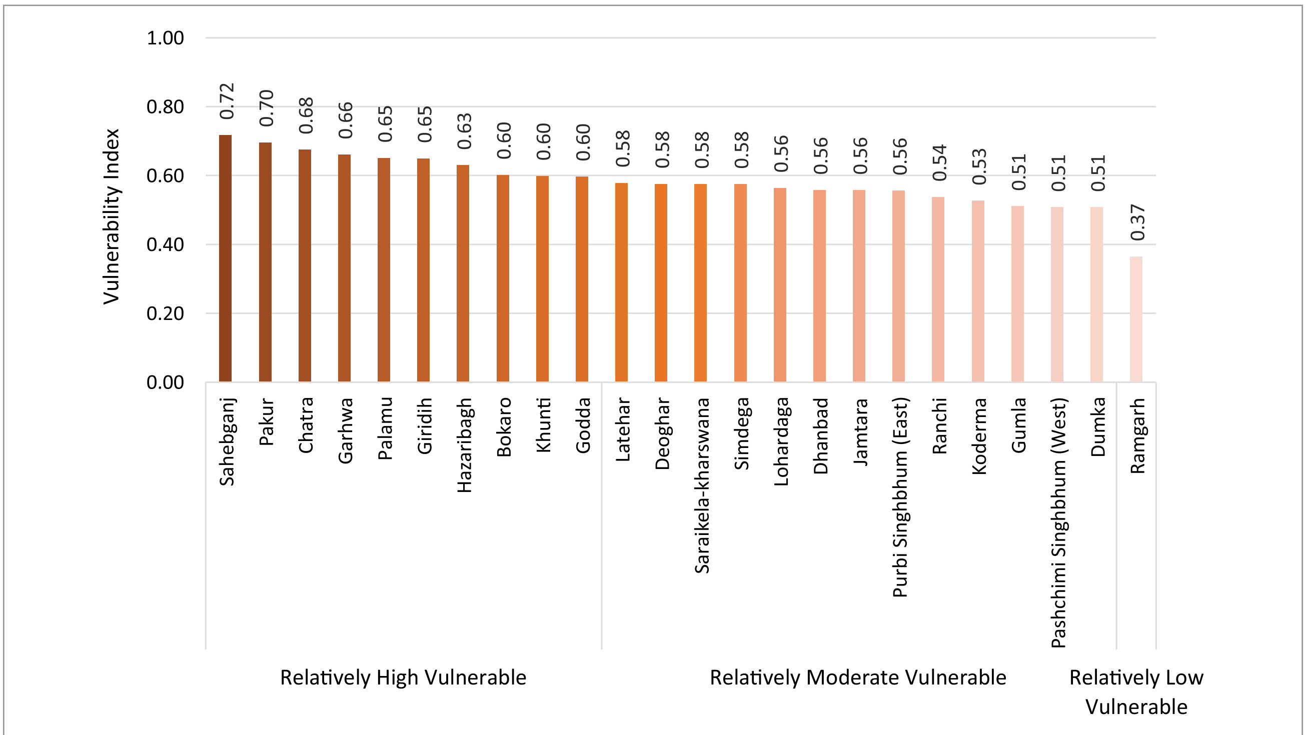

Figure 46: Vulnerability Indices (VIs) and ranking of districts in Jharkhand

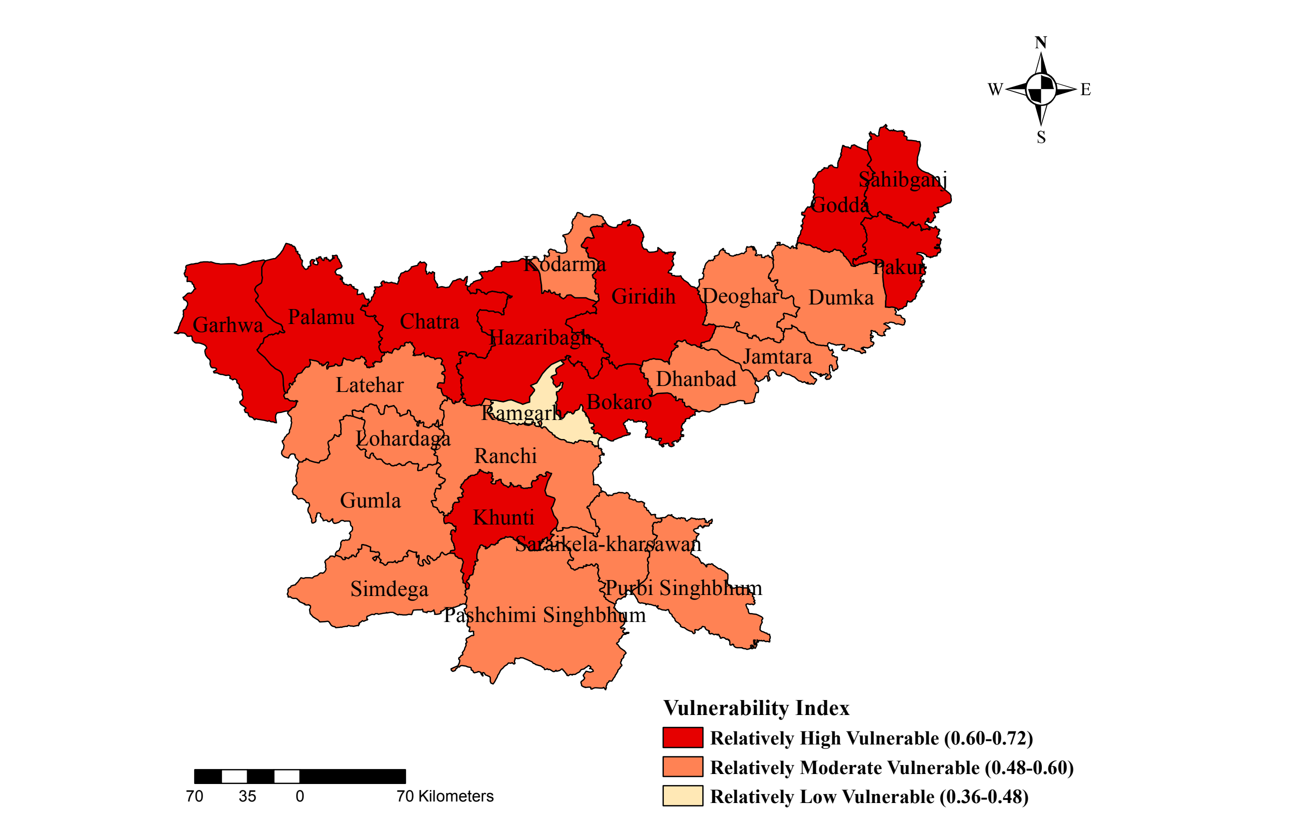

Figure 47: Map showing vulnerability categories of Jharkhand at district level

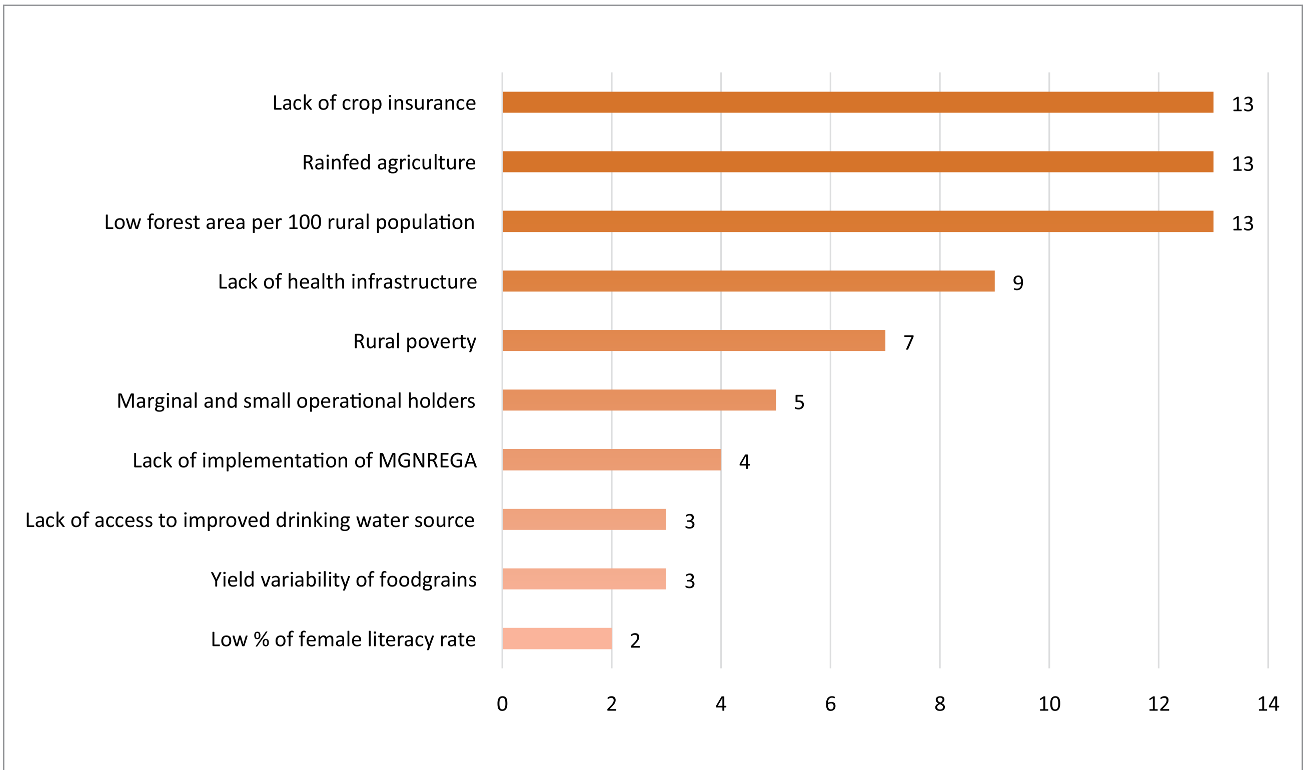

Figure 48: Drivers of vulnerability in Jharkhand (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.11. Karnataka

Karnataka has an area of 191,791 km² and accounts for 5.83% of the total geographical area of India. The state is situated on the western edge of the Deccan Peninsular region. It is located between 11.5° and 18.5° N latitudes and 74° and 78.5° E longitudes and is divided into 30 districts. Karnataka comprises the Deccan Plateau, the Western Ghats Mountain Range and the Coastal Plains. According to land utilisation statistics of 2017-2018, the net cropped area was found to be 98.95 lakh ha, which is 51.94% of the total area of the state

The climate is hot with an excessive rainfall during the monsoon (June to September). Over a period of almost 35 years (1980-2013) the average rainfall was calculated as 1191.6 mm. The winter season runs from mid-December to February (with 5.2 mm rainfall), the summer season from March to May (125 mm), the South-West monsoon from June to September (869.3 mm,) and the North-East monsoon from October to mid-December (192.1 mm).

The present district-level vulnerability assessment for Karnataka is based on 19 indicators related to biophysical, institutional infrastructure, health, socio-economic, and livelihood conditions. The list of indicators along with their functional relationships with vulnerability is presented in Table 18. Three indicators, percentage of BPL households, water scarcity, and percentage of households using improved sanitation facility, were initially considered, but finally dropped from the analysis because of their high correlation with other indicators.

A PCA was run to calculate weights but very little variation was found in the results based on PCA-determined weights of the indicators and on equal weights. So, the present analysis was based on the equal weights assigned to each indicator.

Chikballapur has the highest VI (0.728), which is much higher as compared to the second most vulnerable district Kolar (0.68). Lowest vulnerability is found for the distinct Kodagu (0.492). Following categorisation was obtained: those that were relatively very high vulnerable (~0.68 – 0.73), relatively high vulnerable (~0.63 – 0.68), and relatively moderately vulnerable (~0.69 – 0.63), and districts with a relatively low vulnerable (~0.54 – 0.59) and a relatively very low vulnerable (~0.49- 0.54). Chikballapur, with its VI 0.728 is the only district in the first category, followed by Kolar, Gadag, Bidar, Udupi and Dharwad falling in the second category. However, However, given minor differences between VIs of any two districts, this exercise might not prove significantly meaningful for Karnataka as a whole and it may be concluded that all districts are more or less equally vulnerable. District-level VIs and related maps are presented in Figure 49 - Figure 50.

Drivers of vulnerability are presented in Figure 51. Road density and forest area (in ha) per 1000 rural population were found to be important key drivers, since they are repeated in all the 19 districts, followed by households with a Kisan credit card with a credit limit of Rs.50,000 and above (14 districts), per capita income (12 districts), percentage of area under rainfed agriculture (11 districts).

Morni Hills Panchkula, Haryana

Table 18: Indicators used for district-level assessment for Karnataka

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Per capita income	Adaptive Capacity	Negative
Livestock to human ratio per ha (sheep and goats)	Adaptive Capacity	Negative
Percentage of marginal and small farmers (land <2.5 ha)	Sensitivity	Positive
Women's participation in the workforce	Adaptive Capacity	Negative
Forest area (in ha) per 1000 rural population	Adaptive Capacity	Negative
Value of output of total horticulture (only perennial)/ value of agricultural output	Adaptive Capacity	Negative
Percentage area under rainfed agriculture (i.e. ratio total area – net sown area)	Sensitivity	Positive
Yield variability of food grain	Sensitivity	Positive
Groundwater extraction	Sensitivity	Positive
Households having a Kisan credit card with credit limit of Rs.50,000 and above	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Access to electricity	Adaptive Capacity	Negative
Percentage of households with improved drinking water facility	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Self Help Groups per 1000 population	Adaptive Capacity	Negative
Health-sector related infrastructure	Adaptive Capacity	Negative
No of doctors, specialists, health assistants and health workers per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Cases of vector-borne diseases per 1000 population (malaria, dengue)	Sensitivity	Positive

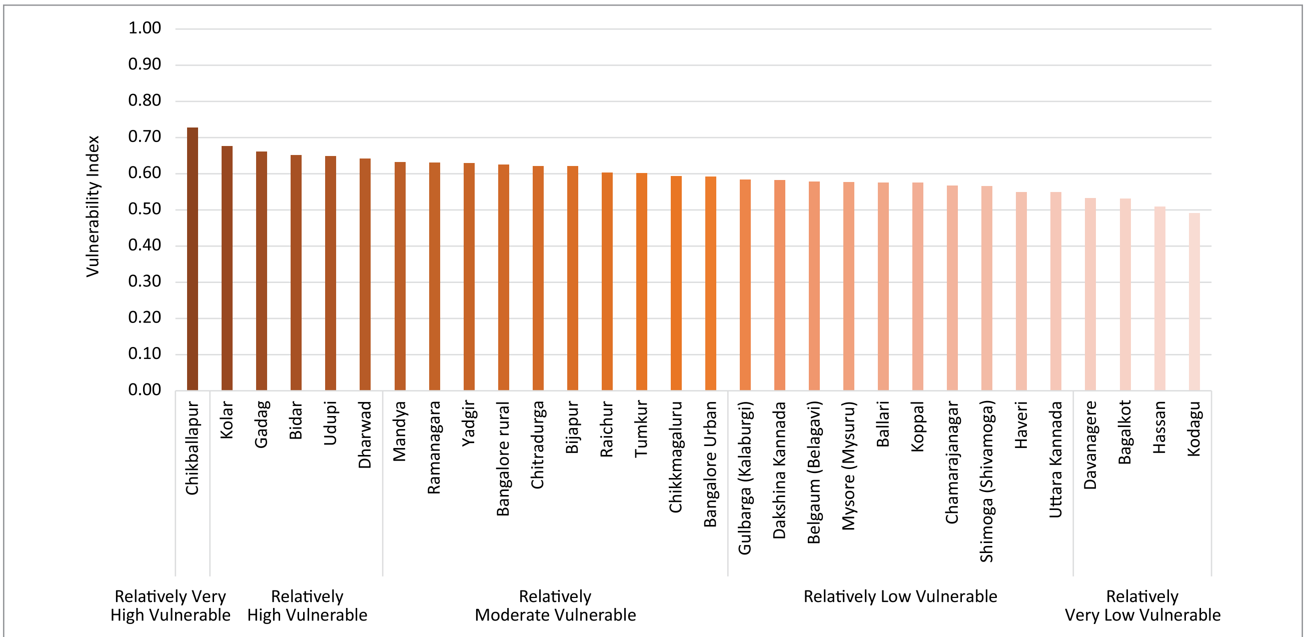

Figure 49: Vulnerability Indices (VIs) and ranking of districts in Karnataka

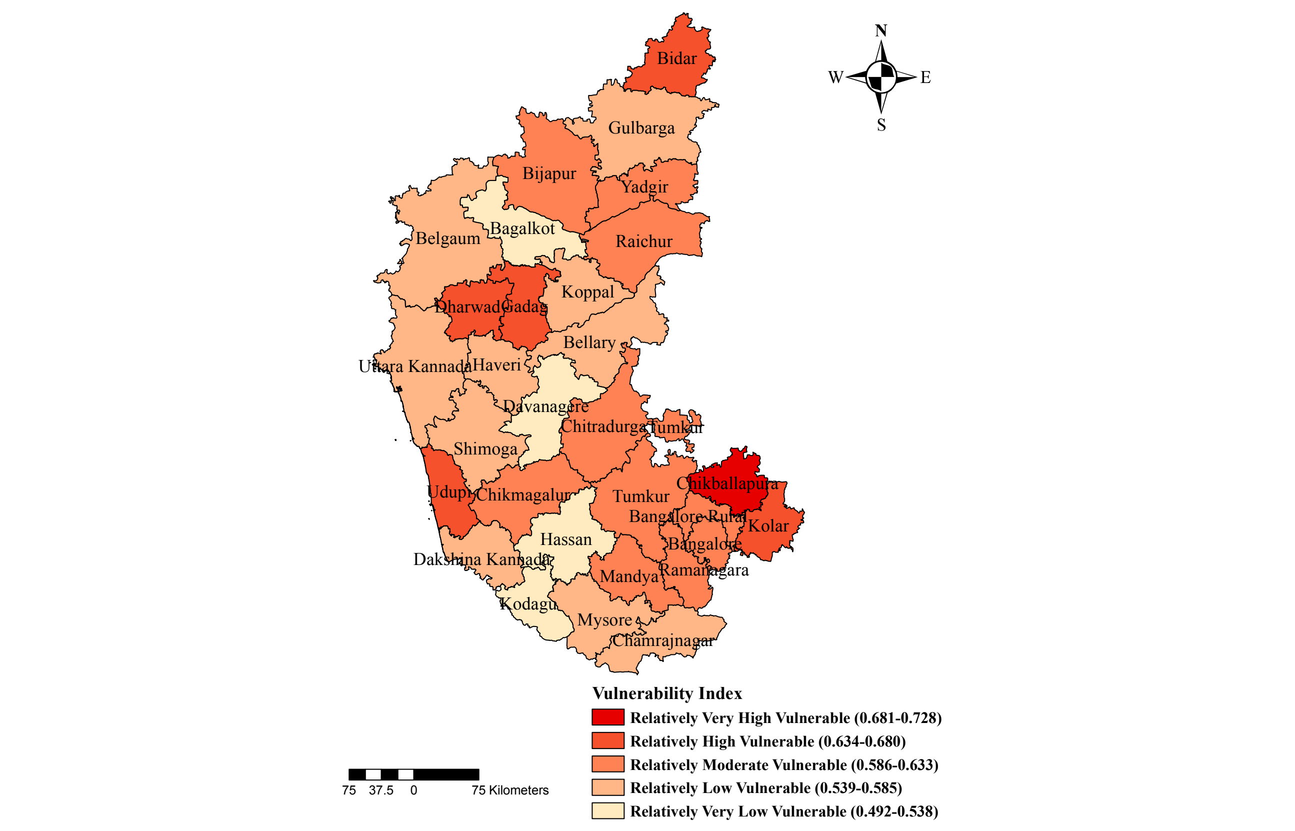

Figure 50: Map showing vulnerability categories for Karnataka at district level

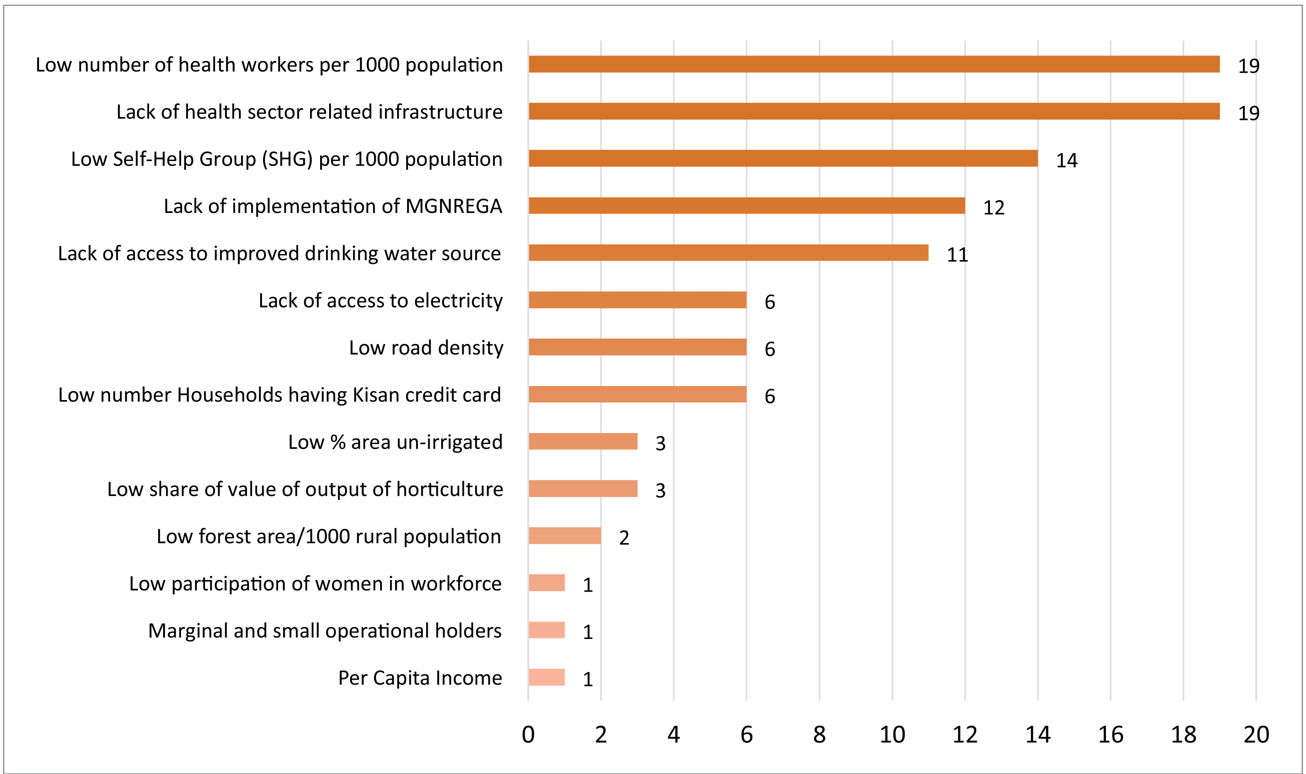

Figure 51: Drivers of vulnerability in Karnataka (the length of the bars representing the number of districts with the corresponding indicator as a driver of vulnerability)

3.12. Kerala

Kerala is located between 80° 17’ 30’’ N and 12° 47’40’’ N latitudes and 74° 27 ‘47” E and 77° 37’12” E longitudes. It lies between the Arabian Sea in the West and the Western Ghats (Sahyadris) in the East. It covers an area of 38,863 km^2 with a population of 33,387,677 and has 14 districts.

The climate of Kerala is equable and varies little from season to season. Throughout the year, daily temperatures range from about 20°C up to around 30°C. The state is directly exposed to the southwest monsoon, which prevails from July through September, but it also receives rain from the reverse (northeast) monsoon, which blows in October and November. Statewide precipitation averages about 3,000 mm annually, with some slopes receiving more than 5,000 mm. The state was hit by Cyclone Ockhi in 2017 and by severe floods resulting from unusually heavy rains in 2018 and again in 2019.

The state has 14 districts, and the present vulnerability assessment was conducted based on 18 indicators. The list of indicators along with their functional relationships with vulnerability is presented in Table 19. Two indicators, livestock to human ratio and proportion of income derived from natural resources, were initially considered, but finally dropped from the analysis due to their high correlation with other indicators. Equal weights were assigned to each indicator to calculate the VIs.

The highest value of vulnerability was obtained for Malappuram District (0.701) and the lowest for Ernakulam (0.488). The range of VIs was then divided into three categories: relatively high (~0.63-0.70), relatively moderate (~0.56-0.63), and relatively low vulnerability (~0.49-0.56). Two districts fall under the first category (Malappuram and Kollam), and 4 under the second; 8 districts are in the third category. Mostly, the high and moderately vulnerable districts are located in the southern or northern part of the state. District-level VIs and the related maps are presented in Figure 52- Figure 53

Major drivers of vulnerability are presented in Figure 54. Five indicators emerged as the main drivers of vulnerability: lack of crop insurance, high rate of marginal landholdings, relatively low forest cover per 1000 population, lack of irrigation, lack of doctors per 1000 population.

Table 19: **Indicators used for district-level vulnerability assessment for Kerala**

Indicator	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Percentage of BPL households	Sensitivity	Positive
Percentage of marginal land- holdings	Sensitivity	Positive
Women’s participation in the work force	Adaptive Capacity	Negative
Proportion of income generated from tertiary sector	Adaptive Capacity	Negative
Forest area per 1000 population	Adaptive Capacity	Negative
Proportion of value of horticulture to total value of agriculture	Adaptive Capacity	Negative
Proportion of net irrigated area	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive
Groundwater availability	Adaptive Capacity	Negative
Percentage of population in multi-hazard areas	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Rural bank per 1000 rural population	Adaptive Capacity	Negative
Average person days per household employed under MGNERGA	Adaptive Capacity	Negative
Percentage of area under crop insurance	Adaptive Capacity	Negative
Vector-borne diseases per 1000 population	Sensitivity	Positive
Waterborne diseases per 1000 Population	Sensitivity	Positive
Doctors per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive

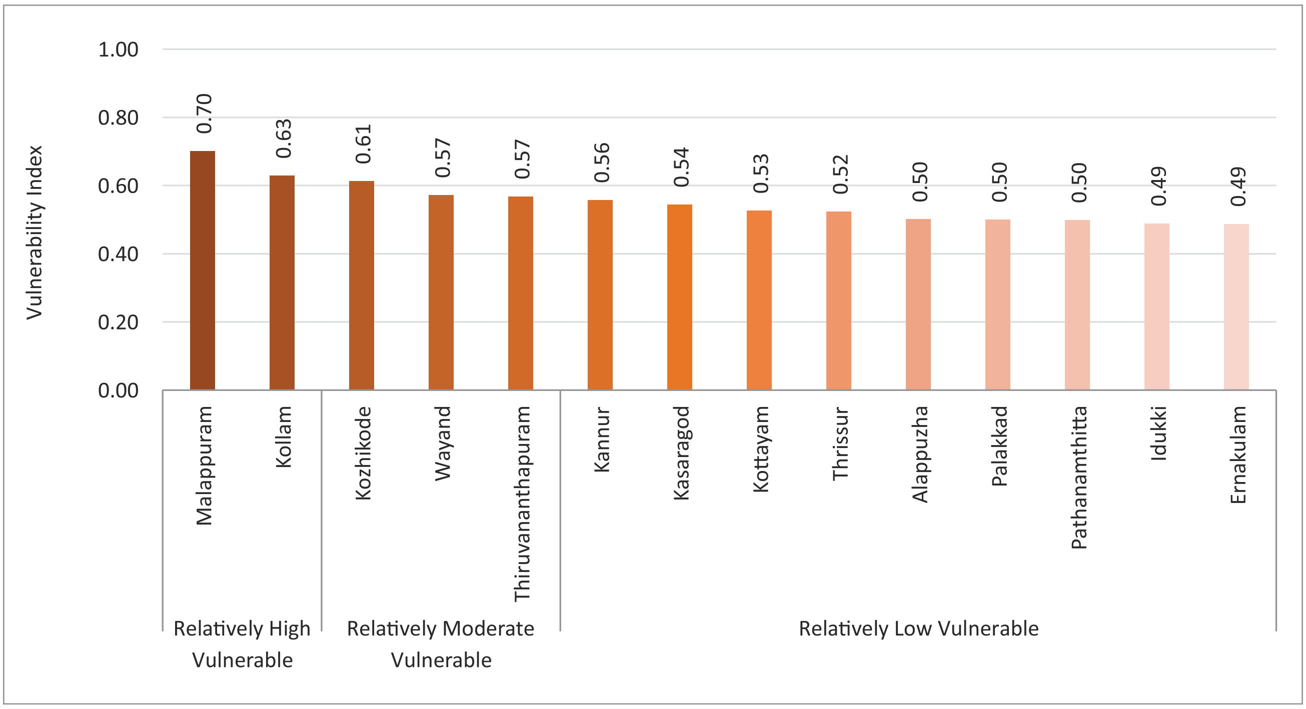

Figure 52: Vulnerability Indices (VIs) and ranking of districts in Kerala

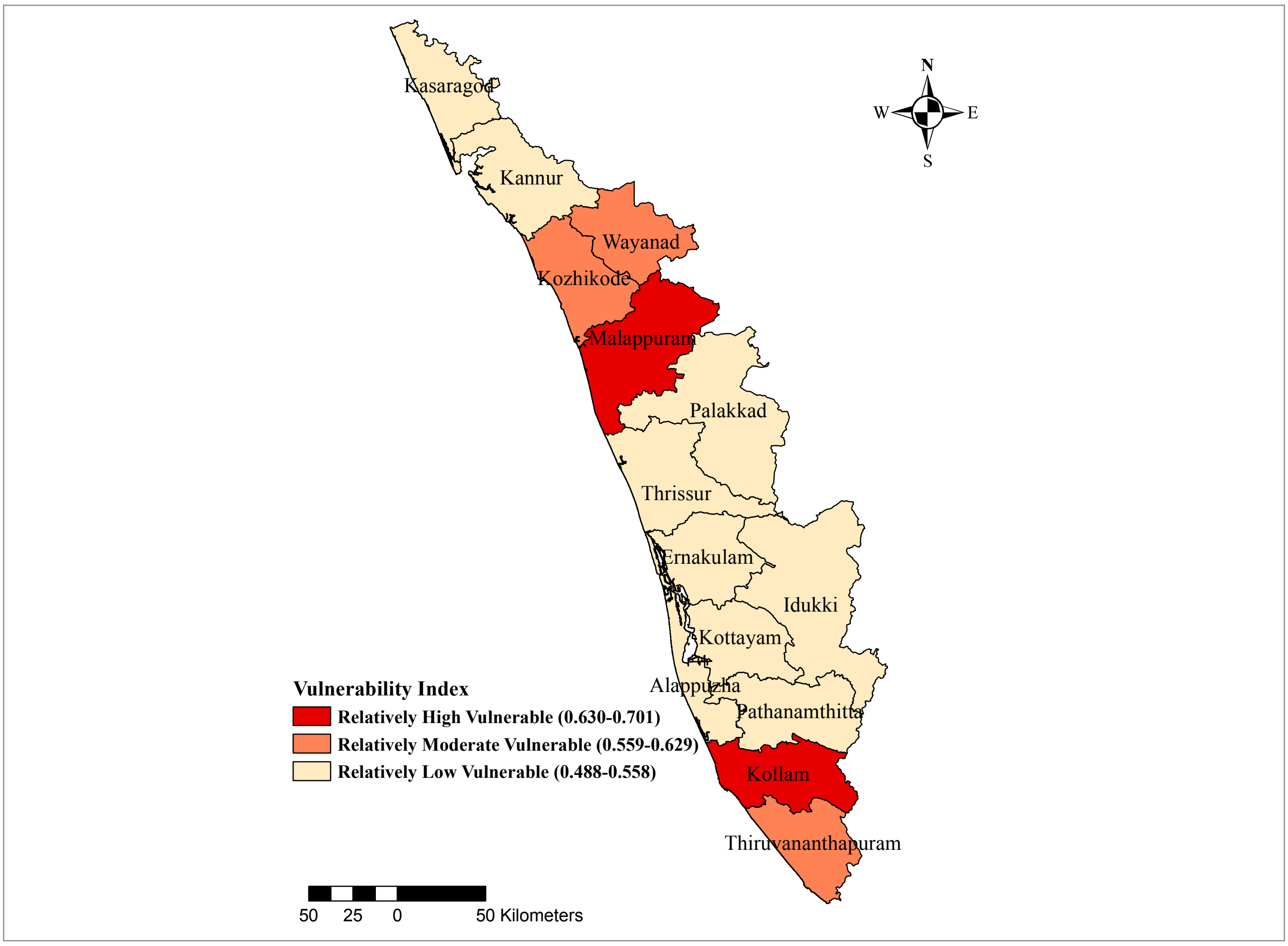

Figure 53: Map showing vulnerability categories of Kerala at district level

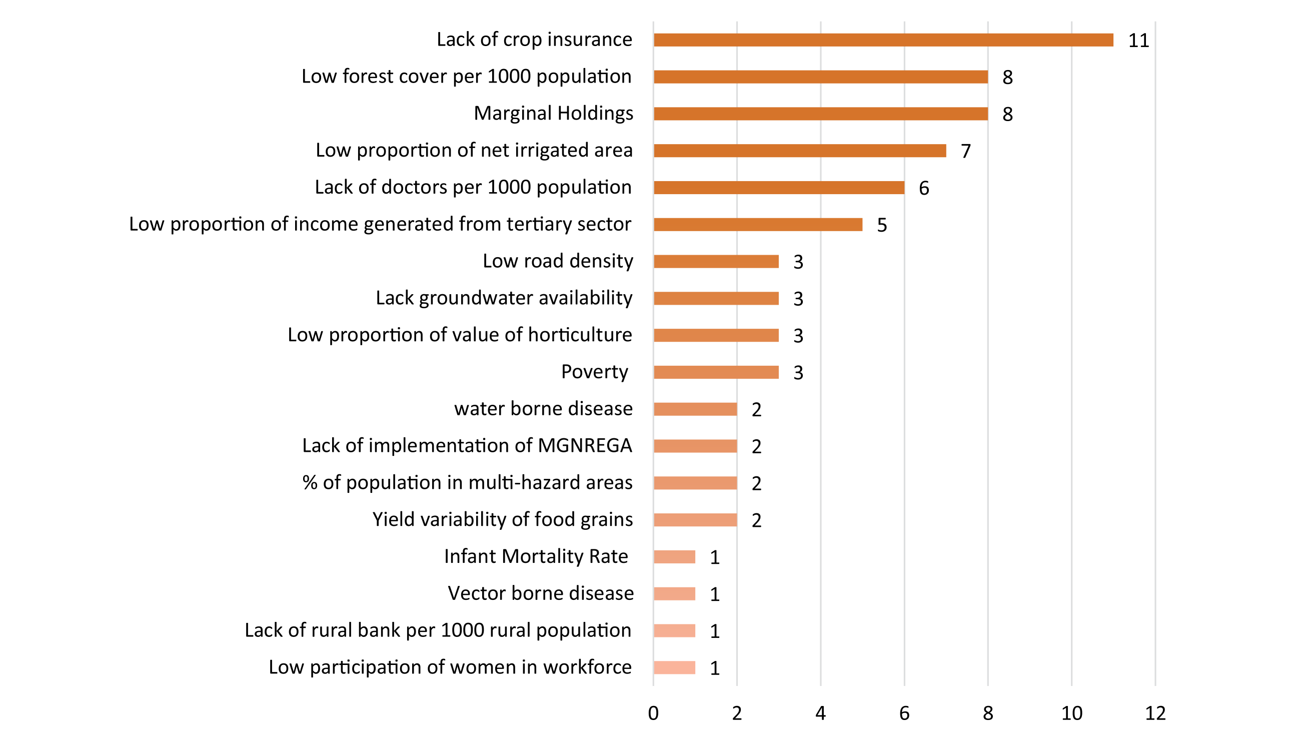

Figure 54: Drivers of vulnerability in Kerala (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.13. Madhya Pradesh

Madhya Pradesh is India's second largest state, covering a total area of 3,08,252 km^2 constituting 9.38% of the total geographical area of the country. The state is in Central India at the latitude of 21.6°N-26.30°N and longitude of 74°9'E-82°48'E.

The state has a sub-tropical climate. Like most of North India it has a hot, dry summer (April to June) followed by monsoon rains (July to September), and a cool and relatively dry winter (November to January. In summer, the temperature reaches over 45°C. The average rainfall is around 1160 mm and decreases from east to west. The south-eastern districts have the heaviest rainfall -some places receive as much as 2,150 mm, while the western and north-western districts receive 1,000 mm or less.

The state has 52 districts, but the present district-level vulnerability assessment was conducted for only 50 districts because of non-availability of data with respect to the 18 selected indicators related to biophysical, socio-economic, and institution and infrastructure-related aspects. The list of indicators along with their functional relationships with vulnerability is presented in Table 20 along with the weights attached. A PCA was run to calculate weights and then the analysis was done.

The highest value of vulnerability was obtained for Satna (0.692) and the lowest for Indore (0.421). The range of the VIs was then divided into five categories, each of an equal interval: relatively very high (0.638-0.692), relatively high (0.584-0.637), relatively moderate (0.529-0.583), relatively low (0.475-0.528), and relatively very low vulnerability (0.421-0.474). Most vulnerable districts are Satna, Rewa, Singrauli, Sidhi, Panna, Mandla, Sahdol, Katni and Damoh. They are all located in the eastern part of the state that evidently shows a high concentration of vulnerable districts. District-level VIs and the related maps are presented in Figure 55- Figure 56.

Major drivers of vulnerability are presented in Figure 57. Six indicators emerged as the main drivers of vulnerability: lack of area crop insurance, lack of forest area per 1000 rural population, low road density, lack of groundwater availability, a small number of doctors per 1000 population, and lack of horticulture.

Table 20: Indicators used for district-level assessment for Madhya Pradesh

Indicators	Adaptive Capacity / Sensitivity / Exposure	Functional relationship with Vulnerability	Weights (WI)
Percentage share of area under crop insurance (National Agricultural Insurance Scheme in 2015)	Adaptive Capacity	Negative	0.06
Percentage of agricultural labourers	Sensitivity	Positive	0.06
Forest area per 1000 rural population	Adaptive Capacity	Negative	0.07
Percentage BPL households	Sensitivity	Positive	0.06
Total length of roads per 100 km^2	Adaptive Capacity	Negative	0.06
Percentage of households availing banking services	Adaptive Capacity	Negative	0.05
Insant Mortality Rate (IMR)	Sensitivity	Positive	0.06
Cases of water-borne diseases (Diarrhoea / Dysentery)	Sensitivity	Positive	0.05
Cases of vector-borne diseases per 1000 population	Sensitivity	Positive	0.05
Groundwater availability	Adaptive Capacity	Negative	0.05
Average person days / household employed under MGNREGA	Adaptive Capacity	Negative	0.06
Total number of livestock per 1000 population	Adaptive Capacity	Negative	0.07
Yield variability of food grain	Sensitivity	Positive	0.03
Women's' workforce participation	Adaptive Capacity	Negative	0.06
Percentage of net irrigated area to net sown area	Adaptive Capacity	Negative	0.06
No of doctors per 1000 population	Adaptive Capacity	Negative	0.06
Percentage of marginal & small farmers	Sensitivity	Positive	0.05
Value of total horticulture output / value of total agriculture output	Adaptive Capacity	Negative	0.04

Figure 55: Vulnerability Indices (VIs) and ranking of districts in Madhya Pradesh

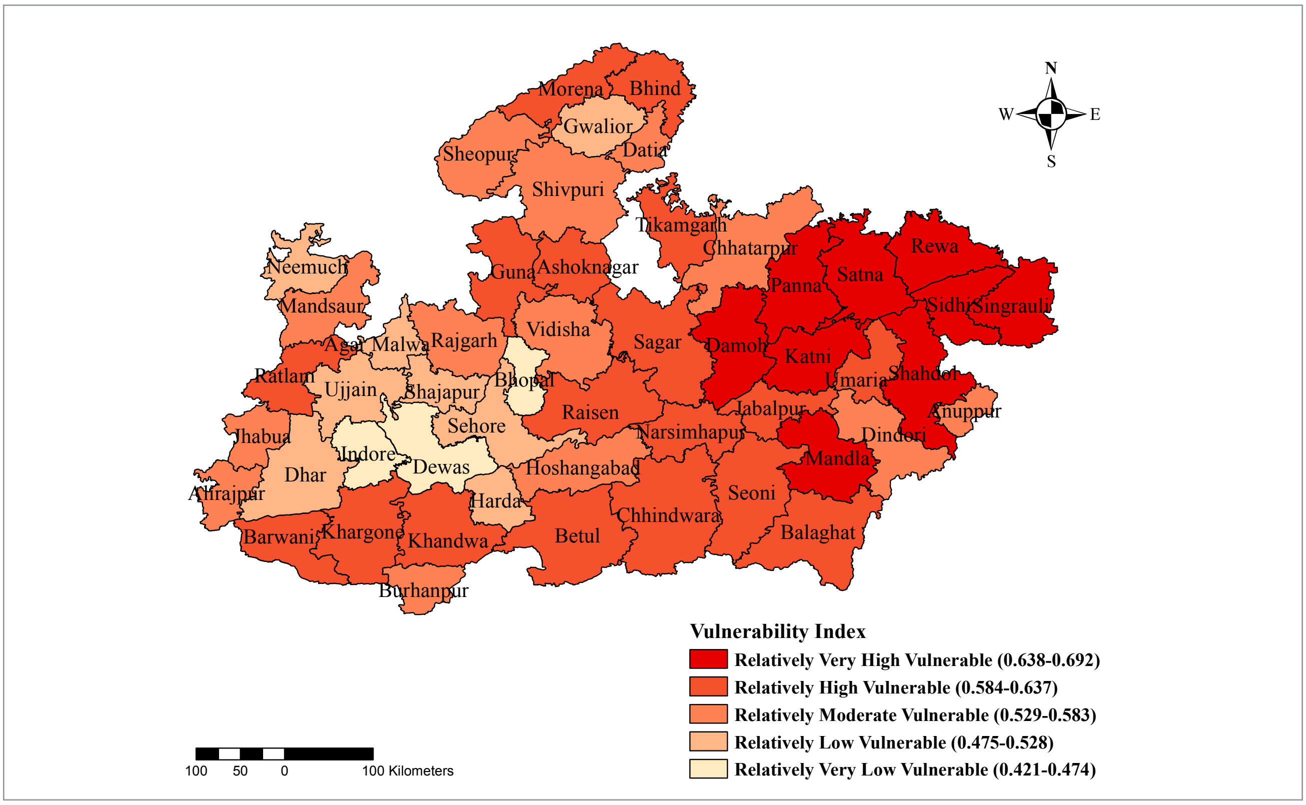

Figure 56: Map showing vulnerability Categories of Madhya Pradesh at district level

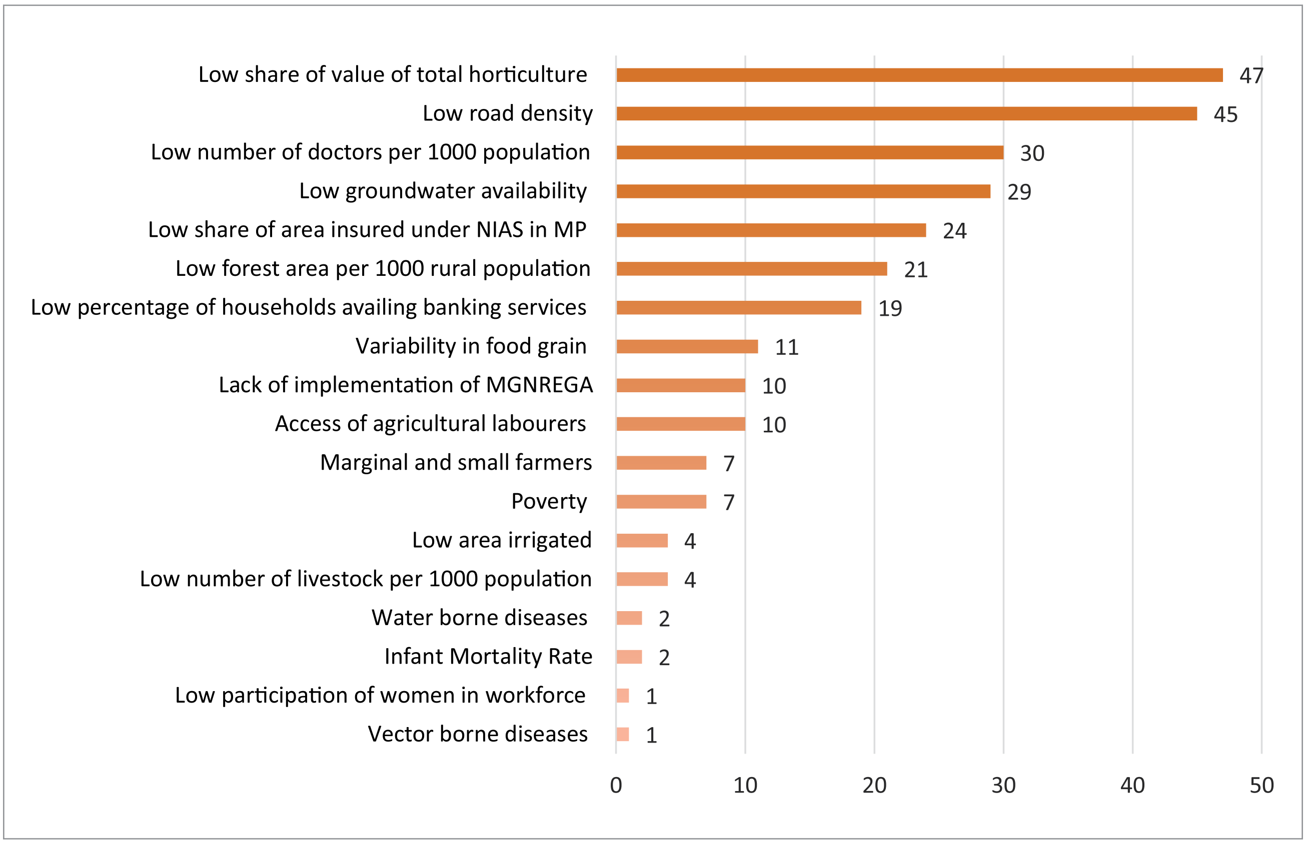

Figure 57: Drivers of Vulnerability (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.14. Maharashtra

Maharashtra is the third largest state in India by size and second largest by population. It is located in the western and central part of India at the latitude of 19°39'47.8080" N and 75°18'1.0548" E longitude. It covers 3,07,713 km^2 and has 36 districts.

Maharashtra has a tropical climate. It has three distinct seasons: summer (March-May), monsoon (June-September), and winter (October-February). Summers are extremely hot with temperatures rising from 22°C to as high as 43°C. In winter, the temperature varies from 12°C to 34°C. Rainfall varies from region to region. Districts such as Thane, Raigad, Ratnagiri, and Sindhudurg receive heavy rainfall with an average of 200 cm, whereas Nashik, Pune, Ahmednagar, Dhule, Jalgaon, Satara, Sangli, Solapur, and parts of Kolhapur receivea rainfall of less than 50 cm.

For the district-level integrated vulnerability assessment a set of 14 indicators were selected. These indicators along with their dimensions and functional relationships are given in Table 21. Mumbai was excluded for the present analysis, because it is a big city with very different characteristics from the other districts. Equal weights were assigned to all indicators to calculate the VIs.

The highest VI was found for Nandurbar District (0.695) and the lowest for Gadchiroli (0.502). Figure 58 gives the VI and corresponding ranking of the districts. It may be observed that the VI of the least vulnerable districts in the state is >0.5 and the VIs vary over a very small range. The range of VIs was divided into three equal intervals to identify relatively high vulnerability (~0.63-0.70), moderate vulnerability (~0.57-0.63), and relatively low vulnerability (~0.50-0.57) categories of districts. Nandurbar, Jalna, Dhule, Thane, Palghar, Buldhana, Washim, Yavatmal, and Hingoli were found to be in the first category. The map showing the categorisation of districts is given in Figure 59.

The major drivers contributing to vulnerability of the districts are low road density (32 districts), lack of forest area per 100 rural population (31 districts), lack of crop insurance schemes (20 districts), and a high percentage of marginal and small operational landholders. Other drivers are a high prevalence of rainfed agriculture, i.e., lack of irrigation facilities (16 districts). Figure 60 depicts the drivers of vulnerability of the state.

Table 21: List of indicators used for the assessment of district level vulnerability for Maharashtra

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Livestock to human ratio	Adaptive Capacity	Negative
% of marginal and small operational holders	Sensitivity	Positive
% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Adaptive Capacity	Negative
Proportion of rain-fed agriculture	Sensitivity	Positive
Forest area per 100 rural population	Adaptive Capacity	Negative
% Women's participation in workforce	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
IMR	Sensitivity	Positive
% HH with improved drinking water source	Adaptive Capacity	Negative
% HH using improved sanitation facility	Adaptive Capacity	Negative
% of female literacy rate	Adaptive Capacity	Negative
Coefficient of variation/ yield variability of food grains	Sensitivity	Positive

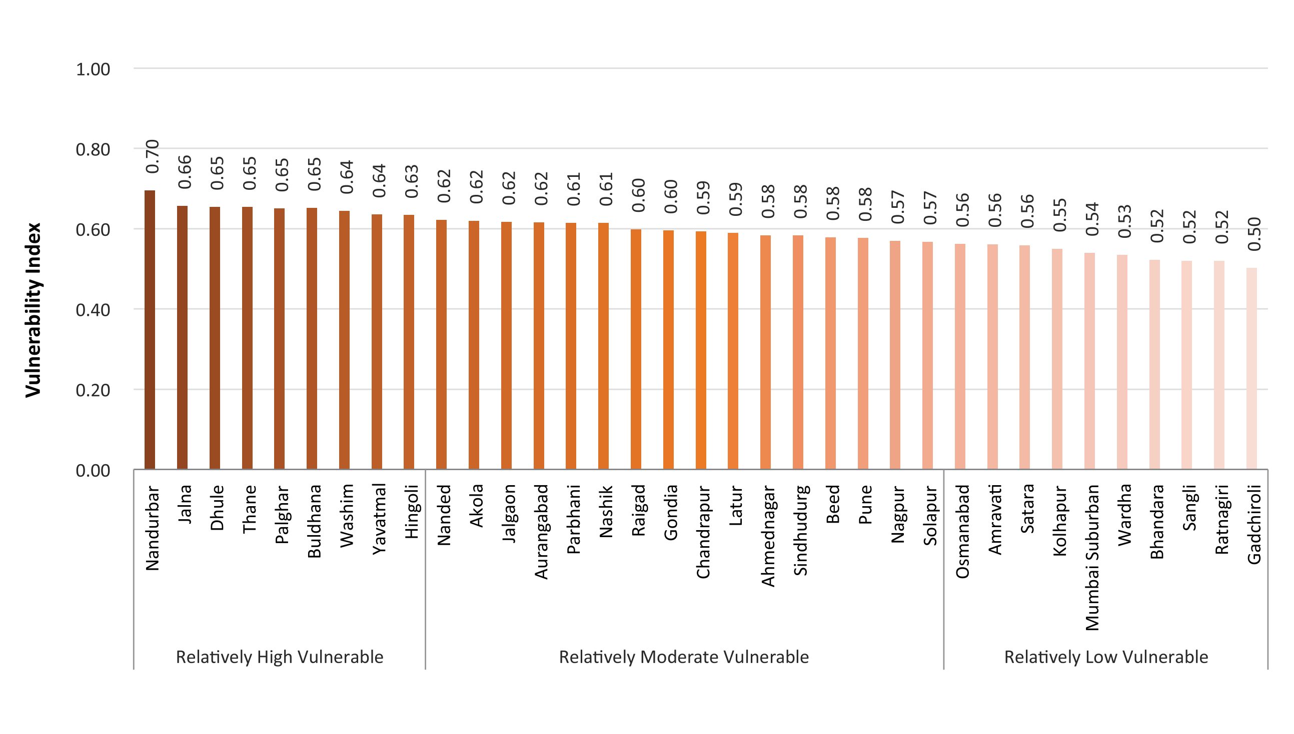

Figure 58: Vulnerability Indices (VIs) and ranking of districts of Maharashtra

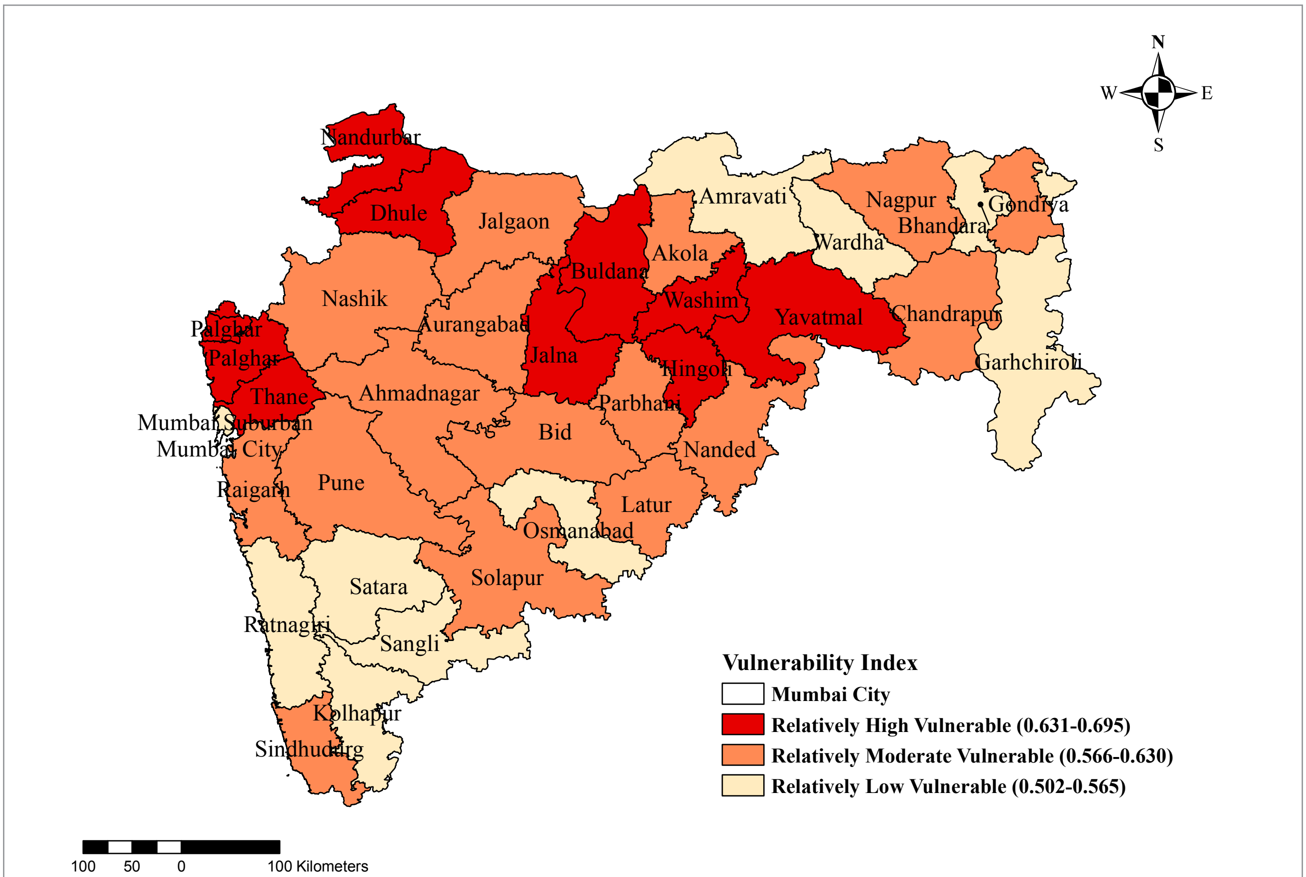

Figure 59: Map of districts of Maharashtra with respect to categories of vulnerability

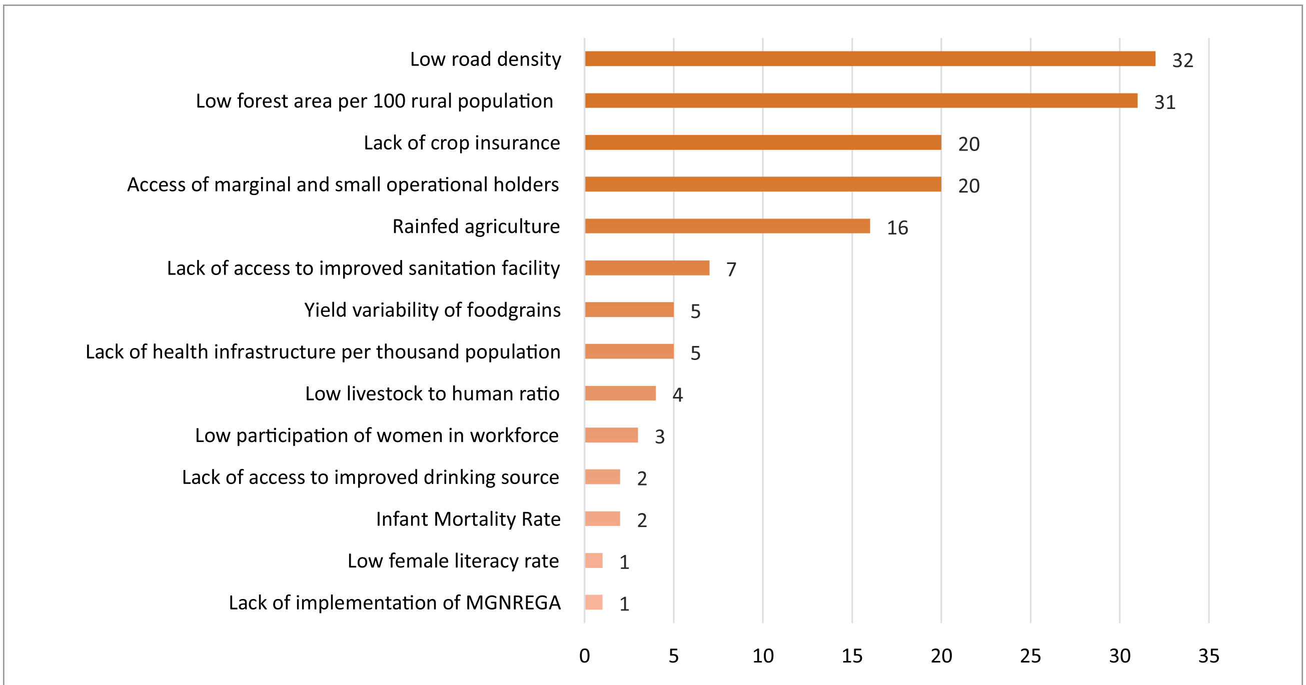

Figure 60: Drivers of vulnerability in Maharashtra (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.15. Manipur

Manipur covers an area of 22,327 km^2 which constitute 0.7% of the total geographical area of the country. It lies between the latitude of 23° 83' N and longitude of 94° 45' E. The average altitude of the valley is 760m above sea level, while the maximum altitude reaches up to 3000 m in the upper ranges. Although the valley region is only 10% of the total geographical area of the state, its population density is as high as 730 per km^2 as opposed to the population density in the hills with just 61 per km^2.

The climate of Manipur is classified as tropical. It is largely influenced by the topography of this hilly region. The state experiences a warm climate with an average temperature of 32°C and annual rainfall of about 1500 mm. Like elsewhere, its climate is slowly getting warmer and moving above the comfort level of the people. Also, rainfall has become very erratic.

The area of the state is divided into 16 districts, of which 7 districts were newly created. As a result, data was mainly available for the previous 9 districts only. Consequently, the present district-level vulnerability assessment was conducted in these 9 districts only, based on 7 indicators related to agriculture. The list of indicators used in the present assessment along with their functional relationships with vulnerability is presented in Table 22. Equal weights were assigned to all indicators.

District-level VIs and the related maps are presented in Figure 61- Figure 62. The highest value of vulnerability was obtained for Uphurl District (0.74) and the lowest for Bishnupur (0.37).

The range of the VIs was then divided into three categories: relatively high vulnerability (>0.62), relatively moderate vulnerability (~0.50-0.62), and relatively low vulnerability (0.37-0.50). Three districts (Ukhrul, Churachandpur, Tamenglong) fall under the first category, 4 under the second, and the remaining 2 under the last category.

Major drivers of vulnerability are presented in Figure 63.Three indicators were found to be the main drivers of vulnerability: lack of area covered under crop insurance, lack of implementation of MGNREGA, and high prevalence of landless, marginal and small farmers (land <5 acre). Ensuring crops can be a safety net, which essentially will help farmers to cope with crop failure due to climate hazards. While smaller land holdings are unavoidable features of hilly areas, crop insurance and better implementation of MGNREGA would definitely be important safely nets from the state.

Table 22: Indicators used for district-level agricultural vulnerability assessment for Manipur

Indicators	Adaptive Capacity/ Sensitivity	Functional relationship with Vulnerability
Percentage crop area covered under crop insurance	Adaptive capacity	Negative
Total number of livestock per 1000 rural households	Adaptive capacity	Negative
Average person days employment provided per household (MGNREGA)	Adaptive Capacity	Negative
Percentage net area under agriculture to total geographical area	Sensitivity	Positive
Percentage of landless, marginal and small farmers (landholding <5 acre)	Sensitivity	Positive
Percentage of net rain-fed area to net sown area	Sensitivity	Positive
Yield variability in food grain	Sensitivity	Positive

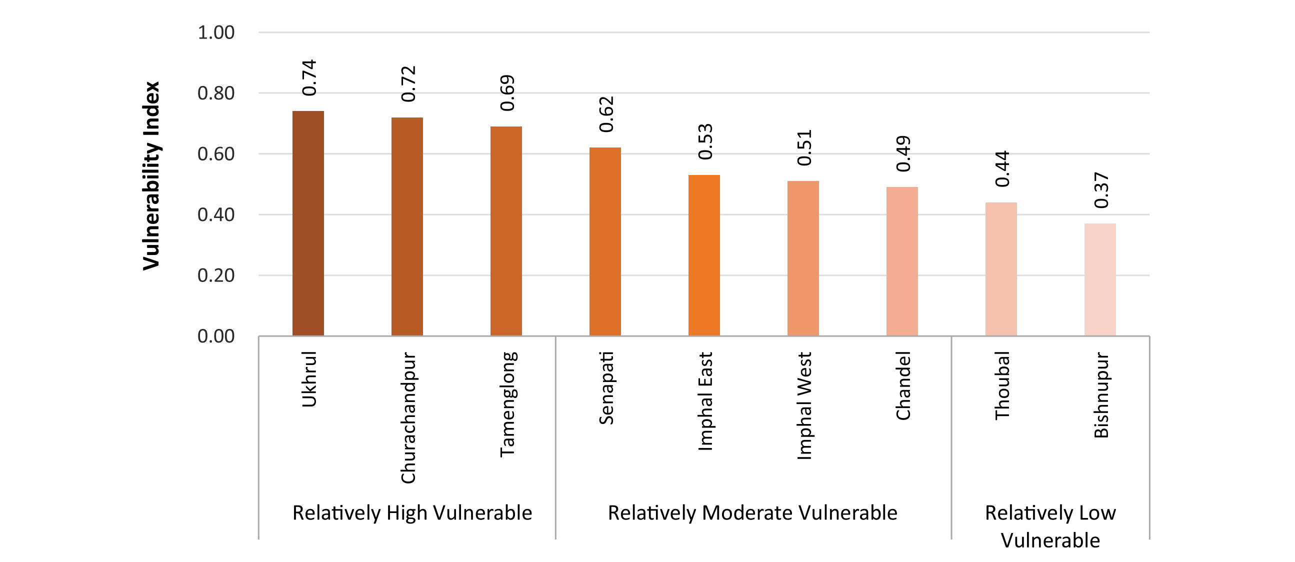

Figure 61: Vulnerability indices (VIs) and ranking of districts in Manipur with respect to agricultural sector

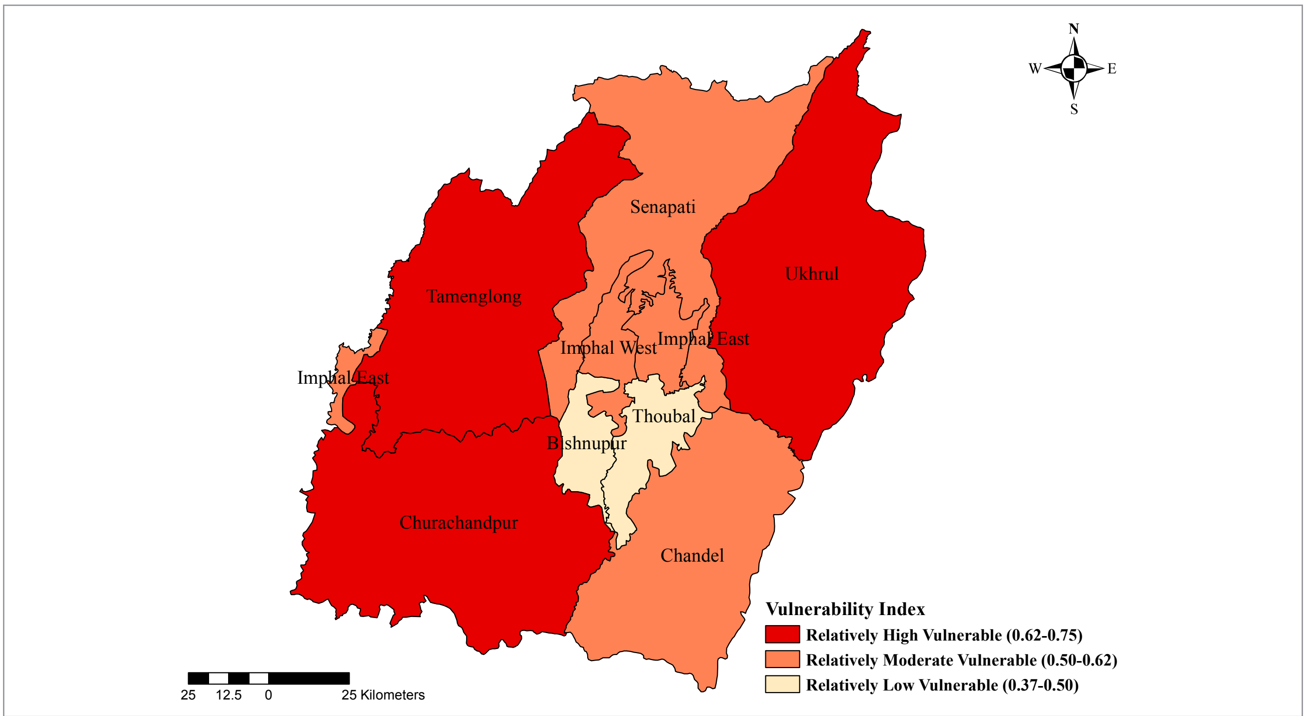

Figure 62: Map showing district-level agricultural vulnerability category in Manipur

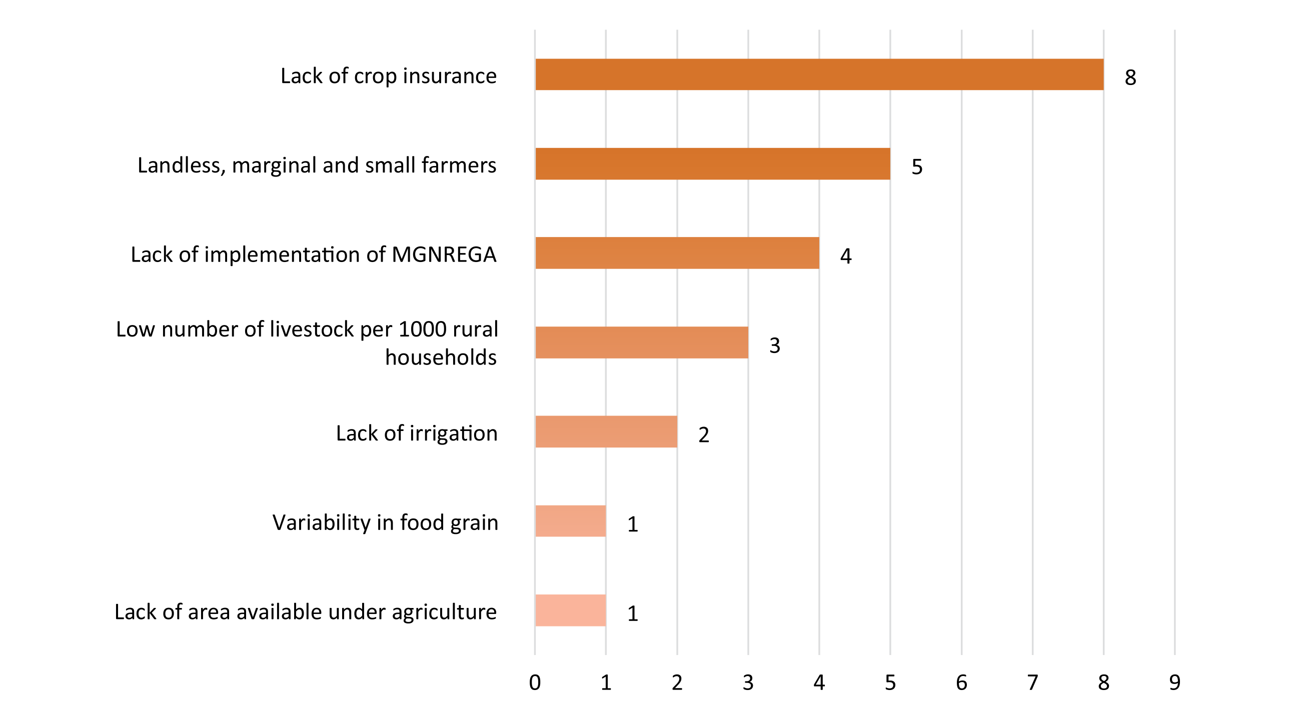

Figure 63: Drivers of agricultural vulnerability in Manipur (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.16. Meghalaya

Meghalaya is located in the north-eastern part in India and is a part of the Indian Himalayan Region, spreading over an area of 22,429 km^2. It is divided into 11 districts covering 46 Blocks. Its main economy is agrarian: 80% of the population depends directly and indirectly on agriculture. This sector contributes 22% to the GSDP. Employment and income generation also depend to a great extent on agriculture. Since the area is prone to floods and soil erosion, the agriculture sector is particularly vulnerable.

The state is influenced by the south-west monsoon and the north-east winter wind and characterised by a temperate climate. While the state receives the highest amount of rainfall in the country, the average rainfall varies from 4000 mm to 11,436 mm with the maximum rainfall occurring over the southern slopes of the Khasi Hills. Temperatures range between 2°C to 35°C, depending on the location.

The present report includes two types of assessments for the state: a block-level assessment of integrated vulnerability and a district-level assessment of agricultural vulnerability.

3.16.1. Block - level integrated vulnerability assessment

For the block-level integrated vulnerability assessment, the indicators mentioned in Table 23 were used. The weights were assigned based on a PCA, also mentioned in Table 23.

The block-level vulnerability shows that the range of VI is 0.44 (Zikzak block) to 0.65 (Thadlaskein block). The range was divided into 3 categories based on 3 equal intervals: relatively high vulnerability (0.582-0.651), relatively moderate vulnerability (0.513-0.581), and relatively low vulnerability (0.444-0.512). Thalesian Block was found the most vulnerable. Other than Thadlaskein, the blocks of Ranikor, Laskein, Mawkynrew, Mawthadraishan, Mairang, Saipung, Mawryngkneng, Amlarem, Shella Bholaganj, Ronggara, Gasuapara, Dalu, Khliehriat, Jirang, Rongram, Khatarshnong Laitkroh, Kharkutta, Mawphlang, Dadenggre, Pynursla also fall in the high vulnerability category. Relatively lower vulnerability was observed in Zakzaky Block (0.44), while blocks such as Betasing and Mylliem also fall under the relatively low vulnerability category.

In the current assessment, the drivers were identified, based on the percent contribution of each indicator across all blocks to the overall VIs of all indicators averaged across all blocks. Vulnerability was found to be mainly driven by 5 indicators: lack of Anganwadi Centres per 1000 ha, lack of distribution of Kisan credit card with the credit limit of Rs.50,000 and above and household income, lack of forest area per 1000 rural population and lack of irrigation. It was noted that in all the Blocks the percentage of households with a Kisan credit card with the credit limit of Rs.50,000 was less than 2% except for Zikzak which, surprisingly, has 16%. This is an indication of the degree of vulnerability of farming households in the State. Additionally, the net irrigated area is only 14.45% of the net sown area and irrigation is almost non-existent in some blocks, significantly reducing the adaptive capacity of the agricultural sector.

Table 23: Indicators used for block-level assessment for Meghalaya and weights assigned

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability	Weights
Proportion of households with monthly income of the highest earning household member < Rs. 5000/-	Sensitivity	Positive	0.081
Livestock per 1000 rural household	Adaptive Capacity	Negative	0.075
Percentage of rural households with no land- ownership	Sensitivity	Positive	0.058
Women's participation in the workforce	Adaptive Capacity	Negative	0.061
Forest area per 1000 population	Adaptive Capacity	Negative	0.075
Value of output of horticulture /Value of output of agriculture	Adaptive Capacity	Negative	0.068
Area net irrigated/ Net sown area	Adaptive Capacity	Negative	0.054
Uield variability in food grain	Sensitivity	Positive	0.065
Drainage density	Sensitivity	Positive	0.053
Road density	Adaptive Capacity	Negative	0.071
Total rural banks per 1000 rural population	Adaptive Capacity	Negative	0.070
Average person days/household employed under MGNREGA	Adaptive Capacity	Negative	0.074
NRM works per 1000 ha	Adaptive Capacity	Negative	0.058
Households having Kisan credit card with credit limit of Rs.50,000 (percentage)	Adaptive Capacity	Negative	0.064
Anganwadi Centres per 1000 ha	Adaptive Capacity	Negative	0.074

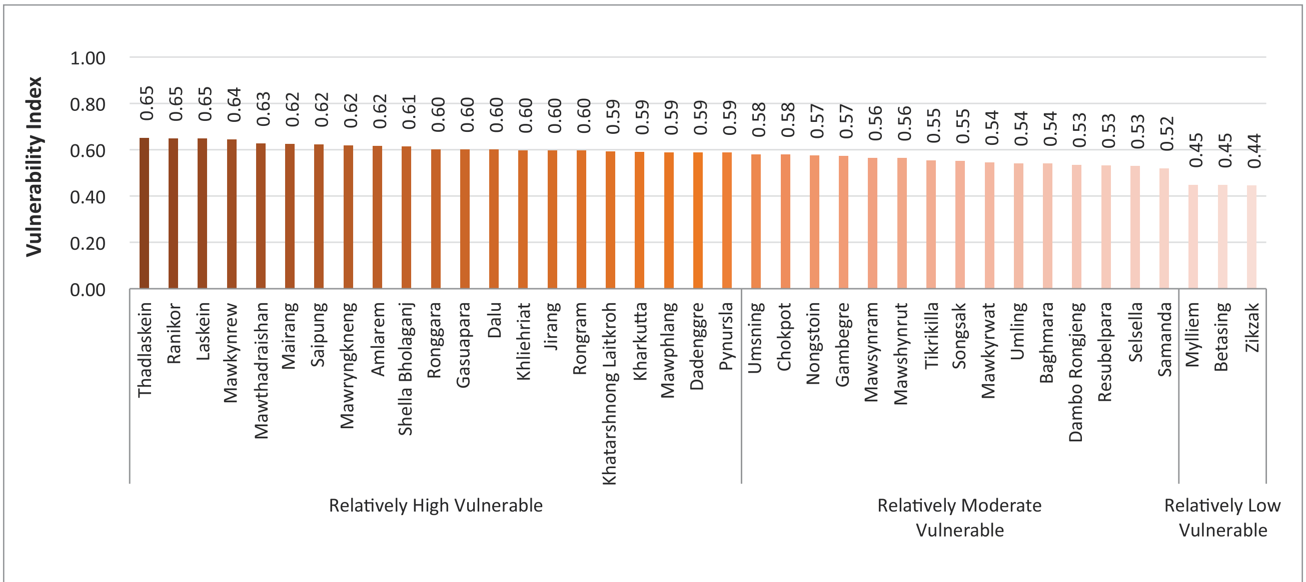

Figure 64: Vulnerability Indices (VIs) of the blocks in Meghalaya

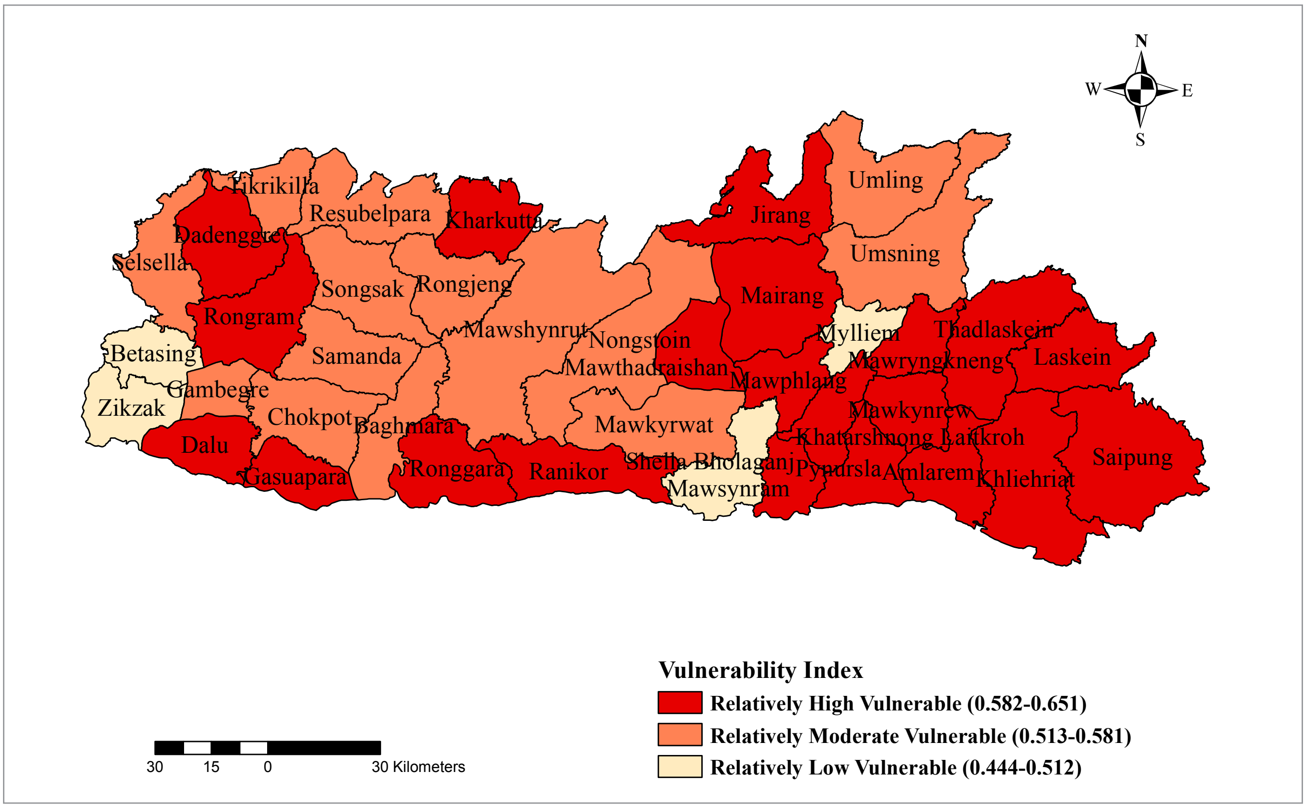

Figure 65: Map showing vulnerability categories of Meghalaya at block level

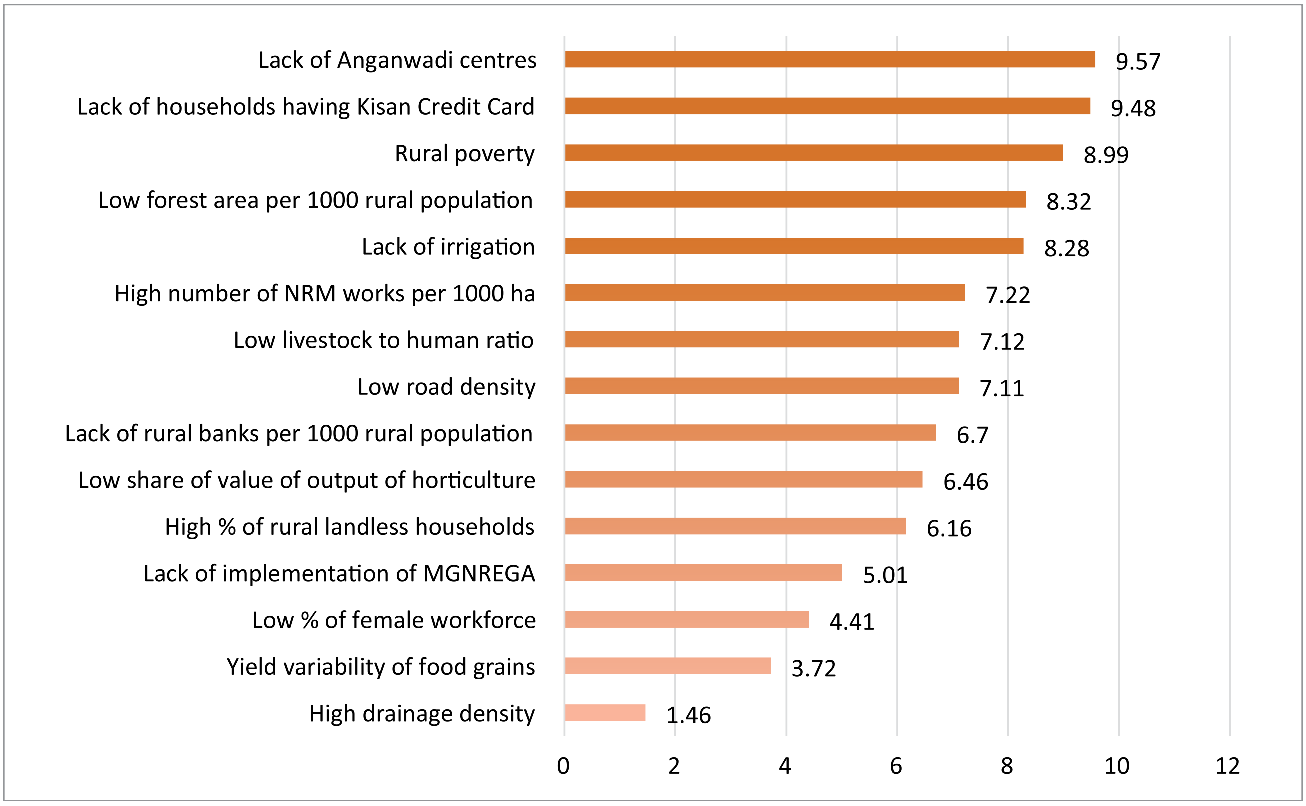

Figure 66: Drivers of vulnerability in the block-level analysis in Meghalaya (percentage contribution of each indicator to overall vulnerability)

3.16.2. District - level agricultural vulnerability assessment of Meghalaya

The indicators used for the district-level assessment of the agricultural sector in Meghalaya have been presented in Table 24 along with the weights attached. A Principal Component Analysis was run to calculate weights and then the analysis was done. District-level VIs and the related maps are presented in Figure 67 - Figure 68. The VI value for Meghalaya ranges between 0.25-0.78. Based on this value, the districts were categorised into 3 classes: relatively high (~0.60-0.78), relatively moderate (~0.42-0.60), and relatively low (~0.25-0.42) vulnerability. The East Jaintia Hills were found to be highly vulnerable with a VI value of 0.784 followed by the South-West Khasi hills (0.78) and West Khasi Hills (0.67). The South-West Garo Hills District is the least vulnerable of all (0.25), followed by the West Garo Hills (0.43). The drivers were identified (Figure 69), based on the percent contribution of each indicator across all districts to the overall VIs of all indicators averaged across all districts. Out of 14, 5 indicators were found to contribute to 50% of the state's agricultural vulnerability: low percentage of rural households with a Kisan credit card with limit of Rs.50,000 & above (12%), lack of main and local markets (11%), low road density (10%), lack of number of NRM works per 1000 ha (9%), and low livestock to human ratio (8%).

Table 24: Indicators for district-level assessment of the agricultural sector in Meghalaya

Indicators	Adaptive Capacity/ Sensitivity	Functional relationship with Vulnerability	Weights (WI)
Proportion of net irrigated area to net sown area	Adaptive Capacity	Negative	0.03
Yield variability in food grain	Sensitivity	Positive	0.06
Drainage density	Sensitivity	Positive	0.08
Percentage of rural households with no Land-ownership	Sensitivity	Positive	0.08
Percentage of agricultural area under slopes >45 degree	Sensitivity	Positive	0.08
Percentage share of total crop produced in both agricultural & horticultural crops	Adaptive Capacity	Negative	0.06
Value of output of total horticulture (only perennial) / Value of agricultural output	Adaptive Capacity	Negative	0.07
Livestock to human ratio	Adaptive Capacity	Negative	0.08
Percentage rural households having Kisan Credit Card with limit of Rs. 50,000	Adaptive Capacity	Negative	0.08
Road density	Adaptive Capacity	Negative	0.09
No. of main & local markets per geographical area	Adaptive Capacity	Negative	0.08
Diversity index of main income source for rural households	Adaptive Capacity	Negative	0.06
Average person days employed under MGNREGA	Adaptive Capacity	Negative	0.06
No. of NRM works/ 1000 ha (under MGNREGA)	Adaptive Capacity	Negative	0.08

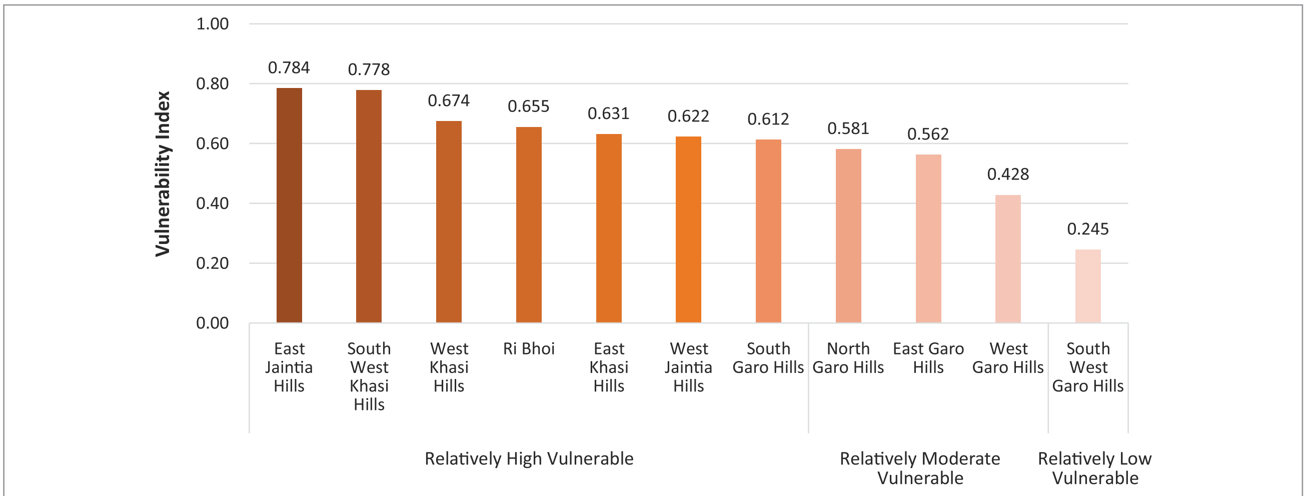

Figure 67: Agricultural vulnerability indices (VIs)and ranking of districts in Meghalaya

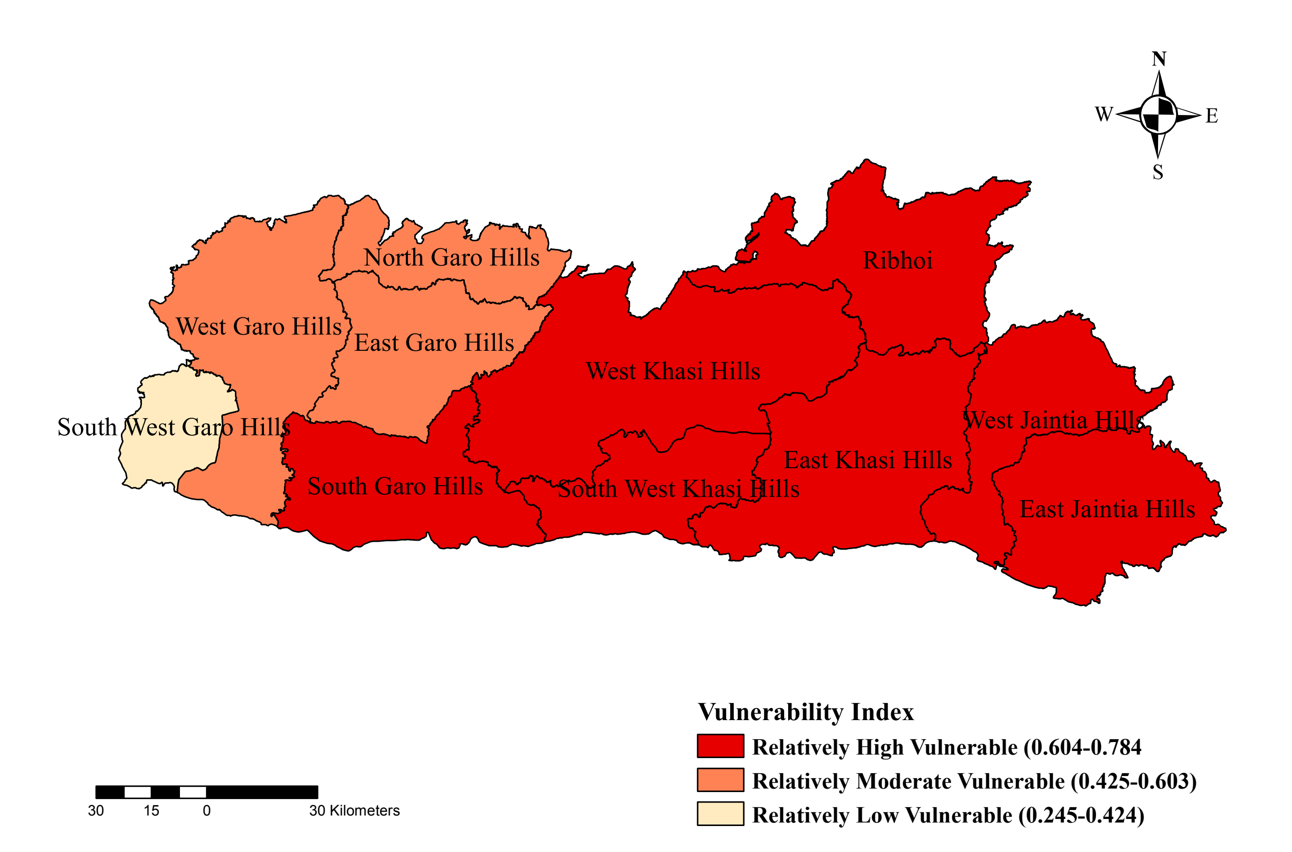

Figure 68: **Map showing agriculture vulnerability categories of Meghalaya at district level**

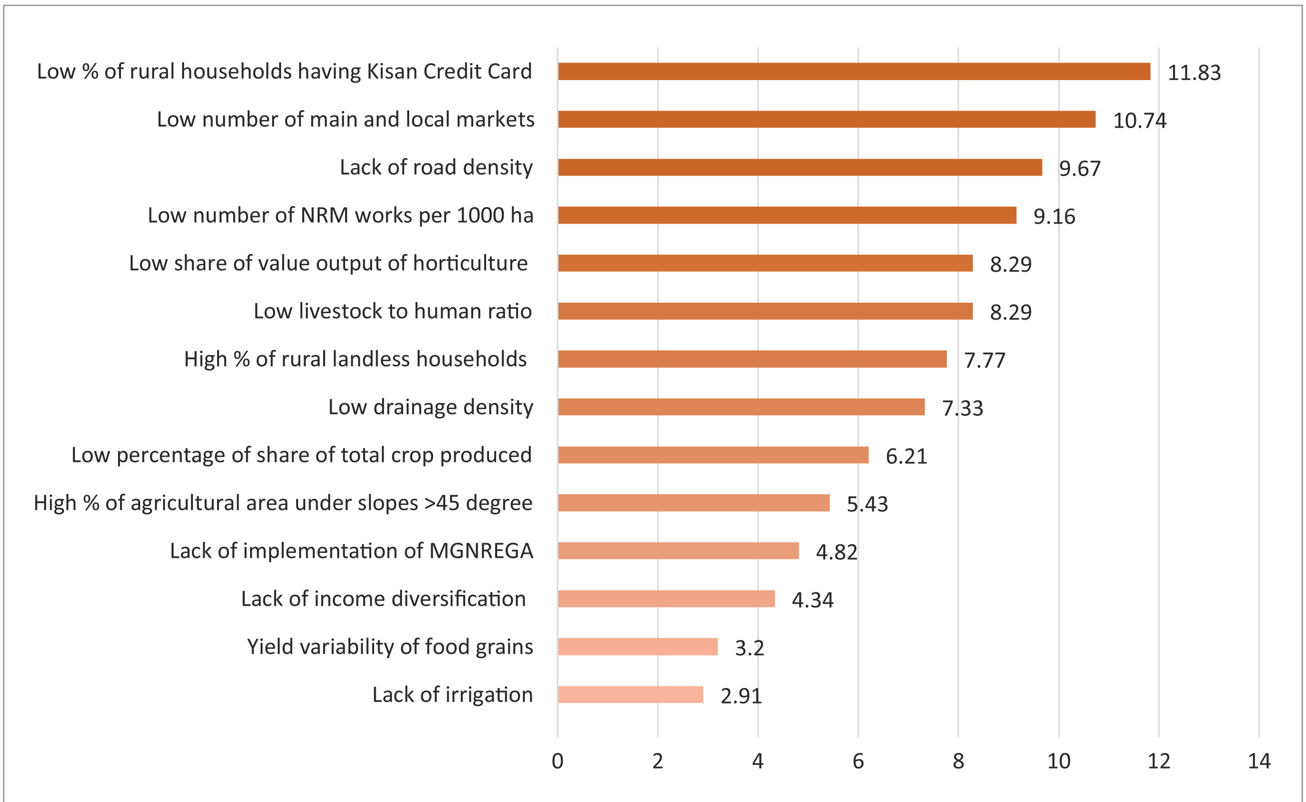

Figure 69: **Drivers of agricultural vulnerability (percentage contribution of each indicator to overall vulnerability)**

3.17. Mizoram

Mizoram is the southernmost state among the seven sisters of north-east India. It is located in the eastern Himalayan region at 21° 58′ and 24° 35′ N latitude and 92° 15′ and 93° 29′ E longitude. It falls within the Patkai Hill Range of the southern foothills of the Eastern Himalayas and has a hilly, rugged terrain with steep slopes and deep valleys. The altitude ranges from 50 m to slightly over 2000 m above sea level. The total geographical area of Mizoram is 21,087 km^2, divided into 11 administrative districts, of which 3 were newly formed.

Overall, Mizoram has a moderate climate. At the foothills and in the valleys, a typical tropical climate prevails, while in the mid-region mostly a subtropical, moist climate is found. The state receives an average rainfall of 2519.3 mm every year. Rainfall data from 1986 to 2019 show a variability ranging from 3121.9 in 2007 to 1930.3 in 2019 with a linear decreasing trend of 9.19 mm every year. The temperature is quite pleasant with an average of 11° to 21° C in winter and 20°C to 30°C in summer. Data from 1986 up to 2017 show a slightly increasing rate in the yearly average maximum (0.01°C), mean (0.04°C) and minimum (0.08°C) temperatures.

It is estimated that more than 70% of the total population is engaged in agriculture. The age-old practice of Jhum cultivation is carried out annually by many people living in rural areas. About 5% of the total area is under cultivation of which only 11.47% is under irrigation. The slope area of 0 to 15% that offers a possibility for wet rice cultivation, is a mere 74,644 ha (2.8%) in the state; the area with slope land of 10 to 33% is only 5,09,365 ha.

In this report, agricultural vulnerability assessment of the state has been presented. The state also carried out a socio-economic vulnerability assessment which has not been presented in the report. For agricultural vulnerability, 15 indicators related to agriculture were considered. The list of indicators along with their functional relationships with vulnerability is presented in Table 25. All the indicators have assigned equal weights for the analysis.

District-level VIs and the related maps are presented in Figure 70- Figure 71. The highest value of vulnerability was obtained for Lawngtlai (0.66) and the lowest for Kolasib (0.29). Then the range of the VIs was divided into three categories: relatively high vulnerability (0.53-0.66), relatively moderate vulnerability (0.41-0.53), and relatively low vulnerability (0.29-0.41). After the categorisation it was found that 6 districts fall under the first category (Lowngtlai, Siaha, Mamit, Serchhip, Lunglei, and Champhai).

Based on the percent contribution of each indicator across all districts to the aggregated VI, a lack of horticulture output to agriculture output was found to contribute the highest (9.2%). This was followed by a large area under rain-fed crop land (8.6%), a high number of farmers with limited landholdings (8.0%), and a limited area with fertile soil (7.9 %). These are the top major drivers of overall vulnerability. The rest of the percent contribution of other indicators can be seen in Figure 72.


Terrace farming, Manipur

Table 25: Indicators used for district-level agricultural vulnerability assessment for Mizoram

Indicators	Adaptive Capacity/ Sensitivity	Functional relationship with Vulnerability
Percentage area under rain-fed agriculture	Sensitivity	Positive
Yield variability in food grain	Sensitivity	Positive
Water stress	Sensitivity	Positive
Drainage density	Sensitivity	Positive
Percentage of landless, marginal and small farmers (land <5 acre)	Sensitivity	Positive
Soil fertility	Adaptive Capacity	Negative
Groundwater availability	Adaptive Capacity	Negative
Crop diversification	Adaptive Capacity	Negative
Value of output of total horticulture (only perennial) / value of agricultural output	Adaptive Capacity	Negative
Total number of livestock per 1000 rural households	Adaptive Capacity	Negative
Road connectivity	Adaptive Capacity	Negative
Access to market	Adaptive Capacity	Negative
Income diversification within agriculture sector (income from agriculture, livestock, forestry, and fishing)	Adaptive Capacity	Negative
MGNREGA (person days employment generated per 100 days)	Adaptive Capacity	Negative
Number of NRM works per 1000 ha (MGNREGS)	Adaptive Capacity	Negative

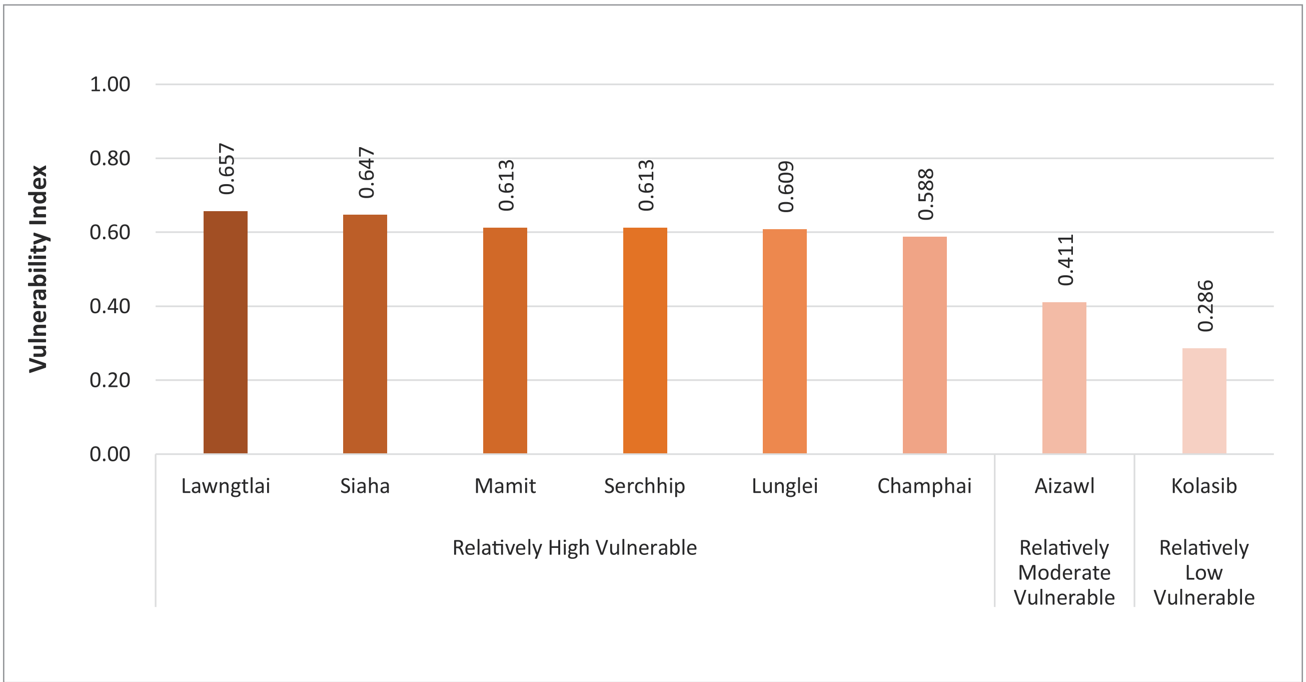

Figure 70: Vulnerability Indices (VIs) in the agricultural sector and ranking of districts in Mizoram

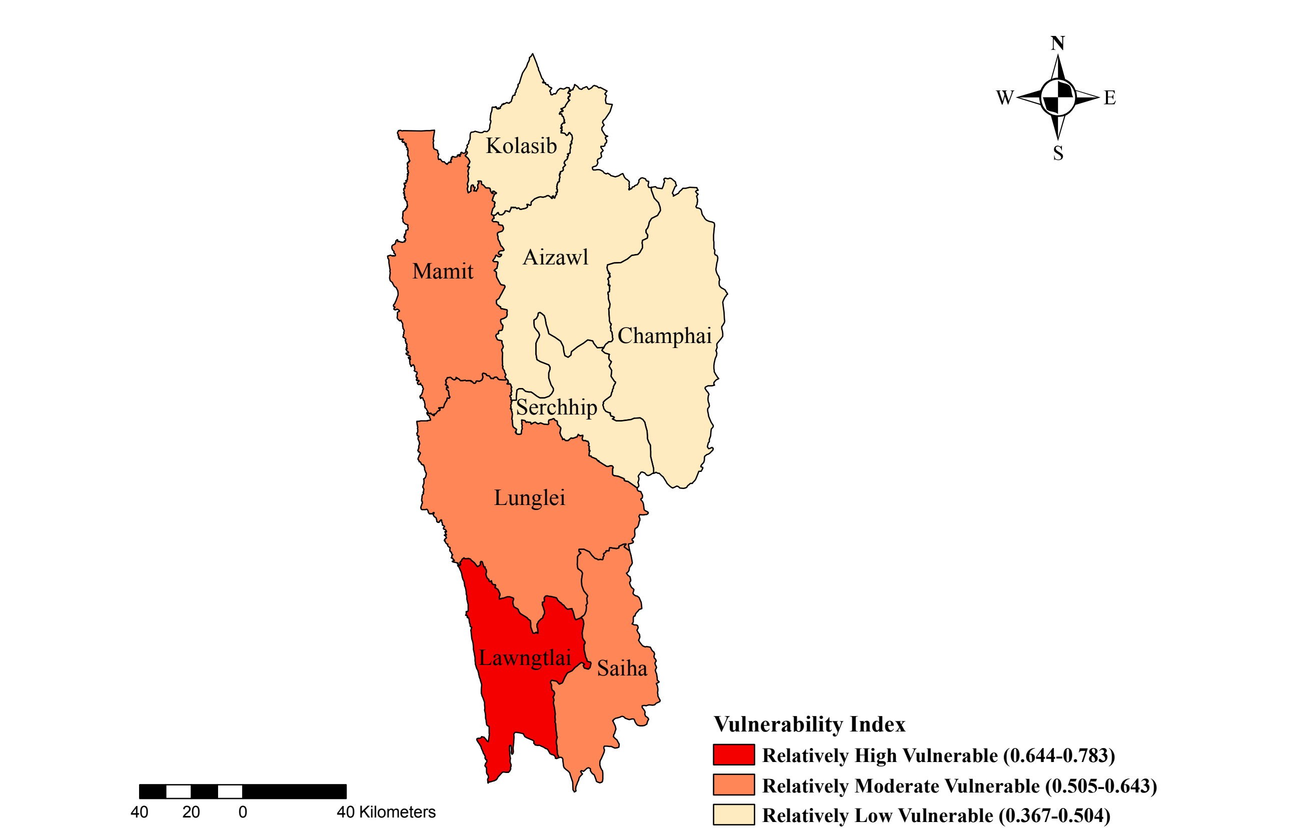

Figure 71: **Map showing agricultural vulnerability categories of Mizoram at district level**

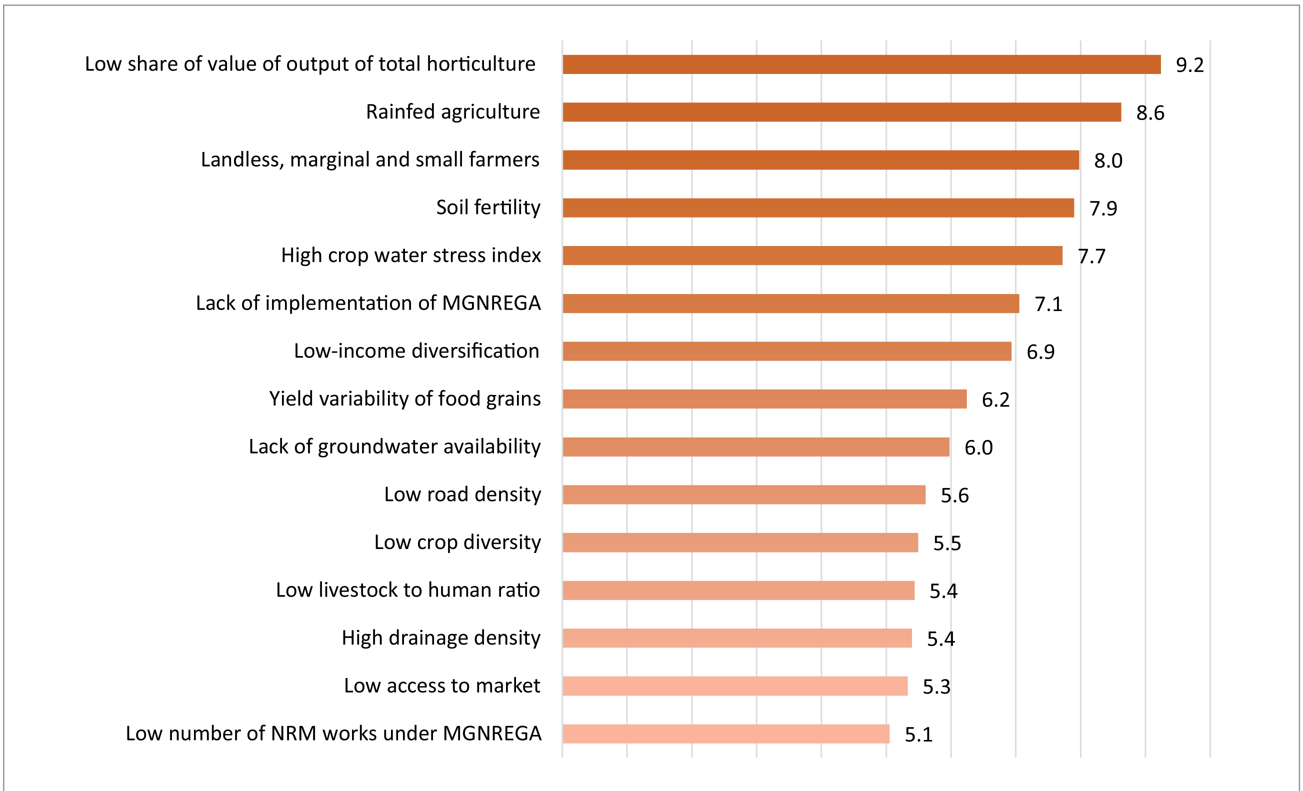

Figure 72: **Drivers of agricultural vulnerability (percentage contribution of each indicator to overall vulnerability)**

3.18. Nagaland

Nagaland is located between 25°10'N- 27°4'N latitude and 93°15'E- 95°20'E longitude. It is one of the smaller states of India covering a total geographical area of 16,579 km^2, which accounts for a measly 0.5 percent of the total geographical area of the country and consists of 11 districts. Nagaland is almost entirely hilly, except along the foothills bordering the Assam plains.

The climate of Nagaland is humid and tropical. Minor variations are caused by differences in physiography. Dimapur district, which is a plain area, has a warm and subtropical climate. The heavy monsoon rain normally occurs from May to August with occasional dry spells from September to October. Owing to the varied topography and relief the annual rainfall varies from 1000 mm to over 3000 mm at different places with an average of 2000 mm. During winter, frost is common at high elevations, although the temperature generally does not drop below 4°C. The summer temperature stands between 16°C to 31°C.

The present district-level vulnerability assessment is conducted for all 11 districts based on 11 indicators related to agriculture. The list of indicators along with their functional relationships with vulnerability is presented in Table 26. Equal weights were assigned to all indicators.

District-level VIs and the related maps are presented in Figure 73-Figure 74. The highest value of vulnerability was obtained for Kohima District (0.737) and the lowest for Dimapur (0.36). In fact, the VIs of Kohima and Dimapur are quite high and low, respectively, compared to the rest of the districts in Nagaland. Dividing the rage of VIs (~0.36 – 0.74) into 3 equal intervals, the following categories are obtained: districts with relatively high vulnerability (0.611-0.737), that with moderate vulnerability (0.486-0.611), and relatively low vulnerability (0.126-0.486). Kohima is the only district falling in the first category and Dimapur the only one in the last category. The rest of the districts fall under the category of moderately vulnerable.

In the current assessment, the drivers were identified based on the percent contribution of each indicator across all districts to the aggregated VIs value. Most indicators appeared to contribute almost evenly as the drivers of agriculture vulnerability. The major drivers of vulnerability are presented in Figure 75. The 4 indicators that contributed most to drivers of agriculture vulnerability in Nagaland are high drainage density that intensifies vulnerability to soil erosion and affects soil fertility in the area, lack of irrigation, a smaller number of NRM works per 1000 ha and low crop diversification.

Table 26: **Indicators used for district-level agriculture vulnerability assessment for Nagaland**

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Percentage of net irrigated area to net sown area	Adaptive capacity	Negative
Yield variability in food grain	Sensitivity	Positive
Water scarcity	Sensitivity	Positive
Drainage density	Sensitivity	Positive
Percentage rural household with no land	Sensitivity	Positive
Crop diversification	Adaptive Capacity	Negative
Total number of livestock per 1000 rural households	Adaptive capacity	Negative
Percentage of villages connected by surfaced roads	Adaptive capacity	Negative
Access to market	Adaptive capacity	Negative
Average person days employed under MGNREGA	Adaptive capacity	Negative
Number of NRM works per 1,000 ha (MGNREGA and/or other schemes)	Adaptive Capacity	Negative

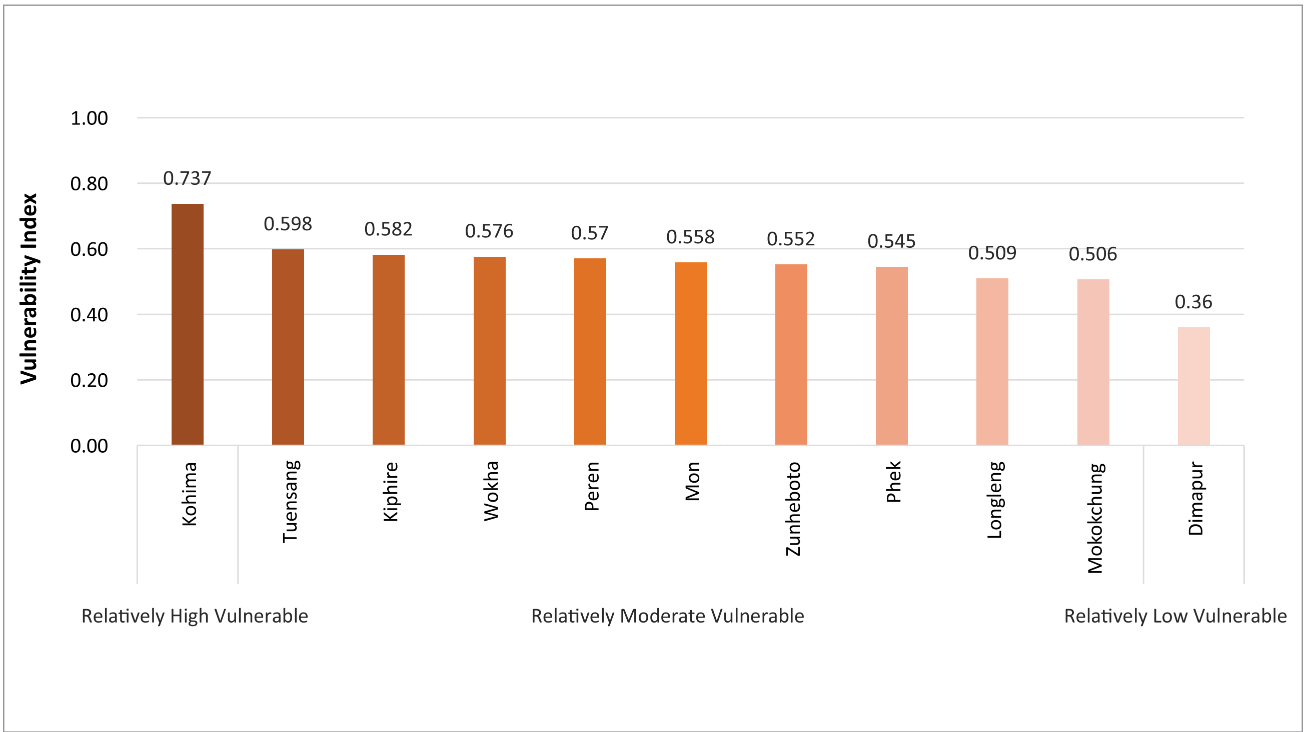

Figure 73: Vulnerability Indices (VIs) in agriculture and ranking of districts in Nagaland

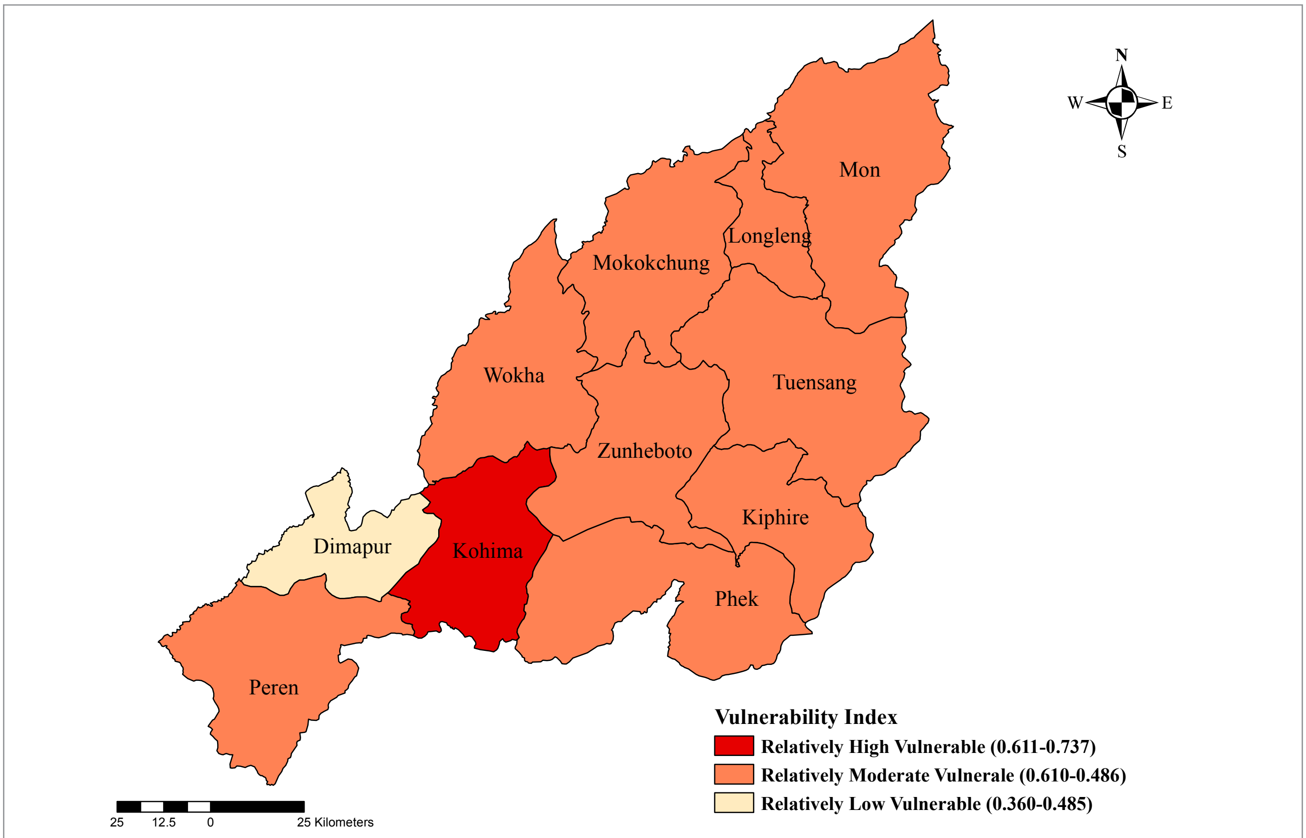

Figure 74: Map showing agricultural vulnerability categories of Nagaland at district level

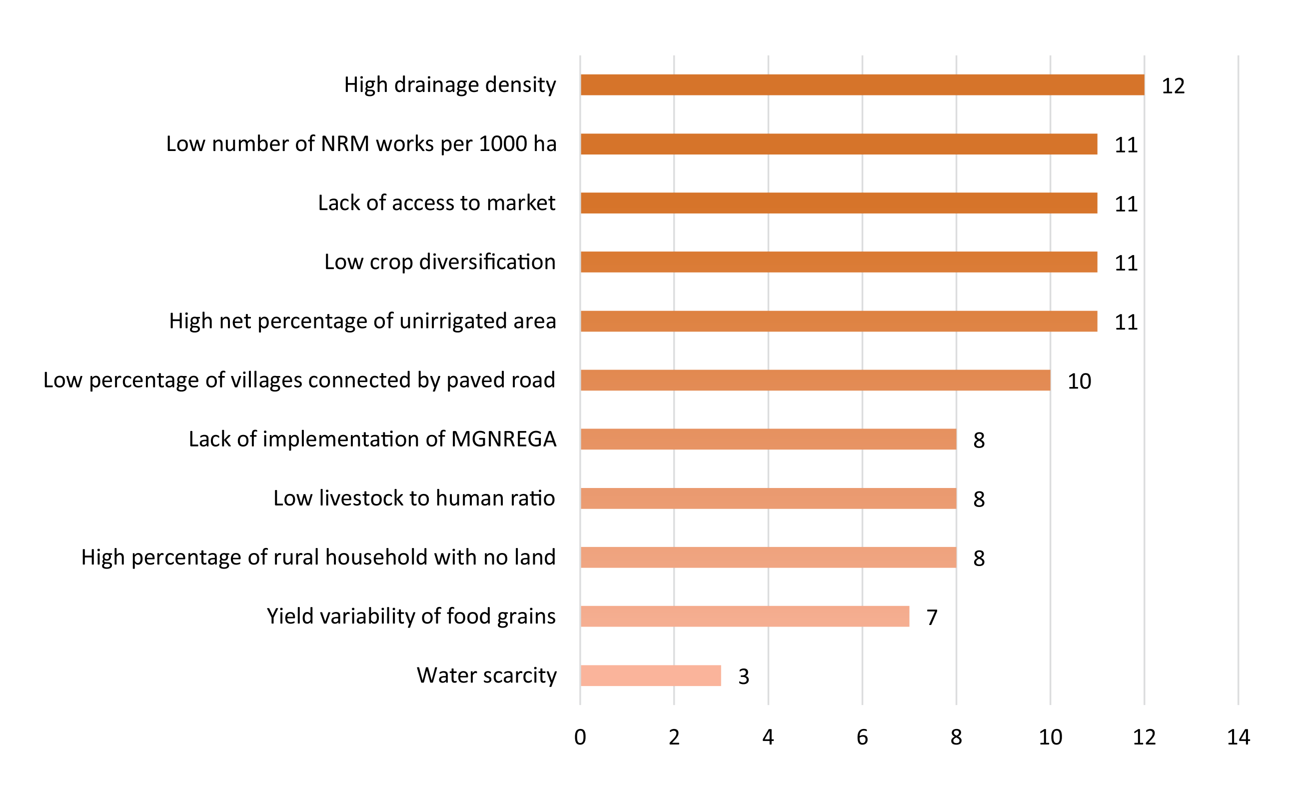

Figure 75: Drivers of agriculture vulnerability in Nagaland (percentage contribution of each indicator to overall vulnerability)

3.19. Orissa

Orissa is situated at the latitude of 17° 31'N to 22° 31' N and longitude of 81° 31' E to 87° 29' E. The state is spread over an area of 155,707 km^2 and extends for 1030 km from north to south and 500 km from east to west. It is divided into 30 districts which are subdivided into 314 blocks. With a 480 km coastline that is prone to climate-mediated cyclones and coastal erosion, and water resources dependent on monsoons, Orissa is relatively highly vulnerable to climate change. Based on climate type, it has been divided into ten agro-climatic zones. The normal rainfall of the state is 1451.2 mm. About 75 to 80% of rainfall is received from June to September. Floods, droughts, and cyclones occur almost every year in varying intensities.

The present district-level vulnerability assessment was conducted in all 30 districts based on 9 indicators. The list of indicators along with their functional relationships with vulnerability is presented in Table 27. Equal weights were assigned to each indicator to calculate the VIs.

District-level VIs and the related maps are presented in Figure 76- Figure 77. The highest value of vulnerability was obtained for Malkangiri District (0.73) and the lowest for Khurdha (0.39). The range of VIs was divided into three categories: relatively high (~0.62-0.73), relatively moderate (~0.50-0.62) and relatively low vulnerability (~0.39-0.48). After categorisation it was observed that 7 districts falls under the first category and 15 under the second; 8 districts are in the third and last category. Malkhangiri, Nayangarh, Gajapati, Kalahandi, Rayagada, and Koraput are the districts in the high vulnerability category.

Four out of the 9 indicators emerged as the main drivers of vulnerability Figure 78: lack of health infrastructure, lack of area under crop insurance, rainfed agriculture, and lack of forest area per 1000 rural population. Among the 4 selected drivers, health infrastructure per 100 population. It shows two of the drivers are related to agricultural sector which may be considered for adaptation interventions.

Table 27: Indicators used for district-level assessment for Orissa

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Percentage area covered under centrally funded crop insurance	Adaptive Capacity	Negative
Proportion of rainfed agriculture	Sensitivity	Positive
Forest area per 100 rural population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Sensitivity	Positive
Insant Mortality Rate (IMR)	Sensitivity	Positive
Percentage of households with improved drinking water source	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive

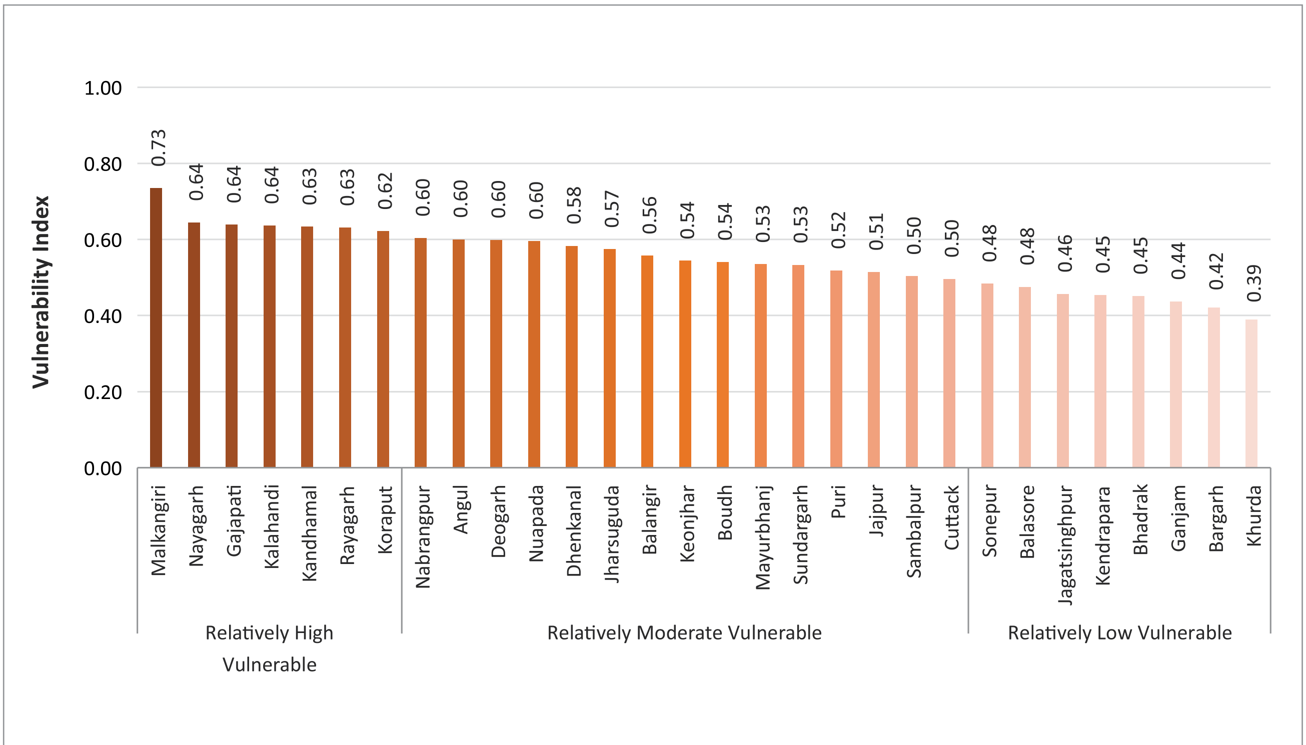

Figure 76: Vulnerability Indices (VIs) and ranking of districts in Orissa

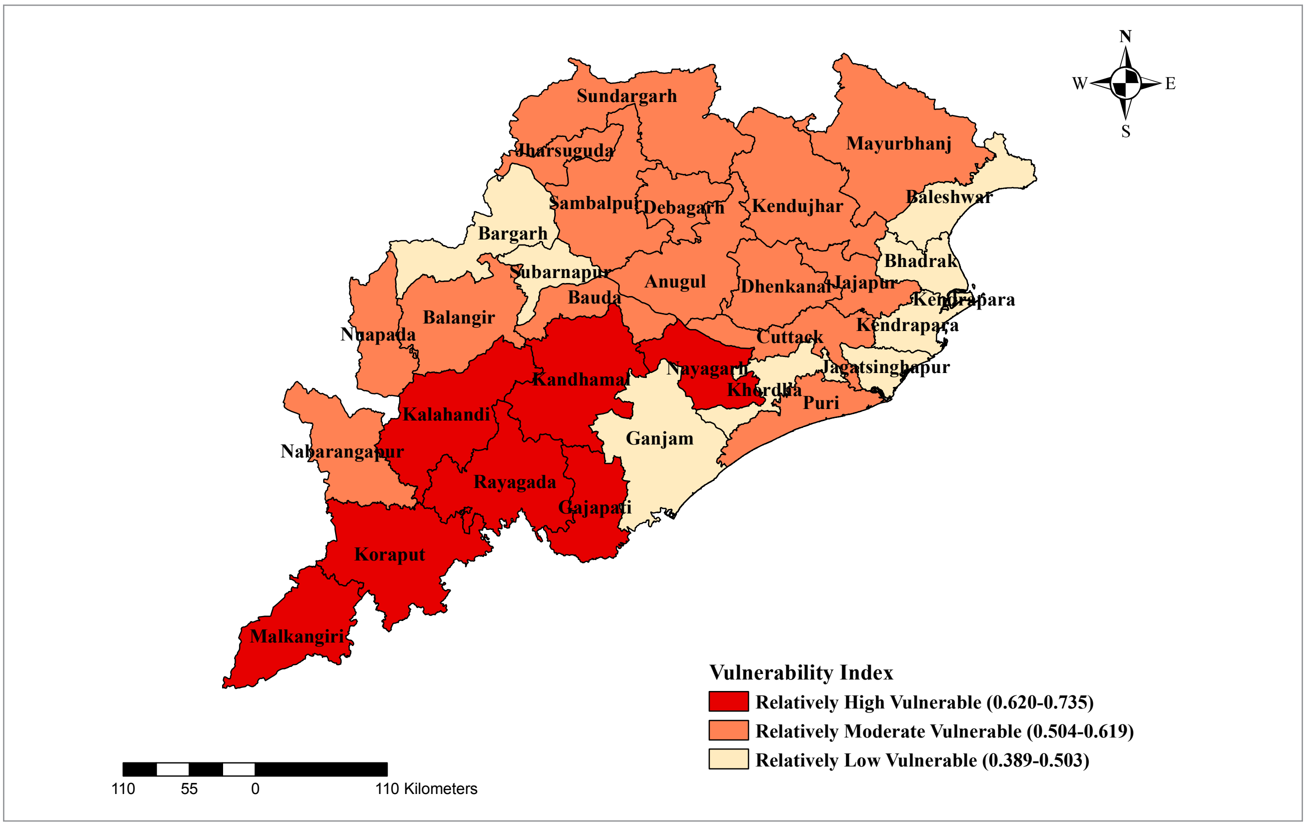

Figure 77: Map showing vulnerability categories of Orissa at district level

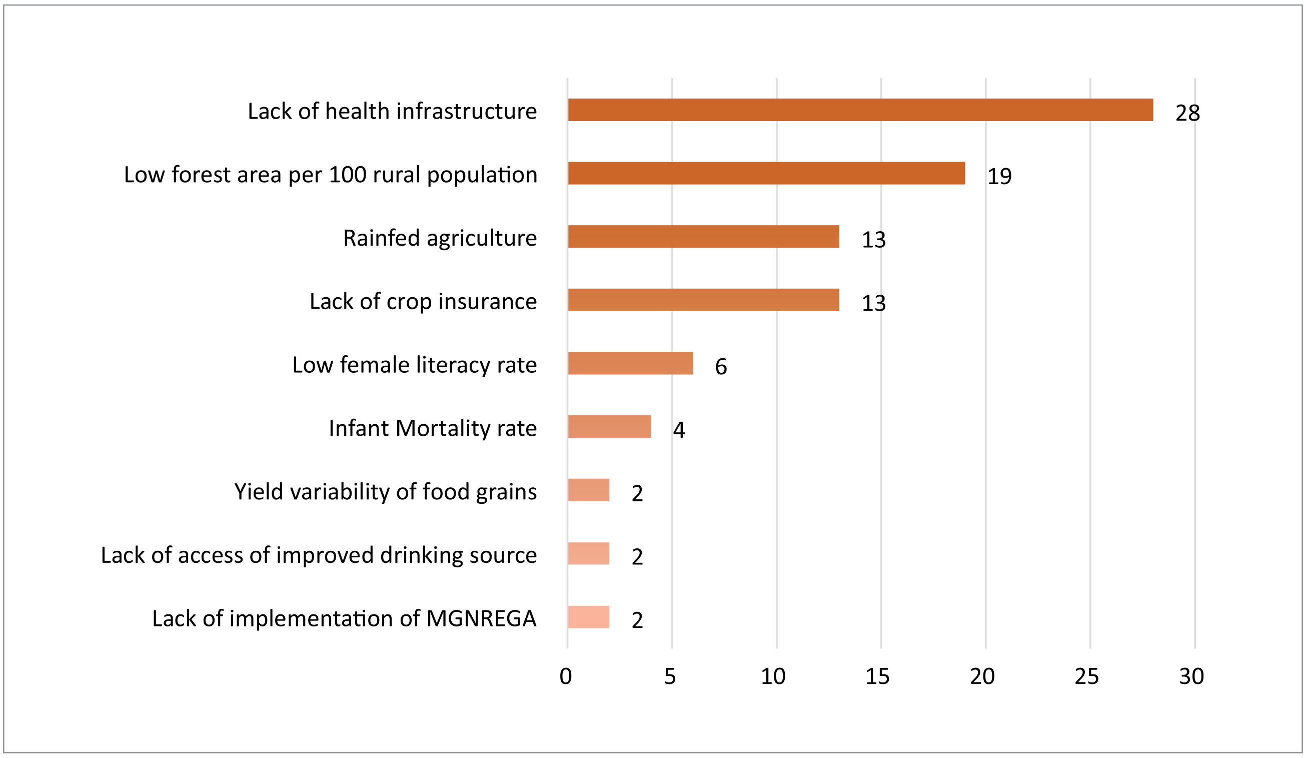

Figure 78: Drivers of agriculture vulnerability in Odisha (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.20. Punjab

Punjab lies in the north-western part of India, extending from 9.30° to 32.32° North and from 73.55° to 76.50° East. The state covers an area of 50,362 km^2. Its small size lends easy accessibility to all its interior parts. There are 22 administrative districts in the state. Agriculture and allied sectors are the backbone of the rural economy of Punjab. The state has Irrigation facilities which forms one of the best networks in the country. Around 99.6% of gross area sown and 99.9% of net area sown are irrigated in the state. About 75% of irrigation depends on groundwater, but this is declining at an alarming rate.

There are considerable spatial differences in the climate in Punjab: the region lying near the foothills of the Himalayas receives heavy rainfall, whereas in the region lying at a distant from the hills, rainfall remains scanty and the temperature remains high. Maximum temperatures occur in mid-May and June with temperatures above 40°C in the entire region during this period. Minimum winter temperature of the region is found between December and February with an average below 5°. The districts along the Shivalik Hills, i.e., Gurdaspur, Pathankot, Hoshiarpur, and Ropar receive maximum rain.

The present district-level vulnerability assessment was conducted for all 22 districts based on 18 indicators. The list of indicators along with their functional relationships with vulnerability is presented in Table 28. Equal weights were assigned to each indicator to calculate the VIs.

District-level VIs and the related maps are presented in Figure 79-Figure 80. The highest value of vulnerability was obtained for Tarn Taran District (0.74) and the lowest for Ludhiana (0.47). The range of the VIs was divided into three equal intervals to obtain three categories: relatively high (0.65-0.74), relatively moderate (0.56-65), and relatively low vulnerability (0.47-0.56). After categorisation it was observed that 3 districts falls under the first category (Tarn Taran, Moga, Gurdaspur), and 14 under the second; 5 districts are in the third and the last category.

6 indicators emerged as the main drivers of vulnerability: low value of output of total horticulture (perennial) against value of agriculture output, lack of forest area per 1000 rural population, lack of implementation of MGNREGA, low women's participation in workforce, a smaller number of rural banks per 1000 rural population, number of NRM works per 1000 ha. Among the 6 selected drivers, the value of output of horticulture (perennial) against the value of agriculture output has a greater NV value than the threshold in 17 districts. Further, forest area per 1000 rural population and average person days per household employed under MGNREGA were observed to be accountable for the vulnerability of 17 districts as well. Major drivers of vulnerability are presented in Figure 81.

Table 28: List of indicators used for the assessment of district-level vulnerability for Punjab

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Per capita income	Adaptive Capacity	Negative
Livestock per 1000 rural population	Adaptive Capacity	Negative
Female workforce (main & marginal works)	Adaptive Capacity	Negative
Forest area per 1000 rural population	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Rural banks per 1000 rural population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Cases of vector-borne diseases per 1000 population	Sensitivity	Positive
Cases of water-borne diseases per 1000 population	Sensitivity	Positive
Number of doctors, specialists, health assistants and health workers per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Water Scarcity	Sensitivity	Positive
Number of NRM works per 1000 ha	Adaptive Capacity	Negative
Value of output horticulture (perennial) against value of agriculture output	Adaptive Capacity	Negative

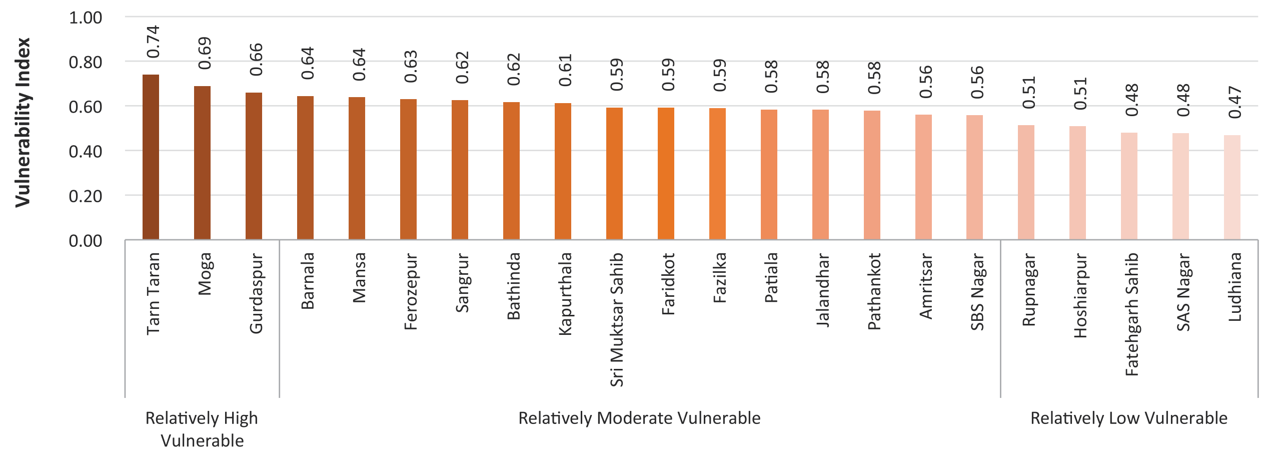

Figure 79: Vulnerability Indices (VIs) and ranking of districts in Punjab

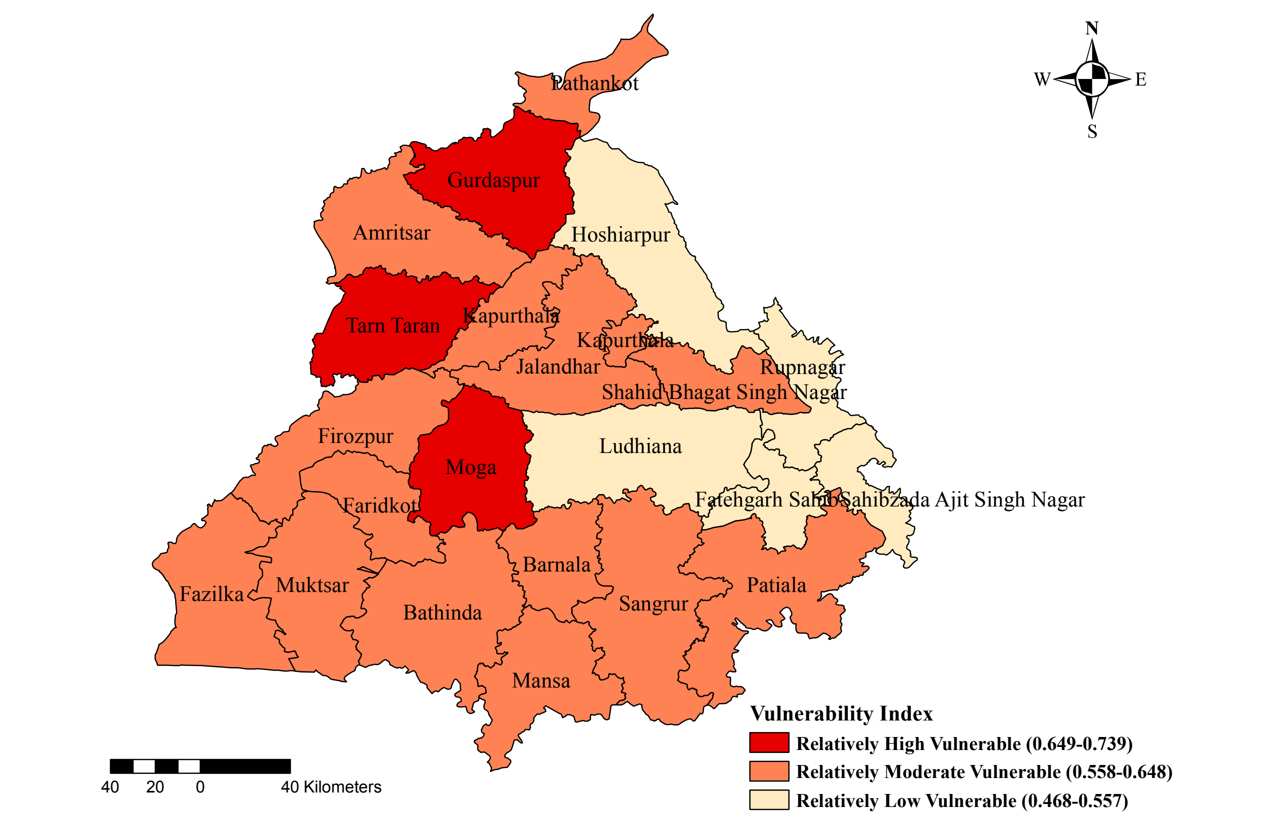

Figure 80: Categories of vulnerability of the districts in Punjab

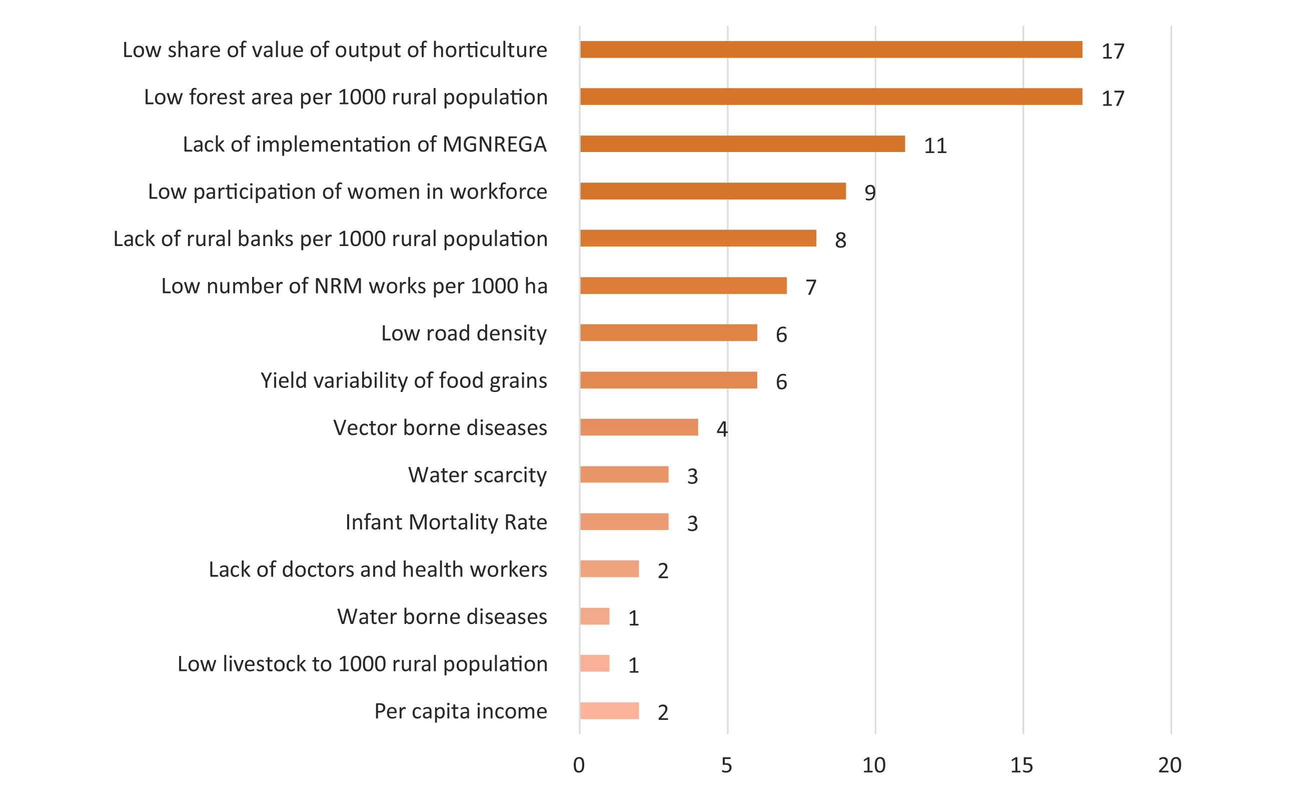

Figure 81: Drivers of vulnerability in the districts of Punjab (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.21. Rajasthan

Rajasthan is located at the latitude of 23°4'N to 30°11'N and longitude of 69°29'E to 78°17'E. The state has 4 distinct regions, the Western Desert with barren hills, level rocky and sandy plains, the Aravalli Hills, and the South-Eastern Plateau. It covers an area of 3,42,239 km^2 and has 33 districts. A large area is covered with desert and there is a very small forest cover.

The state has a climate that varies from extremely arid to humid. The humid zone spans the southeast and east. Except in the hills, the heat during summer is intense everywhere, with temperatures in June, the warmest month, typically rising from about 30° to 40°C daily. The western desert has little rain, averaging about 100 mm, annually. In the southeast, some areas receive almost 500 mm. The average annual temperature ranges between 0°C to 50°C and the average annual rainfall is in the range of 500-750 mm.

The present district-level vulnerability assessment was conducted based on 15 indicators. The list of indicators along with their functional relationships with vulnerability is presented in Table 29.

3 indicators, percentage of net irrigated out of net sown area, percentage households using improved sanitation facility, and percentage households with improved drinking water source, were initially considered but finally dropped from the analysis due to their high correlation with other indicators. Equal weights were assigned to each indicator to calculate the VIs.

District-level VIs and the related maps are presented in Figure 82- Figure 83. The highest value of vulnerability was obtained for Dholpur District (0.665) and the lowest for Barmer (0.432).

The range of the VIs was divided into three categories: relatively high vulnerability (0.59-0.66), relatively moderate vulnerability (0.51-0.59), and relatively low vulnerability (0.43-0.51).

After categorisation it was observed that 5 districts falls under the first category (Dholpur, Bharatpur, Udaypur, Dausa, and Banswara), and 11 under the second (Baran, Ajmer, Dungarpur, Rajsamand, Tonk, Karauli, Bundi, Nagaur, Jodhpur, Alwar, and Pali); and the rest, i.e., 17 districts are in the third and last category. It may be observed that the VI values for the state varies over a small range and all the districts are somewhat vulnerable and needs attention.

Three indicators emerged as the main drivers of vulnerability: lack of forest area per 1000 rural population, a smaller number of NRM works per 1,000 ha (under MGNREGS and/or other schemes), and low road density. Major drivers of vulnerability are presented in Figure 84. Among the 3 selected drivers, the number of NRM works per 1,000 ha (MGNREGS and/or other schemes) has a greater NV value than the threshold in 20 districts. Further, low road density was observed to be accountable for the vulnerability of 18 districts, and forest area per 1000 rural population was found responsible for the vulnerability of 17 districts.

Table 29: Indicators used for district-level assessment for Rajasthan

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Per capita income	Adaptive Capacity	Negative
Total number of livestock per 1000 rural households	Adaptive Capacity	Negative
Percentage of marginal and small farmers (land <5 acre)	Sensitivity	Positive
Female workforce participation	Adaptive Capacity	Negative
Forest area (in ha) per 1000 rural population	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Rural banks per 1000 rural population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Percentage crop area covered under crop insurance	Adaptive Capacity	Negative
Cases of vector-borne diseases per 1000 population	Sensitivity	Positive
Cases of water-borne diseases per 1000 population	Sensitivity	Positive
Insant Mortality Rate (IMR)	Sensitivity	Positive
Crop diversification	Adaptive Capacity	Negative
Number of NRM works per 1,000 ha (under MGNREGS and/or other schemes)	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative

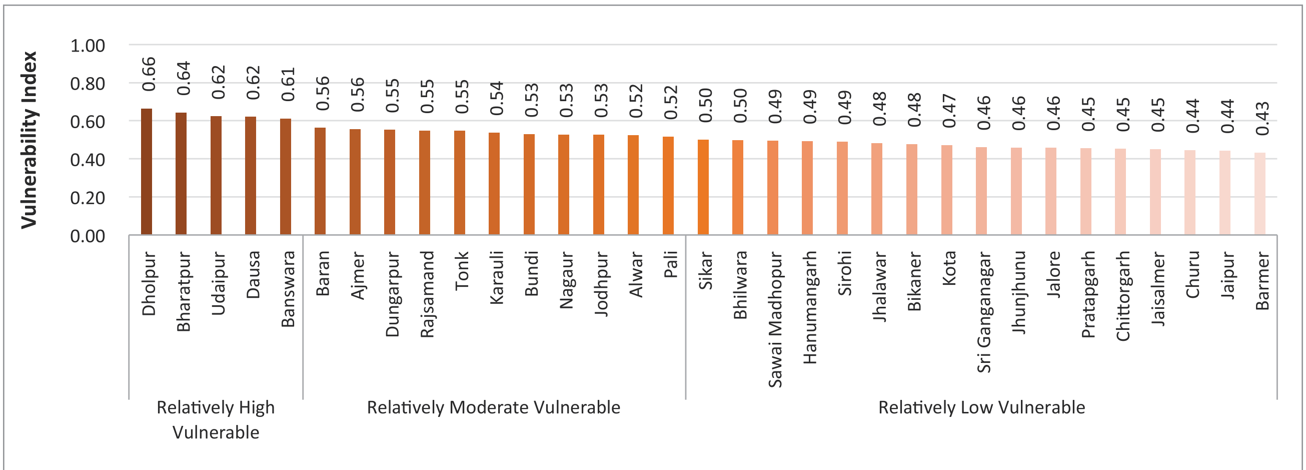

Figure 82: Vulnerability Indices (VIs) and ranking of districts in Rajasthan

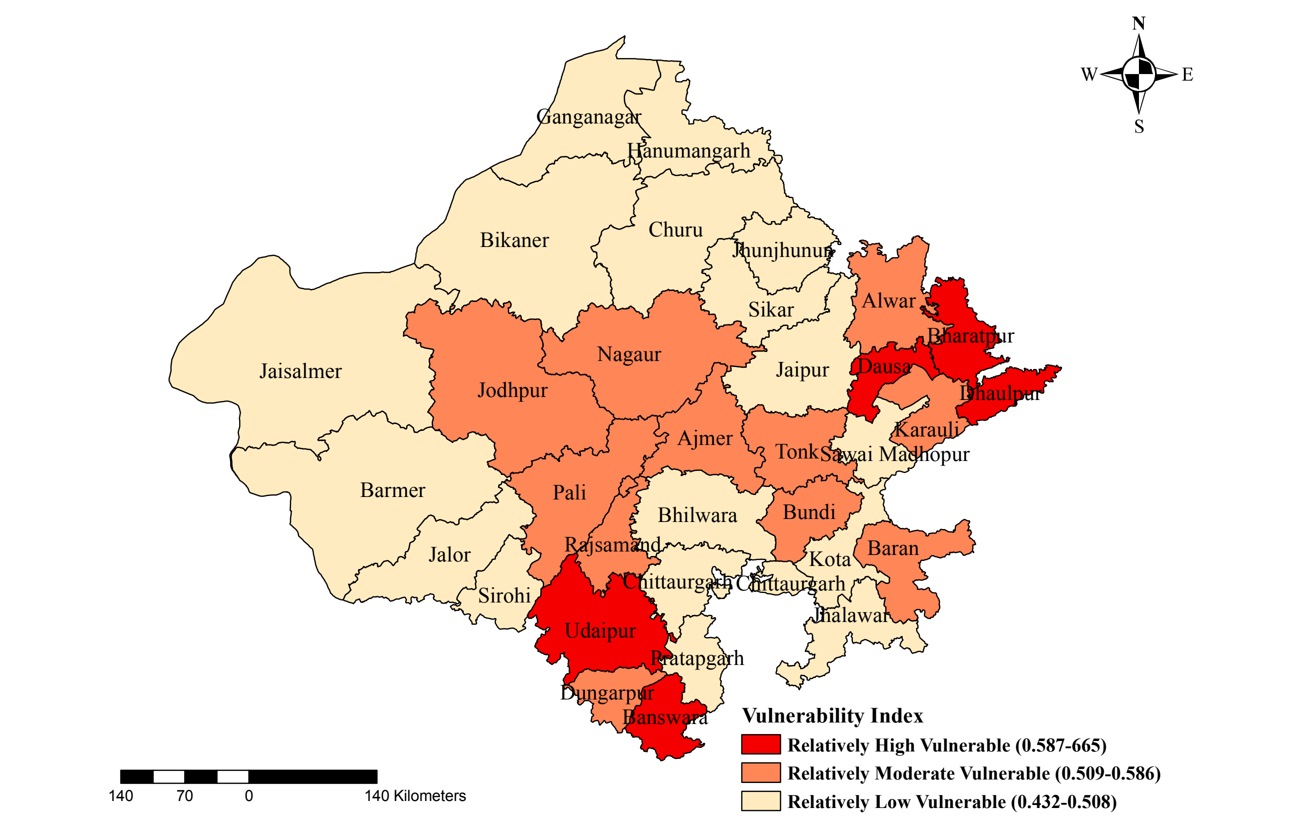

Figure 83: **Map showing vulnerability categories vulnerability of Rajasthan at district level**

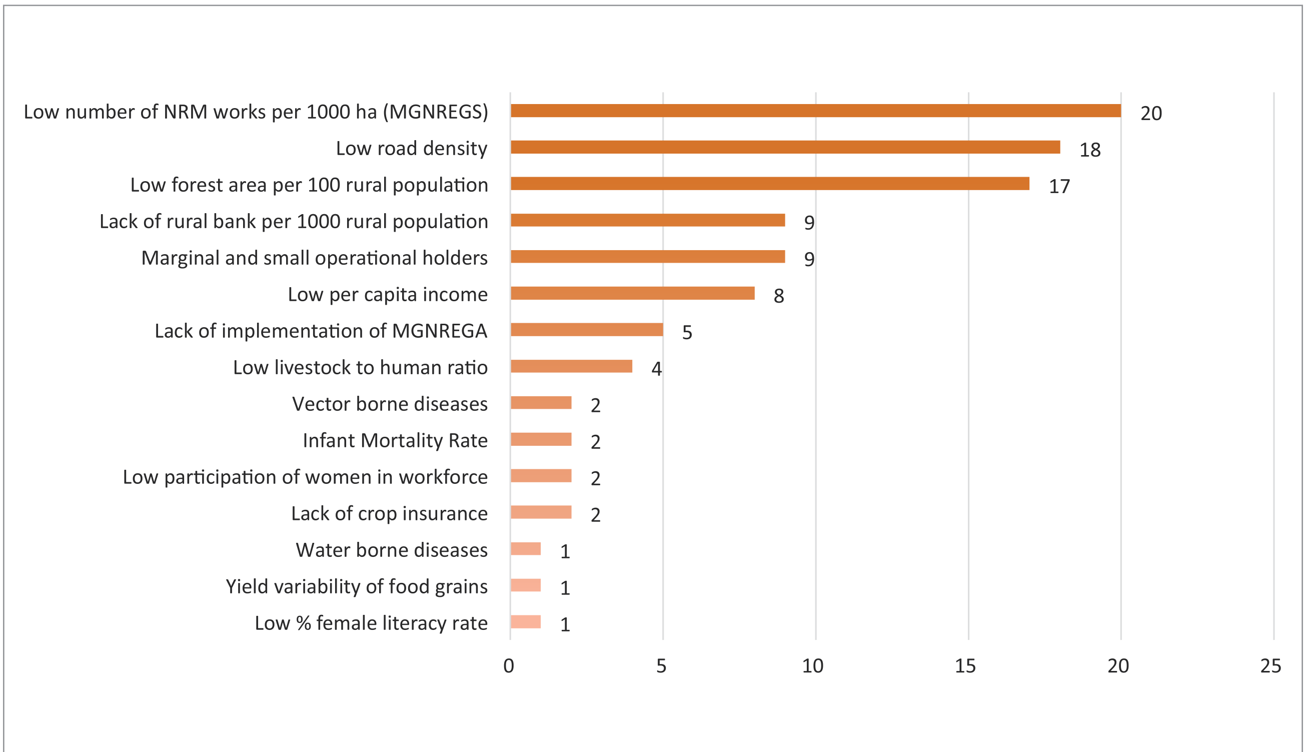

Figure 84: **Drivers of vulnerability in Rajasthan (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)**

3.22. Sikkim

The hill state of Sikkim is located between the 27° 04'46" N to 28° 07'48" N latitudes and 88°00'55" E to 88° 55'25" E longitudes in the north- eastern part of India dominated by the Himalayas and the high, snow-capped mountain ranges. A small portion is covered by the Tibetan Plateau in the northern part. Slopes are on an average of 450, representing one of the steepest altitude gradients anywhere in the world. It has 4 districts, North, South, East, and the West.

The sharp altitudinal variation from 300m to 8600m plays a vital role in weather and climatic conditions in the state. Sikkim Himalayas consists of high mountains that act as barriers for the movement of monsoon winds. Because of these general conditions one finds high temperatures and a hot and humid climate in the low-lying area, a pleasant weather condition in the mid-hill mountains, and low temperatures and cold climatic conditions in the higher elevation area. A maximum temperature of over 35°C has been recorded in low-lying places like Jorethang, Melli, Rangpo, and Singtam. The average annual temperature of Sikkim is around 18°C.

The present district-level vulnerability assessment was conducted for all districts based on 8 indicators. The list of indicators along with their functional relationships with vulnerability is presented in Table 30. Equal weights were assigned to all indicators. District- level VIs and the related maps are presented in Figure 85- Figure 86. The highest value of vulnerability was obtained for East Sikkim and South Sikkim (0.7), followed by North Sikkim (0.6) and the lowest for West Sikkim (0.4). The range of the VIs was divided into three categories: relatively high vulnerability (0.6-0.7), relatively moderate vulnerability (0.5-0.6), and relatively low vulnerability (0.4-0.5). While East and South Sikkim fall under the first category, North in the second and West in the third. However, in presence of very less number of districts, such categorisations is not very meaningful.

Major drivers of vulnerability are presented in Figure 87. 3 indicators, viz., percentage of marginal farmer + small farmer, forest area per 1000 rural population, and doctors' availability emerged as the main drivers responsible for the vulnerability.

Table 30: Indicators used for district-level assessment for Sikkim

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Livestock to rural population	Adaptive capacity	Negative
Percentage of marginal farmer + small farmer	Sensitivity	Positive
Percentage of women participating in the work force	Adaptive capacity	Negative
Proportion of unirrigated agricultural land	Sensitivity	Positive
Forest area (ha) per 1000 rural population	Adaptive capacity	Negative
Average person days per household employed under MGNREGA	Adaptive capacity	Negative
Doctors' available in district towns	Adaptive capacity	Negative
Yield variability of food grains	Sensitivity	Positive

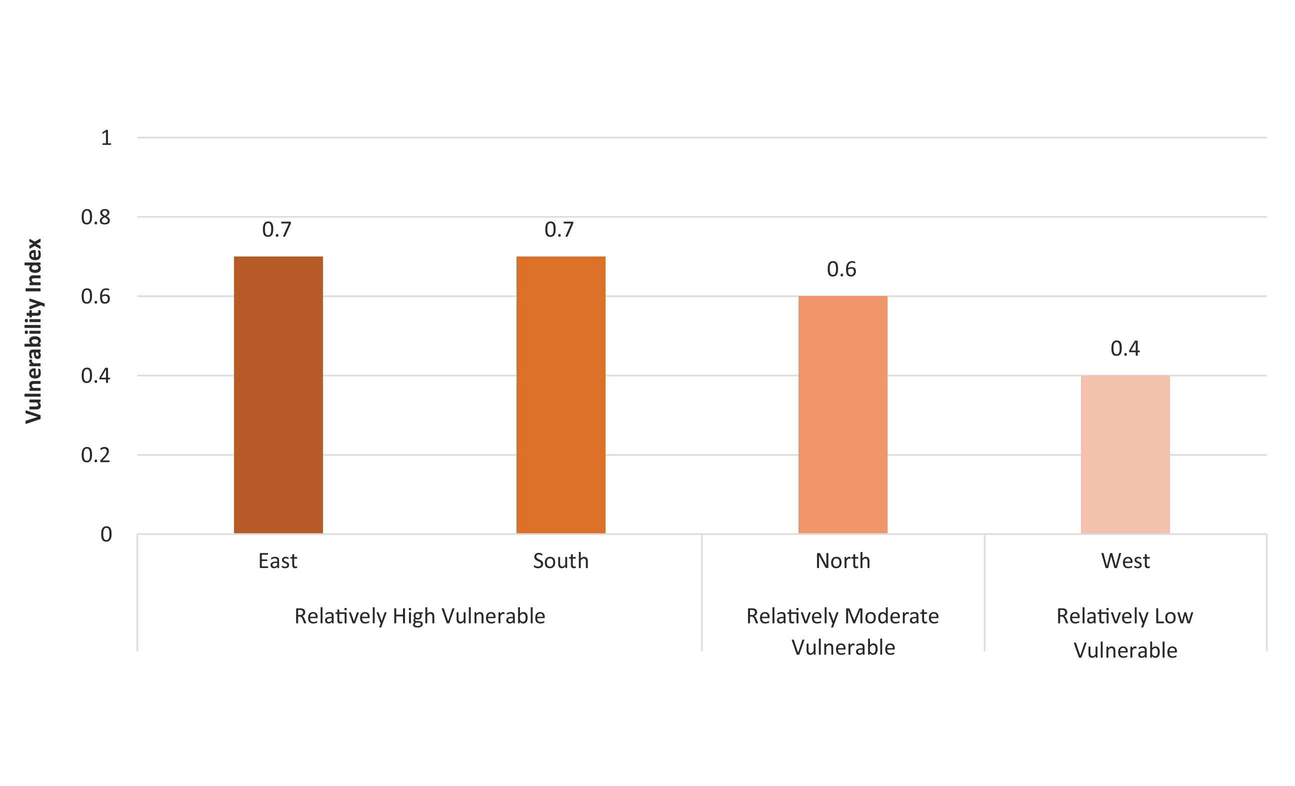

Figure 85: **Vulnerability Indices (VIs) and ranking of districts in Sikkim**

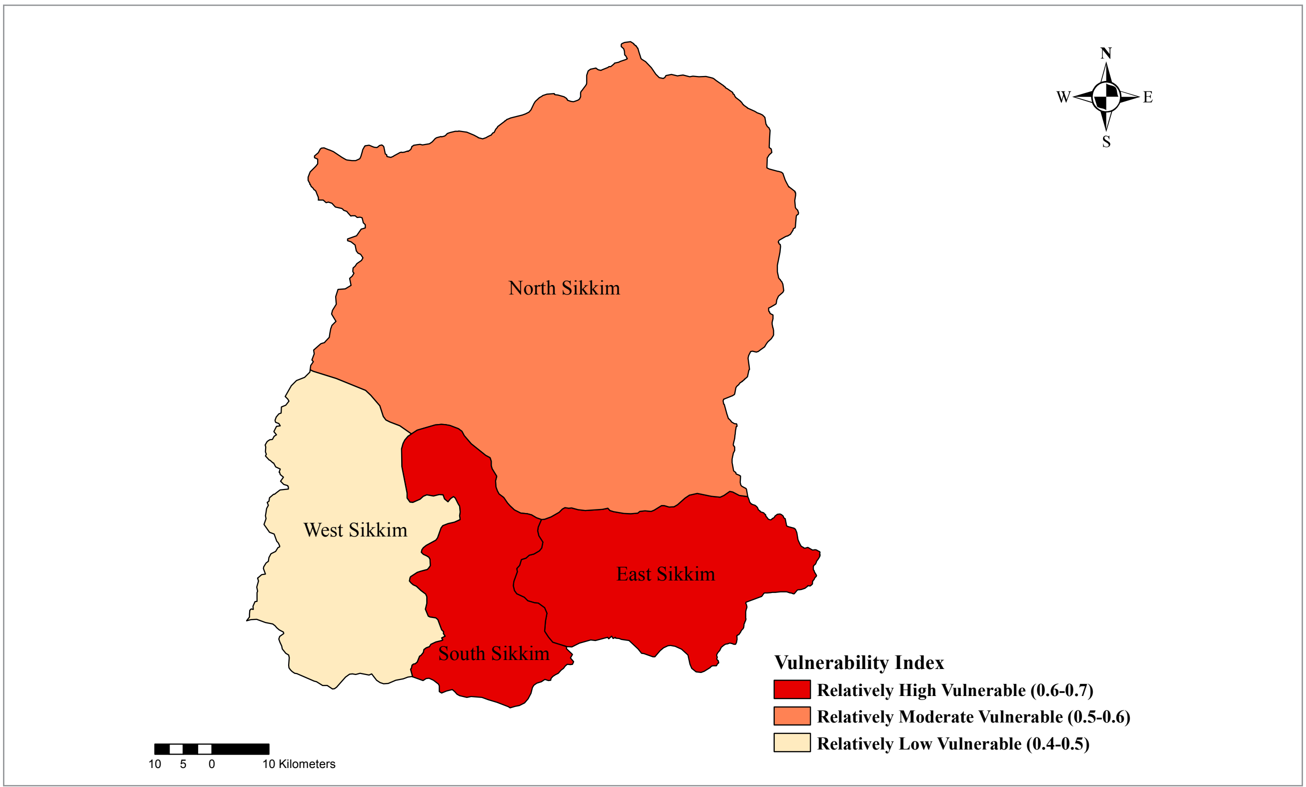

Figure 86: **Map showing vulnerability categories of Sikkim at district level**

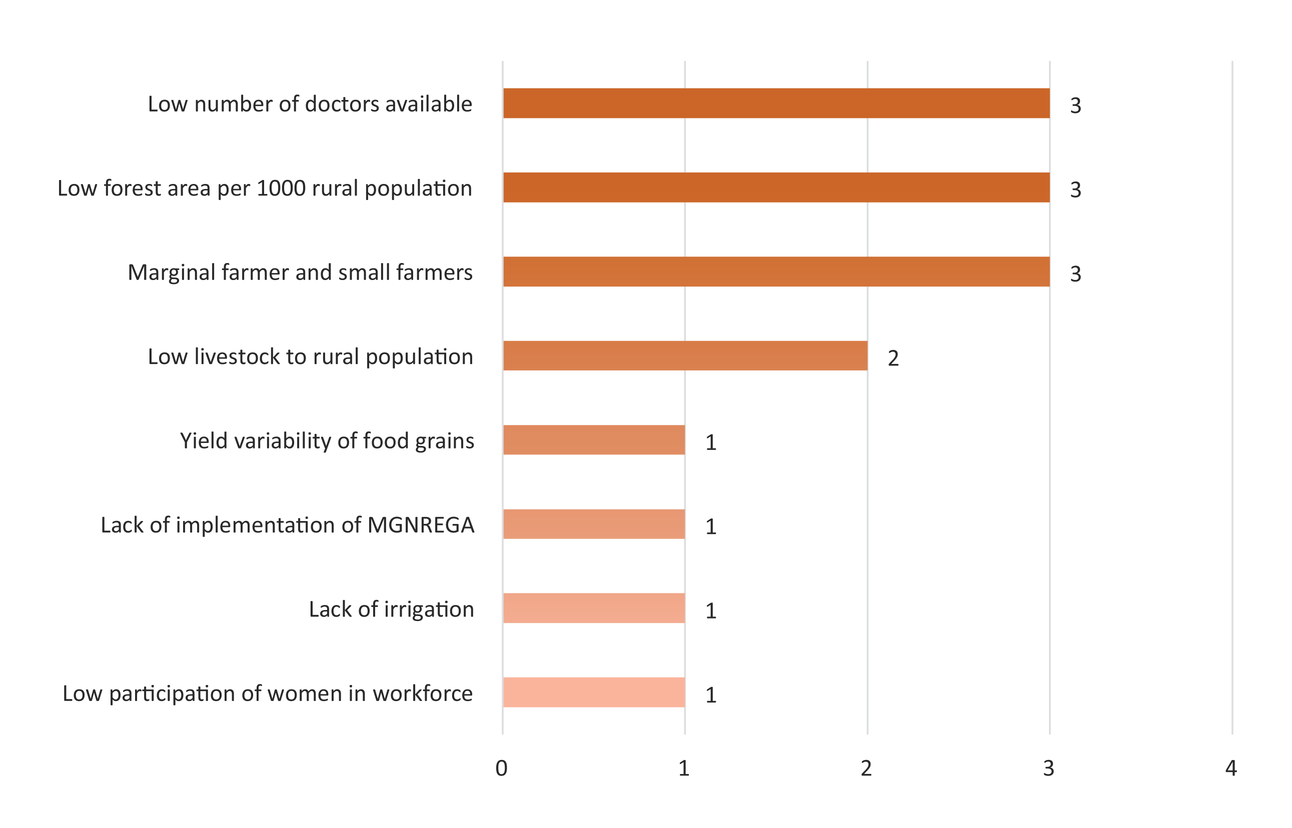

Figure 87: Drivers of vulnerability in Sikkim (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.23. Tamil Nadu

Tamil Nadu extends between 8°5′ and 13° 35′ N and between 76°15′ and 80°20′ E with a total area of 1,30,060 km^2. There are 38 districts, of which 6 are newly constructed. According to the Tamil Nadu State Land Use (Planning) Policy report, more than 55% of the total geographical area is agricultural land, 16% is forest area, 4% built-up area, 5% is taken up by waterbodies, and 8% by wasteland. The per capita income of Tamil Nadu over 2016-17 is projected at Rs.1,84,210.

In the state, the summer is hot, with temperatures rising to 43^{o}C. November to February is the coolest winter period with temperatures around 18^{0}C. The maximum rainfall comes during October, November, and December (generally considered post-monsoon), whereas in the rest of the country maximum rain falls in June, July, August, and September (usually considered the monsoon season). Drought, water depletion, soil erosion, sea water incursion, forest fire, species extinction, and thermal discomfort are major evidence of climate change in the area.

The present district-level vulnerability assessment was conducted for 31 districts based on 13 indicators. The boundary of the districts considered are not the most recent ones, given the non-availability of data for 6 newly created districts. Additionally, from the collected values it was concluded that, for a few indicators, Chennai, which is a 100% urbanised district, has a very different adaptive capacity compared to the rest. At the same time, it experiences high stress on natural resources such as a high-water demand. As a result, Chennai is not included in the analysis. The list of indicators along with their functional relationships with vulnerability is presented in Table 31. Equal weights were assigned to each indicator.

District-level VIs and the related maps are presented in Figure 88 - Figure 89. The highest value of vulnerability was obtained for Ariyalur (0.724) and the lowest for Kanyakumari (0.427). It shows that the VIs vary over a small range and the VIs of two consecutive districts are very close to each other. The range of the VIs was divided into three categories: relatively high vulnerability (0.625-0.724), relatively moderate vulnerability (0.526-0.625), and relatively low vulnerability (0.427-0.526). Based on this categorisation, 9 districts are found to fall under the most vulnerable category.

5 indicators emerged as the main drivers of vulnerability: a low value of output from horticulture (only perennial) as a proportion of value of agricultural output, lack of forest cover area per 1000 rural population, low road density, high percentage of marginal and small farmers (land <5 acres), and lack of crop insurance scheme. Among the 5 selected drivers, the value of output of horticulture (only perennial) against the value of agricultural output is a driver for 29 districts. Further, the percentage of forest cover per 1000 rural population was observed to be accountable for the vulnerability of 24 districts. Road density and percentage of marginal and small famers (land <5 acres) are responsible for the vulnerability of 18 districts. Crop insurance covered was found responsible for the vulnerability of 17 districts.

Table 31: Indicators used for district-level assessment for Tamil Nadu

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Per capita income	Adaptive capacity	Negative
Livestock to human ratio (rural population)	Adaptive capacity	Negative
Doctors per 1000 population	Adaptive capacity	Negative
Average person days per household employed under MGNREGA	Adaptive capacity	Negative
Road density	Adaptive capacity	Negative
Women's participation in labour force	Adaptive capacity	Negative
Forest cover per 1000 rural population	Adaptive capacity	Negative
Value of output of horticulture (only perennial) against value of agricultural output	Adaptive capacity	Negative
Agricultural land covered under crop insurance	Adaptive capacity	Negative
Proportion of rainfed agricultural land	Sensitivity	Positive
Percentage marginal and small farmers (land <5 acres)	Sensitivity	Positive
Yield variability in food grains	Sensitivity	Positive
Stage of groundwater extraction	Sensitivity	Positive

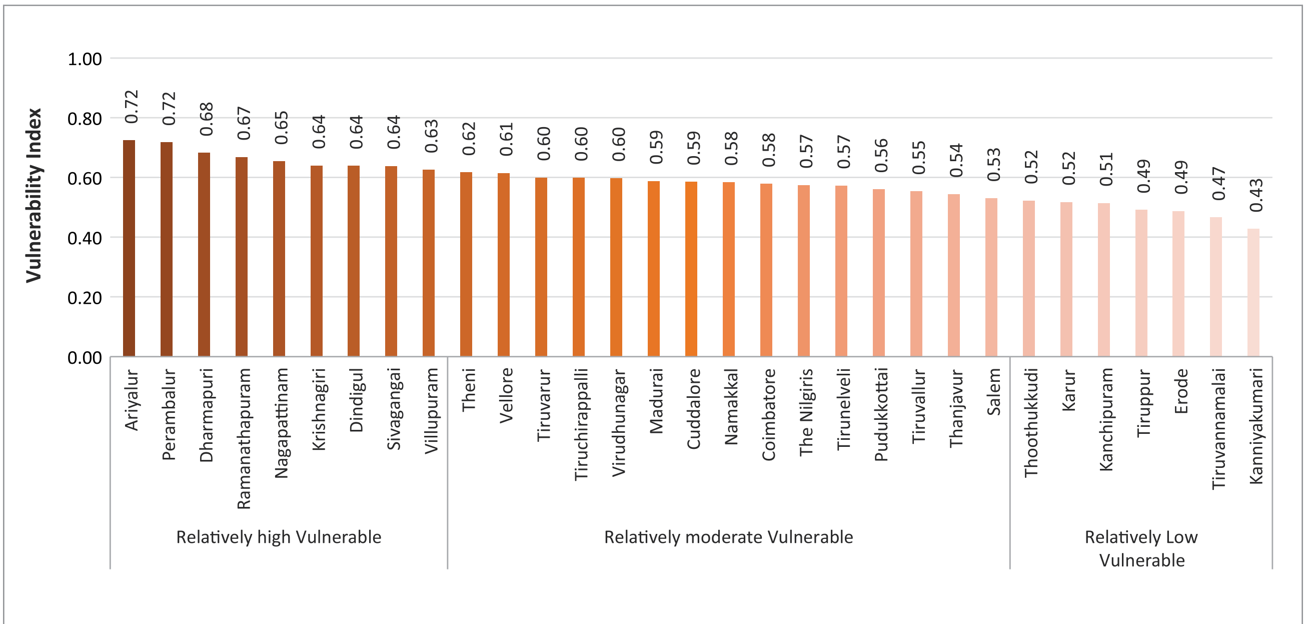

Figure 88: Vulnerability Indices (VIs) and ranking of districts in Tamil Nadu

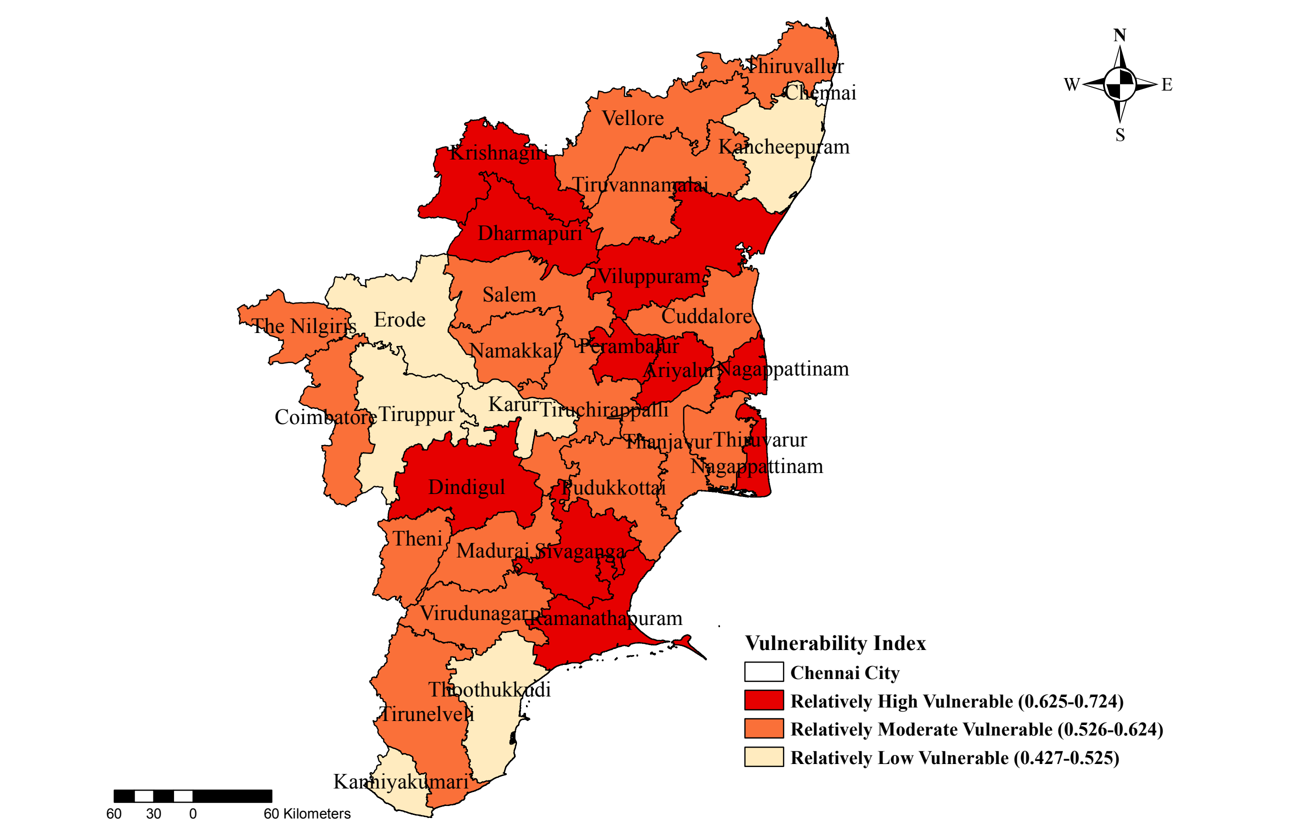

Figure 89: **Map showing vulnerability categories of Tamil Nadu at district level**

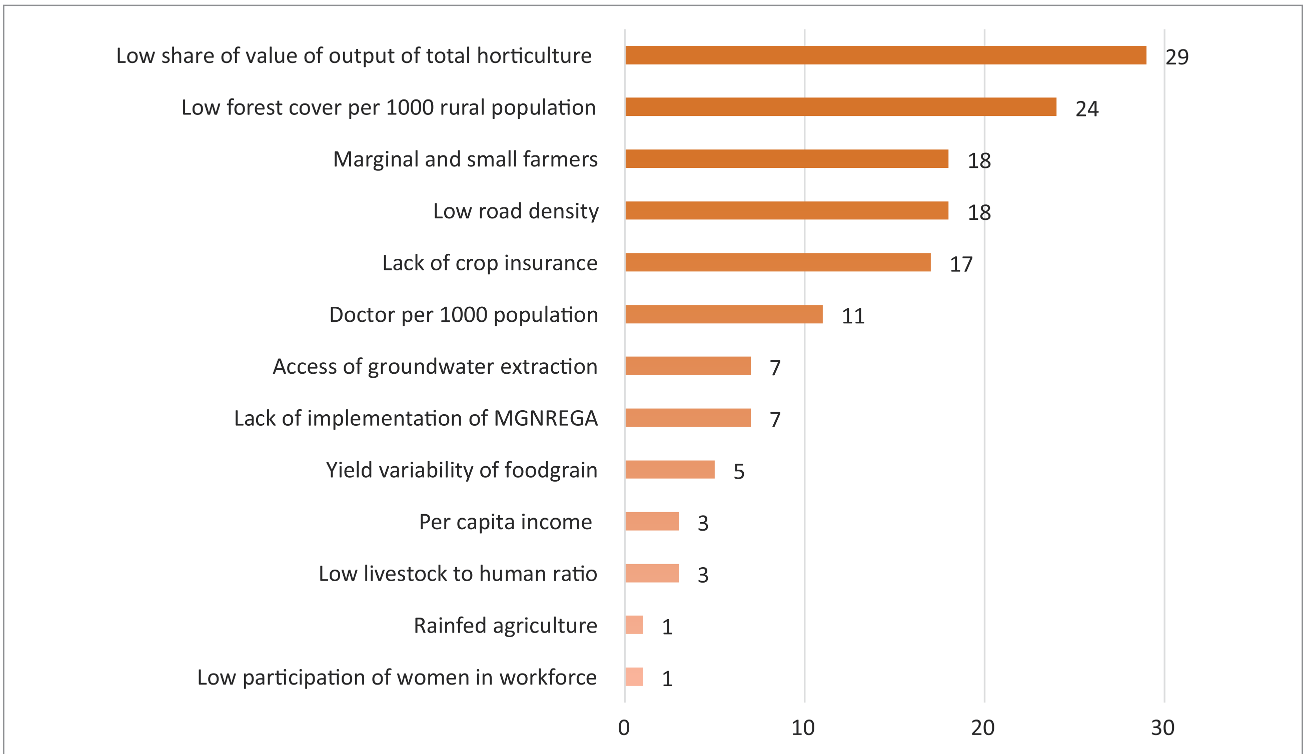

Figure 90: **Drivers of vulnerability in Tamil Nadu (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)**

3.24. Telangana

Telangana is situated on the south-central stretch of the Indian peninsula on the high Deccan Plateau. It lies between the 15^0 46′ and 19^0 47′ N latitudes and 77° 16′ and 81° 43′ E longitudes. The climate is predominantly hot and dry. The mean annual precipitation ranges from 490 to 1670 mm. There is a large variation in the distribution of rainfall. The south-west monsoon (June- September) contributes 72% to the average annual rainfall, while the contribution of the post-monsoon (October-December) is 20%. For the pre-monsoon (March-May) it is 6% and in winter (January-February) it is 2%.

The present district-level vulnerability assessment was conducted for 30 districts out of the total of 31, based on 18 indicators. In this analysis Hyderabad was not included, because it is considered a wholly urban district without agricultural land. The list of indicators along with their functional relationships with vulnerability is presented in Table 32. Equal weights were assigned to each indicator.

District- level VIs and the related maps are presented in Figure 91 - Figure 92. The highest VI value was obtained for Kumarambheem Asifabad (0.70) and the lowest for Rangareddy (0.39). The range of the VIs was divided into three categories: relatively high vulnerability (0.599-702), relatively moderate vulnerability (0.495-0.599), and relatively low vulnerability (0.391-0.495). After categorisation it was observed that a maximum number of districts (22) falls under the moderately vulnerable category (Rajanna Sircilla, Maha-bubabad, Jangaon, Nagarkurnool, Jagtial, Sangareddy, Medak, Wanaparthy, Nirmal, Siddipet, Warangal Urban, Kamareddy, Yadadri Bhuvanagiri, Nalgonda, Mahabubnagar, Jogulamba Gadwal, Mancherial, Bhadradri Kothagudem, Vikarabad, Karimnagar, Khammam). A further 5 districts fall under the moderate and 3 districts under the low vulnerability categories.

Five indicators emerged as the main drivers of vulnerability: low per capita income, lack of forest area per 1000 rural population, low share of value of output of total horticulture (only perennial) to value of agriculture output, lack of doctors, specialists, health assistants & health Workers per 1000 population and a smaller number of rural banks per 1000 population. Major drivers of vulnerability are presented in Figure 93. Among the 5 selected drivers, the indicator of per capita income has a greater NV than the threshold in 28 of the 30 districts. Further, the forest area per 100 rural population was observed to be accountable for the vulnerability of 22 districts. Share of value output of total horticulture (for perennial) to value output of agriculture accounts for the vulnerability of 13 districts, and percentage of doctors, specialists, health assistants and health workers per 1000 population and number of rural banks per 1000 population is responsible for the vulnerability of 12 districts.

Table 32: List of indicators used for the assessment of district-level vulnerability for Telangana

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Per capita income	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Percentage of landless, marginal, and small farmers	Sensitivity	Positive
Livestock to human ratio or per ha (sheep and goats)	Adaptive Capacity	Negative
Women's participation in the labour force	Adaptive Capacity	Negative
Forest area (in ha) per 1000 rural population	Adaptive Capacity	Negative
Value of output of horticulture (only perennial) against value of agricultural output	Adaptive Capacity	Negative
Percentage area under unirrigated (rainfed) agriculture (i.e., total area-net sown area)	Sensitivity	Positive
Yield variability of food grain	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Rural bank per 1000 population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
% crop area covered under crop insurance	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
No of doctors, specialists, health assistants & health workers per 1000 population	Adaptive Capacity	Negative
Cases of Water borne diseases per 1000 of population	Sensitivity	Positive
Cases of Vector borne diseases per 1000 of population	Sensitivity	Positive

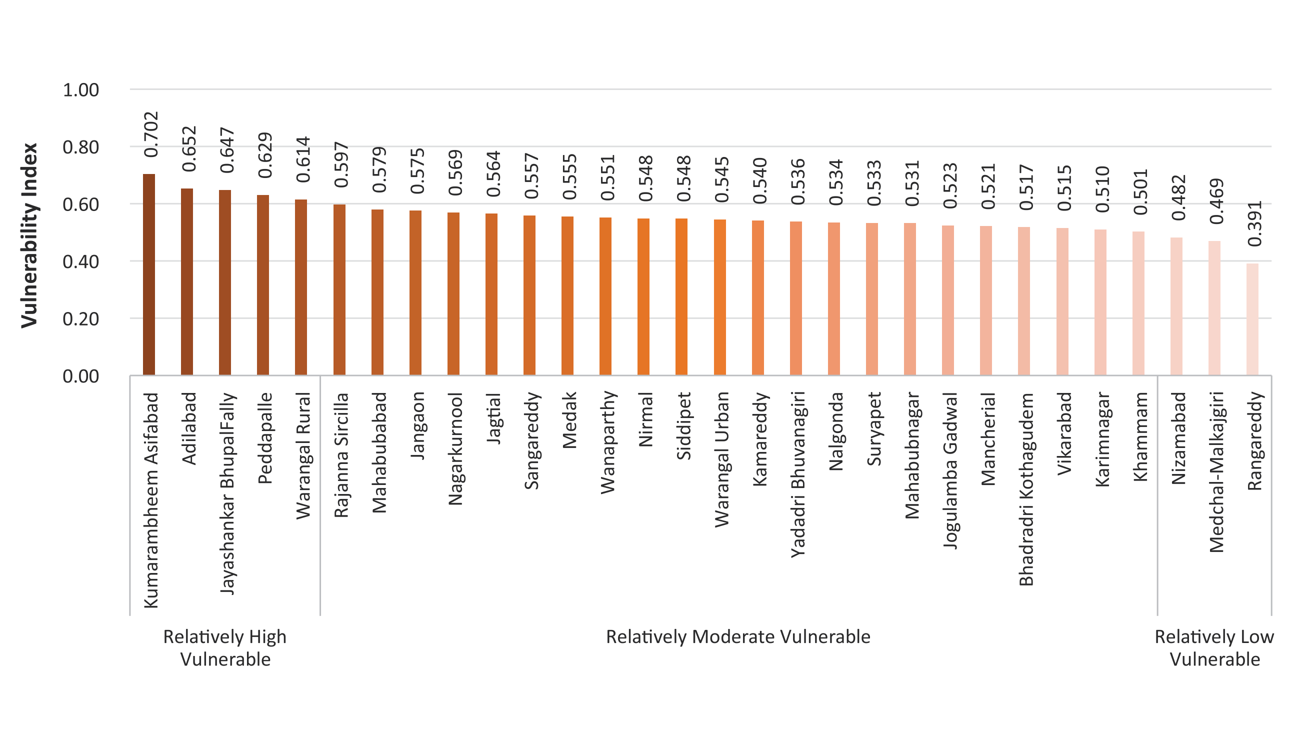

Figure 91: **Vulnerability Indices (VIs) and ranking of districts in Telangana**

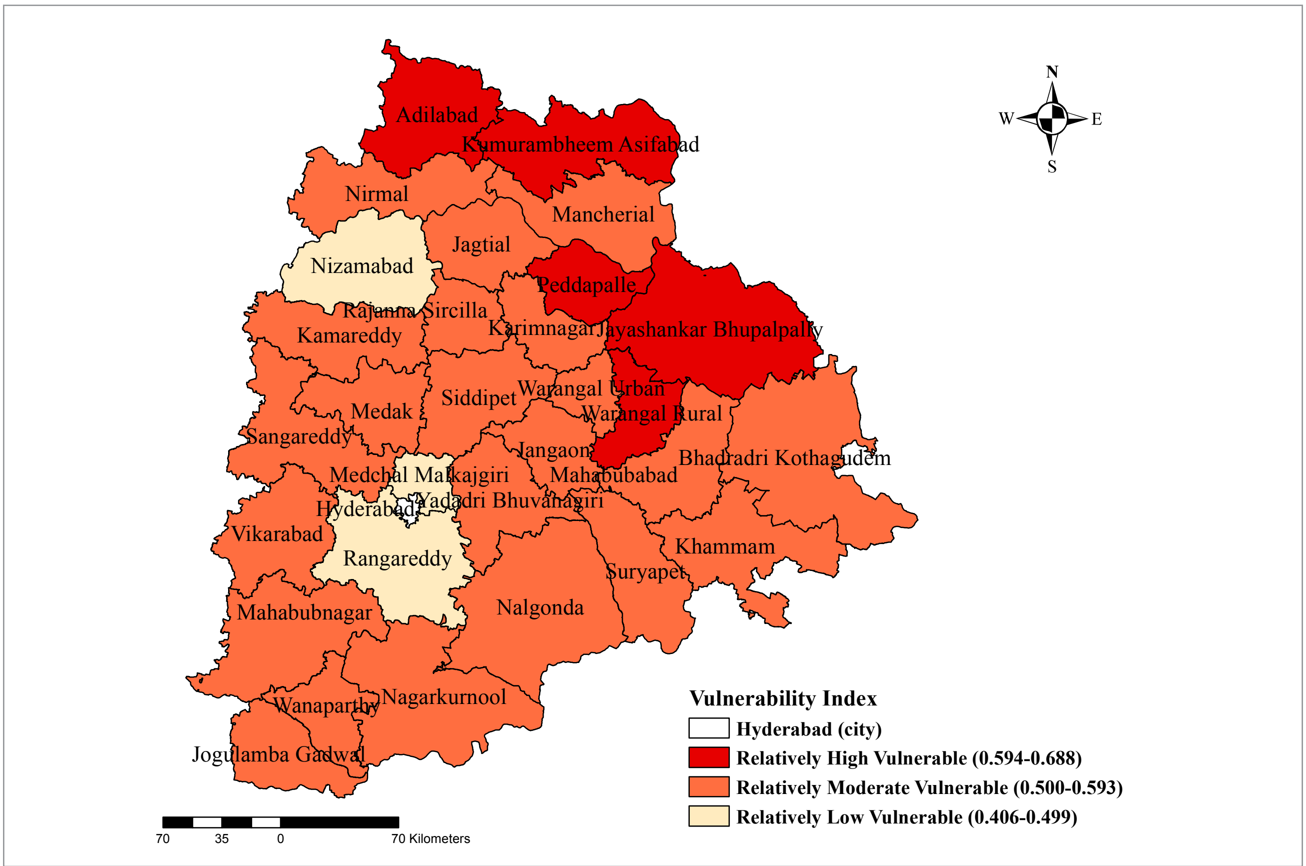

Figure 92: **Map showing vulnerability categories of Telangana districts**

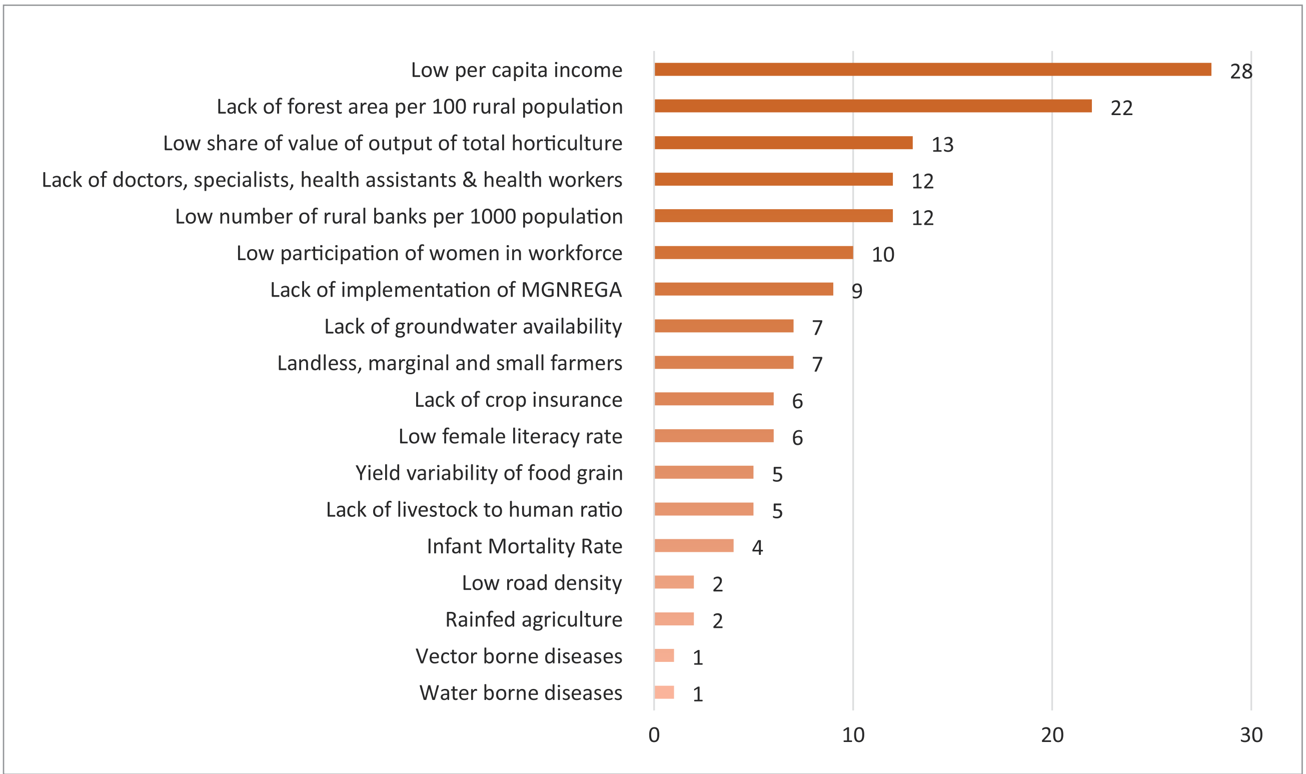

Figure 93: Drivers of vulnerability in Telangana (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.25. Tripura

Tripura spreads over 10,491 km^2, located precisely from 22°56'N to 24°32'N and 91°09'E to 92°20'E. The state is characterised by hill ranges, valleys, and plains, and a tropical savanna climate. The state has 8 districts. The climate of Tripura exhibits a strong seasonal rhythm. It is a warm and humid tropical climate with five distinct seasons: spring, summer, monsoon, autumn, and winter.

The present district-level vulnerability assessment was conducted for 8 districts, based on 10 indicators related to agriculture, biophysical, institutional infrastructure, health, and socio-economic and livelihood practices. The list of indicators along with their functional relationships with vulnerability is presented in Table 33. Equal weights were assigned to each indicator.

District-level VIs and the related maps are presented in Figure 94 - Figure 95. Districts were ranked from high to low vulnerability. The highest value of vulnerability was obtained for Unakoti (0.760) and the lowest for South Tripura (0.426). The range of the VIs was divided into three categories: relatively high vulnerability (0.649-0.760), relatively moderate vulnerability (0.537-0.649), and relatively low vulnerability (0.426-0.537). Unkoti and Dalai are the 2 districts falling under the first category.

Major drivers of vulnerability are presented in Figure 96. They are low livestock to human ratio (7 districts), lack of access of improved drinking source (5 districts), low percentage of female literacy rate (4 districts), low cropping intensity (3 districts), high yield variability of food grains (3 districts), lack of implementation of MGNREGA (2 districts), high IMR (2 districts), low proportion of area under forest (2 districts), lack of health infrastructure per 1000 population (1 district), and high proportion of BPL households (1 district).

Table 33: Indicators used for district-level assessment for Tripura

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Percentage of BPL households	Sensitivity	Positive
Percentage of area under forest	Adaptive Capacity	Negative
Livestock per 1000 population	Adaptive Capacity	Negative
Percentage of households with improved Drinking water source	Adaptive Capacity	Negative
Yield variability of food grains	Sensitivity	Positive
Female literacy rate	Adaptive Capacity	Positive
Insant Mortality Rate (IMR)	Sensitivity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Positive
Cropping intensity	Adaptive Capacity	Positive
Health infrastructure per 1000 population	Adaptive Capacity	Positive

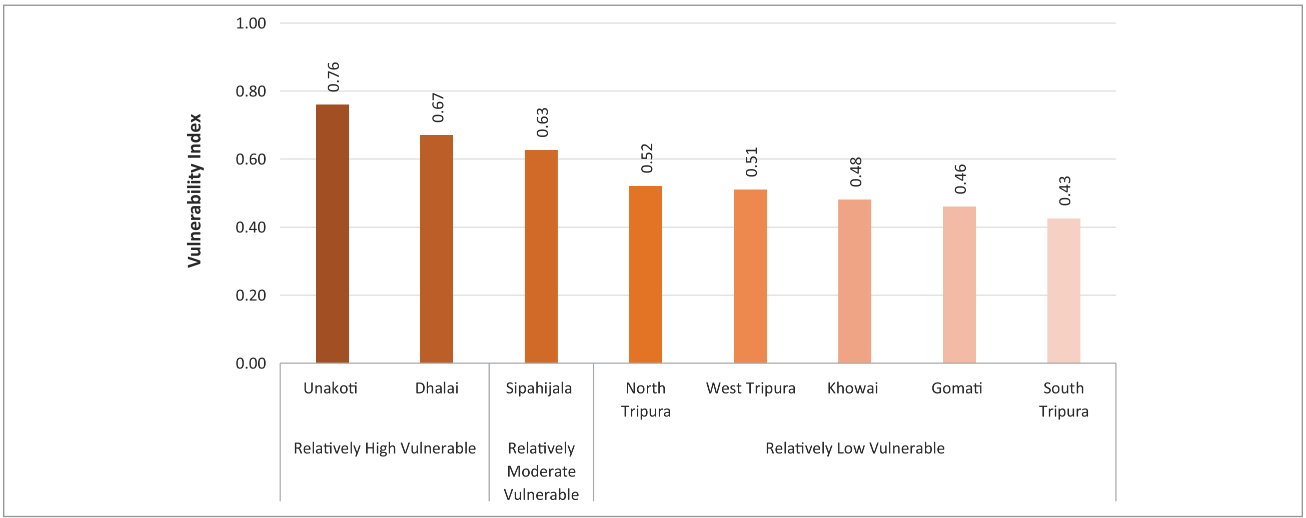

Figure 94: Vulnerability Indices (Vis) and ranking of districts in Tripura

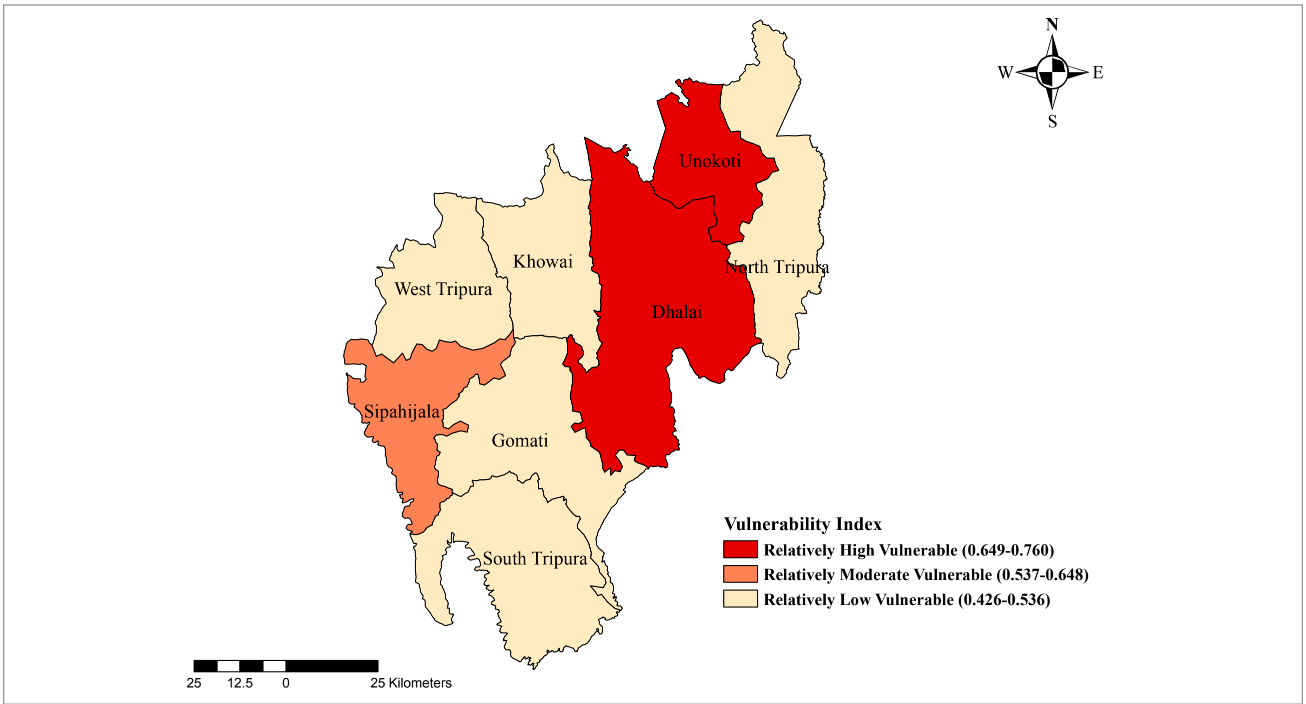

Figure 95: Map showing vulnerability categories of Tripura at district level

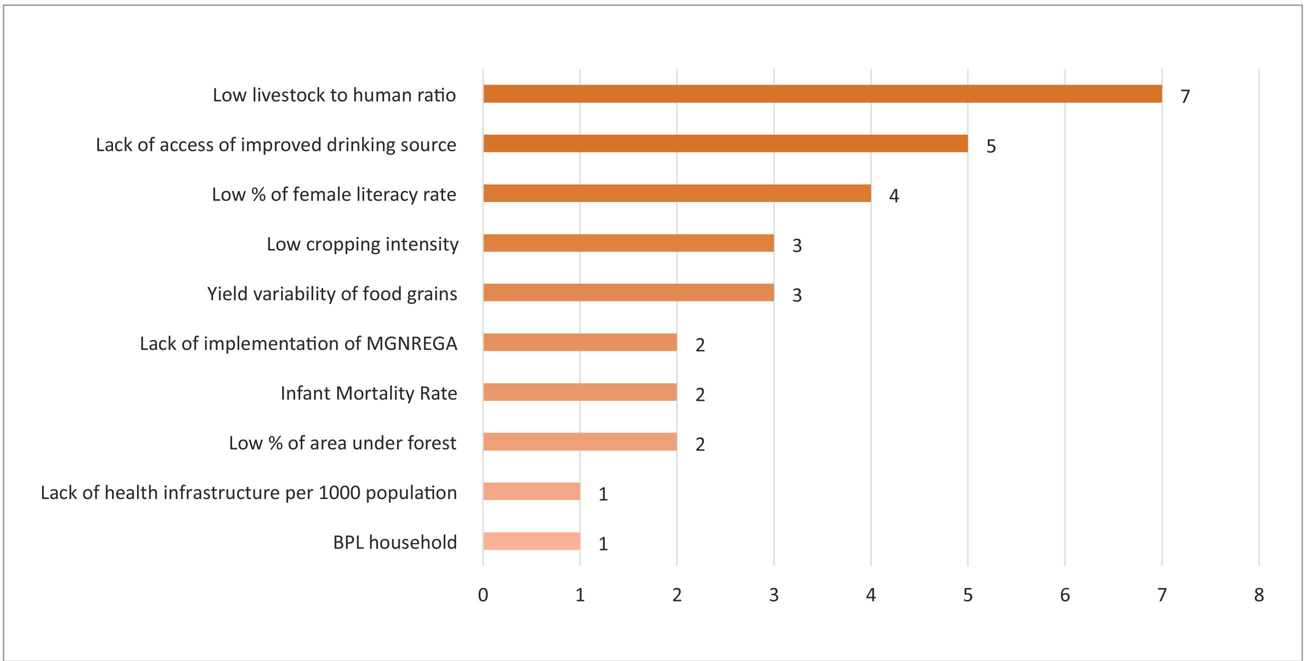

Figure 96: Drivers of vulnerability in Tripura (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.26. Uttar Pradesh

Uttar Pradesh (UP) is situated between the latitude of 24° to 31°N and longitude of 77° to 84° E. The state has 75 districts, of which 5 are newly created for which data are not yet available. Its economy predominantly depends on agriculture (66% farm workers).

The climate of the state is primarily defined as humid subtropical with dry winters, with parts of Western UP considered to be semi-arid. Variations do exist in different parts of the large state, but the uniformity of the vast Indo-Gangetic Plain forming the bulk of the state gives a predominantly single climatic pattern to it with minor regional variations. UP has a climate of extremes. With temperature fluctuating from 0 °C to 50 °C in several parts of the state, and cyclical droughts and floods due to unpredictable rains. The summers are extremely hot, winters cold, and the rainy season can be either very wet or very dry.

The present district-level vulnerability assessment was conducted for 70 districts since data for newly constructed districts are not available. It was based on 13 indicators related to agriculture, biophysical, institutional infrastructure, health, and socio-economic and livelihood practices. The list of indicators along with their functional relationships with vulnerability is represented in Table 34. 3 indicators, proportion of rainfed agriculture, percentage of households using improved sanitation facility, and percentage of female literacy rate were initially considered, but finally dropped from the analysis due to their high correlation with other indicators. Equal weights were assigned to each indicator to calculate the VIs.

District-level VIs and the related maps are presented in Figure 97 - Figure 98. The highest value of vulnerability was obtained for Sitapur (0.694) and the lowest for Lalitpur (0.403). The range of the VIs was divided into five categories: relatively very high vulnerability (0.636-0.694), relatively high vulnerability (0.577-0.636), relatively moderate vulnerability (0.519-0.577), relatively low vulnerability (0.461-0.519) and relatively very low vulnerability (0.403-0.461). After categorisation it was observed that 14 districts fall under the relatively very high vulnerable category (Sitapur, Shahjahanpur, Bahraich, Ghaziabad, Pilibhit, Budaun, Gautam Buddha Nagar, Sant Ravidas Nagar, Kheri, Hardoi, Kushinagar, Saharanpur, Farrukhabad, Balrampur).

Major drivers of vulnerability are presented in Figure 99. Five indicators emerged as the main drivers of vulnerability: high percentage of marginal and small operational holders, low percentage area covered under centrally funded crop insurance , lack of forest area per 1000 rural population, less number of NRM works per 1000 ha (MGNREGs), and the lack of health infrastructure per 1000 population. Among the 5 selected drivers, forest area per 1000 rural population is a driver in 64 of the 70 districts. Further, the percentage area covered under centrally funded crop insurance (PMFBY, WBCIS) was observed to be accountable for the vulnerability of 55 districts. The percentage of marginal and small operational holders accounts for the vulnerability of 49 districts. NRM works per 1000 ha (MGNREGA) is responsible for the vulnerability of 30 districts, and health infrastructure per 1000 population for the vulnerability of 22 districts.

Table 34: Indicators used for district-level assessment for Uttar Pradesh

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Livestock per 1000 rural households	Adaptive Capacity	Negative
Percentage of marginal and small operational holders	Sensitivity	Positive
Forest area (in ha) per1000 rural population	Adaptive Capacity	Negative
Percentage area covered under centrally funded crop insurance (PMFBY, WBCIS)	Adaptive Capacity	Negative
Yield variability of food grain	Sensitivity	Positive
Women's participation in workforce	Adaptive Capacity	Negative
Road density	Adaptive Capacity	Negative
Average person days/household employed under MGNREGA	Adaptive Capacity	Negative
Number of NRM works per 1,000 ha (MGNREGA and/or other schemes)	Adaptive Capacity	Negative
Percentage households with electricity	Adaptive Capacity	Negative
Percentage households with improved drinking water source	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive

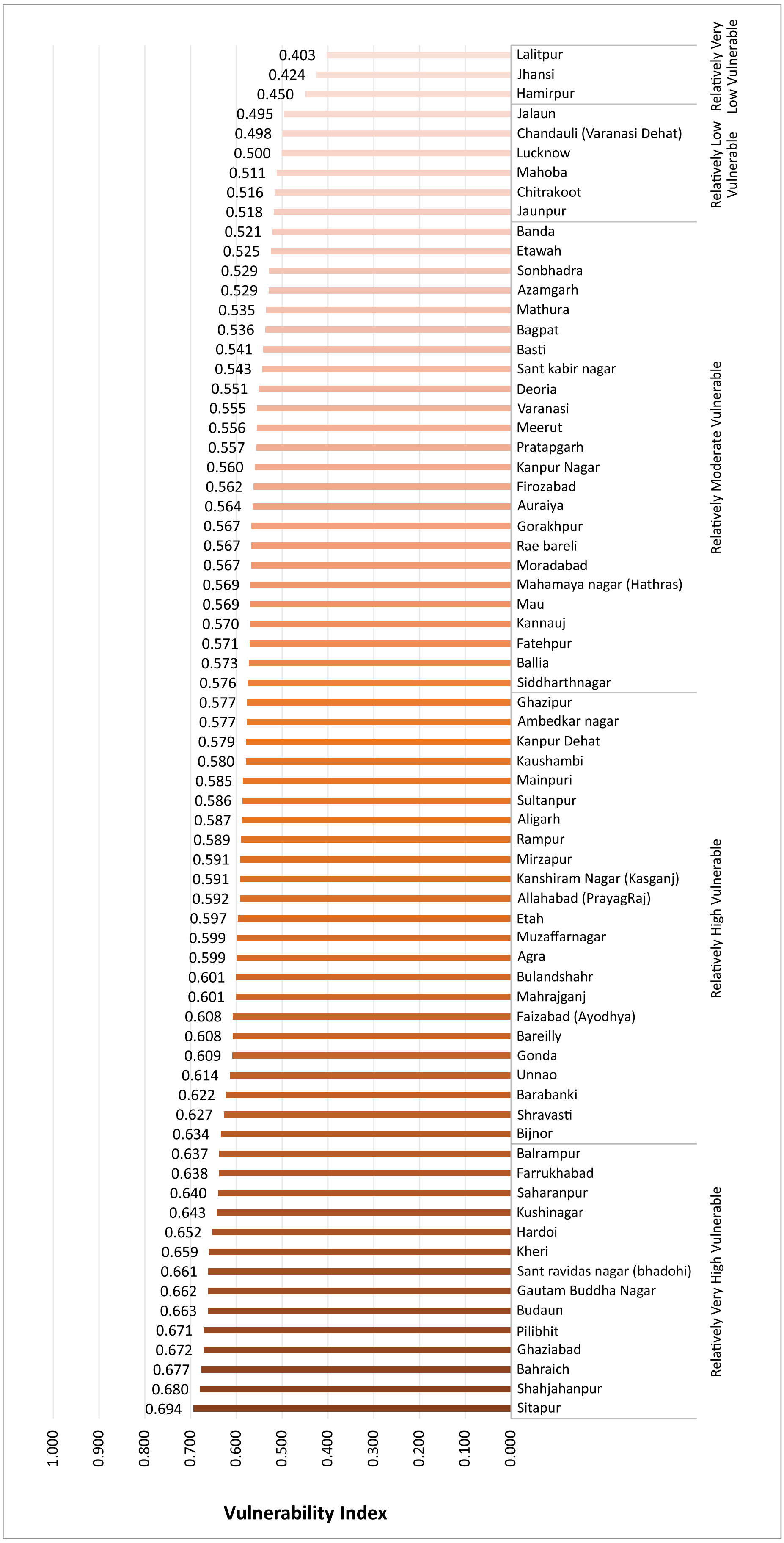

Figure 97: Vulnerability Indices (VIs) and ranking of districts in Uttar Pradesh

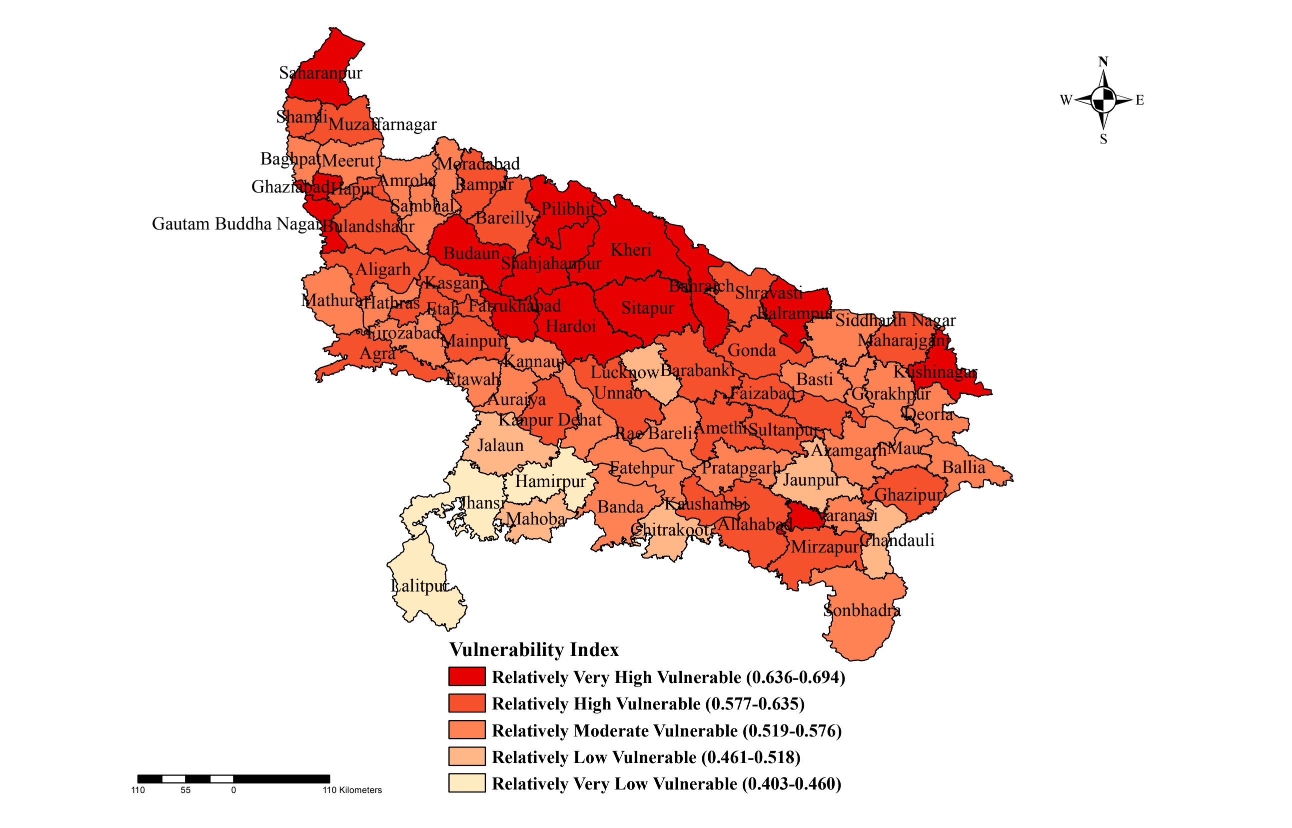

Figure 98: Map showing vulnerability categories of Uttar Pradesh at district level

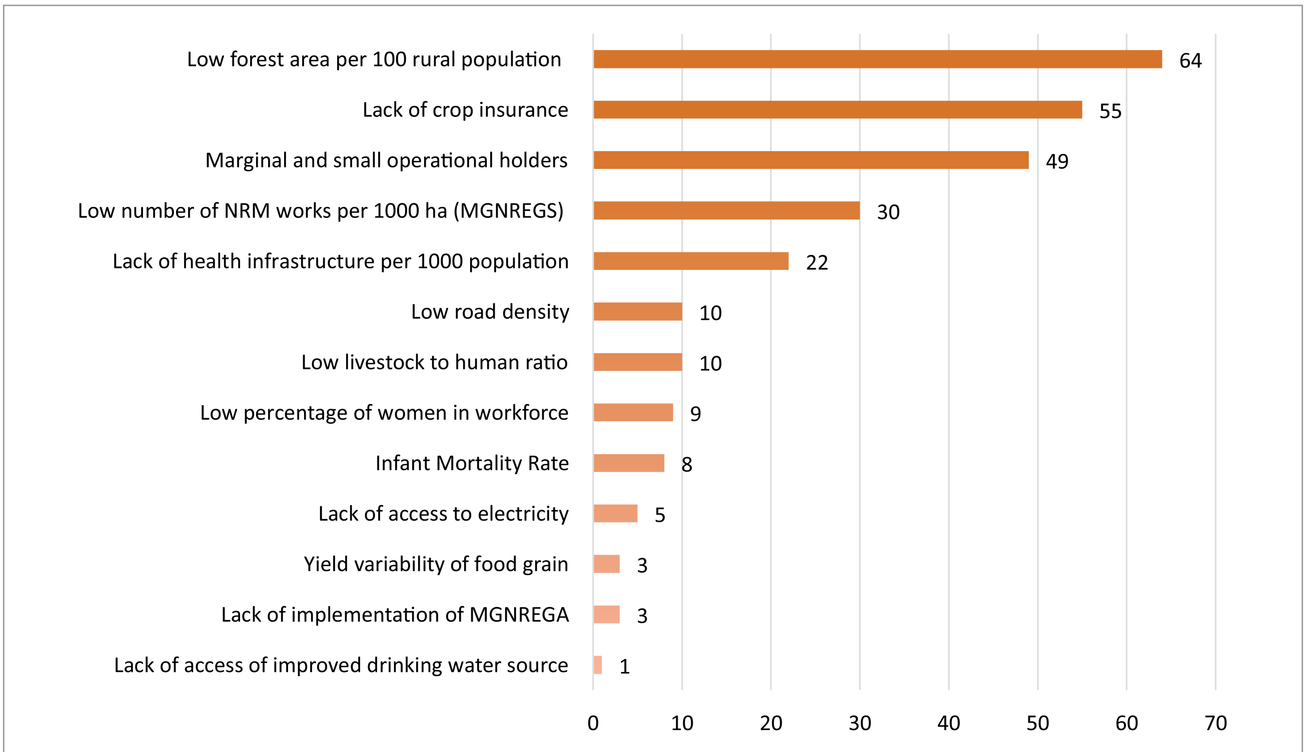

Figure 99: Drivers of vulnerability (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.27. Uttarakhand

Uttarakhand has a total geographic area of 53,483 km^2 and is in the Central Himalayan Region of the country. It is situated between the 28° 43′ to 31° 27′ N latitudes and 77° 34′ to 81° 02′ E longitudes. It is largely a hilly state at the foothills of the Himalayan mountain range. The forest cover is 24,303 Km^2, 45.44% of the state's geographical area (ISFR, 2019). There are 13 districts according to the Census of 2011, with a population of 10.09 million (density of 189 persons per km^2).

Uttarakhand is temperate with seasonal variations in temperature and affected by tropical monsoons. Since it lies in the Himalayan range, the climate and vegetation vary greatly with altitude, from glaciers at the highest elevations to subtropical forests in the plains. Ice and bare rocks cover the higher elevations. The average annual rainfall is 1,500 mm and the annual temperature varies from 0° C to 43° C.

The present district-level agricultural vulnerability assessment was conducted for all 13 districts, based on 11 indicators. The list of indicators along with their functional relationships with vulnerability is represented in Table 35. Equal weights were assigned to each indicator.

District-level VIs and the related maps are presented in Figure 100 - Figure 101. The highest value of vulnerability was obtained for Garhwal (Pauri Garhwal) (0.716) and the lowest for Haridwar (0.340). The range of the VIs was divided into three categories: relatively high vulnerability (0.590-0.716) (Pauri Garhwal , Tehri Garhwal, Almora, Dehradun, Rudraprayag, Bageshwar), relatively moderate vulnerability (0.465-0.590) (Champawat, Pithoragarh, Uttarkashi, Chamoli, Nainital), and relatively low vulnerability (0.340-0.465) (Udham Singh Nagar, Haridwar).

Major drivers of vulnerability are presented in Figure 102. Six indicators emerged as the main drivers of vulnerability: low percentage of commercial crops to net sown area, lack of NRM works per 1000 ha, less number of households having Kisan Credit Cards with limit 50,000 or above, low road density, and high percentage of marginal and small operational holders. Among the 6 selected drivers, percentage of commercial crops to net sown area is a driver in 10 of the 13 districts. Further, the number of NRM works per 1000 ha (MGNREGA) was observed to be accountable for the vulnerability of 9 districts, and NRM works per 1000 ha and percentage of households having KCC with limit 50,000 or above were found responsible for the vulnerability of 8 districts.

Table 35: Indicators used for district-level agriculture assessment for Uttarakhand

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Cropping intensity	Adaptive Capacity	Negative
Proportion of area under commercial crops to net sown area	Adaptive Capacity	Negative
Percentage of marginal and small operational land holders	Sensitivity	Positive
Drainage density	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Annual average days of work per household under MGNREGA	Adaptive Capacity	Negative
Net irrigated area to net sown area	Sensitivity	Positive
NRM work per 1000 ha	Adaptive Capacity	Negative
Income diversification	Adaptive Capacity	Negative
Percentage of household having Kisan Credit Card with limit 50,000 or above	Adaptive Capacity	Negative
Livestock to human ratio	Adaptive Capacity	Negative

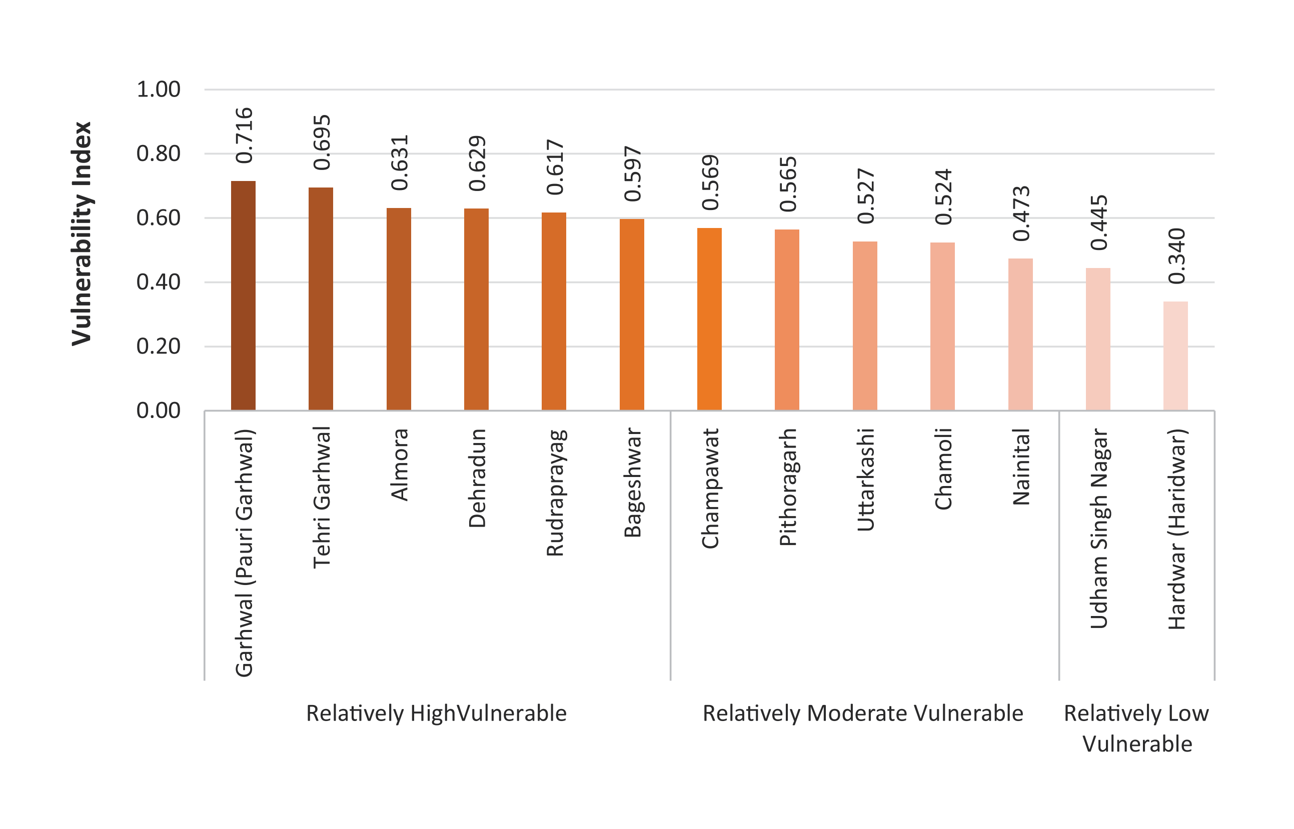

Figure 100: **Vulnerability Indices (VIs) and ranking of districts in Uttarakhand**

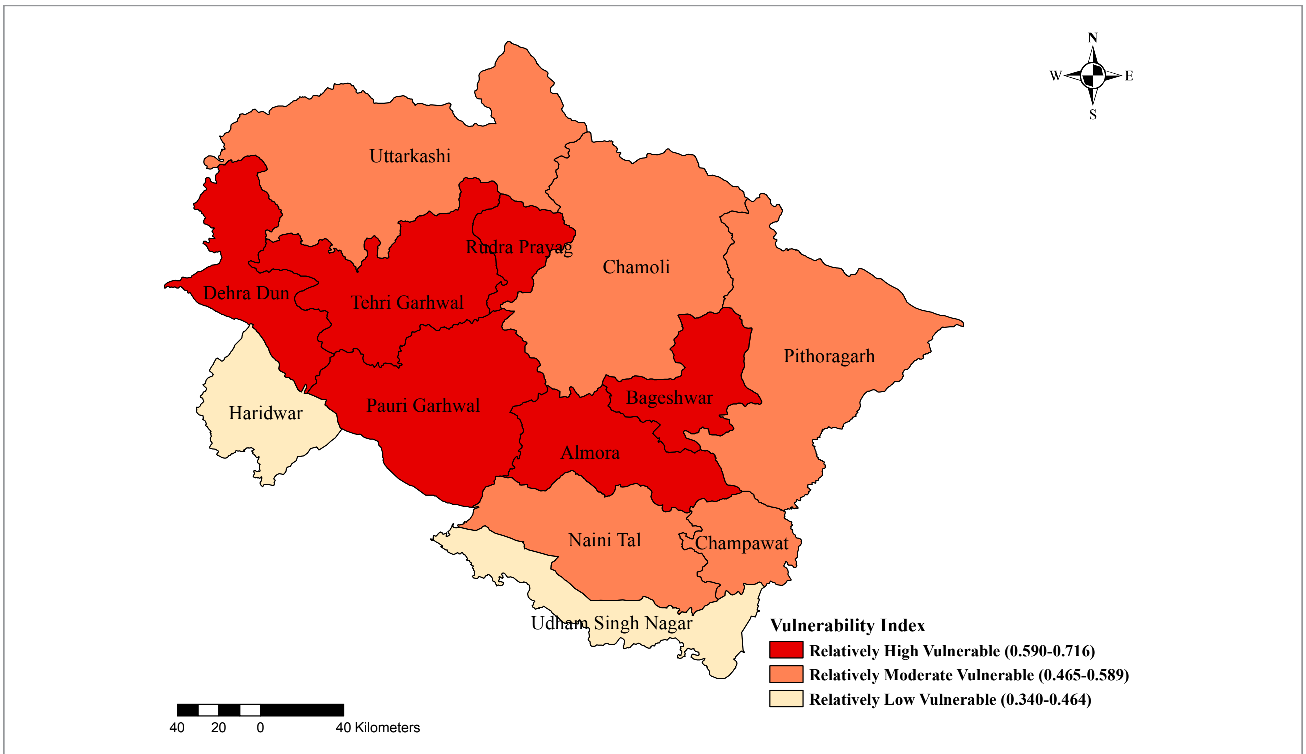

Figure 101: **Map showing agriculture vulnerability categories of Uttarakhand at district level**

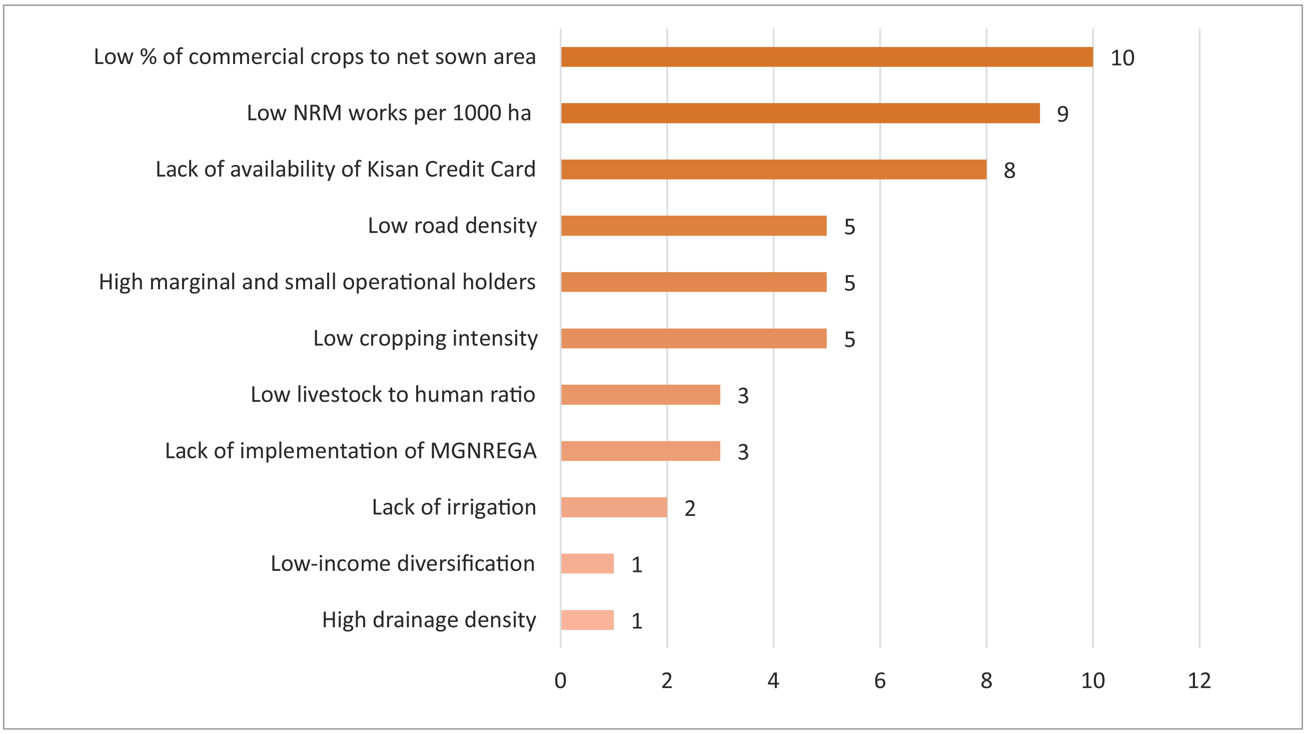

Figure 102: Drivers of agricultural vulnerability (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.28. West Bengal

West Bengal lies in the eastern part of the country at the latitude of 27°13'15"N to 21°25'24"N and longitude of 85°48'20"E to 89°53'04"E. The state has a very peculiar configuration, since its breadth varies from 320 km at one point to only 16 km at another. Its diverse fauna and flora reflect the combined characteristics of the Himalayan, sub-Himalayan, and Gangetic Plain areas.

West Bengal's climate is transitional between tropical wet-dry in the south and humid subtropical in the north. There are four weather types: dry summer, monsoon, autumn, and winter. Throughout the state, there is a pronounced seasonal disparity in rainfall. The average, normal rainfall is 1830 mm in general, and 2486 mm in Sub-Himalayan West Bengal and 1502 mm in the Gangetic Region.

In this report, a district-level integrated vulnerability assessment for West Bengal and a block-level agricultural vulnerability assessment for the Darjeeling Himalayan Region are presented. An integrated vulnerability assessment for the Darjeeling Himalayan Region had already been taken up under the previous IHCAP project (2019).

3.33.1. District-level vulnerability assessment of West Bengal

The district-level integrated vulnerability assessment was carried out based on a set of 12 indicators. These indicators along with their dimensions and functional relationships are given in Table 36. While the state has 19 districts altogether, in the present analysis, Kolkata was excluded, because it is a big city with very different characteristics from the other districts.

The highest vulnerability was found for district Malda (0.69) and the lowest for district Purba Medinipur (0.384). Figure 103 gives the VIs and corresponding ranking of the districts. The map showing the categorisation of districts is given in Figure 104.. The range shows that all the districts lie within a small range of VIs. This means all districts are requiring attention in terms of adaptation. The range of VIs was divided into three equal intervals to identify relatively high vulnerability (0.59-0.69), moderate vulnerability (0.49 -0.59), and relatively low vulnerability (0.38-0.49). Malda, Jalpaiguri, Nadia, and Uttar Dinajpur were found to be highly vulnerable districts.

The major drivers contributing to the vulnerability of the districts were found to be lack of forest area per 1000 rural population (15 districts), less number of NRM works per 1000 ha (MGNREGA and/or other schemes) (13 districts), and low road density (18 districts).

Table 36: List of indicators used for the assessment of district-level vulnerability for West Bengal

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with Vulnerability
Per capita income	Adaptive Capacity	Negative
Female literacy rate	Adaptive Capacity	Negative
Livestock per 1000 rural households	Adaptive Capacity	Negative
Forest area (in ha) per 1000 rural population	Adaptive Capacity	Negative
Yield variability of food grain	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA	Adaptive Capacity	Negative
Number of NRM works per 1,000 ha (MGNREGS and/or other schemes)	Adaptive Capacity	Negative
Percentage household with improved drinking water source	Adaptive Capacity	Negative
Health infrastructure per 1000 population	Adaptive Capacity	Negative
Insant Mortality Rate (IMR)	Sensitivity	Positive
Cases of vector-borne diseases per 1000 population (dengue & malaria)	Sensitivity	Positive

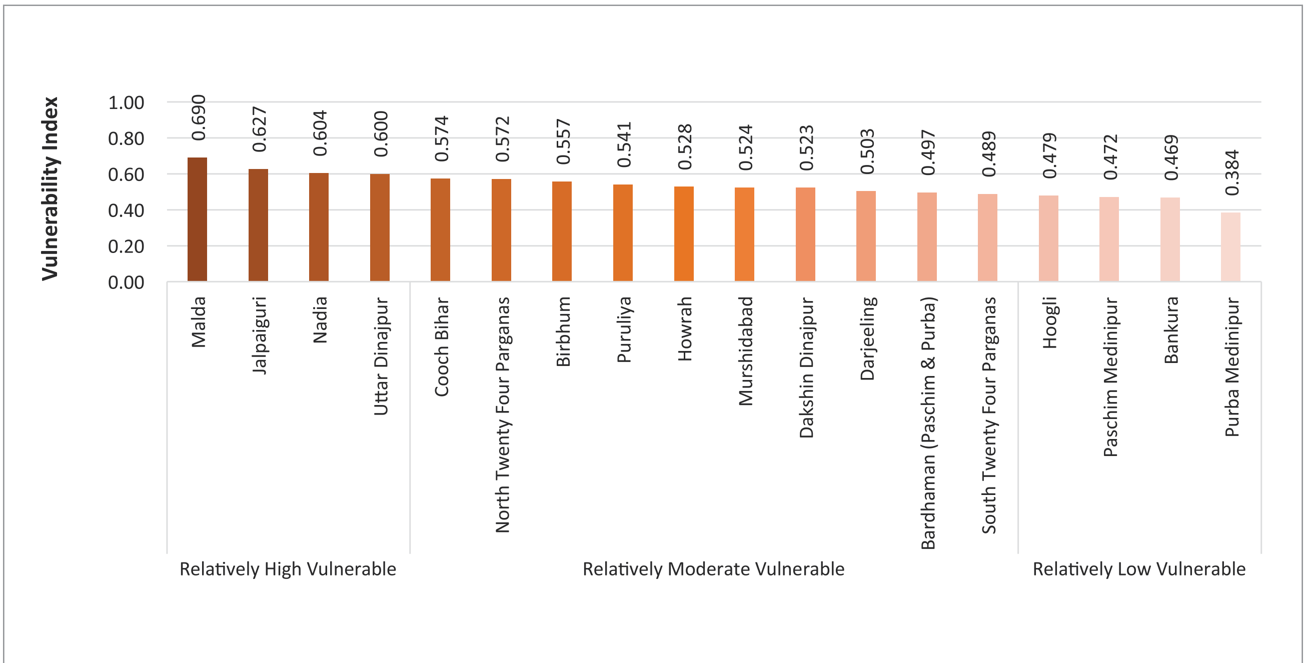

Figure 103: Vulnerability Indices (VIs) and ranking of districts in West Bengal

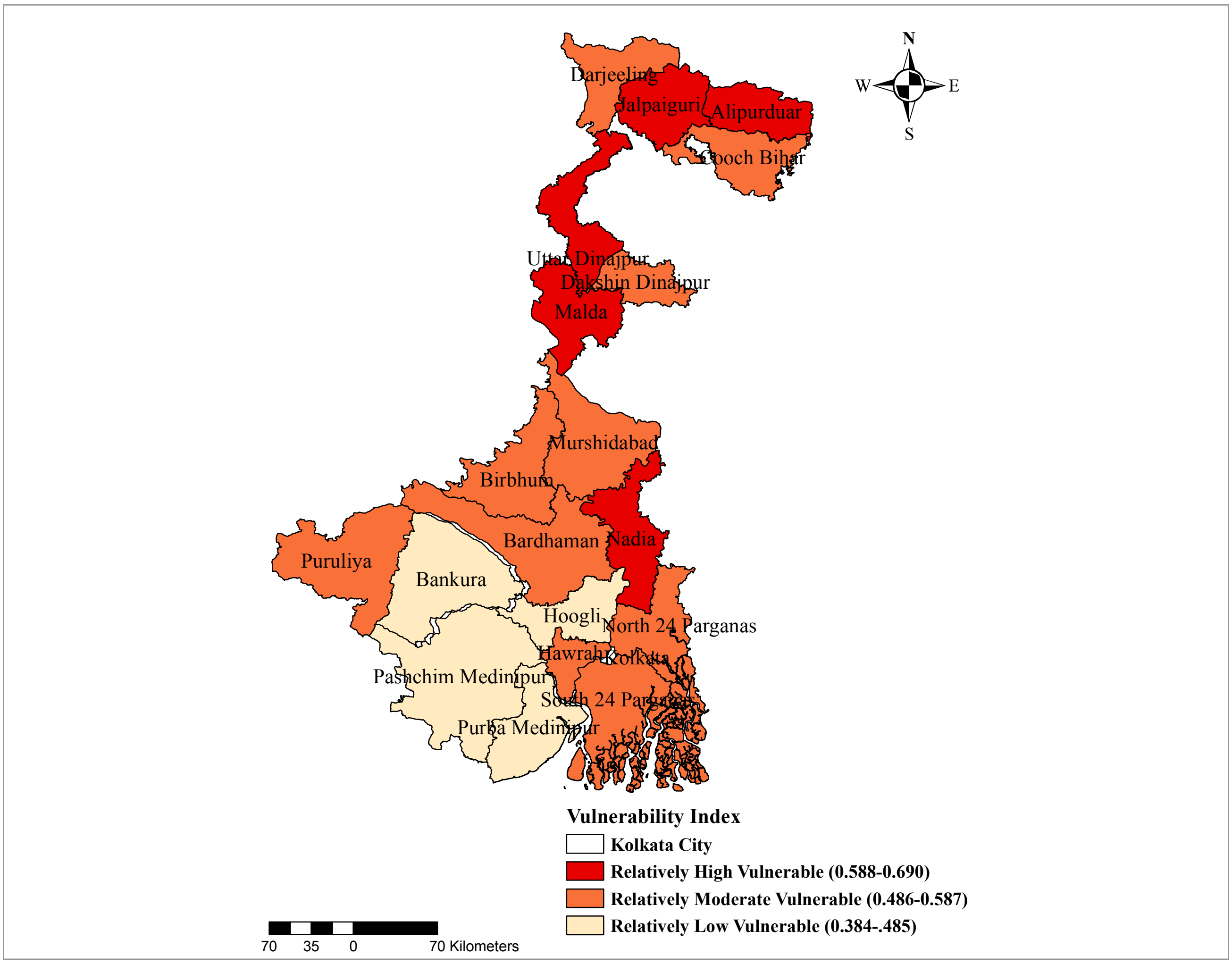

Figure 104: Map showing the categories of vulnerability of the districts in West Bengal

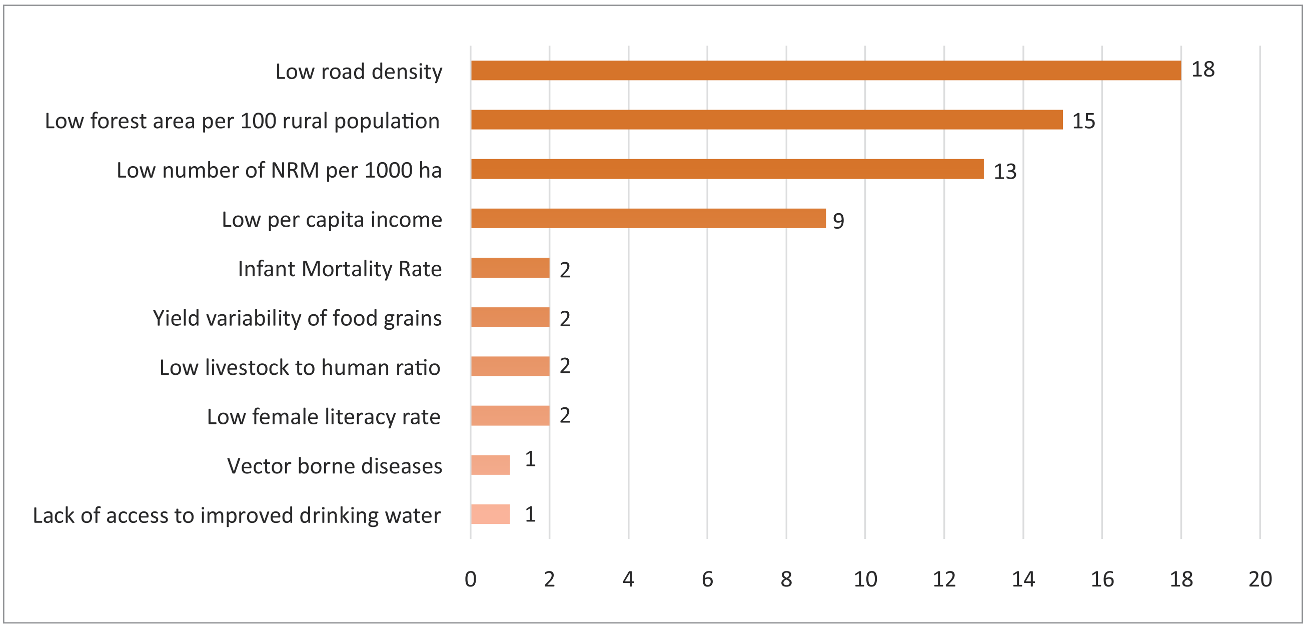

Figure 105: Drivers of vulnerability in districts of West Bengal (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

3.33.2. Block-level agricultural vulnerability of Darjeeling Himalayan Region in West Bengal

The communities living in the Darjeeling Himalayan Region in West Bengal have a large dependency on climate-sensitive factors as well as the use of 'not-so-modern' technology options and inputs in the agricultural sector. An attempt has been made to bring out the situation of agricultural vulnerability of the blocks in this Region by analysing the vulnerability of people engaged in agricultural practices and weighing the impacts of climate change on agriculture produce and the economy at large there.

The net sown area is particularly small in the hilly blocks and agriculture is mostly practiced at subsistence level as rain-fed agriculture. There is a good potential, though, for horticulture, herbarium keeping and growing medicinal plants among other. Tea cultivation is already practiced at a large scale, but it seeks better attention in all aspects. The block-level integrated vulnerability assessment was carried out based on a set of 6 indicators. Table 37 gives the list of indicators used for the assessment. Unequal weights were assigned to all the indicators based on a literature review and views of the project staff.

VIs range between 0.591 in Mirik and 0.241 in Matigara Block. Darjeeling-Pulbazar, and Jorbunglow-Sukhiapokhri Blocks too have been identified as highly vulnerable blocks. The average value of NVs across blocks is considered to identify the drivers of vulnerability. The study reveals that a high yield variability, low crop intensity, and low ratio of livestock to total population contribute significantly to a high agricultural vulnerability. High and fluctuating yields of foodgrains in the hill blocks as well as in the plains reflect the change in climate variables and are highly indicative of the adverse impacts of climate change on agriculture.

Table 37: List of indicators used for the assessment of block-level agricultural vulnerability of the Darjeeling Himalayan Region in West Bengal

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability	Weights
Yield variability of food grains	Sensitivity	Positive	28
Crop intensity	Adaptive Capacity	Negative	22
Percentage of marginal land- holders to total agricultural population	Sensitivity	Positive	18
Percentage of population in agricultural and allied activities	Sensitivity	Positive	15
MGNREGA	Adaptive Capacity	Negative	11
Livestock to total population	Adaptive Capacity	Negative	6

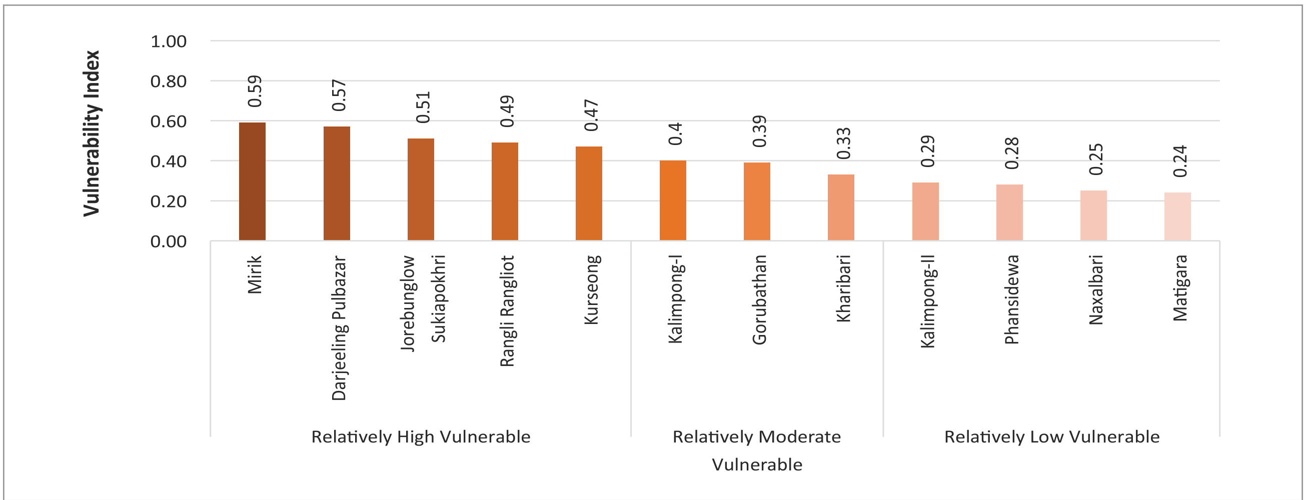

Figure 106: Agricultural Vulnerability Indices (VIs) and ranking of blocks of Darjeeling Himalayan Region in West Bengal

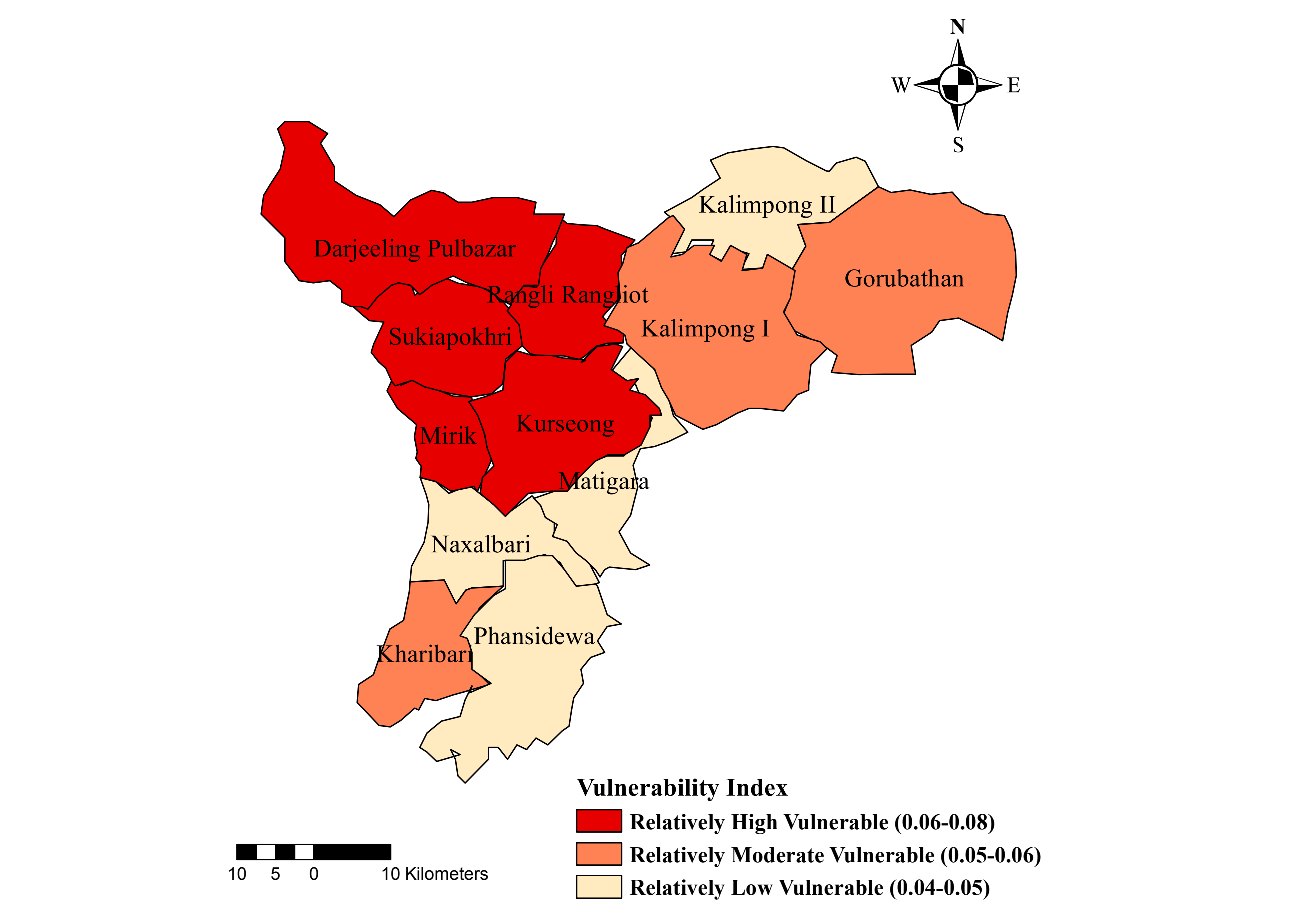

Figure 107: **Map showing the categories of agricultural vulnerability of the blocks of the Darjeeling Himalayan Region in West Bengal**

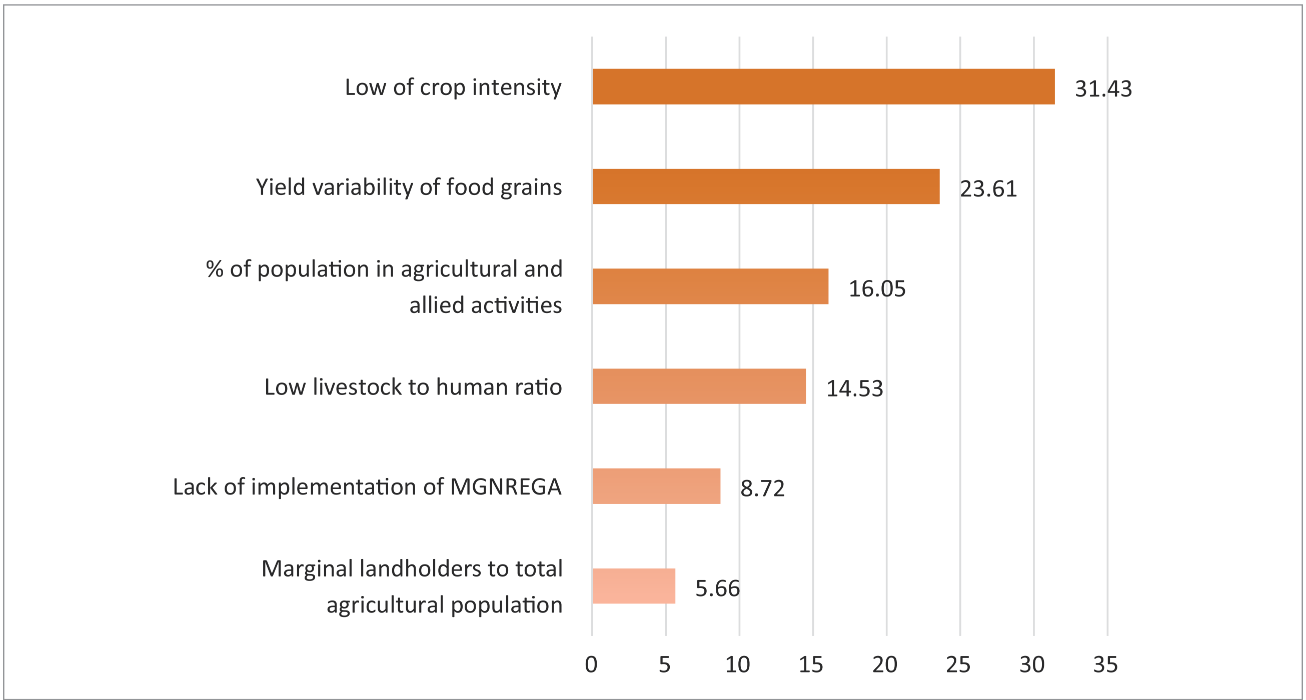

Figure 108: **Drivers of agricultural vulnerability of blocks of the Darjeeling Himalayan Region in West Bengal (length of the bar representing the average normalized value of the corresponding indicator)**

3.29. Pondicherry

Pondicherry is one of the UTs of India, situated on the south-east coast. It comprises of 4 districts that are geographically disjoint. The climate of Pondicherry is classified as tropical wet and dry. The summer lasts from April to early June when maximum temperatures may reach 41°C. The average maximum temperature is 36°C. Minimum temperatures are in the order of 28°-32°C. Summer is followed by a period of high humidity and occasional thundershowers from June till September. The annual average rainfall is 1,355 mm. Winters are very warm, with highs of 30°C and lows often dipping to around 18°-20°C.

The present district-level vulnerability assessment was conducted for the 4 districts of Pondicherry based on 16 indicators. The list of indicators along with their functional relationships with vulnerability is represented in Table 38. Equal weights were assigned to each indicator.

District-level VIs and the related maps are presented in Figure 109 -Figure 110. Districts were ranked from high to low vulnerability. The highest value of vulnerability was obtained for Mahe (0.590), followed by Puducherry (0.570), and Yanam (0.470), while the lowest value was for Karaikal (0.450). Major drivers of vulnerability are presented in Figure 111. Eight indicators emerged as the main drivers of vulnerability: total number of livestock per 1000 population, tourist footfall per 1000 population (3), forest area (in ha) per 1000 rural population (2), variability in food grain crop yield (3 years: 2016-2017 to 2018-2019) (2), number of banks per 1000 population (2), average person days per household employed under MGNREGA over the last 5 years (2015-2016 – to 2019-2020) (2), cases of vector-borne diseases per 1000 population (dengue & malaria) (2), and cases of water- borne diseases per 1000 population (2).

Table 38: Indicators used for district-level vulnerability assessment for Pondicherry

Indicators	Adaptive Capacity / Sensitivity	Functional relationship with vulnerability
Percentage BPL households (as per BPL card)	Sensitivity	Positive
Tourist footfall per 1000 population	Sensitivity	Positive
Total number of livestock per 1000 population	Adaptive Capacity	Negative
Percentage of marginal and small farmers (land <5 acre)	Sensitivity	Positive
Women's participation in labour force	Adaptive Capacity	Negative
Forest area (in ha) per 1000 rural population	Adaptive Capacity	Negative
Percentage net area irrigated to net sown area	Adaptive Capacity	Negative
Yield variability of food grain	Sensitivity	Positive
State of groundwater development (draft of groundwater in relation to availability)	Sensitivity	Positive
Road density	Adaptive Capacity	Negative
Number of banks per 1000 population	Adaptive Capacity	Negative
Average person days per household employed under MGNREGA over last 5 years	Adaptive Capacity	Negative
Percentage of households electrified	Adaptive Capacity	Negative
Cases of Vector-borne diseases per 1000 population	Sensitivity	Positive
Cases of Water-borne diseases per 1000 of population	Sensitivity	Positive
Number of doctors, specialists, health assistants & health workers per 1000 population	Adaptive Capacity	Negative

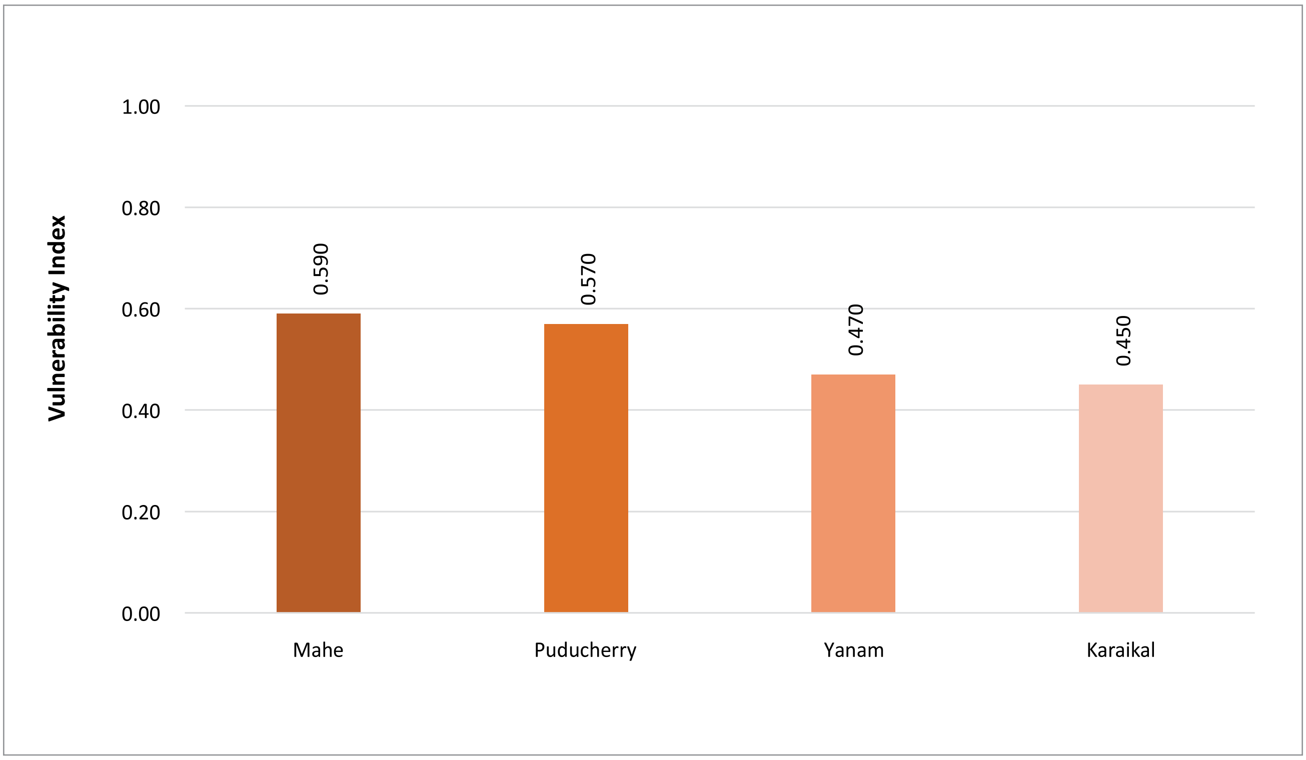

Figure 109: Vulnerability Indices (VIs) and ranking of districts in Pondicherry

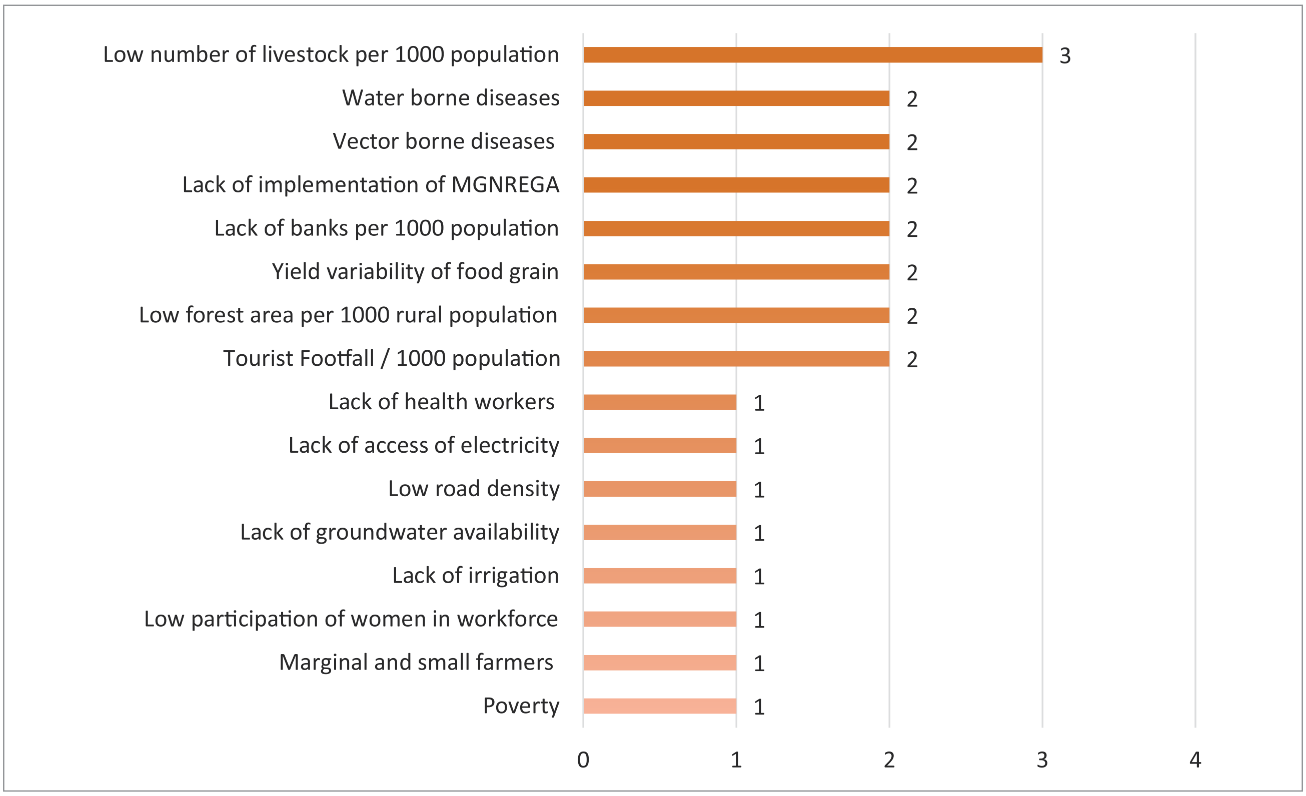

Figure 111: Drivers of vulnerability (length of the bar representing the number of districts in which the indicator acts as a driver of vulnerability)

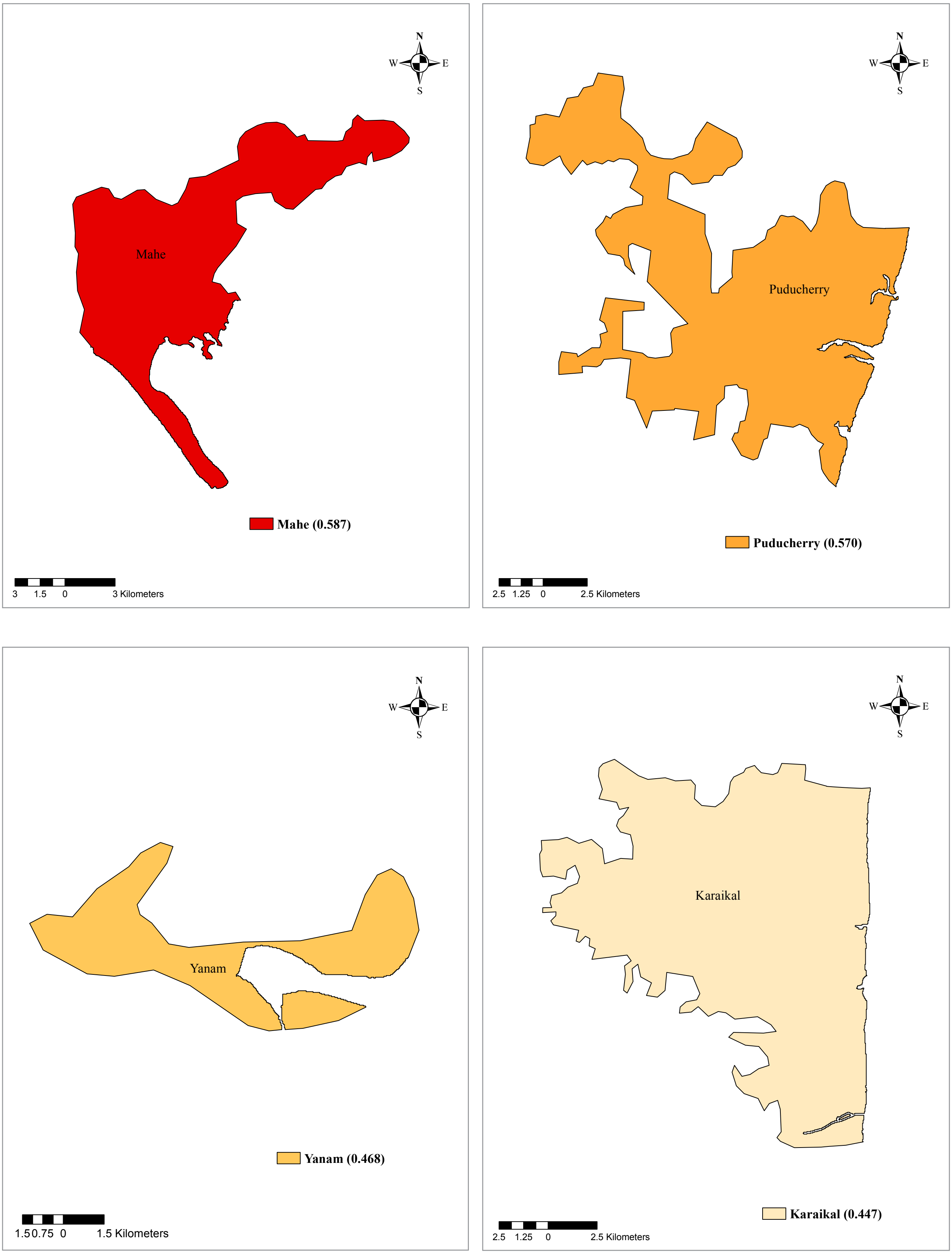

Figure 110: Map showing Vulnerability Ranking of Pondicherry at District level

Utility of the report and way forward

Utility of the report and way forward

Assessing vulnerability to climate change is important as it helps to understand climate risks and provides information, on the location specific measures to be taken to adapt to climate change. Hence, a vulnerability assessment is the first step in adaptation planning. This project was initiated to inform the policymakers of India on the vulnerability profiles of different states using a common assessment framework. The present assessment has used the IPCC 2014 'Risk and Vulnerability Framework' as the base of such a common framework, which is a clear improvement over the IPCC-2007 framework. The purpose is to measure the comparable degrees of vulnerability for all Indian states for prioritization of the states for climate change adaptation planning and investment. The analysis also helps the states in understanding the major drivers of vulnerability and target the adaptation actions accordingly.

It needs to be mentioned that vulnerability is a relative measure and shows the position of one spatial unit with respect to the other relatively low vulnerability doesn't necessarily imply that the spatial unit has low vulnerability in an absolute sense. Based on the VIs derived, the report concludes that all states in India are vulnerable to climate risks. However, the ranking of states using a VI indicates the relative vulnerability of the states and such an assessment helps policymakers and funding agencies to prioritize states for adaptation interventions.

Also, with differentiation in the relative vulnerability of districts in India, the corresponding response by various stakeholders should ideally be differentiated as well. In more vulnerable districts the adaptation action should focus on reducing vulnerability while in districts that are relatively less vulnerable the adaptation actions should be geared towards managing climate-induced hazards and exposure to these hazards. Such a targeted approach would help in enhancing the efficiency and effectiveness of adaptation actions.

This assessment would allow for better-suited climate adaptation actions by factoring in differentiating features of districts and assist in the following:

- A vulnerability assessment can assist in ranking and identification of the most vulnerable districts and states and help states prioritise adaptation planning and investments. It will provide a basis to identify the entry-point of intervention for adaptation planning and investment at the district-level through the identification of priority sectors and major drivers of vulnerability.
- It is critical for developing adaptation projects for the Green Climate Fund, Adaptation Fund, and funds from multilateral and bilateral agencies.
- The vulnerability assessments carried out by the states (Part III of the report) could become a chapter in their revised State Action Plan on Climate Change, as per the outline provided by the Ministry of Environment, Forests and Climate Change.
- It will also facilitate Nationally Determined Contributions, which aims to adapt better to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, health sector and regions such as Himalayan region, coastal regions, etc. It may also aid to plan disaster management.
- A vulnerability assessment contributes to reporting under the Paris Agreement, Article-9 through the assessment of climate change impacts and vulnerability; the formulation and implementation of a National Adaptation Plan, monitoring and evaluation of adaptation plans, policies and programmes; and the development and implementation of resilience of socio-economic and ecological systems.

A vulnerability assessment is a first step, considering only current climate risks. A future direction of research and implementation is towards developing a climate risk map based on a hazard, vulnerability, and exposure framework. There is a need for a climate-change risk index development and a risk ranking of districts and states, based on a risk framework under climate change, where:

Risk = f (Hazard, Exposure, Vulnerability).

The future direction of work involves:

- Development of a common framework, methodology, and guidelines for an overall risk assessment.
- Development of a Risk Index for states. All State Climate Change Centres funded by the Department of Science and Technology could undertake this assessment. It requires building capacity for risk assessment and adaptation planning.

A vulnerability assessment is inherently a data-intensive process and hence non-availability of the latest data remained a major challenge, as reported by multiple states. Lack of availability of data, in many cases, had both spatial as well as temporal dimension. Followed by the state and district-level analysis, the vulnerability assessment should ideally be carried out also at a block/village level. Therefore, availability of data is important in a similar resolution. Moreover, given the current pandemic, the effort of the states to collect data from their line departments had to be stalled. Also, for various important demographic indicators, including proportion of BPL population and women's participation in the workforce, the assessment had to rely on data obtained from Census, 2011. Overall, it shows the importance of generation of data on important indicators in regular and relatively shorter intervals. Generation of data for risk assessment is also important. There is need of a strategy for data generation for a climate-change risk and vulnerability assessment and adaptation planning.

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Appendix

Appendix_Table 1: State-level land use pattern in India

States	Geographical area (km²) (2019)	The area under forest (km²) (2019)	Area under agriculture ('000 ha) (2014-15)	The area under wasteland (km²) (2015-16)	% Area irrigated (2014-15)
Andhra Pradesh	162970	29137	9047	23982	46.94
Arunachal Pradesh	83743	66688	423	13906	24.89
Assam	78438	28327	3364	9003	10.47
Bihar	94163	7306	6579	7685	56.59
Chhattisgarh	135192	55611	5558	10875	31.32
Goa	3702	2237	197	516	30.23
Gujarat	196244	14857	12661	21740	41.09
Haryana	44212	1602	3656	1659	84.44
Himachal Pradesh	55673	15434	812	22832	20.55
Erstwhile Jammu & Kashmir	222236	23612	1075	175697	43.67
Jharkhand	79716	23611	4343	11767	14.95
Karnataka	191791	38575	12827	13230	35.73
Kerala	38852	21144	2266	2288	20.26
Madhya Pradesh	308252	77482	17252	39537	62.43
Maharashtra	307713	50778	21099	36075	18.70
Manipur	22327	16847	390	5652	18.02
Meghalaya	22429	17119	1056	4136	28.32
Mizoram	21081	18006	367	4301	11.03
Nagaland	16579	12486	694	5064	25.26
Orissa	155707	51619	6784	18422	28.14
Punjab	50362	1849	4285	462	99.98
Rajasthan	342239	16630	25511	78851	44.99
Sikkim	7096	3342	97	3295	15.58
Tamil Nadu	130060	26364	8112	8222	56.57
Telangana	112077	20582	6877	14241	39.43
Tripura	10486	7726	272	921	30.98
Uttar Pradesh	240928	14806	18939	12726	86.69
Uttarakhand	53483	24303	1549	8537	47.14
West Bengal	88752	16902	5655	1655	59.22

Source: Geographical Area Km^2 (1), Area Under forest Km^2 (1), Area under agriculture 000's of a hectare (2), Area under wetlands Km^2 (3), % area irrigated (4)

Appendix_Table 2: Demographic and socio-economic features of the states in India

States	Population density (person/ Km) (2019)	Literacy rate (2011)	GSDP in 2014-15 at a constant price, the base year 2011-12 (Billion INR)	% of BPL Households (2011)	Infant Mortality Rate (2011)
Andhra Pradesh	308	67.02	4.42	9.20	34
Arunachal Pradesh	17	65.39	0.14	34.67	36
Assam	398	72.19	1.67	31.98	44
Bihar	1,106	61.80	3.05	33.74	38
Chhattisgarh	189	70.28	1.96	39.93	39
Goa	394	88.70	0.35	5.09	8
Gujarat	308	78.03	7.92	16.63	30
Haryana	573	75.55	3.67	11.16	33
Himachal Pradesh	123	82.80	0.89	8.06	25
Erstwhile Jammu and Kashmir	124	67.16	0.85	10.35	24
Jharkhand	414	66.41	1.86	36.96	29
Karnataka	319	75.37	7.60	20.91	24
Kerala	860	94.00	4.32	7.05	10
Madhya Pradesh	236	69.32	3.84	31.65	47
Maharashtra	365	82.34	15.25	17.19	19
Manipur	128	76.90	0.15	36.89	11
Meghalaya	132	74.43	0.21	11.87	39
Mizoram	52	91.33	0.10	20.40	27
Nagaland	119	79.60	0.14	18.88	12
Orissa	270	72.89	2.75	32.59	44
Punjab	551	75.84	3.13	8.26	21
Rajasthan	201	66.11	5.12	14.71	41
Sikkim	86	81.42	0.13	8.19	16
Tamil Nadu	555	80.09	9.01	11.28	17
Telangana	314	66.46	4.24	25.82	31
Tripura	350	87.22	0.25	14.05	24
Uttar Pradesh	829	67.68	8.54	29.43	43
Uttarakhand	189	78.82	1.41	11.26	38
West Bengal	1,028	76.26	3.98	19.98	25

Source: Literacy rate, % BPL household and IMR (5), Population Density-calculated based on population data from (6), GSDP (4)

Appendix_Table 3: Database for 14 indicators used in the all-India state-level assessment

States	Poverty rate (% BPL population) (2011)	Proportion of Income from Natural Resources to GSDP (2014-15/2015-16)	Proportion of output from perennial trees to total value of agricultural and allied output (2015-16)	% of marginal and small operational holding (2015-16)	Coefficient of variation/ Yield variability of food grains (2004-2005 - 2014-15)	Proportion of area under PMFBY and RWBCIS crop insurance (2017 -18)	proportion of rainfed agriculture (2014-15)	Forest area (sq. KM) per 1,000 rural population (2019)	Work participation rate (Women) (2011)	Average person day per household employed under MNAREGA (2014-15 - 2015-16)	Road Rail Density (KM/KM2) (2016-17+2018-19)2019	Density of health care workers (per lakh population) (2016)	Vector Borne Diseases per 1,000 population (2018-19)	Water Borne Diseases per 1,000 population (2018-19)
Andhra Pradesh	9.2	0.31	0.11	0.89	0.08	0.35	0.53	0.77	36.16	47	1.11	212.7	0.20	25.13
Arunachal Pradesh	34.67	0.44	0.19	0.45	0.18	0.00	0.75	55.88	35.44	14	0.51	270.3	0.73	16.42
Assam	31.98	0.26	0.09	0.86	0.15	0.02	0.90	0.94	22.46	22	4.31	148.5	0.17	7.16
Bihar	33.74	0.27	0.08	0.97	0.20	0.40	0.43	0.07	19.07	34	2.23	110.2	0.06	3.31
Chhattisgarh	39.93	0.21	0.06	0.83	0.16	0.48	0.69	2.50	39.7	32	0.72	165.3	2.75	6.90
Goa	5.09	0.07	0.15	0.91	0.08	0.00	0.70	3.78	21.92	23	6.09	446.8	0.76	15.39
Gujarat	16.63	0.19	0.06	0.68	0.13	0.26	0.59	0.40	23.38	35	0.92	174.6	0.61	12.12
Haryana	11.16	0.22	0.01	0.69	0.08	0.55	0.16	0.09	17.79	28	1.93	204.8	0.18	9.90
Himachal Pradesh	8.06	0.22	0.21	0.89	0.10	0.20	0.79	2.32	44.82	42	1.16	259.2	0.65	44.15
Erstwhile Jammu and Kashmir	10.35	0.22	0.21	0.95	0.10	0.20	0.56	2.37	19.11	36	0.29	220.5	0.03	38.48
Jharkhand	36.96	0.16	0.05	0.84	0.18	0.22	0.85	0.82	29.1	41	0.99	153.8	1.56	3.13
Karnataka	20.91	0.12	0.11	0.80	0.09	0.18	0.64	0.94	31.87	40	1.88	206.2	0.46	15.71
Kerala	7.05	0.12	0.16	0.99	0.07	0.02	0.80	1.14	18.23	43	6.30	394	0.14	15.59
Madhya Pradesh	31.65	0.40	0.05	0.76	0.18	0.82	0.38	1.28	32.64	42	1.11	163	0.35	7.05
Maharashtra	17.35	0.11	0.10	0.81	0.11	0.34	0.81	0.76	31.06	53	2.03	292	0.26	5.72
Manipur	36.89	0.28	0.15	0.83	0.12	0.05	0.82	7.81	38.56	22	1.24	258.5	0.12	10.67
Meghalaya	11.87	0.19	0.15	0.79	0.14	0.01	0.72	6.45	32.67	48	1.02	153	2.05	39.32
Mizoram	20.4	0.42	0.08	0.81	0.36	0.00	0.89	30.76	36.16	22	0.52	588.2	3.65	14.78
Nagaland	18.88	0.34	0.13	0.19	0.15	0.00	0.75	7.91	44.74	22	2.19	272.7	0.23	10.58
Orissa	32.59	0.19	0.08	0.93	0.10	0.32	0.72	1.35	27.16	36	1.95	199.2	1.60	14.25
Punjab	8.26	0.31	0.03	0.33	0.21	0.00	0.00	0.10	13.91	22	2.77	271.3	0.55	7.59
Rajasthan	14.71	0.36	0.01	0.62	0.17	0.54	0.55	0.28	35.12	46	0.78	143.7	0.17	12.87
Sikkim	8.19	0.09	0.04	0.85	0.11	0.00	0.84	6.56	39.57	43	1.60	465.6	1.04	61.12
Tamil Nadu	11.28	0.14	0.11	0.93	0.20	0.26	0.43	0.66	31.8	47	2.01	222.7	0.13	5.40
Telangana	9.2	0.15	0.08	0.88	0.08	0.22	0.61	0.87	36.16	43	1.13	212.7	0.22	13.86
Tripura	14.05	0.29	0.12	0.96	0.07	0.01	0.69	2.54	23.57	88	4.09	180.6	3.46	20.24
Uttar Pradesh	29.43	0.31	0.06	0.93	0.08	0.28	0.13	0.08	16.75	34	1.78	134.6	0.31	8.88
Uttarakhand	11.26	0.12	0.11	0.92	0.08	0.17	0.53	3.13	26.68	32	1.30	216.3	0.10	11.13
West Bengal	19.98	0.38	0.06	0.96	0.10	0.36	0.41	0.25	18.08	33	3.63	243.7	0.29	25.37
STDEV	10.84	0.10	0.05	0.19	0.06	0.21	0.23	11.19	8.70	13.72	1.51	106.9	0.99	13.28
Mean	19.37	0.24	0.10	0.80	0.13	0.22	0.61	4.92	29.09	36.90	1.99	240.8	0.79	16.63
COV	56%	44%	54%	23%	46%	95%	37%	227%	30%	37%	76%	44%	125%	80%

Appendix_Table 4: Data source of the indicators used in the all-India state-level assessment

Indicators	Data Source
% BPL population	(Reserve Bank of India (RBI), 2011-12), https://m.rbi.org.in/Scripts/PublicationsView.aspx?id=18810 (Census 2011)
Income share from natural resources*	(NITI Ayog, 2012), https://niti.gov.in/content/2011-12-series (NITI Aayog)
Share of horticulture in agriculture	(Ministry of Statistics and Programme Implementation (MoSPI), 2018), http://mospi.nic.in/sites/default/files/publication_reports/Final1Brochure_30july2018.pdf (State-wise and item-wise estimates of the value of output from agriculture and allied sectors (2011-12 to 2015-16), CSO, MoSPI)
Marginal and small landholdings	(Ministry of Agriculture & Farmers Welfare, 2018) http://agricoop.gov.in/sites/default/files/agristatglance2018.pdf (Table 15.2: Area of Operational Holding by size group, 2015-16 (P), Agricultural Statistics at a Glance 2018)
Yield variability of food grains*	(Ministry of Agriculture & Farmers Welfare, 2018), http://agricoop.gov.in/sites/default/files/agristatglance2018.pdf (Table 4.1.4: Total Foodgrains: State-wise yield, Agricultural Statistics at a Glance 2018)
Area covered under crop insurance*	(Ministry of Agriculture & Farmers Welfare, 2018-19)http://agricoop.nic.in/sites/default/files/AR_2018-19_Final_for_Print.pdf (Table 9.2.2: Restructured Weather Based Crop Insurance Scheme (RWBCIS), Coverage under PMFBY & RWBCIS, Annual Report 2018-19, Department of Agriculture, Corporation and Farmers Welfare)
The area under rainfed agriculture	(Reserve Bank of India (RBI), 2011-12)https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=18844 (Reserve Bank of India)
Livestock to human ratio	(20th Livestock Census, 2019) http://dadf.gov.in/sites/default/filess/20th%20Livestock%20census-2019%20All%20India%20Report.pdf (20th Livestock Census 2019); Population: Population Data: https://uidai.gov.in/images/state-wise-aadhaar-saturation.pdf
Forest area per 1,000 rural population	(Unique Identification Authority of India Estimates (UIDAI), 2020)Population Data: https://uidai.gov.in/images/state-wise-aadhaar-saturation.pdf (UIDAI, Govt. of India); % Rural Population: http://statisticstimes.com/demographics/population-of-indian-states.php (UIDAI, Govt. of India); (Forest Survey of India, 2019), http://fsi.nic.in/isfr19/vol1/chapter2.pdf (Forest Statistics of India, 2019)
Women participation in labour force	(Ministry of Statistics and Program Implementation (MoSPI), 2017) http://mospi.nic.in/sites/default/files/reports_and_publication/statistical_publication/social_statistics/WM17Chapter4.pdf (Census, 2011)
MGNREGA*	(Mahatma Gandhi National Rural Employment Guarantee Act, 2005 (MGNREGA), 2015-16), https://visualize.data.gov.in/?inst=51a18f1b-c3a8-45fb-82fb-cd884d1c2650&vid=16861# (MGNREGA Website)
Road + rail density	(Ministry of Road Transport & Highways Transport Research Wing, 2016-17), https://morth.gov.in/sites/default/files/Basic%20_Road_Statics_of_India.pdf (Ministry of Railways, 2018-19), http://www.indianrailways.gov.in/railwayboard/uploads/directorate/stat_econ/Year_Book/Year%20Book%202018-19-English.pdf;
Density of Health care Workers	(World Health Organization, 2016), https://www.who.int/hrh/resources/16058health_workforce_India.pdf
Vector-borne diseases (VBD)	(Ministry of Health & Family Welfare, 2019), 3.1.1 State/UT wise Cases and Deaths due to Malaria, 2014 - 2018 (P) (ICD- 10 Code B50- B54), 3.1.5 State/UT wise Cases and Deaths Due to Dengue in India, 2014 - 2018(P); (ICD- 10 Code A90- A91), 3.1.2 State/UT wise Clinically Suspected Chikungunya Cases in India, 2014- 2018 (P) (ICD-10 Code A92.0), 3.1.3 State/UT wise Cases and Deaths Due to Kala-azar in India, 2014- 2018(P); (ICD- 10 Code B55.0), 3.1.4 (A) State/UT wise Cases and Deaths Due to Acute Encephalitis Syndrome, 2014- 2018 (P); ICD- 10 Code A83.0, State/UT wise Cases and Deaths Due to Japanese Encephalitis, 2014- 2018 (P) ICD- 10 Code A83, National health profile, 2019, 14th edition, https://www.cbhidghs.nic.in/showfile.php?lid=1147
Water-borne diseases (WBD)	(Ministry of Health & Family Welfare, 2019), State/UT wise Cases and Deaths due to Acute Diarrhoeal Diseases in India, 2017; ICD – 10 Code A09, ICD – 10 Code B15-B19, 3.1.8(A) State/UT wise Cases and Deaths due to Enteric Fever (Typhoid) in India, 2017 ICD – 10 Code A01, 3.1.6(B) State/UT wise Cases and Deaths due to Cholera in India, 2018 (P) ICD – 10 Code A00National health profile, 2019, 14th edition;

Appendix_Table 5: Data-source for indicators used in the all-India district-level vulnerability assessment

Indicators	Data Source
% of households having monthly income of highest earning household members in a rural area in a rural area less than Rs. 5,000/-	(Socio Economic and Caste Census, 2011) https://secc.gov.in/welcome
Livestock to human ratio	1. (20th Livestock Census, 2019), http://www.dahd.nic.in/about-us/divisions/statistics; Total Sheep http://dadf.gov.in/sites/default/filess/District-wise%20Sheep%20Population_0.pdf; Total cattle http://dadf.gov.in/sites/default/filess/District-wise%20cattle%20population%202019_0.pdf; Total Pig http://dadf.gov.in/sites/default/filess/District-wise%20Pig%20Population_0.pdf ; Total Goat http://dadf.gov.in/sites/default/filess/District-wise%20Goat%20Population_0.pdf ; Total Buffalo http://dadf.gov.in/sites/default/filess/District-wise%20buffalo%20population%202019_0.pdf 2. For equivalent values- (Ministry of Statistics and Programme Implementation, 2011)http://www.mospi.gov.in/sites/default/files/publication_reports/Manual%20on%20Animal%20Husbandry%20Statistics.pdf
Marginal and small landholders	(Agriculture Census Division, 2019) District Tables- Input Survey Data 2011 http://inputsurvey.dacnet.nic.in/districttables.aspx
Women participation in the workforce	(Census, 2011); PCA tables Census 2011, Total Worker Population Female http://censusindia.gov.in/pca/pca.aspx
Forest area per 100 rural population	(Forest Survey of India, 2019); India state of forest report- ISFR 2019; https://fsi.nic.in/isfr-volume-ii?pgID=isfr-volume-ii
The area under rainfed agriculture	1. (Department of Agriculture, Cooperation and Farmers Welfare, 2015-16) Web-Based Land Use Statistics Information System https://aps.dac.gov.in/LUS/Public/Reports.aspx, 2015-16; 2. (Department of Agriculture, Cooperation & Farmers Welfare, 2016)http://agricoop.nic.in/agriculturecontingency/west-bengal?page=1, 2016; 3. (Department of Agriculture, Cooperation & Farmers Welfare, 2019) http://agricoop.nic.in/agriculturecontingency/Mizoram, 2019 ; 4. (Department of Agriculture, Cooperation & Farmers Welfare, 2019)http://www.agrimanipur.gov.in/district-wise-area-production/http://agricoop.nic.in/agriculturecontingency/Maharashtra, 2019 ; 5. (Department of Agriculture, Cooperation & Farmers Welfare, 2016) http://agricoop.nic.in/agriculturecontingency/Manipur, 6. (Department of Agriculture, Cooperation & Farmers Welfare, 2019), http://agricoop.nic.in/agriculturecontingency/Gujarat, 2019; 7. (Department of Agriculture, 2016-17)http://www.agrimanipur.gov.in/district-wise-area-production/; 8. (Department of Agriculture, Cooperation & Farmers Welfare, 2016)http://agricoop.nic.in/agriculturecontingency/Sikkim, 2016
% Net Sown area under horticulture	(Ministry of Agriculture & Farmers' Welfare, 2018) http://agricoop.nic.in/sites/default/files/Horticulture%20Statistics%20at%20a%20Glance-2018.pdf
Yield variability of food grains	1. (Crop Production Statistics Information System, 2006-2018), https://aps.dac.gov.in/APY/Public_Report1.aspx ; 2. (Abraham, 2019); (Kerala State Planning Board, 2006-2018); (Kerala State Planning Board, 2017); 3. (Orissa University of Agriculture and Technology, 2013-14); https://www.rkvy.nic.in/static/SAP/OR/For%20this%20Period(2017-18%20to%202019-20)/SAP_of_Orissa_Report_Final.pdf
Road density	(Census, 2011), district census handbook- town amenities; Statistical data handbook
Area covered under crop insurance	(Pradhan Mantri Fasal Bima Yojana (PMFBY, WBCIS), 2019), https://pmfby.gov.in/ceo/dashboard
Health infrastructure per thousand population	(Health Management Information System, 2020); https://nrhm-mis.nic.in/SitePages/HMIS-Publications.aspx?RootFolder=%2FPubStatistical%5FPublications%2FRural%20Health%20 Statistics&FolderCTID=0x012000AC878C9A74E6DC46A4B9220C1AAC27300098F49E13CE4ED442AB009F0A97E0CFFA&View={963874F4-C1DD-4335-9EEB-C1FC961508FB} 2014- 2018 (P)
Female literacy rate	(District Level Key Findings From NFHS-4, 2015-16), http://rchiips.org/NFHS/districtfactsheet_NFHS-2015-16
% HH with the improved drinking water source	(District Level Key Findings From NFHS-4, 2015-16)http://rchiips.org/NFHS/districtfactsheet_NFHS-4.shtml , 2015-16

Appendix_Table 6: List of districts, their vulnerability indices and ranks in the all-India assessment 5

District Considered	States	VI	Ranking
Karimganj	Assam	0.753	1
Goalpara	Assam	0.752	2
Dhubri	Assam	0.734	3
Darrang	Assam	0.732	4
Katihar	Bihar	0.725	5
Sonitpur	Assam	0.720	6
Araria	Bihar	0.707	7
Kishanganj	Bihar	0.707	8
Golaghat	Assam	0.707	9
Cachar	Assam	0.703	10
Barpeta	Assam	0.703	11
Purnia	Bihar	0.701	12
Jamui	Bihar	0.700	13
Nuapada	Orissa	0.699	14
Kokrajhar	Assam	0.699	15
Sahebganj	Jharkhand	0.696	16
Sheohar	Bihar	0.694	17
Tinsukia	Assam	0.693	18
Baksa	Assam	0.690	19
Perambalur	Tamil Nadu	0.688	20
Morigaon	Assam	0.688	21
Ariyalur	Tamil Nadu	0.686	22
Dibrugarh	Assam	0.685	23
Sivasagar	Assam	0.685	24
Hailakandi	Assam	0.684	25
Nagaon	Assam	0.683	26
Cooch Bihar	West Bengal	0.681	27
Madhepura	Bihar	0.680	28
Jalpaiguri	West Bengal	0.679	29
Bahraich	Uttar Pradesh	0.676	30
Puruliya	West Bengal	0.676	31
Lakhimpur	Assam	0.673	32
Purba champaran (East)	Bihar	0.673	33
Lakhisarai	Bihar	0.672	34
Siwan	Bihar	0.669	35
Sitamarhi	Bihar	0.668	36
Ramban	Erstwhile J&K	0.665	37
Bishnupur	Manipur	0.665	38
Mewat (Nuh)	Haryana	0.663	39
Ramanathapuram	Tamil Nadu	0.663	40
Jorhat	Assam	0.663	41
Chirang	Assam	0.662	42
Nayagarh	Orissa	0.661	43
Khagaria	Bihar	0.660	44
Gopalganj	Bihar	0.659	45
Madhubani	Bihar	0.659	46
Udalguri	Assam	0.659	47
Balrampur	Uttar Pradesh	0.659	48
Giridih	Jharkhand	0.657	49
Nandurbar	Maharashtra	0.656	50
Buxar	Bihar	0.656	51
Vaishali	Bihar	0.655	52
Supaul	Bihar	0.655	53
Buldhana	Maharashtra	0.655	54
Koraput	Orissa	0.654	55
Nalbari	Assam	0.654	56
Paschim Medinipur	West Bengal	0.653	57
Shravasti	Uttar Pradesh	0.653	58
Dhemaji	Assam	0.651	59
Jajpur	Orissa	0.651	60
Chatra	Jharkhand	0.651	61
Dakshin Dinajpur	West Bengal	0.649	62
Arwal	Bihar	0.648	63
Gaya	Bihar	0.647	64
Kamrup Metropolitan	Assam	0.647	65
Jabalpur	Madhya Pradesh	0.645	66
Palamu	Jharkhand	0.645	67
Hazaribagh	Jharkhand	0.644	68
Washim	Maharashtra	0.644	69
Lawngtlai	Mizoram	0.644	70
Muzaffarpur	Bihar	0.643	71
Mandla	Madhya Pradesh	0.643	72
Pakur	Jharkhand	0.643	73
Nabarangpur	Orissa	0.643	74
Godda	Jharkhand	0.642	75
Sonbhadra	Uttar Pradesh	0.640	76
Balangir	Orissa	0.640	77
Simdega	Jharkhand	0.640	78
Bareilly	Uttar Pradesh	0.639	79
Lohardaga	Jharkhand	0.639	80
Nawada	Bihar	0.639	81
Saraikela-kharswana	Jharkhand	0.638	82
Shahdol	Madhya Pradesh	0.637	83
Pilibhit	Uttar Pradesh	0.637	84
Pulwama	Erstwhile J&K	0.637	85
Rewa	Madhya Pradesh	0.636	86

5 It is better not to consider the VIs obtained for 7 major cities (going by 2014 data), namely, Mumbai Urban, Chennai, Ahmedabad (including Bhavnagar), Bengaluru Urban, Hyderabad, Kolkata, and Pune. Delhi, as a Union Territory, has not been considered in the present study. These cities have very different characteristics in terms of income, infrastructure, population density, etc. and may not be considered together with the rest of the districts.

District Considered	States	VI	Ranking
Mahoba	Uttar Pradesh	0.636	87
Kupwara	Erstwhile J&K	0.635	88
Hingoli	Maharashtra	0.635	89
Khunti	Jharkhand	0.634	90
Medak	Telangana	0.634	91
Singrauli	Madhya Pradesh	0.634	92
Chhatarpur	Madhya Pradesh	0.634	93
Bandipore	Erstwhile J&K	0.634	94
Pashchim Champaran (West)	Bihar	0.633	95
Darbhanga	Bihar	0.632	96
Jalna	Maharashtra	0.631	97
Bongaigaon	Assam	0.631	98
Siddharthnagar	Uttar Pradesh	0.631	99
Malkangiri	Orissa	0.631	100
Dhule	Maharashtra	0.630	101
Chitrakoot	Uttar Pradesh	0.630	102
Umaria	Madhya Pradesh	0.629	103
Prakasam	Andhra Pradesh	0.628	104
Satna	Madhya Pradesh	0.628	105
Jamtara	Jharkhand	0.627	106
Munger	Bihar	0.627	107
Howrah	West Bengal	0.627	108
Kheri (Lakhimpur Kheri)	Uttar Pradesh	0.627	109
Garhwa	Jharkhand	0.626	110
Mahrajganj	Uttar Pradesh	0.626	111
Karbi Anglong	Assam	0.626	112
Jehanabad	Bihar	0.626	113
Guntur	Andhra Pradesh	0.625	114
Ganderbal	Erstwhile J&K	0.623	115
Samastipur	Bihar	0.623	116
Viluppuram	Tamil Nadu	0.623	117
Malda	West Bengal	0.622	118
Tikamgarh	Madhya Pradesh	0.622	119
Shahjahanpur	Uttar Pradesh	0.622	120
Latehar	Jharkhand	0.622	121
Aurangabad	Bihar	0.622	122
Udhampur	Erstwhile Jammu & Kashmir	0.622	123
Mahabubnagar	Telangana	0.622	124
Gonda	Uttar Pradesh	0.621	125
Nalanda	Bihar	0.621	126
Purba Medinipur	West Bengal	0.621	127
Ukhrul	Manipur	0.621	128
Anuppur	Madhya Pradesh	0.620	129
Srinagar	Erstwhile J&K	0.620	130

District Considered	States	VI	Ranking
Imphal west	Manipur	0.619	131
Sant Ravidas Nagar (bhadohi)	Uttar Pradesh	0.619	132
Sant kabir nagar	Uttar Pradesh	0.619	133
Banka	Bihar	0.619	134
Kurnool	Andhra Pradesh	0.619	135
Bhind	Madhya Pradesh	0.618	136
Jhabua	Madhya Pradesh	0.618	137
Bhojpur	Bihar	0.618	138
Virudhunagar	Tamil Nadu	0.617	139
Sidhi	Madhya Pradesh	0.617	140
Gadag	Karnataka	0.616	141
Saharsa	Bihar	0.616	142
Cuttack	Orissa	0.616	143
Jagatsinghapur	Orissa	0.616	144
Jharsuguda	Orissa	0.615	145
Bankura	West Bengal	0.615	146
Shivpuri	Madhya Pradesh	0.615	147
Mirzapur	Uttar Pradesh	0.615	148
Panna	Madhya Pradesh	0.615	149
Baramulla	Erstwhile J&K	0.614	150
Ghaziabad	Uttar Pradesh	0.614	151
South Twenty-Four Parganas	West Bengal	0.614	152
Koderma	Jharkhand	0.613	153
Dhenkanal	Orissa	0.613	154
Subarnapur (Sonepur)	Orissa	0.613	155
Satara	Maharashtra	0.612	156
Bidar	Karnataka	0.612	157
Sheikhpura	Bihar	0.612	158
Begusarai	Bihar	0.611	159
Banda	Uttar Pradesh	0.610	160
Birbhum	West Bengal	0.609	161
Purbi Singhbhum (East)	Jharkhand	0.609	162
Patna	Bihar	0.609	163
Hardoi	Uttar Pradesh	0.608	164
Kolar	Karnataka	0.608	165
Debagarh (Deogarh)	Orissa	0.608	166
Yavatmal	Maharashtra	0.607	167
Saran	Bihar	0.607	168
Darjeeling	West Bengal	0.607	169
Ballia	Uttar Pradesh	0.606	170
Srikakulam	Andhra Pradesh	0.605	171
Kannauj	Uttar Pradesh	0.605	172
Bhagalpur	Bihar	0.605	173

District Considered	States	VI	Ranking
Rajauri	Erstwhile Jammu & Kashmir	0.605	174
Kozhikode	Kerala	0.605	175
Damoh	Madhya Pradesh	0.605	176
Patan	Gujarat	0.604	177
Porbandar	Gujarat	0.604	178
Barwan	Madhya Pradesh	0.603	179
Badaun	Uttar Pradesh	0.603	180
Gondia	Maharashtra	0.603	181
Deoghar	Jharkhand	0.603	182
Koppal	Karnataka	0.602	183
Pashchimi Singhbhum (West)	Jharkhand	0.602	184
Wayanad	Kerala	0.602	185
Kaimur (bhabua)	Bihar	0.601	186
Sri Potti Sriramulu Nellore	Andhra Pradesh	0.601	187
Sitapur	Uttar Pradesh	0.600	188
Udaipur	Rajasthan	0.600	189
Haveri	Karnataka	0.600	190
Ahmedabad and Bhavnagar	Gujarat	0.600	191
Katni	Madhya Pradesh	0.599	192
Baudh (Boudh)	Orissa	0.599	193
Bokaro	Jharkhand	0.599	194
Dhanbad	Jharkhand	0.599	195
Ranchi	Jharkhand	0.599	196
Reasi	Erstwhile J&K	0.597	197
Dahod	Gujarat	0.597	198
Malappuram	Kerala	0.597	199
Kanpur Dehat	Uttar Pradesh	0.596	200
Mon	Nagaland	0.596	201
Mainpuri	Uttar Pradesh	0.596	202
Dumka	Jharkhand	0.596	203
Gautam Buddha Nagar	Uttar Pradesh	0.596	204
Jammu	Erstwhile J&K	0.595	205
Chandauli (Varanasi Dehat)	Uttar Pradesh	0.595	206
Etawah	Uttar Pradesh	0.595	207
Dharwad	Karnataka	0.594	208
Kolhapur	Maharashtra	0.593	209
Bijnor	Uttar Pradesh	0.593	210
Farrukhabad	Uttar Pradesh	0.593	211
Visakhapatnam	Andhra Pradesh	0.593	212
Surendranagar and rajkot	Gujarat	0.593	213
Samba	Erstwhile J&K	0.592	214
Rae bareli	Uttar Pradesh	0.592	215
Ashoknagar	Madhya Pradesh	0.592	216

District Considered	States	VI	Ranking
Aurangabad	Maharashtra	0.592	217
North Tripura	Tripura	0.592	218
Mau (maunath Bhanjan)	Uttar Pradesh	0.591	219
Jalaun	Uttar Pradesh	0.591	220
Yadgir	Karnataka	0.590	221
Budgam	Erstwhile J&K	0.590	222
Rampur	Uttar Pradesh	0.589	223
Bangalore (Bengaluru Urban)	Karnataka	0.589	224
Mandsaur	Madhya Pradesh	0.589	225
Hassan	Karnataka	0.587	226
Baleswar (Balasore)	Orissa	0.587	227
Jaisalmer	Rajasthan	0.587	228
Barmer	Rajasthan	0.587	229
Gulbarga (Kalaburagi)	Karnataka	0.586	230
Kendrapara	Orissa	0.586	231
Ghazipur	Uttar Pradesh	0.586	232
Kalahandi	Orissa	0.586	233
Sultanpur	Uttar Pradesh	0.585	234
Barabanki	Uttar Pradesh	0.585	235
Morena	Madhya Pradesh	0.585	236
Madurai	Tamil Nadu	0.585	237
Dindori	Madhya Pradesh	0.585	238
Chandel	Manipur	0.585	239
Rohtas	Bihar	0.585	240
Hamirpur	Uttar Pradesh	0.584	241
Cuddalore	Tamil Nadu	0.584	242
Nanded	Maharashtra	0.584	243
Basti	Uttar Pradesh	0.584	244
Thane	Maharashtra	0.583	245
Uttar Dinajpur	West Bengal	0.583	246
Gumla	Jharkhand	0.583	247
Jamnagar	Gujarat	0.582	248
Seoni	Madhya Pradesh	0.582	249
Azamgarh	Uttar Pradesh	0.581	250
Firozabad	Uttar Pradesh	0.581	251
Jaunpur	Uttar Pradesh	0.581	252
Faridabad	Haryana	0.580	253
Thoubal	Manipur	0.580	254
Kathua	Erstwhile Jammu & Kashmir	0.580	255
Senapati	Manipur	0.579	256
Raichur	Karnataka	0.579	257
Bargarh	Orissa	0.578	258
Deoria	Uttar Pradesh	0.578	259
Sagar	Madhya Pradesh	0.577	260

District Considered	States	VI	Ranking
Nashik	Maharashtra	0.577	261
Chikballapur	Karnataka	0.577	262
Raigarh	Chhattisgarh	0.577	263
Dhalai	Tripura	0.577	264
Tawang	Arunachal Pradesh	0.576	265
Kheda and Panch-mahal	Gujarat	0.576	266
Longleng	Nagaland	0.576	267
East Godavari	Andhra Pradesh	0.575	268
Ahmednagar	Maharashtra	0.575	269
Bangalore rural	Karnataka	0.575	270
Tirap	Arunachal Pradesh	0.575	271
Janjgir - Champa	Chhattisgarh	0.574	272
Bilaspur	Chhattisgarh	0.574	273
Ajmer	Rajasthan	0.574	274
Bhadrak	Orissa	0.573	275
Thiruvananthapuram	Kerala	0.573	276
Navsari	Gujarat	0.573	277
Nadia	West Bengal	0.573	278
Guna	Madhya Pradesh	0.572	279
Pudukottai	Tamil Nadu	0.572	280
Banaskantha	Gujarat	0.572	281
Tamenglong	Manipur	0.572	282
Parbhani	Maharashtra	0.572	283
Agra	Uttar Pradesh	0.572	284
Chandrapur	Maharashtra	0.571	285
Kushinagar	Uttar Pradesh	0.571	286
Krishna	Andhra Pradesh	0.571	287
Tapi	Gujarat	0.571	288
Bhandara	Maharashtra	0.570	289
Bharuch	Gujarat	0.570	290
Neemuch	Madhya Pradesh	0.570	291
Etah	Uttar Pradesh	0.568	292
Mahamaya nagar (Hathras)	Uttar Pradesh	0.568	293
Thiruvannamalai	Tamil Nadu	0.567	294
Krishnagiri	Tamil Nadu	0.566	295
Kollam	Kerala	0.566	296
Hardwar (Haridwar)	Uttarakhand	0.566	297
West Godavari	Andhra Pradesh	0.566	298
Churachandpur	Manipur	0.566	299
Akola	Maharashtra	0.566	300
Nagaur	Rajasthan	0.566	301
Amreli	Gujarat	0.565	302
Sivagangai	Tamil Nadu	0.565	303
Nalgonda and Wa-rangal	Telangana	0.565	304
Kanpur Nagar	Uttar Pradesh	0.565	305
Bijapur	Karnataka	0.564	306
Bharatpur	Rajasthan	0.564	307
Valsad	Gujarat	0.564	308
Varanasi	Uttar Pradesh	0.563	309
Banswara	Rajasthan	0.563	310
Bagalkot	Karnataka	0.563	311
Davanagere	Karnataka	0.561	312
Pali	Rajasthan	0.561	313
Ratlam	Madhya Pradesh	0.560	314
Salem	Tamil Nadu	0.560	315
Kulgam	Erstwhile Jammu & Kashmir	0.559	317
Angul	Orissa	0.559	318
Uttara Kannada	Karnataka	0.558	319
Tehri Garhwal	Uttarakhand	0.558	320
Wardha	Maharashtra	0.558	321
Chittoor	Andhra Pradesh	0.558	322
Imphal East	Manipur	0.557	323
Fatehpur	Uttar Pradesh	0.557	324
Kannur	Kerala	0.556	325
West Sikkim	Sikkim	0.556	326
Beed	Maharashtra	0.556	327
Mahasamund	Chhattisgarh	0.555	328
Rajgarh	Madhya Pradesh	0.555	329
Vadodara	Gujarat	0.555	330
Karauli	Rajasthan	0.554	332
Sawai Madhopur	Rajasthan	0.554	333
South Sikkim	Sikkim	0.554	334
Jaintia Hills (East and Jaintia Hills)	Meghalaya	0.554	335
Sabarkantha	Gujarat	0.554	336
Raigad	Maharashtra	0.553	337
Jodhpur	Rajasthan	0.553	338
Gurdaspur	Punjab	0.553	339
Rajsamand	Rajasthan	0.553	340
Dima Hasao	Assam	0.553	341
Thiruvallur	Tamil Nadu	0.553	342
Bardhaman (Paschim & Purba)	West Bengal	0.553	343
Kendujhar (Keojhar)	Orissa	0.552	344
Dharmapuri	Tamil Nadu	0.551	345
Kurung Kumey	Arunachal Pradesh	0.551	346
Puri	Orissa	0.551	347
Belgaum (Belagavi)	Karnataka	0.550	348
East Sikkim	Sikkim	0.550	349
Dungarpur	Rajasthan	0.550	350

District Considered	States	VI	Ranking
Dhaulpur (Dholpur)	Rajasthan	0.549	351
Auraiya	Uttar Pradesh	0.549	352
Dibang Valley	Arunachal Pradesh	0.549	353
Bhilwara	Rajasthan	0.549	354
The dangs (Dangs)	Gujarat	0.548	355
Sindhudurg	Maharashtra	0.548	356
Pathanamthitta	Kerala	0.548	357
Kaushambi	Uttar Pradesh	0.548	358
Latur	Maharashtra	0.548	359
Bhiwani	Haryana	0.548	360
Alappuzha	Kerala	0.548	361
Saharanpur	Uttar Pradesh	0.547	362
Mamit	Mizoram	0.547	363
Hoogli	West Bengal	0.547	364
Jalgaon	Maharashtra	0.547	365
Dausa	Rajasthan	0.546	366
Aizawl (East and west Aizawl)	Mizoram	0.546	367
Ambedkar nagar	Uttar Pradesh	0.546	368
Sambalpur	Orissa	0.546	369
Karimnagar	Telangana	0.546	370
Shopian	Erstwhile Jammu & Kashmir	0.546	371
Mysore (Mysuru)	Karnataka	0.545	372
Gajapati	Orissa	0.544	373
Tumkur	Karnataka	0.544	374
Balaghat	Madhya Pradesh	0.544	375
Kottayam	Kerala	0.544	376
Alirajpur	Madhya Pradesh	0.543	377
Udham Singh Nagar	Uttarakhand	0.543	378
Champawat	Uttarakhand	0.542	379
Ernakulam	Kerala	0.542	380
Bikaner	Rajasthan	0.541	381
Kapurthala	Punjab	0.541	382
Nagapattinam	Tamil Nadu	0.541	383
Pune	Maharashtra	0.540	384
Tuticorin (Thoothuku-di) 1987	Tamil Nadu	0.540	385
North goa	Goa	0.540	386
Allahabad (PrayagRaj)	Uttar Pradesh	0.539	387
Palakkad	Kerala	0.539	388
Ramgarh	Jharkhand	0.539	389
Osmanabad	Maharashtra	0.539	390
East Kameng	Arunachal Pradesh	0.538	391
Mehsana	Gujarat	0.537	392
Changlang	Arunachal Pradesh	0.537	393
Kandhamal	Orissa	0.536	394
Ujjain	Madhya Pradesh	0.536	395
Faizabad (Ayodhya)	Uttar Pradesh	0.536	396
Sirohi	Rajasthan	0.536	397
Udupi	Karnataka	0.536	398
Churu	Rajasthan	0.536	399
Mahendragarh (Narnal)	Haryana	0.535	400
Kasaragod	Kerala	0.535	401
Faridkot	Punjab	0.533	402
Ratnagiri	Maharashtra	0.533	403
Unnao	Uttar Pradesh	0.532	404
Kancheepuram	Tamil Nadu	0.532	405
Ballari	Karnataka	0.532	406
North Twenty Four Parganas	West Bengal	0.532	407
Sundargarh	Orissa	0.532	408
Bhopal	Madhya Pradesh	0.531	409
Murshidabad	West Bengal	0.531	410
Jhansi	Uttar Pradesh	0.531	411
Muzaffarnagar	Uttar Pradesh	0.531	412
Korba	Chhattisgarh	0.530	413
Gwalior	Madhya Pradesh	0.529	414
Pratapgarh	Rajasthan	0.529	415
Moga	Punjab	0.528	416
Anantapur	Andhra Pradesh	0.528	417
Tarn Tarn	Punjab	0.527	418
Surguja	Chhattisgarh	0.527	419
Bagpat	Uttar Pradesh	0.527	420
Khandwa (East Nimar)	Madhya Pradesh	0.527	421
Vellore	Tamil Nadu	0.527	422
Bastar	Chhattisgarh	0.526	423
Aligarh	Uttar Pradesh	0.526	424
Namakkal	Tamil Nadu	0.526	425
Muktsar	Punjab	0.526	426
Jashpur	Chhattisgarh	0.526	427
Gandhinagar	Gujarat	0.526	428
West Kameng	Arunachal Pradesh	0.525	429
Karur	Tamil Nadu	0.525	430
Lalitpur	Uttar Pradesh	0.525	431
Jhajjar	Haryana	0.524	432
Lunglei	Mizoram	0.524	433
South Garo Hills	Meghalaya	0.524	434
west Garo Hills	Meghalaya	0.524	435
Tuensang	Nagaland	0.523	436
Rayagada	Orissa	0.523	437
Panchkula	Haryana	0.523	438

District Considered	States	VI	Ranking
Sangli	Maharashtra	0.523	439
Theni	Tamil Nadu	0.522	440
Kiphire	Nagaland	0.521	441
Kadapa	Andhra Pradesh	0.521	442
Moradabad	Uttar Pradesh	0.521	443
Tonk	Rajasthan	0.520	444
Rohtak	Haryana	0.520	445
Mansa	Punjab	0.519	446
Junagadh	Gujarat	0.519	447
South Tripura	Tripura	0.519	448
Thrissur	Kerala	0.518	449
Surat	Gujarat	0.517	450
Poonch	Erstwhile J&K	0.517	451
Kanshiram Nagar (Kasganj)	Uttar Pradesh	0.517	452
Mandya	Karnataka	0.517	453
Narayanpur	Chhattisgarh	0.515	454
Tichirappalli	Tamil Nadu	0.515	455
Almora	Uttarakhand	0.515	456
Anand	Gujarat	0.514	457
Kaithal	Haryana	0.514	458
Jhalawar	Rajasthan	0.514	459
Khammam	Telangana	0.514	460
Sangrur	Punjab	0.514	461
Kodagu	Karnataka	0.513	462
Peren	Nagaland	0.513	463
Mathura	Uttar Pradesh	0.513	464
Jalore	Rajasthan	0.513	465
Saiha	Mizoram	0.513	466
Gadchiroli	Maharashtra	0.512	467
Chikkamagaluru	Karnataka	0.512	468
Amravati	Maharashtra	0.512	469
Kamrup	Assam	0.512	470
Bulandshahr	Uttar Pradesh	0.512	471
Solan	Himachal Pradesh	0.511	472
Yamunanagar	Haryana	0.511	473
Kabirdham (Kaward-ha)	Chhattisgarh	0.511	474
Karnal	Haryana	0.511	475
Sehore	Madhya Pradesh	0.510	476
Bathinda	Punjab	0.510	477
Dhar	Madhya Pradesh	0.510	478
Vidisha	Madhya Pradesh	0.510	479
Chitradurga	Karnataka	0.510	480
Pratapgarh	Uttar Pradesh	0.509	481
Wokha	Nagaland	0.509	482
West Tripura	Tripura	0.509	483
Dindigul	Tamil Nadu	0.509	484
West Khasi Hills	Meghalaya	0.508	485
Solapur	Maharashtra	0.508	486
East Garo Hills	Meghalaya	0.507	487
Khargone (West Nimar)	Madhya Pradesh	0.507	488
Bilaspur	Himachal Pradesh	0.507	489
Shimoga (Shivamoga)	Karnataka	0.506	490
Jaipur	Rajasthan	0.506	491
Kargil	Erstwhile JJ&K	0.505	492
Hyderabad	Telangana	0.505	493
Vizianagaram	Andhra Pradesh	0.504	494
Anjaw	Arunachal Pradesh	0.504	495
Kolkata	West Bengal	0.504	496
The Nilgiris	Tamil Nadu	0.504	497
Burhanpur	Madhya Pradesh	0.503	498
Chamarajanagar	Karnataka	0.503	499
Mumbai suburban	Maharashtra	0.503	500
Jind	Haryana	0.502	501
Palwal	Haryana	0.502	502
Adilabad	Telangana	0.502	503
Tiruppur	Tamil Nadu	0.502	504
Nagpur	Maharashtra	0.501	505
Kangra	Himachal Pradesh	0.501	506
Bundi	Rajasthan	0.500	507
Narsinghpur	Madhya Pradesh	0.500	508
South goa	Goa	0.500	509
Pithoragarh	Uttarakhand	0.499	510
Chennai	Tamil Nadu	0.499	511
Ramanagara	Karnataka	0.499	512
Ambala	Haryana	0.499	513
Sonipat	Haryana	0.498	514
Kutch	Gujarat	0.497	515
Barnala	Punjab	0.496	516
Lower Dibang Valley	Arunachal Pradesh	0.496	517
Lohit	Arunachal Pradesh	0.495	518
Idukki	Kerala	0.495	519
Koriya	Chhattisgarh	0.495	520
Betul	Madhya Pradesh	0.494	521
Kohima	Nagaland	0.494	522
Lucknow	Uttar Pradesh	0.494	523
Baran	Rajasthan	0.493	524
Panipat	Haryana	0.493	525
Chittorgarh	Rajasthan	0.493	526
Uttarkashi	Uttarakhand	0.491	527
Thanjavur	Tamil Nadu	0.491	528

District Considered	States	VI	Ranking
Dhamtari	Chhattisgarh	0.491	529
Bageshwar	Uttarakhand	0.490	530
Ri bhoi	Meghalaya	0.490	531
Durg	Chhattisgarh	0.489	532
Dakshina Kannada	Karnataka	0.488	533
Shahid bhagat singh nagar (nawanshahr)	Punjab	0.488	534
Kishtwar	Erstwhile Jammu & Kashmir	0.488	535
Lower Subansiri and Upper Subansiri	Arunachal Pradesh	0.488	536
Rewari	Haryana	0.487	537
Gorakhpur	Uttar Pradesh	0.487	538
Rupnagar	Punjab	0.487	539
Mumbai	Maharashtra	0.487	540
Kurukshetra	Haryana	0.486	541
Gurgaon (Gurugram)	Haryana	0.486	542
Chhindwara	Madhya Pradesh	0.486	543
Thirunelveli	Tamil Nadu	0.486	544
Doda	Erstwhile J&K	0.485	545
Ganjam	Orissa	0.485	546
Sikar	Rajasthan	0.485	547
Raisen	Madhya Pradesh	0.485	548
Hoshangabad	Madhya Pradesh	0.485	549
Patiala	Punjab	0.484	550
Upper Siang	Arunachal Pradesh	0.484	551
Uttar Bastar Kanker (Kanker)	Chhattisgarh	0.484	552
East Khasi Hills	Meghalaya	0.482	553
Ferozpur	Punjab	0.482	554
Dewas	Madhya Pradesh	0.482	555
Amritsar	Punjab	0.481	556
Rajnandgaon	Chhattisgarh	0.480	557
Datia	Madhya Pradesh	0.480	558
Meerut	Uttar Pradesh	0.480	559
Hamirpur	Himachal Pradesh	0.480	560
Dakshin bastar Dantewada	Chhattisgarh	0.478	561
Raipur	Chhattisgarh	0.477	562
Sirsa	Haryana	0.476	563
Champhai	Mizoram	0.473	564
Anantnag	Erstwhile Jammu & Kashmir	0.471	565
Hisar	Haryana	0.469	566
Shajapur	Madhya Pradesh	0.469	567
Thiruvarur	Tamil Nadu	0.468	568
Zunheboto	Nagaland	0.466	569
Jhunjhunu	Rajasthan	0.465	570

District Considered	States	VI	Ranking
Harda	Madhya Pradesh	0.464	571
Una	Himachal Pradesh	0.464	572
Jalandhar	Punjab	0.464	573
Garhwal (Pauri Garhwal)	Uttarakhand	0.464	574
Mayurbhanj	Orissa	0.462	575
Coimbatore	Tamil Nadu	0.462	576
Hoshiarpur	Punjab	0.462	577
Sheopur	Madhya Pradesh	0.462	578
Fatehgarh sahib	Punjab	0.462	579
Alwar	Rajasthan	0.461	580
East Siang and west Siang	Arunachal Pradesh	0.461	581
Ludhiana	Punjab	0.459	582
Hanumangarh	Rajasthan	0.459	583
Serchhip	Mizoram	0.459	584
Sahibzada Ajit Singh Nagar (Mohali)	Punjab	0.458	585
Mandi	Himachal Pradesh	0.455	586
Indore	Madhya Pradesh	0.453	587
North Sikkim	Sikkim	0.452	588
Phek	Nagaland	0.451	589
Kanyakumari	Tamil Nadu	0.450	590
Rudraprayag	Uttarakhand	0.449	591
Leh (ladakh)	Erstwhile Jammu & Kashmir	0.447	592
Narmada	Gujarat	0.446	593
Fatehabad	Haryana	0.445	594
Ganganagar (Sri Ganganagar)	Rajasthan	0.445	595
Bijapur	Chhattisgarh	0.443	596
Papum Pare	Arunachal Pradesh	0.439	597
Nainital	Uttarakhand	0.438	598
Puri	Orissa	0.434	599
Kota	Rajasthan	0.431	600
Kolasib	Mizoram	0.425	601
Mokokchung	Nagaland	0.421	602
Erode	Tamil Nadu	0.414	603
Dimapur	Nagaland	0.413	604
Chamoli	Uttarakhand	0.409	605
Shimla	Himachal Pradesh	0.396	606
Kullu	Himachal Pradesh	0.392	607
Dehradun	Uttarakhand	0.387	608
Chamba	Himachal Pradesh	0.369	609
Sirmaur	Himachal Pradesh	0.369	610
Kinnaur	Himachal Pradesh	0.350	611
Lahul & Spiti	Himachal Pradesh	0.344	612

Appendix_Table 7: Actual values of Indicators for Andhra Pradesh

Districts	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Proportion of rainfed agriculture	Forest area per 100 rural population	% Womens participation in workforce	MGNREGA	Road Density	Health infrastructure per thousand population	IMR	% Households with Electricity	% HH With improved drinking water source	Yield variability of foodgrains
Anantapur	0.69	1.13	0.84	0.03	0.41	58.62	0.07	0.18	73.00	99.10	61.30	0.19
Chittoor	0.90	0.21	0.53	0.11	0.38	50.96	0.09	0.19	56.00	98.60	65.30	0.18
East Godavari	0.93	0.29	0.35	0.13	0.26	47.88	0.14	0.20	46.00	99.10	82.10	0.13
Guntur	0.90	0.33	0.47	0.03	0.39	30.10	0.23	0.17	41.00	99.50	74.80	0.13
Y.S.R. (Kadapa)	0.83	0.93	0.61	0.23	0.38	55.54	0.06	0.19	44.00	99.70	55.80	0.28
Krishna	0.90	0.23	0.43	0.02	0.35	32.56	0.23	0.17	60.00	99.00	70.00	0.11
Kurnool	0.74	0.54	0.79	0.07	0.43	40.33	0.06	0.17	55.00	99.70	81.70	0.14
Prakasam	0.82	0.48	0.75	0.12	0.42	46.22	0.04	0.19	44.00	97.70	58.20	0.12
Sri Potti Sriramulu Nellore	0.88	0.15	0.30	0.06	0.35	36.66	0.09	0.20	40.00	97.90	67.70	0.16
Srikakulam	0.95	0.58	0.39	0.04	0.41	59.36	0.08	0.21	58.00	97.30	75.70	0.19
Visakhapatnam	0.91	0.42	0.58	0.17	0.34	62.16	0.13	0.17	60.00	98.50	84.30	0.18
Vizianagaram	0.92	0.37	0.42	0.06	0.41	70.24	0.08	0.22	73.00	98.10	89.50	0.16
West Godavari	0.91	0.27	0.22	0.05	0.32	40.34	0.10	0.20	44.00	98.70	74.30	0.10

Appendix_Table 8: Actual values of Indicators for Arunachal Pradesh

Districts	Percentage of Net Area Irrigated to net sown area	Variability in Food Grain Crop yield (Ton/ha)	Water Availability	Drainage Density	% of Landless, Marginal and Small farmers	% of area under Water Bodies	Ground Water Availability	Crop Diversity	Value of Output of Total horticulture (only perennial) / Value of agricultural output 2018	Total Number of Livestock per 1000 rural households	Fair Price shops per 1000 population	Road Density	Diversity Index of the Main Source of Income for Rural HHs; SECC,2011	Average Person days/household employed under MGNREGA over last 6 years
Tawang	10.85	0.13	3457.98	2.37	95.00	2.34	15.00	0.22	0.88	219.00	0.76	0.64	0.69	15.01
West Kameng	5.86	0.14	12244.17	3.27	69.00	1.12	15.76	0.28	0.91	115.00	0.80	0.21	0.63	17.49
East Kameng	15.00	0.19	9246.95	3.26	22.00	3.86	147.55	0.46	0.23	200.00	2.24	0.20	0.39	7.39
Papum Pare	37.46	0.14	8948.70	3.66	32.00	1.42	119.32	0.57	0.33	117.00	1.29	0.19	0.63	12.94
Lower Subansiri	59.65	0.27	9368.93	3.71	59.00	0.98	23.08	0.55	0.75	291.00	1.53	0.19	0.56	12.52
Kurung Kumey	39.41	0.49	23038.09	2.89	35.00	1.23	23.00	0.35	0.95	40.00	0.72	0.12	0.35	14.30
Upper Subansiri	15.32	0.20	21980.00	3.33	19.00	0.94	3.00	0.41	0.69	150.00	1.04	0.15	0.36	10.17
West Siang	44.36	0.15	23981.20	3.07	40.00	1.22	56.01	0.63	0.25	77.00	1.24	0.15	0.39	20.16
East Siang	38.36	0.10	5046.01	2.59	17.00	4.41	677.46	0.47	0.85	266.00	1.10	0.16	0.51	8.96
Upper Siang	21.28	0.20	20909.93	2.84	43.00	1.92	670.00	0.47	0.37	163.00	3.71	0.13	0.40	17.20
Dibang Valley	3.22	0.13	27968.77	3.61	13.00	1.70	850.00	0.31	0.37	61.00	3.75	0.04	0.60	5.11
Lower Dibang Valley	47.38	0.12	10685.38	2.52	15.00	5.97	856.18	0.42	0.84	213.00	1.02	0.11	0.54	16.60
Lohit	24.96	0.10	10207.98	2.64	43.00	4.01	1756.77	0.39	1.25	297.00	0.21	0.17	0.55	31.08
Anjaw	3.36	0.34	1098.00	2.19	56.00	1.50	1740.00	0.36	0.29	65.00	4.63	0.08	0.48	11.22
Changlang	14.53	0.11	10237.11	2.57	49.00	1.95	249.42	0.51	1.29	124.00	0.50	0.19	0.44	27.51
Tirap	4.09	0.29	5046.01	3.32	64.00	0.85	83.27	0.34	0.67	16.00	0.26	0.57	0.31	11.84

Appendix_Table 9: Actual values of Indicators for Assam

Districts	% of Households having Monthly income of highest earning household member Less than Rs. 5,000 in rural area	Livestock to human ratio	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Proportion of rainfed agriculture	Forest area per 100 rural population	% Womens participation in workforce	Average person days per household employed under MGNREGA	Road Density	IMR	% Households with Electricity	% HH With improved drinking water source	% HH using improved sanitation facility	% of Female literacy rate
Baksa	75.47	0.22	0.81	0.18	0.89	0.06	0.34	26.54	0.02	59.00	98.10	94.80	58.80	61.80
Barpeta	80.06	0.17	0.80	0.37	0.64	0.01	0.21	34.30	0.08	62.00	81.80	82.40	54.30	72.60
Bongaigaon	78.27	0.20	0.93	0.73	0.82	0.04	0.23	24.38	0.27	59.00	72.30	97.80	34.90	67.40
Cachar	72.66	0.14	0.85	0.17	0.96	0.16	0.23	39.37	0.09	56.00	88.40	74.00	45.90	71.40
Chirang	77.77	0.27	0.89	0.19	0.89	0.16	0.34	41.91	0.05	61.00	67.50	61.60	37.30	74.90
Darrang	82.30	0.32	0.88	0.34	0.79	0.01	0.24	32.03	0.12	70.00	72.00	70.80	32.60	63.30
Dhemaji	80.35	0.53	0.87	0.27	0.99	0.05	0.41	36.07	0.03	52.00	77.00	97.00	45.60	67.70
Dhubri	85.54	0.16	0.87	0.27	0.93	0.01	0.22	37.11	0.11	75.00	66.45	90.55	37.20	66.35
Dibrugarh	74.05	0.17	0.83	0.07	0.97	0.07	0.34	20.52	0.07	49.00	75.40	98.80	56.60	72.60
Dima Hasao	77.67	0.20	0.99	0.01	0.98	2.77	0.34	26.09	0.03	53.00	75.40	98.80	56.60	72.60
Goalpara	80.06	0.20	0.88	0.38	0.82	0.05	0.26	22.87	0.09	64.00	79.20	47.70	59.00	71.80
Golaghat	79.38	0.38	0.82	0.06	1.00	0.07	0.36	21.30	0.07	56.00	71.30	87.10	46.20	70.70
Hailakandi	80.88	0.14	0.89	0.29	0.96	0.13	0.20	24.35	0.11	71.00	86.80	94.30	59.60	75.80
Jorhat	70.38	0.32	0.85	0.19	0.96	0.06	0.36	32.07	0.12	49.00	71.25	69.65	50.25	77.75
Kamrup	71.58	0.20	0.33	0.58	0.94	0.07	0.32	29.79	0.08	56.00	88.80	93.90	52.60	76.70
Kamrup Metropolitan	57.56	0.06	0.87	0.02	0.85	0.21	0.23	33.09	0.82	47.00	95.00	80.10	61.20	84.30
Karbi Anglong	80.22	0.29	0.84	0.02	0.85	0.94	0.36	23.65	0.01	70.00	88.35	66.25	51.35	73.10
Karimganj	73.79	0.15	0.79	0.12	0.96	0.08	0.20	30.15	0.09	67.00	71.30	62.80	39.50	78.60
Kokrajhar	78.18	0.26	0.91	0.18	0.82	0.14	0.31	38.39	0.02	75.00	74.10	76.50	39.20	64.50
Lakhimpur	76.76	0.39	0.85	0.27	0.89	0.03	0.34	46.99	0.08	55.00	77.60	73.40	49.60	79.00
Morigaon	81.02	0.21	0.88	0.31	0.98	0.02	0.27	42.61	0.06	69.00	77.70	98.00	40.10	73.00
Nagaon	77.86	0.20	0.85	0.22	0.80	0.04	0.22	36.95	0.09	63.00	83.40	92.70	45.50	73.30
Nalbari	66.64	0.20	0.82	0.10	0.98	0.02	0.21	42.09	0.13	48.00	84.00	98.40	51.20	79.30
Sivasagar	73.58	0.15	0.81	0.10	0.98	0.07	0.33	17.72	0.07	51.00	78.70	96.20	55.50	77.10
Sonitpur	76.51	0.28	0.86	0.13	0.88	0.06	0.30	30.71	0.05	64.00	79.60	71.20	61.00	68.30
Tinsukia	74.39	0.19	0.81	0.10	1.00	0.15	0.34	19.55	0.09	49.00	76.30	96.00	50.80	59.10
Udalguri	80.16	0.30	0.87	0.23	0.70	0.05	0.33	39.90	0.05	62.00	84.80	81.20	53.80	66.60

Appendix_Table 10: Actual values of Indicators for Bihar

Districts	% of marginal and small operational holders	Proportion of rainfed agriculture	% Womens participation in workforce	Average person days per household employed under MGNREGA	Health infrastructure per thousand population	IMR	% HH with improved drinking water source	% of Female literacy rate	Yield variability of foodgrains
Araria	0.95	0.53	0.34	32.07	0.10	71.00	99.60	38.80	0.33
Arwal	0.97	0.40	0.29	44.02	0.14	69.00	99.10	54.60	0.15
Aurangabad	0.94	0.17	0.28	49.80	0.13	60.00	98.80	59.30	0.29
Banka	0.98	0.26	0.33	40.50	0.14	56.00	92.90	42.70	0.38
Begusarai	0.98	0.13	0.24	42.30	0.12	56.00	99.10	50.70	0.40
Bhagalpur	0.98	0.61	0.25	44.34	0.15	50.00	97.30	54.60	0.32
Bhojpur	0.96	0.46	0.22	39.35	0.13	58.00	99.90	56.40	0.27
Buxar	0.90	0.33	0.25	40.22	0.12	64.00	99.70	62.90	0.47
Darbhanga	0.98	0.53	0.23	38.75	0.13	64.00	99.90	43.50	0.30
Gaya	0.96	0.42	0.35	40.49	0.08	66.00	96.70	50.20	0.25
Gopalganj	0.99	0.38	0.26	38.72	0.21	62.00	99.00	57.00	0.33
Jamui	0.96	0.45	0.38	47.58	0.13	58.00	78.60	44.40	0.39
Jehanabad	0.96	0.11	0.27	50.04	0.13	65.00	99.40	55.30	0.28
Kaimur (bhabua)	0.93	0.24	0.26	44.38	0.19	71.00	95.30	59.70	0.14
Katihar	0.98	0.70	0.25	39.71	0.07	67.00	99.20	40.20	0.41
Khagaria	0.95	0.25	0.29	33.26	0.23	54.00	98.80	44.20	0.37
Kishanganj	0.97	0.81	0.20	45.33	0.13	72.00	98.70	33.70	0.35
Lakhisarai	0.99	0.32	0.26	41.50	0.17	54.00	93.80	52.40	0.25
Madhepura	0.97	0.59	0.36	45.89	0.06	60.00	100.00	32.60	0.32
Madhubani	0.97	0.63	0.32	37.83	0.07	57.00	99.60	40.90	0.25
Munger	0.98	0.43	0.23	45.73	0.34	54.00	90.50	62.50	0.29
Muzaffarpur	0.98	0.51	0.23	35.83	0.04	60.00	99.40	53.80	0.26
Nalanda	0.96	0.38	0.33	48.92	0.21	60.00	97.90	48.80	0.34
Nawada	0.97	0.42	0.34	41.72	0.20	57.00	98.80	47.50	0.21
Pashchim Champaran (West)	0.97	0.34	0.32	37.15	0.10	64.00	96.10	44.40	0.34
Patna	0.98	0.55	0.24	40.14	0.04	62.00	98.80	64.70	0.30
Purba Champaran (East)	0.97	0.58	0.27	43.12	0.12	64.00	99.40	44.60	0.54
Purnia	0.93	0.71	0.30	38.02	0.11	70.00	99.70	41.10	0.54
Rohtas	0.96	0.21	0.30	38.41	0.13	59.00	99.40	64.20	0.21
Saharsa	0.95	0.37	0.30	46.09	0.16	57.00	99.70	39.00	0.23
Samastipur	0.99	0.38	0.23	59.71	0.05	54.00	98.50	50.00	0.34
Saran	0.99	0.38	0.18	53.01	0.11	54.00	98.40	57.50	0.25
Sheikhpura	0.98	0.42	0.33	47.18	0.75	59.00	94.40	49.10	0.29
Sheohar	0.97	0.31	0.23	41.85	0.17	71.00	99.50	40.90	0.32
Sitamarhi	0.99	0.21	0.22	36.02	0.03	67.00	100.00	37.60	0.37
Siwan	0.98	0.37	0.22	45.58	0.08	55.00	98.40	61.60	0.38
Supaul	0.96	0.54	0.37	41.98	0.20	58.00	99.90	35.90	0.21
Vaishali	0.99	0.44	0.19	41.13	0.06	56.00	97.60	54.10	0.34

Appendix_Table 11: Actual values of Indicators for Chhattisgarh

Districts	Crop, livestock, and fish yield variability	Percentage net area cultivated under Horticulture	Percentage of available water resources under fish culture	Forest dependence of rural tribal communities	Number of approved Minor Forest Produce (MFP) Microenterprises	Percentage of rural households below the poverty line - adjusted for inequalities	Dependency ratio	Access to an alternate employment sources (MGNREGS)	Number of establishments (OAE, Estt., Micro, small and Medium)	IMR	Number of functional Health Care Facilities/ 10,000 population	Households with any usual member covered by a health scheme or health insurance
Balod	13.13	0.04	95.57	0.17	0.00	88.49	80.60	45.88	2324.50	32.84	2.90	68.30
Baloda Bazar	12.34	0.22	92.19	0.16	0.00	92.71	88.67	42.45	2658.80	38.00	1.04	58.50
Balrampur	16.35	0.17	91.61	0.62	0.00	93.05	85.14	55.17	1009.60	41.00	1.62	71.80
Bastar	19.46	0.69	86.72	0.42	20.89	92.56	75.30	43.03	1737.80	33.68	5.32	71.20
Bemetara	23.53	0.41	88.63	0.00	0.00	88.49	80.60	43.27	1279.40	38.00	2.17	68.30
Bijapur	21.36	0.31	86.79	2.46	0.00	90.66	78.79	53.05	253.50	36.00	2.52	86.00
Bilaspur	17.11	0.18	91.93	0.20	17.82	93.02	89.27	57.45	4343.50	34.21	1.01	69.00
Dantewara	23.46	0.31	98.11	0.92	10.00	90.74	71.61	52.37	997.70	36.00	2.00	65.00
Dhamtari	20.33	0.15	97.96	0.48	11.42	89.34	71.33	47.91	2256.30	37.71	2.52	83.20
Durg	26.26	0.30	95.94	0.00	0.00	88.49	80.60	41.16	5266.90	32.84	2.36	68.30
Gariaband	18.80	0.13	94.63	0.73	12.12	92.71	88.67	54.09	925.40	35.65	2.37	58.50
Janjgir-Champa	18.51	0.11	99.35	0.03	0.00	92.73	75.81	40.50	3159.40	37.29	0.89	70.10
Jashpur	14.55	0.35	89.70	0.46	17.50	91.97	67.62	50.89	1384.10	41.26	3.85	78.10
Kanker	17.67	0.08	90.58	0.79	37.33	90.96	70.22	59.90	4853.70	36.12	5.31	78.90
Kawardha	18.28	0.22	97.51	0.36	0.00	90.95	86.87	58.71	6983.00	41.69	0.97	66.40
Kondagaon	11.47	0.22	96.97	0.63	29.67	92.56	75.30	43.19	1067.20	36.00	2.10	71.20
Korba	20.66	0.10	98.11	0.73	30.12	91.84	85.74	41.91	11836.20	38.08	2.20	62.30
Koriya	22.28	0.14	92.80	1.03	27.51	90.55	80.85	65.56	1446.50	41.04	3.38	63.40
Mahasamund	18.11	0.04	85.48	0.27	0.00	93.59	77.27	44.45	2299.10	45.38	2.35	73.10
Mungeli	5.90	0.32	92.42	0.26	0.00	93.02	89.27	48.82	1177.90	38.00	0.87	69.00
Narayanpur	15.23	0.05	98.33	1.89	25.20	92.83	83.40	46.99	235.40	36.00	5.79	81.40
Raigarh	16.34	0.28	98.72	0.37	20.83	92.20	79.83	37.87	3004.60	43.59	2.04	62.60
Raipur	24.20	0.23	90.07	0.00	30.27	92.71	88.67	44.88	7224.40	36.83	1.18	58.50
Rajnandgaon	20.39	0.12	97.62	0.33	17.50	90.82	72.39	56.64	4298.70	38.66	2.47	76.60
Sukma	11.18	0.24	95.83	1.75	8.88	90.74	71.61	57.93	2938.90	34.87	2.22	65.00
Surajpur	9.02	0.30	90.81	0.47	0.00	93.05	85.14	61.64	1187.00	40.00	3.34	71.80
Surguja	17.79	0.28	99.94	0.51	38.80	93.05	85.14	46.96	1351.40	40.50	2.13	71.80

Appendix_Table 12: Actual values of Indicators for Gujarat

Districts	% of Households having Monthly income of highest earning household member Less than Rs. 5,000 in rural area	Livestock to human ratio	% of marginal and small operational holders	Proportion of rainfed agriculture	Percentage area under forest cover	Women's' participation in workforce	Average person days per household employed under MGNREGA	Road density	Health infrastructure per thousand population	IMR	Percentage of households with access to electricity	Percentage of households improved drinking water source	Percentage of households with improved sanitation facility	Female literacy rate	Yield variability of food grains
Ahmedabad	62.77	0.1	0.6	0.71	1.62	0.21	44.84	0.2	0.08	60	99.35	95.4	77.15	74.35	0.2
Amreli	56.82	0.19	0.58	0.81	3.52	0.31	49.65	0.12	0.2	50	98.9	96.6	74.8	76.7	0.22
Anand	72.67	0.28	0.89	0.23	1.58	0.26	35.96	0.2	0.17	62	97.6	96.2	67.2	76.7	0.18
Banaskantha	68.35	0.69	0.55	1	7.66	0.33	42.99	0.04	0.29	52	87.3	97.8	39.6	56.1	0.32
Bharuch	64.15	0.14	0.63	0.78	4.26	0.25	46.91	0.15	0.19	56	96.1	85.9	67.2	72.4	0.21
Bhavnagar	62.77	0.1	0.6	0.71	1.62	0.21	44.84	0.2	0.08	60	99.35	95.4	77.15	74.35	0.2
Dahod	81.95	0.42	0.61	0.64	14.55	0.46	46.26	0.08	0.36	66	78.5	72.5	21.9	52.2	0.27
Gandhinagar	69.31	0.29	0.82	0.37	4.3	0.24	39.78	0.45	0.16	56	94.8	96.5	62.3	68.8	0.15
Jamnagar	59.4	0.28	0.56	0.81	3.32	0.24	48.52	0.07	0.21	48	98	88.8	68	72.5	0.15
Junagadh	60	0.21	0.69	0.6	19.17	0.29	38.33	0.1	0.19	52	99.3	97.8	75.1	77	0.15
Kutch	59.74	0.38	0.39	0.74	5.13	0.2	59.51	0.02	0.25	51	95.4	81.5	61.5	56.7	0.08
Kheda	80.46	0.41	0.81	0.52	2.39	0.67	42.09	0	0.22	60.5	90.2	88.95	45.55	67.8	0.24
Mehsana	71.88	0.31	0.81	0.5	3.6	0.28	51.11	0.08	0.18	59	96.8	92.7	66.1	77.1	0.2
Narmada	82.28	0.31	0.65	0.31	33.65	0.41	42.47	0.04	0.35	60	91.3	97.6	34.8	70.2	0.19
Navsari	74.48	0.13	0.83	0.48	16.14	0.31	31.48	0.23	0.27	52	97.8	67.2	68.8	84.3	0.23
Panchmahal	80.46	0.41	0.81	0.52	2.39	0.67	42.09	0	0.22	60.5	90.2	88.95	45.55	67.8	0.24
Patan	74.8	0.36	0.58	0.7	1.77	0.31	38.04	0.05	0.3	57	93.2	95.8	56.3	61.4	0.33
Porbandar	62.27	0.3	0.66	0.84	5.47	0.25	47	0.14	0.18	51	99.3	85.1	72.4	78.5	0.26
Rajkot	58.52	0.22	0.75	0.71	1.67	0.24	48.72	0.18	0.2	49	97.1	86.8	60	74.6	0.16
Sabarkantha	71.6	0.52	0.74	0.63	1.38	0.37	39.2	0.07	0.25	58	95.2	94.2	46.7	68.2	0.2
Surat	63.57	0.06	0.71	0.4	10.99	0.16	36.84	0.51	0.08	48	98.3	93.4	77.4	81	0.19
Surendranagar	58.52	0.22	0.75	0.71	1.67	0.24	48.72	0.18	0.2	49	97.1	86.8	60	74.6	0.16
Tapi	66.29	0.37	0.68	0.61	25.24	0.44	22.62	0.04	0.36	53	91.6	87.6	38.6	67.2	0.27
Dang (The Dangs)	83.17	0.33	0.29	0.94	77.16	0.48	50.88	0.02	0.36	55	87	69.9	19.4	56.9	0.33
Vadodara	68.7	0.19	0.72	0.59	7.99	0.27	45.93	0.2	0.17	58	97	95.5	60.8	71.6	0.21
Valsad	71.49	0.15	0.82	0.64	32.77	0.31	34.81	0.24	0.25	45	98.3	68.7	61.2	76.2	0.18

Appendix_Table 13: Actual values of Indicators for Haryana

Districts	% of women participation in workforce	% of households with electricity	IMR	Landless, marginal and small farmers (land<5 acre)	Variability of food grain crop yield (ton/ha)	Average days of employment provided per Household under MGNERGA in days	Proportion of rainfed agriculture	Forest area (in ha)/1000 rural population	Per Capita Income	Total no. of livestock to human ratio	Number of functional health centres / 1000 population	% of Villages connected with Paved roads	Road Density	Total Area Insured	Total Ground Water Extraction per 1000 Hectare
Ambala	0.14	95.28	43.00	0.76	0.08	36.27	0.12	8.44	0.83	0.14	0.12	100.00	0.69	0.65	51.14
Bhiwani	0.31	97.50	50.00	0.67	0.13	24.48	0.50	6.93	0.96	0.26	0.16	100.00	0.49	2.85	74.40
Faridabad	0.18	98.16	57.00	0.78	0.13	42.25	0.00	18.93	0.71	0.07	0.07	100.00	0.66	0.09	18.55
Fatehbad	0.29	97.92	57.00	0.60	0.07	35.64	0.02	7.28	0.94	0.27	0.17	100.00	0.58	2.03	92.96
Gurgaon	0.21	97.50	41.00	0.79	0.12	52.37	0.00	18.85	0.00	0.08	0.08	100.00	0.50	0.23	42.12
Hisar	0.29	97.50	53.00	0.55	0.07	28.22	0.24	5.31	0.90	0.25	0.14	100.00	0.49	2.94	66.27
Jhajjar	0.23	97.92	47.00	0.81	0.15	38.13	0.17	5.58	0.92	0.18	0.18	100.00	0.60	0.47	21.17
Jind	0.30	99.38	56.00	0.75	0.07	31.65	0.02	6.66	0.96	0.28	0.15	100.00	0.37	1.83	102.04
Kaithal	0.22	100.00	64.00	0.60	0.08	31.19	0.00	8.61	0.95	0.26	0.16	100.00	0.72	0.94	104.78
Karnal	0.20	94.38	65.00	0.69	0.09	37.12	0.01	7.35	0.89	0.17	0.12	100.00	0.59	1.17	118.70
Kurukshetra	0.22	97.92	49.00	0.67	0.08	24.62	0.00	6.59	0.92	0.18	0.15	100.00	0.70	1.03	73.01
Mahendragarh	0.31	97.92	54.00	0.78	0.12	49.09	0.72	7.26	0.98	0.20	0.18	100.00	0.50	0.82	26.30
Mewat	0.23	89.58	78.00	0.71	0.13	54.02	0.40	8.18	1.00	0.14	0.11	98.13	0.55	0.17	18.73
Palwal	0.22	79.02	57.00	0.00	0.07	54.64	0.07	3.66	0.95	0.18	0.12	100.00	0.53	0.45	50.14
Panchkula	0.22	98.21	50.00	0.75	0.15	37.73	0.80	154.05	0.82	0.13	0.11	100.00	0.58	0.09	8.32
Panipat	0.20	92.97	49.00	0.70	0.09	42.50	0.00	6.39	0.72	0.14	0.10	99.12	0.62	0.52	56.07
Rewari	0.30	94.79	81.00	0.74	0.13	32.14	0.04	7.40	0.82	0.17	0.15	100.00	0.60	0.71	35.08
Rohtak	0.21	97.62	46.00	0.79	0.15	44.24	0.14	7.47	0.92	0.16	0.14	100.00	0.54	0.45	19.06
Sirsa	0.26	95.63	52.00	0.58	0.21	20.57	0.07	4.96	0.93	0.27	0.14	100.00	0.40	3.78	128.88
Sonipat	0.25	88.75	45.00	0.70	0.09	39.63	0.01	9.41	0.88	0.16	0.14	100.00	0.60	0.90	66.85
Yamuna Nagar	0.12	97.66	51.00	0.66	0.09	44.40	0.03	30.78	0.91	0.14	0.12	100.00	0.63	0.40	75.49
Charkhi Dadri	0.31	97.50	50.00	0.67	0.13	24.48	0.50	6.93	0.96	0.26	0.16	100.00	0.49	2.85	74.40

Appendix_Table 14: Actual values of Indicators for Himachal Pradesh

District	% of Households having Monthly income of highest earning household member Less than Rs. 5,000 in rural area	Livestock to human ratio	% area covered under centrally funded crop insurance	Proportion of rainfed agriculture	Forest area per 100 rural population	% Women participation in workforce	Average person days per household employed under MGNREGA	Road Density	Health infrastructure per thousand population	IMR	% HH with improved drinking water source	% of Female literacy rate	Yield variability of food grains
Bilaspur	48.5	0.30	0.29	0.86	0.11	0.46	47.92	0.07	0.44	56	82.8	92.1	0.25
Chamba	67.71	0.44	1.48	0.91	0.51	0.46	69.09	0.02	0.45	46	89.4	75	0.28
Hamirpur	37.76	0.21	0.41	0.94	0.08	0.51	40.31	0.09	0.42	46	96.8	97.8	0.24
Kangra	48.69	0.21	0.23	0.7	0.17	0.4	39.61	0.03	0.38	57	97.8	94.3	0.21
Kinnaur	52.41	0.28	59.85	0.34	0.77	0.4	60.9	0.00	0.76	47	92.7	87.7	0.21
Kullu	64.88	0.26	41.74	0.93	0.5	0.45	41.94	0.01	0.32	46	94.7	82.3	0.2
Lahual & Spiti	50.01	0.32	12.28	0.09	0.51	0.44	35.5	0.00	1.81	43	97.1	80.9	0.27
Mandi	56.6	0.31	9.89	0.85	0.19	0.48	46.96	0.04	0.44	38	96	86.9	0.71
Shimla	53.44	0.19	53.68	0.97	0.39	0.4	41.34	0.05	0.26	45	97.8	85.8	0.27
Sirmaur	64.47	0.37	1.08	0.61	0.29	0.4	49.78	0.03	0.75	58	90.7	82.1	0.22
Solan	53.44	0.26	0.17	0.64	0.19	0.36	42.97	0.08	0.39	46	91.9	86.1	0.36
Una	50.64	0.25	0.36	0.54	0.13	0.34	53.13	0.11	0.33	59	98.5	91.9	0.21

Appendix_Table 15: Actual values of Indicators for Jharkhand

Districts	% of Households having Monthly income of highest earning household member Less than Rs. 5,000 in rural area	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Proportion of rainfed agriculture	Forest area per 100 rural population	Average person days per household employed under MGNREGA	Health infrastructure per thousand population	% HH with improved drinking water source	% of Female literacy rate	Coefficient of variation/ yield variability of food grains
Bokaro	76.12	0.83	1.03	0.89	0.05	44.39	0.07	79.80	63.30	0.22
Chatra	83.23	0.90	0.83	0.77	0.18	43.28	0.11	66.50	52.40	0.34
Deoghar	84.13	0.81	0.90	0.83	0.02	46.20	0.14	86.60	52.70	0.11
Dhanbad	73.57	0.90	1.54	0.91	0.02	49.70	0.06	78.90	68.30	0.15
Dumka	89.00	0.68	0.23	0.90	0.05	50.83	0.23	89.00	51.80	0.11
Garhwa	81.29	0.92	0.79	0.81	0.11	47.72	0.10	86.30	51.00	0.41
Giridih	77.50	0.94	0.67	0.37	0.04	48.87	0.09	65.60	50.60	0.32
Godda	80.35	0.78	0.25	0.81	0.03	50.91	0.15	83.80	42.50	0.17
Gumla	70.78	0.76	0.15	0.94	0.15	48.20	0.25	47.50	68.00	0.07
Hazaribagh	72.31	0.92	0.53	0.81	0.09	45.74	0.09	67.50	62.60	0.18
Jamtara	86.97	0.77	0.31	0.93	0.01	59.04	0.19	90.40	46.90	0.20
Khunti	91.44	0.73	0.32	0.72	0.19	45.11	0.23	53.50	59.20	0.35
Koderma	74.69	0.81	0.49	0.77	0.18	46.65	0.12	80.60	57.60	0.15
Latehar	88.94	0.77	0.49	0.77	0.36	46.10	0.16	76.30	51.40	0.45
Lohardaga	85.41	0.75	0.30	0.74	0.12	39.87	0.20	71.20	60.00	0.16
Pakur	91.12	0.92	0.65	0.88	0.03	44.00	0.15	89.30	39.10	0.17
Palamu	76.09	0.93	0.77	0.66	0.07	38.94	0.11	90.50	58.00	0.41
Pashchimi Singhbhum (West)	53.78	0.71	0.22	0.98	0.26	37.22	0.25	68.90	49.80	0.24
Purbi Singhbhum (East)	67.03	0.88	0.50	0.96	0.11	42.06	0.12	90.20	71.40	0.19
Ramgarh	69.70	0.68	2.07	0.61	0.06	52.10	0.07	67.80	74.50	0.12
Ranchi	67.10	0.79	0.91	0.86	0.07	43.41	0.13	75.00	73.00	0.29
Sahebganj	85.53	0.86	0.32	0.93	0.06	40.30	0.13	77.60	45.90	0.19
Saraikela-kharswana	65.62	0.85	0.44	0.90	0.07	48.85	0.20	80.70	60.00	0.39
Simdega	79.17	0.68	0.17	0.97	0.22	47.26	0.28	59.60	58.60	0.51

Appendix_Table 16: Actual values of Indicators for Karnataka

Districts	Per Capita Income	Livestock to human ratio	% of marginal and small farmers	Women participation in labour	Forest area	Value of output of total horticulture	% area under un-irrigated	Variability in food grain crop yield	Groundwater extraction	Households having kisan credit card	Road density	Access to electricity	Percentage of households with improved drinking water facility	Average person's days per household employed under MGNREGA	SHG/1000 population	Health sector related infrastructure	No of doctors, specialists, health assistants & health Workers
Belgaum (Belagavi)	82287	0.12	0.63	0.33	0.24	91.72	0.96	0.13	76.11	1.8	0.01	91.8	98.6	43.35	1.6	157	2.29
Bagalkot	121404	0.22	0.81	0.33	0.13	112.16	0.91	0.49	94.52	9.48	0.02	98.1	88.3	47.76	2.89	194	2.41
Bangalore (Bangaluru Urban)	320346	0.17	0.8	0.34	0.03	9.74	0.64	0.52	143.81	1.73	0.08	81.8	92	47.34	0.5	116	2.36
Bangalore rural	139598	0.2	0.93	0.21	0.16	93.71	0.82	0.45	123.27	1.76	0.27	72.3	77.5	49.87	5.87	214	2.48
Ballari	116807	0.14	0.85	0.23	0.30	118.9	0.96	0.43	53.7	2.51	0.09	88.4	94.4	53.47	3.2	146	3.12
Bidar	73892	0.27	0.89	0.23	0.05	53.43	0.89	0.43	42.35	4.58	0.05	67.5	96	43.03	4.21	69	1.89
Bijapur	74741	0.32	0.88	0.34	0.01	59.37	0.79	0.58	80.31	10.88	0.12	72	88.2	45.1	3.52	46	1.45
Chamarajanagar	99988	0.53	0.87	0.24	2.67	102.76	0.99	0.61	82.67	1.3	0.03	77	95	44.63	7.62	135	2.67
Chikballapur	99600	0.16	0.87	0.41	0.22	14.35	0.93	0.47	164.11	1.01	0.11	66.45	76.9	47.53	4.97	93	1.94
Chikkamagaluru	175179	0.16	0.87	0.22	3.47	73.57	0.93	0.47	50.5	1.7	0.11	66.45	81.9	48.86	6.67	249	5.57
Chitradurga	88185	0.17	0.83	0.22	0.35	94.89	0.97	0.41	115.03	2.33	0.07	75.4	90.5	57.84	4.79	115	2.39
Dakshina Kannada	240448	0.2	0.99	0.34	1.47	84.29	0.98	0.47	62.6	3.16	0.03	75.4	85.7	47.31	2.29	351	4.72
Davanagere	89946	0.2	0.88	0.34	0.37	146.89	0.82	0.52	92.96	2.85	0.09	79.2	94.3	58.63	3.8	292	3.46
Dharwad	114827	0.38	0.82	0.26	0.20	75.26	1	0.64	61.34	1.74	0.07	71.3	95.4	40.14	3.26	76	3.19
Gadag	88942	0.14	0.89	0.2	0.13	92.11	0.96	0.56	90.4	2.55	0.11	86.8	85.5	44.78	5.49	158	3.87
Gulbarga (Kalaburagi)	65493	0.32	0.85	0.36	0.08	52.24	0.96	0.46	40.54	3.29	0.12	71.25	94.9	40.66	2.97	163	3.38
Hassan	115946	0.32	0.85	0.36	0.31	154.51	0.96	0.46	63.38	1.33	0.12	71.25	91.1	53.33	10.68	112	2.85
Haveri	84629	0.2	0.33	0.32	0.22	108.95	0.94	0.45	56.83	1.64	0.08	88.8	95.1	48.11	3.29	87	1.99
Kodagu	96939	0.06	0.87	0.23	5.89	8.2	0.85	0.44	33.54	3.1	0.82	95	81.6	46.43	4.87	58	5.01
Kolar	98953	0.29	0.84	0.36	0.25	7.82	0.85	0.35	211.29	1.49	0.01	88.35	67.3	55.26	3.47	185	1.76
Koppal	74134	0.29	0.84	0.36	0.02	89.95	0.85	0.35	56.6	1.89	0.01	88.35	92.6	53.2	4.77	44	1.34
Mandya	129304	0.15	0.79	0.2	0.16	122.57	0.96	0.44	59.28	0.84	0.09	71.3	95.5	41.82	8.24	97	2.96
Mysore (Mysuru)	100939	0.26	0.91	0.31	0.35	111.88	0.82	0.57	51.28	2.26	0.02	74.1	95.6	44.44	3.93	407	3.4
Raichur	78057	0.39	0.85	0.34	0.55	12.45	0.89	0.7	43.91	3.51	0.08	77.6	83.5	68.49	1.45	131	2.15
Ramanagara	126441	0.21	0.88	0.27	0.61	106.73	0.98	0.57	96.56	1.14	0.06	77.7	93.1	65.41	5.8	56	2.29

Appendix_Table 17: Actual values of Indicators for Kerala

District	Percentage of BPL households	Percentage of marginal land-moldings	Women's participation in labour force	Proportion of income generated from tertiary sector	Forest area per 1000 population	Proportion of value of horticulture in total value of agriculture	Proportion of net irrigated area	Yield variability of food grains	Groundwater availability	Percentage of population in multi-hazard areas	Road density	Rural bank per 1000 rural population	Average man days her household employed under MGNERGA	Percentage of area under crop insurance	Vector borne diseases per 1000 population	Water borne diseases per 1000 Population	Doctors per 1000 Population
Thiruvananthapuram	19.31	99.83	29.84	65.87	0.39	0.12	5.85	6.74	269.70	25.23	13.87	0.19	54.98	0.04	0.50	14.34	8.92
Kollam	22.81	99.82	29.35	63.45	0.50	0.14	4.19	7.18	332.94	47.32	10.87	0.13	46.63	0.06	0.29	8.04	5.35
Pathanamthitta	17.55	99.28	28.24	55.20	1.63	0.08	6.67	14.40	255.83	32.97	6.81	0.25	57.57	0.09	0.22	13.44	9.17
Alappuzha	24.45	99.43	33.28	61.18	0.04	0.12	42.83	7.81	404.57	79.46	10.35	0.14	61.85	8.22	0.18	9.53	5.64
Kottayam	19.67	98.13	27.92	65.75	0.56	0.05	10.07	6.26	374.54	49.78	9.68	0.19	51.69	0.54	0.11	9.08	8.69
Idukki	21.70	97.31	35.76	53.25	2.84	0.12	21.78	6.15	186.14	59.85	5.42	0.17	51.84	0.59	0.11	11.68	5.91
Ernakulam	12.48	99.20	26.90	67.37	0.42	0.09	16.15	5.97	499.53	65.67	7.63	0.20	52.87	0.30	0.15	13.52	12.15
Thrissur	22.68	99.56	27.95	66.89	0.37	0.13	48.62	8.58	590.48	48.30	6.48	0.14	54.52	1.97	0.07	16.14	8.00
Palakkad	15.46	98.10	28.42	60.49	0.74	0.10	35.93	8.30	591.44	61.09	5.32	0.12	43.98	7.86	0.05	17.51	4.65
Malappuram	17.94	99.35	15.46	65.02	0.48	0.12	15.05	12.75	470.53	57.38	6.85	0.09	48.78	0.07	0.11	20.98	5.30
Kozhikode	18.77	99.55	20.72	60.37	0.47	0.15	3.35	8.69	306.12	50.42	11.77	0.13	48.10	0.01	0.17	22.06	8.11
Wayand	16.90	96.53	32.77	59.54	1.93	0.09	11.21	3.94	231.63	71.37	4.36	0.22	55.15	0.24	0.31	27.16	6.07
Kannur	16.19	99.07	26.06	58.35	0.66	0.24	7.64	4.45	412.55	55.54	6.78	0.13	42.28	0.02	0.11	21.99	5.61
Kasaragod	17.51	98.15	29.78	54.91	0.74	0.11	39.13	3.33	285.75	23.91	7.46	0.16	52.51	0.23	0.24	26.53	4.33

Appendix_Table 18: Actual values of Indicators for Madhya Pradesh

District	% BPL Households	% of agricultural labourers	Total Number of Livestock per 1,000 population	% of marginal, small farmers	% of Female Workforce participation	Forest area / 1,000 rural population	Value of Agricultural Output / Value of Horticulture output	% of net irrigated area to net sown area	Variability in food grain crop (tons/ha)	Groundwater availability	Total length of roads per 100 sq. km.	% of households availing banking services	Average person days / household employed under MGNREGA	Share of area insured under NIAS in MP during 2015	IMR	Cases of water borne diseases (Diarrhoea/Dysentery) / 1,00,000 population	Cases of vector borne diseases / 1,000 population	No of Doctors / 1,000 population
Alirajpur	42.8	20.09	1125	0.67	49	1.02	0.000286	20.87	0.54	20.2	2.29	36.1	45.72	0.7	66	877	0.1	0.02
Anuppur	50.2	37.63	610	0.7	40	1.6	0.000277	2.9	0.53	93.4	6.34	69.7	47.42	0.2	73	496	0.38	0.03
Ashoknagar	14.4	38.82	509	0.62	26	1	0.000106	61.26	0.52	37.4	3.01	30.4	51.11	1.7	77	964	0.22	0.05
Balaghat	64	51.49	581	0.86	45	3.39	0.000126	57.39	0.8	15.7	10.24	38.5	40.5	2.3	62	336	0.08	0.04
Barwani	38	40.86	640	0.62	44	0.79	0.000373	55.9	0.75	6.4	3.24	38.3	40.93	1.4	67	511	0.03	0.05
Betul	77.2	45.51	549	0.61	42	2.89	0.000229	44.47	0.65	15.6	3.01	62	40.33	1.7	64	1074	0.05	0.03
Bhind	40.8	30.39	387	0.74	12	0.08	0.000085	62.9	0.35	13.5	8.26	34.4	57.43	0.3	53	486	0.16	0.03
Bhopal	8.5	12.13	107	0.63	26	0.73	0.000256	69.07	0.42	16.5	54.61	61.9	52.5	1.5	49	555	0.74	0.21
Burhanpur	28.1	47.6	399	0.66	35	2.6	0.00375	59.85	0.85	16.5	7.11	42.5	42.77	0.1	68	393	0.02	0.06
Chhatarpur	10.5	31.71	582	0.72	36	1.29	0.000409	45.92	0.75	21.2	3.93	42.1	54.93	1.2	68	1155	0.04	0.05
Chhindwara	62.6	44.12	524	0.7	39	2.9	0.000471	44.16	0.61	12.2	6.86	55.4	45.91	1.8	70	395	0.24	0.05
Damoh	22.2	43.54	538	0.75	36	2.55	0.000199	43.72	0.71	34.5	2.23	30.5	50.43	1.7	77	1536	0.07	0.02
Datia	29.6	29.19	653	0.75	30	0.33	0.000159	93.64	0.49	31.3	12.65	41.8	53.19	0.3	73	613	0.37	0.03
Dewas	3.8	41.82	496	0.61	39	1.76	0.000302	76.98	0.5	15.9	7.02	47.2	53.66	6.4	57	114	0.03	0.05
Dhar	5.6	42.55	657	0.65	42	0.37	0.000217	80.27	0.56	7	4.32	42.7	47.27	3	54	182	0.12	0.04
Dindori	74.5	48.97	736	0.68	48	4.51	0.000011	1.72	0.59	66.5	0.61	69.1	47.46	0.3	70	699	0.1	0.04
Guna	14.7	34.11	580	0.61	35	1.43	0.000088	41.16	0.71	25.7	5.37	34	49.96	1.9	77	964	0.21	0.06
Gwalior	25	17.56	255	0.73	20	1.61	0.000157	87.08	0.5	11.1	22.67	55.1	59.2	0.5	49	647	0.23	0.03
Harda	34.5	43.84	492	0.45	32	2.12	0.000079	97.22	0.57	72.4	2.27	45.1	47.03	2.6	65	474	0.03	0.05
Hoshangabad	36.6	38.06	376	0.62	28	2.85	0.000067	68.61	0.79	18	6.52	49.9	44.12	4.6	63	876	0.09	0.02
Indore	11.2	14.63	150	0.69	26	0.8	0.001027	77.13	0.84	7.2	48.89	61.8	55.25	2.9	39	361	0.1	0.14
Jabalpur	38.7	28.2	188	0.78	30	1.09	0.000478	21.36	1.12	21.8	11.62	57.6	40.13	0.4	51	951	0.17	0.17
Jhabua	23.1	22.45	848	0.79	48	0.24	0.000426	63.93	0.8	22.6	2.48	42.4	44.34	0.6	66	877	0.3	0.03
Katni	42.8	41.17	431	0.83	36	1.32	0.000657	57.65	0.95	21.3	7.76	50.4	44.05	0.7	68	792	0.18	0.06

(Cont.)

Appendix_Table 18: Actual values of Indicators for Madhya Pradesh

District	% BPL Households	% of agricultural labourers	Total Number of Livestock per 1,000 population	% of marginal, small farmers	% of Female Workforce participation	Forest area / 1,000 rural population	Value of Agricultural Output / Value of Horticulture output	% of net irrigated area to net sown area	Variability in food grain crop (tons/ha)	Groundwater availability	Total length of roads per 100 sq. km.	% of households availing banking services	Average person days / household employed under MGNREGA	Share of area insured under NIAS in MP during 2015	IMR	Cases of water borne diseases (Diarrhoea/Dysentery) / 1,00,000 population	Cases of vector borne diseases / 1,000 population	No of Doctors / 1,000 population
Khandwa	41.2	50.02	506	0.62	40	1.99	0.000725	81.04	0.89	12.6	6.83	49.3	38.07	1.2	68	393	0.04	0.06
Khargone	29.8	47.61	617	0.66	42	0.83	0.000268	46.8	0.05	5.3	2.56	36.6	46.06	1	56	359	0.04	0.04
Mandla	67.6	56.98	578	0.76	46	2.79	0.00006	22.15	0.59	31.9	4.37	77.5	44.76	0.6	70	1915	0.17	0.06
Mandsaur	21.5	39.19	490	0.74	41	0.23	0.000426	68.17	0.73	19.1	8.75	39	55.4	4.1	62	529	0.05	0.05
Morena	26.8	21.93	437	0.83	22	0.49	0.000132	80.51	0.48	10.2	7.97	35.5	54.69	0.3	60	696	0.24	0.03
Narsimhpur	16.2	53.97	398	0.68	32	1.51	0.000172	90.88	1.05	42.1	3.5	39.5	43.72	1.8	67	630	0.09	0.04
Neemuch	20.1	32.56	617	0.76	41	1.37	0.000436	67.24	0.74	34.5	8.95	42.2	50.91	1.8	56	268	0.19	0.04
Panna	38.8	46.03	677	0.76	36	3.08	0.000115	41.69	0.67	32.5	1.86	44.5	45.21	0.7	90	1256	0.31	0.04
Raisen	24.3	52.4	485	0.61	28	2.6	0.000112	93.4	0.83	31.4	5.12	35.2	47.82	5	74	1294	0.2	0.02
Rajgarh	20.2	44.37	528	0.7	42	0.14	0.000236	79.44	0.99	18.5	5.21	36.2	49.25	5.6	61	384	0.11	0.04
Ratlam	38.2	44.28	481	0.71	40	0.06	0.000519	59.92	0.95	13.1	3.18	46	49.17	1.9	66	292	0.19	0.05
Rewa	52.7	46.73	465	0.8	38	0.4	0.000132	34.01	0.7	11.9	6.52	42.6	45.5	1.5	70	1067	0.3	0.1
Sagar	25.5	37.63	426	0.74	32	1.67	0.00065	61.84	0.73	17.1	6.94	38.6	47.13	4.1	70	2019	0.13	0.03
Satna	61.8	40.77	449	0.8	35	1	0.000249	51.04	0.74	12.5	7.07	53.5	44.8	1.3	87	687	0.35	0.01
Sehore	24.9	38.74	523	0.6	38	1.28	0.000148	81.72	0.99	27.7	2.91	52.4	50.07	6.5	67	481	0.11	0.03
Seoni	38.6	54.91	493	0.72	42	2.53	0.000117	48.86	0.41	20.3	2.9	53.6	40.27	2.4	70	1072	0.07	0.05
Shahdol	70.4	52.53	648	0.75	41	2.33	0.000506	15.98	0.94	48.2	4.23	62.2	42.45	0.3	73	496	0.16	0.06
Shajapur	5	42.23	551	0.69	40	0.05	0.000882	65.5	0.84	17.1	4.91	38.6	53.09	6.6	60	200	0.03	0.03
Sheopur	47.2	41.54	864	0.72	34	5.96	0.000157	85.3	0.53	41.1	2.99	52.4	50.07	6.5	71	1499	4.25	0.06
Shivpuri	12.7	29.03	589	0.71	37	1.78	0.000336	56.83	0.53	16.8	2.93	37.2	51.62	1.3	70	438	0.21	0.02
Sidhi	45.8	56.75	740	0.77	38	1.91	0.000374	30.7	0.72	36.8	3.28	37.5	44.9	0.1	71	945	0.48	0.05
Singrauli	45.1	45.75	643	0.76	39	2.29	0.000289	18.01	0.94	38.3	5.8	48	40.43	0.1	71	945	0.72	0.04
Tikamgarh	10	34.16	624	0.71	39	0.32	0.000605	48.86	0.92	24.5	8.47	37.3	63.42	0.4	65	1410	0.12	0.01
Ujjain	7.8	33.65	392	0.63	37	0.03	0.000293	74.79	0.93	11.1	8.63	48	52.3	6	56	500	0.01	0.05
Umaria	68.8	50.29	661	0.75	39	3.79	0.000041	34.46	0.93	77.9	4.77	61.6	41.34	0.2	64	451	0.48	0.03
Vidisha	22.9	41.48	340	0.56	27	0.7	0.000143	79.07	0.9	24.7	3.97	37.4	49.39	5.8	68	649	0.15	0.06

Appendix_Table 19: Actual values of Indicators for Maharashtra

Districts	Livestock to human ratio	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Proportion of rainfed agriculture	Forest area per 100 rural population	% Womens participation in workforce	Average person days per household employed under MGNREGA	Road Density	Health infrastructure per thousand population	IMR	% HH With improved drinking water source	% HH using improved sanitation facility	% of Female literacy rate
Ahmednagar	0.27	0.78	0.44	0.71	0.01	0.41	37.65	0.08	0.15	42.00	86.10	50.80	80.30
Akola	0.11	0.74	0.52	0.94	0.03	0.32	31.37	0.29	0.12	53.00	97.40	46.50	84.50
Amravati	0.15	0.75	0.35	0.91	0.17	0.32	73.59	0.09	0.15	44.00	95.80	64.50	85.30
Aurangabad	0.13	0.83	0.86	0.75	0.03	0.36	42.95	0.14	0.10	47.00	88.40	45.30	78.30
Bhandara	0.19	0.91	0.43	0.40	0.10	0.42	32.91	0.11	0.20	52.00	85.90	67.30	90.60
Beed	0.22	0.81	0.87	0.84	0.01	0.42	65.13	0.09	0.14	41.00	86.10	39.70	67.00
Buldhana	0.17	0.75	0.27	0.94	0.03	0.40	34.83	0.10	0.14	51.00	86.80	45.70	77.70
Chandrapur	0.14	0.50	0.18	0.76	0.28	0.39	37.37	0.12	0.19	55.00	84.00	53.90	80.50
Dhule	0.19	0.71	0.18	0.80	0.02	0.39	38.72	0.07	0.14	54.00	93.80	32.00	60.90
Gadchiroli	0.33	0.73	0.20	0.62	1.04	0.45	30.40	0.02	0.41	62.00	86.10	32.60	72.60
Gondia	0.21	0.92	0.22	0.46	0.18	0.42	41.70	0.05	0.23	66.00	78.80	55.40	83.50
Hingoli	0.19	0.72	0.43	0.77	0.01	0.42	45.20	0.04	0.14	50.00	86.00	40.30	69.00
Jalgaon	0.15	0.72	0.21	0.75	0.04	0.36	31.36	0.13	0.13	51.00	96.00	42.10	72.60
Jalna	0.19	0.78	1.30	0.78	0.00	0.41	34.49	0.07	0.14	49.00	72.60	34.00	65.70
Kolhapur	0.19	0.93	0.00	0.69	0.07	0.34	25.14	0.22	0.14	37.00	95.40	67.00	84.30
Latur	0.15	0.74	1.17	0.40	0.00	0.36	39.81	0.14	0.13	54.00	93.00	39.70	77.10
Mumbai suburban	0.00	0.00	0.00	0.00	0.00	0.21	0.00	2.27	0.00	43.00	99.20	26.70	82.00
Nagpur	0.07	0.68	0.13	0.73	0.14	0.29	49.32	0.42	0.09	48.00	95.40	71.10	89.60
Nanded	0.15	0.79	0.96	0.84	0.04	0.38	48.14	0.10	0.14	47.00	88.30	43.80	75.30
Nandurbar	0.18	0.65	0.08	0.78	0.09	0.44	28.75	0.06	0.22	55.00	83.70	23.60	46.10
Nashik	0.14	0.77	0.21	0.74	0.03	0.37	34.32	0.04	0.12	48.00	89.70	52.80	82.20
Osmanabad	0.24	0.68	1.43	0.79	0.00	0.39	45.60	0.06	0.16	43.00	89.00	27.30	78.20
Parbhani	0.15	0.74	0.99	0.75	0.00	0.39	35.05	0.24	0.14	46.00	89.90	34.00	70.70
Pune	0.09	0.81	0.04	0.70	0.05	0.31	42.50	0.22	0.08	38.00	95.30	63.50	87.60
Raigad	0.06	0.87	0.03	0.93	0.18	0.30	35.02	0.08	0.14	47.00	93.60	75.40	84.90
Ratnagiri	0.12	0.83	0.06	0.97	0.31	0.43	35.24	0.05	0.28	27.00	85.00	67.80	85.10
Sangli	0.24	0.83	0.24	0.69	0.01	0.34	39.50	0.08	0.14	40.00	95.80	68.80	85.60
Satara	0.18	0.93	0.09	0.84	0.05	0.38	33.84	0.08	0.16	40.00	93.00	63.80	85.40
Sindhudurg	0.13	0.88	0.08	0.90	0.38	0.34	33.08	0.05	0.35	45.00	75.10	77.60	91.00
Solapur	0.14	0.67	0.43	0.73	0.00	0.36	37.29	0.13	0.13	42.00	86.90	49.30	76.40
Thane	0.03	0.81	0.09	0.97	0.12	0.25	76.68	0.52	0.06	50.00	92.00	64.70	78.40
Palghar	0.03	0.81	0.09	0.97	0.12	0.25	76.68	0.52	0.06	50.00	92.00	64.70	78.40
Wardha	0.17	0.61	0.15	0.89	0.10	0.35	61.08	0.10	0.17	39.00	93.70	56.90	82.90
Washim	0.14	0.70	0.54	0.99	0.03	0.40	38.61	0.06	0.08	48.00	88.10	41.50	77.00
Yavatmal	0.17	0.60	0.46	0.96	0.12	0.40	44.37	0.05	0.22	56.00	80.80	43.70	75.80

Appendix_Table 20: Actual values of Indicators for Manipur

Districts	% crop area covered under crop insurance	Total Number of Livestock per 1000 rural households	Average person days provided per household (MGNREGA)	% net area under agriculture to GA	% of landless, marginal and small farmers (land <5 acre)	% of net un-irrigated area to net sown area	Variability in food grain crop yield (ton/ha)
Senapati	0.00	0.16	20.14	0.77	83.58	66.27	0.10
Tamenglong	0.00	0.30	19.74	1.51	35.65	86.28	0.18
Churachandpur	0.05	0.16	20.39	0.79	92.20	96.00	0.12
Chandel	0.08	0.27	20.98	1.27	65.36	34.00	0.11
Ukhrul	0.00	0.25	19.58	1.29	97.56	70.46	0.14
Imphal East	0.55	0.13	20.62	0.62	90.16	34.42	0.09
Imphal West	0.19	0.12	22.14	0.56	86.50	46.71	0.10
Bishnupur	8.37	0.15	21.37	0.71	84.55	28.39	0.11
Thoubal	0.65	0.20	24.18	0.81	86.42	41.21	0.12

Appendix_Table 21: Actual values of indicators for Meghalaya (Block-level integrated vulnerability assessment)

Districts	Monthly income of highest earning household member is < 5000 (%)	Livestock Ratio per 1000 Rural household	% of Rural HHs with No Land ownership	% Total Female Workforce	Forests Area per '000 Rural Pop	Value of Output of Horti/ Value of Output of Agri	% Net Irrigated by Net Sown	Variability in Food grain Yield	Drainage Density (kms)	Road Density per Sq kms	Total Rural Banks/ 1000 Rural population	Avg Persondays/HH employed under NREGS over last 5 years	NRM works per 1000 ha	Households having kisan credit card with the credit limit of Rs.50,000 and above (%)	Anganwadi Centres per 1000 ha
Mylliem	45.54	0.07	94.83	50.04	1.21	7.45	10.94	0.559	0.89	2.41	0.15	68.16	9.77	0.25	151.59
Mawphlang	85.22	0.31	76.38	48.1	2.32	7.45	27.19	0.292	0.79	1.68	0.06	52.03	1.09	0.36	64.25
Mawsynram	83.1	0.29	78.5	49.6	5.85	7.45	30.82	0.291	0.76	1.05	0.07	59.53	2.3	0.08	31.225
Shella Bholaganj	69.68	0.12	84.11	48.99	4.51	7.45	11.6	0.37	0.75	1.31	0.07	64.91	1.92	0.08	37.065
Pynursla	89.29	0.16	83.82	49.89	4.62	7.45	8.49	0.409	0.72	0.97	0.03	81.78	1.4	1.54	31.982
Khatarshnong Laitkroh	87.92	0.14	90.43	49.44	1.98	7.45	14.36	0.273	0.73	1.36	0.02	79.3	6.8	0.18	21.117
Mawkynrew	92.18	0.24	88	49.35	3.69	7.45	27.85	0.391	0.95	1.1	0.07	58.99	0.93	0.34	24.381
Mawryngkneng	81.67	0.18	90.17	49.24	1.9	7.45	15.75	0.352	0.95	1.85	0.09	49.29	0.88	0.11	38.67
Mairang	77.83	0.27	79.97	48.68	7.86	2.06	22.26	0.225	0.9	1.4	0.07	47.08	0.54	0.26	19.712
Mawthadraishan	71.95	0.48	68.76	48.47	4.04	2.06	15.73	0.304	0.77	1.7	0.06	50.55	4.69	0.25	27.035
Nongstoin	81.48	0.55	65.21	49.39	12.36	2.06	38.1	0.217	0.76	1.05	0.06	56.36	2.5	0.61	13.693

(Cont.)

Appendix_Table 21: Actual values of indicators for Meghalaya (Block-level integrated vulnerability assessment)

Districts	Monthly income of highest earning household member is < 5000 (%)	Livestock Ratio per 1000 Rural household	% of Rural HHs with No Land ownership	% Total Female Workforce	Forests Area per '000 Rural Pop	Value of Output of Horti/ Value of Output of Agri	% Net Irrigated by Net Sown	Variability in Food grain Yield	Drainage Density (kms)	Road Density per Sq kms	Total Rural Banks/ 1000 Rural population	Avg Persondays/HH employed under NREGS over last 5 years	NRM works per 1000 ha	Households having kisan credit card with the credit limit of Rs.50,000 and above (%)	Anganwadi Centres per 1000 ha
Mawshynrut	75.84	0.33	80.4	50.18	16.15	2.06	8.45	0.263	0.82	0.87	0.05	63.73	0.79	0.26	10.027
Mawkyrwat	83.07	0.3	58.16	50.34	7.87	4.76	4.57	0.375	0.74	1.11	0.06	68.12	1.76	0.47	19.214
Ranikor	74.21	0.31	67.24	49.95	11.36	4.76	13.6	0.522	0.74	0.94	0.02	43.54	1.15	0.14	17.021
Umsning	74.87	0.15	79.2	49.6	5.21	2.16	41.95	0.179	1.01	1.48	0.06	43.97	1.18	1.13	28.187
Umling	72.57	0.17	57.45	50.41	7.76	2.16	19.26	0.328	0.8	1.13	0.14	58.64	4.39	0.22	23.129
Jirang	85.17	0.39	55.16	49.83	17.27	2.16	10.38	0.33	0.65	0.66	0.06	54.08	1.67	0.37	11.152
Thadlaskein	75.19	0.16	81.85	50.58	5.19	2.29	10.33	0.332	1.09	1.48	0.05	37.01	1.18	0.22	25.849
Laskein	63.95	0.12	93.07	50.37	4.03	2.29	19.22	0.211	1.11	1.07	0.04	50.95	3.66	0.26	24.949
Amlarem	65.16	0.21	88.96	48.88	7.05	2.29	67.61	0.347	1.13	0.95	0.09	59.09	4.4	0.27	19.93
Khliehriat	43.33	0.29	91.86	49.84	23.52	0.37	7.55	0.355	1.08	1.24	0.14	40.07	0.48	0.7	16.381
Saipung	58.19	0.93	88.54	49.77	25.32	0.37	0.72	0.279	1	0.73	0.03	44.36	1.26	0.26	6.7221
Dambo Rongjeng	91.61	0.43	84.79	50.23	7.43	2.08	10.8	0.276	0.89	1.31	0.08	73.97	14.65	0.35	24.091
Songsak	85.41	0.52	74.86	49.56	8.35	2.08	2.68	0.272	0.96	1.45	0.04	82.08	5.49	1.93	23.435
Samanda	91.12	0.44	71.97	50.74	12.95	2.08	4.96	0.271	0.92	1.12	0.06	80.68	6.96	0.21	23.375
Rongram	84.95	0.49	83.89	48.42	7.51	1.43	3.16	0.259	0.82	1.51	0.05	66.3	2.17	0.35	40.347
Dadenggre	92.26	0.7	88.46	49.31	9.93	1.43	4.37	0.406	0.83	2.14	0.02	67.61	1.99	2.48	21.657
Selsella	81.45	0.44	69.21	48.37	1.44	1.43	13.36	0.165	0.62	2.55	0.05	55.18	6.9	0.65	59.968
Tikrikilla	77.39	0.57	29.27	49.27	3.39	1.43	9.22	0.416	0.71	1.76	0.02	76.37	6.39	0.48	44.57
Gambegre	88.79	0.77	33.67	49.86	5.18	1.43	1.64	0.288	1.98	1.23	0.06	83.36	3.07	0.27	33.127
Dalu	82.44	0.63	80.51	48.9	4.41	1.43	6.23	0.421	0.83	1.2	0.02	71.09	17.51	0.2	36.866
Resubelpara	82.86	0.44	58.23	49.57	5.16	1.41	26.15	0.222	0.65	1.45	0.04	77.96	2.83	1.2	36.748
Kharkutta	81.5	0.52	76.21	49.57	6.2	1.41	12.59	0.164	0.77	0.86	0.06	62.35	1.23	0.86	35.815
Betasing	84.51	0.76	48.38	49.42	2.31	0.92	24.99	0.243	0.69	2.39	0.07	62.63	12.18	0.49	70.094
Zikzak	82.26	0.79	54.71	50.48	3.53	0.92	9.44	0.22	0.64	1.6	0.04	55.43	9.01	16.39	47.119
Baghmara	69.4	0.5	69.11	49.87	11.06	2.75	10.24	0.295	0.83	1.2	0.05	80.8	4.76	0.2	22.852
Gasuapara	83.47	0.4	64.41	49.32	10.06	2.75	1.69	0.31	0.75	1.08	0.04	75.95	0.83	1.25	18.995
Ronggara	79.83	0.48	65.89	48.47	22.38	2.75	13.45	0.353	0.77	0.66	0	79.45	3.88	0.32	11.989
Chokpot	76.45	0.68	82.39	49.24	12.68	2.75	12.12	0.282	0.91	1.11	0.02	79.07	2.03	0.1	15.223

Appendix_Table 22: Actual values of indicators for Meghalaya (Sectoral vulnerability assessment)

District	% of Net Irrigated Area to Net Sown Area	Variability in Foodgrain Crop Yield	Drainage Density	% of Rural HHs with No Land ownership	% of Agricultural Area under slopes >45 degree	% Share of Total Crop Produced (2018-19)	Value of Output of Total horticulture/ Value of agricultural output	Livestock to Human Ratio	% Rural HHs having Kisan Credit Card(KCC) with limit Rs. 50,000 & above	Road Density	No. of Main & Local Markets / Geographical Area	Diversity Index of Main Income Source for Rural HHs	Average person days/ HH employed under MGNREGA over last 5 years (2016-17 to 2020-21)	No. of NRM works/ 1000 ha
East Garo Hills	5.84	0.261	0.92	77.7	4.7	7.63	2.08	0.47	0.97	1.3	0.01	0.52	79.46	8.46
East Jaintia Hills	4.14	0.291	1.03	90.82	10.46	1.01	0.37	0.16	0.56	0.97	0.01	0.65	41.41	0.79
East Khasi Hills	17.22	0.28	0.81	88.42	27.93	22.97	7.45	0.15	0.34	1.41	0.01	0.65	62.62	1.95
North Garo Hills	20.06	0.317	0.7	64.84	12.83	6.09	1.41	0.47	1.07	1.22	0.02	0.62	78.08	4.79
Ri Bhoi	27.6	0.23	0.85	69.44	14.84	10.31	2.16	0.18	0.75	1.15	0.01	0.64	51	2.06
South Garo Hills	9.18	0.3	0.82	71.6	9.26	5.32	2.75	0.53	0.43	1	0.01	0.6	78.86	2.97
South West Garo Hills	16.5	0.262	0.66	51.68	0.06	9.04	0.92	0.78	8.78	1.96	0.04	0.68	58.2	10.43
South West Khasi Hills	9.42	0.479	0.74	62.06	19.7	4.6	4.76	0.3	0.33	1.04	0	0.54	56.75	1.44
West garo Hills	6.98	0.18	0.88	66.23	2.72	21.18	1.43	0.54	0.67	1.8	0.01	0.65	66.71	6.49
West Jaintia Hills	22.51	0.177	1.1	87.38	8.31	5.06	2.29	0.48	0.25	1.23	0.01	0.59	48.47	2.52
West Khasi Hills	20.78	0.183	0.82	74.72	11.05	6.8	2.06	0.39	0.33	1.12	0.01	0.59	55.19	1.61

Appendix_Table 23: Actual values of indicators for Mizoram (Sectoral vulnerability assessment)

Districts	% of rainfed agriculture	Variability in food grain crop yield	Water Scarcity	Drainage density	% of landless, marginal and small farmers (land <5 acre)	Soil fertility	Groundwater availability	Crop Diversification (Shannon-Weiner Index)	Value of Output of Total horticulture / Value of agricultural output	Total Number of Livestock per 1000 rural households	Road connectivity	Access to market	Income diversification within agriculture sector	Average person days/ household employed under MGNREGA	Number of NRM works per 1,000 ha (MGNREGS)
Aizawl	88.03	21.25	0.99999977	5.08	92.76	46.06	0.39	2.38	4.77	263.35	0.33	90.38	0.93	86.23	0.51
Champhai	89.02	7.61	0.9999998	5.14	90.86	40.00	0.43	1.92	2.27	236.32	0.31	91.11	0.74	85.14	0.42
Kolasib	73.69	7.73	0.99999976	5.48	61.33	52.57	1.29	2.06	4.41	258.24	0.35	69.39	1.04	80.36	0.62
Lawngtlai	94.96	34.04	0.99999981	6.36	95.93	49.54	1.40	1.83	2.73	91.43	0.24	94.64	0.96	87.89	0.43
Lunglei	94.82	28.46	0.9999998	6.73	90.76	46.42	1.14	2.20	3.19	82.85	0.21	98.97	0.96	85.09	0.70
Mamit	93.80	21.06	0.99999978	5.78	72.79	59.84	1.40	2.15	3.81	110.66	0.24	69.92	0.72	81.11	0.24
Serchhip	85.96	23.65	0.99999979	6.29	83.03	40.31	0.53	2.32	2.55	156.32	0.35	85.25	0.70	80.25	0.73
Siaha	91.00	36.43	0.99999981	5.68	86.29	40.00	0.63	2.17	11.30	256.61	0.20	87.50	0.70	81.28	0.55

Appendix_Table 24: Actual values of indicators for Nagaland

Districts	% of net irrigated area to net sown area	Variability in food grain crop yield	Water Scarcity	% Rural household with no Land	Drainage density	Crop diversification	No of Livestock / 1000 RHH	Road connectivity Percentage of villages connected by paved roads	Access to market	Average person days under MGNREGA	Number of NRM works per 1,000 ha
Mon	12.16	11.28	0.00	40.17	3.77	0.37	0.28	35.90	0.24	51.18	0.24
Mokokchung	21.76	10.89	0.00	40.27	3.83	0.27	0.14	64.08	0.51	54.09	0.12
Zunheboto	14.47	12.95	0.00	43.31	3.88	0.35	0.49	71.67	0.37	48.00	0.11
Wokha	29.20	12.30	0.00	36.80	3.53	0.33	0.23	20.42	0.33	42.88	0.33
Dimapur	63.28	11.15	0.00	72.98	2.96	0.49	0.35	35.48	0.22	42.70	0.48
Phek	41.02	11.39	0.09	13.12	3.77	0.35	0.30	40.78	0.31	43.06	0.14
Tuensang	17.39	12.00	0.00	28.39	3.87	0.34	0.36	33.06	0.32	45.18	0.10
Longleng	16.69	12.29	0.00	44.32	3.91	0.30	0.36	93.48	0.38	54.25	0.20
Kiphire	13.62	11.74	0.03	28.11	4.00	0.37	0.45	28.40	0.26	53.37	0.06
Kohima	34.30	12.37	0.18	46.32	3.99	0.33	0.21	65.31	0.31	35.42	0.19
Peren	41.02	11.64	0.09	70.58	3.65	0.33	0.41	15.15	0.32	59.32	0.17

Appendix_Table 25: **Actual values of indicators for Orissa**

Districts	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Proportion of rainfed agriculture	Forest area per 100 rural population	Average person days per household employed under MGNREGA	Health infrastructure per thousand population	IMR	% HH With improved drinking water source	% of Female literacy rate	Yield variability of foodgrains
Angul	0.66	0.90	0.26	44.48	0.16	68.00	77.20	70.60	0.38
Balangir	1.22	0.96	0.08	49.79	0.18	69.00	94.00	61.90	0.47
Balasore	0.35	0.62	0.02	41.46	0.16	55.00	97.70	75.80	0.13
Bargarh	1.04	0.62	0.08	41.40	0.18	53.00	95.60	69.20	0.16
Boudh	0.46	0.56	0.31	43.04	0.19	75.00	88.80	64.30	0.29
Bhadrak	0.42	0.53	0.01	37.32	0.16	56.00	99.40	76.80	0.07
Cuttack	0.26	0.44	0.04	38.12	0.16	59.00	91.10	83.60	0.22
Deogarh	0.36	0.91	0.51	41.33	0.18	70.00	85.60	66.80	0.40
Dhenkanal	0.38	0.75	0.13	55.34	0.18	62.00	58.80	72.80	0.23
Gajapati	0.19	0.51	0.50	44.54	0.29	91.00	69.20	45.00	0.24
Ganjam	0.36	0.31	0.27	64.45	0.17	68.00	90.30	64.10	0.31
Jagatsinghpur	0.31	0.31	0.01	29.34	0.21	53.00	96.90	85.80	0.19
Jajpur	0.49	0.79	0.02	42.24	0.18	57.00	87.80	79.10	0.16
Jharsuguda	0.78	0.98	0.10	47.53	0.16	56.00	91.30	76.10	0.55
Kalahandi	0.42	0.70	0.17	42.73	0.20	83.00	93.60	46.10	0.32
Kandhamal	0.19	0.96	0.82	49.34	0.31	101.00	61.40	55.90	0.10
Kendrapara	0.67	0.68	0.02	39.62	0.20	61.00	98.80	81.10	0.13
Keonjhar	0.27	0.82	0.21	43.05	0.24	60.00	85.40	66.30	0.15
Koraput	0.09	0.64	0.04	42.72	0.17	59.00	84.70	39.70	0.14
Malkangiri	0.07	0.94	0.18	53.42	0.14	88.00	89.30	34.80	0.36
Mayurbhanj	0.12	0.81	0.41	45.59	1.16	91.00	81.50	58.30	0.20
Nabrangpur	0.11	0.95	0.18	55.07	0.14	55.00	98.40	41.80	0.33
Nayagarh	0.28	0.93	0.10	50.35	0.18	84.00	80.20	75.50	0.31
Nuapada	0.68	0.86	0.19	40.06	0.12	68.00	95.00	49.90	0.29
Khurda	0.37	0.24	0.22	46.76	0.51	73.00	95.00	82.90	0.22
Puri	0.50	0.74	0.04	42.72	0.13	73.00	95.00	82.90	0.17
Rayagarh	0.17	0.72	0.38	43.75	0.30	90.00	91.70	35.30	0.17
Sambalpur	0.69	0.85	0.45	42.49	0.21	65.00	87.40	72.20	0.28
Sonepur	0.52	0.54	0.06	44.79	0.19	57.00	96.70	69.50	0.28
Sundargarh	0.58	0.91	0.32	51.61	0.23	60.00	89.30	68.60	0.42

Appendix_Table 26: Actual values of indicators for Punjab

Districts	Per capita income / annum (in Rs.)	Livestock to 1000 rural population	Female workforce	Forest Area\ 1000 rural population	Yield variability of food grains (Rice, wheat) (ton/ha)	Road density	Rural Banks /1000 Rural Population	Number of NRM works per 1000 ha	Average person days/ household employed under MGNREGA	Cases of Vector Borne diseases /1000 population	Cases of Water Borne diseases /1000 population	No of doctors, specialists, health assistants & health Workers per 1000 population	IMR	Water Scarcity (% Ground water Development)	Value of output total horticulture (perennial)/ value of agriculture output
Ferozepur	103,552.00	365.19	74,585.00	1.67	0.07	1.57	0.06	1.84	25.03	0.32	3.65	8.80	48.00	144.00	0.00
Hoshiarpur	129,478.00	247.13	87,316.00	57.92	0.08	1.79	0.09	2.07	30.00	0.45	3.39	5.60	43.00	104.00	0.11
Sri Muktsar Sahib	110,254.00	341.99	62,627.00	2.77	0.05	1.65	0.05	3.17	26.40	0.18	3.21	4.40	61.00	69.00	0.07
Bathinda	98,955.00	436.81	116,998.00	6.30	0.06	1.47	0.06	2.25	28.28	0.59	2.89	4.90	49.00	119.00	0.03
Rupnagar	156,900.00	405.32	46,766.00	51.30	0.10	2.13	0.10	2.86	39.51	0.39	30.27	8.20	47.00	110.00	0.07
Mansa	95,316.00	519.88	97,773.00	1.65	0.06	1.23	0.06	1.92	28.72	0.48	4.49	8.50	59.00	138.00	0.01
Faridkot	118,686.00	402.02	36,506.00	5.24	0.07	1.38	0.08	2.58	28.57	0.33	7.61	12.30	51.00	159.00	0.02
Gurdaspur	76,983.00	299.02	93,602.00	1.35	0.10	2.02	0.05	2.67	32.88	0.48	6.46	9.20	43.00	126.00	0.01
Amritsar	104,170.00	388.31	182,661.00	2.34	0.09	2.17	0.08	2.40	32.65	0.42	4.73	5.80	42.00	126.00	0.02
Jalandhar	136,583.00	318.49	134,988.00	1.07	0.06	2.07	0.10	1.68	28.96	0.17	18.56	5.80	45.00	229.00	0.02
SBS Nagar	137,029.00	302.26	34,077.00	24.24	0.08	1.91	0.12	4.49	40.29	0.69	11.82	5.50	52.00	112.00	0.03
Ludhiana	142,543.00	416.47	231,222.00	3.85	0.05	2.78	0.05	2.56	36.48	0.38	9.99	7.00	43.00	170.00	0.02
Fatehgarh Sahib	137,764.00	435.87	83,629.00	0.96	0.07	2.05	0.10	6.38	52.87	0.59	5.06	4.40	44.00	169.00	0.01
Moga	131,391.00	356.87	66,793.00	1.17	0.10	1.88	0.09	2.72	28.80	0.45	3.61	5.90	63.00	207.00	0.00
Sangrur	127,528.00	505.41	32,006.00	2.02	0.06	1.71	0.08	1.84	23.79	0.26	4.95	4.60	56.00	183.00	0.01
Kapurthala	138,262.00	323.30	48,603.00	1.88	0.06	1.67	0.14	3.86	39.21	0.51	23.04	4.70	50.00	242.00	0.01
Patiala	115,290.00	358.03	110,606.00	6.62	0.05	1.69	0.07	2.68	23.45	0.06	3.35	5.00	53.00	195.00	0.02
Barnala	120,254.00	525.03	31,168.00	1.98	0.05	1.39	0.06	2.10	29.50	0.54	6.67	5.40	50.00	194.00	0.00
Fazilka	94,291.00	406.04	85,704.00	2.90	0.05	1.09	0.07	1.68	26.26	0.63	3.79	1.70	48.00	95.00	0.31
SAS Nagar	141,439.00	364.42	72,628.00	31.55	0.08	3.20	0.09	0.79	34.18	0.36	15.42	5.30	37.00	102.00	0.10
Pathankot	97,294.00	250.28	25,884.00	51.79	0.10	1.88	0.08	1.46	46.16	0.36	18.42	0.60	43.00	64.00	0.21
Tarn Taran	89,894.00	131.16	67,063.00	1.84	0.09	1.49	0.06	0.82	28.20	0.33	0.63	4.80	47.00	181.00	0.02

Appendix_Table 27: Actual values of indicators for Rajasthan

Districts	Per capita income	Livestock to human ratio	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Forest area per 100 rural population	% Womens participation in workforce	Average person days per household employed under MGNREGA	Number of NRM works per 1,000 ha (MGNREGS) and/or other schemes	Rural Bank/1000rural population	Road Density	% of Female literacy rate	IMR	Yield variability of foodgrains	Total vector borne diseases/1000 population	Total water borne diseases/1000 population
Ajmer	84093	0.26	0.71	0.50	0.02	0.35	61.40	81.12	0.02	0.10	59.10	72	0.26	0.19	20.49
Alwar	87778	0.29	0.82	0.55	0.04	0.42	45.01	50.12	0.03	0.19	44.10	57	0.11	0.19	36.50
Banswara	40295	0.44	0.88	0.37	0.02	0.47	56.44	0.00	0.02	0.04	52.90	90	0.17	0.36	21.59
Baran	60288	0.31	0.64	0.48	0.10	0.40	58.39	54.78	0.03	0.03	37.80	68	0.19	0.84	25.19
Barmer	128226	0.36	0.18	0.61	0.01	0.42	63.57	209.74	0.01	0.01	52.50	58	0.43	0.13	6.84
Bharatpur	47878	0.28	0.77	0.37	0.01	0.40	41.97	101.07	0.02	0.12	48.50	60	0.10	0.55	45.04
Bhilwara	81252	0.36	0.72	0.62	0.01	0.41	67.93	146.92	0.03	0.10	59.80	78	0.26	0.20	25.38
Bikaner	84462	0.39	0.06	0.40	0.02	0.35	58.25	17.96	0.04	0.02	51.80	52	0.34	0.19	6.44
Bundi	65173	0.34	0.72	0.87	0.06	0.40	55.20	60.77	0.04	0.05	48.60	62	0.19	0.35	66.06
Chittorgarh	67678	0.40	0.71	0.75	0.08	0.43	54.71	172.33	0.03	0.06	58.10	72	0.18	0.33	7.83
Churu	52781	0.25	0.18	0.72	0.01	0.40	60.55	69.75	0.05	0.05	57.30	54	0.28	0.10	3.97
Dausa	47373	0.20	0.72	0.45	0.01	0.42	46.19	90.33	0.02	0.03	57.10	68	0.13	0.12	45.10
Dholpur	36523	0.29	0.81	0.12	0.04	0.35	55.88	67.92	0.01	0.09	53.90	66	0.11	0.14	81.37
Dungarpur	35768	0.44	0.86	0.31	0.02	0.46	68.21	0.00	0.02	0.06	69.00	67	0.18	0.43	25.59
Sri Ganganagar	103750	0.30	0.08	0.52	0.01	0.35	54.05	0.00	0.03	0.09	62.60	56	0.15	0.21	10.79
Hanumangarh	92906	0.33	0.27	0.75	0.01	0.39	61.87	0.00	0.03	0.05	68.60	94	0.28	0.07	19.66
Jaipur	89731	0.21	0.64	0.66	0.02	0.30	44.45	534.33	0.04	0.29	37.00	46	0.15	0.18	9.00
Jaisalmer	78278	0.57	0.11	0.58	0.06	0.37	75.76	13.33	0.03	0.01	41.70	56	0.68	0.14	15.54
Jalore	48931	0.37	0.29	0.74	0.02	0.45	62.32	144.36	0.03	0.02	49.90	61	0.38	0.05	15.09
Jhalawar	59191	0.32	0.67	0.74	0.04	0.41	61.32	87.31	0.03	0.03	68.70	62	0.16	0.09	28.01
Jhunjhunu	49513	0.23	0.70	0.64	0.01	0.39	62.27	59.21	0.06	0.11	55.70	50	0.21	0.06	4.03
Jodhpur	67763	0.26	0.23	0.40	0.00	0.35	60.98	58.99	0.02	0.11	49.30	56	0.30	0.09	14.14
Karauli	46131	0.32	0.79	0.22	0.07	0.41	49.79	174.69	0.02	0.05	70.60	66	0.08	0.13	22.16
Kota	75918	0.17	0.57	0.92	0.07	0.29	58.70	59.42	0.07	0.36	53.20	51	0.19	0.92	41.62
Nagaur	53761	0.26	0.33	0.44	0.01	0.40	62.57	11.63	0.02	0.04	57.80	63	0.22	0.11	12.02
Pali	72449	0.28	0.53	0.35	0.04	0.38	62.29	69.10	0.06	0.05	45.70	71	0.29	0.19	29.98
Pratapgarh	48002	0.50	0.77	0.52	0.13	0.48	58.04	207.24	0.02	0.03	59.00	74	0.18	0.44	9.11
Rajsamand	73744	0.32	0.81	0.46	0.05	0.42	64.70	84.21	0.02	0.08	44.90	75	0.17	0.52	17.52
Sawai Madhopur	53660	0.22	0.71	0.50	0.04	0.41	48.31	528.46	0.03	0.04	66.50	63	0.12	0.17	24.15
Sikar	58044	0.25	0.66	0.60	0.01	0.35	61.67	35.31	0.05	0.11	43.50	48	0.21	0.06	17.30
Sirohi	72883	0.32	0.63	0.36	0.11	0.35	62.31	36.02	0.04	0.09	52.10	70	0.31	0.17	6.32
Tonk	56744	0.32	0.58	0.63	0.01	0.43	45.91	56.71	0.03	0.04	50.50	68	0.19	0.08	35.18
Udaipur	62289	0.37	0.82	0.35	0.11	0.39	54.16	27.21	0.02	0.03	0.00	76	0.17	0.39	28.77

Appendix_Table 28: Actual values of indicators for Sikkim

District	Livestock to rural population	Marginal farmer + small farmer (%)	Women work force (%)	Unirrigated land (%)	Forest Area (ha)/1000 rural pop	MGNREGA (Days)	Doctors available in district towns (Number)	Yield variability
East	0.042	82.25	33.88	54.8	4.42	55.35	147	0.61
West	0.07	9.4	42.04	44.54	5.9	58.14	24	0.75
North	0.146	78.21	31.78	70.87	32.87	60.92	17	0.39
South	0.05	79.04	39.4	58.43	4.55	56.83	33	0.97

Appendix_Table 29: Actual values of indicators for Tamil Nadu

District	Average person days per household employed under MGNREGA	Livestock to human ratio	Stage of groundwater extraction	Yield variability in food grains	Women participation in labour force	Road density	Percentage marginal and small farmers	Proportion of rainfed agricultural land	Doctors per thousand population	Per capita income	Forest cover per 1000 rural Population	Agricultural land covered under crop Insurance	Value of output of total horticulture (only perennial) / Value of agricultural output
Ariyalur	33.78	71.68	43.31	0.32	0.42	87.00	0.95	0.61	4466.83	16559.00	58.59	21251.00	0.02
Coimbatore	47.85	97.72	121.85	0.58	0.39	170.00	0.74	0.20	5215.75	65781.00	236.55	3247.00	3.66
Cuddalore	38.68	88.43	61.73	0.27	0.41	119.00	0.93	0.13	5665.03	47042.00	22.72	77936.00	0.23
Dharmapuri	36.14	100.25	125.90	0.20	0.42	55.00	0.93	0.40	3326.36	46828.00	136.53	16474.00	0.10
Dindigul	54.81	26.56	110.57	0.32	0.44	88.00	0.87	0.40	5280.62	47812.00	138.64	41602.00	0.68
Erode	55.78	124.62	99.04	0.19	0.43	122.00	0.81	0.24	5803.46	61631.00	209.73	15582.00	0.49
Kanchipuram	67.45	89.35	66.68	0.16	0.36	129.00	0.94	0.02	5338.12	70667.00	21.08	17759.00	0.13
Kanniyakumari	59.27	114.53	25.49	0.11	0.24	287.00	0.99	0.16	5667.80	81094.00	303.18	1855.00	21.89
Karur	61.26	134.31	102.36	0.28	0.44	96.00	0.81	0.27	6412.61	61181.00	18.80	6321.00	0.57
Krishnagiri	54.59	89.42	117.81	0.23	0.39	59.00	0.92	0.53	5837.92	55719.00	111.47	6495.00	0.76

(Cont.)

Appendix_Table 29: Actual values of indicators for Tamil Nadu

District	Average person days per household employed under MGNREGA	Livestock to human ratio	Stage of groundwater extraction	Yield variability in food grains	Women participation in labour force	Road density	Percentage marginal and small farmers	Proportion of rainfed agricultural land	Doctors per thousand population	Per capita income	Forest cover per 1000 rural Population	Agricultural land covered under crop Insurance	Value of output of total horticulture (only perennial) / Value of agricultural output
Madurai	48.06	70.02	69.70	0.14	0.42	128.00	0.95	0.16	3956.06	56506.00	46.61	20760.00	1.28
Nagapattinam	48.39	87.63	135.92	0.49	0.34	95.00	0.91	0.06	4631.66	34640.00	12.71	153950.00	0.19
Namakkal	53.64	121.05	135.19	0.28	0.44	124.00	0.89	0.36	4531.76	58133.00	56.22	26216.00	0.10
Perambalur	36.00	81.67	12.78	0.55	0.48	61.00	0.93	0.72	3324.84	17922.00	30.18	67714.00	0.03
Pudukkottai	60.26	127.88	120.44	0.22	0.41	75.00	0.95	0.06	5041.57	37390.00	28.02	85222.00	0.35
Ramanathapuram	53.07	35.66	46.82	0.57	0.39	76.00	0.94	0.43	4101.35	37707.00	27.25	137030.00	0.25
Salem	51.03	136.79	12.90	0.21	0.42	117.00	0.92	0.41	3890.57	48802.00	86.06	31473.00	0.08
Sivagangai	56.10	109.30	145.76	0.41	0.41	85.00	0.95	0.04	2457.07	41912.00	35.60	89731.00	0.22
Thanjavur	50.79	101.84	18.17	0.24	0.34	129.00	0.93	0.03	3912.02	40366.00	22.26	98192.00	0.38
The Nilgiris	43.21	49.41	109.89	0.10	0.44	104.00	0.94	0.98	3116.08	44993.00	577.00	2229.00	89.46
Theni	35.31	62.87	74.56	0.20	0.43	87.00	0.71	0.27	2952.37	35539.00	204.40	6082.00	1.49
Thoothukkudi	62.24	60.91	120.49	0.16	0.36	89.00	0.93	0.08	10591.20	70778.00	21.97	59939.00	1.54
Tiruchirappalli	60.45	89.50	69.71	0.21	0.34	95.00	0.67	0.32	2684.24	27408.00	6.71	11842.00	0.18
Tirunelveli	52.07	47.08	43.03	0.15	0.39	157.00	0.95	0.08	3075.88	63467.00	29.40	32080.00	0.09
Tiruppur	61.32	97.16	64.62	0.11	0.42	99.00	0.95	0.16	4376.67	65011.00	34.06	94363.00	0.08
Tiruvallur	62.80	69.74	110.93	0.48	0.43	89.00	0.89	0.01	3359.42	54259.00	83.51	162755.00	0.20
Tiruvannamalai	48.96	111.23	88.26	0.26	0.41	123.00	0.84	0.59	8790.96	72479.00	88.15	137335.00	10.97
Tiruvarur	37.78	120.60	89.56	0.18	0.43	127.00	0.93	0.30	5910.97	35241.00	66.41	24320.00	2.12
Vellore	51.71	104.12	117.79	0.18	0.38	87.00	0.95	0.34	5165.79	52900.00	81.41	30504.00	0.18
Villupuram	36.49	76.68	91.21	0.11	0.42	78.00	0.94	0.24	4569.18	30181.00	29.17	106051.00	0.01
Virudhunagar	43.24	76.63	65.11	0.28	0.44	75.00	0.90	0.42	4954.82	70689.00	36.02	47975.00	0.30

Appendix_Table 30: Actual values of indicators for Telangana

District	Per capita income	Female Literacy Rates by Districts	% of landless, marginaland small formars	Livestock to human ratio or Fer hectare (sheeps and goats)	Women participation in labour	Forest area (in ha)/1000 rural Population	Value of output of Total horticulture (only perennaial)/ Value of agricultral output)	raifedagriculture	Variability in food grain crop yield (10 years) (check availability at the district level)	Stage of Groundwater Development(%)	Road density	Rural bank / 1000 Population	Average Person days per household employed under MGNREGA	% crop area covered under crop insurance	IMR	No of doctors, specialists, health assistants & health Workers per 1000 Population	Water Borne	Vector Borne
Adilabad	0.89	0.63	0.01	0.97	0.82	0.54	0.91	0.75	0.78	0.56	0.76	0.90	0.41	0.23	0.29	0.67	1.00	0.61
Bhadradri Kothagudem	0.89	0.48	0.70	1.00	0.58	0.14	0.37	0.33	0.22	0.06	0.95	0.39	0.33	0.74	0.88	0.45	0.33	0.48
Jagtial	1.00	0.71	0.82	0.48	0.38	0.89	0.26	0.07	0.67	0.72	0.65	0.60	0.70	0.57	0.76	0.72	0.16	0.00
Jangaon	0.96	0.67	0.45	0.30	0.91	0.99	0.86	0.28	0.50	0.97	0.16	0.95	0.61	0.74	0.12	0.72	0.10	0.04
Jayashankar BhupalFally	0.92	0.69	0.67	0.94	0.71	0.00	0.54	0.20	0.87	0.42	1.00	0.87	0.75	0.83	0.06	0.63	0.55	1.00
Jogulamba Gadwal	0.97	1.00	0.06	0.65	0.82	1.00	0.40	0.38	0.20	0.32	0.60	0.84	0.87	0.09	0.06	0.83	0.31	0.02
Kamareddy	0.98	0.82	0.70	0.66	0.51	0.85	0.99	0.42	0.51	0.76	0.52	0.16	0.17	0.54	0.41	0.62	0.08	0.01
Karimnagar	0.88	0.45	0.87	0.33	0.68	1.00	0.97	0.16	0.26	0.73	0.24	0.00	1.00	0.52	1.00	0.00	0.02	0.05
Khammam	0.93	0.50	0.71	0.70	0.21	0.92	0.19	0.55	0.37	0.59	0.42	0.28	0.88	0.82	0.12	0.61	0.18	0.05
Kumarambheem Asifabad	0.93	0.79	0.60	0.96	1.00	0.18	0.97	0.51	0.87	0.00	0.73	0.89	0.75	0.88	0.94	0.70	0.36	0.59
Mahabubabad	0.96	0.78	0.71	0.47	0.66	0.69	0.04	0.18	0.62	0.69	0.62	0.88	0.86	0.79	0.29	0.82	0.34	0.05
Mahabubnagar	0.91	0.84	0.30	0.00	0.09	0.95	0.68	0.91	1.00	0.63	0.46	0.56	0.69	0.42	0.06	0.58	0.21	0.25
Mancherial	0.96	0.57	0.64	0.78	0.93	0.43	0.73	0.27	0.78	0.25	0.67	0.52	0.63	0.00	0.35	0.71	0.08	0.05
Medak	0.82	0.85	0.81	0.47	0.73	0.88	0.85	0.20	0.40	0.58	0.41	0.77	0.55	0.28	0.29	0.64	0.36	0.08
Medchal-Malkajgiri	0.73	0.00	0.72	0.75	0.39	0.94	0.01	0.00	0.15	1.00	0.70	0.28	0.48	0.62	0.53	0.92	0.07	0.14
Nagarkurnool	0.99	0.89	0.00	0.75	0.59	0.53	0.82	0.71	0.33	0.61	0.78	0.76	0.68	0.57	0.24	0.87	0.09	0.04
Nalgonda	0.92	0.63	0.43	0.68	0.00	0.93	0.52	1.00	0.33	0.72	0.48	0.42	0.87	0.74	0.35	0.46	0.13	0.02
Nirmal	0.92	0.80	0.53	0.77	0.70	0.68	0.71	0.42	0.22	0.20	0.63	0.53	0.30	0.76	0.47	0.78	0.43	0.01
Nizamabad	0.95	0.59	0.97	0.70	0.04	0.89	0.89	0.14	0.17	0.73	0.52	0.13	0.76	0.46	0.29	0.33	0.04	0.06
Peddapalle	0.87	0.53	0.87	0.48	0.92	0.91	1.00	0.05	0.47	0.41	0.66	0.94	0.66	0.58	1.00	0.96	0.01	0.02
Rajanna Sircilla	0.97	0.66	0.78	0.55	0.88	0.87	1.00	0.22	0.53	0.83	0.22	1.00	0.44	0.66	0.12	1.00	0.00	0.00
Rangareddy	0.00	0.34	0.86	0.68	0.03	0.96	0.00	0.53	0.00	0.82	0.42	0.45	0.03	0.75	0.18	0.86	0.01	0.13
Sangareddy	0.85	0.59	0.61	0.79	0.39	0.97	0.62	0.78	0.80	0.68	0.63	0.57	0.46	0.87	0.24	0.00	0.11	0.08
Siddipet	0.89	0.69	0.63	0.51	0.49	0.96	0.66	0.65	0.62	1.00	0.20	0.88	0.31	0.19	0.53	0.37	0.25	0.02
Suryapet	0.94	0.59	0.66	0.56	0.42	0.98	0.78	0.28	0.00	0.54	0.35	0.36	0.98	0.67	0.59	0.80	0.07	0.01
Vikarabad	0.95	0.77	0.34	0.82	0.58	0.92	0.38	0.61	0.23	0.46	0.39	0.58	0.00	0.43	0.53	0.87	0.33	0.08
Wanaparthy	0.99	0.85	0.28	0.01	0.90	0.97	0.84	0.15	0.61	0.62	0.57	0.84	0.49	0.15	0.24	0.83	0.29	0.30
Warangal Rural	0.95	0.70	0.77	0.25	0.72	0.96	0.51	0.15	0.81	0.89	0.18	0.92	0.97	1.00	0.35	0.74	0.12	0.07
Warangal Urban	0.96	0.25	1.00	0.30	0.82	0.99	0.84	0.06	0.11	0.96	0.00	0.55	0.81	0.96	0.06	0.91	0.13	0.09
Yadadri Bhuvanagiri	0.86	0.60	0.50	0.50	0.83	0.97	0.83	0.30	0.06	0.73	0.37	0.84	0.98	0.29	0.00	0.88	0.07	0.05

Appendix_Table 31: Actual values of indicators for Tripura

District	% BPL Households	% of area under forest	Livestock per 1000 population	Percentage of households with the improved Drinking water source	Yield variability of foodgrains	Female literacy	IMR	Average person days per household employed under MGNREGA	Cropping Intensity	Health infrastructure per thousand population
Dhalai	70.86	80.35	0.00	20.15	9.11	79.79	21.60	93.54	177.00	3.91
North Tripura	66.52	62.95	0.03	23.96	5.55	84.39	15.00	74.92	168.00	2.76
Unakoti	64.95	48.03	0.00	20.01	8.89	82.79	21.60	79.26	179.00	2.58
South Tripura	64.39	66.76	0.00	20.12	5.31	79.54	9.90	98.56	191.00	3.93
Gomati	67.64	67.62	0.00	22.08	5.31	79.00	8.10	93.54	194.00	3.80
West Tripura	59.78	27.97	0.01	37.87	7.18	88.01	14.40	86.19	182.00	1.90
Khowai	62.51	59.03	0.00	17.85	6.32	83.17	8.10	88.69	176.00	3.83
Sipahijala	66.33	30.06	0.00	16.48	9.46	79.49	5.60	84.98	219.00	3.50

Appendix_Table 32: Actual values of indicators for Uttar Pradesh

District	Livestock to human ratio	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Forest area per 100 rural population	% Womens participation in workforce	Average person days per household employed under MGNREGA	Number of NRM works per 1,000 ha (MGNREGS)	Road Density	Health infrastructure per thousand population	IMR	% Households with Electricity	% HH With improved drinking water source	Yield variability of foodgrains
Agra	0.24	0.85	0.16	0.01	0.19	43.55	146.50	0.55	0.11	64.00	92.00	71.30	0.14
Aligarh	0.25	0.86	0.13	0.00	0.21	37.89	293.15	0.30	0.11	73.00	84.60	97.80	0.13
PrayagRaj (Allahabad)	0.17	0.93	0.11	0.00	0.32	44.73	754.65	0.51	0.11	80.00	78.50	92.20	0.19
Ambedkar nagar	0.18	0.97	0.11	0.00	0.30	45.18	417.45	0.08	0.13	69.00	72.60	99.90	0.13
Auraiya	0.27	0.93	0.26	0.00	0.18	38.02	430.06	0.35	0.14	65.00	67.90	98.30	0.11
Azamgarh	0.14	0.96	0.07	0.00	0.31	41.43	995.56	0.06	0.13	57.00	82.90	99.50	0.14
Bagpat	0.25	0.87	0.01	0.00	0.18	35.77	130.96	0.23	0.18	61.00	92.00	99.40	0.10
Bahraich	0.16	0.95	0.20	0.02	0.22	49.70	116.10	0.06	0.11	80.00	31.30	99.10	0.13
Ballia	0.15	0.94	0.17	0.00	0.29	43.18	514.93	0.09	0.14	60.00	69.80	98.50	0.20
Balrampur	0.15	0.93	0.06	0.03	0.30	55.00	176.77	0.05	0.12	78.00	35.80	98.50	0.15
Banda	0.27	0.80	0.23	0.01	0.31	52.28	433.76	0.06	0.19	72.00	67.30	97.80	0.32
Barabanki	0.19	0.96	0.44	0.00	0.27	50.19	416.86	0.12	0.13	85.00	49.70	99.20	0.16
Bareilly	0.16	0.93	0.08	0.00	0.18	35.64	1950.00	0.18	0.12	79.00	69.60	99.00	0.15
Basti	0.14	0.96	0.24	0.00	0.29	50.59	1349.70	0.10	0.13	67.00	66.60	99.80	0.18
Bijnor	0.19	0.89	0.01	0.01	0.15	26.11	709.71	0.14	0.11	76.00	79.60	99.90	0.07
Badaun	0.29	0.93	0.10	0.00	0.15	47.04	336.11	0.18	0.10	85.00	52.40	100.00	0.13
Bulandshahr	0.28	0.91	0.24	0.01	0.23	20.60	150.49	0.16	0.12	73.00	87.90	99.60	0.11
Chandauli (Varanasi Dehat)	0.23	0.94	0.27	0.03	0.29	47.78	1096.42	0.09	0.15	57.00	70.80	88.90	0.17
Chitrakoot	0.36	0.85	0.20	0.07	0.35	54.13	303.17	0.02	0.17	73.00	67.30	92.20	0.42
Deoria	0.10	0.96	0.23	0.00	0.27	47.77	868.11	0.15	0.13	56.00	70.50	99.50	0.18
Etah	0.30	0.93	0.08	0.00	0.19	48.52	316.33	0.12	0.13	75.00	65.90	99.10	0.15
Etawah	0.24	0.93	0.25	0.02	0.18	44.20	662.05	0.09	0.13	61.00	91.30	98.60	0.13
Ayodhya (Fazaibad)	0.18	0.97	0.22	0.00	0.18	48.45	721.91	0.18	0.12	72.00	65.40	98.70	0.15
Farrukhabad	0.23	0.94	0.15	0.00	0.16	40.28	381.02	0.12	0.12	72.00	62.60	99.90	0.17
Fatehpur	0.24	0.92	0.31	0.00	0.33	52.02	421.72	0.05	0.14	76.00	45.40	97.60	0.17

(Cont.)

Appendix_Table 32: **Actual values of indicators for Uttar Pradesh**

District	Livestock to human ratio	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Forest area per 100 rural population	% Womens participation in workforce	Average person days per household employed under MGNREGA	Number of NRM works per 1,000 ha (MGNREGS)	Road Density	Health infrastructure per thousand population	IMR	% Households with Electricity	% HH With improved drinking water source	Yield variability of foodgrains
Firozabad	0.25	0.87	0.18	0.00	0.18	48.31	358.12	0.13	0.12	70.00	85.50	96.40	0.11
Gautam Buddha Nagar	0.16	0.92	0.20	0.00	0.22	22.73	156.79	0.81	0.10	61.00	98.60	63.60	0.14
Ghaziabad	0.10	0.91	0.05	0.00	0.19	16.98	448.69	1.65	0.09	65.00	97.40	84.90	0.34
Ghazipur	0.18	0.95	0.16	0.00	0.33	43.19	252.00	0.07	0.14	70.00	67.90	99.10	0.12
Gonda	0.17	0.96	0.05	0.00	0.27	50.63	394.70	0.06	0.11	68.00	39.60	100.00	0.08
Gorakhpur	0.09	0.96	0.23	0.00	0.25	45.14	663.96	0.46	0.14	59.00	74.80	99.20	0.21
Hamirpur	0.24	0.76	0.25	0.03	0.30	53.78	474.01	0.05	0.24	65.00	73.10	99.10	0.28
Hardoi	0.23	0.93	0.14	0.00	0.17	52.67	357.17	0.08	0.12	84.00	42.20	99.60	0.12
Jalaun	0.24	0.77	0.44	0.02	0.24	33.41	379.41	0.09	0.20	56.00	89.00	98.10	0.31
Jaunpur	0.18	0.97	0.06	0.00	0.35	49.36	1179.79	0.09	0.14	66.00	78.30	95.40	0.14
Jhansi	0.19	0.81	1.08	0.03	0.31	51.34	265.33	0.10	0.20	61.00	88.90	96.10	0.23
Kannauj	0.31	0.96	0.29	0.00	0.18	39.57	839.94	0.09	0.14	70.00	70.70	99.70	0.17
Kanpur Dehat	0.33	0.92	0.32	0.00	0.21	44.79	254.55	0.07	0.15	68.00	45.50	98.70	0.19
Kanpur Nagar	0.11	0.93	0.36	0.00	0.17	42.67	328.68	1.48	0.11	62.00	85.90	99.20	0.21
Kanshiram Nagar (Kansganj)	0.33	0.93	0.08	0.00	0.21	45.56	717.82	0.15	0.15	82.00	54.30	99.80	0.15
Kaushambi	0.24	0.94	0.17	0.09	0.37	46.11	112.63	0.02	0.14	85.00	49.00	96.80	0.17
Lakhimpur Kheri (Kheri)	0.24	0.90	0.02	0.00	0.16	43.47	805.51	0.16	0.11	82.00	41.40	99.10	0.16
Kushinagar	0.07	0.97	0.03	0.02	0.28	46.89	864.85	0.04	0.12	75.00	48.30	97.60	0.15
Lalitpur	0.36	0.80	1.36	0.00	0.35	53.52	627.11	0.10	0.19	77.00	78.00	94.10	0.24
Lucknow	0.08	0.95	0.19	0.02	0.21	44.48	846.12	1.85	0.09	59.00	93.50	98.90	0.14
Hathras (Mahamaya Nagar)	0.26	0.88	0.08	0.00	0.18	33.41	422.83	0.13	0.15	63.00	86.30	96.30	0.14
Mahoba	0.23	0.75	0.46	0.02	0.32	49.91	126.91	0.04	0.20	68.00	79.20	93.40	0.38
Mahrajganj	0.07	0.96	0.25	0.02	0.34	45.55	810.30	0.04	0.13	77.00	51.70	99.30	0.11
Mainpuri	0.29	0.95	0.10	0.00	0.17	45.89	544.93	0.09	0.14	78.00	81.90	99.30	0.12

(Cont.)

Appendix_Table 32: Actual values of indicators for Uttar Pradesh

District	Livestock to human ratio	% of marginal and small operational holders	% area covered under centrally funded crop insurance (PMFBY, WBCIS)	Forest area per 100 rural population	% Womens participation in workforce	Average person days per household employed under MGNREGA	Number of NRM works per 1,000 ha (MGNREGS)	Road Density	Health infrastructure per thousand population	IMR	% Households with Electricity	% HH With improved drinking water source	Yield variability of foodgrains
Mathura	0.22	0.58	0.59	0.00	0.24	42.88	150.90	0.19	0.10	73.00	95.60	84.20	0.17
Maunath Bhanjan (Mau)	0.12	0.97	0.11	0.00	0.32	48.20	741.97	0.10	0.13	67.00	82.90	99.50	0.20
Meerut	0.16	0.88	0.01	0.00	0.18	47.68	391.17	0.43	0.10	62.00	95.90	99.50	0.09
Mirzapur	0.22	0.91	0.31	0.04	0.30	48.23	287.85	0.08	0.13	78.00	68.30	88.10	0.19
Moradabad	0.24	0.91	0.08	0.00	0.18	48.11	821.52	0.46	0.12	77.00	79.00	99.60	0.13
Muzaffarnagar	0.19	0.87	0.01	0.00	0.16	39.52	318.11	0.27	0.12	70.00	84.10	99.90	0.11
Pilibhit	0.13	0.87	0.21	0.04	0.14	36.40	339.12	0.09	0.12	79.00	51.70	99.50	0.12
Pratapgarh	0.26	0.97	0.19	0.00	0.34	45.82	353.78	0.07	0.13	68.00	71.30	92.50	0.15
Rae bareli	0.18	0.95	0.44	0.00	0.28	45.12	773.49	0.07	0.12	74.00	71.60	98.40	0.14
Rampur	0.15	0.89	0.35	0.00	0.17	45.26	695.82	0.21	0.11	72.00	80.80	99.80	0.14
Saharanpur	0.15	0.85	0.02	0.02	0.12	27.33	217.95	0.13	0.13	71.00	93.40	99.30	0.11
Sant kabir nagar	0.10	0.96	0.29	0.00	0.29	49.16	1527.95	0.05	0.12	64.00	63.10	99.70	0.16
Sant ravidas nagar (bhadohi)	0.16	0.98	0.07	0.00	0.27	43.31	320.20	0.24	0.12	77.00	80.10	86.40	0.22
Shahjahanpur	0.21	0.91	0.07	0.00	0.12	39.86	230.86	0.25	0.12	79.00	53.30	99.80	0.15
Shravasti	0.22	0.94	0.23	0.03	0.27	51.59	408.54	0.02	0.13	82.00	25.60	98.00	0.13
Siddharthnagar	0.08	0.96	0.22	0.00	0.34	47.54	1187.56	0.07	0.14	73.00	61.90	99.70	0.19
Sitapur	0.18	0.94	0.05	0.01	0.18	48.11	611.18	0.12	0.12	87.00	29.90	98.70	0.15
Sonbhadra	0.25	0.85	0.29	0.16	0.37	42.42	175.38	0.05	0.11	69.00	52.40	87.50	0.26
Sultanpur	0.25	0.97	0.23	0.01	0.30	49.60	681.47	0.06	0.15	66.00	75.00	95.30	0.43
Unnao	0.23	0.95	0.22	0.01	0.24	47.11	413.78	0.11	0.14	76.00	45.00	97.70	0.15
Varanasi (Kashi)	0.19	0.99	0.11	0.00	0.25	36.08	586.32	1.29	0.11	64.00	88.40	96.00	0.16

Appendix_Table 33: Actual values of indicators for Uttarakhand

Districts	Cropping intensity	Proportion of area under commercial crops to set sown area	% of marginal and small operational holders	Drainage Density	Road Density	Annual average days of work per household under MGNREGA	Net irrigated area to net sown area	NRM work per 1000 ha	Income Diversification	% of household have KCC with limit 50000 or above	Livestock to human ratio
Almora	146.00	2.67	0.95	0.20	1.21	34.84	59.07	0.00	0.94	1.32	365.55
Bageshwar	166.00	1.20	0.97	0.17	0.42	42.94	57.51	0.00	0.95	0.86	442.26
Chamoli	147.00	5.64	0.94	0.05	0.29	46.38	54.58	0.00	0.92	1.14	536.73
Champawat	154.73	5.83	0.98	0.14	0.81	45.60	47.69	0.00	0.93	1.72	378.85
Dehradun	145.78	9.36	0.98	0.33	1.94	51.22	28.71	0.00	0.75	4.29	141.16
Garhwal (Pauri Garhwal)	149.00	3.01	0.98	0.15	0.92	37.12	81.45	0.00	0.83	0.71	425.14
Hardwar (Haridwar)	142.00	43.57	0.96	0.19	1.62	42.65	41.89	0.01	0.97	9.82	212.47
Nainital	157.00	19.52	0.90	0.20	0.98	45.75	35.53	0.00	0.89	2.90	267.34
Pithoragarh	168.00	5.44	0.98	0.05	0.32	44.74	59.45	0.00	0.91	1.64	441.53
Rudraprayag	160.08	1.86	0.96	0.24	0.36	46.51	89.10	0.01	0.92	0.60	449.31
Tehri Garhwal	148.92	4.32	0.99	0.21	1.19	34.38	46.92	0.00	0.91	1.10	281.83
Udham Singh Nagar	188.00	8.83	0.96	0.40	1.69	42.07	35.75	0.01	0.95	7.64	197.69
Uttarkashi	139.00	10.39	0.96	0.08	0.08	46.98	47.32	0.00	0.97	3.56	477.01

Appendix_Table 34: Actual values of indicators for districts of West Bengal

Districts	Per Capita Income	% of Female literacy rate	Livestock to human ratio	Forest area per 100 rural population	Yield variability of foodgrains	Average person days per household employed under MGNREGA	Number of NRM works per 1,000 ha (MGNREGS) and/or other schemes	Road Density	Health infrastructure per thousand population	IMR	% HH With improved drinking water source	Cases of vector borne diseases/1000 Population (Dengue & Malaria)
Bankura	63521.00	65.20	0.28	0.04	0.19	45.86	765.62	0.02	0.18	38.00	96.40	0.34
Bardhaman (Paschim & Purba)	210175.00	66.60	0.15	0.01	0.10	44.16	803.46	0.29	0.12	44.00	96.60	0.17
Birbhum	53362.00	62.10	0.23	0.01	0.16	42.57	2345.87	0.15	0.16	49.00	97.40	0.24
Dakshin Dinajpur	26766.00	67.30	0.20	0.01	0.11	52.57	5977.02	0.00	0.17	52.00	99.40	0.27
Darjeeling	57090.00	78.00	0.09	0.21	0.20	75.51	283.58	0.18	0.15	43.00	71.00	0.73
Howrah	121930.00	78.40	0.03	0.02	0.25	50.96	4509.88	1.66	0.11	41.00	96.50	0.51
Hoogli	129568.00	76.30	0.10	0.00	0.09	40.34	2002.86	0.68	0.14	38.00	98.50	0.30
Jalpaiguri	73656.00	64.20	0.21	0.10	0.21	48.26	900.11	0.15	0.09	49.00	85.20	0.63
Cooch Bihar	42765.00	66.80	0.26	0.01	0.42	44.96	3286.09	0.13	0.16	47.00	97.90	0.12
Malda	62792.00	64.20	0.17	0.01	0.37	52.59	4819.98	0.15	0.14	58.00	82.90	0.59
Murshidabad	109973.00	66.10	0.10	0.01	0.10	56.64	10590.72	0.39	0.13	53.00	97.50	0.36
Nadia	95466.00	73.70	0.10	0.01	0.21	44.44	1227.40	0.26	0.11	42.00	95.00	0.66
North Twenty Four Parganas	37010.00	82.90	0.04	0.02	0.14	59.44	3682.95	3.39	0.09	44.00	92.00	1.89
Paschim Medinipur	44540.00	70.70	0.23	0.04	0.14	48.17	668.29	0.09	0.17	40.00	96.50	0.10
Purba Medinipur	101532.00	76.10	0.12	0.02	0.06	52.59	20989.82	0.15	0.16	43.00	98.90	0.17
Puruliya	44540.00	48.10	0.25	0.04	0.11	57.66	978.11	0.03	0.19	40.00	82.70	0.73
South Twenty Four Parganas	155058.00	74.60	0.07	0.05	0.22	68.72	2982.83	0.24	0.15	48.00	97.70	0.57
Uttar Dinajpur	36531.00	51.10	0.22	0.01	0.12	57.40	2469.43	0.18	0.13	56.00	97.50	0.14

About DST

The Department of Science and Technology (DST) was established in May 1971, with the objective of promoting new areas of Science & Technology and to play the role of a nodal department for organising, coordinating and promoting S&T activities in the country. The Department of Science & Technology (DST) has been entrusted with the responsibility of coordinating two out of eight national missions launched under the National Action Plan on Climate Change (NAPCC). These are National Mission for Sustaining the Himalayan Ecosystem (NMSHE) and National Mission on Strategic Knowledge for Climate Change (NMSKCC).

About SDC

The Swiss Agency for Development and Cooperation (SDC) has been a partner of India for more than 60 years. Since 2011, SDC's engagement focuses specifically on climate change and other environmental issues. The office in India is part of SDC's Global Programme Climate Change and Environment (GPCCE). Other SDC Global Programmes like Food Security and Water also have ongoing activities in India, as part of their regional/global initiatives.