ASSESSING THE IMPACT OF CLIMATE CHANGE ON FOOD AND NUTRITION SECURITY IN INDIA

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Contents

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We are confident that this report will add value to understanding the implications of climate change in the food and nutrition scenarios and motivate policymakers to develop effective policy options to combat the most pressing challenge of our times. We hope the report instils interest in international and national organisations addressing this issue and joining hands with the Government of India.

Authors:

1. Dr. Srinivas Goli (Associate Professor, IIPS)
2. Kaustav Chakraborty (Research Associate, IIPS)
3. Dr. Antaryami Dash (Nutrition Specialist, UNICEF)
4. Dr. Bheemeshwar Reddy A (Associate Professor, BITS Hyderabad)
5. Marie Claude Desilets (Chief of Nutrition, UNICEF)
6. Dr. Richa Singh Pandey (Nutrition Specialist, UNICEF)
7. Sylvie Chamois (Nutrition Specialist, UNICEF)
8. Dr. Usha Singh (Scientist, RPCAU - PUSA)

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List of Abbreviations

ANM	Auxiliary Nurse Midwife
AQLI	Air Quality Life Index
ASHA	Accredited Social Health Activist
AWC	Anganwadi Centre
CEEW	Council on Energy, Environment, and Water
CVI	Climate Vulnerability Index
DST	Department of Science & Technology
FAO	Food and Agriculture Organisation
FNS	Food and Nutrition Security
GDP	Gross Domestic Product
HSSF	(Food) High in Sugar, Salt and/or Fat
ICDS	Integrated Child Development Services
ICF	Inner City Fund
ICRISAT	International Crop Research Institute for Semi-Arid Tropics
IIPS	International Institute for Population Sciences
IMD	Indian Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
MAD	Minimum Adequate Diet
m-CVI	Modified Climate Vulnerability Index
MDD	Minimum Dietary Diversity
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MMF	Minimum Meal Frequency
MoAFW	Ministry of Agriculture & Farmers Welfare
MoSPI	Ministry of Statistics and Programme Implementation

MSSRF	M.S. Swaminathan Research Foundation
NCT	National Capital Territory
NFHS	National Family and Health Survey
NSS	National Sample Survey
OBC	Other Backward Class
PDS	Public Distribution System
PQs	Parliamentary Questions
RBI	Reserve Bank of India
RPCAU	Rajendra Prasad Central Agricultural University
SC	Schedule Caste
SDG	Sustainable Development Goals
SHG	Self-Help Group
ST	Schedule Tribe
UNICEF	United Nations Children's Fund
USD	United States Dollar
UT	Union Territory
WASH	Water, Sanitation & Hygiene

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Foreword

Climate change is no longer a distant threat – it is a lived reality, increasingly shaping the lives of millions of children in India. Rising temperatures, erratic rainfall, frequent extreme weather events, and degrading agricultural systems are converging to challenge food availability, accessibility, and the overall nutritional well-being of communities. For children, especially those from vulnerable geographies and marginalized communities, the risks are profound and multi-dimensional.

In this context, this report, "Measuring the Impact of Climate Change on Food and Nutrition Security in India", is both timely and critical. It provides robust empirical evidence linking climate vulnerability with key child nutrition outcomes across India. By integrating climate exposure metrics with disaggregated data on malnutrition, morbidity, dietary diversity, and socio-demographic factors, the study offers an essential foundation for climate-informed nutrition policy and programming. As India intensifies its climate resilience agenda, this evidence must serve to anchor multi-sectoral efforts that address both the immediate nutritional needs of children and the structural determinants of vulnerability.

I sincerely thank our academic partners, including the International Institute for Population Sciences (IIPS), Dr. Rajendra Prasad Central Agricultural University, PUSA (RPCAU), and our dedicated colleagues at UNICEF for their collaboration in this pioneering research. My appreciation to the authors for their scholarly rigour and commitment.

I also wish to acknowledge the contributions of all technical experts, reviewers, and workshop participants whose insights have enriched this report.

It is our hope that this report will inform and inspire national and state-level policymakers, practitioners, and development partners to take decisive action. By integrating climate considerations into nutrition planning and programme delivery, we move one step closer to securing a healthier, more resilient future for every child in India.

Cynthia McCaffrey
Country Representative
UNICEF India


Save Animals
Dont Cut Trees
Save Water
Save Energy
Reuse
3R
Recycle
Reduce
Stop Pollution
Dont Litter

Foreword

Climate change has swiftly shifted from a distant threat to an urgent public health crisis, especially for India's children. From my decades-long journey in public health and global health leadership, I have seen firsthand how disruptions caused by rising temperatures, unpredictable weather patterns, and extreme climate events undermine efforts to eliminate child malnutrition.

This timely study, "Measuring the Impact of Climate Change on Food and Nutrition Security in India," stands out for its rigorous integration of climate vulnerability indices with granular nutrition data. The study findings such as linking rising climate stress to increased stunting, underweight, and anaemia are indispensable for shaping resilient health, nutrition, and climate policies in India.

I urge policymakers and practitioners to use this robust evidence to craft climate-adaptive, nutrition-sensitive strategies. Investing in scientific approaches that span agriculture, health, and social protection is vital to safeguard children's growth trajectories, particularly during the first 1,000 days of life.

My profound thanks to UNICEF, IIPS, RPCAU-PUSA, and all collaborators for their dedication to generating high-quality evidence. May this report inspire decisive action to protect India's most vulnerable and build a nourishing, climate-resilient future for every child.

Dr. Soumya Swaminathan

Chairperson, MS Swaminathan Research Foundation (MSSRF)

Principal Adviser, Union Ministry of Health and Family Welfare (MoHFW)
Former WHO Chief Scientist
Former Director-General of the Indian Council of Medical Research (ICMR)

Executive Summary

The climate crisis has been called the most significant global health threat facing the world in the 21st century. In the past 5 years, record-breaking temperatures, extreme precipitation, and other severe weather events have occurred at an alarming rate. Climate change is a major risk factor to food and nutrition security in India, significantly impacting agricultural productivity, food systems, water resources, household nutrition, and socio-economic stability. This report investigates the intricate relationship between Climate Vulnerability and Food and Nutrition Security (FNS), utilising a novel district-level analogous Climate Vulnerability Index (CVI) tailored to the Indian context. Leveraging nationally representative datasets, the analysis captures both spatial (across districts) and temporal (over time) variations in key indicators around climate risks, socio-economic sensitivity, and adaptive capacity. It provides a comprehensive analysis of the climate vulnerability from 2009 to 2020.

Key findings: Climate vulnerability and child undernutrition

- **Geographic Disparities in Climate Vulnerability:** District-level mapping reveals that northern and eastern states, including regions in Bihar, Uttar Pradesh, Assam, and Odisha, exhibit higher climate vulnerability. These areas face compounded risks due to both exposure to extreme weather events and low adaptive capacity, making populations, especially children, more susceptible to climate-induced adversities.
- **Elevated Malnutrition in Climate-Vulnerable and Rural Areas:** The prevalence of child malnutrition – including stunting, wasting, underweight, and anaemia – is significantly higher in rural and high climate-vulnerability zones. This pattern underscores the compounded effect of poor infrastructure, limited health access, and food insecurity in climate-stressed rural settings.
- **Social Inequities in Nutritional Outcomes:** Children from Scheduled Tribes (ST), Scheduled Castes (SC), and Other Backward Classes (OBC) are disproportionately affected by malnutrition across all indicators. These inequities reflect deep-rooted structural disadvantages exacerbated by climate stressors.
- **Stunting and Underweight Strongly Linked to Climate Vulnerability:** The likelihood of stunting and underweight increases sharply with climate vulnerability. Children in very high vulnerability zones experience stunting and underweight at rates that are 15 and 13.6 percentage points higher, respectively, than those in very low vulnerability areas.
- **Wasting and Anaemia Follow Similar Patterns:** Although wasting shows a relatively smaller increase than stunting with rising climate vulnerability, the association remains statistically significant. Anaemia prevalence also rises significantly, with an 8 percentage points higher burden among children in very high vulnerability zones compared to those in the least vulnerable zones.

- **Inadequate Dietary Diversity and Feeding Practices:** High climate vulnerability constrains household capacity to provide diverse and age-appropriate diets. Poor dietary diversity and low meal/snack frequency contribute directly to poor nutritional outcomes among children.
- **Increased Morbidity in High-Risk Zones:** Children living in higher climate-vulnerable zones are more likely to suffer from infectious diseases, further impairing their nutritional status through repeated episodes of illness and poor nutrient absorption.
- **Association with Agricultural and WASH Indicators:** The results identify a moderate association between climate vulnerability and key agricultural or WASH indicators. Factors such as monthly household income, marginal farming status, grain productivity, and access to improved water and sanitation appear to be influenced by other socio-economic and infrastructural factors, suggesting the need for more nuanced, localised analysis.

Suggested Pathways for Developing a Nutrition-Responsive and Climate-Resilient System

To break the cyclical relationship between climate vulnerability, child malnutrition and socio-economic distress, the report proposes a multi-pronged strategy:

1. **Invest in Further Research and Knowledge Generation**

   1.1 Measurement of Magnitude and Pathways

   - Conduct state- and district-specific assessments to quantify the impact of climate shocks (droughts, floods, erratic monsoons, etc.) on child nutrition and identify mediating pathways.
   - Conduct vulnerability audits to identify gaps in community resilience (e.g., water scarcity in Rajasthan and coastal salinity in Odisha).

   1.2 Enhanced Multi-Level Surveillance System

   - Hotspots of climate vulnerability and childhood malnutrition are not uniform within and across the regions or states. Thus, it is imperative to strengthen real-time surveillance mechanisms at the state, district, and sub-district levels to detect climate-induced threats to FNS.

2. **Programme Strengthening Opportunities**

   2.1 Systems Strengthening to Ensure Nutrition Service Resilience and Continuity

   - Assess risks of climate change to health and nutrition service delivery systems and allocate resources towards the establishment of climate-resilient health facilities and Anganwadi centres, safeguarding the uninterrupted delivery of essential health and nutrition services amidst climate-induced disasters.
   - Enhance the existing Poshan Tracker system to evolve into a real-time nutrition surveillance system or an early warning mechanism, enabling proactive intervention and mitigation efforts.
   - Equip frontline workers (ASHAs, Anganwadi Workers, ANMs) and SHGs to deliver climate-adaptive nutrition counselling to increase knowledge and practices around consuming sustainable, local, seasonal, and climate-resilient healthy diets.

- Develop contingency plans to ensure uninterrupted access to nutrition services (e.g., Mobile Anganwadis) during extreme weather events.

2.2 Cross-Sectoral Integration of Strategies

Facilitate mainstreaming of climate resilience across health, agriculture, WASH, education, and social protection existing programmes while considering equity and gender empowerment as well as geographical challenges:

- **Agriculture:** Promote climate-smart agriculture; Diversify livelihoods for smallholder farmers; Link crop insurance schemes (e.g., PM Fasal Bima Yojana) to nutrition outcomes by incentivising nutrient-rich crop production; Strengthen farmer collectives, including women groups, to adopt sustainable practices (e.g., zero-budget farming in Karnataka) and access climate advisory services via digital platforms.
- **WASH:** Improve access to safe drinking water and sanitation, particularly in the drought-prone or flood-affected areas, by upgrading water supply systems and promoting water-efficient technologies for hygiene, sanitation and irrigation to ensure climate-resilient sanitation infrastructure.
- **Education:** Embed comprehensive climate change, environmental sustainability and nutrition education into school curricula and teacher training programmes, including eating local and seasonal foods, saying no to ultra-processed foods and foods HSSF, purchasing products with minimum packaging, recycling, and reducing energy and water consumption, etc.
- **Social Protection:** Engineer mechanisms to ensure the adaptability of social protection schemes, expand climate-responsive safety nets (e.g., MGNREGA) to include food security activities, such as building community grain banks in disaster-prone areas, etc.

2.3 Prioritising Marginalised Populations

- **Targeted Support:** Map and capacitate small/ marginal farmers with subsidies for climate-resilient seeds, training in agroecology, and market linkages for indigenous crops.
- **Social Equity:** Design gender- and social group-sensitive programmes, such as nutrition grants for female-headed households in climate-stressed regions.

3. Potential Policy Implications

3.1 Build more environmentally sustainable food systems

- Advocate for the adoption of food regulations that are aimed at protecting children from aggressive ultra-processed food marketing; establish food pricing policies that subsidise unprocessed or minimally processed local foods while taxing ultra-processed foods and foods high in salt, sugar and/or fat (HSSF).

3.2 Engagement of Members of Parliament and Policymakers:

- There is a need to further and better inform Parliamentarians on the linkages between climate vulnerability and nutrition and provide them with user-friendly toolkits to engage in discussions with the population in their constituencies on low-cost and local ways to increase community resilience.

Conclusion:

India stands at a critical juncture where the convergence of climate change and malnutrition demands urgent policy attention. The findings underscore that climate vulnerability is not solely an environmental issue – it is a determinant of public health, nutrition, and equity. By embedding climate resilience across sectors and prioritising the most vulnerable populations, India can safeguard its future generations and advance its national food and nutrition security agenda in a warming world.

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Introduction and Overview

Achieving food security and eliminating all forms of malnutrition are at the heart of India's development agenda and its agenda toward Sustainable Development Goal 2 Zero Hunger (SDG2). The National Family Health Survey (NFHS) allows for the study of trends in India's development agenda and its agenda toward Sustainable Development Goal 2 – Zero Hunger (SDG-2). Impressive economic growth in recent times has not translated into commensurate gains in the nutritional status of the population, especially among women and children. Anthropometric data collected in successive rounds of the National Family Health Survey (NFHS) allow for the study of trends in child malnutrition in India. The prevalence of stunting, which indicates chronic malnutrition, decreased from 48 per cent in 2005-06 to 38 per cent in 2015-16 and further to 36 per cent in 2019-21. However, the persistence of high levels of malnutrition emphasises ongoing challenges, especially in addressing underlying social and economic determinants in high-prevalence states like Meghalaya (47 per cent), Bihar (43 per cent), Uttar Pradesh (40 per cent), and Jharkhand (40 per cent).

On the other hand, the prevalence of wasting has shown a static trend over the last three rounds of NFHS. The underweight prevalence has consistently declined from 43 per cent in 2005-06 to 36 per cent in 2015-16 and further to 32 per cent in 2019-21. However, despite progress, one in three children in India is still underweight, signalling that malnutrition remains a critical public health challenge.

Anaemia among children continues to be at an alarmingly high rate: 70 per cent in 2005-06, 59 per cent in 2015-16, and 67 per cent in 2019-21. NFHS-5 (2019-21) also reports that 57 per cent of women in the reproductive age group were anaemic.

In its SDG India Baseline Report (NITI Aayog 2018), the Government of India, aims to reduce child stunting to 21 per cent and anaemia in women to 24 per cent by 2030. However, progress is slower than expected, and it is likely that India will miss the target.

A key aggravating factor related to nutrition globally, as well as in India, is climate change. As climate-related events escalate, food systems become unstable, compromising food security and diet quality, particularly for vulnerable populations grappling with various forms of undernutrition (Khandelwal et al., 2024). The net impact of climate change depends not only on the extent of the climatic shock but also on the underlying vulnerabilities, such as high sensitivities and poor adaptive capacities (MSSRF, 2024).

Studies predict that by the end of the century, climate change-induced labour productivity cuts may be as high as 40 percent in India (Nelson et al., 2024).

Due to climate change, there is an increasing risk of synchronous failure of major crops across the global breadbaskets (Gaupp et al., 2020) and decreased global agricultural productivity growth rate over recent decades (Ortiz-Bobea et al., 2021). With an average monthly income of INR 10,218 (USD 118.1) (MoSPI, 2021), agricultural workers and farmers India are primarily dependent on rainfed agriculture and traditional livestock production in India for food and nutrition security. Although the green revolution and technological achievements have brought improved output and food security, the challenge remains to achieve an equitable improvement amidst the unpredictable changing climatic conditions (Bawa & Seidler, 2023; Das et al., 2022). The unusual trends in hydrometeorological events adversely impact crop production, livestock production, agro-diversity and sustainability, which directly determine the food security of the population. Climate-sensitive indicators, including agriculture, biodiversity, and water availability, are expected to face the impact of climate change over the years (Bolan et al., 2024).

Up to 4.5 per cent of India's GDP could be at risk by 2030 due to climate change-related impacts (RBI, 2022)

Climate change and nutrition are deeply interconnected, forming what is increasingly recognised as a global 'syndemic' - a convergence of multiple epidemics that interact synergistically (Swinburn et al., 2019). These challenges stem from shared systemic drivers such as unsustainable food systems, agricultural practices, urbanisation patterns, transportation systems, and land use policies. Together, these factors create environments that encourage unhealthy dietary habits, sedentary lifestyles, and poor health outcomes, disproportionately affecting vulnerable populations.

In many developing countries, including India, poverty further amplifies this syndemic, particularly in states where human development has been low. The limited resources, fragile health systems, and social inequities exacerbate the syndemic, including the burden of malnutrition (Swinburn et al., 2019; Fanzo et al., 2021). Moreover, climate change acts as a catalyst in this dynamic, disrupting ecosystems, depleting natural resources, and intensifying food insecurity. As a result, the health crises linked with malnutrition in all its forms and climate change are no longer isolated phenomena. Still, they are interconnected challenges that require integrated and multidisciplinary responses.

Recognising climate change as a global pandemic underscores the urgency to address its far-reaching implications on public health and sustainability. Tackling this syndemic demands coordinated action that bridges health, environmental, and social sectors, with particular emphasis on poverty reduction, sustainable development, and resilient health systems.

Climate change contributes to child malnutrition through multiple pathways, influencing the enabling, underlying, and immediate determinants of maternal and child nutrition (Figure 1). These effects stem from rising temperatures, erratic and unpredictable weather patterns, sea-level rise, ocean warming and acidification, as well as climate-induced shocks and stresses such as floods, droughts, and extreme heat events. Collectively, these disruptions undermine the stability of the enabling environment for nutrition.

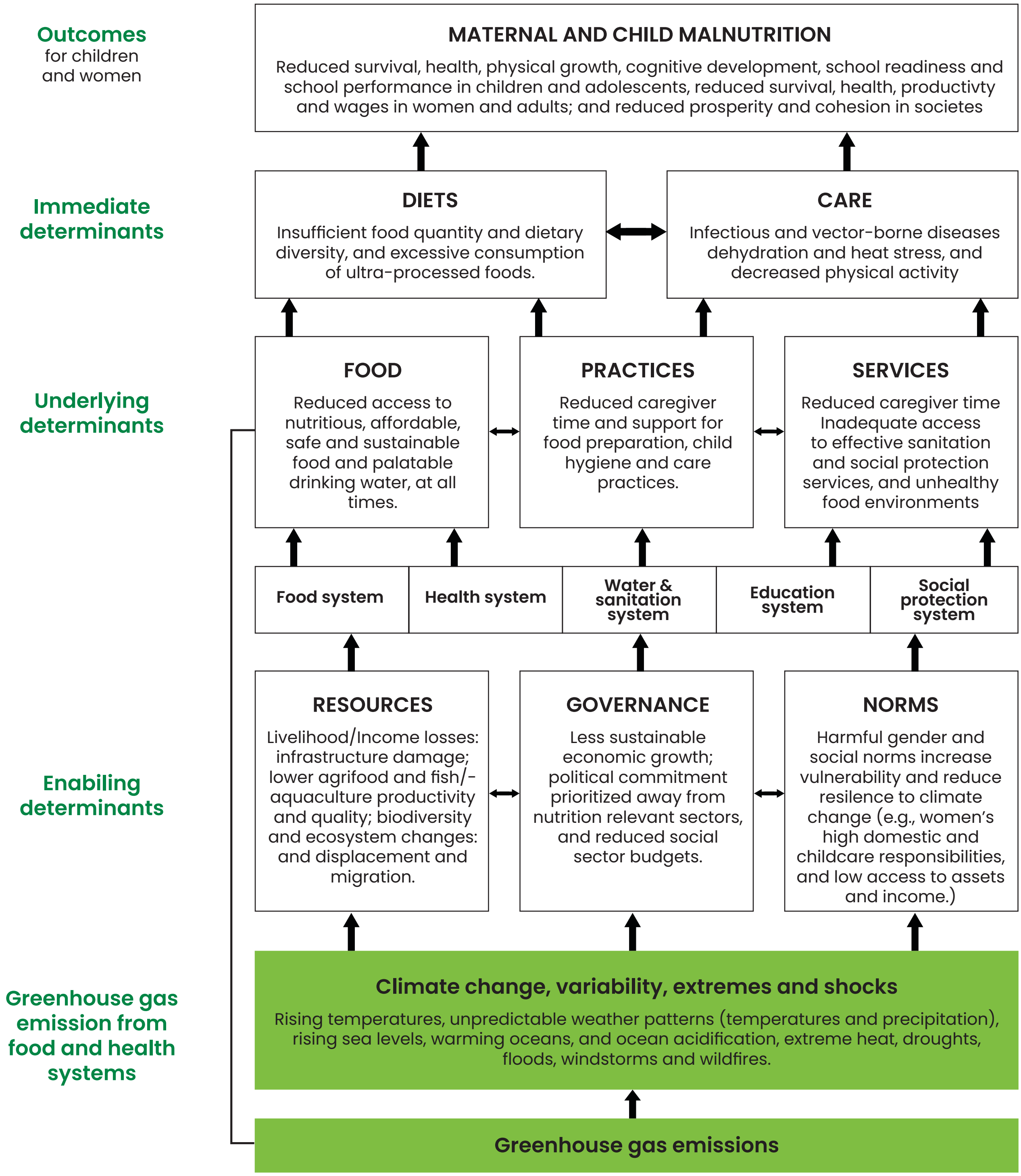

Figure 1. Conceptual framework for maternal and child malnutrition, indicating the effects of climate change on the immediate, underlying and enabling determinants (UNICEF, 2025)

According to the Food and Agriculture Organisation (FAO, 2016), the combined effects of biophysical (i.e. physiological changes owing to direct exposure to adverse climatic events like damage of houses, water, sanitation, hygiene and health care infrastructure, agricultural and roads) and social vulnerabilities (i.e. effect on income or wage, schooling and aggravating social and gender discriminations) critically shape the net impact of climate change on food security. Climate vulnerability in India has intensified significantly, as highlighted by the India Meteorological Department (IMD), which declared the decade 2010–19 as the warmest in Indian history, marking a clear manifestation of global warming within the country. Additionally, in recent years, India has witnessed an alarmingly high frequency of extreme weather events, occurring, on average, nine out of every ten days (Pandey & Sengupta, 2024). In 2023 alone, India faced extreme weather events on 318 out of 365 days and affected 2.2 million hectares of crop area, causing the loss of 3,287 human lives and 124,000 animal lives in the country (Pandey & Sengupta, 2024).

The higher frequency of heatwaves and drought in 2022, compared with 1981–2010, was associated with 151 million more people experiencing moderate or severe food insecurity across 124 countries (Romanello et al., 2024)

Children remain the most vulnerable population group, bearing a disproportionate burden of death and disability arising from climate vulnerability. The crop loss owing to extreme weather events is more than 3 times higher compared to non-climatic reasons (MoAFW, 2022). Climate change continues to undermine agricultural yield, a trend further intensified by emerging stressors such as rising air pollution. Air pollution leads to reduced crop yield and affects the nutrient content of crops (Dong & Wang, 2023). For instance, particulate matter (PM2.5) and ozone exposure correlate with reduced zinc and iron content in cereals, amplifying risks of childhood stunting and anaemia. Drought and early child health and nutrition links have also been documented previously (Kumar et al., 2016). Furthermore, rising temperatures and erratic precipitation patterns disrupt food production cycles, leading to seasonal food shortages and micronutrient deficiencies, consequently causing long-term nutritional deficiencies like stunting (Dimitrova & Muttarak, 2020). Flooding and waterlogging events not only destroy crops but also exacerbate the spread of vector-borne diseases and diarrheal infections, both of which are critical determinants of child malnutrition.

These alarming trends emphasise the urgent need for targeted interventions to address the multifaceted impacts of climate change and environmental hazards on the most vulnerable sections of the population.

This evidence underscores the interplay between climate change, environmental degradation, and child health & nutrition, necessitating coordinated efforts to mitigate risks, enhance resilience, and reduce inequities in climate vulnerability and its health & nutrition outcomes.

1.1 Climate Vulnerability Measure

A climate vulnerability measurement contributes to decision-making by identifying and analysing the potential harms and consequences associated with climate change. The vulnerability assessment frameworks are increasingly popular, considering their utility in identifying 'hotspots' of climatic risk zones and predicting negative health and nutritional outcomes and for planning and designing adaptive capacities. Moreover, a composite measure of Climate Vulnerability Index (CVI) has become an important and essential empirical tool to quantify the levels of climate vulnerability and rank different places based on their values. Recently, it has become a critical predictive variable for investigating the impact of climate vulnerability on FNS in the Indian context (MSSRF, 2024). However, previous studies have shown only a moderate association between climate vulnerability and FNS (McMohan & Gray, 2021; Phalkey et al., 2015). The lack of a strong association between climate vulnerability and FNS can be attributed to the absence of a robust, holistic, sensitive and nationally comparable measure of climate vulnerability.

Existing climate vulnerability indices using a common vulnerability assessment framework have played a key role in identifying climate-vulnerable zones and their association with FNS. Among them, those developed by the Council on Energy, Environment, and Water (CEEW) and the Department of Science and Technology (DST) are well recognised (Mohanty & Wadhawan, 2021; DST, 2020; Rao et al., 2016). Using a wide range of variables for the different components of climate vulnerability, these existing CVIs provide essential information regarding the climate vulnerability "hotspots" in the country. However, these indices present an opportunity for further enhancement to better align or predict nutritional indicators and to allow for more consistent comparisons across regions. For instance, the CVI developed by CEEW has considered a limited range of variables across the dimensions of exposure, sensitivity, and adaptation over a very long period. A limited number of weather shock indicators and a very long reference period make the index an imperfect fit for associating with the recent information on nutritional status indicators. On the other hand, the DST index is not comparable across states due to its varying indicators. However, it has considered more meteorological and adaptive capacity components over time. Additionally, the district coverage was not comprehensive in either of the previous measures of CVI. A recent report shows a moderate association of CEEW's CVI levels with child nutritional indicators from NFHS across districts (MSSRF, 2024). Therefore, the need for constructing a robust CVI to capture the impact of climate change on the economy, health and nutrition became imperative.

1.2 Focus and Objectives

The report presents a comprehensive, data-driven assessment of the impacts of climate change on FNS in India. It aims to investigate both direct and indirect pathways through which climate variability and long-term climatic shifts influence children's nutritional status. Drawing on recent scientific evidence and nationally representative datasets, the study seeks to inform actionable policy and programmatic interventions to enhance resilience and ensure sustainable FNS outcomes under changing climatic conditions.

Specifically, the report focuses on the following objectives:

- Assessing the cumulative exposure to climate vulnerability from the in-utero period to the time of survey, and its relationship with child growth outcomes.
- Quantifying the impact of climate change on children's anthropometric indicators—stunting, wasting, and underweight—as well as anaemia levels, using national survey data.
- Employing a modified district-level Climate Vulnerability Index (m-CVI) as an analytical tool to establish the linkage between climate vulnerability and nutrition outcomes.
- Identifying critical climate vulnerability "hotspots" using the m-CVI framework and connecting them with FNS outcomes to inform geographically nuanced strategies.
- Examining proxies for child dietary intake patterns—including minimum meal

frequency, minimum dietary diversity, and minimum acceptable diet—to capture dimensions of nutrition security (WHO and UNICEF., 2021).

The m-CVI, constructed based on a conventional vulnerability assessment approach, serves as a robust and context-sensitive tool for formulating localised resilience strategies. By integrating climate-proofing measures at the community and district levels, the index enables targeted, evidence-based interventions aimed at mitigating climate risks and fostering sustainable development in vulnerable regions.


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Data, Methodology and Limitations

This study employs an analytical framework to examine the intricate relationship between climate vulnerability and FNS in India. By leveraging comprehensive datasets from nationally representative sources, the analysis captures spatial (across districts) and temporal (over time) variations in key indicators of agricultural productivity, household food security, and child nutrition and health outcomes. A multi-pronged empirical approach comprising robust econometric tools is adopted to assess the impact of climate shocks on vulnerable populations across districts of the country.

2.1 Data Sources

This study aims to model the relationship between 'comprehensive and multi-dimensional climate vulnerability measure' and 'child undernutrition levels' across Indian districts. Districts serve as key policy units and represent the lowest administrative level at which child undernutrition measures are reliably estimated through national representative surveys.

A wide range of climate vulnerabilities exists. Based on global evidence (Thiede & Strube, 2020; Dimitrova & Muttarak, 2020; Lieber et al., 2022), climate shocks—such as floods, droughts, heatwaves, cold waves, excessive rainfall variance, air pollution, and water deficits—was identified as key predictors of child health and nutrition for which reasonably good data are available to test this association. However, the literature also suggests that exposure to shocks alone cannot determine child undernutrition (Niraj & Techato, 2024). The sensitivity and adaptive capacities of districts are crucial in shaping the overall relationship between climate vulnerability and child nutritional status (Paavola, 2017; Dimitrova & Muttarak, 2020).

Consequently, this study, in addition to exposure to climate shocks, also employs measures such as 'sensitivity' and 'adaptive capacity' to construct a climate vulnerability index, which is then linked to child undernutrition. Indicators within these categories were carefully selected based on existing evidence and input from the two expert consultation workshops organised by UNICEF on 25 October 2024 (virtual) and 23 December 2024 in Patna. Experts from ICMR, ICRISAT, BITS- Hyderabad, BITS Pilani, IIPS, RPCAU-PUSA provided their expert suggestions to design the construct.

The present study derives sensitivity levels using triangulation of four indicators, which include the proportion of irrigated agricultural land and average maternal height, along with sensitivity indices from the Council on Energy, Environment and Water (CEEW) and the Department of Science and Technology (DST). The rationale for adding two additional indicators to existing sensitivity indices of CEEW and DST is: a higher share of irrigated land protects agricultural productivity from climate shocks, thereby reducing sensitivity. Similarly, attained maternal height is an indicator of long-term intergenerational nutrition, with the hypothesis that districts with better maternal and child health outcomes display lower sensitivity to climate vulnerability, making children less prone to undernutrition.

Existing adaptive capacity indices, such as those from CEEW, often include broad district-level disaster preparedness indicators and socioeconomic data from the Census (Mohanty, 2020; Mohanty & Wadhawan, 2021). These may not reflect conditions consistent with the exposure time period considered for this study and are not closely associated with child nutrition. Notably, macroeconomic indicators like gross domestic product are often poor explainers of micro-level individual nutritional health and wellbeing (Joe et al., 2016). The DST index uses different indicators for different states for sub-state level analysis, preventing comparison across the districts in the country.

Alternative climate vulnerability indicators that construct sensitivity and adaptive capacity differently were explored previously for India (IIT Mandi, IIT Guwahati and IIS Bengaluru, 2020). However, although these variables were not linked with district-level nutrition data, drivers varied widely across and within states, making the identification of uniform indicators difficult.

The present study employs proxies of household-level adaptive capacity that could be suited to capture household resilience to climate shocks and their implications for child nutrition. An additional consideration in variable selection was the need to rely on a single national database that provides both outcome and explanatory variables at the household level. In this case, both the malnutrition outcomes and the adaptive capacity variables were drawn from NFHS, strengthening the robustness of the district-level analysis. These include the following.

1. Mothers' mean years of schooling as an indicator of caregiving capacity.
2. Household wealth index, a composite measure based on over 30 assets covering housing quality, water access, and sanitation; and
3. Institutional delivery rates reflect the strength of local health infrastructure and maternal-child healthcare environments. There are no better and simpler variables than this in the NFHS to explain the strength of health infrastructure.

To explore the relationship between climate change and FNS, this study used multiple data sources on hydro-meteorological, environmental, and socio-economic variables. While the environmental indicators have been compiled from several different sources, socio-economic and nutritional indicators have been collected from the NFHS (IIPS and ICF, 2017, 2021), and meteorological data have been compiled from published gridded data provided by the

Indian Meteorological Department (IMD). The extraction procedure of IMD gridded data on temperature, rainfall and other information is explained in Table B of the appendix.

Table 1. Indicators and data sources

Component	Selected Indicator	Source of Data
Exposure	Flood Index, Drought Index, Heatwave Index, Cold Wave Index Total precipitation, Maximum Temperature, Minimum temperature PM2.5 Concentration Water Deficit Levels	Indian Meteorological Department Indian Meteorological Department Air Quality Life Index (AQLI) publication ICRISAT
Sensitivity	CEEW Climate Sensitivity Index DST Climate Vulnerability Index Share of irrigated agricultural land Average Maternal Height	CEEW publication DST publication Agricultural Census of India NFHS-4 and NFHS-5
Adaptive Capacity	Mean years of schooling Household wealth status Levels of institutional delivery	NFHS-4 and NFHS-5

2.2 CVI: Computational Methodology

The concept of vulnerability has evolved over time. Vulnerability encompasses a variety of ideas and elements, including sensitivity or susceptibility to harm and a lack of capacity to cope and adapt. In other words, climate vulnerability is a multi-dimensional concept that represents the overall climate risk profile of a region. In this study, we measured climate vulnerability as a function of exposure, sensitivity and adaptive capacity, i.e., CVI=f (Exposure, Sensitivity, Adaptive Capacity), which is mathematically calculated as below:

$$\textbf{Climate Vulnerability Index} = \frac{\textbf{(Exposure X Sensitivity)}}{\textbf{(Adaptive Capacity)}}$$

In this function, exposure and sensitivity are positively related to vulnerability and adaptive capacity is inversely associated with vulnerability. Where,

Exposure is "the presence of people, livelihoods, species or ecosystems, environmental functions, services, resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by climate-related stimuli" (IPCC, 2014).

Sensitivity is "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a 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)" (Houghton & IPCC, 2001).

Adaptive capacity is "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (Houghton & IPCC, 2001).

2.3 CVI: Computational Steps

Both the CVI developed by DST (2020) and CEEW (2021) were reviewed and incorporated into the composite sensitivity index. To develop a more comprehensive framework that captures exposure, sensitivity, and adaptive capacity, a modified CVI (m-CVI) was constructed. The district-level m-CVI draws on a range of indicators sourced from multiple datasets. A detailed methodology for extracting exposure data from the IMD gridded format using the Python program, along with generating measures of district-level averages and deviations, is explained in Appendix Table B.

The computational steps for constructing the m-CVI are outlined below:

Step 1:

$$\text{Each indicator is made unit free using linear scaling method} = \frac{(X_{it}-\text{Min}(X_{it}))}{(\text{Max}(X_{it})-\text{Min}(X_{it}))}$$

Where, X_{it} be the value of the selected indicator for the year t (t=2009 to 2020, subject to availability of data) at district i. Normalised values of an indicator range between 0 and 1.

Step 2: Computation of each dimension:

Composite Exposure Index=
[0.3*(1-Weighted precipitation index)]
+(0.3*Weighted water deficit index)
+(0.2*Weighted PM2.5 concentration index)
+(0.1*Weighted surface gust index)
+(0.1*IMD flood Index)

Composite Sensitivity Index=
(0.35*CEEW sensitivity index)
+(0.35*DST CVI)
+(0.2*Irrigated agriculture land)
+(0.1*Maternal Height)

Composite Adaptive Capacity Index=
(0.33*Mean years of schooling)
+(0.33*Percentage of rich as per wealth quintile)
+(0.33*Percentage of institutional delivery)

$$\text{m-CVI} = \frac{(\text{Composite Exposure Index}) \times (\text{Composite Sensitivity Index})}{(\text{Adaptive Capacity Index})}$$

Step 3:

The theoretical possible range of the m-CVI is from 0 to 1. A higher value of the index emphasises higher vulnerability, while a lower value of the index shows low climate vulnerability in the region. It is to be noted that the m-CVI is not an absolute measure of the climate vulnerability profile; the index is only a relative measure among the districts. In this study, the climate indicators were collected from 2009 to 2020 to illustrate changes in climate vulnerability over time. We considered three variables: the overall m-CVI, m-CVI for 2009-14, and m-CVI for 2015-20.

Table 2. Comparison of the m-CVI vis-à-vis the CVI of DST and CEEW

Variable	Number of districts	Mean	Min	Max
m-CVI (2009-2014)	698	0.437	0.0009	1
m-CVI (2015-2020)	698	0.467	.027	1
m-CVI (2009-2020)	698	0.452	.028	1
DST CVI (2020)	605	0.563	.344	.753
CEEW CVI (2021)	463	0.278	0	1

Note: For the newly constructed m-CVI, observations are based on NFHS unit level information.

2.4 Statistical Approach

The linkage between climate change and FNS is not straightforward, as it impacts the outcome through multiple direct and indirect pathways. This study adopts a systematic and rigorous statistical methodology to investigate and quantify the impact of climate change on FNS in India. Our approach is designed to ensure clarity, robustness, and reproducibility of the analysis. In this study, we have built a new district-level m-CVI that is used as an aggregate measure of climate vulnerability to estimate the impact of climate change on FNS in the population. The newly constructed m-CVI has been linked to unit-level data from the NFHS to conduct multivariate econometric analyses. The key steps in detail include:

Step 1: Modified Climate Vulnerability Index (m-CVI) building	This index was built based on variables like heatwaves, droughts, floods, and other climate-related risks, sensitivity to the risks and adaptive capacity of the population. i.e., m-CVI=f (Exposure, Sensitivity, Adaptive Capacity)
Step 2: Constructing district-level m-CVI by linking m-CVI data to NFHS	Using district IDs, birth year and date of the interview, the m-CVI levels were linked to individual-level NFHS data. This linked each child in the NFHS dataset to the climate vulnerability level of their district average exposure and within-district climate variability.
Step 3: Assigning cumulative exposure	For each child, cumulative exposure to climate vulnerability was calculated from in-utero (pregnancy) to the current age of the child at the time of the survey. For instance, children who are 59 months at the time of the survey, i.e. a child surveyed at 59 months (approximately 5 years old) in January 2015 during NFHS-4, were exposed to m-CVI levels for 59 months post-birth (2010-2015) + 9 months in-utero (2009) = 68 months.
Step 4: Classification of m-CVI levels	Based on quintile distribution and corresponding cut-off values, the estimated m-CVI scores were classified into five vulnerability categories: very low, low, medium, high, and very high. However, for indicators such as agriculture, food systems, and WASH available only at the state level, the m-CVI scores were grouped into three vulnerability zones (low, medium, and high) using tertile thresholds.
Step 5: Statistical analysis	Descriptive and multivariate analysis (marginal effects from linear and logistic regression estimates) to explore the impact of m-CVI levels on child malnutrition and its mediating mechanisms, including dietary intake and childhood morbidities.

2.5 Constraints and Limitations

It is important to note that the impact of climate change is an intricate and complex concept. This study offers an important starting point to unpack some of the complexities. Despite the adoption of a robust methodology to assess the impact of climate change on FNS, certain data-related limitations and constraints must be acknowledged. The m-CVI employed in this study relies on a defined set of indicators to measure exposure, sensitivity, and adaptive capacity. However, it would be inaccurate to suggest that the index captures all relevant parameters. Several vital factors remain outside the scope of this framework and were not included in the current analysis. Estimating the impact of climate change on the demand and supply scenarios of food in a population is an intricate and challenging chapter to delve into (Pritchard, 2016). A vast number of socioeconomic, environmental, and agricultural variables need to be incorporated with a robust and interconnected mechanism to unfold the complex relationship where most of the variables are associated in an unpredictable and indirect relationship with considerable spatio-temporal variability. A few districts have been omitted due to data availability issues. Since most of the indicators used in this study have been available up to the district level only, the study could not be extended beyond the district level to estimate the intra-district variation. Our primary source of data for socio-economic and nutritional indicators is the NFHS, but the absence of georeferenced data prevented us from assigning individual-level exposure in this study. The sample used for various indicators, along with the explanation of the variables, is annexed in Table A.

An inherent problem with climate change and its impact analysis is the uncertainty of the phenomenon. Climate change is a long process with multiple uncertainties associated with the pattern, variability, spatial extent, and frequency of meteorological events. Also, it is essential to note that the impact of climate change is a complex concept, and there are multiple direct and indirect mechanisms through which climate change impacts the FNS of a population.

3

Results and Study Highlights

At the national level, climate vulnerability has emerged as one of the most pressing challenges, particularly for countries like India, which are geographically and climatologically predisposed to adverse climate events. As a subtropical nation, India experiences a diverse range of extreme weather phenomena, including intense heat waves, severe thunderstorms, torrential rains and floods, cold waves, and escalating air pollution. These meteorological extremes are compounded by significant fluctuations in daily and seasonal weather patterns, driven by both natural variability and anthropogenic climate change.

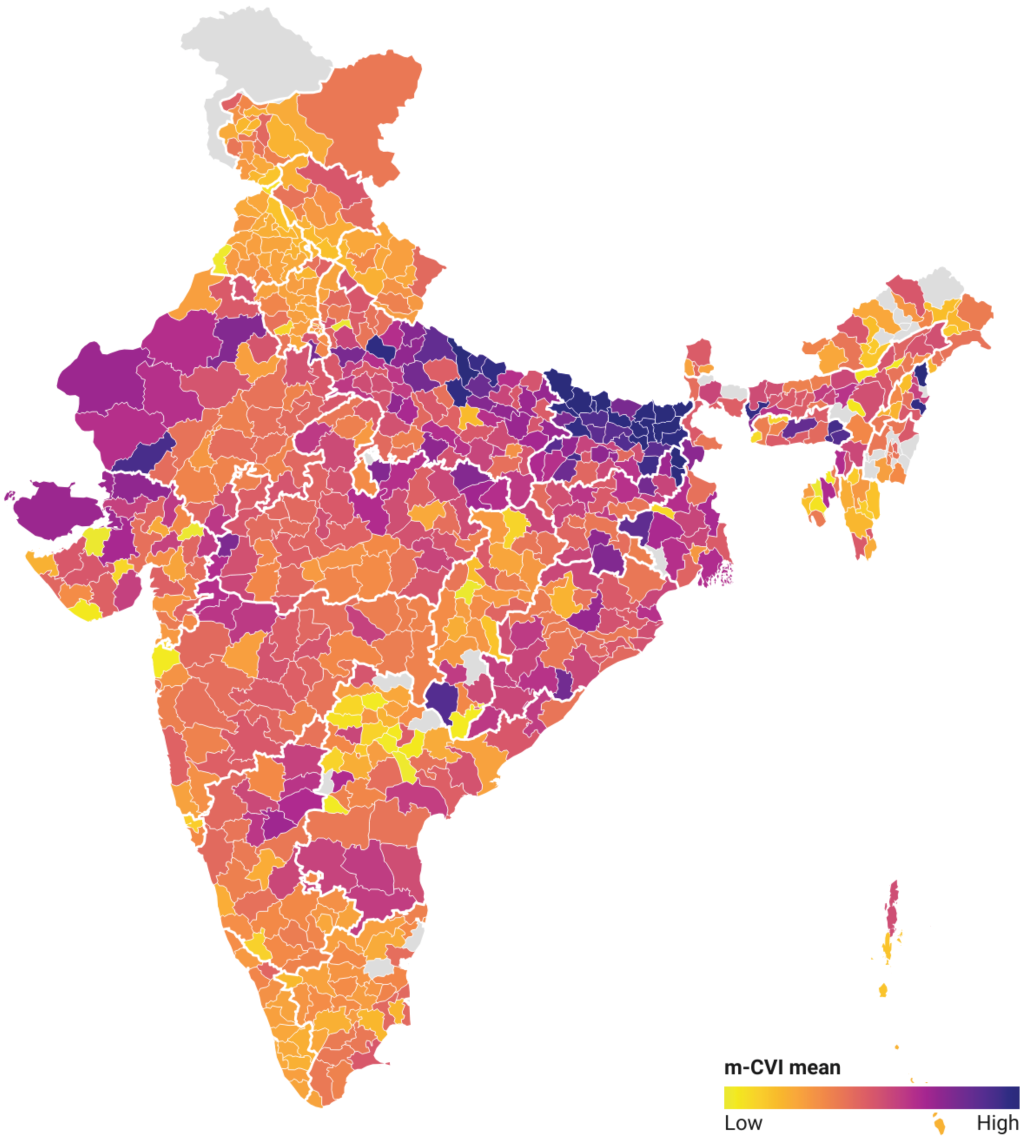
3.1 Components of the m-CVI

While theoretically, the possible range of the newly constructed m-CVI is from 0 to 1, the national average is found to be 0.452 with a considerable amount of significant spatial clustering and variation across districts. The m-CVI estimates show that for a state or UT, the lowest CVI is for Daman & Diu, that is 0.15, and the highest value is for Bihar, 0.83. Among the populous states, the lowest m-CVI is estimated to be for Punjab, 0.25. However, it is to be noted that the vulnerability index values are a relative measure; it does not provide an absolute measure. Based on the m-CVI, derived for each state and district, the report shows that all states in India are vulnerable to climate risks. However, the ranking of states using a vulnerability index indicates the relative vulnerability of the states, and such an assessment helps policymakers and financial partners to prioritise states with adapted interventions (DST, 2020).

Table 3. Component-wise climate vulnerability profile of Indian States

States Name	Average Exposure	Average Sensitivity	Average Adaptive Capacity	Average m-CVI
Andaman & Nicobar Islands	0.397	0.479	0.647	0.322
Andhra Pradesh	0.51	0.59	0.593	0.509
Arunachal Pradesh	0.308	0.427	0.416	0.319
Assam	0.367	0.568	0.441	0.484
Bihar	0.56	0.555	0.355	0.835
Chhattisgarh	0.456	0.346	0.465	0.357
Daman & Diu	0.372	0.294	0.7	0.149
Goa	0.428	0.506	0.875	0.251
Gujarat	0.528	0.459	0.6	0.417
Haryana	0.586	0.439	0.751	0.356
Himachal Pradesh	0.441	0.457	0.691	0.294
Jammu & Kashmir	0.377	0.507	0.605	0.325
Jharkhand	0.499	0.422	0.371	0.594
Karnataka	0.483	0.512	0.613	0.417
Kerala	0.383	0.636	0.826	0.301
Madhya Pradesh	0.524	0.465	0.498	0.501
Maharashtra	0.502	0.537	0.632	0.435
Manipur	0.329	0.531	0.438	0.41
Meghalaya	0.341	0.411	0.303	0.511
Mizoram	0.334	0.42	0.584	0.254
Nagaland	0.296	0.394	0.291	0.499
NCT of Delhi	0.592	0.439	0.846	0.308
Odisha	0.459	0.535	0.481	0.521
Punjab	0.55	0.347	0.777	0.25
Rajasthan	0.587	0.46	0.555	0.498
Sikkim	0.425	0.546	0.613	0.382
Tamil Nadu	0.468	0.512	0.692	0.347
Telangana	0.45	0.349	0.587	0.272
Tripura	0.383	0.319	0.431	0.269
Uttar Pradesh	0.581	0.478	0.493	0.584
Uttarakhand	0.434	0.434	0.589	0.326
West Bengal	0.47	0.549	0.492	0.536

The state-wise climate vulnerability profiles provide a comparative understanding of Indian states. It gives a preliminary understanding of the entry point for any adaptation intervention. However, for a comprehensive vulnerability assessment, sub-state level estimation is a crucial step. Figure 2 shows the district-level geographical pattern of vulnerability based on the m-CVI values. Although we have included 698 districts for the assessment, some of the districts with their most recent district boundaries could not be included due to the unavailability of data.



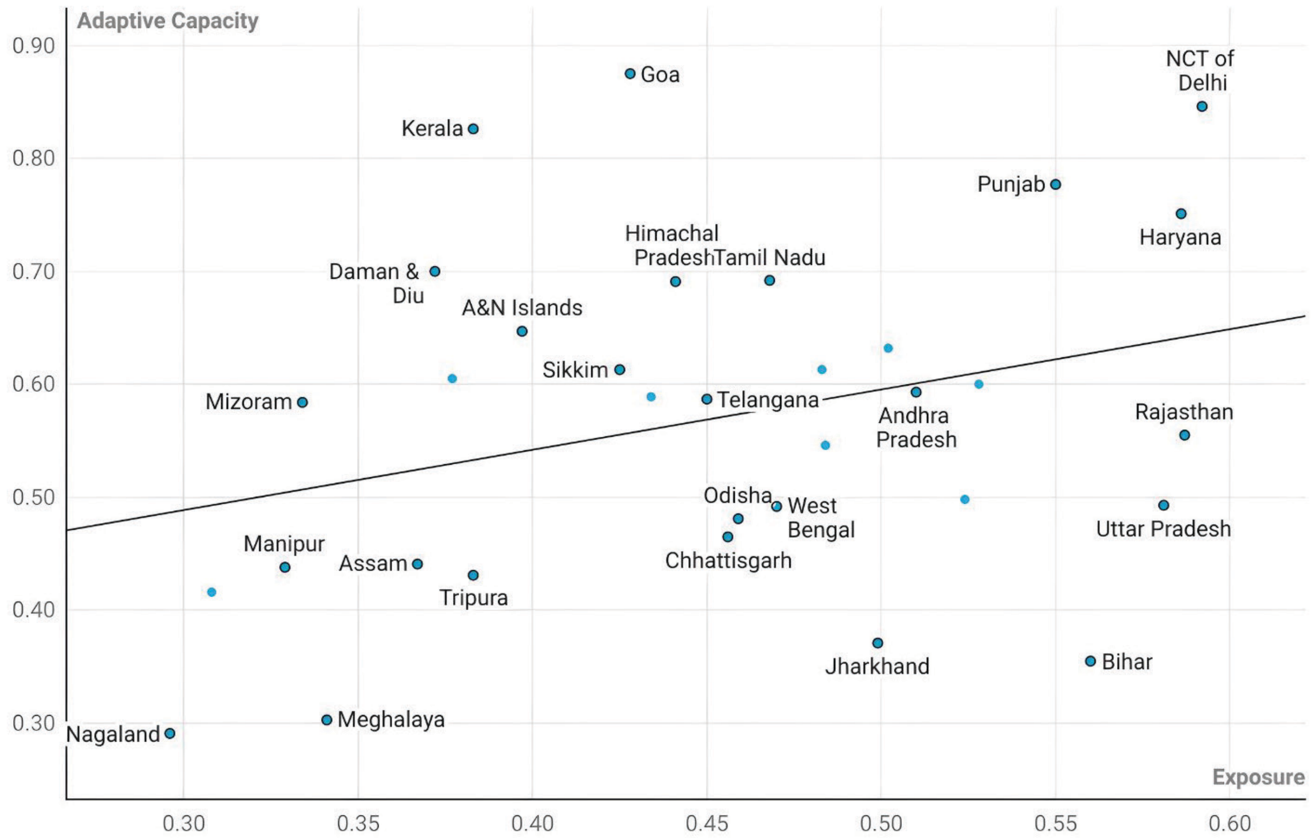
Source: Constructed by authors. Data not available for the region is highlighted in grey colour.

Figure 2. Geographical pattern of climate vulnerability in India, 2009-2020

3.2 Regional Patterns of Climate Vulnerability

The district-level analysis shows the stark contrast between districts with low (yellow) and high (purple) m-CVI values, underscoring significant heterogeneity, reflecting disparities in exposure, sensitivity, and adaptive capacity (Figure 2). The higher climate vulnerability in Eastern, North-Eastern, and Central India correlates with the frequent occurrence of extreme weather events like cyclones, floods, heatwaves, cold waves, and drought in these regions.

- **High vulnerable zone:** The Northern and Eastern regions, particularly Uttar Pradesh, Bihar, and parts of West Bengal, exhibit the highest levels of climate vulnerability (dark purple regions). These areas are prone to frequent flooding due to monsoonal variations, glacial melt, and inadequate drainage infrastructure. North-Eastern states like Assam and parts of Arunachal Pradesh show elevated climate vulnerability, likely attributable to heavy rainfall, frequent floods, and landslides.
- **Low vulnerable zone:** Several districts of Southern India (Kerala and interior Tamil Nadu) show lesser vulnerability to climate shocks, reflecting better adaptive capacities and diversified livelihoods. Districts of Punjab, Himachal Pradesh, and Haryana also show a relatively lesser vulnerability to extreme weather, potentially due to a lesser occurrence of cyclones, floods, and heatwaves.



Source: Constructed by authors

Figure 3. Relationship between climate change exposure and adaptive capacity across Indian States

In Figure 3, while some states with higher exposure also exhibit higher adaptive capacity (e.g., Punjab, Haryana, and NCT of Delhi), others, such as Bihar, Uttar Pradesh, and Jharkhand, display high exposure but low adaptive capacity, making them particularly vulnerable to climate shocks. The wide dispersion of data points suggests that states vary significantly in their ability to cope with climate change despite similar exposure levels.

One of the most critical insights from Figure 3 is that exposure alone does not determine vulnerability; adaptive capacity is a key moderating factor. While states such as Punjab, Haryana, and Tamil Nadu have similar exposure levels as Bihar, Uttar Pradesh, and Jharkhand, they remain significantly less vulnerable, possibly due to better adaptive capacities in terms of emergency preparedness and response, infrastructure, and climate resilience strategies. In contrast, states with both high exposure to climate vulnerability and low adaptive capacity draw attention to the need for adapted policies and interventions to enhance resilience, climate-adaptive agriculture models, better preparedness for disasters, and socio-economic development measures to mitigate long-term risks on the systems and the population.

3.3 CVI and Malnutrition: Inequalities across Socio-Economic Indicators

Tables 4 to 7 below present the prevalence of childhood malnutrition (stunting, wasting, underweight, anaemia and overweight) among children across the different levels of climate vulnerability (very low, low, medium, high and very high), disaggregated by place of residence (urban and rural), sex (male and female), and social groups (STs, SCs, OBCs and Others). The data in the tables refers to the period of 2009-20. However, the following section provides the figures of the same indicators in three panels – period 2009-20, 2009-14 and 2015-20 for an easier visualisation of changes over time.

3.3.1 CVI and Childhood Stunting

Child stunting refers to a child who is too short for their age and is the result of chronic or recurrent malnutrition. A child is classified as "stunted" if their height-for-age z-score (HAZ) is more than two standard deviations (SD) below the median of the World Health Organisation (WHO) Child Growth Standards reference population. As shown in Table 4, the prevalence of stunting in very high climate-vulnerable zones (45 per cent) is 15 percentage points higher than the prevalence in very low climate-vulnerable zones (30 per cent).

Across different socio-economic variables, the prevalence varies significantly:

- In the very high climate vulnerable zone, rural children have a higher prevalence of stunting (45 per cent) compared to urban children (36 per cent), indicating a greater susceptibility to climate-related stressors in rural settings.
- With respect to gender, there is not much difference; however, over the spectrum of climate vulnerability, stunting prevalence in both boys and girls increases across the vulnerability levels.
- Results show the existence of a social group-wise disparity in the prevalence of stunting over the climate gradient. Children from SCs, STs and OBCs groups face a persistently higher rate of stunting than "Other" groups. Stunting prevalence worsens in all groups according to the increased climate vulnerability.

Table 4 Prevalence (%) of stunting by climate vulnerability levels across socio-economic characteristics of children (2009-20)

Variables	Climate vulnerability levels					Range across vulnerability	P value
	Very low	Low	Medium	High	Very high		
Place of residence							
Urban	27.0	28.8	32.7	33.4	36.3	9.3	***
Rural	30.7	35.2	37.9	40.7	45.0	14.3	***
Sex of child							
Male	29.9	33.9	37.3	39.9	43.9	14.0	***
Female	28.4	31.4	35.7	38.5	44.0	15.6	***
Social groups							
Scheduled castes (SC)	32.5	36.2	40.2	43.8	48.5	16.0	***
Scheduled tribes (ST)	36.6	39.8	41.9	43.5	48.0	11.4	***
Other backward classes (OBC)	28.2	31.7	36.7	39.0	44.2	16.0	***
Others	25.0	26.8	30.7	30.3	35.6	10.6	***
TOTAL	**29.6**	**33.2**	**37.2**	**40.8**	**44.6**	**15.0**	

Note: P-values represent tests of association across climate vulnerability levels within each subgroup (chi-square test).
Level of significance: *p < 0.05, **p < 0.01, ***p < 0.001

3.3.2 CVI and Childhood Wasting

Child wasting refers to a child who is too thin for their height and is the result of recent rapid weight loss or failure to gain weight. A child is classified as wasted if their weight-for-height z-score (WHZ) is < -2 standard deviations (SD) below the median of the WHO reference population. Wasting reflects acute undernutrition, indicating recent or severe weight loss, often associated with acute food shortage, illness (like diarrhoea), or inadequate feeding practices. As shown in Table 5, the prevalence of wasting is found to rise with increasing climate vulnerability, from 18 per cent in very low climate vulnerable zones to 20 per cent in very high vulnerable zones.

With respect to the place of residence, the differences are minimal. In the very high climate vulnerable zone, children from Scheduled Tribes (ST) exhibit 6 per cent more prevalence of wasting (24 per cent) than the "Others" social groups (18 per cent) and 4 per cent above the overall average for that zone.

Table 5 Prevalence (%) of wasting by climate vulnerability levels across socio-economic characteristics of children (2009-20)

Variables	Climate vulnerability levels					Range across vulnerability	P value
	Very low	Low	Medium	High	Very high		
Place of residence							
Urban	18.2	18.6	20.5	20.0	20.7	2.5	***
Rural	18.4	20.5	20.4	21.3	20.4	2.0	***
Sex of child							
Male	19.0	20.4	21.2	21.9	21.3	2.3	***
Female	17.6	19.0	19.7	19.9	19.4	1.8	***
Social groups							
Scheduled castes (SC)	18.8	19.7	20.5	20.9	21.6	2.8	***
Scheduled tribes (ST)	22.2	24.7	25.5	27.6	24.1	1.9	***
Other backward classes (OBC)	18.6	19.3	20.3	20.1	20.0	1.4	***
Others	15.8	17.8	19.4	18.2	17.9	2.1	***
TOTAL	**18.3**	**19.8**	**20.4**	**21.0**	**20.4**	**2.1**	

Note: P-values represent tests of association across climate vulnerability levels within each subgroup (chi-square test).
Level of significance: *p < 0.05, **p < 0.01, ***p < 0.001

3.3.3 CVI and Childhood Underweight

Underweight refers to low weight for age, when a child can be either thin or short for their age. Underweight reflects a combination of chronic and acute malnutrition. Thus, it is sensitive to both current and cumulative climate vulnerabilities. A child is underweight if the weight-for-age z-score (WAZ) is < - 2 SD below the median of the WHO reference population. The prevalence of underweight consistently increases as the climate vulnerability worsens: The prevalence of underweight children (WAZ < –2 SD) increases from 26 per cent in very low climate-vulnerable zones to 40 per cent in very high climate-vulnerable zones – a considerable gap of 14 percentage points across climate vulnerability levels. Children in rural areas face a consistently higher level of underweight across all the climate vulnerability levels, and this difference widens as climate vulnerability increases. In very high climate-vulnerable zones, the prevalence of underweight is 7 per cent higher in rural areas than in urban areas, suggesting a higher disadvantage for rural children.

Gender-based disparities in underweight prevalence are minimal, with girls exhibiting a slightly higher overall range across climate vulnerability levels (15 per cent) compared to boys (13 per cent). However, marked social group disparities are evident. Children from SC and ST households consistently experience higher levels of underweight across all climate vulnerability categories. Notably, children from SC and OBC categories show the steepest increase, with underweight prevalence rising by 15 percentage points from very low to very high vulnerability. Among all groups, children from ST households show the highest concentration in the 'very high' category, with 46 per cent falling into this group—the highest proportion recorded across all demographic segments.

Table 6. Prevalence (%) of Underweight by Climate Vulnerability Levels across Socio-Economic Characteristics of Children (2009-20)

Variables	Climate Vulnerability Levels					Range across vulnerability	P value
	Very low	Low	Medium	High	Very high		
Place of residence							
Urban	24.5	26.3	30.3	31.0	33.7	9.2	***
Rural	27.0	33.1	34.9	37.9	40.3	13.3	***
Sex of child							
Male	26.8	31.5	34.4	37.0	39.4	12.6	***
Female	25.0	29.3	33.0	36.0	39.5	14.5	***
Social groups							
Scheduled castes (SC)	28.9	32.8	36.1	39.7	43.7	14.8	***
Scheduled tribes (ST)	34.8	40.8	42.1	45.9	45.8	11.0	***
Other backward classes (OBC)	24.7	29.1	33.6	35.7	39.5	14.8	***
Others	22.1	25.1	28.7	27.0	31.1	9.0	***
TOTAL	**25.9**	**30.4**	**33.7**	**36.5**	**39.5**	**13.6**	

Note: P-values represent tests of association across climate vulnerability levels within each subgroup (chi-square test).
Level of significance: *p < 0.05, **p < 0.01, ***p < 0.001

3.3.4 CVI and Childhood Anaemia

Childhood anaemia is a condition where a child's blood haemoglobin concentration falls below a sex- and age-specific cutoff, indicating impaired oxygen-carrying capacity of red blood cells. A child aged 6–59 months has anaemia if their altitude-adjusted haemoglobin is < 11.0 g/dL. The prevalence of childhood anaemia remains consistently high across all levels of climate vulnerability, indicating a widespread public health concern. Notably, children residing in very high climate vulnerability zones experience anaemia rates that are approximately 8 percentage points higher than those in very low vulnerability zones (67 per cent vs. 59 per cent). Although there is minimal difference between boys and girls, children from rural areas have a slightly higher prevalence of anaemia across all vulnerable groups.

However, social group disparities are pronounced. Children from ST and SC households consistently exhibit higher anaemia rates across vulnerability levels. For instance, ST children report 74 per cent anaemia prevalence in high vulnerability zones, while SC children reach 69 per cent in very high vulnerability zones. In contrast, children from the 'Others' group show comparatively lower rates, with 58 per cent in high and 64 per cent in very high vulnerability zones.

Table 7. Prevalence (%) of anaemia by climate vulnerability levels across socio-economic characteristics of children (2009-20)

Variables	Climate Vulnerability Levels					Range across vulnerability	P value
	Very low	Low	Medium	High	Very high		
Place of residence							
Urban	56.7	60.8	61.5	60.3	65.6	8.9	***
Rural	60.4	62.7	64.0	65.3	66.9	6.5	***
Sex of child							
Male	59.1	61.9	63.4	64.2	66.1	7.0	***
Female	58.6	62.1	63.3	64.3	67.4	8.8	***
Social groups							
Scheduled castes (SC)	63.2	63.2	65.5	66.1	68.9	5.7	***
Scheduled tribes (ST)	62.9	67.5	67.1	73.9	72.5	9.6	***
Other backward classes (OBC)	56.4	60.2	63.6	62.6	65.6	9.2	***
Others	57.4	60.8	59.8	57.9	64.0	8.6	***
TOTAL	**58.9**	**62.0**	**63.3**	**64.3**	**66.7**	**7.8**	

Note: P-values represent tests of association across climate vulnerability levels within each subgroup (chi-square test).
Level of significance: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

3.3.5 CVI and Childhood Overweight

Childhood overweight refers to excess body weight relative to height, indicating a risk of obesity-related health issues. A child under 5 years is classified as overweight if their weight-for-height z-score (WHZ) exceeds +2 SD above the median of the WHO reference population. As shown in Table 8, the overall prevalence of childhood overweight declined from 3.8 per cent in very low to 2.2 per cent in very high vulnerability zones – a 1.6 per cent decrease. In contrast to other forms of undernutrition (stunting, wasting, underweight, anaemia), the association between climate vulnerability and overweight appears to be inverse. Nevertheless, the difference between very low and very high vulnerability zones is statistically significant, highlighting this as a potential area for further investigation.

Table 8. Prevalence (%) of childhood overweight by climate vulnerability levels across socio-economic characteristics of children (2009-20)

Variables	Climate Vulnerability Levels					Range across vulnerability	P value
	Very low	Low	Medium	High	Very high		
Place of residence							
Urban	4.10	4.22	3.44	2.99	2.66	-1.44	***
Rural	3.65	2.83	2.48	2.22	2.15	-1.50	***
Male	4.05	3.45	2.84	2.42	2.22	-1.83	***
Female	3.60	3.28	2.60	2.29	2.20	-1.4	***
Social groups							
Scheduled castes (SC)	3.06	3.04	2.38	2.38	2.13	-0.93	***
Scheduled tribes (ST)	4.19	3.08	2.44	2.19	2.35	-1.84	***
Other backward classes (OBC)	4.06	3.23	2.67	2.06	2.11	-1.95	***
Others	4.15	4.17	3.09	3.22	2.62	-1.53	***
TOTAL	**3.83**	**3.37**	**2.73**	**2.37**	**2.21**	**-1.62**	***

Note: P-values represent tests of association across climate vulnerability levels within each subgroup (chi-square test).
Level of significance: *p < 0.05, **p < 0.01, ***p < 0.001

3.4 CVI and Its Association with Nutritional Indicators across Time Periods

All the malnutrition indicators show a strong positive association with climate vulnerability, indicating that climate vulnerability is a significant determinant of child nutritional outcomes (p<0.001).

Figures 4 to 8 contain three scatter plots, in each, depicting the relationship between child malnutrition (stunting, wasting, underweight, anaemia and overweight) and the m-CVI levels (very low, low, medium, high and very high) across three time periods: 2009–20 (top panel), 2009–14 (bottom left panel), and 2015–20 (bottom right panel).

These visualisations provide a detailed understanding of how varying degrees of climate vulnerability impact child nutritional outcomes, highlighting stark disparities between regions classified as very low and very high on the m-CVI scale. By incorporating 95 per cent confidence intervals, the figures ensure statistical reliability and emphasise the robustness of the observed trends.

3.4.1 Child Stunting by m-CVI across Time Periods

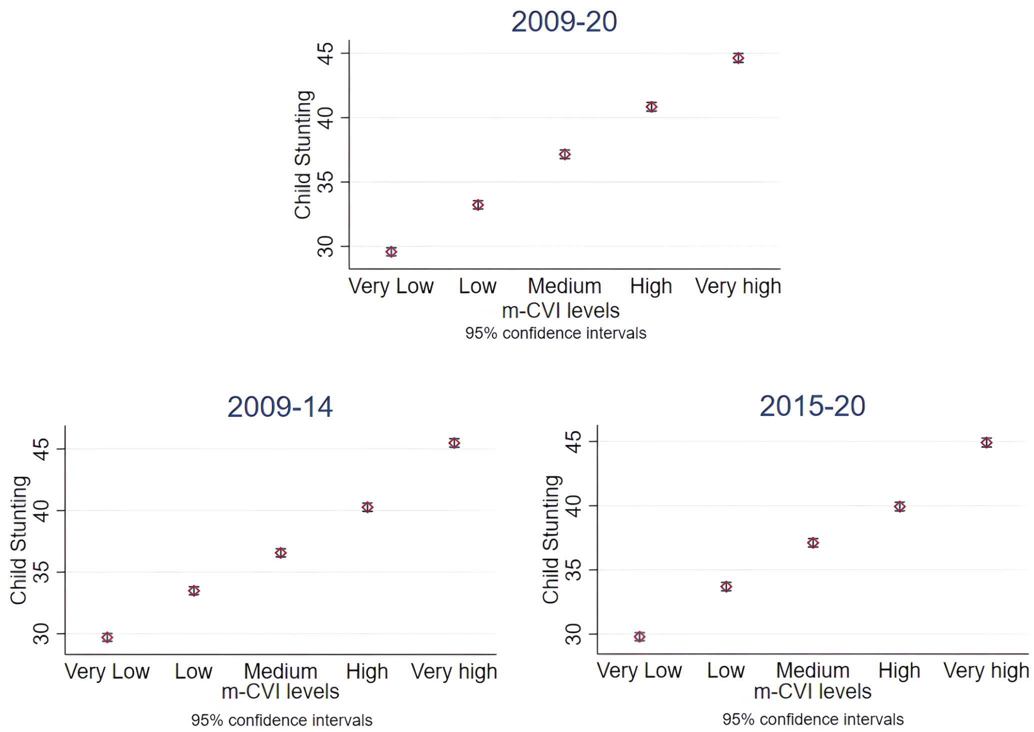


Figure 4. Child stunting (%) by climate vulnerability levels

An increasing number of children under five years of age are found to be short for their age (stunted) due to growing exposure to climate vulnerability. Across all panels, the disparity between very low and very high climate vulnerable zones is striking, with the stunting prevalence 15 percentage points higher in the very high climate vulnerable zones compared to very low zones.

3.4.2 Child Wasting by m-CVI across Time Periods

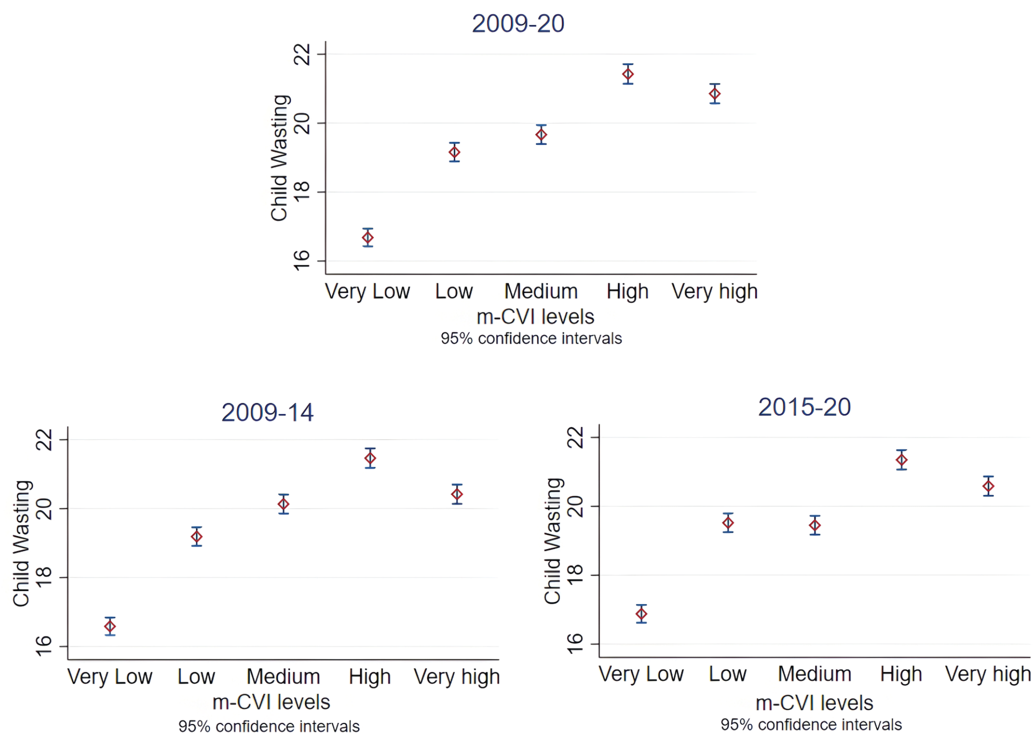


Figure 5. Child wasting (%) by climate vulnerability levels

Although the relationship is not clearly linear, there is a rising trend of children who are wasted. Between 2009 and 2020, children in the very high climate-vulnerable zones (20 per cent) were found to be nearly 2 per cent more wasted than their counterparts living in the very low climate-vulnerable zones (18 per cent).

Although the upward trajectory in child wasting with increasing climate vulnerability is consistent across time periods, the absolute prevalence in child wasting is slightly higher in 2015-20 in comparison to 2009-14, especially in the high and very high zones. This might be reflective of the escalating impact of climate change over time. However, the non-monotonous relationship between the m-CVI score and child wasting can be attributed to the highly sensitive nature of wasting indicators to changes in recent childhood conditions, seasonality, environmental alteration, and socio-economic status (Johnston et al., 2021).

3.4.3 Child Underweight by m-CVI across Time Periods

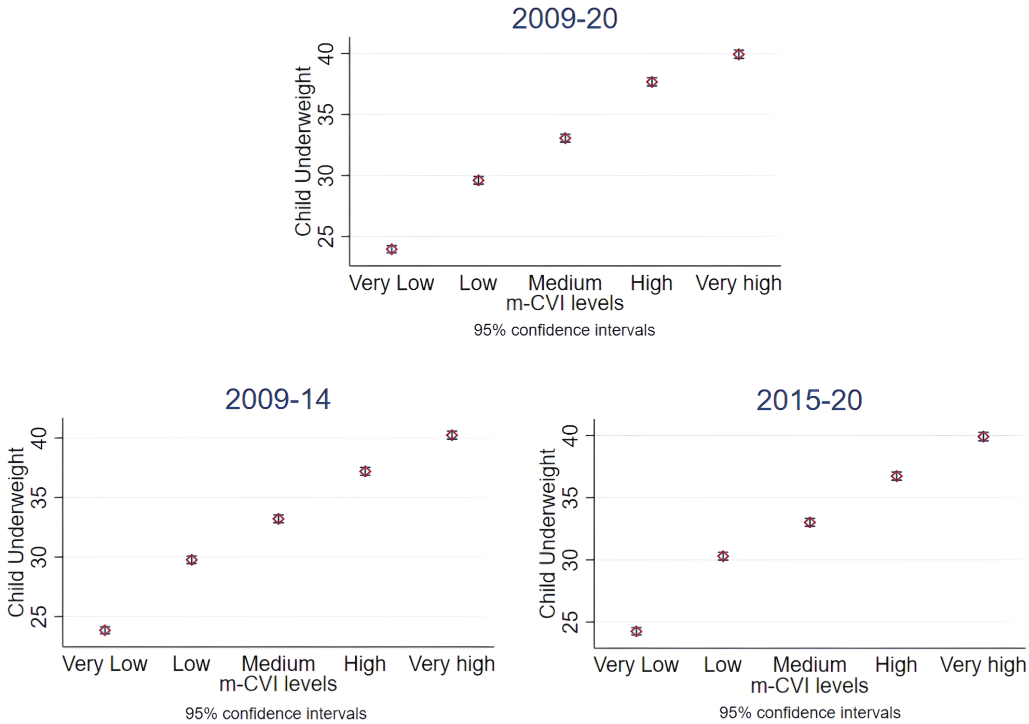


Figure 6. Child underweight (%) by climate vulnerability levels

Low weight-for-age explains childhood underweight. With respect to climate vulnerability, a significantly higher proportion of children (14 per cent higher) are found to be underweight in very high vulnerable areas (40 per cent) when compared with very low vulnerable regions (26 per cent). The consistency of trends across all three panels underscores a strong and persistent association between climate vulnerability and child underweight prevalence, regardless of the specific time period.

3.4.4 Child Anaemia by m-CVI across Time Periods

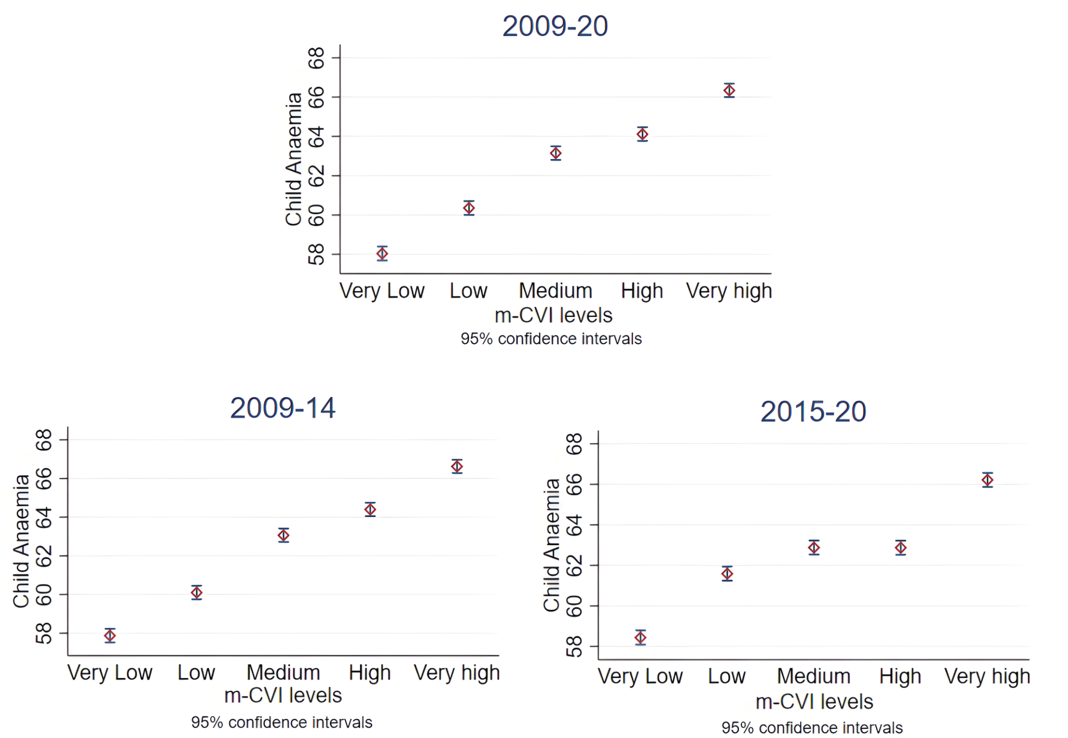


Figure 7. Child Anaemia (%) by Climate Vulnerability Levels

Anaemia in children has been one of the biggest concerns in India, with a historically very high prevalence (Sarna et al., 2020). In terms of climate vulnerability, nearly 8 per cent more children are found to be anaemic in the very high climate vulnerable zones (67 per cent) than their counterparts living in the very low climate environment vulnerable zones (59 per cent). Findings highlight a critical and consistent link between climate vulnerability and child anaemia. Consistent upward trends displayed in all three panels suggest that cumulative exposure to climate vulnerability has a direct or indirect role to play in contributing to anaemia.

3.4.5 Childhood Overweight by m-CVI across Time Periods

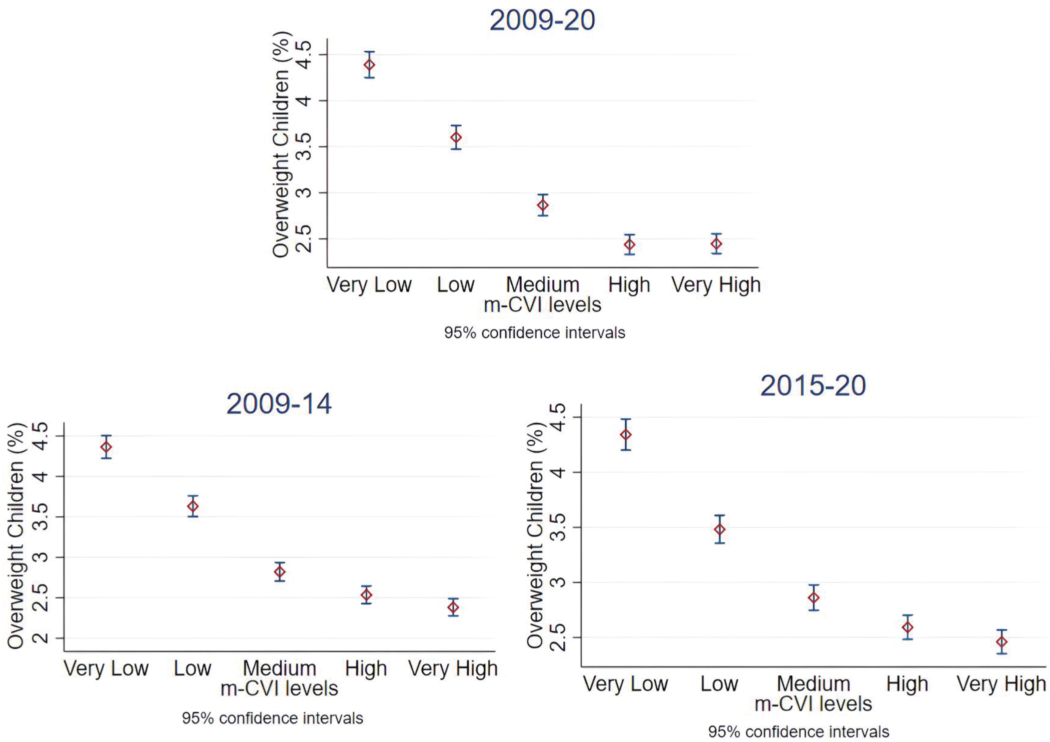


Figure 8. Childhood overweight (%) by climate vulnerability levels

However, cumulative exposure to climate vulnerability has shown an inverse relation with overweight status. The overall prevalence of childhood overweight decreased from 3.8 per cent in areas classified as very low climate vulnerability to 2.2 per cent in very high vulnerability areas. The trend looks similar across all three panels of data. While looking at all malnutrition indicators in unison, it is apparent that all forms of undernutrition are higher in very high climate-vulnerable zones.

3.4.6 Dietary Adequacy by m-CVI

Figure 9 visualises the Minimum Acceptable Diet (MAD), which is an index combining minimum dietary diversity (MDD) and minimum meal frequency (MMF).

All three child feeding indicators decline consistently as m-CVI (vulnerability) levels increase. The highest MAD is seen in "very low" and "low" m-CVI levels (≈13–14%). Although non-linear, children's dietary adequacy declines as m-CVI increases, reaching its lowest in "high" and "very high" categories. Overall, children residing in areas with higher vulnerability are significantly less likely to receive adequate meals, dietary diversity, or an overall acceptable diet compared to those in very low-vulnerability settings. This pattern underscores a clear association between greater climate vulnerability and poorer child feeding practices, highlighting the urgent need for targeted nutrition interventions in the most vulnerable populations.

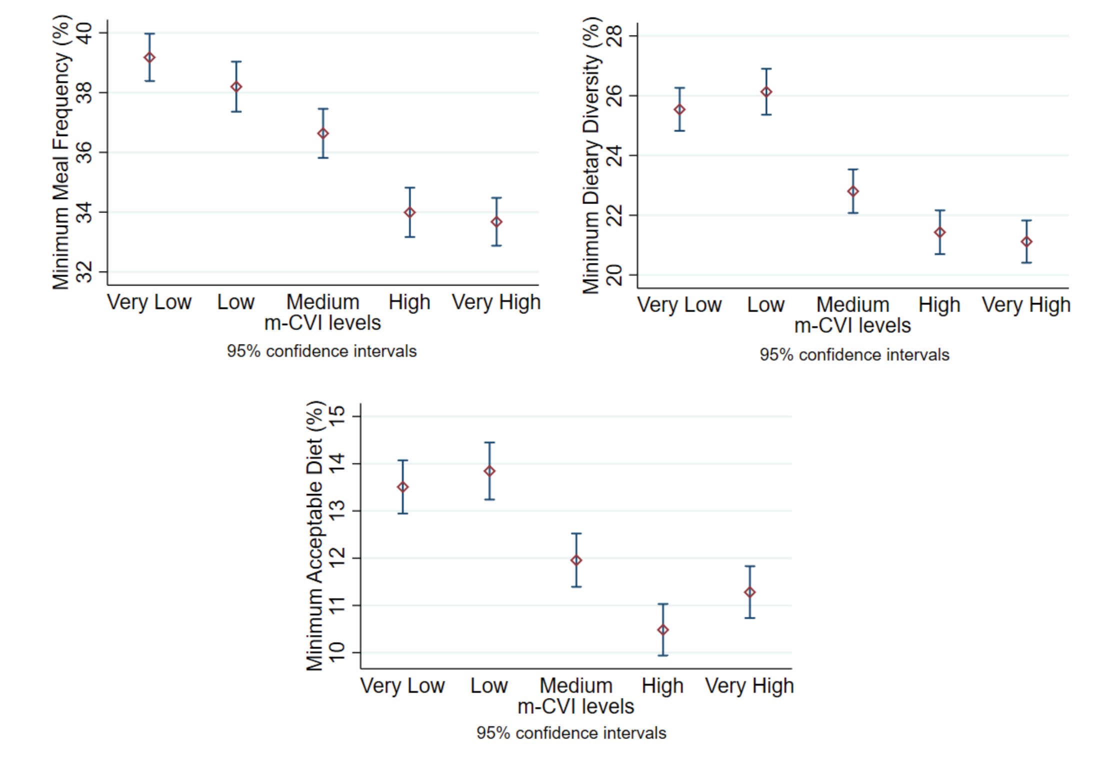
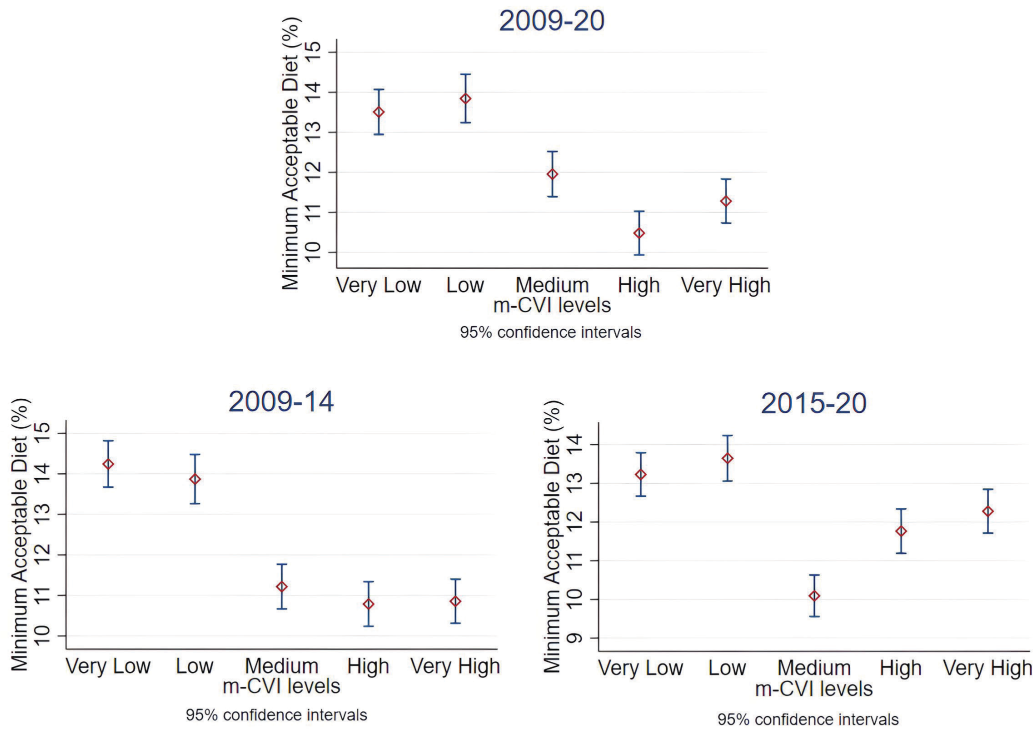


Figure 9. Percentage of children with minimum dietary diversity, minimum meal frequency and minimum acceptable diet by climate vulnerability levels (2009-20)

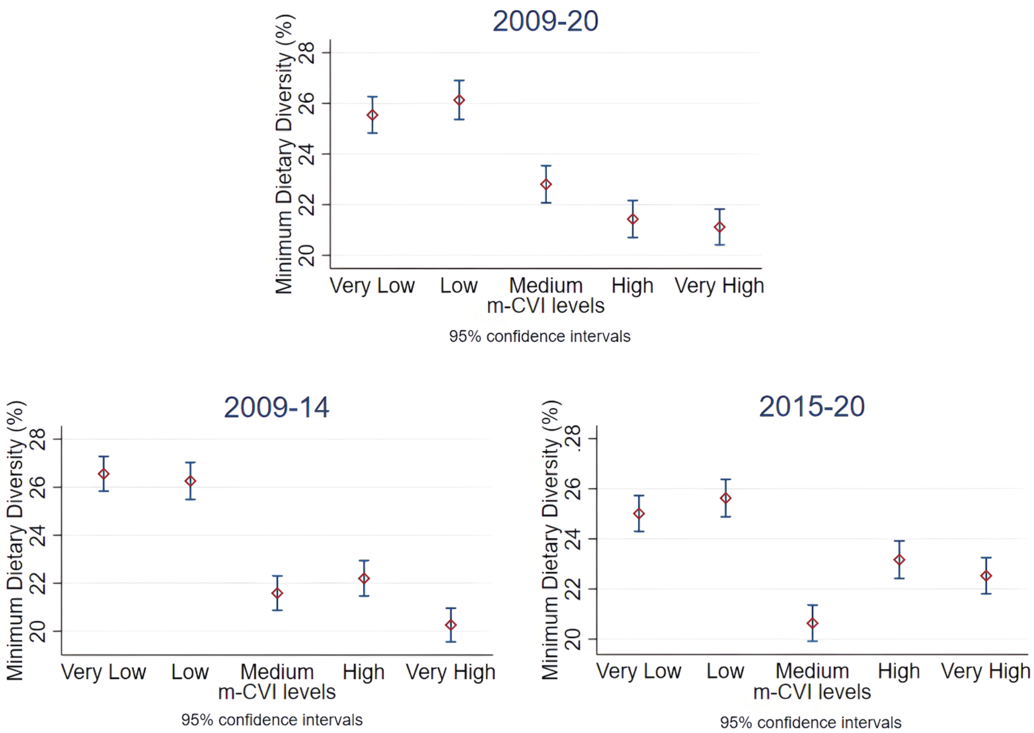
Figure 10 shows the three indicators MDD, MMF and MAD in three different time series. For the period 2009-14, all three indicators show a linear decline with increasing climate vulnerability. The non-linear pattern of diet-specific indicators, especially MDD during 2015-20, would need to be studied further. Previous research has shown that climate change, particularly rising temperatures, can adversely affect child nutrition. One recent study found that higher temperatures are associated with a modest but statistically significant decline in dietary diversity among children aged 6–23 months, with stronger, more substantial effects observed in specific temperature ranges. The relationship was further shaped by seasonal and climatic context, as well as child age, while access to infrastructure and maternal education were found to mitigate these negative effects (Rajkhowa et al., 2024).

A low MAD score indicates inadequate patterns of dietary diversity and meal frequency impairing optimal child growth. Minimum Dietary Diversity (MDD) assesses the proportion of children 6-23 months of age who have consumed at least five out of eight pre-defined food groups the previous day or night; threshold of adequate diet diversity. Minimum Meal Frequency (MMF) reflects the minimum number of meals/snacks to be consumed per day at different ages for children 6-23 months of age; a low frequency is associated with insufficient nutrient intake for optimal growth (WHO and UNICEF, 2021).

Minimum Acceptable Diet



Minimum Dietary Diversity



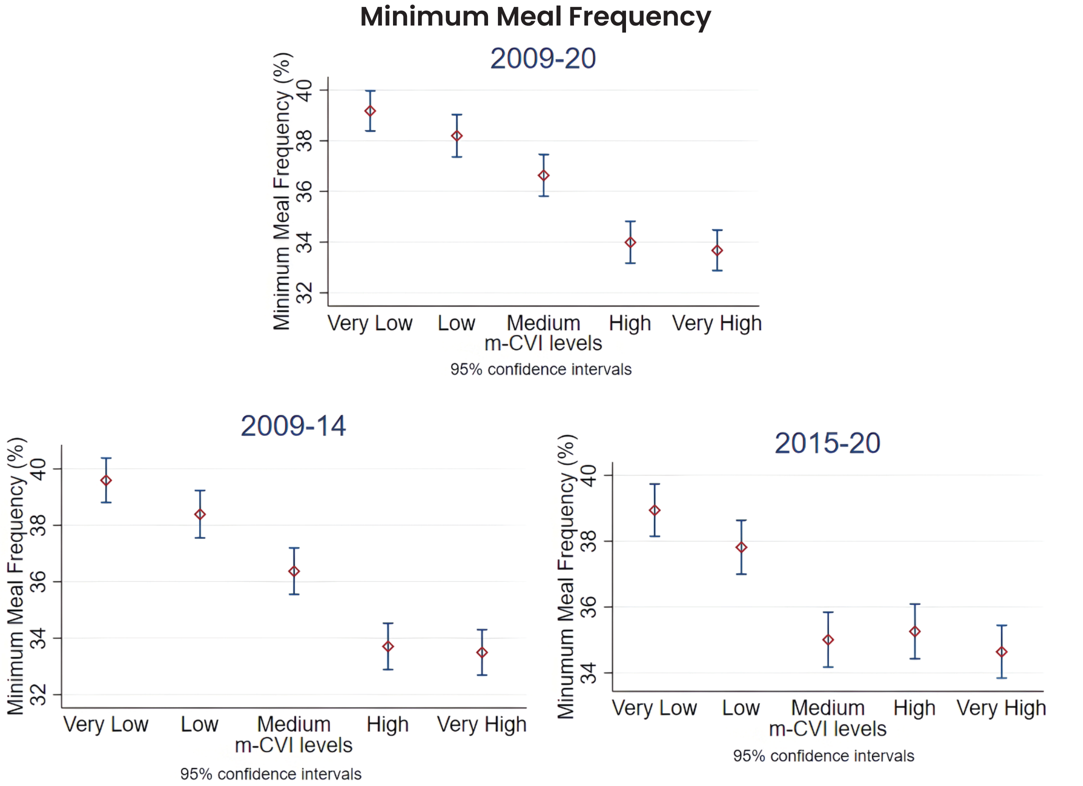


Figure 10. Percentage of children with minimum dietary diversity, minimum meal frequency and minimum acceptable diet by climate vulnerability levels and different periods

3.4.7 Childhood infections and illnesses by m-CVI across Time Periods

Infectious diseases have a profound impact on children's health and growth. Frequent infections weaken immune systems and limit a child's ability to thrive, perpetuating cycles of poor health, nutrition and poverty (Stephensen, 1999). In this study, children who have been diagnosed with diarrhoea or had cough, or fever in the last 2 weeks before the surveys have been considered to have "infections and illnesses". As shown in Figure 11, the prevalence of illness is much higher in regions with very high climate vulnerability, compared to those with very low climate vulnerability. However, it does not show a linear trend. Further research is necessary to better understand this non-linear relationship, which was not explored in the current work.

The increasing prevalence of infections and illnesses among children is likely due to the following potential reasons:

- **Poor sanitation:** Heatwaves and humidity foster the transmission of waterborne diseases, such as cholera and diarrhoea, particularly in areas with inadequate sanitation infrastructure.
- **Compromised immunity system:** Households in high CVI zones frequently experience food insecurity and undernutrition, which weaken immune responses, making individuals more susceptible to infections
- **Healthcare access disparities:** Climatic disruptions often exacerbate the inability to access healthcare in high or very high CVI zones.

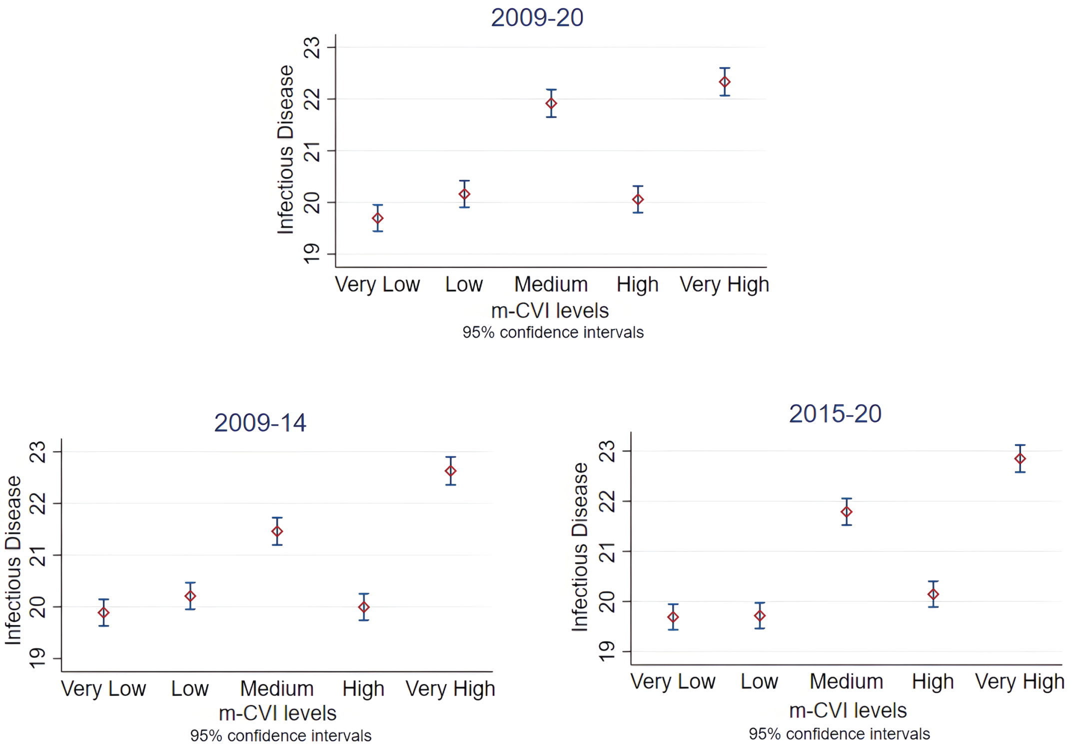


Figure 11. Prevalence of childhood infections and illness (%) by climate vulnerability levels

3.5 Association of m-CVI with Key Agriculture and Food System Indicators

Climate change can amplify the malnutrition outlook of a population through multiple pathways: household food security (access to safe, affordable, and sufficient food at all times, independently of seasonal variations or shocks), child feeding and care practices, and environmental health and access to health services (UNICEF 2025, Choularton et al.,2012). Climate change affects food availability and food accessibility, impacting the overall consumption of healthy foods (Fanzo et al., 2018). This subsequently can have an impact on all forms of malnutrition and health status. Although marginal and small farmers dominate the Indian agricultural system, climate vulnerability has the potential to worsen the agricultural productivity, access to adaptive technologies, and, in turn, possibly result in compromised nutrition status of the region (Gupta & Pathak, 2016).

Household income remains one of the most crucial determinants of a family's ability to access nutritious, safe and hygienic food on a daily basis. Investing in improving the family's adaptive capacities, such as an improved irrigation system, a climate-resilient cropping system, and diversified livelihoods, can help mitigate the highly fluctuating and frequent weather shocks. In addition to vulnerability to shocks, reduced agricultural incomes not only limit direct access to food but also exacerbate vulnerabilities to malnutrition, poor health outcomes, and social inequalities, particularly among marginalised populations (Siddiqui et al., 2020).

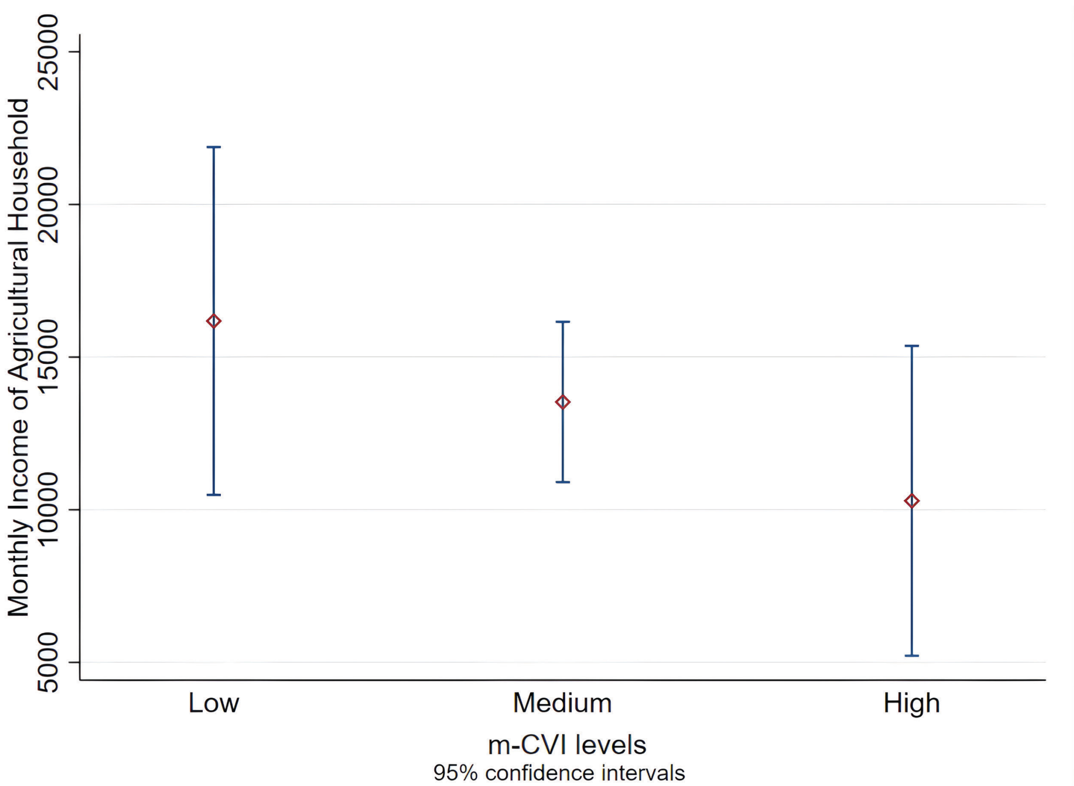
Marginal farmers, who typically operate on less than one hectare of land as per operational land holding statistics, represent about 69 per cent of the total operational holdings (MoAFW, 2020). As their primary source of income could be highly affected by shocks, it appears essential to explore the proportion of marginal farmers in different climate vulnerability zones.

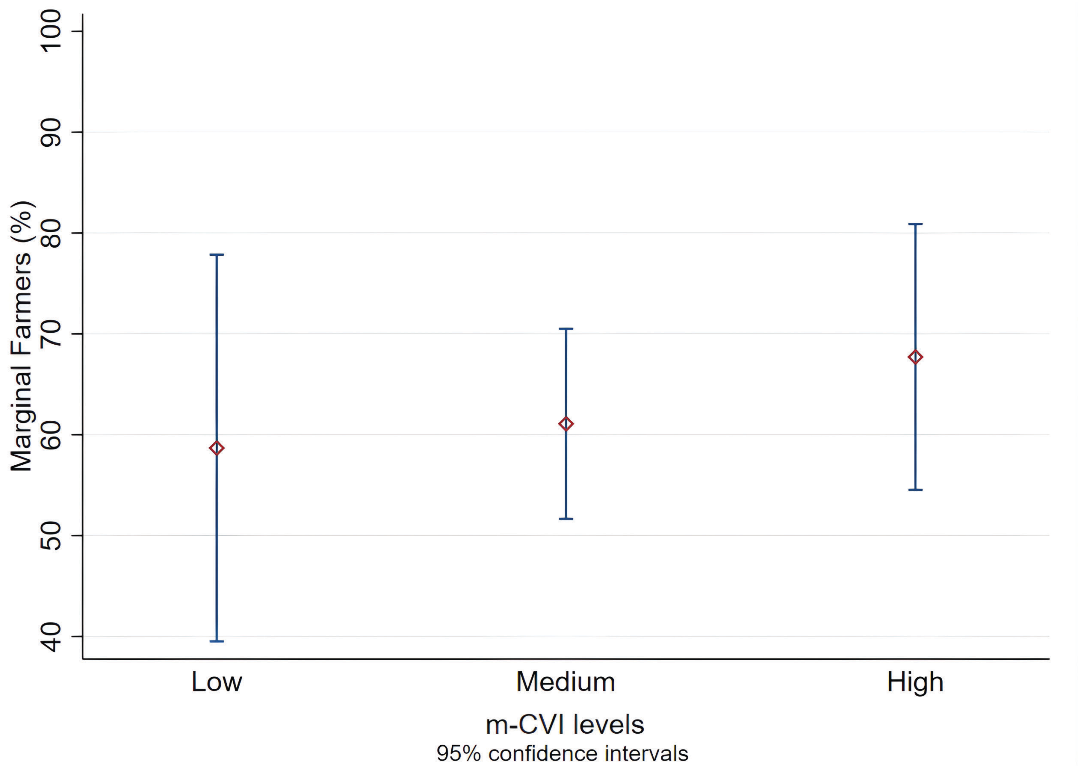
Although a stable market, as well as food availability, access and absorption, all four dimensions of food security are equally essential to ensure food security (FAO, 2003), food production can be affected directly by critical climate elements like extreme temperature, air pollution, erratic precipitation, floods, and drought (Swaminathan & Bhavani, 2013; Chattopadhyay, 2011). A higher occurrence of extreme events could exacerbate soil degradation and water scarcity, leading to a substantial reduction in crop yield. The compounding effect of reduced food grain productivity could leave a devastating impact on the food security of the population, especially for the children (Asian Development Bank, 2019).

In the present study, the association of three key related agriculture and food system indicators with the climate vulnerability zones was considered: monthly income of farmer households, proportion of marginal farmers and food grain productivity. Since these data points could only be obtained at the state level (and not for each of the 698 districts) due to limited sample size, all state-level data (as presented in the following section) have been categorised into three CVI zones—low, medium, and high—using tertile thresholds. This approach differs from the quintile-based classification used for district-level m-CVI indicators.

Results illustrate a lack of significant association between the three indicators and climate vulnerability zones. The overlapping confidence intervals suggest that factors other than CVI may influence the monthly income of farmer households, the proportion of marginal farmers and the food grain productivity.

However, the limited resources, lower adaptive capacities, and insufficient climate-sensitive agricultural practices of the marginal farmers make them highly susceptible to productivity disruptions and food insecurity, a critical pathway linking climate change to broader developmental and health outcomes (Fanzo et al., 2020). Further documentation is necessary to better understand the association between agriculture and food systems indicators and climate vulnerability, as well as how the presence or absence of this association affects the resilience mechanisms of marginal farmers. This information could better guide the government in offering more adapted programmes and schemes to these vulnerable populations, aiming at decreasing the potential impact of climate change on their main livelihood.





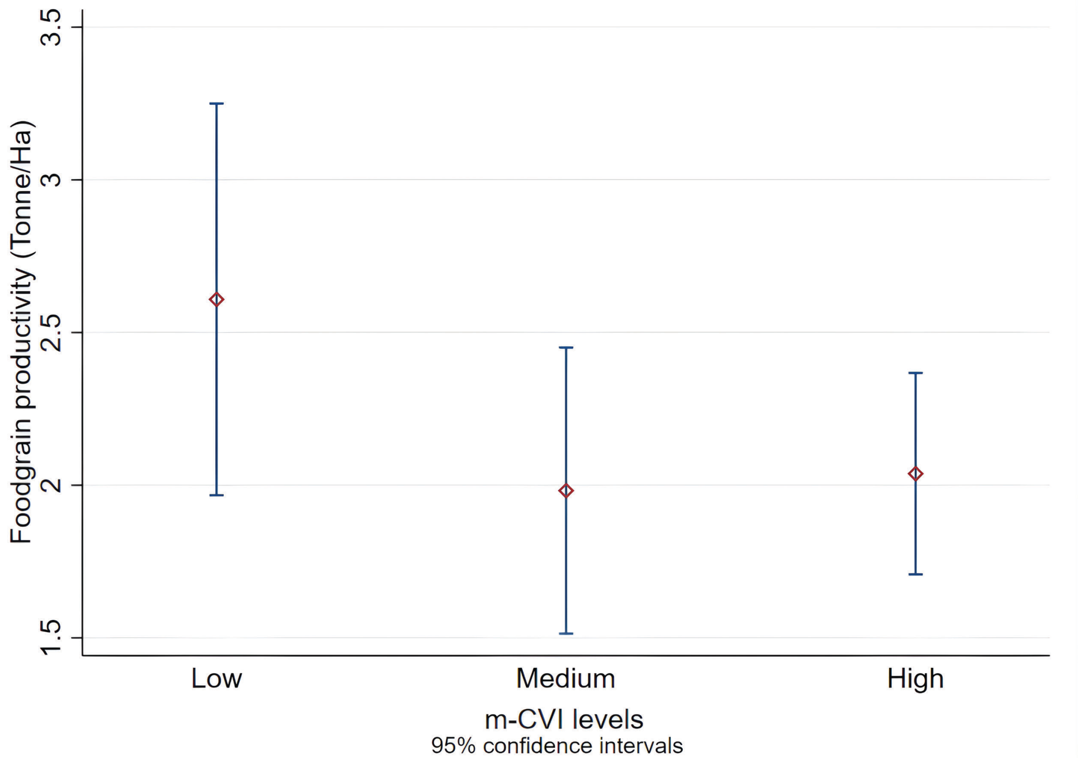


Figure 12. Association of m-CVI with Key Agriculture and Food System Indicators

Figure 12 shows a non-significant negative trend between the average monthly income of farmers' households and the climate vulnerability. The NSS 77th round defines an agricultural household as one receiving produce worth more than Rs. 4,000 from agriculture activities and having at least one member who is self-employed in agriculture either in the principal or subsidiary status in the last 365 days. According to this criterion, agricultural households account for 54 per cent of rural households in India (NSS 77th, 2019).

Households in low climate-vulnerable regions have the highest mean monthly income, while those in high climate-vulnerable regions have the lowest mean income. The difference in average monthly income between the low and high climate vulnerability regions is 36 per cent, which is substantial but not statistically significant. The overlapping confidence intervals suggest that factors other than CVI may influence the monthly income of farmer households. Reduced household incomes can exacerbate malnutrition, leaving households in a vicious loop of poverty and vulnerability to shocks.

Marginal farmers—defined as those operating less than one hectare of land according to operational landholding statistics—constitute approximately 69 per cent of all operational holdings (MoAFW, 2020). Given their heightened sensitivity to economic and environmental shocks, it is pertinent to examine the distribution of marginal farmers across different climate vulnerability zones. The analysis indicates a non-significant positive trend, with a higher proportion of marginal farmers observed in high climate vulnerability zones. However, the substantial overlap in confidence intervals suggests that factors beyond the climate vulnerability may be influencing this distribution.

The limited resources, lower adaptive capacities, and insufficient climate-sensitive agricultural practices of the marginal farmers make them highly susceptible to productivity disruptions and food insecurity, a critical pathway linking climate change to broader developmental and health outcomes (Fanzo et al., 2020). Further documentation is necessary to better understand why there could be more fragile farmers in high climate-vulnerable zones and how their resilience mechanisms could be further improved to decrease the potential impact of climate change on their main livelihood.

Although the Indian agricultural system is dominated by marginal and small farmers, climate vulnerability has the potential to worsen agricultural productivity, access to adaptive technologies, and, in turn, possibly result in a compromised nutrition status of the region (Gupta & Pathak, 2016).

Food security is defined as a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2003). Although a stable market, as well as food availability, access and absorption, all four dimensions of food security are equally important, the starting point of the FNS discussion remains food production, which can be affected directly by critical climate elements like extreme temperature, air pollution, erratic precipitation (Swaminathan & Bhavani, 2013; Chattopadhyay, 2011).

As Figure 12 illustrates, the overlapping confidence intervals suggest that factors other than CVI may influence food grain production.
Higher occurrence of extreme weather events, including floods, droughts, and unusual temperatures, could exacerbate soil degradation and water scarcity, leading to a substantial reduction in crop yield. The compounding effect of reduced food grain productivity could leave a devastating impact on the food security of the population, especially for the children (Asian Development Bank, 2019).

3.6 Improved Access to Basic WASH Services by m-CVI

The health environment is determined by the sanitation and hygienic practices within the home and the community. Poor hygiene and sanitation in and around the household often result in chronic diseases and nutrition problems. Decreased water quality and availability, along with sanitation problems, can result in water-borne diseases such as diarrheal disease (Choularton et al., 2012), while the transmission of vector-borne diseases is projected to increase with climate change (Caminade et al., 2019). Coupled with potential disruption in access to health facilities and healthcare service delivery by climate shocks, these changes in the environment have the potential to affect nutrient utilisation and increase malnutrition (Choularton et al.,2012).

In the present study, the association between access to improved sources of drinking water and improved sanitation facilities and climate vulnerability zones was examined. Since these environmental data points were analysed at the state level due to limited sample size, they have been categorised against three CVI zones—low, medium, and high—using tertile thresholds. This approach differs from the quintile-based classification used for district-level m-CVI indicators.

In high-CVI regions, water quality may deteriorate due to climate-induced stressors (Mehran et al., 2017) such as contamination due to flooding or droughts, and insufficient infrastructure in high-vulnerability areas (TCI, 2022).

Figure 13 displays a non-significant relationship between m-CVI levels (low, medium, and high) and the percentage of households with access to improved drinking water. The overlapping confidence intervals indicate that other factors are influencing access to improved drinking water.

Similarly, the result suggests a non-significant relationship between climate vulnerability and access to toilet facilities across climate-vulnerable zones. However, the non-overlapping confidence intervals between low and high m-CVI levels indicate that people in high climate vulnerable zones have lower access to improved toilet facilities.

Further documentation is needed to understand if this could be related to flooding, waterlogging, or damage to infrastructure in highly vulnerable areas, as well as reduced investments in sanitation in socioeconomically disadvantaged regions (Abdel Sattar et al., 2024).

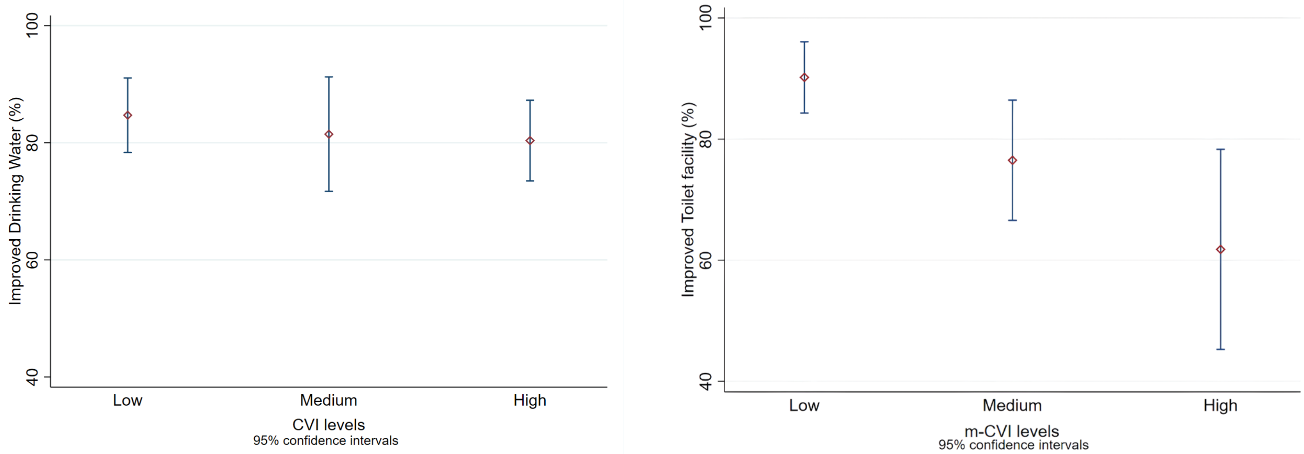


Figure 13. Improved source of drinking water and improved toilet facilities by climate vulnerability levels (2009-20)

4

Key Findings

- Mapping of districts as per their climate vulnerability illustrates the higher vulnerability of northern and eastern states to climate change, including the population's lower adaptive capacity to shocks.
- The proportion of undernourished (stunted, wasted, underweight or anaemic) children is higher in rural areas and in higher climate-vulnerable zones. However, there is no significant difference between boys and girls. Similarly, there is a modest increase (by 1 percentage point) in the prevalence of childhood overweight in very high climate-vulnerable areas compared to very low climate-vulnerable areas.
- Children from marginalised sections of the society are significantly more malnourished (stunted, wasted, underweight or anaemic) than other children, highlighting existing inequities.
- Increased exposure to climate vulnerability exacerbates the likelihood of child malnutrition, mostly stunting and underweight, with a significant difference of 15 and 14 percentage points, respectively, between children in the very low and those in the very high climate vulnerability zone.
- Although the rise in prevalence of wasting with increased climate vulnerability is not as high as stunting, the overall association is like other child nutritional indicators, with significantly higher prevalence of wasting in high and very high climate zones compared to others.
- The likelihood of anaemia among children was found to be positively associated with climate vulnerability. Specifically, children residing in very high climate-vulnerable zones exhibited an approximately eight–percentage point higher prevalence of anaemia compared to those living in very low vulnerability zones, indicating a statistically significant association.

- High climate vulnerability reduces the family's ability to offer an acceptable diet to their children, including minimal food diversity and meals/snacks frequency, which are essential to ensure growth and development.
- Children living in higher climate-vulnerable zones are more likely to experience infectious disease than those in lower vulnerability zones.
- Our analysis found a weak link between climate vulnerability and key agricultural indicators and water and sanitation access. Although climate vulnerability is one of the key drivers of monthly farm household income, its relationship with the prevalence of marginal farmers, food grain productivity and security, or access to safe drinking water and sanitation facilities could not be established due to data-related limitations, which need to be analyzed more thoroughly in future research.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5

Recommendations

The recommendations presented below are drawn not only from current data analysis but also from programmatic experiences and scientific studies that have independently examined the effects of climate crises on soil health, agricultural productivity, disease prevalence, and overall food and nutrition security. Consideration has also been given to identifying key platforms, policy and programme stakeholders critical to leading a response.

- Conduct granular, state and district-specific assessments to identify climate-related shocks and mediating pathways.
- Integrate climate vulnerability data with nutrition surveillance systems for hotspot mapping.
- Enhance infrastructure and service delivery systems (e.g., climate resilient Anganwadi Centres, health facilities) to withstand climate shocks.
- Equip frontline workers to deliver climate-adaptive nutrition counselling, promoting sustainable and climate-resilient diets.
- Develop contingency plans for disaster preparedness, including mobile nutrition services during climate emergencies.
- Embed climate resilience into agriculture, WASH, education, and social protection policies.
- Promote climate-smart agriculture and sustainable food systems while discouraging the consumption of ultra-processed foods.
- Strengthen WASH systems in climate-stressed areas and integrate climate change and nutrition education in school curricula.
- Target marginalized groups, including Scheduled Tribes, Scheduled Caste, Other Backward groups, marginal farmers, and landless households with tailored nutrition and resilience-building interventions.
- Develop gender and caste-sensitive

social protection programmes, including climate-responsive safety nets.

- Raise awareness among policymakers and Members of Parliament on the nutrition–climate linkages using user-friendly toolkits.

Even though it's not easy to put these recommendations into action, the next section (Section 6) offers some ideas for creating a nutrition-sensitive response - one that shows how a differential, need and context-based targeted approach can possibly help in averting some of the response challenges.

6

Suggested Pathways for Developing a Nutrition-Responsive and a Climate-Resilient System

6.1 Further Research and Knowledge Generation

In addition to the unpredictable nature of hydrometeorological events, the rising variability of unusual climatic events poses an important challenge for India to mitigate further in the coming years. To disrupt the cyclical nexus between climate vulnerability and child malnutrition in India, this report advocates for a transformative, evidence-based policy framework that integrates climate resilience with FNS. Considering the district-level disparity in climate vulnerability and nutrition linkages, the following knowledge generation activities could help in further documenting the linkages between climate vulnerability and nutrition:

Measurement of Magnitude and Pathways

- Conduct state- and district-specific assessments to *quantify the impact of climate shocks* (droughts, floods, erratic monsoons, etc.) *on child nutrition and identify mediating pathways*. This requires harmonised data systems to track co-clustering of extreme weather events, agricultural disruptions (e.g., crop yield losses), and malnutrition rates across geographies, gender and social groups. Such granular evidence will inform spatially targeted interventions and prioritise high-risk zones, such as extreme temperature-prone districts in Bihar, Uttar Pradesh, and Rajasthan, flood-prone districts in Assam or drought-vulnerable regions in Maharashtra.
- *Conduct vulnerability audits* to identify gaps in community resilience (e.g., water scarcity in Rajasthan and coastal salinity in Odisha).

Enhanced Multi-Level Surveillance Systems

- Hotspots of climate vulnerability and childhood malnutrition are not uniform within and across the regions or states.

Thus, it is imperative to *strengthen real-time surveillance mechanisms at the state, district, and sub-district levels to detect climate-induced threats to FNS.* Existing platforms like the ICDS and Poshan Abhiyaan should integrate climate vulnerability indices with gender, socio-economic, WASH and health data. For example, deploy geospatial tools to map hotspots where high climate risk overlaps with high malnutritionrates; and establish early warning systems for agro-climatic shocks (e.g., delayed monsoons) to trigger mitigation and resilience-building measures, etc.

6.2 Programme Strengthening Opportunities

Systems Strengthening to Ensure Nutrition Service Resilience and Continuity

Since short- and long-term effects of climate change threaten the uninterrupted delivery of nutrition services, it is essential to strengthen existing systems for preparedness to climate shocks. Suggested areas of support:

- Assess risks of climate change to health and nutrition service delivery systems and allocate resources towards the establishment of climate-resilient health facilities and Anganwadi centres, safeguarding the uninterrupted delivery of essential health and nutrition services amidst climate-induced disasters.
- Enhance the existing Poshan Tracker system to evolve into a real-time nutrition surveillance system or an early warning mechanism, enabling proactive intervention and mitigation efforts. Additionally, research on linking existing weather-related data systems to assess how it can affect malnutrition rates could contribute towards localised, adapted-to-the-context and timely delivery of nutrition interventions for disaster-affected children, adolescents, and women.
- Equip frontline workers (ASHAs, Anganwadi Workers, ANMs and SHGs) to deliver climate-adaptive nutrition counselling to increase knowledge and practices around consuming sustainable, local, seasonal, and climate-resilient healthy diets. This means promoting sustainable, healthy diets that are climate-resilient, high in whole grains, pulses, a variety of endogenous fruits and vegetables, and nuts and seeds; and low in high-greenhouse gases emission-intensive foods (such as ultra-processed manufactured foods).
- Disaster Preparedness: Develop contingency plans to ensure uninterrupted access to nutrition services (e.g., Mobile Anganwadis) during extreme weather events.

Cross-Sectoral Integration of Strategies

The negative impact of climate vulnerability influences child nutrition. While a direct association or linkage is missing in some sectors (eg climate vulnerability and WASH) due to data gaps, scientific wisdom necessitates inclusion of these sectors while developing a strategic plan. Thus, some actions could be further explored to facilitate mainstreaming of climate resilience across health, agriculture, WASH, education, and social protection existing programmes, while considering equity and gender empowerment as well as geographical challenges:

- **Agriculture:**
  - Promote climate-smart agriculture (drought-resistant crops, drip irrigation, etc.)
  - Diversify livelihoods for smallholder farmers.
  - Link crop insurance schemes (e.g., PM Fasal Bima Yojana) to nutrition outcomes by incentivising nutrient-rich crop production.
  - Strengthen farmer collectives, including

women groups, to adopt sustainable practices (e.g., zero-budget farming in Karnataka) and access climate advisory services via digital platforms.

- **WASH:** Improve access to safe drinking water and sanitation, particularly in the drought-prone or flood-affected areas, by upgrading water supply systems and promoting water-efficient technologies for hygiene, sanitation and irrigation to ensure climate-resilient sanitation infrastructure.
- **Education:** Embed comprehensive climate change, environmental sustainability and nutrition education into school curricula and teacher training programmes, including eating local and seasonal foods, saying no to ultra-processed foods and foods HSSF, purchasing products with minimum packaging, recycling, and reducing energy and water consumption, etc.
- **Social Protection:**
  - Engineer mechanisms to ensure the adaptability of social protection schemes, ensuring they swiftly respond to shocks, safeguarding resilience capacities, and maintaining food and nutrition security for the most vulnerable populations, including women.
  - Expand climate-responsive safety nets (e.g., MGNREGA) to include food security activities, such as building community grain banks in disaster-prone areas, etc.

Prioritising Marginalised Populations

Considering the heterogeneous effects of climate vulnerability on child malnutrition, it seems important to consider the disproportionate impacts on marginalised groups (e.g., ST, SC and OBC communities, landless labourers, marginal farmers, etc.) in the design of policies and programmes through:

- **Targeted Support:** Map and capacitate small/ marginal farmers with subsidies for climate-resilient seeds, training in agroecology, and market linkages for indigenous crops.
- **Social Equity:** Design gender- and social group-sensitive programmes, such as nutrition grants for female-headed households in climate-stressed regions.

6.3 Potential Policy Implications

Build more environmentally sustainable food systems

- Production and consumption of 'unhealthy foods' contribute to an environmentally unsustainable food production system with high greenhouse gas emissions in India. Therefore, it seems important to advocate for the adoption of food regulations that are aimed at protecting children from aggressive ultra-processed food marketing; Establishing food pricing policies that subsidise unprocessed or minimally processed local foods while taxing ultra-processed foods and foods high in salt, sugar and/or fat (HSSF). These activities would contribute to promoting endogenous traditional nutrient-rich food and consumption of environmentally sustainable 'healthy diets'.

Engagement of Members of Parliament and Policymakers

- As Mundoli et al. (2022) have shown that despite growing climate vulnerability in India, the topic has failed to grab significant attention among policymakers in the country. Only 895 unique Parliamentary Questions (PQs) related to climate change were raised by 1,019 ministers, forming only a fraction (~0.3%) of the total PQs asked in parliament during 1990-2019, showing the largely missing climate discussion in the era of climate change. There is a need to further and better inform Parliamentarians on the linkages between climate vulnerability and nutrition and provide them with user-friendly toolkits to engage in discussions with the population in their constituencies on low-cost and local ways to increase community resilience.

- Over time, the Government of India has taken several steps to address FNS through multiple nationwide programmes, including the ICDS and PDS, as part of the National Nutrition Mission (POSHAN 2.0) and the National Food Security Act. However, in these nationwide programmes, separate strategies for the highly climate-vulnerable places have not been sufficiently undertaken. Therefore, there is a need to disseminate results for this study to policymakers of key ministries involved (health, women and child development, agriculture, water and sanitation, education, social policy) and disaster risk reduction government bodies to increase their awareness and engagement for the integration of climate-related mitigation measures into national policies, strategies and programmes.

7

Discussion and Conclusion

The Intergovernmental Panel on Climate Change (IPCC), in its Sixth Assessment Report, warns that a 1.5°C rise in global surface temperature is imminent, likely occurring by 2030 (IPCC, 2021). For India—a country with over 1.4 billion people and diverse geographic landscapes—this poses a critical challenge. The highly heterogeneous and unpredictable nature of hydro-meteorological hazards, compounded by limited adaptive capacities, necessitates an urgent and comprehensive climate action framework to mitigate risks and enhance resilience. Despite growing awareness of the intricate nexus between climate change, food security and nutrition security, a lack of extensive national-level evidence remains a significant barrier to formulating effective policies that safeguard the optimum growth and development of future generations.

While climate change has emerged as a key global concern, its impact varies significantly among different regions and social groups within a region (Bolan et al., 2024).

This study explored the complex relationship between climate vulnerability and child malnutrition in the country using a unique approach by taking data on multiple climatic and environmental indicators over several years and assigning the exposure of distinct climate-vulnerability (as per m-CVI categories) to children from their in-utero period to their current age. Built on previous works (MSSRF, 2024; Nelson et al., 2024), a modified CVI was created for use at the district level for an aggregate measure of climate vulnerability to estimate the impact of climate change on FNS in the population.

Our findings show that between 2009 and 2020, climate-related malnutrition in children has increased. By decoding the components of vulnerability assessment, we show that exposure alone does not determine overall vulnerability; adaptive capacity is a key moderating factor.

While states such as Tamil Nadu and Kerala have similar exposure levels as Bihar and Uttar Pradesh, they remain significantly less vulnerable due to better mitigating policies and improved infrastructure (Sharma et al., 2025). Climatic shocks—including droughts, floods, erratic monsoons, and extreme temperature variations—destabilise food systems, increase disease prevalence, and limit access to essential health and nutrition services. However, the impact is not uniform across populations.

The most marginalised, socioeconomically disadvantaged communities living in high and/or very high climate vulnerable zones, particularly Scheduled Tribes (ST), Scheduled Castes (SC), Other Backward Castes (OBC) and rural populations, bear a disproportionate burden of malnutrition compared to other children. Their families present a low adaptive capacity to face shocks and to be resilient. It is crucial for policymakers and other stakeholders to incorporate mitigation measures into their programs and services to address climate vulnerability in children.

Our findings highlight that climate vulnerability is not merely an environmental concern but a multidimensional challenge that directly impacts public health, nutrition, equity, and sustainable development. Addressing the climate-malnutrition cycle requires a transformative, multisectoral approach that integrates climate resilience into health, agriculture, WASH, education and social protection systems. This study emphasises the need to strengthen multi-level surveillance systems to enhance real-time monitoring of malnutrition trends, food insecurity, and climate shocks at state, district, and sub-district levels, integrating gender, socioeconomic, and geographic vulnerability indices to prioritise high-risk populations.

By embedding climate resilience into national development frameworks, India can fortify its food and nutrition security agenda while shielding its most vulnerable populations from the escalating threats of a warming planet.

8

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Appendix

Table A: Definition and Sample Size of the selected indicators for the analysis

Variables	Definition	Sample Size
Stunting	Height for Age <-2 SD	407553
Wasting	Weight for Height <-2 SD	403284
Underweight	Weight for Age <-2 SD	412014
Anaemia in children	Haemoglobin level < 11.0 g/ decilitre	371765
Childhood overweight	Weight for Height > 2 SD	403284
Full Immunisation	Children under 5 years who received one dose of the BCG vaccine, three doses of the DPT vaccine, three doses of the polio vaccine, and one dose of the measles vaccine	465353
Common Childhood Illness	Children with fever, cough or diarrhoea in the last 2 weeks (of survey)	465353
Improved sanitation	Flush/pour flush to piped sewer system, septic tank, pit latrine, biogas latrine, pit latrine with slab, twin pit, composting toilet	441755
Improved drinking water	Piped into dwelling/yard/plot, piped to neighbour, public tap/ standpipe, Tube well or borehole, Protected dug well, protected spring, Rainwater, Tanker truck, Bottled water, Community RO plant	441756
Minimum Meal Frequency	For breast-fed children, minimum meal frequency is receiving solid or semi-solid food at least twice a day for infants 6-8 months and at least three times a day for children 9-23 months. For non-breastfed children aged 6-23 months, the minimum meal frequency is receiving solid or semi-solid food or milk feeds at least four times a day. At least one of the foods must be a solid or semi-solid food.	113943
Minimum Dietary Diversity	Children receive foods from 5 or more of the following food groups: a. infant formula, milk other than breast milk, cheese or yoghurt or other milk products; b. foods made from grains or roots, including porridge or gruel, fortified baby food; c. vitamin A-rich fruits and vegetables; d. other fruits and vegetables; e. eggs; f. meat, poultry, fish, shellfish, or organ meats; g. beans, peas, lentils, or nuts	113943
Minimum Acceptable Diet	Breastfed children aged 6-23 months are fed a minimum acceptable diet if they are fed the minimum dietary diversity and the minimum meal frequency as described earlier. Non-breastfed children aged 6-23 months are fed a minimum acceptable diet if they receive other milk or milk products at least twice a day, receive the minimum meal frequency as described in footnote 5, and receive solid or semi-solid foods from at least four food groups, not including the milk or milk products food group	113943
Monthly average income of Agricultural HH	Average monthly income of agricultural households (in INR)	28 (states)
Marginal farmer (%)	Percentage of farmers operating less than one hectare of land according to operational landholding statistics.	28 (states)
Foodgrain productivity	Overall foodgrain productivity in tons per hectare	28 (states)

Table B. Extraction and Variability Analysis of IMD Gridded Climate Data for District-Level Insights

Step	Process Description	Technical Details
1. Data Acquisition	Retrieval of daily gridded temperature and rainfall datasets from the India Meteorological Department (IMD).	Coverage: 2009–2021; Spatial resolution: 0.25°; Format: Binary (*.grd)
2. Binary Data Parsing	Reading binary files and skipping header metadata.	Implemented in Python using NumPy; Skipped the first four integers per file.
3. Data Reshaping	Conversion of parsed data into a structured multi-dimensional array.	3D array format: (time × latitude × longitude)
4. Spatio-Temporal Indexing	Linking each grid cell to its geographical coordinates.	Grid-to-coordinate mapping applied to all data points.
5. Missing Value Handling	Replacement of placeholder values with nulls.	Missing values: -999.0 → NaN.
6. Variability Computation – Temperature	Assessment of temperature patterns and extremes.	Metrics: Standard deviation (σ), linear trends, extreme heat frequency (days more than 90th percentile).
7. Variability Computation – Rainfall	Quantification of rainfall variability and distribution.	Metrics: Coefficient of variation ($CV = \sigma/\mu$), dry spell duration, precipitation concentration index (PCI).
8. Distance Calculation	Determining the nearest district for each weather grid point.	Applied the Haversine formula for great-circle distance computation.
9. District Mapping	Assigning weather data to administrative districts.	Nearest district selected; one-year data span aggregated per district.
10. Ocean Data Exclusion	Filtering out non-terrestrial grid points.	No mapping is performed if the nearest district is more than 300 km away.

Table C: District-Wise List of Climate Vulnerability and Undernutrition Levels

State	District	CVI level	Stunting level	Wasting level	Underweight level	Anaemia level
Jammu & Kashmir	Kupwara	High	Very Low	Very high	Low	Very high
Jammu & Kashmir	Badgam	Very Low	Low	Medium	Very Low	Very high
Jammu & Kashmir	Ladakh (Leh)	Medium	Very Low	Medium	Very Low	Very high
Jammu & Kashmir	Kargil	Very Low	High	Medium	Low	Very high
Jammu & Kashmir	Poonch	Very Low	Very Low	Low	Very Low	Low
Jammu & Kashmir	Rajouri	Medium	Low	High	Medium	Very high
Jammu & Kashmir	Kathua	Very Low	Very Low	High	Low	Medium
Jammu & Kashmir	Baramula	Low	Very Low	Medium	Very Low	High
Jammu & Kashmir	Bandipore	Low	Very Low	Low	Very Low	High
Jammu & Kashmir	Srinagar	Low	Medium	Medium	Very Low	High
Jammu & Kashmir	Ganderbal	Very Low	Very Low	Very high	Very Low	Very high
Jammu & Kashmir	Pulwama	Very Low	Very Low	Low	Very Low	High
Jammu & Kashmir	Shopian	Very Low	Very Low	Very high	High	High
Jammu & Kashmir	Anantnag	Medium	Low	Very high	Medium	Very high
Jammu & Kashmir	Kulgam	Medium	Low	Very Low	Very Low	Very high
Jammu & Kashmir	Doda	Low	Medium	Very Low	Very Low	High
Jammu & Kashmir	Ramban	Medium	Very Low	Low	Low	Low
Jammu & Kashmir	Kistwar	Very Low	Low	High	Very Low	Very high
Jammu & Kashmir	Udhampur	Very Low	High	High	Medium	High
Jammu & Kashmir	Reasi	Low	Very Low	Low	Very Low	Low
Jammu & Kashmir	Jammu	Low	Low	Medium	Very Low	Low
Jammu & Kashmir	Samba	Very Low	Very Low	High	Very Low	Medium
Himachal Pradesh	Chamba	Very Low	Very high	Low	Low	Very Low
Himachal Pradesh	Kangra	Medium	Low	Medium	Medium	Very Low
Jammu & Kashmir	Lahaul & Spiti	High	Low	Low	Very Low	Very high
Himachal Pradesh	Kullu	Low	High	Low	Low	High
Himachal Pradesh	Mandi	Low	Medium	High	Low	Very Low
Himachal Pradesh	Hamirpur	Low	Low	Low	Low	Low
Himachal Pradesh	Una	Very Low	Very Low	Low	Low	Very Low
Himachal Pradesh	Bilaspur	Very Low	Very high	Very Low	Very high	Low
Himachal Pradesh	Solan	Very Low	Medium	High	Low	Very Low
Himachal Pradesh	Sirmaur	Very Low	Low	Medium	Low	Low

Himachal Pradesh	Shimla	Very Low	Low	Low	Very Low	Low
Himachal Pradesh	Kinnaur	Medium	Medium	Very Low	Very Low	Very high
Punjab	Kapurthala	Very Low	Very Low	Low	Very Low	Medium
Punjab	Jalandhar	Very Low	Very Low	Very Low	Very Low	High
Punjab	Hoshiarpur	Very Low	Very Low	Very Low	Very Low	Medium
Punjab	SBS Nagar	Very Low	Very Low	Very Low	Very Low	Low
Punjab	Fatehgarh Sahib	Very Low	Low	Very Low	Very Low	Low
Punjab	Ludhiana	Very Low	Very Low	Very Low	Very Low	Very high
Punjab	Moga	Low	Very Low	Very Low	Very Low	Medium
Punjab	Muktsar	Low	Medium	Low	Medium	High
Punjab	Faridkot	Low	Low	Very Low	Very Low	High
Punjab	Bhatinda	Low	Very Low	Low	Low	Medium
Punjab	Mansa	Low	High	Very Low	Low	Very high
Punjab	Patiala	Very Low	Very Low	Very Low	Very Low	Very high
Punjab	Amritsar	Very Low	Very Low	Very Low	Very Low	High
Punjab	Tarn Taran	Low	Very Low	Very Low	Very Low	Medium
Punjab	Rupnagar	Very Low	Very Low	Very Low	Very Low	Medium
Punjab	Sas Nagar (Mohali)	Very Low	Very Low	Very Low	Low	Low
Punjab	Sangrur	Very Low	Very Low	Very Low	Very Low	Medium
Punjab	Barnala	Very Low	Medium	Very Low	Very Low	Low
Uttarakhand	Uttarkashi	Very Low	Medium	Very Low	Low	High
Uttarakhand	Chamoli	Low	Medium	Low	Low	Low
Uttarakhand	Rudraprayag	Very Low	Very Low	Very Low	Very Low	Very Low
Uttarakhand	Garhwal Tehri	Low	Low	Low	Low	Low
Uttarakhand	Dehradun	Very Low	Very Low	Very Low	Very Low	Low
Uttarakhand	Garhwal Pauri	Very Low	Low	Very Low	Very Low	Very Low
Uttarakhand	Pithoragarh	Medium	Low	Very Low	Very Low	Very Low
Uttarakhand	Bageshwar	Very Low	Very Low	Very Low	Very Low	Very Low
Uttarakhand	Almora	Low	Low	Medium	Low	Low
Uttarakhand	Champawat	Low	Very Low	Very Low	Very Low	Very Low
Uttarakhand	Nainital	Low	Very Low	Low	Very Low	Low
Uttarakhand	Udham Singh Nagar	Low	Low	Very Low	Low	Low
Uttarakhand	Hardwar	High	Medium	Low	Medium	Low
Haryana	Panchkula	Very Low	Very Low	Very Low	Very Low	Very Low
Haryana	Ambala	Medium	Very Low	Very Low	Very Low	Low

Haryana	Yamuna Nagar	High	Low	Very Low	Low	High
Haryana	Kurukshetra	Very Low	Very Low	Low	Low	High
Haryana	Kaithal	Low	Low	High	Medium	Low
Haryana	Karnal	Low	Low	Very Low	Very Low	Very high
Haryana	Panipat	Low	Very Low	Very Low	Very Low	High
Haryana	Sonepat	Very Low	Very Low	Very Low	Very Low	Medium
Haryana	Jind	Very Low	Very Low	Very Low	Low	Medium
Haryana	Fatehabad	Low	Very Low	Low	Low	Low
Haryana	Sirsa	High	Very Low	Low	Low	Medium
Haryana	Hisar	Low	Low	Low	Low	Medium
Haryana	Rohtak	Low	Low	Very Low	Low	Very high
Haryana	Jhajjar	Low	Very Low	Very Low	Very Low	High
Haryana	Mahendragarh	Medium	Very Low	Very Low	Very Low	High
Haryana	Rewari	Very Low	Low	Very Low	Very Low	High
Haryana	Gurgaon	High	Very Low	Low	Low	Medium
Haryana	Nuh	Very high	Very high	Low	High	High
Haryana	Faridabad	Low	Low	Very Low	Very Low	Medium
Haryana	Palwal	Low	Medium	Very Low	Low	High
Rajasthan	Sri Ganganagar	Low	Very Low	Very high	Low	High
Rajasthan	Hanumangarh	High	Very Low	High	Low	Very high
Rajasthan	Bikaner	Very high	Very Low	Very high	Medium	Very high
Rajasthan	Churu	Very high	Low	Medium	Low	Very high
Rajasthan	Jhunjhunu	High	Very Low	Low	Very Low	Very high
Rajasthan	Alwar	High	Medium	Low	Low	Low
Rajasthan	Bharatpur	High	High	Very Low	Medium	High
Rajasthan	Dholpur	High	Very high	Low	Medium	Very high
Rajasthan	Karauli	Medium	High	Very high	High	High
Rajasthan	Sawai Madhopur	Medium	Low	High	Low	High
Rajasthan	Dausa	Low	High	High	High	High
Rajasthan	Jaipur	Medium	Very Low	Low	Very Low	High
Rajasthan	Sikar	Low	Very Low	Low	Very Low	Low
Rajasthan	Nagaur	High	Medium	Low	Low	Low
Rajasthan	Jodhpur	Very high	Medium	Low	Low	Low
Rajasthan	Jaisalmer	Very high	Very Low	Very high	Medium	Very Low
Rajasthan	Barmer	Very high	High	Very Low	Medium	Low

Rajasthan	Jalore	Very high	Very high	Very Low	High	Medium
Rajasthan	Sirohi	Medium	Low	Low	Medium	Very high
Rajasthan	Pali	Medium	High	Medium	High	High
Rajasthan	Ajmer	Low	Very Low	High	Low	Very high
Rajasthan	Tonk	Medium	Medium	Medium	Medium	Medium
Rajasthan	Bundi	Medium	Low	Medium	Medium	High
Rajasthan	Bhilwara	Medium	Very Low	Medium	Low	Low
Rajasthan	Rajsamand	Low	Low	Low	Low	Very high
Rajasthan	Dungarpur	Medium	Medium	Low	Low	Very high
Rajasthan	Banswara	Very high	Very high	Medium	Very high	Very high
Rajasthan	Chittorgarh	Low	Medium	Low	Low	High
Rajasthan	Kota	Low	Low	High	Low	Medium
Rajasthan	Baran	Medium	Very high	High	Very high	Medium
Rajasthan	Jhalawar	High	Medium	Very high	High	High
Rajasthan	Udaipur	Low	Medium	Very Low	Low	Very high
Rajasthan	Pratapgarh	High	Low	Very high	Medium	Very Low
Uttar Pradesh	Saharanpur	Very Low	Low	High	Medium	Medium
Uttar Pradesh	Bijnor	High	High	Very Low	Low	Low
Uttar Pradesh	Rampur	Medium	High	Medium	Medium	Medium
Uttar Pradesh	Amroha	High	Very high	High	High	Medium
Uttar Pradesh	Meerut	Medium	Medium	Very Low	Low	Very Low
Uttar Pradesh	Baghpat	Medium	Very Low	Very Low	Low	Low
Uttar Pradesh	Gautam Buddha Nagar	Medium	Very Low	Very Low	Low	Medium
Uttar Pradesh	Bulandshahar	High	High	Low	Low	Low
Uttar Pradesh	Aligarh	Very high	Medium	Very Low	Low	Low
Uttar Pradesh	Hathras	Very high	High	Very Low	Low	High
Uttar Pradesh	Mathura	High	Medium	Very Low	Low	Very high
Uttar Pradesh	Agra	Very high	Medium	Medium	Low	Very high
Uttar Pradesh	Firozabad	High	Very high	Very Low	Low	High
Uttar Pradesh	Mainpuri	High	Very high	Low	High	High
Uttar Pradesh	Bareilly	Very high	Very high	Low	High	High
Uttar Pradesh	Pilibhit	Very high	High	High	Very high	Very Low
Uttar Pradesh	Shahjahanpur	Very high	Very high	Medium	High	Very high
Uttar Pradesh	Kheri	Very high	Very high	Low	High	Low
Uttar Pradesh	Sitapur	High	Very high	Medium	High	Medium

Uttar Pradesh	Hardoi	Very high	Very high	High	High	High
Uttar Pradesh	Unnao	High	High	Very Low	Medium	High
Uttar Pradesh	Lucknow	Medium	Medium	Very Low	Low	Very Low
Uttar Pradesh	Farrukhabad	Very high	Very high	Low	Medium	High
Uttar Pradesh	Kannauj	Very high	Very high	High	High	Very high
Uttar Pradesh	Etawah	High	High	Low	Low	High
Uttar Pradesh	Auraiya	Very high	High	Medium	High	Low
Uttar Pradesh	Kanpur Dehat	Very high	Very high	Low	High	Medium
Uttar Pradesh	Kanpur City	Medium	Medium	High	Medium	Very high
Uttar Pradesh	Jalaun	High	Very high	Medium	High	Very Low
Uttar Pradesh	Jhansi	Medium	High	Very high	Very high	Medium
Uttar Pradesh	Lalitpur	Low	Very high	Medium	High	Very Low
Uttar Pradesh	Hamirpur	Low	Very high	High	High	
Uttar Pradesh	Mahoba	Medium	Very high	Very high	High	Medium
Uttar Pradesh	Banda	Very high	Very high	Very high	Very high	Very high
Uttar Pradesh	Chitrakoot	High	Very high	Very high	Very high	Very Low
Uttar Pradesh	Fatehpur	Very high	Very high	Medium	Very high	High
Uttar Pradesh	Pratapgarh	High	Medium	Very Low	Medium	Low
Uttar Pradesh	Kaushambi	Very high	High	Medium	High	Medium
Uttar Pradesh	Prayagraj	High	High	Low	High	Very Low
Uttar Pradesh	Barabanki	Very high	High	Low	High	Low
Uttar Pradesh	Ayodhya	Very high	Very high	Medium	Medium	Very Low
Uttar Pradesh	Ambedkar Nagar	Very high	Low	Very Low	Medium	Very Low
Uttar Pradesh	Bahraich	Very high	Medium	Medium	Medium	Medium
Uttar Pradesh	Shrawasti Nagar	Very high	Very high	Low	Very high	Low
Uttar Pradesh	Balrampur	Very high	Very high	High	Very high	Medium
Uttar Pradesh	Gonda	Very high	Very high	Very high	High	Low
Uttar Pradesh	Siddharth Nagar	Very high	Very high	Very Low	Medium	Very high
Uttar Pradesh	Basti	High	High	Very high	High	Low
Uttar Pradesh	Sant Kabir Nagar	High	High	High	Very high	High
Uttar Pradesh	Maharajganj	High	Very high	Medium	High	Low
Uttar Pradesh	Gorakhpur	Very high	High	High	High	High
Uttar Pradesh	Kushi Nagar	Very high	Low	High	High	Very Low
Uttar Pradesh	Deoria	High	Medium	Very high	High	Very Low
Uttar Pradesh	Azamgarh	Very high	High	Very high	Very high	Low

Uttar Pradesh	Mau	High	Medium	Low	Medium	Low
Uttar Pradesh	Ballia	Very high	Very Low	High	Medium	High
Uttar Pradesh	Jaunpur	High	Very high	High	Very high	Medium
Uttar Pradesh	Ghazipur	Very high	High	Low	Medium	High
Uttar Pradesh	Chandauli	High	High	Very high	High	Medium
Uttar Pradesh	Varanasi	Low	High	Medium	Medium	Medium
Uttar Pradesh	Bhadohi	Very high	High	High	Very high	Low
Uttar Pradesh	Mirzapur	Medium	Very high	Low	Medium	Low
Uttar Pradesh	Sonbhadra	Very high	High	Very high	Very high	Low
Uttar Pradesh	Etah	High	Very high	Low	Medium	Very high
Uttar Pradesh	Kasganj	Very high	Very high	Medium	High	Very high
Bihar	West Champaran	Very high	Very high	Low	Medium	Low
Bihar	East Champaran	Very high	Very high	Medium	High	Low
Bihar	Sheohar	Very high	Medium	Very high	Very high	High
Bihar	Sitamarhi	Very high	Very high	Low	Very high	Medium
Bihar	Madhubani	Very high	Very high	Medium	High	Medium
Bihar	Supaul	Very high	Very high	Very high	Very high	Low
Bihar	Araria	Very high	Very high	High	Very high	High
Bihar	Kishanganj	Very high	High	High	Very high	Medium
Bihar	Purnea	Very high	Very high	Very high	Very high	High
Bihar	Katihar	Very high	Very high	High	Very high	Medium
Bihar	Madhepura	Very high	Very high	High	Very high	Medium
Bihar	Saharsa	Very high	Very high	High	Very high	High
Bihar	Darbhanga	Very high	Very high	Medium	Very high	Medium
Bihar	Muzaffarpur	Very high	Very high	High	High	Low
Bihar	Gopalganj	Very high	Medium	High	Medium	Low
Bihar	Siwan	Very high	High	Medium	Medium	Medium
Bihar	Saran	Very high	High	Very high	Very high	High
Bihar	Vaishali	Very high	High	Medium	Very high	Very high
Bihar	Samastipur	Very high	Very high	High	Very high	Medium
Bihar	Begusarai	Very high	High	High	High	High
Bihar	Khagaria	Very high	Medium	Very high	High	Medium
Bihar	Bhagalpur	Very high	High	High	Very high	Very high
Bihar	Banka	Very high	Very high	Very high	Very high	Very high
Bihar	Munger	High	Medium	Very high	Very high	High

Bihar	Lakhisarai	Medium	Very high	Very high	Very high	Very high
Bihar	Sheikhpura	Very high	Very high	Low	High	Very high
Bihar	Nalanda	Very high	Very high	Very high	Very high	Very high
Bihar	Patna	High	Medium	Very high	Very high	Low
Bihar	Bhojpur	Very high	High	Very high	Very high	Medium
Bihar	Buxar	Very high	High	Very high	Very high	Medium
Bihar	Bhabua	Very high	Very high	Very high	Very high	High
Bihar	Rohtas	Very high	High	Very high	Very high	High
Bihar	Aurangabad	Very high	Very high	Very high	Very high	High
Bihar	Gaya	Medium	Very high	Very high	Very high	Very high
Bihar	Nawada	High	Very high	Medium	High	Very high
Bihar	Jamui	Very high	Very high	Medium	High	Very high
Bihar	Jahanabad	High	Very high	Very high	Very high	Medium
Bihar	Arwal	Very high	Very high	Very high	Very high	Medium
Sikkim	North Sikkim	High	Medium	Very Low	Very Low	Very Low
Sikkim	West Sikkim	Very Low	Very Low	High	Very Low	Medium
Sikkim	South Sikkim	Medium	Very Low	Very Low	Very Low	Low
Sikkim	East Sikkim	Very Low	Very Low	Low	Very Low	
Arunachal Pradesh	Tawang	Low	Low	Very Low	Very Low	Very high
Arunachal Pradesh	West Kameng	Very Low	Very Low	High	Very Low	Low
Arunachal Pradesh	East Kameng	Medium	Medium	Low	Very Low	Very Low
Arunachal Pradesh	Papumpare	Very Low	Low	Very Low	Very Low	Very Low
Arunachal Pradesh	Upper Subansiri	Very Low	High	Very Low	Very Low	Very Low
Arunachal Pradesh	Upper Siang	High	Low	Very Low	Very Low	Very Low
Arunachal Pradesh	Changlang	Medium	Low	Low	Low	Low
Arunachal Pradesh	Lower Subansiri	Very Low	Medium	Very Low	Very Low	Very Low
Arunachal Pradesh	Dibang Valley	Low	Very Low	Medium	Very Low	Very high
Arunachal Pradesh	Lower Dibang Valley	Very Low	Very Low	Very Low	Very Low	Very Low
Arunachal Pradesh	Anjaw	Medium	Very Low	Low	Very Low	Very Low
Nagaland	Mon	Very high	Medium	Very Low	Low	Very Low
Nagaland	Mokokchung	Very Low	Medium	Very Low	Low	Very Low
Nagaland	Zunheboto	Medium	Very high	Very high	Very high	Very Low
Nagaland	Wokha	Low	Low	High	Medium	Very Low
Nagaland	Dimapur	Very Low	Low	Very high	Medium	Very Low
Nagaland	Phek	High	Low	Low	Very Low	Very Low

Nagaland	Tuensang	High	High	Very high	High	Very Low
Nagaland	Longleng	High	Medium	High	Low	Very Low
Nagaland	Kiphire	Very high	High	Very Low	Low	Very Low
Nagaland	Kohima	Very Low	Low	Very high	Low	Very Low
Nagaland	Paren	Medium	Medium	Very Low	Very Low	Very Low
Manipur	Senapati	Medium	Low	Very Low	Very Low	Very Low
Manipur	Tamenglong	Medium	Low	Very Low	Very Low	Very Low
Manipur	Churachandpur	Low	Very Low	Very Low	Very Low	Very Low
Manipur	Bishnupur	Medium	Very Low	Very Low	Very Low	Very Low
Manipur	Thoubal	Medium	Medium	Very Low	Very Low	Very Low
Manipur	Imphal West	Medium	Very Low	Very Low	Very Low	Very Low
Manipur	Imphal East	Medium	Very Low	Very Low	Very Low	Very Low
Manipur	Ukhrul	High	Low	Very Low	Very Low	Very Low
Manipur	Chandel	Low	Medium	Very Low	Very Low	Very Low
Mizoram	Mamit	Very Low	Low	Very Low	Very Low	Very Low
Mizoram	Kolasib	Very Low	Low	Very Low	Very Low	Very Low
Mizoram	Aizwal	Low	Very Low	Very Low	Very Low	Very Low
Mizoram	Champhai	Very Low	Low	Very Low	Very Low	Very Low
Mizoram	Serchhip	Very Low	Medium	Very Low	Very Low	Very Low
Mizoram	Lunglei	Very Low	Low	Very Low	Very Low	Very Low
Mizoram	Lawngtlai	High	Medium	Low	Very Low	Low
Mizoram	Saiha	Very Low	Very high	Very Low	Very Low	Very Low
Tripura	Dhalai	Very high	Very high	Low	Medium	Very high
Meghalaya	South Garo Hills	High	Low	Medium	Very Low	Very Low
Meghalaya	Ribhoi	High	Very high	Medium	Medium	Very Low
Meghalaya	East Khasi Hills	Medium	Very high	Very Low	Low	Very Low
Assam	Kokrajhar	High	Medium	High	High	Very high
Assam	Goalpara	Very high	High	High	High	Low
Assam	Barpeta	High	Low	Medium	Low	Medium
Assam	Morigaon	High	Very high	Low	Medium	Very Low
Assam	Lakhimpur	High	High	Medium	High	High
Assam	Dhemaji	Medium	High	Medium	Low	High
Assam	Tinsukia	High	Medium	High	Medium	Medium
Assam	Dibrugarh	High	Low	High	Medium	Medium
Assam	Golaghat	High	Low	Medium	Low	Very high

Assam	N.C.Hills	Low	Low	High	Low	High
Assam	Cachar	High	Low	Very high	Very high	Low
Assam	Karimganj	Very high	Low	Very high	Very high	Low
Assam	Hailakandi	High	Very high	High	Very high	Low
Assam	Bongaigaon	High	Very high	High	High	Very high
Assam	Chirang	High	Very high	Medium	Very high	High
Assam	Kamrup (Rural)	High	Very Low	Low	Very Low	Medium
Assam	Kamrup Metro.	Medium	Very Low	Medium	Low	Very high
Assam	Nalbari	High	Low	Low	Low	Medium
Assam	Baksa	Low	Very high	Medium	High	Very high
Assam	Darrang	Very high	Very high	Very high	High	Medium
Assam	Udalgiri	Medium	Medium	High	High	Very high
West Bengal	Darjeeling	Medium	Medium	High	Medium	Medium
West Bengal	Jalpaiguri	High	Low	Medium	Low	Medium
West Bengal	Cooch Behar	High	Low	Medium	Low	Low
West Bengal	North Dinajpur	High	Very high	Low	Medium	Very high
West Bengal	South Dinajpur	Medium	Medium	High	Medium	High
West Bengal	Malda	Very high	High	High	High	High
West Bengal	Murshidabad	Medium	High	Low	High	High
West Bengal	Birbhum	Very high	High	Very high	Very high	Very high
West Bengal	Nadia	Very high	Low	Medium	Low	Low
West Bengal	North 24 Parganas	High	Medium	Low	Low	Very Low
West Bengal	Hooghly	High	Low	High	High	Medium
West Bengal	Bankura	Very high	Low	Very high	Very high	Medium
West Bengal	Puruliya	Very high	High	Very high	Very high	Very high
West Bengal	Howrah	Low	Low	High	Medium	Medium
West Bengal	Kolkata	Low	Low	Very high	High	High
West Bengal	South 24 Parganas	Very high	High	High	Medium	Medium
West Bengal	West Midnapore	Very high	Medium	Very high	Very high	Medium
West Bengal	East Midnapore	Medium	Very Low	Low	Medium	Low
Jharkhand	Garhwa	Medium	Very high	Medium	Very high	Low
Jharkhand	Chatra	Very high	Very high	Medium	Very high	Low
Jharkhand	Koderma	High	Medium	Medium	Medium	Low
Jharkhand	Giridih	Very high	Medium	Very high	High	Low
Jharkhand	Deoghar	Very high	Very high	Medium	High	High
Jharkhand	Godda	Very high	High	Very high	Very high	Very high

Jharkhand	Sahibganj	Very high	Very high	Medium	Very high	High
Jharkhand	Pakur	Very high	Very high	High	Very high	High
Jharkhand	Dhanbad	Medium	Low	Low	Low	Medium
Jharkhand	Bokaro	Medium	High	Medium	High	Low
Jharkhand	Lohardaga	Medium	High	Very high	Very high	Medium
Jharkhand	East Singbhum	Medium	High	Very high	Very high	Medium
Jharkhand	Palamu	High	Very high	Medium	High	Medium
Jharkhand	Latehar	High	High	Medium	Very high	Medium
Jharkhand	Hazaribag	High	High	Low	High	Low
Jharkhand	Ramgarh	Very high	Medium	High	High	Low
Jharkhand	Dumka	High	High	Very high	Very high	Very high
Jharkhand	Jamtara	Very high	Very high	High	Very high	High
Jharkhand	Ranchi	Medium	Low	Very high	Very high	Low
Jharkhand	Khunti	Very high	High	Very high	Very high	Medium
Jharkhand	Gumla	Medium	High	High	Very high	Medium
Jharkhand	Simdega	High	Very high	High	High	Very high
Jharkhand	West Singbhum	Very high	Very high	Very high	Very high	Very high
Jharkhand	Seraikela-Kharsawan	Medium	High	Very high	Very high	Very high
Odisha	Bargarh	Medium	High	Medium	Medium	Low
Odisha	Jharsuguda	Low	Low	Medium	Low	Low
Odisha	Sambalpur	Very Low	High	Very high	High	Low
Odisha	Deogarh	Medium	Low	Very high	High	Low
Odisha	Sundargarh	High	Medium	High	High	Very high
Odisha	Keonjhargarh	High	High	High	High	Medium
Odisha	Mayurbhanj	Medium	High	Very high	Very high	High
Odisha	Balasore	High	Very Low	Low	Low	Very Low
Odisha	Bhadrak	Very high	Medium	Low	Medium	Medium
Odisha	Kendrapara	High	Low	Very Low	Very Low	Low
Odisha	Jagatsinghpur	High	Very Low	Very Low	Very Low	Very Low
Odisha	Cuttack	Medium	Very Low	Low	Very Low	Low
Odisha	Jajpur	High	Very Low	Low	Low	Medium
Odisha	Dhenkanal	High	Medium	High	Medium	Low
Odisha	Angul	Very high	Low	Very high	Medium	High
Odisha	Nayagarh	Medium	Very Low	Very Low	Very Low	Very Low
Odisha	Khurda	High	Very Low	Low	Very Low	Very Low

Odisha	Puri	Medium	Very Low	Very Low	Very Low	Very Low
Odisha	Ganjam	High	Very Low	Very Low	Very Low	Low
Odisha	Gajapati	Very high	Very high	Low	High	Low
Odisha	Kandhamal	Medium	Medium	High	High	Very Low
Odisha	Boudhgarh	Medium	High	High	Very high	Very Low
Odisha	Sonepur	Medium	Low	Very high	High	High
Odisha	Balangir	Very high	Medium	Very high	High	High
Odisha	Nawapara	High	Very high	Medium	Very high	High
Odisha	Kalahandi	High	Medium	Medium	High	High
Odisha	Rayagada	Very high	Very high	Low	Very high	Medium
Odisha	Nawarangpur	Very high	Very high	Very high	Very high	High
Odisha	Koraput	High	Very high	Low	High	Medium
Odisha	Malkangiri	Very high	Very high	Medium	Very high	Very high
Chhattisgarh	Korea	Low	Medium	Medium	Medium	Very Low
Chhattisgarh	Jashpur	Medium	Medium	Medium	High	Very Low
Maharashtra	Raigad	Medium	High	Low	Medium	Low
Chhattisgarh	Korba	Very Low	Medium	Low	Medium	Low
Chhattisgarh	Janjgir-Champa	Medium	Medium	Very high	Medium	High
Chhattisgarh	Kabirdham	Medium	High	Very Low	Medium	Low
Chhattisgarh	Rajnandgaon	Low	Low	Medium	Medium	Very high
Chhattisgarh	Mahasamund	Medium	High	Low	Low	High
Chhattisgarh	Dhamtari	Low	Low	Medium	Medium	Medium
Chhattisgarh	Kanker	Low	Very Low	Very high	High	Medium
Chhattisgarh	Narayanpur	Very high	Very high	High	Very high	Very high
Chhattisgarh	Bijapur	Very high	Very high	High	Very high	Very high
Madhya Pradesh	Sheopur	Very high	Very high	Low	High	High
Madhya Pradesh	Morena	Medium	High	Very Low	Medium	High
Madhya Pradesh	Bhind	High	Medium	Very Low	Medium	High
Madhya Pradesh	Gwalior	Medium	High	Very Low	High	Very high
Madhya Pradesh	Datia	Low	High	Low	Medium	High
Madhya Pradesh	Shivpuri	High	High	Medium	High	High
Madhya Pradesh	Tikamgarh	Very high	Low	High	High	Medium
Madhya Pradesh	Chhatarpur	Very high	Very high	Medium	High	Very high
Madhya Pradesh	Panna	High	Very high	High	Very high	High
Madhya Pradesh	Sagar	Very high	Very high	Low	High	Very high

Madhya Pradesh	Damoh	High	High	Low	High	Very high
Madhya Pradesh	Satna	High	Very high	Medium	Medium	Very high
Madhya Pradesh	Rewa	Very high	High	Medium	Medium	Very high
Madhya Pradesh	Umaria	Medium	Very high	Low	High	High
Madhya Pradesh	Neemuch	Low	Medium	Low	Medium	Very high
Madhya Pradesh	Mandsaur	High	Medium	Low	Low	Low
Madhya Pradesh	Ratlam	High	Low	Low	Medium	High
Madhya Pradesh	Ujjain	Medium	Medium	Very high	High	Very high
Madhya Pradesh	Dewas	High	High	High	Medium	Very high
Madhya Pradesh	Dhar	High	Low	Very high	High	High
Madhya Pradesh	Indore	Low	Low	High	Low	Very high
Madhya Pradesh	Khargone	Low	Medium	Very high	Very high	High
Madhya Pradesh	Barwani	High	Very high	Medium	Very high	Very high
Madhya Pradesh	Rajgarh	Medium	Low	High	Low	Very high
Madhya Pradesh	Vidisha	High	High	Medium	High	Very Low
Madhya Pradesh	Bhopal	High	Very Low	High	Medium	High
Madhya Pradesh	Sehore	Medium	Very Low	Medium	Medium	Very high
Madhya Pradesh	Raisen	Medium	Low	High	Low	Low
Madhya Pradesh	Betul	Low	Medium	High	Medium	Low
Madhya Pradesh	Harda	Low	High	Very high	High	Very high
Madhya Pradesh	Narmadapuram	Low	Medium	High	Medium	Very high
Madhya Pradesh	Katni	Very Low	Very high	High	Very high	Very high
Madhya Pradesh	Jabalpur	High	Very Low	Very high	Medium	Very Low
Madhya Pradesh	Narsinghpur	Low	Medium	Medium	Medium	High
Madhya Pradesh	Dindori	High	High	Low	High	Very high
Madhya Pradesh	Mandla	High	Medium	Low	High	Medium
Madhya Pradesh	Chhindwara	Low	Very Low	Medium	High	Very Low
Madhya Pradesh	Seoni	Medium	Very Low	High	Medium	High
Madhya Pradesh	Balaghat	High	Very high	High	Very high	Low
Madhya Pradesh	Guna	Medium	Medium	Very Low	Low	High
Madhya Pradesh	Ashoknagar	High	Medium	Medium	Medium	Low
Madhya Pradesh	Shahdol	High	Very high	High	Very high	Very Low
Madhya Pradesh	Anuppur	Low	Very Low	Medium	Medium	Very Low
Madhya Pradesh	Sidhi	Very high	High	Low	High	High
Madhya Pradesh	Singrauli	Very high	High	Very high	High	Very Low

Madhya Pradesh	Jhabua	Very high	Very high	Medium	Very high	Very high
Madhya Pradesh	Alirajpur	Very high	Medium	Low	Medium	Very high
Madhya Pradesh	Khandwa	Medium	High	High	High	Very high
Madhya Pradesh	Burhanpur	High	High	Very high	Very high	Very high
Gujarat	Kutch	Very high	High	High	High	Medium
Gujarat	Banaskantha	Very high	High	Very high	Very high	Very high
Gujarat	Patan	Very high	Very high	High	Very high	Very high
Gujarat	Mehsana	Medium	Medium	Very high	Very high	Very high
Gujarat	Gandhinagar	Very Low	High	Very high	Very high	Very high
Gujarat	Porbandar	Medium	Very Low	High	Low	Very high
Gujarat	Amreli	High	Medium	High	Medium	Medium
Gujarat	Anand	Low	High	Very high	Very high	Very high
Gujarat	Dahod	Very high	Very high	Very high	Very high	Very high
Gujarat	Narmada	Low	Very high	High	Very high	Very high
Gujarat	Bharuch	High	Very high	Very high	Very high	Very high
Gujarat	Dangs	Low	High	Very high	Very high	Very high
Gujarat	Navsari	Medium	High	Very high	Very high	High
Gujarat	Valsad	Low	High	High	High	Very high
Gujarat	Surat	Low	High	Very high	High	Very high
Gujarat	Tapi	Medium	Very high	Very high	Very high	Very high
Daman & Diu	Diu	Very Low	Medium	Medium	Medium	Low
Daman & Diu	Daman	Very Low	Low	Very high	Medium	Very high
Daman & Diu	Dadara & Nagar Haveli	Very Low	Very high	High	Very high	Very high
Maharashtra	Nandurbar	Very high	Very high	Very high	Very high	Very high
Maharashtra	Dhule	Very high	High	Very high	Very high	Very high
Maharashtra	Jalgaon	Very high	High	Very high	High	Very high
Maharashtra	Buldhana	High	Very high	Very high	Very high	Very high
Maharashtra	Akola	Medium	Medium	Very high	Medium	Very high
Maharashtra	Washim	High	Medium	Very high	Very high	High
Maharashtra	Amravati	Medium	Low	Very high	Very high	High
Maharashtra	Wardha	High	Low	Very high	Medium	Medium
Maharashtra	Nagpur	Medium	Low	Very high	High	High
Maharashtra	Bhandara	Medium	Medium	Very high	High	High
Maharashtra	Gondia	Low	High	High	High	Very high
Maharashtra	Gadchiroli	Low	Medium	Very high	High	Very high

Maharashtra	Chandrapur	Medium	High	Very high	Very high	Very high
Maharashtra	Yeotmal	Low	High	Very high	Very high	High
Maharashtra	Nanded	Medium	Medium	Medium	High	Very high
Maharashtra	Hingoli	Medium	High	Very high	Very high	High
Maharashtra	Parbhani	High	High	High	Very high	High
Maharashtra	Jalna	High	High	High	Very high	Medium
Maharashtra	Chh. Sambhajinagar	Low	Medium	Very high	Very high	Medium
Maharashtra	Nashik	Medium	Very high	Very high	Very high	Medium
Maharashtra	Mumbai Suburban	Medium	High	Medium	Low	Low
Maharashtra	Mumbai City	Low	Low	Very high	Medium	High
Chhattisgarh	Raigarh	Low	High	Medium	High	Low
Maharashtra	Pune	Medium	Medium	Very high	High	Low
Maharashtra	Ahmednagar	Medium	Medium	Very high	Very high	Low
Maharashtra	Beed	High	High	Very high	High	Low
Maharashtra	Latur	Low	Very high	Medium	High	Low
Maharashtra	Dharashiv	Medium	High	Low	Medium	Medium
Maharashtra	Sholapur	High	High	High	High	High
Maharashtra	Satara	Low	Very Low	High	Medium	Medium
Maharashtra	Ratnagiri	Medium	Medium	High	Medium	Medium
Maharashtra	Sindhudurg	Very Low	Medium	Very high	Medium	Low
Maharashtra	Kolhapur	Low	Medium	Medium	High	Low
Maharashtra	Sangli	High	Medium	Medium	Medium	Low
Andhra Pradesh	Srikakulam	Medium	Very Low	Medium	Low	Low
Andhra Pradesh	Vizianagaram	Very high	High	Medium	High	Medium
Andhra Pradesh	Vishakhapatnam	High	Medium	High	High	High
Andhra Pradesh	East Godavari	Very Low	Very Low	Low	Low	Medium
Andhra Pradesh	West Godavari	High	Medium	Very Low	Low	Low
Andhra Pradesh	Krishna	High	Low	Low	Low	Low
Andhra Pradesh	Guntur	Very high	Very Low	Medium	Medium	Low
Andhra Pradesh	Prakasam	Medium	Very Low	Very Low	Low	Low
Tamil Nadu	Spsr Nellore	High	Low	Medium	Medium	Medium
Andhra Pradesh	Ysr District	Very high	Medium	Low	Low	Low
Andhra Pradesh	Kurnool	Medium	Very high	Medium	Very high	High
Andhra Pradesh	Anantapuramu	High	High	Medium	Very high	Very Low
Andhra Pradesh	Chittoor	Very high	Low	Low	Medium	Very Low

Karnataka	Belagavi	Medium	Medium	High	High	High
Karnataka	Bagalkote	High	Very high	Medium	Very high	Medium
Karnataka	Vijayapura	Low	Very high	Low	Very high	Medium
Karnataka	Bidar	Medium	High	High	High	Medium
Karnataka	Raichur	Very high	High	High	Very high	Very high
Karnataka	Koppal	Very high	Very high	High	Very high	High
Karnataka	Gadag	Very high	Very high	Medium	Very high	Medium
Karnataka	Dharwad	Medium	Very high	Low	Very high	Medium
Karnataka	Uttara Kannada	Medium	Low	High	High	Medium
Karnataka	Haveri	Medium	Low	Medium	High	Medium
Karnataka	Ballari	Medium	High	High	High	Medium
Karnataka	Chitradurga	High	High	Medium	High	Low
Karnataka	Davangere	Very Low	High	Medium	High	Medium
Karnataka	Shivamogga	Low	Low	High	High	Medium
Karnataka	Udupi	Very Low	Very Low	Medium	Low	Low
Karnataka	Chikkamagaluru	Medium	Low	Very high	Low	Very Low
Karnataka	Tumakuru	Low	High	Very Low	Medium	Medium
Karnataka	Bengaluru Urban	Very Low	Medium	Medium	Medium	Low
Karnataka	Mandya	Medium	Very Low	Very Low	Very Low	Very Low
Karnataka	Hassan	Low	Low	Low	Low	Low
Karnataka	Dakshina Kannada	Low	Very Low	Very high	Low	Very Low
Karnataka	Kodagu	Very Low	Low	High	Low	Very Low
Karnataka	Mysuru	Low	Low	Low	Medium	Low
Karnataka	Chamarajanagar	Low	Medium	Medium	Medium	Medium
Karnataka	Gulbarga	High	Medium	Very high	High	High
Karnataka	Yadgir	Very high	Very high	Medium	Very high	Very high
Karnataka	Kolar	Very Low	Medium	Low	Very Low	Low
Karnataka	Chikaballapura	Low	Medium	Low	Low	Low
Karnataka	Bengaluru Rural	Low	High	Low	Low	Low
Karnataka	Ramanagara	Low	Very Low	High	Very Low	Low
Goa	North Goa	Very Low	Very Low	Medium	Low	Very Low
Goa	South Goa	Low	Low	High	Low	Very Low
Kerala	Kasargod	Low	Very Low	Very Low	Low	Very Low
Kerala	Kannaur	Low	Very Low	Low	Very Low	Very Low
Kerala	Wayanad	Medium	Medium	Low	Low	Very Low

Kerala	Kozhikode	Low	Very Low	Low	Very Low	Very Low
Kerala	Malappuram	Low	Low	Medium	Low	Very Low
Kerala	Palakkad	Very Low	Low	High	Medium	Very Low
Kerala	Thrissur	Low	Very Low	Very Low	Very Low	Very Low
Kerala	Ernakulam	Very Low	Very Low	Medium	Very Low	Very Low
Kerala	Idukki	Very Low	Very Low	Low	Low	Very Low
Kerala	Kottayam	Very Low	Very Low	Very Low	Very Low	Very Low
Kerala	Alapuzha	Very Low	Very Low	Low	Very Low	Very Low
Kerala	Pathanamthitta	Very Low	Very Low	Very Low	Very Low	Very Low
Kerala	Kollam	Low	Very Low	High	Very Low	Very Low
Kerala	Thiruvananthapuram	Very Low	Very Low	Medium	Very Low	Very Low
Tamil Nadu	Tiruvallur	Low	Very Low	Medium	Very Low	Low
Tamil Nadu	Chennai	Low	Very Low	Medium	Low	Very Low
Tamil Nadu	Kancheepuram	Low	Very Low	Low	Very Low	Medium
Tamil Nadu	Vellore	Low	Low	Low	Very Low	Low
Tamil Nadu	Tiruvannamalai	Very Low	Low	Low	Low	Low
Tamil Nadu	Villupuram	Medium	Very Low	Very Low	Very Low	High
Tamil Nadu	Salem	Low	Very Low	Very Low	Very Low	Very Low
Tamil Nadu	Namakkal	Low	Very Low	Very Low	Very Low	Medium
Tamil Nadu	Erode	Very Low	Very Low	High	Medium	Very Low
Tamil Nadu	Nilgiris	Very Low	Very Low	Medium	Low	Very Low
Tamil Nadu	Dindigul	Very Low	Low	High	Medium	Very Low
Tamil Nadu	Karur	Low	Medium	Medium	High	High
Tamil Nadu	Trichy	Low	Low	High	Medium	Very high
Tamil Nadu	Perambalur	Low	Low	Low	Low	Medium
Tamil Nadu	Ariyalur	Low	Very Low	Low	Very Low	Low
Tamil Nadu	Cuddalore	Low	Very Low	Low	Very Low	Low
Tamil Nadu	Nagapattinam	Medium	Medium	Very Low	Low	Low
Tamil Nadu	Tiruvarur	Very Low	Very Low	Medium	Low	Very Low
Tamil Nadu	Thanjavur	Medium	Very Low	Very Low	Low	Low
Tamil Nadu	Pudukkottai	Very Low	Medium	Very Low	Low	Medium
Tamil Nadu	Sivaganga	Medium	Low	High	Medium	Low
Tamil Nadu	Madurai	Medium	Medium	Very Low	Low	Very Low
Tamil Nadu	Theni	Very Low	Very Low	Low	Very Low	Very Low
Tamil Nadu	Virudhunagar	Medium	Low	Low	Low	Low

Tamil Nadu	Ramanathapuram	High	Low	Medium	Low	Very Low
Tamil Nadu	Toothukudi	Low	Very Low	Medium	Very Low	Very Low
Tamil Nadu	Tirunelveli	Medium	Low	Very Low	Low	Very Low
Tamil Nadu	Kanyakumari	Very Low	Very Low	Very Low	Very Low	Very Low
Tamil Nadu	Dharmapuri	Low	Low	Medium	Low	Very Low
Tamil Nadu	Krishnagiri	Low	Low	Very Low	Very Low	Very Low
Tamil Nadu	Coimbatore	Low	Very Low	Very Low	Very Low	Very Low
Tamil Nadu	Tiruppur	Low	Very Low	Low	Low	Very Low
Andaman & Nicobar Islands	Nicobar	Very Low	Very Low	Low	Low	Very Low
Andaman & Nicobar Islands	North & Middle Andaman	High	Low	Very high	Very high	Very Low
Andaman & Nicobar Islands	South Andaman	Very Low	Very Low	Low	Very Low	Very Low
Arunachal Pradesh	East Siang	Low	Very Low	Very Low	Very Low	Very Low
Arunachal Pradesh	Kradaadi	Very Low	Low	Very Low	Very Low	Very Low
Arunachal Pradesh	Kurung Kumey	High	Low	Low	Very Low	Low
Assam	Lohit	Very Low	Very Low	Low	Very Low	Very Low
Arunachal Pradesh	Longding	Very Low	Very Low	High	Very Low	Very Low
Arunachal Pradesh	Namsai	Very Low	Low	Very Low	Very Low	Low
Arunachal Pradesh	Siang	Low	Very Low	Very Low	Very Low	Very Low
Arunachal Pradesh	Tirap	Medium	High	Low	Very Low	Very Low
Assam	Biswanath	Very Low	Very high	Very high	Very high	Very high
Assam	Charaideo	Low	High	High	High	High
Assam	Dhubri	Very high	Very high	High	High	High
Assam	Hojai	Very Low	High	Low	Medium	Low
Assam	Jorhat	Medium	High	Low	High	High
Assam	Karbi Analog	High	Medium	Medium	Medium	Medium
Assam	Majuli	Very Low	Medium	Low	Low	High
Assam	Nagaon	Very high	High	Medium	High	High
Assam	Sibsagar	Medium	Low	High	Low	Medium
Assam	Sonitpur	High	High	Low	Low	Medium
Assam	South Salamara Manakchar	Very high	High	Medium	Medium	High
Chhattisgarh	Balod	Very Low	Medium	Low	High	Medium
Chhattisgarh	Baloda Bazar	Low	High	Medium	High	Medium
Chhattisgarh	Balrampur	High	Medium	High	Very high	

Chhattisgarh	Bastar	High	Very high	High	Very high	Very high
Chhattisgarh	Bemetara	Very Low	High	Low	Medium	Low
Chhattisgarh	Bilaspur	High	Very Low	Very high	Medium	
Chhattisgarh	Dantewada	Low	Very high	High	Very high	Very high
Chhattisgarh	Durg	Low	High	Medium	Medium	Very Low
Chhattisgarh	Gariaband	Very Low	Low	High	Low	High
Chhattisgarh	Mungeli	Very Low	Low	Medium	Medium	Low
Chhattisgarh	Raipur	Low	Medium	High	High	High
Chhattisgarh	Sukma	Very Low	Very high	High	High	Very high
Chhattisgarh	Surajpur	Very Low	Low	Medium	Medium	Very Low
Chhattisgarh	Surguja	Medium	Low	Medium	Medium	Very Low
NCT of Delhi	Central Delhi	Low	Medium	Low	Low	High
NCT of Delhi	East Delhi	Low	Medium	Low	Medium	Low
NCT of Delhi	New Delhi	Low	Low	Very Low	Very Low	High
NCT of Delhi	North Delhi	Medium	Very Low	Very Low	Very Low	Medium
NCT of Delhi	North-East Delhi	Low	High	Very Low	Low	Low
NCT of Delhi	North-West Delhi	Very Low	Low	Very Low	Low	High
NCT of Delhi	Shahdara	Very Low	Medium	High	Medium	High
NCT of Delhi	South Delhi	Low	Medium	Very Low	Very Low	Medium
NCT of Delhi	South-East Delhi	Very Low	Very Low	Low	Very Low	High
NCT of Delhi	South-West Delhi	Very Low	Low	Very Low	Very Low	Medium
NCT of Delhi	West Delhi	Medium	High	Very Low	Very Low	Medium
Gujarat	Ahmedabad	Medium	Medium	Medium	High	High
Gujarat	Aravalli	Low	Very high	Very high	Very high	Very high
Gujarat	Bhavnagar	Very high	Medium	Very high	Very high	High
Gujarat	Botad	Very Low	Medium	Very high	Medium	Very high
Gujarat	Chhota Udepur	Medium	Very high	Very high	Very high	Very high
Gujarat	Devbhoomi Dwarka	Very Low	Low	Very high	High	Low
Gujarat	Gir Somnath	Very Low	Very high	Medium	Medium	Medium
Gujarat	Jamnagar	High	Low	High	Medium	Very high
Gujarat	Junagadh	Low	High	Medium	Low	High
Gujarat	Kheda	High	High	Very high	Very high	Very high
Gujarat	Mahisagar	Very Low	Very high	Very high	Very high	Very high
Gujarat	Morbi	Very Low	Medium	Very high	Medium	Very high
Gujarat	Panchmahal	Medium	Very high	Very high	Very high	Very high
Gujarat	Rajkot	High	High	Medium	High	Very high

Gujarat	Sabarkantha	Very high	High	Very high	Very high	Very high
Gujarat	Surendranagar	Very high	High	Very high	Very high	Very high
Gujarat	Vadodara	Very Low	Very high	High	Very high	Very high
Haryana	Bhiwani	Medium	Low	Very Low	Very Low	Medium
Haryana	Charkhi Dadri	Very Low	Very Low	Very Low	Very Low	Medium
Madhya Pradesh	Agar-Malwa	Medium	Very high	Medium	High	High
Madhya Pradesh	Shajapur	Medium	Low	High	Medium	Very high
Maharashtra	Palghar	Very Low	Medium	High	High	High
Maharashtra	Thane	Low	High	Medium	Medium	Medium
Meghalaya	East Garo Hills	Low	High	High	Low	Very Low
Meghalaya	East Jaintia Hills	Very high	Very high	Very Low	Low	Very Low
Meghalaya	North Garo Hills	Very Low	Medium	Very Low	Very Low	Very Low
Meghalaya	South West Garo Hills	Very Low	Medium	High	Low	Very Low
Meghalaya	South West Khasi Hills	High	Very high	Very Low	Medium	Low
Meghalaya	West Garo Hills	Medium	High	Low	Low	Very Low
Meghalaya	West Jaintia Hills	Very high	Very high	Very Low	Medium	Very Low
Meghalaya	West Khasi Hills	Very high	Very high	Very Low	Medium	Very Low
Punjab	Fazilka	Very Low	Medium	Very Low	Very Low	High
Punjab	Ferozepur	Low	Low	Low	Low	High
Punjab	Gurdaspur	Very Low	Very Low	Very Low	Very Low	High
Punjab	Pathankot	Very Low	Very Low	Very Low	Very Low	Medium
Telangana	Adilabad	High	Very high	Very high	Very high	High
Telangana	B. Kothagudem	Very Low	Low	High	Low	Medium
Telangana	Hyderabad	Low	Low	Medium	Very Low	Medium
Telangana	Jagtial	Very Low	Low	Medium	High	Low
Telangana	Jangaon	Very Low	Medium	High	Medium	Medium
Telangana	J. Bhupalpally	Low	Medium	Very high	High	Medium
Telangana	Jogulamba Gadwal	Very Low	Very high	Medium	Very high	Very high
Telangana	Kamareddy	Very Low	Medium	Very high	Very high	High
Telangana	Karimnagar	Very Low	Low	Low	Low	High
Telangana	Khammam	Medium	Very Low	Very high	Low	Low
West Bengal	Kumaram Bheem	Very Low	High	Very high	Very high	Medium
Telangana	Mahabubabad	Very Low	Medium	High	Low	Very high
Telangana	Mahabubnagar	Very high	Very high	Medium	High	Very high
Telangana	Mancherial	Very Low	Very Low	High	Medium	Low
Telangana	Medak	High	High	High	Very high	High

Telangana	M. Malkajgiri	Very Low	Medium	Very Low	Low	Medium
Telangana	Nagarkurnool	Low	Medium	Very high	Medium	Very high
Telangana	Nalgonda	Medium	Medium	Very high	Medium	High
Telangana	Nirmal	Low	Medium	Medium	High	Medium
Telangana	Nizamabad	Very Low	Medium	Very high	Very high	Medium
Telangana	Peddapalle	Low	Low	Very high	High	Medium
Telangana	Rajanna Sircilla	Low	Very Low	Medium	Low	Medium
Telangana	Rangareddy	Very Low	High	Low	Medium	High
Telangana	Sangareddy	Low	Medium	Very high	High	Medium
Telangana	Siddipet	Very Low	Low	Medium	Medium	Low
Telangana	Suryapet	Very Low	Low	Very high	Medium	Very high
Telangana	Vikarabad	Very Low	Medium	High	High	Medium
Telangana	Wanaparthy	Low	High	Low	High	Very high
Telangana	Warangal	High	High	Medium	Very high	Medium
Telangana	Hanumakonda	Very Low	Low	Very high	High	Medium
Telangana	Y. Bhuvanagiri	Low	High	Very Low	Medium	Low
Tripura	Gomati	Very Low	Very Low	Very high	Medium	Medium
Tripura	Khowai	Very Low	Very high	Medium	Low	High
Tripura	North Tripura	Medium	Low	Very high	High	Very Low
Tripura	Sipahijala	Very Low	Medium	Low	Very Low	Medium
Tripura	South Tripura	Medium	Very Low	Low	Low	Low
Tripura	Unakoti	Very Low	Medium	High	Medium	Low
Tripura	West Tripura	Low	Low	Very Low	Low	Very Low
Uttar Pradesh	Amethi	Very Low	High	High	High	Very Low
Uttar Pradesh	Badaun	Very high	Very high	Medium	Very high	High
Uttar Pradesh	Ghaziabad	High	Low	Medium	Low	Low
Uttar Pradesh	Hapur	Very Low	Low	Medium	Medium	Medium
Uttar Pradesh	Moradabad	Medium	Medium	Medium	Medium	Medium
Uttar Pradesh	Muzaffarnagar	Medium	Low	High	Medium	Medium
Uttar Pradesh	Rae Bareilly	High	Very high	Low	Medium	High
Uttar Pradesh	Sambhal	Medium	Very high	Low	Medium	High
Uttar Pradesh	Shamli	Very Low	Low	High	Medium	Medium
Uttar Pradesh	Sultanpur	Very high	Medium	Very Low	Medium	Low
West Bengal	Paschim Bardhaman	High	High	Very high	Very high	High
West Bengal	Purba Bardhaman	High	Medium	High	Medium	Medium

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(स्थापना / Established in 1956)
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